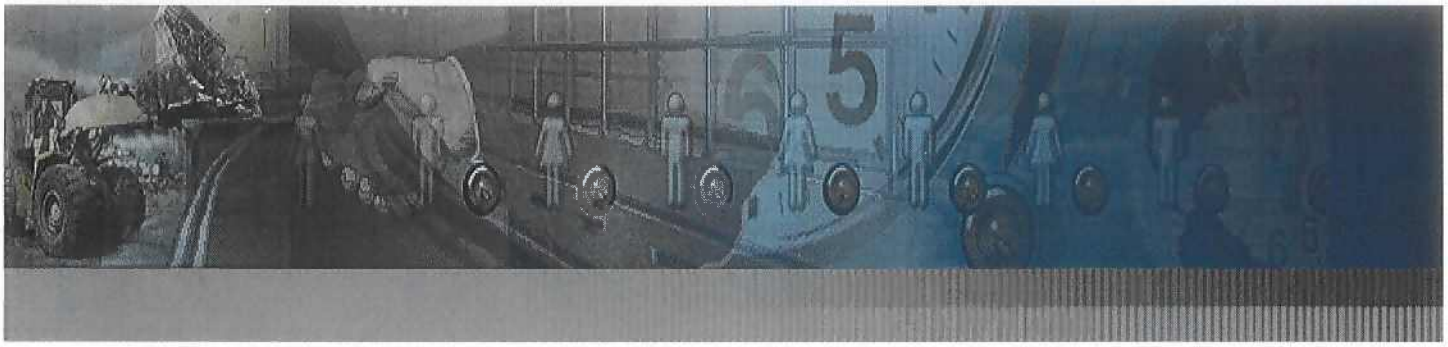
APPENDIX E Part 2

OU-1 O&M Maintenance Manual

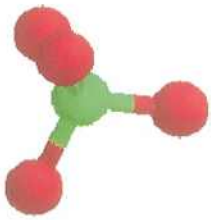
ATTACHMENT 6:
FLUIDIZED BED REACTOR SYSTEM MANUFACTURER'S LITERATURE VOL. II



Shaw® Shaw Environmental, Inc.

FLUIDIZED BED REACTOR SYSTEM FOR NASA – JPL PASADENA, CA







OPERATION AND MAINTENANCE MANUAL

Manufacturer's Literature

Volume II

SEPT 2004

Shaw Project 100770

JPL-NASA
OPERATION AND MAINTENANCE MANUAL
EQUIPMENT MANUAL

MANUFACTURER'S INSTRUCTIONS & MAINTENANCE MANUALS

TABLE OF CONTENTS

MANUFACTURER	MODEL #	ITEM
Asco	8321G2	Solenoid Valve for FV-301
Bray Valves	Series 31-124	FV-301, LCV-401, V-302, V-303, V-304, V-305, V-307, V-308
Conery	2-2900-B3S2C2-20'	Narrow Angle Float Switch, LSHH-801
DeZurik	KGL,2,W1,S1,C,EPDM	Knife Gate Valve V-804
Duobloc	½" – 2" PVC Ball valves	Various
Dwyer Instruments	VFB-53-BV	Flowmeters, FI-301 & FI-302
Dwyer Instruments	DS-400-8	Averaging Pitot Tube, FI-301
Dwyer Instruments	VFA-1-BV	Flow Indicator FE-801
Emerson/Rosemount	3051CD2A22A1A	LT-810
Emerson/Rosemount	Sensor – 385+02-10	AE-301
	Transmitter – 1055-01-11-22	AIT-301
Emerson/Rosemount	1151LT5EG0X52D	LIT-401
Gardener Denver	2MP Sutorbilt	B-401
Glentech	Model 850	Strainer S-301
Goulds Pumps	2DM51F4NA	Backwash Submersible Pump P-801
LMI Pumps		P-701, P-702, P-703, P-705,
Markland Specialty	Model 10, Sludge Gun	Sludge Level Detector
Midwest Instruments	130-PC-00-01	Diff. Pressure Indicator FI-301
Penberthy	Tank Mixing Eductor, 3/4"	In-bed Cleaning Eductor
SOR	1510B-G5A-C-W1-ES	LSH-401
SSI Equipment	8" WCT	Dual Disc Check Valves
Stranco Polyblend	PB100-0.4, PB200-2	P-704, P-706
Sulzer	APT21-3	P-401
	APT31-6	Fluidization Pumps P-301A/B
United Electric	H-402-S146B-M202-M446	PSH/PSL-301
	J6-152B	PSL-401
USFilter/Memcor	TM-350A	F-501
US Gauge	Solfrunt Century 100 03 A 2 P 01 B	Pressure Indicator PI-402, PI-801
		PI-304, PI-305
Wilkerson	R16-02-G00 w/GPA-95-011	Pressure Regulator, PCV-301 with PI-301

Installation & Maintenance Instructions

3–WAY PISTON VALVE

BULLETIN

8321

Form No.V5417R2

DESCRIPTION

Bulletin 8321 is an internal pilot operated 3-way solenoid valve. Standard valves have a General Purpose Nema Type 1 Solenoid Enclosure. Valves may also be equipped with an enclosure which is designed to meet Nema Type 4-Watertight, Nema Type 7 (C or D) Hazardous Locations – Class 1, Group 'C' or 'D' and Nema Type 9 ('E', 'F' or 'G') Hazardous Location – Class II, Group 'E', 'F' or 'G'.

MANUAL OPERATOR (Optional)

Valves with suffix "MO" or "MS" after catalog number are provided with a manual operator which allows manual operation when desired or during an interruption of electrical power.

OPERATION

NORMALLY CLOSED (Refer to Figure 1)

Solenoid De-energized: Flow is from Cylinder 'A' to Exhaust. Pressure connection is closed.
Solenoid Energized: Flow is from Pressure to Cylinder 'A'. Exhaust connection is closed.

NORMALLY OPEN (Refer to Figure 1)

Solenoid De-energized: Flow is from Pressure to Cylinder 'A'. Exhaust-connection is closed.
Solenoid Energized: Flow is from Cylinder 'A' to Exhaust. Pressure connection is closed.

NOTE: To change from normally closed construction to normally open construction, the plastic pilot insert and lower disc spring have to be replaced. (Consult factory).

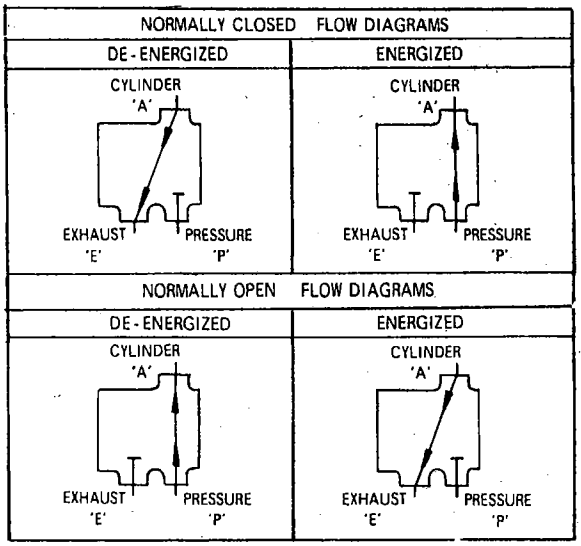


FIGURE 1

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

POSITIONING

valve may be mounted in any position.

PIPING

Connect piping to the Pressure (P), Exhaust (E), and Cylinder (A) Ports according to flow diagram. If a speed/flow control valve is used, it must be located in the piping between the solenoid valve and the cylinder. For precision control of cylinder positions, there should be no leaks in piping between cylinder and valve. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening pipe, do not use valve as a lever.

CAUTION: To insure operation of the valve, the pressure and exhaust lines must be full area without restriction, and a minimum differential pressure as stamped on the nameplate must be maintained between the pressure and exhaust. Do not install any restrictive devices in either the pressure (inlet) connection or the exhaust (outlet) connection of the valve. Restricting either of these lines may cause valve malfunction. Should metering or restrictive devices be required they must be installed in cylinder connection (between solenoid valve and cylinder).
IMPORTANT: For protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required, depending on the service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. For valves equipped with an explosion-proof, watertight enclosure (Nema 4, 7 & 9), the electrical fittings must be approved for use in the approved hazardous locations. Housings for all solenoids are made with connections for 1/2 inch conduit. The general purpose enclosure may be rotated to facilitate wiring by removing the retaining cap. After rotating to desired position, be certain to replace cap before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) Solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid, not just the coil.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand for only an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power and line pressure to valve before making repairs. It is not necessary to remove valve from pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending on the media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation or excessive leakage will indicate that cleaning is required.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. Operate the valve periodically to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart below. For higher ambient and fluid temperatures, consult factory. Check catalog number and watt rating on nameplate to determine the maximum temperatures.

WATTAGE	CATALOG NUMBER COIL PREFIX	COIL CLASS	MAXIMUM AMBIENT TEMP. °F	MAXIMUM FLUID TEMP. °F
6	none or S	A	77	180
6	FT or SF	F	122	200
6	HT	H	140	200
9.7	none, FT, HT S, or SF	A, F or H	77	120

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or grounded coil, broken lead wires or splice connections.

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50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

2. **Burned-Out Coil:** Check for open-circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within the range specified on nameplate.
5. **Excessive Leakage (Improper Opening and Closing of Ports):** Disassemble valve (See Valve Disassembly Instructions) and clean all parts and passageways. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.

COIL REPLACEMENT (Refer to Figure 2)

Turn off electrical power, disconnect coil lead wires.

CAUTION: The solenoid must be fully reassembled as the housing is part of, and completes the magnetic circuit. Be careful to place insulating washers at each end of the coil if required.

1. Remove retaining cap, nameplate and solenoid cover.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. **NOTE:** Insulating washers are omitted when molded coil is used. In some D-C Constructions, a single flux plate over the coil replaces yoke, sleeves and insulating washers.
3. Reassemble in reverse order of disassembly.

VALVE DISASSEMBLY AND REASSEMBLY (Refer to Figure 2)

Depressurize valve and turn off electrical power.

1. Solenoid may be removed intact by loosening and removing solenoid base sub-assembly from body.
2. Remove core spring, core assembly and body gasket respectively.
3. A 4-36 Machine Screw (provided in "Spare Parts Kits") serves as a self-tapping screw to remove insert from body. Thread screw a few turns in thru hole located in the flat surface of insert. **CAUTION:** Do not damage center hole (Pilot Orifice) in raised surface of insert. Remove insert by using a pair of pliers on the head of the screw.
4. Remove three gaskets from insert. Tag each as they are removed so that they can be reassembled in the same locations. **NOTE:** Middle and lower gaskets have the same physical dimensions, however, the lower gasket is made of a softer material.
5. Remove lower disc holder assembly and lower disc spring. This completes pilot disassembly.
6. Remove end cap, end cap gasket and outer piston gasket.
7. Slide out piston assembly and inner piston gasket.
8. All parts and passageways are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.
9. Reassemble valve in reverse order of disassembly. **NOTE:** Lubricate all rubber parts with Dow Corning's Valve Seal or equivalent silicone grease.

MANUAL OPERATOR DISASSEMBLY AND REASSEMBLY

(Refer to Figure 3)

Depressurize valve and turn off electrical power.

1. Remove two retaining screws.
2. Slide out manual operator stem/knob/retainer sub-assembly.
3. Remove stem O-ring.
4. Remove guide and gasket.
5. Manual operator parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete "Spare Parts Kit" for best results.
6. Reassemble manual operator in reverse order of disassembly. **NOTE:** Lubricate all rubber parts with Dow Corning's Valve Seal or equivalent silicone grease.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils Specify Valve Catalog Number, Serial Number and Voltage.

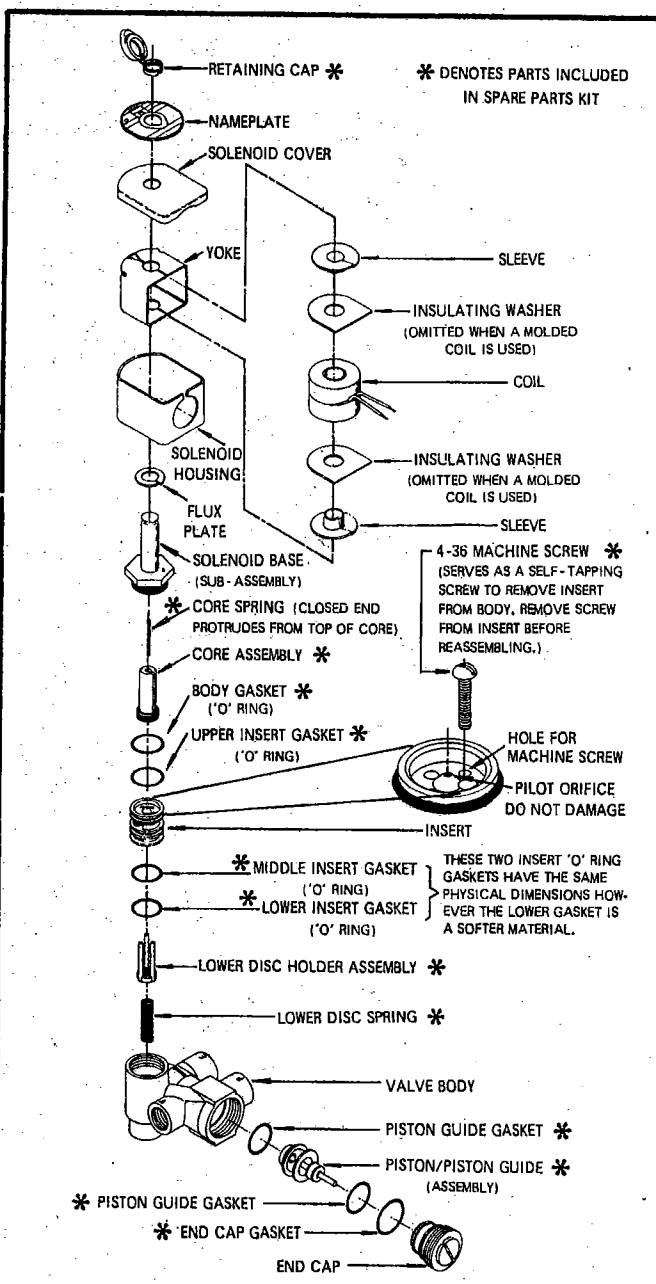
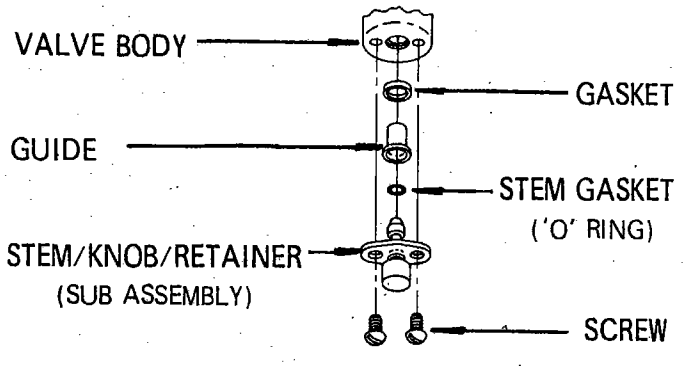


FIGURE 2 BULLETIN 8321



MANUAL OPERATOR
(PUSH TYPE 'MO')
(SCREW TYPE 'MS')

FIGURE 3

Form No.V5417R2

ASCO® 50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

PROCEDURES - SERIES 20/21 BUTTERFLY VALVES

I. Shipment & Storage

A. The seat, disc, stem, and bushing of the butterfly valve should be coated with silicone lubricant as recommended by Bray Technical Bulletin 1028.

B. The disc should be positioned at 10% open.

C. The faces of each valve should be covered with cardboard, plywood, plastic plates, etc. to prevent damage to the seat face, disc edge, or butterfly valve interior.

D. Valves should be stored indoors with face protectors intact. Temperature should preferably be 40 degrees F to 85 degrees F.

E. When valves are stored for a long time, open and close the valves once every 3 months.

F. Ship and store valves so that no heavy loads are applied to the bodies.

II. Installation Considerations - Piping and Valve Orientation and Placement

A. **Piping and Flange Compatibilities** - The Series 20/21 butterfly valves have been designed to be suitable for all types of ANSI 125/150 flanges, whether flat-faced, raised-face, slip-on, weld-neck, etc. (Type C stub-end flanges conform to no standard for the flange face and are not recommended for use with resilient-seated butterfly valves.)These valves have been engineered so that the critical disc chord dimension at the full open position will clear the adjacent inside diameter of most types of piping, including Schedule 40, lined pipe, heavy wall, etc. If in question, one should compare the minimum pipe I.D. with the published disc cord dimension at full open.

B. **Valve Location and Orientation in Piping.**

1. **Valve Location** - Butterfly valves should be installed if possible a minimum of 6 pipe diameters from other line elements, i.e., elbows, pumps, valves, etc. Of course, 6 pipe diameters is not always practical, but it is important to achieve as much distance as possible. Where the butterfly valve is connected to a check valve or pump, use an expansion joint between them to ensure the disc does not interfere with the adjacent equipment.

2. **Valve Orientation**

   a. In general, Bray recommends the valve be installed with the stem in the vertical position and the actuator mounted vertically directly above the valve,; however there are those applications as discussed below where the stem should be horizontal. The valve should not be installed upside down.

   b. For slurries, sludge, mine tailings, pulp stock, dry cement, and any media with sediment or particles, Bray recommends the valve be installed with the stem in the horizontal position with the lower disc edge opening in the downstream direction.

   c. For valve orientation downstream of pump, bend, etc., see Bray Technical Bulletin 1025.

III. Installation Procedure

A. **General Installation**

1. Make sure the pipeline and pipe flange faces are clean. Any foreign material such as pipe scale, metal chips, welding slag, welding rods, etc., can obstruct disc movement or damage the disc or seat.

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2. The Bray elastomer seat has molded o-rings on the face of the seat. As a result, no gaskets are required as these o-rings serve the function of a gasket.
3. Align the piping and then spread the pipe flanges a distance apart so as to permit the valve body to be easily dropped between the flanges without contacting the pipe flanges.
4. Check to see that the valve disc has been positioned to a partially open position, with the disc edge about 1/2" to 3/8" from the face of the seat (approximately 10 degrees open.)
5. Insert the valve between the flanges, taking care not to damage the seat faces. Always pick the valve up by the locating holes or by using a nylon sling on the neck of the body. Never pick up the valve by the actuator or operator mounted on top of the valve.
6. Place the valve between the flanges, center it, and then span the valve body with all flange bolts, but do not tighten the bolts. Carefully open the disc to the full open position, making sure the disc does not hit the adjacent pipe I.D. Now systematically remove jack bolts on the other flange spreaders, and hand-tighten the flange bolts. Very slowly close the valve disc to ensure disc edge clearance from the adjacent pipe flange I.D. Now open the disc to full open and tighten all flange bolts per specification. Finally repeat a full close to full open rotation of the disc to ensure proper clearances.

B. **Installation with Flange Welding** - When butterfly valves are to be installed between ANSI welding type flanges, care should be taken to abide by the following procedure to ensure no damage will occur to the seat:

1. Place the valve between the flanges with the flange bores and valve body bore aligned properly. The discs should be in the 10 degrees open position.
2. Span the body with the bolts.
3. Take this assembly of flange-body-flange and align it properly to the pipe.
4. Tack weld the flanges to the pipe.
5. When tack welding is complete, remove the bolts and the valve from the pipe flanges and complete the welding of the flanges. Be sure to let the pipe and flanges cool before installing the valve.
   NOTE: Never complete the welding process (after tacking) with the valve between pipe flanges. This causes severe seat damage due to heat transfer.

IV. Maintenance and Repair

The many Bray features minimize wear and maintenance requirements. No routine lubrication is required. All components - stem, disc, seat, bushing, stem seal, etc., are field replaceable, no adjustment is required. If components require replacement, the valve may be removed from the line by placing the disc near the closed position, then supporting the valve and removing the flange bolts. No valve maintenance, including removal of manual or power actuators, should be performed until the piping system is completely de-pressurized.

V. Disassembly and Assembly

A. **Disassembly** - Remove handle, manual gear box of actuator from actuator mounting flange. Remove the body bolts and pull the lower body half away from the seat. Pull the seat and disc stem from the upper body half. Remove bushing and seal from the upper body. Push the seat into an oval shape and remove the disc stem by withdrawing the short stem end first.

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B. **Assembly** - Push the long stem end of the disc stem into the seat, then push the seat over the disc stem short stem. Place the disc stem and seat into the upper body half. Align the lower body bolt lugs with the upper body lugs and position lower body in the seat. Replace the body bolts and tighten. Install the stem seal, then the stem bushing. Replace handle, manual gear box or actuator on the actuator mounting flange. Note: The body halves have a matching casting node on one side only to ensure correct assembly of body halves.

PROCEDURES - SERIES 30/31/34 BUTTERFLY VALVES

I. Shipment & Storage

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B. The disc should be positioned at 10% open.

C. The faces of each valve should be covered with cardboard, plywood, plastic plates, etc. to prevent damage to the seat face, disc edge, or butterfly valve interior.

D. Valves should be stored indoors with face protectors intact. Temperature should preferably be 40°F to 85°F.

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1025.

III. Installation Procedure

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2. Span the body with the bolts.
3. Take this assembly of flange-body-flange and align it properly to the pipe.
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The many Bray features minimize wear and maintenance requirements. No routine lubrication is required. All components - stem, disc, seat, bushing, stem seal, etc., are field replaceable, no adjustment is required. If components require replacement, the valve may be removed from the line by placing the disc near the closed position, then supporting the valve and removing the flange bolts. No valve maintenance, including removal of manual or power actuators, should be performed until the piping system is completely de-pressurized.

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V. Disassembly and Assembly

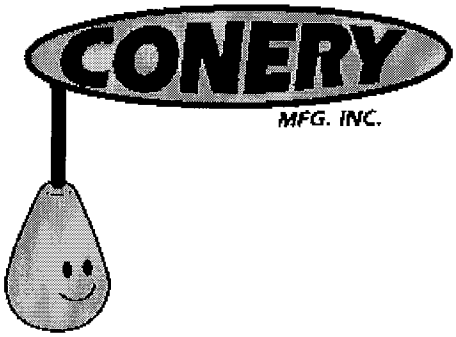
A. Disassembly - Remove handle, gear operator, or actuator from actuator mounting flange. Remove the "Spirolox" retaining ring and the two C-ring stem retainers from the stem hole, then remove the stem, bushing and seal. Remove the disc from the seat, protecting disc edge at all times. Push the seat into an oval shape, then remove the seat from the body.

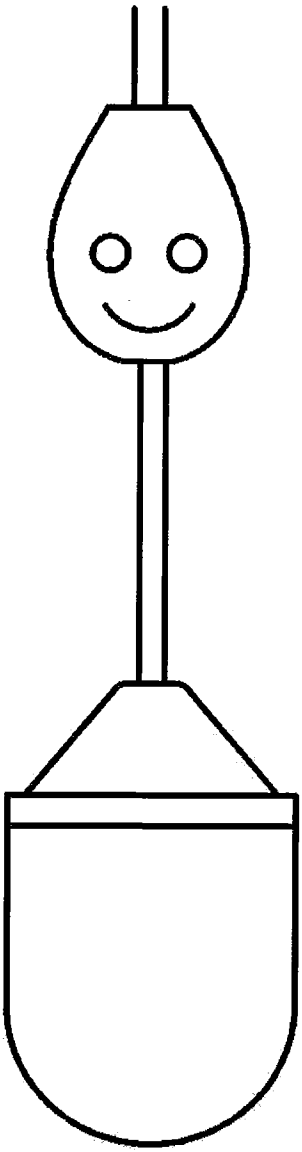
B. **Assembly** - Push the valve seat into an oval and push it into the body with seat stem holes aligned to body stem holes. Insert stem seal and bushing. Push stem into the stem hole of body until the bottom of the stem is flush with the inner top edge of the seat. Install a light coating of silicone or grease on the I.D. of seat. Insert the disc into the seat by lining up the disc hole with the stem hole of the seat. NOTE: the broached double "D" flats in the disc must be toward the bottom of the valve body. With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole. Make certain that when pushing stem through disc bottom, the broached flats of stem and disc are aligned. Replace the stem bushing and two stem retainers, then replace the "Spirolox" retaining ring back into position.

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FLOAT SWITCH – CONTROL DUTY

2900 MECHANICAL SERIES – NARROW ANGLE FLOAT SWITCH





GENERAL

DESIGNED FOR ACCURATE LIQUID LEVEL CONTROL IN MANY APPLICATIONS INCLUDING POTABLE WATER OR SEWAGE ENVIRONMENTS. THE FLOAT SWITCH CAN BE UTILIZED TO SIGNIFY SPECIFIC WATER LEVELS OR FOR DIRECT ALARM ACTUATION.

SWITCH VARIATIONS

NORMALLY OPEN (N/O)

THE CONTACTS ARE OPEN (OR OFF) IN THE HANGING POSITION. AS THE FLOAT RISES 1" (5°) ABOVE HORIZONTAL, THE CONTACTS BECOME CLOSED AND ACTUATE (TURN ON) THE SWITCH. THIS FLOAT IS GENERALLY USED IN PUMP DOWN APPLICATIONS.

NORMALLY CLOSED (N/C)

THE CONTACTS ARE CLOSED (OR ON) IN THE HANGING POSITION. AS THE FLOAT RISES 1" (5°) ABOVE HORIZONTAL, THE CONTACTS BECOME OPEN AND ACTUATE (TURN OFF) THE SWITCH. THIS FLOAT IS GENERALLY USED IN PUMP UP APPLICATIONS.

SINGLE POLE, DOUBLE THROW (SPDT)

A VARIATION OF THE PREVIOUSLY LISTED SWITCHES. THIS FLOAT SWITCH CAN BE WIRED TO OPERATE AS EITHER (BUT NOT BOTH) A NORMALLY OPEN OR NORMALLY CLOSED SWITCH BASED ON THE USER'S NEED.

SWITCH SPECIFICATIONS

2900 SERIES MECHANICAL FLOAT SWITCHES ARE DESIGNED TO OPERATE UNDER THE FOLLOWING PARAMETERS.

MINIMUM OPERATING TEMPERATURE	-	32 DEGREES F.
MAXIMUM OPERATING TEMPERATURE	-	190 DEGREES F.
ELECTRICAL RATING	-	10 AMP – 120 VAC, 5 AMP – 240 VAC
ACTUATION POINT	-	1" ABOVE / BELOW HORIZONTAL.

POWER CORD SPECIFICATIONS

CONDUCTOR CORD – PHYSICAL	-	CHLORINATED POLY ETHYLENE.
ELECTRICAL FOR N/O OR N/C SWITCH	-	16 AWG 2, TYPE SJOW-300 VOLT.
ELECTRICAL FOR SPDT SWITCH	-	16 AWG 3, TYPE SJOW-300 VOLT.

FLOAT SPECIFICATIONS

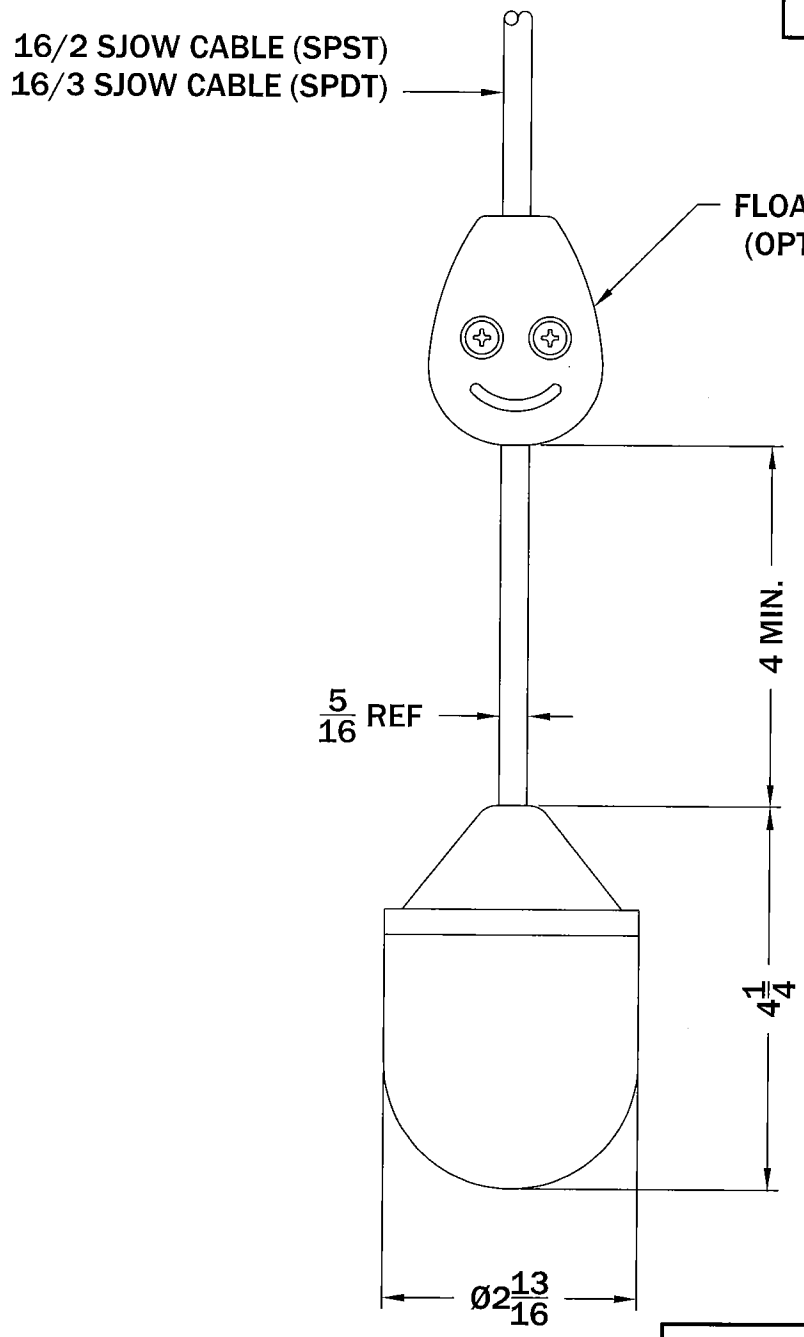
DURABLE ABS MATERIAL CONSTRUCTION.
LEAK PROOF, SHOCK PROOF, AND IMPACT RESISTANT.
RESISTANT TO SEWAGE AND WASTEWATER APPLICATIONS.
FOR USE WITH INTRINSICALLY SAFE CIRCUITS.

CORD WEIGHT

ZINC PLATED CAST IRON – 1.22 LBS.
SPLIT WEIGHT DESIGN ALLOWS FOR EASY ADJUSTMENT.
DESIGN ALLOWS FOR SECURE AND PERMANENT ATTACHMENT TO CORD.

CONERY MFG INC 1380 ENTERPRISE PARKWAY ASHLAND, OH 44805
info@conerymfg.com PH (419) 289-1444 FAX (419) 281-0366

2900 SERIES B3



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CONERY MFG INC

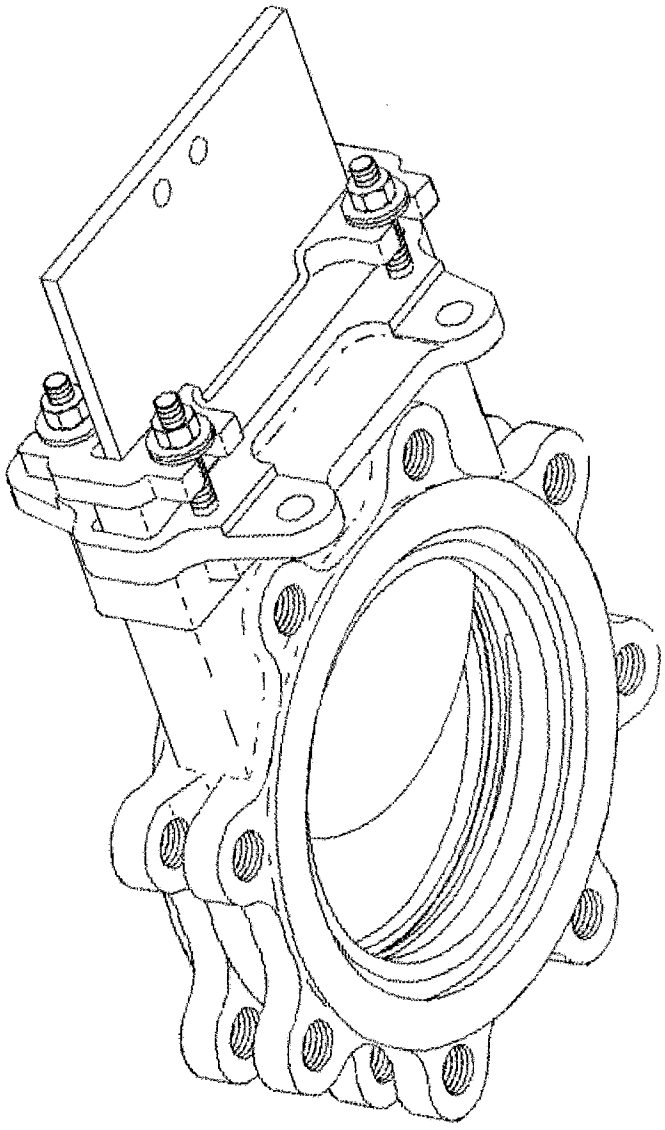
CHANGES		TOLERANCES	DRAWN BY	DATE
F		DECIMALS .XXX = ±.005 .XX = ±.010 FRACTIONAL X/X = ±.1/64 ANGLES X° = ±1/2°	D. MIDDLETON	02/20/04
E			MATERIAL SPECIFICATION: NARROW ANGLE MECHANICAL FLOAT	
D				
C				
B				
A				

SPECIFICATION SHEET
MECHANICAL FLOAT

SCALE:	PART NO.
HALF	2900 SERIES B3

DeZURIK®

2–36" KGS & KGL KNIFE GATE VALVES



SPX VALVES & CONTROLS™

Instruction D10288
January 2003

Instructions

These instructions are intended for personnel who are responsible for the installation, operation and maintenance of your KGS & KGL knife gate valve.

Safety Messages

All safety messages in the instructions are flagged with the word Caution, Warning or Danger. These messages must be followed exactly to avoid equipment damage, personal injury or death.

Safety label(s) on the product indicate hazards that can cause equipment damage, personal injury or death. If a safety label becomes difficult to see, or if a label has been removed, please contact SPX Valves & Controls for replacement.

Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of process material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous process materials. Handle valves which have been removed from service with the assumption of process material within the valve.

Inspection

Your KGS & KGL knife gate valve has been packaged to provide protection during shipment. Carefully inspect the unit for damage upon arrival and file a claim with the carrier if damage is apparent.

Parts

Order parts from your local sales representative, or directly from SPX Valves & Controls, as listed on the back cover. Recommended spare parts are listed on the assembly drawing. These parts should be stocked to minimize downtime.

SPX Valves & Controls' Service

SPX Valves & Controls service personnel are available to install, maintain and repair all DeZURIK products. SPX Valves & Controls also offers customized training programs and consultation services. For more information, contact your local SPX Valves & Controls sales representative or visit our website at www.spxvalves.com.

Table of Contents

Description - - -

Description

The SPX Valves & Controls KGS & KGL knife gate valves are bonnetless valves with a stainless steel body and gate, and an all-metal or resilient-faced seat. A choice of several actuators and accessories is available.

Installation

Install the valve between ANSI Class 125 or Class 150 pipeline flanges. Flange gaskets are required. Before installation, remove foreign material such as weld spatter, oil, grease, and dirt from the valve and pipeline.

Install the valve so that the side marked "seat" is on the lower pressure side of the valve when the valve is closed; the pipeline pressure will then help seal the valve in the closed position.

Observe the following points to prevent distortion of the valve body and gate when the flange bolts are tightened:

- Align the mating pipeline flanges.
- Select the length of the flange bolts so that the bolts used in the blind holes near the chest area of the valve do not bottom out when tightened.
- Tighten the flange bolts evenly, in a crisscross pattern.Refer to Table A for recommended flange bolt/stud torques.

Table A: *Recommended Flange Bolt/Stud Torque Range in ft-lbs*

Note: Torque ranges are based on ASME Pressure Vessel Code Calculations and lab test data. These torques are only for the listed gasket types. For other gasket types listed in ASME, consult SPX Valves and Controls.

Valve Size	ASME Gasket Types Rubber, Soft Fabric Filler, and 1/8" Thick Hard
2"	9 - 50
3"	21 - 50
4"	15 - 50
6"	23 - 50
8"	43 - 50
10"	45 - 70
12"	62 - 90
14"	81 - 140
16"	77 - 190
18"	112 - 300
20"	107 - 300
24"	165 - 300
30"	179 - 300
36"	264 - 300

Operation

The gate in the valve is positioned by the valve actuator. The actuator moves the gate over the valve seat in the closed position, and withdraws the gate from the seat in the throttling and open positions. Refer to the Actuator Instructions for adjustment and maintenance requirements for the actuator.

Lubrication

The valve does not require lubrication. Refer to the Actuator Instructions for lubrication requirements for the actuator.

Packing

The gate packing is contained and compressed by the packing gland. See Figure 1 for component identification.

Adjustment

If packing leaks, tighten the adjustment nuts on top of the packing gland. Tighten the nuts evenly and gently — just enough to stop the leak. Overtightening will cause excessive operating forces, and will decrease the life of the packing.

Drawings

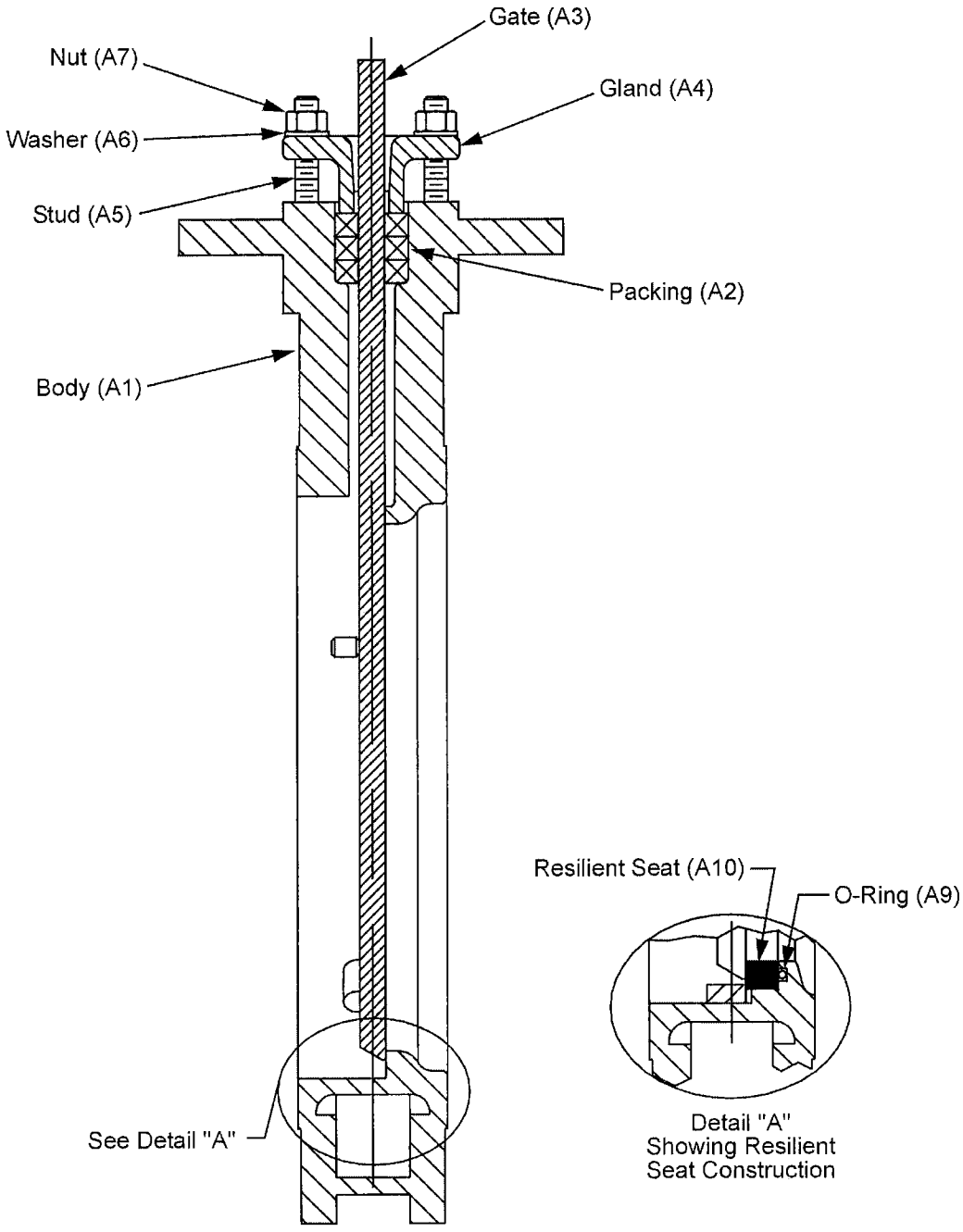


Figure 1—Component Identification

Packing Replacement

Removing the Old Packing

WARNING!

Pipeline pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing gate stem and packing gland nuts.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out power to prevent accidental operation of the actuator.
3. Remove the two screws and nuts near the top of the gate and disengage the stem from the gate by stroking the actuator (not the valve) to the open position.
4. Remove the gland nuts (A7), washers (A6), and packing gland (A4).
5. Remove the used packing (A2) from the packing chamber.

Installing the New Packing

SPX Valves & Controls recommends using a square-ended wood or plastic tool, driven by a hammer or mallet for packing the rings.
DO NOT USE ANY SHARP TOOLS TO PACK THE RINGS.

Install the packing with the ends together, but not overlapped. Stagger the packing joints on the long sides of the packing chamber.

1. With the gate closed, center the gate in the body below the packing chamber.
2. Cut new packing rings to the length and quantity shown in Table B.

Table B: *Packing Ring Length*

Valve Size	Size (Sq. Inches)	Length (Inches)	# Rings
2	3/8	7-1/2	2
3	3/8	9-3/4	3
4	3/8	11-3/4	3
6	3/8	16	3
8	3/8	20	3
10	1/2	23-3/4	3
12	1/2	28	3
14	1/2	31-3/4	3
16	1/2	36	3
18	5/8	40-1/4	3
20	5/8	45	4
24	5/8	53	4
30	3/4	65-3/4	4

Packing Replacement *(Continued)*

3. Install and pack the rings one at a time in the sequence shown in Figure 2.

   Note: Make sure the inside and outside edges of each ring are tightly packed against the gate and packing chamber, especially in the corner areas. Pack each ring until it is flat and even.

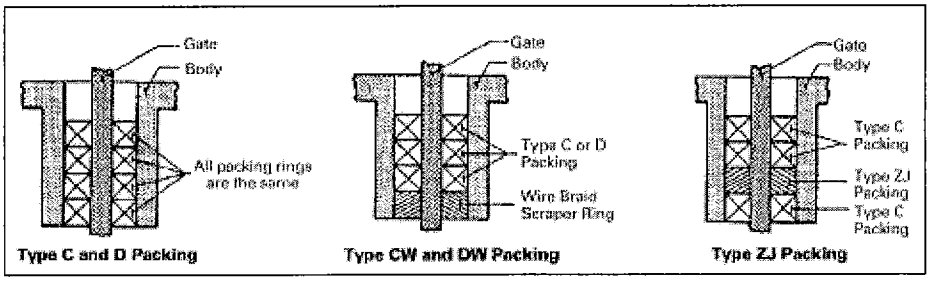


Figure 2—Packing Ring Sequence

With type C and type D packing, all rings are the same material; with type CW packing, the first (bottom) ring is a wire braid scraper, and the other rings are type C; with type DW packing, the first (bottom) ring is a wire braid scraper, and the other rings are type D; with type ZJ packing, the second ring (from the bottom) is zip joint, and the other rings are type C.

Reassembling Valve

1. Replace the packing gland (A4), washers (A6), and nuts (A7). Tighten the nuts evenly and finger tight, plus 1/2 turn.
2. Reconnect the stem to the gate with the two screws and nuts.
3. If the actuator is a powered actuator, reconnect power to the actuator.
4. Pressurize the pipeline and inspect packing for leakage.
5. If packing leaks, tighten the adjustment nuts on top of the packing gland. Tighten the nuts evenly and slowly, just enough to stop the leak. Overtightening will cause excessive operating forces, and will decrease the life of the packing.

Seat Replacement

See Figure 1 for component identification.

WARNING!

Pipeline pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing gate stem and packing gland nuts.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out power to prevent accidental operation of the actuator.
3. Remove the pipeline flange bolts and flange from the side of the valve body opposite the word "seat". As an alternative, remove both flanges, and remove the valve from the pipeline.
4. Remove the two screws and nuts near the top of the gate and disengage the stem from the gate.
5. Remove the actuator yoke and actuator from the valve.
6. Remove the gland nuts (A7), washers (A6), and packing gland (A4).
7. Remove the gate (A3) from the body.
8. Remove the packing (A2) from the packing chamber.
9. Remove the seat following the procedure for the size of the valve:
   - **2" and 14–36" sizes**
     Push the top of the resilient seat (A10) toward the center of the valve, and remove the seat through the packing chamber.
   - **3–12" sizes**
     Push the top of the resilient seat (A10) toward the center of the valve, and remove the seat through the valve port.
10. Install the new seat following the procedure for the size of the valve:
    - **2–12" sizes**

    a. Note the gate side and body side of the seat as shown in Figure 1.
    b. Insert the new seat (A10) through the packing chamber (2" and 5" sizes) or valve port (other sizes).
    c. Place the seat behind the lug at the 6 o'clock position in the body. Then push the top of the seat into position.

Seat Replacement *(Continued)*

✦ **14–24" sizes**

a. Inspect the O-ring in the body groove.

b. If worn or damaged, remove and replace the O-ring and sealant.

c. Seal the new O-ring to the groove with a paint-like thickness of silicone sealant.

d. Insert the new seat (A10) through the packing chamber so that the resilient seal will be towards the gate.

e. Place the seat behind the lug at the 6 o'clock position in the body, then push the top of the seat into position.

Reassembling the Valve

1. Replace the gate (A3) in the body, with the beveled age facing away from the resilient seat. See Figure 3.

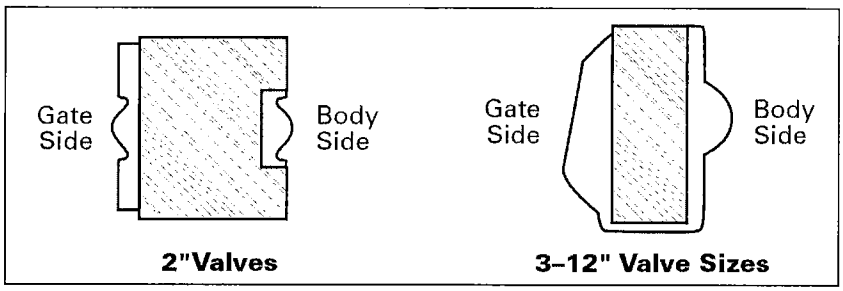


Figure 3—Resilient Seat Configurations

2. Place the gate in the fully closed position.
3. Replace the packing, as described in "Installing New Packing".
4. Replace the packing gland (A4), washers (A6), and nuts (A7). Tighten the nuts evenly and finger tight, plus 1/2 turn.
5. Replace the yoke and actuator on the valve.
6. Reconnect the stem to the gate with the two screws and locknuts.
7. Replace the pipeline flange and flange bolts, or replace the valve in the pipeline if the valve was removed. Refer to the requirements in the "Installation" section.
8. If the actuator is a powered actuator, reconnect power to the actuator.
9. Pressurize the pipeline and inspect the valve for leaks.
10. If the packing leaks, tighten the adjustment nuts (A7) on top of the packing gland. Tighten the nuts evenly and slowly, just enough to stop the leakage. Overtightening will cause excessive operating forces, and will decrease the life of the packing.

Replacing the Gate

See Figure 1 for component identification.

WARNING!

Pipeline pressure can cause personal injury or equipment damage. Relieve pipeline pressure before removing gate stem and packing gland nuts.

1. Relieve the pressure in the pipeline and close the valve.

WARNING!

Accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

2. If the actuator is powered, disconnect and lock out power to prevent accidental operation of the actuator.
3. Remove the pipeline flange bolts, and remove the valve from the pipeline.
4. Remove the actuator, actuator yoke, packing gland (A4), and packing (A2) from the valve.
5. Remove and inspect the gate (A3). If the gate appears to be scratched or galled due to too-long flange bolts in the chest area of the body, check for body damage in the tapped flange holes and within the chest cavity. Repair or replace the body, as appropriate.
6. Remove and inspect the seat components.
7. Replace or reinstall the seat components as described in step 10 in the "Seat Replacement" section.
8. Place the new gate (A3) in the body, in the fully closed position.
9. Replace the packing (A2) as described in "Installing New Packing".
10. Replace the yoke and actuator on the valve.
11. Adjust the actuator, yoke, and packing gland so that the valve actuates smoothly full stroke in both directions, and so that there is no evidence of binding or scratching on the gate when the gate is visible in the fully open position.
12. Replace the valve in the pipe line as described in the "Installation" section.
13. If the actuator is a powered actuator, reconnect power to the actuator.
14. Pressurize the pipeline and inspect the valve for leaks.
15. If the packing leaks, tighten the adjustment nuts (A7) on top of the packing gland. Tighten the nuts evenly and slowly, just enough to stop the leakage. Overtightening will cause excessive operating forces, and will decrease the life of the packing.

Troubleshooting

Condition	Possible Cause	Corrective Action
Packing leaks, with no evidence of galling on gate	Packing is loose.	Adjust packing gland.
	Packing is worn or torn.	Replace packing.
Packing leaks, and gate is galled.	Packing is worn or torn.	Replace packing and gate.
Valve leaks when fully closed, with no evidence of galling on gate.	Seats are worn or torn.	Replace seats.
Valve leaks when fully closed, and gate is galled.	Seats are worn or torn.	Replace seats and gate.

Guarantee

Products, auxiliaries and parts thereof, of SPX Valves & Controls' manufacture, are guaranteed for a period of one year from date of shipment against defective workmanship and material only, when properly installed, operated and serviced in accordance with SPX Valves & Controls' recommendations. Replacement for items of SPX Valves & Controls' manufacture will be made free of charge if proved to be defective within such time. No claim for special or consequential damages, transportation, or labor shall be allowed. Purchaser shall be solely responsible for determining suitability for use and in no event shall SPX Valves & Controls be liable in this respect. Equipment or parts manufactured by others but furnished by SPX Valves & Controls will be repaired or replaced, only to the extent provided in the original manufacturer's warranty to SPX Valves & Controls. SPX Valves & Controls does not guarantee resistance to corrosion, erosion, abrasion or other sources of failure, nor does SPX Valves & Controls guarantee a minimum length of service. Failure of the purchaser to give prompt written notice of any alleged defect under this guarantee forthwith upon its discovery, or use and possession thereof after an attempt has been made and completed by someone other than SPX Valves & Controls or an authorized representative to remedy defects therein, or failure to return products or parts for replacement as herein provided, of failure to install, operate and maintain said products or parts according to instructions provided by SPX Valves & Controls, of failure to pay the entire contract price when due, shall be a waiver of all rights under these representations.

The foregoing guarantee shall be null and void, if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as, but not limited to, an actuator is attached to the item by valves & controls other than an SPX Valves & Controls Factory Service Personnel. All orders accepted shall be deemed accepted subject to this guarantee, which shall be exclusive of any other previous guarantee, and this shall be the only effective guarantee or warranty binding on SPX Valves & Controls, anything to the contrary contained in the purchase order, or represented by any agent or employee of SPX Valves & Controls, in writing or otherwise, notwithstanding, including but not limited to implied warranties.

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Limitation of Liability

In no event shall SPX Valves & Controls be liable for any Direct, indirect, Special or Consequential damages whatsoever, and SPX Valves & Controls' liability, under no circumstances, will exceed the contract price for the goods and/or services for which liability is claimed. Any action for breach of contract, must be commenced within 1 year after the cause of the action has occurred.

Sales and Service

For information about our worldwide locations, approvals and certifications and local representatives, please visit our website:

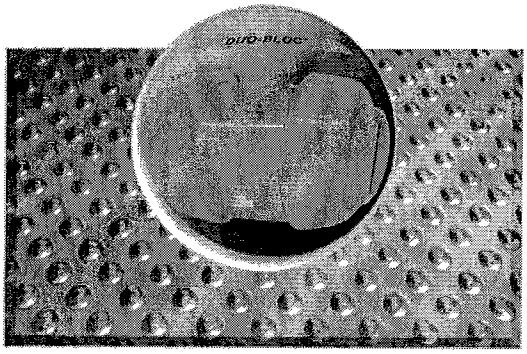
Web site: www.spxvalves.com E-Mail: info@spxvalves.com

SPX VALVES & CONTROLS™

250 Riverside Ave. N., Sartell, MN 56377-1743 • Phone: 320-259-2000 Fax: 320-259-2227

SPX Valves & Controls reserves the right to incorporate the latest design and material changes without notice or obligation. Design features and materials of construction as described in this manual are for informational purposes only. Certified drawings are available upon request.

Printed in U.S.A.



Duo-Bloc® Ball Valve

Specifications

Sizes:	1/2" – 2"
Models:	Socket, Threaded, Flanged (ANSI), Butt
Bodies:	PVC, CPVC
Seats:	PTFE backed with EPDM or Viton®†
Seals:	EPDM or Viton®† or AFLAS®‡

† Trademarks of E. I. du Pont de Nemours and Company
‡ Trademark of Asahi Glass Co., Ltd.

Standard Features (Sizes 1/2" – 2")

- True Union design for easier installation or repairs without expanding the pipe system.
- Rated up to 150 psi.
- Full vacuum rated.
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve.
- PTFE seats with elastomeric backing cushions insure bubble-tight shut-off and a low fixed torque, while at the same time compensating for wear.
- Two sets of end connectors (socket and threaded) included.

Options

- Pneumatic and electric actuators & accessories
- Stem extensions
- 2" square operating nut or "T" nut
- Locking and/or spring return handles
- Limit switches
- Vented ball

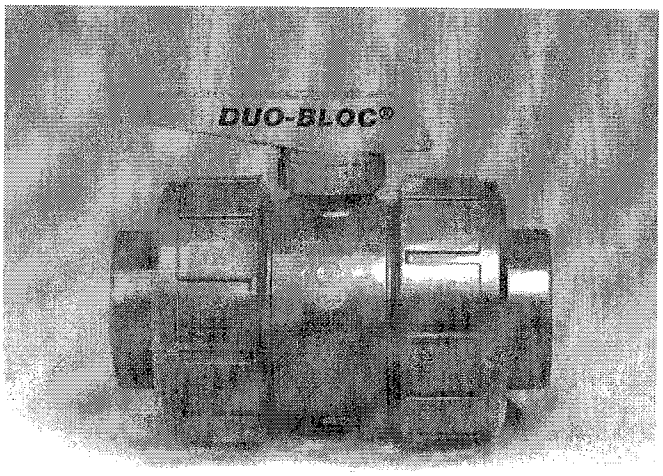
Caution

- Never remove valve from pipeline under pressure.
- Always wear protective gloves and goggles.
- Watch out for trapped fluid in valve. It is safe to close valve before removing it from the pipeline.
- Do not use ball valves where media has suspended particles. Use the following valves: *Butterfly Valves* – PVDF disc is most abrasion resistant and make sure of chemical compatibility. *Diaphragm Valves* – Elastomeric diaphragm is designed for handling suspended particles.
- Volatile fluids such as sodium hypochlorite (NaClO) and hydrogen peroxide (H_2O_2) could be trapped and gasified within the valve. We can provide you with a Type 21 ball valve with a *vented ball* to relieve pressure build-up inside the valve.

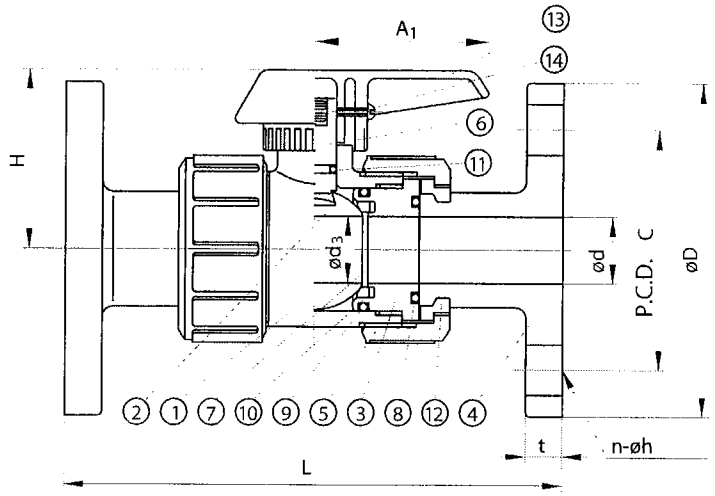
Parts List (Sizes 1/2"– 2")

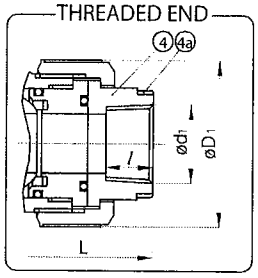
	PARTS		
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC
2	Ball	1	PVC, CPVC
3	Carrier	1	PVC, CPVC
4	End Connector	2	PVC, CPVC
5	Union Nut	2	PVC, CPVC
6	Stem	1	PVC, CPVC
7	Seat	2	PTFE
8	O-Ring (A)	2	EPDM, Viton,® Others
9	O-Ring (B)	1	EPDM, Viton,® Others
10	Cushion	2	EPDM, Viton,® Others
11	O-Ring (C)	1	EPDM, Viton,® Others
12	Stop Ring*	2	PVDF
13	Handle	1	ABS
14	Screw	1	304 Stainless Steel
4a	Ring**	2	304 Stainless Steel

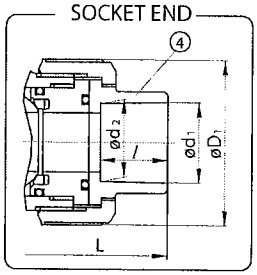
* Used for flanged end
** Used for CPVC body, threaded end, 1/2"–1"



FLANGED END







Dimensions (Sizes 1/2" – 2")

NOMINAL SIZE		FLANGED ANSI CLASS 150							SOCKET PVC, CPVC ANSI SCH 40				THREADED						
INCHES	mm	d	D	C	n	h	L	t	d1	d2	l	L	d1	l	L	d3	D1	H	A1
1/2	15	0.59	3.50	2.38	4	0.62	5.63	0.47	0.848	0.836	0.688	3.86	1/2-14 NPT	0.59	3.90	0.59	1.89	1.97	1.97
3/4	20	0.79	3.88	2.75	4	0.62	6.77	0.55	1.058	1.046	0.719	4.53	3/4-14 NPT	0.67	4.65	0.79	2.36	2.24	2.26
1	25	0.98	4.25	3.12	4	0.62	7.36	0.55	1.325	1.310	0.875	5.28	1-11 1/2 NPT.	0.79	5.35	0.98	2.76	2.64	2.56
1 1/4	30	1.22	4.62	3.50	4	0.62	7.48	0.63	1.670	1.655	0.938	5.83	1 1/4-11 1/2 NPT	0.87	5.87	1.22	3.15	3.07	2.56
1 1/2	40	1.57	5.00	3.88	4	0.62	8.35	0.63	1.912	1.894	1.094	6.65	1 1/2-11 1/2 NPT	0.98	6.69	1.57	3.78	3.35	2.95
2	50	2.01	6.00	4.75	4	0.75	9.21	0.63	2.387	2.369	1.156	7.56	2-11 1/2 NPT	1.10	7.76	2.01	4.17	3.86	3.35

Pressure vs. Temperature (PSI, WATER, NON-SHOCK)

NOMINAL SIZE		PVC	CPVC			
		30° F	30° F	121° F	141° F	176° F
INCHES	mm	120° F	120° F	140° F	175° F	195° F
1/2-2	15-50	150	150	120	85	55

Cv Values

NOMINAL SIZE		Cv
INCHES	mm	
1/2	15	14
3/4	20	29
1	25	47
1 1/4	32	72
1 1/2	40	155
2	50	190

Weight (POUNDS)

NOMINAL SIZE		SOCKET	FLANGED
INCHES	mm		
1/2	15	0.38	2.00
3/4	20	0.66	2.25
1	25	1.00	2.50
1 1/4	32	1.39	3.25
1 1/2	40	2.18	4.00
2	50	2.93	4.75

FOR TROUBLESHOOTING, REFER TO PAGE 9.

Sample Specification

All True Union DUO-BLOC® Ball Valves, sizes 1/2" to 2", shall be of True Union design with two-way blocking capability. All O-rings shall be EPDM or Viton®with PTFE seats. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. PVC shall conform to ASTM D1784 Cell Classification 12454-A, CPVC shall conform to ASTM D1784 Cell Classification 23567-A. All True Union DUO-BLOC Ball Valves shall have a pressure rating up to 150 psi at 70° F. True Union Duo-Bloc Ball Valves must carry a two-year guarantee, as manufactured by Asahi/America Inc.

Caution

- Never remove valve from pipeline under pressure.
- Always wear protective gloves and goggles.
- Watch out for trapped fluid in valve. It is safe to close valve before removing it from the pipeline.

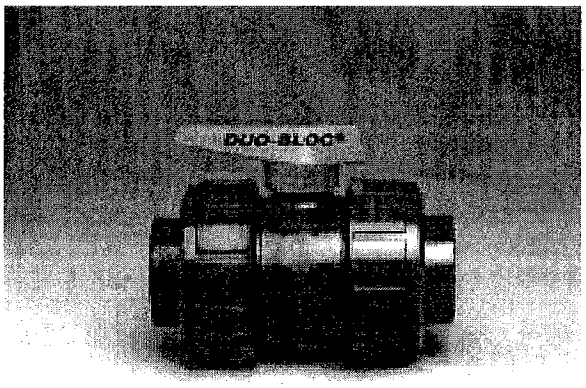
ASAHI AV Valves

Serial No.	H – VAAE – 0

Ball Valve

(DUO BLOC®)

User's Manual



Contents

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ASAHI ORGANIC CHEMICALS INDUSTRY CO., LTD.

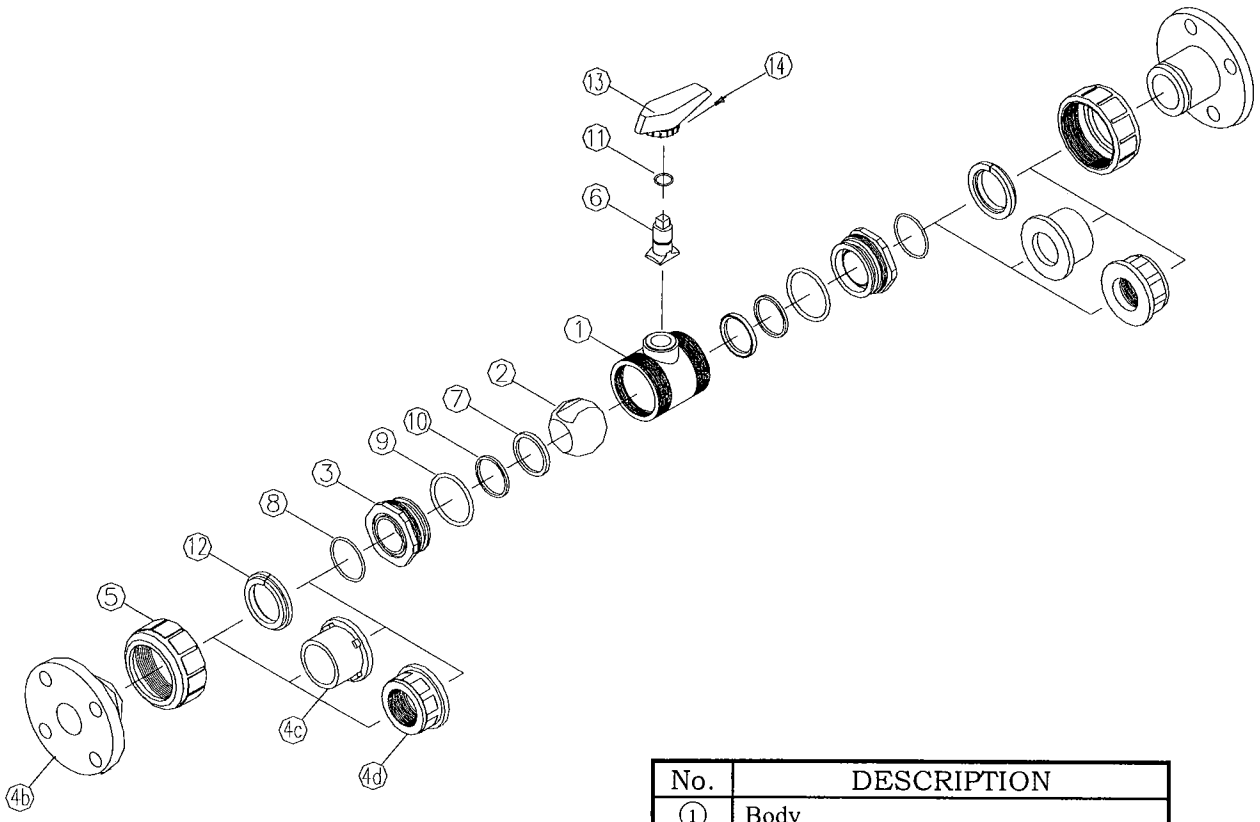
(1) General operating instruction

- O Operate the valve within the range of the published working temperature and pressure.
  (The valve can be damaged by operation beyond the maximum allowable range of temperature vs pressure.)
- O To select a valve in appropriate materials, refer to "CHEMICAL RESISTANCE ON ASAHI AV VALVE".
  (Some chemicals give heavy damage to valve materials.)
- O Do not use the valve for fluid containing slurry or crystallization.
  (The valve will not operate properly.)
- O The valve is not designed to bear any kind of external load. Never stand on or place anything heavy on the valve at anytime.
- O When the valve is disposed of, contact waste disposal specialist.
- O The valve should be installed at place where space for periodic inspection & maintenance is sufficient.
- O Do not store or install the valve near any heat source or hot surface.
  (It may cause deformation, destruction, and fire.)

(2) General instructions for transportation, unpacking and storage

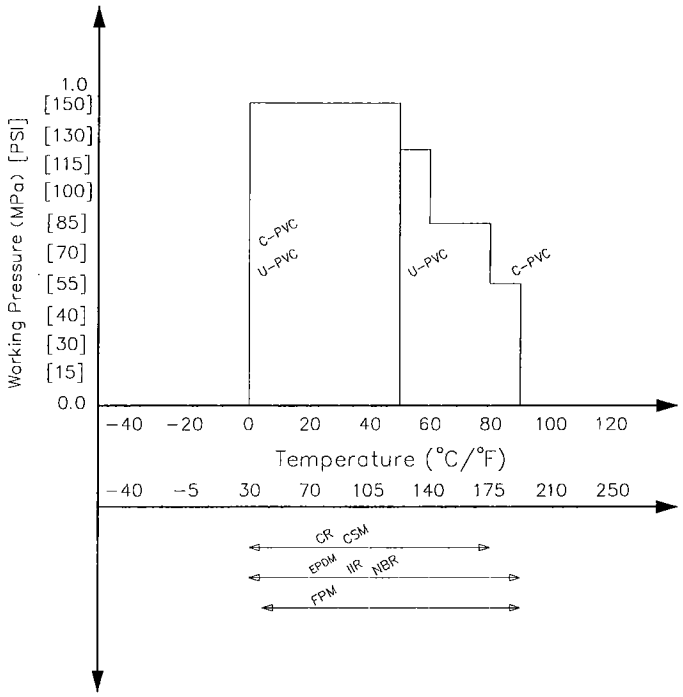
- O Keep the valve in its original packaging until needed for installation.
- O Avoid contact with any coal tar creosote, insecticides, vermicides or paint.
  (The force of swelling may damage the valve.)
- O The valve is not designed to handle any kind of impact. Avoid throwing or dropping the valve.
- O Avoid scratching the valve with any sharp object.

(3) Name of parts



No.	DESCRIPTION
①	Body
②	Ball
③	Carrier (A)
④b	End connector (Flanged end type)
④c	End connector (Socket end type)
④d	End connector (Threaded end type)
⑤	Union nut
⑥	Stem
⑦	Seat
⑧	O-ring (A)
⑨	O-ring (B)
⑩	Cushion
⑪	O-ring (C)
⑫	Stop Ring
⑬	Handle
⑭	Screw

(4) Comparison between working temperature and pressure



Caution

Do not operate the valve beyond the range of working temperature and pressure.
(The valve can be damaged.)

(5) Installation procedure

Flanged Type

Necessary items

- Torque wrench
- AV gasket
- Spanner wrench
- Bolt, Nut, Washer (For many flanges specification)

(When a non-AV gasket is used, a different tightening torque specification should be followed.)

Procedure

1) Set the AV gasket between the flanges.

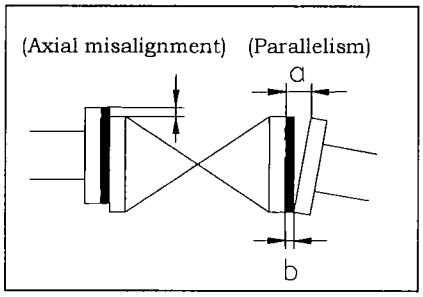
2) Insert washers and bolts from the pipe side, insert washers and nuts from the valve side, then temporarily tighten them by hand.

Remark

The parallelism and axial misalignment of the flange surface should be below the values in the following.
(A failure to observe them can cause damage due to stress application to the pipe)

Unit : mm (inch)

Nom. Size	Axial Misalignment	Parallelism (a-b)
15-32mm (1/2"-1 1/4")	1.0 (0.04)	0.5 (0.02)
40-50mm (1 1/2"-2")	1.0 (0.04)	0.8 (0.03)

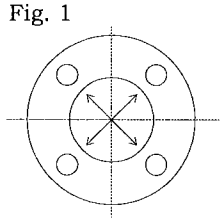


3) Using a torque wrench, tighten the bolts and nuts gradually to the specified torque in a diagonal manner (Refer to fig.1.)

Specified torque value Unit : N-m {kgf-cm} [lb-inch]

Nom. Size	15mm (1/2")	20 (3/4")	25 (1")	32 (1 1/4")	40 (1 1/2")	50 (2")
Torque value	17.5 {179} [155]	17.5 {179} [155]	20.0 {204} [177]	20.0 {204} [177]	20.0 {204} [177]	22.5 {230} [200]

Fig. 1



Remark

Avoid excessive tightening. (The valve can be damaged.)

Threaded type

Necessary items

- Sealing tape (A non-sealing tape can cause leakage.)
- Strap wrench (Do not use Pipe wrench.)
- Spanner wrench

Remark

Make sure that the threaded connections are plastic x plastic.
(Metallic thread can be damaged)

Procedure

1) Wind a sealing tape around the external thread of joint, leaving the end (about 3mm) free.
2) Loosen the union nut ⑤ with a strap wrench.
3) Remove the union nut ⑤ and the end connector ④d.
4) Lead the union nut ⑤ through the pipe.
5) Tighten the external thread of the joint and the end connector ④d lightly by hand.
6) Using a spanner wrench, screw in the end connector by turning 180° -360° carefully without damaging it.

Remark

Avoid excessive tightening. (The valve can be damaged.)

7) Make sure that the O-ring (A) ⑧ is mounted.
8) Tighten the union nut ⑤ lightly by hand.
9) Using a strap wrench, screw it in by turning 90° - 180° carefully without damaging it.

Remark

Avoid excessive tightening. (The valve can be damaged.)

Socket type (PVC)

Necessary items

- Adhesive for hard vinyl chloride pipes
- Strap wrench (Do not use the pipe wrench)
- Sandpaper

Remark

Do not install a socket type valve where the atmospheric temperature is 5°C(40 F) or lower.
(The valve can be damaged.)

Procedure

1) Loosen the union nut ⑤ with a strap wrench.

2) Remove the union nut ⑤ and end connector ④c.

3) Lead the union nut ⑤ through the pipe.

4) Clean the hub part of the end connector ④c by wiping with waste cloth.

5) Apply adhesive evenly to the hub part of the end connector and the pipe spigot.

Remark

Do not apply more adhesives than necessary.
(The valve can be damaged due to solvent cracking.)

Adhesive quantity (guideline)

Nom. Size	15mm (1/2")	20 (3/4")	25 (1")	32 (1 1/4")	40 (1 1/2")	50 (2")
Quantity (g)	1.0	1.3	2.0	2.4	3.5	4.8

6) After applying adhesive, insert the pipe quickly to the end connector ④c and leave it alone for at least 60 seconds.

7) Wipe away overflowing adhesive.

8) Make sure that O-ring (A) ⑧ is mounted

9) Tighten the union nut ⑤ lightly by hand.

10) Using a strap wrench, screw it in by turning 90° - 180° carefully without damaging it.

Remark

Avoid excessive tightening. (The valve can be damaged.)

(6) Operating Procedure

Remark

Avoid excessive tightening. (The valve can be damaged.)

○ Turn the handle gently to open or close.
(Turn the handle clockwise to close and counter clockwise to open.)

Fully closed ····· The position of the handle should be perpendicular to the pipe.
Fully opened ····· The position of the handle should be parallel the pipe.

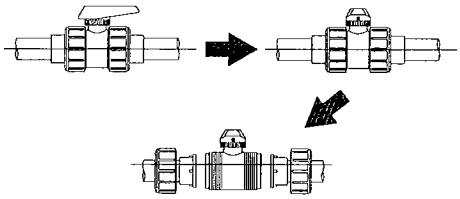
(7) Method of Adjusting Face Pressure between Ball and Street

Necessary items

- Strap wrench
- Protective gloves
- Safety goggles
- Spanner / pipe wrench

<Disassembly>
Procedure

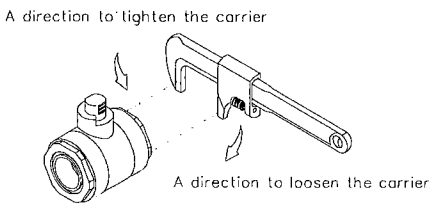
1) Completely discharge fluid from pipes.
2) Turn the handle to full close.
3) Loosen the right union nut and the left one ⑤ with wrench.
4) Pull up the body part only.



Caution

Wear protective gloves and safety goggles as some fluid remains in the valve.
(You may be injured.)

5) Using a spanner / pipe wrench, engage with the carrier ③
6) Make an adjustment by turning the union clockwise or counter clockwise.
7) Make sure that the handle can be operated smoothly.
8) Assemble the valve by following the above procedure in the reverse order; starting at 5.



<Clockwise>
Direction where carrier is tightened
<Counter clockwise>
Direction where carrier is loosened

(8) Disassembling Method for Replacing Parts

Necessary

- Strap wrench
- Cross-headed screwdriver
- Safety goggles
- Spanner / pipe wrench
- Protective gloves

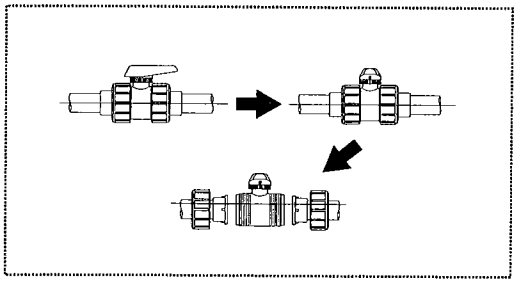
Caution

Wear protective gloves and safety goggles as some fluid remains in the valve.
(You may be injured.)

<Disassembly>

Procedure

1) Completely discharge fluid from pipes.

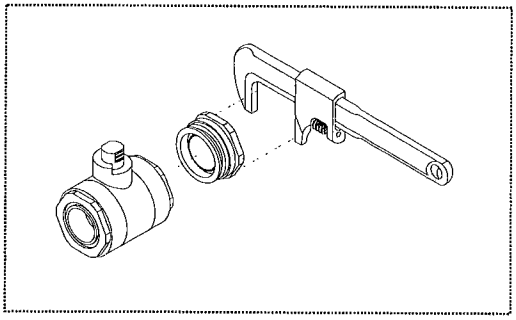


2) Turn the handle to full close.

3) Loosen the right union nut and the left one ⑤ with a strap wrench.

4) Pull up the body part only.

5) Loosen the screw ⑭ fixed to the handle with a cross-headed screwdriver.



6) Pull the handle off the body part.

7) Using a monkey wrench, engage with the carrier ③

8) In the engaged state, turn the carrier counter clockwise to loosen.

9) Push out the ball by hand.

10) Push out the stem from the top flange side to the body side.

<Assembly>

Procedure

Carry out the assembly work in the reverse procedure.

(9) Inspection items

○ Inspect the following items;

(1)	Check for any flaw, crack, or deformation on the outside.
(2)	Check whether fluid leaks to the outside.
(3)	Check whether tightness of bolt nut.
(4)	Check whether the operation of the handle is smooth.

(10) Troubleshooting and action

Problem	Cause	Action
Fluid leaks from the valve even when the valve is closed fully.	The seat is scratched or worn.	Replace the seat with a new one.
	Foreign matter is in the valve.	Clean up.
	The ball is scratched or worn.	Replace the scratched ball with a new one.
	The carrier is loosened.	Adjust the face pressure between the ball and the seat. (Refer to page 7)
Fluid leaks from the valve.	The O-ring is scratched or worn.	Replace the O-ring with a new one.
	The carrier is loosened.	Adjust the face pressure between the ball and the seat. (Refer to page 7)
	The union nut is loosened.	Tighten up the union nut. (Refer to page 7,8)
The handle is not (can not be) turned smoothly.	Foreign matter is in the valve.	Clean up.
	Deformation. (By heat etc.)	Replace the parts.
The handle fails to engage.	The stem is broken.	Replace the stem with a new one.
	The engagement between the stem and the ball is broken.	Replace the stem and ball with new ones.

(11) Handling of residual and waste materials

Remark

In discarding remaining or waste materials, be sure to ask waste service company.
(Poisonous gas is generated.)

(12) Inquiries

ASAHI ORGANIC CHEMICALS INDUSTRY CO., LTD.

Head Office : No. 2-5955, Nakanose- Cho, Nobeoka – City, Miyazaki- Pref., Japan.
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Singapore Branch Office: 16 Raffles Quay, #40-03 Hong Leong Building, Singapore 048581.
Tel (65) 220-4022 Fax (65) 324-6151

Europe Representative Office:Am Wehrhahn 33, 40211, Duesseldorf, Germany.
Tel (49) 6172-9175-0 Fax (49) 6172-9175-25

ASAHI AMERICA, INC

ASAHI AMERICA Inc.: 35 Green Street Malden, Massachusetts U.S.A. 02148
Tel (1) 781-321-5409 Fax (1) 781-321-4421

PMI #	SIZE "A"	CONNECTION "B"	WT.
303-60549-1	1.50	THREADED/SOCKET	2.18
303-60549-2	2.00	THREADED/SOCKET	2.93
303-60549-3	3.00	THREADED	8.07
303-60549-4	4.00	THREADED	21.00
303-60549-5	3.00	SOCKET	8.07 △1
303-60549-6	4.00	SOCKET	21.00 △1
303-60549-7	1.50	FLANGED	4.00
303-60549-8	2.00	FLANGED	4.75
303-60549-9	3.00	FLANGED	13.00
303-60549-10	4.00	FLANGED	33.00
303-60549-11	6.00	FLANGED	
303-60549-12	1.00	THREADED/SOCKET	2.50
303-60549-13	0.75	THREADED/SOCKET	2.25
303-60549-14	0.50	THREADED/SOCKET	2.00 △1

"A" INCH BALL VALVE
DUO BLOC, TRUE UNION
PVC BODY
TEFLON SEATS
VITON SEALS
"B" CONNECTIONS

MANUFACTURED BY: ASAHI/AMERICA

SEE PURCHASE ORDER FOR QUANTITIES - SHIP AS DIRECTED BY PURCHASE ORDER - DIRECT CORRESPONDENCE TO PURCHASING DEPARTMENT
SUBMIT THE FOLLOWING DATA DIRECTLY TO THE ENVIREX PURCHASING DEPARTMENT WITHIN THREE (3) WEEKS AFTER RECEIPT OF ORDER
MINIMUM ONE (1) COPY (OR VENDOR STD. QUANTITY) OF THE FOLLOWING: TYPICAL PERFOMANCE DATA, DIMENSION SHEETS, MANUAL INFORMATION AND SPARE PARTS LIST

ECN NUMBER	REV. NO.	MF	DESCRIPTION OF REVISION	REV. BY	DATE
970047	1		CORRECTED PMI# FOR -5 & -6; ADDED WEIGHTS	GWP	06/19/96
930142	0		ORIGINAL	RAH	2-23-93

LOCATION OF REVISION △1

SCALE	DATE ISSUED
1.0000	6-19-92

DIMENSIONS IN INCHES UNLESS SPECIFIED

TOLERANCES UNLESS OTHERWISE SPECIFIED

TWO (2) PLACE DEC. ±.06
THREE (3) PLACE DEC. ±.005
ANGULAR ±.50°
STRUCTURAL DIMENSIONS ±1/16
MACHINED SURFACES 250

DRAWN	PROJECT ENG.	PRODUCT CODE
RAH	WMP	4093
CHECKED	APPROVED	DRAWING MADE FROM
WMP	WMP	

CUSTOMER
LOCATION
ENGINEER

CONFIDENTIAL - ALL RIGHTS RESERVED

Envirex

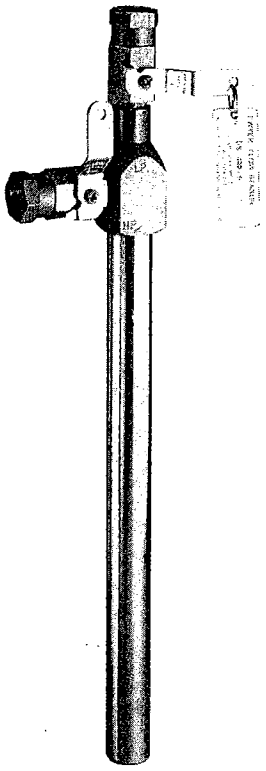
ENVIREX INC. WAUKESHA, WI 53187

TITLE
BALL VALVE
P.V.C.

PART NUMBER	DRAWING NUMBER
SEE TABLE	303-60549

SERIES DS-400 FLOW SENSORS

Installation and Operating Instructions, Flow Calculations



INSPECTION

Inspect the sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General – The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location – The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. This will provide a flow profile as ideal as possible. A rule of thumb is to allow 10-15 pipe diameters upstream and 5 down. The table below lists recommended up and down piping:

PRESSURE AND TEMPERATURE

Maximum 200 psig at 200°F.

UPSTREAM AND DOWNSTREAM DIMENSIONS IN TERMS OF INTERNAL DIAMETER OF PIPE

*SEE NOTE #1

UPSTREAM CONDITION	MINIMUM DIAMETER OF STRAIGHT PIPE		
	UPSTREAM		DOWNSTREAM
	IN-PLANE	OUT-OF-PLANE	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves *See Note 2	24	24	5

*Note #1: Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

*Note #2: Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.

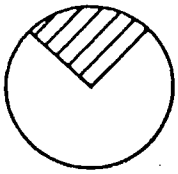
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Telephone 219/879-8000
Fax 219/872-9057

POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

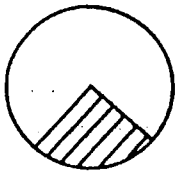
Flow Sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For air or gas flow:
Install in upper quadrant of pipe



Condensate drains back to pipe

For liquid or steam flow:
Install in lower quadrant of pipe



Air bleeds back to pipe.

INSTALLATION

1. Attach a ¾" NPT female fitting, such as a thred-o-let or saddle clamp, to the piping in which flow will be measured. Note the required upstream and downstream conditions on page one which should be observed.

2. Drill a hole through the center of the attached fitting into the pipe with a bit that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes inside the fitting body.

4. Insert the sensor until it contacts the opposite wall of the pipe and then withdraw it 1/16" for models -6 through -12 or ⅛" for models -14 through -24. This is to allow for thermal expansion.

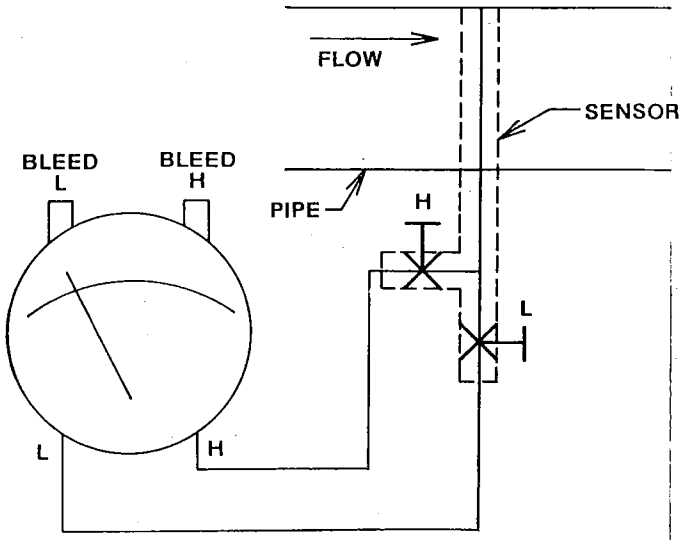
5. Tighten packing gland nut finger tight. Then tighten the nut with a wrench an additional 1¼ turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

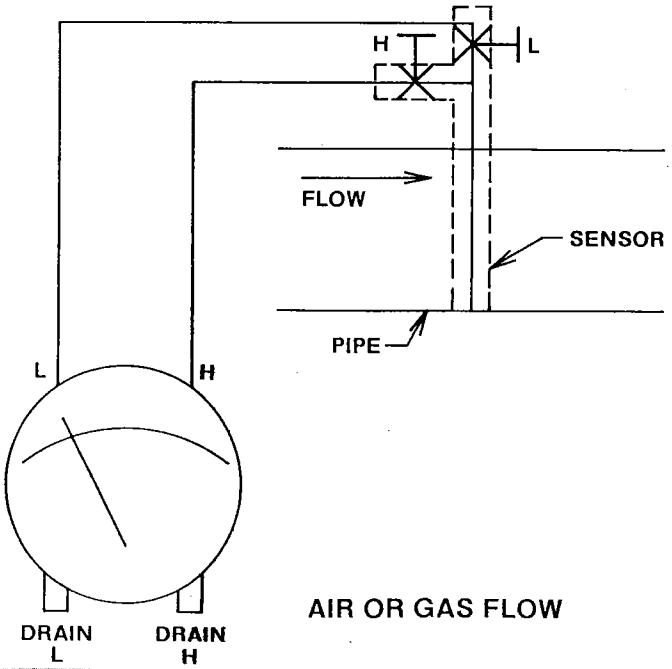
Connect the side pressure tap to the high pressure port of the Magnehelic (air only) or Capsuhelic gage or transmitting instrument and the top connection to the low pressure port. See the connection schematics below.

Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.



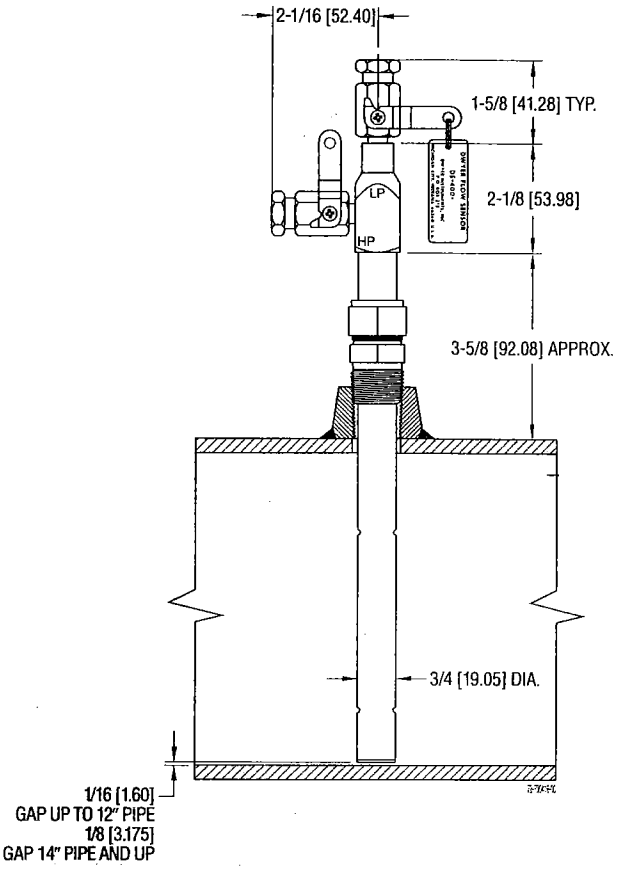
WATER FLOW



AIR OR GAS FLOW

DWYER INSTRUMENTS, INC.
P.O. Box 373 • Michigan City, Indiana 46361, U.S.A.
Phone: 219/879-8000 • Fax: 219/872-9057

SERIES DS-400 FLOW SENSORS



FLOW CALCULATIONS AND CHARTS

The following information contains tables and equations for determining the differential pressure developed by the DS-400 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. Where direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic or Capsuhelic gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletin A-30 for additional information on Magnehelic and Capsuhelic gages.

For additional useful information on making flow calculations, the following reference is recommended: Crane Valve Co. Technical Paper No. 410 "Flow of Fluids Through Valves, Fittings and Pipe." It is available from Crane Valve Co., 104 N. Chicago St., Joliet, IL 60431. Phone 815/727-2600. Price including shipping is $20.00

Using the appropriate differential pressure equation from page 4, calculate the differential pressure generated by by the sensor under **normal** operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges for other gases, liquids and/or operating conditions, consult the factory.

Note the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40 up to 20". Std. wt. for 24")	Flow Coefficient "K"	Operating Ranges Air @ 60°F & 14.7 psia (D/P Inches W.C.)	Operating Ranges Water @ 70°F (D/P Inches W.C.)	Velocity Ranges Not Recommended (Feet per Second)
6	.706	0.70 to 51	2.54 to 187	83 to 124
8	.675	0.64 to 28	2.31 to 102	53 to 79
10	.676	1.12 to 37	4.05 to 136	36 to 54
12	.683	0.19 to 20	0.70 to 72	26 to 40
14	.698	0.17 to 13	0.60 to 46	22 to 33
16	.688	3.78 to 56	13 to 203	17 to 26
18	.689	0.04 to 5.48	0.14 to 19	14 to 21
20	.686	0.39 to 4.93	1.40 to 17	11 to 17
24	.789	0.05 to 11	0.20 to 40	8 to 12

FLOW EQUATIONS

1. Any Liquid
$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\triangle P/S_f}$$

2. Steam or Any Gas
$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \triangle P}$$

3. Any Gas
$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \triangle P}{(T+460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid
$$\triangle P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas
$$\triangle P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas
$$\triangle P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T+460)}{K^2 \times D^4 \times P \times 16{,}590}$$

TECHNICAL NOTATIONS

The following notations apply:

$\triangle P$ = Differential pressure expressed in inches of water column.
Q = Flow expressed in GPM, SCFM or PPH as shown in equation.
K = Flow coefficient — See Values Tabulated on page 3.
D = Inside diameter of line size expressed in inches. For square & rectangular ducts use $D = \sqrt{\frac{4 \times Height \times Width}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460=^{0}Rankin)
p = Density of medium in pounds per cubic foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60^{0}F

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right)\left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right)\left(\frac{520}{460 + °F}\right)$$

1 CUBIC FOOT OF AIR = 0.076 POUNDS PER CUBIC FOOT AT 60°F AND 14.7 PSIA

*(520 = 460 + 60°) Std. Temp. Rankine

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FR 72-440451-02

DWYER INSTRUMENTS, INC.
P.O. Box 373 • Michigan City, Indiana 46361, U.S.A.
Phone: 219/879-8000 Fax: 219/872-9057

VISI-FLOAT® FLOWMETER
Installation and Operating Instructions

DIMENSIONS — IN INCHES		
	Model VFA	Model VFB
A	4	6½
B	3	5½
C	1⅜ 10-32 Thd.	3½ 10-32 Thd.
D	½	½
E	1⅞₄	1½
F	1¼	1¼
I (OPEN)	2¹⁵⁄₆₄ (BV or SSV MODELS ONLY)	2¹⁵⁄₆₄
K	4³¹⁄₃₂	6¹⁹⁄₃₂
L	1	1⅜
M	¾ (⅛ NPT EC MODELS ONLY)	¾
N	³¹⁄₃₂ (EC MODELS ONLY)	³¹⁄₃₂

SPECIFICATIONS	
Meter Body	Acrylic plastic. Metering tube machined into body
Wetted Metal Parts	Brass std. Stainless Steel optional.
Floats	Stainless Steel, Black Glass & Nylon
Float Stops	Stainless Steel Springs
Pipe Connections	⅛" NPT horizontal or vertical*
"O" Rings	Buna-N
Mounting Inserts	10-32x⅜" deep
Scale	Hot pressed into acrylic body
Knobs	ABS Plastic
Pressure Rating	To 100 P.S.I. maximum
Temperature Rating	To 150° F. maximum
Accuracy	Model VFA, 5%; Model VFB, 3% of full scale

*VFB ordering numbers 85 and 86 have ¼" NPT back connections or ⅜" NPT end connections. These ranges not available with valves.

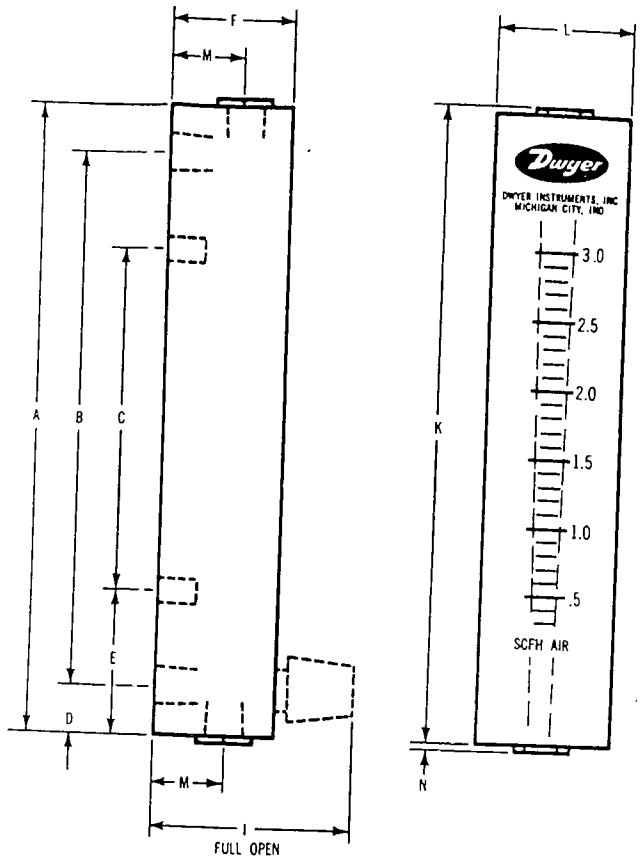


Figure1

Dwyer Visi-Float® Series Flowmeters are furnished in two models (see Figure 1) each available in a broad choice of flow ranges with direct reading scales for air, gas or water. Installation, operation and maintenance are very simple and only a few common sense precautions must be observed to assure long, trouble-free service.

CALIBRATION

Each Dwyer flowmeter is calibrated at the factory. If at any time during the meter's life, you wish to recheck its calibration, do so only with devices of certified accuracy. DO NOT attempt to check the Dwyer Visi-Float® Flowmeter with a similar flowmeter as seemingly unimportant variations in piping and back pressure may cause noticeable differences in the indicated reading. If in doubt, return your Dwyer flowmeter to the factory. It will be calibration checked for you at no charge. Before proceeding with the installation of your Dwyer Visi-Float® Flowmeter, check to be sure you have the model and flow range you require.

LOCATION

TEMPERATURE, PRESSURE, ATMOSPHERE, AND VIBRATION: Visi-Float® Acrylic Flowmeters are exceptionally tough and strong. They are designed for use at pressures up to 100 PSI and temperatures up to 150 deg. F. DO NOT EXCEED THESE LIMITS! The installation should not be exposed to strong chlorine atmospheres or solvents such as benzene, acetone, carbon tetrachloride, etc. The mounting panel should be free of excessive vibration since it may prevent the unit from operating properly.

INLET PIPING RUN: It is good practice to approach the flowmeter inlet with as few elbows and restrictions as possible. In every case the inlet piping should be at least as large as the connection to the flowmeter i.e. 1/8" Iron Pipe Size. Length of inlet piping makes little difference for normal pressure fed flowmeters.

For flowmeters on vacuum air service the inlet piping should be as short and open as possible. This will allow operation near atmospheric pressure and thereby insure the accuracy of the device. (Note that for vacuum air service the flow control valve if any, should be on the discharge side of the flowmeter. Either the TMV unit or a separate in line valve may be applied.)

DISCHARGE PIPING: As on the inlet, discharge piping should be at least as large as the flowmeter connection. In addition, for pressure fed flowmeters on air or gas service the discharge piping should be as short and open as possible. This will allow operation of the flow tube at near atmospheric pressure and insure the accuracy of the device. This is of less importance on water or liquid flowmeters since the flowing medium is generally incompressible and moderate back pressure will not affect the accuracy of the instrument as calibrated.

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VISI-FLOAT® FLOWMETER Instructions

Series VF VISI-FLOAT® Models and Ranges					
Model VFA — 2" Scale				Model VFB — 4" Scale	
Range SCFH Air	Ordering No.	Range LPM Air	Ordering No.	Range SCFH Air	Ordering No.
.1-1.0	1	.06-.5	21	.3-3.0	50
.2-2.0	2	.15-1.0	22	1-10	91
.6-5.0	3			2-20	51
1.0-10	4	.6-5	23	4-40	52
2.0-20	5	1.0-10	24	10-100	53
4.0-30	6			15-150	54
5.0-50	7	3.0-25	25	20-200	55
10-100	8	6-50	26	SCFM Air	
20-200	9	10-100	27	.3-3.0	90
CC Water per min.		Gal. Water per hour		CC Air per min.	
6-50	32	.6-5	41	100-1000	60
10-100	33	2-10	42	LPM Air	
20-200	34	3-20	43	.2-4	65
		8-40	44	1-10	66
				1-20	67
				3-30	68
				4-40	69
		Model VFB—4" Scale		CC Water per min.	
		Range GPM Water	Ordering No.	2-30	82
		.2-2	85	Gal. Water per hour	
		.5-5	86	.5-12	80
				6-60	81

POSITION AND MOUNTING

All Visi-Float® Flowmeters must be mounted in a vertical position with the inlet connection at the bottom and outlet at the top.

SURFACE MOUNTING: Drill appropriate holes in panel using the dimensions shown in Figure 1. Hold the flowmeter in position in front of the panel and install the mounting screws through the panel from the rear. Pipe up inlet and discharge using RTV silicone sealant or Teflon® tape on pipe threads to insure against leakage.

SURFACE MOUNTING ON PIPING ONLY: An alternate method of surface mounting omitting the mounting screws and supporting the Visi-Float® Flowmeter on the connecting piping only is possible. For this method extra long or straight pipe threads should be used so that nuts may be run onto the pipe and later tightened against the back of the panel to retain the unit in proper position. Use the appropriate hole layout information from Figure 1, but omit the small holes.

MOUNTING ON PIPING ONLY WITHOUT PANEL: For a temporary or laboratory type installation, the panel may be omitted altogether and the flowmeter installed directly in rigid piping. Its light weight permits this without difficulty.

OPERATION

To start system, open the valve slowly to avoid possible damage. Rate of flow is read at the point of maximum horizontal width for spherical floats or at the top of the largest diameter for non-spherical floats. Control valves on BV and SSV models are turned clockwise to reduce flow, counter clockwise to increase flow. A nylon insert is provided in the threaded section of the valve stem to give a firm touch to the valve and to prevent change of setting due to vibration.

CAUTION

Do not completely unscrew valve stem unless flowmeter is unpressurized and drained of any liquid. Removal while in service will allow gas or liquid to flow out front of valve body and could result in serious personal injury. For applications involving high pressure and/or toxic gases or fluids, special non-removable valves are available on special order. Contact factory for details.

MAINTENANCE

The only maintenance normally required is occasional cleaning to assure reliable operation and good float visibility.

DISASSEMBLY: The flowmeter can be disassembled for cleaning by simply disconnecting the piping, dismounting the unit from the panel and removing the top-plug-ball stop. Take out the ball or float by inverting the body and allowing the float to fall into your hand. (Note: It is best to cover the discharge port to avoid losing the float through that opening.) When removing the float guide assembly on VFB models 85, 86 and 87, be careful not to lose the short pieces of plastic tubing on both ends of the guide which serve as float stops.

CLEANING: The flow tube and flowmeter body can best be cleaned with a little pure soap and water. Use of a bottle brush or other soft brush will aid the cleaning. Avoid benzene, acetone, carbon tetrachloride, alkaline detergents, caustic soda, liquid soaps (which may contain chlorinated solvents), etc. and avoid prolonged immersion.

REASSEMBLY: Reinstall the float, remount, connect and place the unit back in service. A little stop cock grease or petroleum jelly on the "O" rings will help maintain a good seal as well as facilitate assembly. No other special care is required.

For VFB models 85 and 86, first install the lower fitting, next the float guide and float and finally the upper fitting and plug. Be certain that both ends of the float guide are properly engaged and the float is correctly oriented.

ADDITIONAL INFORMATION

For additional flowmeter application information, conversion curves, factors and other data covering the entire line of Dwyer Visi-Float® Flowmeters, send for Bulletin F-41.

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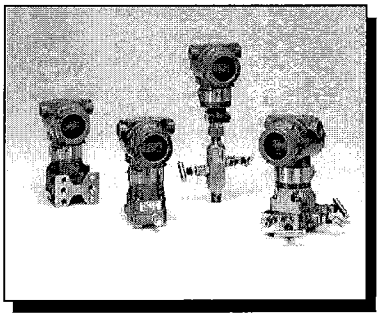
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Reference Manual
00809-0100-4001, Rev EA
December 2002

Model 3051 Pressure Transmitter

with HART protocol®



HART®

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Reference Manual
00809-0100-4001, Rev EA
December 2002

Model 3051

Model 3051 Pressure Transmitter

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

Within the United States, Rosemount Inc. has two toll-free assistance numbers:

Customer Central
Technical support, quoting, and order-related questions.

1-800-999-9307 (7:00 am to 7:00 pm CST)

North American Response Center
Equipment service needs.

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local Rosemount® representative.

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

Rosemount Model 3051 Smart Pressure Transmitters may be protected by one or more of the following: U.S. Patent Nos. 4466290; 4612812; 4791352; 4798089; 4818994; 4866435; 4878012; 4988990; 4926340; 5083091; 5122794; 5166678; 5248167; 5278543; 5287746; 5329818; 5333504; 5585777; 6017143; 6119047; 6295875; Des. 317266; Des. 318432; Des 342456. May depend on model. Other U.S. and foreign patents issued and pending.

CE Fisher-Rosemount satisfies all obligations coming from legislation to harmonize product requirements in the European Union.

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Section 1 Introduction

USING THIS MANUAL

The sections in this manual provide information on installing, operating, and maintaining devices from the Rosemount Model 3051 Smart Pressure Transmitter Family. The sections are organized as follows:

Section 2: Installation contains considerations, mechanical and electrical installation instructions.

Section 3: Configuration contains commissioning, output check, basic setup, LCD display configuration, detailed setup, diagnostic and services, advanced functions and multidrop communication instructions.

Section 4: Operation and Maintenance contains calibration and trim procedures for HART protocol only.

Section 5: Troubleshooting provides troubleshooting techniques for the most common operating problems.

Appendix A: Reference Information supplies reference and specification data, as well as ordering information and spare parts tables.

Appendix B: Product Certifications contains European directive information, Hazardous Location Certifications, and approval drawings.

Service Support

To expedite the return process outside of the United States, contact the nearest Rosemount representative.

Within the United States, call the Rosemount National Response Center using the 1-800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the process material to which the product was last exposed.

⚠CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. The product being returned will require a copy of the required Material Safety Data Sheet (MSDS) for each substance must be included with the returned goods.

Rosemount National Response Center representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

MODELS COVERED

The following Rosemount Model 3051 Pressure Transmitters are covered by this manual:

Model 3051CD Differential Pressure Transmitter

The Model 3051CD measures differential pressures from 0.1 inH_2O to 2000 psi (0,02 to 13 800 kPa) with superior performance including 0.075% accuracy and 100:1 rangeability.

Model 3051CG Gage Pressure Transmitter

The Model 3051CG measures gage pressures from 2.5 inH_2O to 2000 psig (0,62 to 13 800 kPa) using proven Rosemount capacitance cell technology.

Model 3051CA Absolute Pressure Transmitter

The Model 3051CA measures absolute pressures from 0.167 to 4000 psia (8,6 mmHga to 27 580 kPa) using a Rosemount patented piezoresistive silicon sensor.

Model 3051T Gage and Absolute Pressure Transmitter

The Model 3051T measures absolute and gage pressures from 0.3 to 10000 psig/a (2,07 to 68 900 kPa). The Model 3051T uses a single isolator design, microprocessor-based electronics using a Rosemount patented piezoresistive silicon sensor.

Model 3051L Liquid Level Transmitter

The Model 3051L provides precise level and specific gravity measurements from 2.5 to 8310 inH_2O (0,62 to 2 070 kPa) for a wide variety of tank configurations.

Model 3051H High Process Temperature Pressure Transmitter

The Model 3051H provides high process temperature capability to 375 °F (191 °C) without the use of remote diaphragm seals or capillaries. Model 3051H transmitters are available for differential and gage configurations (3051HD and 3051HG).

Model 3051P *Reference Class* Pressure Transmitter

The Model 3051P, at 0.05% accuracy, is the most accurate pressure transmitter available. The Model 3051P is ideal for fiscal and allocation metering.

NOTE
For Model 3051 with FOUNDATION™ fieldbus, see Rosemount Product Manual 00809-0100-4774.

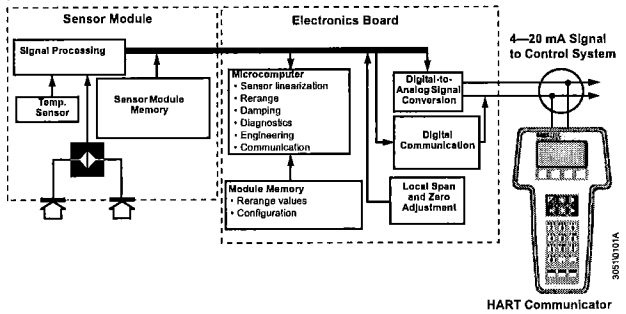
TRANSMITTER OVERVIEW

The Model 3051C Coplanar™ design is offered for Differential Pressure (DP), Gage Pressure (GP) and Absolute Pressure (AP) measurements. The Model 3051C utilizes Rosemount Inc. capacitance sensor technology for DP and GP measurements. Piezoresistive sensor technology is utilized in the Models 3051T and 3051C AP measurements.

The major components of the Model 3051 is the sensor module and the electronics housing. The sensor module contains the oil filled sensor system (isolating diaphragms, oil fill system, and sensor) and the sensor electronics. The sensor electronics are installed within the sensor module and include a temperature sensor (RTD), a memory module, and the capacitance to digital signal converter (C/D converter). The electrical signals from the sensor module are transmitted to the output electronics in the electronics housing. The electronics housing contains the output electronics board (microprocessor, memory module, digital to analog signal converter or D/A converter), the local zero and span buttons, and the terminal block. The basic block diagram of the Model 3051CD is illustrated in Figure 1-1.

For the Model 3051C design pressure is applied to the isolating diaphragms, the oil deflects the center diaphragm, which then changes the capacitance. This capacitance signal is then changed to a digital signal in the C/D converter. The microprocessor then takes the signals from the RTD and C/D converter calculates the correct output of the transmitter. This signal is then sent to the D/A converter, which converts the signal back to an analog signal and superimposes the HART signal on the 4-20 mA output.

Figure 1-1. Block diagram of operation



Section 2 Installation

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OVERVIEW

The information in this section covers installation considerations. Dimensional drawings for each Model 3051 variation and mounting configuration are found on page A-13.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operation. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Both transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

⚠WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals.

⚠WARNING

Process leaks could result in death or serious injury.

- Install and tighten all four flange bolts before applying pressure.
- Do not attempt to loosen or remove flange bolts while the transmitter is in service.

⚠WARNING

Replacement equipment or spare parts not approved by Rosemount Inc. for use as spare parts could reduce the pressure retaining capabilities of the transmitter and may render the instrument dangerous.

- Use only bolts supplied with the Model 3051 or sold by Rosemount Inc. as spare parts for the Model 3051.

⚠WARNING

Improper assembly of manifolds to traditional housing can damage sensor module.

- For safe assembly of manifold to traditional flange, bolts must break back plane of flange web (i.e., bolt hold) but must not contact module housing.

GENERAL CONSIDERATIONS

Measurement accuracy depends upon proper installation of the transmitter and impulse piping. Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. Keep in mind the need for easy access, personnel safety, practical field calibration, and a suitable transmitter environment. Install the transmitter to minimize vibration, shock, and temperature fluctuation.

IMPORTANT
Install the enclosed pipe plug in unused conduit openings with a minimum of five threads engaged to comply with Explosion-Proof requirements. The transmitter is shipped with the plug installed on transmitters ordered with CSA Explosion-Proof approval.

NOTE
Limit use if a continuous cyclic use of universal HART Commands if other than Commands 1, 2 or 3. If there is a requirement to conduct additional continuous cyclic HART Commands, please consult factory.

MECHANICAL CONSIDERATIONS

"Dimensional Drawings" beginning on page A-13 show dimensional drawings of Model 3051 transmitters. Figure 2-4 on page 2-10 shows installation examples.

NOTE
For Models 3051CD0 and 3051CD1, mount the transmitter solidly to prevent tilting. A tilt in the physical transmitter may cause a zero shift in the transmitter output.

NOTE
Do not blow down impulse piping through the transmitter. For steam service, first, isolate the transmitter then flush the lines and refill the lines with water before resuming measurement.

NOTE
When the transmitter is mounted on its side, position the Coplanar flange to ensure proper venting or draining. Mount the flange as shown in Figure 2-4 on page 2-10, keeping drain/vent connections on the bottom for gas service and on the top for liquid service.

NOTE
The Model 3051 transmitter incorporates two independent seals between the process connection and the conduit connection.

DRAFT RANGE CONSIDERATIONS

Installation

For the Model 3051CD0 draft range pressure transmitter, it is best to mount the transmitter with the isolators parallel to the ground. Installing the transmitter in this way reduces oil head effect and provides for optimal temperature performance.

Be sure the transmitter is securely mounted. Tilting of the transmitter may cause a zero shift in the transmitter output.

Reducing Process Noise

There are two recommended methods of reducing process noise: output damping and, in gage applications, reference side filtering.

Output Damping

The output damping for the Model 3051CD0 is factory set to 3.2 seconds as a default. If the transmitter output is still noisy, increase the damping time. If faster response is needed, decrease the damping time. Damping adjustment information is available on page 3-16.

Reference Side Filtering

In gage applications it is important to minimize fluctuations in atmospheric pressure to which the low side isolator is exposed.

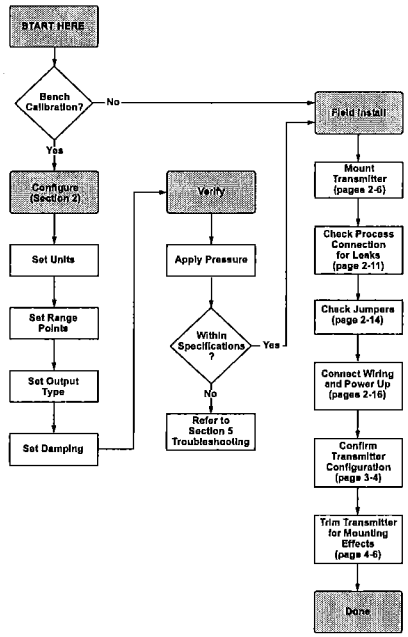
One method of reducing fluctuations in atmospheric pressure is to attach a length of tubing to the reference side of the transmitter to act as a pressure buffer.

Another method is to plumb the reference side to a chamber that has a small vent to atmosphere. If multiple draft transmitters are being used in an application, the reference side of each device can be plumbed to a chamber to achieve a common gage reference.

ENVIRONMENTAL CONSIDERATIONS

The following guidelines can help optimize transmitter performance. Mount the transmitter to minimize ambient temperature changes, vibration, mechanical shock, and to avoid external contact with corrosive materials. Appendix A: Range and Sensor Limits on page A-6 lists the transmitter temperature operating limits.

Figure 2-1. Installation Flowchart



INSTALLATION PROCEDURES

When choosing an installation location and position, take into account the need for access to the transmitter. For dimensional drawing information see page A-13.

Process Flange Orientation

Mount the process flanges with sufficient clearance for process connections. For safety reasons, place the drain/vent valves so the process fluid is directed away from you when the vents are used. In addition, consider the possible need for a testing or calibration input.

Housing Rotation

See "Consider Housing Rotation" on page 2-13.

Terminal Side of Electronics Housing

Mount the transmitter so that the terminal side is accessible. A 0.75-inch (19 mm) clearance is required for cover removal. Use a conduit plug on the unused side of the conduit opening.

Circuit Side of Electronics Housing

Provide 0.75 inches (19 mm) clearance if possible for cover removal. Three inches of clearance is required for cover removal if a display is installed.

Exterior of Electronics Housing

The integral span and zero adjustments are located under the certifications plate on the top of the transmitter. Allow a minimum of 1.0 inch of clearance above the transmitter if you intend to use the integral zero and span adjustments.

Cover Installation

Always install the electronics housing covers metal-to-metal to ensure a proper seal.

Mount the transmitter

The Model 3051C Pressure Transmitter weighs 5.7 lbs (2.6 kg) without additional options. Optional mounting brackets available with the Model 3051 allow mounting to a panel, wall, or 2-inch pipe. The B4 Bracket Option for use with the Coplanar flange and the Model 3051T is 316 SST with 316 SST bolts. "Model 3051T Dimensional Drawings" on page A-16 show bracket dimensions and mounting configurations for the B4 Option.

Mounting Brackets

Bracket options B1, B2, B3, B7, B8, and B9 are sturdy polyurethane painted carbon steel brackets designed for use in pipe or panel mounting the traditional flange (H2, H3, H4, or H7 option). The B1–B3 brackets have carbon steel bolts, while the B7–B9 brackets have stainless steel bolts. Bracket options BA and BC are stainless steel with stainless steel bolts. Dimensionally, these brackets are identical to the B1–B3 brackets used with the Rosemount Model 1151 Pressure Transmitter except for the length of the bolts used to mount the transmitter to the bracket. Bracket options B5/B6 are used for Model 3051H transmitters. These bracket styles facilitate multiple mounting configurations, see "Model 3051H Pressure Transmitter Exploded View and Dimensional Drawings" on page A-17. When installing the transmitter to one of the mounting brackets, torque the bolts to 125 inch-pounds.

NOTE
The transmitter is calibrated in a horizontal or vertical position at the factory. Mounting the transmitter in a position other than factory calibration position will cause the zero point to shift by an amount equivalent to the liquid head. To reset the zero point, refer to "Sensor Trim" on page 4-6.

Mounting Bolts

The following guidelines have been established to ensure a tight flange, adapter, or manifold seal. The Model 3051 is shipped with the Coplanar/Traditional flange installed with four 1.75-inch flange bolts or integral manifold installed with four 2.25-inch bolts. The following bolts are also available to facilitate other mounting configurations:

Differential Pressure

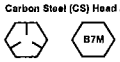
- Four 2.88-inch flange/adapter bolts for mounting the flange adapters to the Coplanar flange with DF option or as a bolt kit.
- Four 2.25-inch conventional manifold/flange bolts for mounting a three-valve manifold to the Coplanar flange when specified as an assembly or as a bolt kit. In this configuration, the 1.75-inch bolts may be used to mount the flange adapters to the process connection side of the manifold.

Gage/Absolute Pressure

- Two 2.88-inch flange/adapter bolts for mounting the flange adapters to the Coplanar flange with DF option or as a bolt kit.

Figure 2-3 shows mounting bolts and bolting configurations for a Coplanar flange. Figure 2-2 for bolting requirements for alternate mounting configurations. Stainless steel bolts supplied by Rosemount Inc. are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. No additional lubricant should be applied when installing either type of bolt. Bolts supplied by Rosemount Inc. are identified by their head markings:

Carbon Steel (CS) Head Markings



Stainless Steel (SST) Head Markings



* The last digit in the F593_ head marking may be any letter between A and M.

Bolt Installation

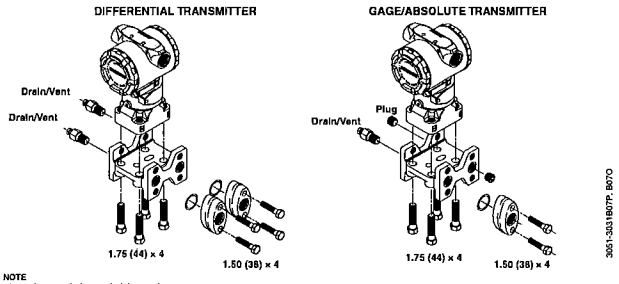
⚠ Only use bolts supplied with the Model 3051 or sold by Rosemount Inc. as spare parts for the Model 3051 transmitter. Use the following bolt installation procedure:

1. Finger-tighten the bolts.
2. Torque the bolts to the initial torque value using a crossing pattern (see Table 2-1 for torque values).
3. Torque the bolts to the final torque value using the same crossing pattern.

Table 2-1. Bolt Installation Torque Values

Bolt Material	Initial Torque Value	Final Torque Value
CS-ASTM-A445 Standard	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
316 SST—Option L4	150 in.-lb (17 N-m)	300 in.-lb (34 N-m)
ASTM-A-193-B7M—Option L5	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
Monel®—Option L6	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)

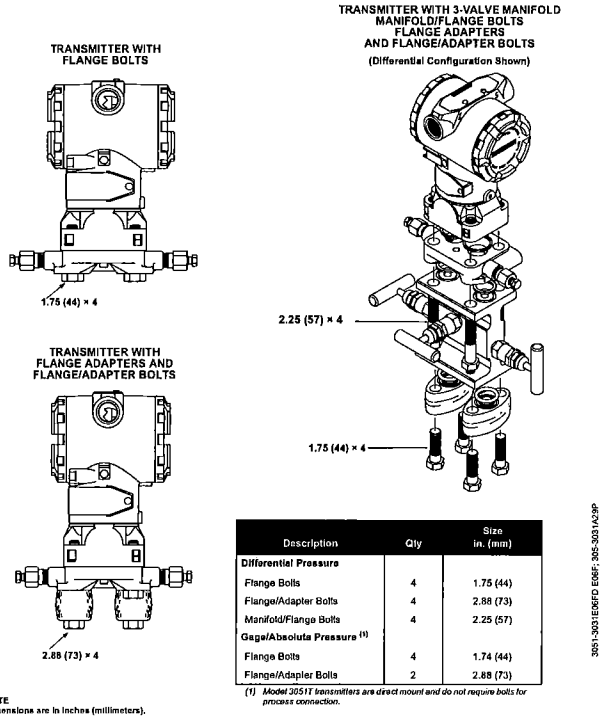
Figure 2-2. Traditional Flange Bolt Configurations



NOTE
Dimensions are in inches (millimeters).

⚠ See "Safety Messages" on page 2-1 for complete warning information.

Figure 2-3. Mounting Bolts and Bolt Configurations for Coplanar Flange



Description	Qty	Size in. (mm)
Differential Pressure		
Flange Bolts	4	1.75 (44)
Flange/Adapter Bolts	4	2.88 (73)
Manifold/Flange Bolts	4	2.25 (57)
Gage/Absolute Pressure (1)		
Flange Bolts	4	1.74 (44)
Flange/Adapter Bolts	2	2.88 (73)

(1) Model 3051T transmitters are direct mount and do not require bolts for process connection.

NOTE
Dimensions are in inches (millimeters).

Mounting Requirements

Refer to Figure 2-4 for examples of the following mounting configurations:

Liquid Flow Measurement

- Place taps to the side of the line to prevent sediment deposits on the transmitter's process isolators.
- Mount the transmitter beside or below the taps so gases can vent into the process line.
- Mount drain/vent valve upward to allow gases to vent.

Gas Flow Measurement

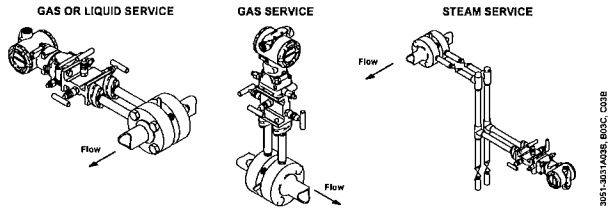
- Place taps in the top or side of the line.
- Mount the transmitter beside or above the taps so liquid will drain into the process line.

Steam Flow Measurement

- Place taps to the side of the line.
- Mount the transmitter below the taps to ensure that the impulse piping will stay filled with condensate.
- Fill impulse lines with water to prevent the steam from contacting the transmitter directly and to ensure accurate measurement start-up.

NOTE
In steam or other elevated temperature services, it is important that temperatures at the coplanar process flanges not exceed 250 °F (121 °C) for transmitters with silicone fill or 185 °F (85 °C) for inert fill. In vacuum service, these temperature limits are reduced to 220 °F (104 °C) for silicone fill and 160 °F (71 °C) for inert fill. Models 3051L, 3051H, and the traditional flange allow higher temperatures.

Figure 2-4. Installation Examples



Process Connections

Model 3051C process connection

Model 3051 process connections on the transmitter flange are ¼–18 NPT. Flange adapter unions with ½–14 NPT connections must be ordered using the DF option. The threads are Class 2; use your plant-approved lubricant or sealant when making the process connections. The process connections on the transmitter flange are on 2⅛-inch (54 mm) centers to allow direct mounting to a three-valve or five-valve manifold. Rotate one or both of the flange adapters to attain connection centers of 2 inches (51 mm), 2⅛ inches (54 mm), or 2¼ inches (57 mm). See page 2-12 for information on the Model 3051T process connection.

⚠ Install and tighten all four flange bolts before applying pressure, or process leakage will result. When properly installed, the flange bolts will protrude through the top of the module housing. Do not attempt to loosen or remove the flange bolts while the transmitter is in service.

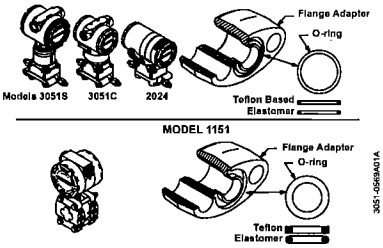
To install adapters to a Coplanar flange, perform the following procedure:

1. Remove the flange bolts.
2. Leaving the flange in place, move the adapters into position with the O-ring installed.
3. Clamp the adapters and the Coplanar flange to the transmitter module using the larger of the bolts supplied.
4. Tighten the bolts. Refer to "Mounting Bolts" on page 2-7 for torque specifications.

⚠WARNING

Failure to install proper flange adapter O-rings can cause process leaks, which can result in death or serious injury.

The two flange adapters are distinguished by unique O-ring grooves. Only use the O-ring that is designed for its specific flange adapter, as shown below.



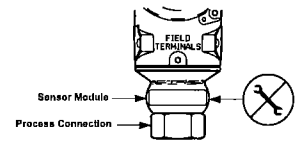
Refer to the Spare Parts list in Appendix A: Reference Data for the correct part numbers of the flange adapters and O-rings designed for Model 3051 transmitters.

When compressed, Teflon® O-rings tend to cold flow, which aids in their sealing capabilities. Whenever you remove flanges or adapters, visually inspect the Teflon O-rings. Replace them if there are any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them. If you replace the O-rings, retorque the flange bolts after installation to compensate for cold flow. Refer to the process sensor body reassembly procedure in Section 5: Troubleshooting.

Model 3051T Process Connection

⚠WARNING

Do not apply torque directly to the sensor module. Rotation between the sensor module and the process connection can damage the electronics. To avoid damage, apply torque only to the hex-shaped process connection.



Impulse Piping

The piping between the process and the transmitter must accurately transfer the pressure to obtain accurate measurements. There are five possible sources of error: pressure transfer, leaks, friction loss (particularly if purging is used), trapped gas in a liquid line, liquid in a gas line, and density variations between the legs.

The best location for the transmitter in relation to the process pipe depends on the process itself. Use the following guidelines to determine transmitter location and placement of impulse piping:

- Keep impulse piping as short as possible.
- For liquid service, slope the impulse piping at least 1 inch per foot (8 cm per m) upward from the transmitter toward the process connection.
- For gas service, slope the impulse piping at least 1 inch per foot (8 cm per m) downward from the transmitter toward the process connection.
- Avoid high points in liquid lines and low points in gas lines.
- Make sure both impulse legs are the same temperature.
- Use impulse piping large enough to avoid friction effects and blockage.
- Vent all gas from liquid piping legs.
- When using a sealing fluid, fill both piping legs to the same level.
- When purging, make the purge connection close to the process taps and purge through equal lengths of the same size pipe. Avoid purging through the transmitter.
- Keep corrosive or hot (above 250 °F [121 °C]) process material out of direct contact with the sensor module and flanges.
- Prevent sediment deposits in the impulse piping.
- Keep the liquid head balanced on both legs of the impulse piping.
- Avoid conditions that might allow process fluid to freeze within the process flange.

Consider Housing Rotation

The electronics housing can be rotated up to 180 degrees (left or right) to improve field access or to better view the optional LCD display. To rotate the housing, perform the following procedure:

1. Loosen the housing rotation set screw using a 9/64-in. hex wrench.
2. Turn the housing up to 180 degrees to the left or right of its original (as shipped) position. **Do not rotate the housing more than 180 degrees without first performing a disassembly procedure (see "Disassembly Procedures" on page 5-3). Over-rotation will sever the electrical connection between the sensor module and the electronics module.**
3. Retighten the housing rotation set screw.

Set Jumpers

Security (Write Protect)

There are three security methods with the Model 3051 transmitter:

1. Security Jumper: prevents all writes to transmitter configuration.
2. Local Keys (Local Zero and Span) Software Lock Out: prevents changes to transmitter range points via local zero and span adjustment keys. With local keys security enabled, changes to configuration are possible via HART.
3. Physical Removal of Local Keys (Local Zero and Span) Magnetic Buttons: removes ability to use local keys to make transmitter range point adjustments. With local keys security enabled, changes to configuration are possible via HART.

NOTE
If the security jumper is not installed, the transmitter will continue to operate in the security OFF configuration.

You can prevent changes to the transmitter configuration data with the write protection jumper. Security is controlled by the security (write protect) jumper located on the electronics board or display face. Position the jumper on the transmitter circuit board in the "ON" position to prevent accidental or deliberate change of configuration data.

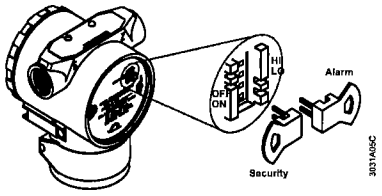
If the transmitter write protection jumper is in the "ON" position, the transmitter will not accept any "writes" to its memory. Configuration changes, such as digital trim and reranging, cannot take place when the transmitter security is on.

Configuring Transmitter Alarm and Security Jumper Procedure

To reposition the jumpers, follow the procedure described below.

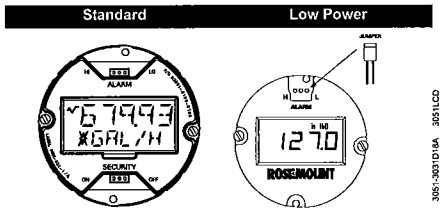
1. If the transmitter is installed, secure the loop and remove power.
2. ⚠ Remove the housing cover opposite the field terminal side. Do not remove the transmitter covers in explosive atmospheres when the circuit is live.
3. Reposition the jumpers as desired.
   - Figure 2-5 shows the jumper positions for the electronics board.
   - Figure 2-6 shows transmitters with an optional LCD display.
   - Figure 2-7 shows the jumper positions for low-power transmitters.
4. ⚠ Reattach the transmitter cover. Transmitter covers must be fully engaged to meet Explosion-Proof requirements.

Figure 2-5. Electronics Board



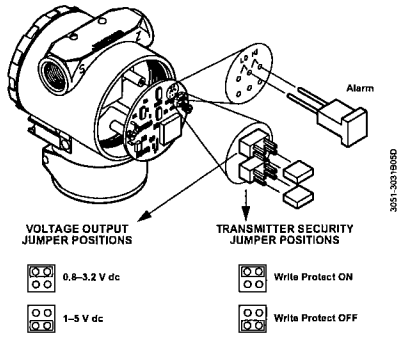
NOTE
Security jumper not installed = Not Write Protected
Alarm jumper not installed = High Alarm

Figure 2-6. Model 3051 with Optional LCD Display



NOTE
Security jumper not installed = Not Write Protected
Alarm jumper not installed = High Alarm

Figure 2-7. Low Power Transmitter Electronics Boards



NOTE
Security jumper not installed = Not Write Protected
Alarm jumper not installed = High Alarm
Voltage output jumper not installed = 1–5 V

Connect Wiring and Power Up

NOTE
Use shielded twisted pairs to yield best results. In order to ensure proper communication, use 24 AWG or larger wire, and do not exceed 5000 feet (1 500 meters). Installed signal wiring should not be run together and should not be in the same cable tray as AC power wiring.

The transmitter terminal block is in the compartment of the electronics housing labeled "FIELD TERMINALS." The other compartment contains the transmitter electronics module. Connections for the HART-based communicator are attached beneath the terminal screws on the terminal block. You can connect the Rosemount Model 282 Loop Validator at the signal terminals to provide power to the transmitter temporarily for calibration or diagnostic purposes. Or you can attach it to the test connections on the terminal block of the transmitter for indication purposes. Figure 2-8 shows power supply load limitations for the transmitter.

To make connections, perform the following procedure:

⚠ 1. Remove the housing cover on the side marked "FIELD TERMINALS." Do not remove the cover in explosive atmospheres when the circuit is live. All power to the transmitter is supplied over the signal wiring.

⚠ 2. Connect the lead that originates at the positive side of the power supply to the terminal marked "+" and the lead that originates from the negative side of the power supply to the terminal marked "–". Avoid contact with the leads and terminals. Do not connect the powered signal wiring to the test terminals. Power could damage the test diode in the test connection.

3. Plug and seal unused conduit connections on the transmitter housing to avoid moisture accumulation in the terminal side of the housing. If you do not seal the unused connections, mount the transmitter with the electrical housing positioned downward for drainage. Install wiring with a drip loop. Arrange the drip loop so the bottom is lower than the conduit connections and the transmitter housing.

Inductive-based transient protectors, including the Rosemount Model 470, can adversely affect the output of Model 3051 4–20 mA transmitters. Do not use the Model 470 for transient protection with the Model 3051. If your application requires transient protection, install the Transient Protection Terminal Block (Section 5: Troubleshooting).

Signal Wiring Grounding

Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. You may ground the signal wiring at any one point on the signal loop, or leave it ungrounded. The negative terminal of the power supply is a recommended grounding point. Device must be properly grounded or earthed according to local electric codes.

Power Supply for 4–20 mA Transmitters

The dc power supply should provide power with less than 2 percent ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, and related pieces. Note that the resistance of intrinsic safety barriers, if used, must be included. See "Power Supply Effect" on page A-5 for additional power supply information.

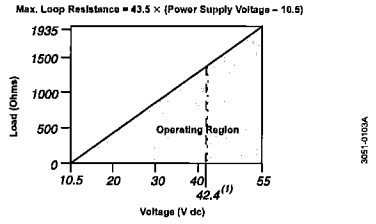
NOTE
A minimum loop resistance of 250 ohms is required to communicate with a HART Communicator. If a single power supply is used to power more than one Model 3051 transmitter, the power supply used, and circuitry common to the transmitters, should not have more than 20 ohms of impedance at 1200 Hz.

⚠ See "Safety Messages" on page 2-1 for complete warning information.

Power supply for low power transmitters

Low-power transmitters require a 6–12 V dc external power supply.

Figure 2-8. Power Supply Load Limitations, 4–20 mA Transmitters



Communication requires a minimum loop resistance of 250 ohms.
(1) For CSA approval, power supply must not exceed 42.4 V.

HAZARDOUS LOCATIONS

The Model 3051 has an Explosion-Proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual transmitters are clearly marked with a tag indicating the certifications they carry. See Appendix B: Product Certifications for specific approval categories and installation drawings.

IMPORTANT NOTE
Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently mark the approval label to distinguish it from unused approval types.

Grounding the Transmitter Case

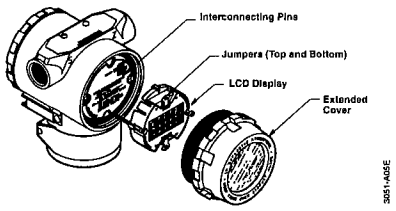
The transmitter case should always be grounded in accordance with national and local electrical codes. The most effective transmitter case grounding method is direct connection to earth ground with minimal impedance. Methods for grounding the transmitter case include:

- **Internal Ground Connection**: The Internal Ground Connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol (⏚), and is standard on all Model 3051 transmitters.
- **External Ground Assembly**: This assembly is included with the optional transient protection terminal block (Option Code T1), and it is included with CESI/CENELEC Flame-Proof Certification (Option Code E8), BASEEFA/CENELEC Intrinsic Safety Certification (Option Code I1), and BASEEFA Type N Certification (Option Code N1). The External Ground Assembly can also be ordered with the transmitter (Option Code V5), or as a spare part (03031-0398-0001).

NOTE
Grounding the transmitter case using the threaded conduit connection may not provide a sufficient ground. The transient protection terminal block (Option Code T1) does not provide transient protection unless the transmitter case is properly grounded. Use the above guidelines to ground the transmitter case. Do not run the transient protection ground wire with signal wiring as the ground wire may carry excessive current if a lightning strike occurs.

INSTALLING THE LCD DISPLAY

Figure 2-9. Optional LCD Display



For transmitters ordered with the LCD display, the display is shipped installed. Installing the display on an existing Model 3051 transmitter requires a small instrument screwdriver and the display kit.

The kits vary depending on the version of transmitter electronics. Examine the following numbers carefully to ensure you are installing the correct kit.

For Use with Shrouded Electronics Board

Meter Kits
Option M5: P/N 03031-0193-0101 (Aluminum housing)

Option M6: P/N 03031-0193-0111 (SST housing)

For Use with Non-Shrouded Electronics Board

Meter Kits
Option M5: P/N 03031-0193-0001

Option M6: P/N 03031-0193-0011

The meter kit includes:

- one LCD display assembly
- one extended cover with O-ring installed
- two nylon standoffs
- two captive screws
- one ten-pin interconnection header

Use the following procedure and Figure 2-9 to install the LCD display. If the display is an upgrade from a previous version, upgrade the electronics board before attempting to install the display.

1. IF the transmitter is installed in a loop, THEN secure the loop and disconnect power.

⚠ 2. Remove the transmitter cover opposite the field terminal side. Do not remove the instrument covers in explosive environments when the circuit is alive.

3. Remove the failure mode and alarm jumpers from the electronics module and insert them in their new positions above and below the display readout on the display assembly.

NOTE
On previous versions, remove only the alarm jumper.

4. Insert the interconnection header in the ten-pin socket exposed by removal of the jumpers. (Previous versions of the display use a six-pin connector.)

5. Remove the two captive screws from the electronics module. To do so, loosen the screws to release the module, then pull out the screws until they are stopped by the captive thread inside of the circuit board standoffs. Continue loosening the screws and remove them.

6. If necessary, rotate the electronics housing up to 180 degrees (left or right) to improve field access or to better view the LCD display. To rotate the housing:
   a. Loosen the housing rotation set screw using a 9/64-in. hex wrench.
   b. Turn the housing up to 180 degrees to the left or right of its original (as shipped) position. **Do not rotate the housing more than 180 degrees without first performing a disassembly procedure (see "Disassembly Procedures" on page 5-3). Over-rotation will sever the electrical connection between the sensor module and the electronics module.**
   c. Retighten the housing rotation set screw.

⚠ See "Safety Messages" on page 2-1 for complete warning information.

7. Decide which direction to orient the display. Insert the long display screws into the two holes on the display assembly that coincide with the holes on the electronics module. You can install the display in 90-degree increments for easy viewing. Position one of the four connectors on the back of the display assembly to accept the interconnection header.
8. Attach the display assembly to the electronics module by threading the screws into the captive threads and attaching the display assembly to the interconnection pins. Tighten the screws to secure the display assembly and electronics board in place.
9. ⚠ Attach and tighten the extended cover. Transmitter covers must be fully engaged to meet Explosion-Proof requirements and to achieve the proper environmental seal.

Note the following LCD temperature limits:
Operating: –4 to 175 °F (–20 to 80 °C)

Storage: –40 to 185 °F (–40 to 85 °C)

NOTE
Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD display, an alarm level test is recommended before returning the transmitter to service (see page 3-19).

⚠ See "Safely Messages" on page 2-1 for complete warning information.

MODELS 305 AND 306 INTEGRAL MANIFOLDS

The Model 305 is available in two designs: Traditional and Coplanar. The traditional Model 305 Integral Manifold can be mounted to most primary elements with mounting adapters in the market today. The Model 306 Integral Manifold is used with in-line transmitters to provide block-and-bleed valve capabilities of up to 10000 psi (690 bar).

Figure 2-10. Integral Manifolds



Model 305 Integral Manifold Installation Procedure

To install a Model 305 Integral Manifold to a Model 3051 transmitter:

⚠ 1. Inspect the Teflon sensor module O-rings. If the O-rings are undamaged, reusing them is recommended. If the O-rings are damaged (if they have nicks or cuts, for example), replace them with new O-rings.

IMPORTANT
If replacing the O-rings, take care not to scratch or deface the O-ring grooves or the surface of the isolating diaphragm while you remove the damaged O-rings.

2. Install the Integral Manifold on the sensor module. Use the four 2.25-in. manifold bolts for alignment. Finger tighten the bolts, then tighten the bolts incrementally in a cross pattern to final torque value. See "Mounting Bolts" on page 2-7 for complete bolt installation information and torque values. When fully tightened, the bolts should extend through the top of the module housing.
3. If the Teflon O-rings have been replaced, the flange bolts should be re-tightened after installation to compensate for cold flow of the O-rings.

NOTE
Always perform a zero trim on the transmitter/manifold assembly after installation to eliminate mounting effects.

Model 306 Integral Manifold Installation Procedure

The Model 306 Manifold is for use only with a Model 3051T transmitter.

⚠ Assemble the Model 306 Manifold to the Model 3051T transmitter with a thread sealant.

⚠ See "Safely Messages" on page 2-1 for complete warning information.

Section 3 Configuration

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Review Configuration Data ..... page 3-7
Check Output ..... page 3-7
Basic Setup ..... page 3-8
LCD Display ..... page 3-16
Detailed Setup ..... page 3-19
Diagnostics and Service ..... page 3-21
Advanced Functions ..... page 3-22
Multidrop Communication ..... page 3-25

OVERVIEW

This section contains information on commissioning and operating Model 3051 Smart Pressure Transmitters. Tasks that should be performed on the bench prior to installation are explained in this section.

For your convenience, HART communicator fast key sequences are listed for each software function. If you are unfamiliar with the communicator or how to follow fast key sequences, please refer to your communicator manual for communicator operations.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

⚠WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

COMMISSIONING ON THE BENCH WITH HART

Commissioning consists of testing the transmitter and verifying transmitter configuration data. You may commission Model 3051 transmitters either before or after installation. Commissioning the transmitter on the bench before installation using a HART-based communicator or AMS ensures that all transmitter components are in good working order and acquaints you with the operation of the device.

⚠ To commission on the bench, connect the transmitter and the communicator as shown in Figure 3-1 and 3-2. Make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices before connecting a communicator or AMS in an explosive atmosphere. Connect the communicator leads at any termination point in the signal loop. It is most convenient to connect them to the terminals labeled "COMM" on the terminal block. Connecting across the "TEST" terminals will prevent successful communication. To avoid exposing the transmitter electronics to the plant environment after installation, set all transmitter jumpers during the commissioning stage on the bench.

For 4–20 mA transmitters, you will need a power supply capable of providing 10.5 to 55 V dc at the transmitter, and a meter to measure output current. To enable communication, a resistance of at least 250 ohms must be present between the communicator or AMS loop connection and the power supply. Do not use inductive-based transient protectors with the Model 3051.

For more information on the Model 275 HART Communicator see document 00275-8026-0002. AMS help can be found in the AMS on-line guides within the AMS system.

Setting the Loop to Manual

Whenever you are preparing to send or request data that would disrupt the loop or change the output of the transmitter, you must set your process application loop to manual. Both the HART Communicator Model 275 and AMS will prompt you to set the loop to manual when necessary. Keep in mind that acknowledging this prompt does not set the loop to manual. The prompt is only a reminder; you have to set the loop to manual yourself as a separate operation.

⚠ See "Safely Messages" on page 3-1 for complete warning information.

Wiring Diagrams

Bench Hook-up

Connect the bench equipment as shown in Figure 3-1 and 3-2, and turn on the HART-based communicator by pressing the ON/OFF key. The communicator will search for a HART-compatible device and will indicate when the connection is made. If the communicator fails to connect, it will indicate that no device was found. If this occurs, refer to Troubleshooting page 5-1.

Field Hook-up

Figures 3-1 and 3-2 illustrate wiring loops for a field hook-up with a HART Communicator or AMS. Signal point may be grounded at any point or left ungrounded.

Figure 3-1. Wiring (4–20 mA)

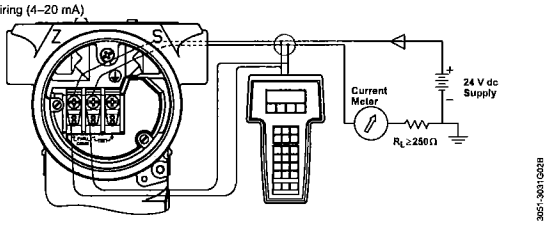
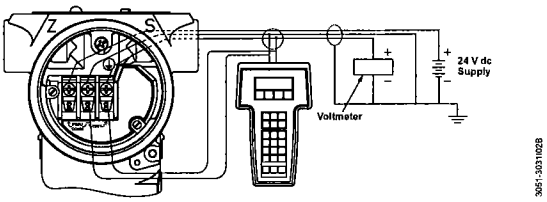


Figure 3-2. Wiring (Low-Power)



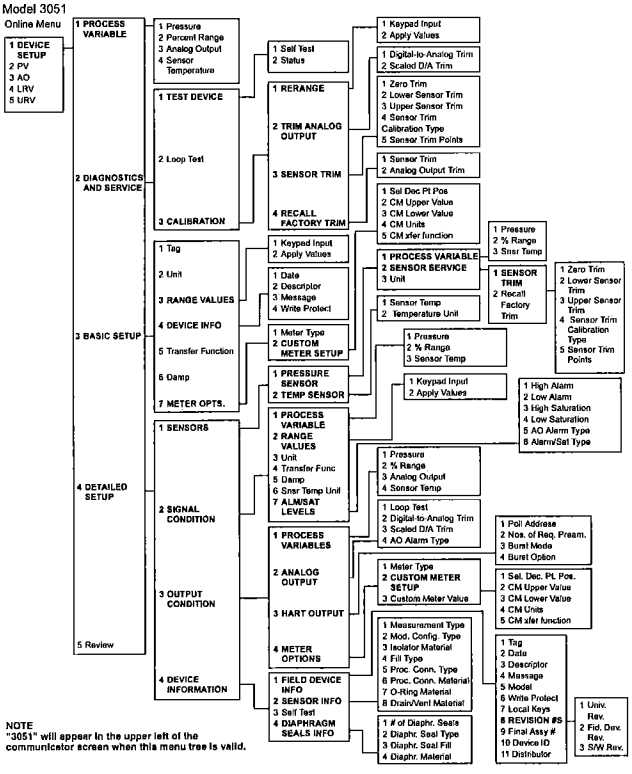
MODEL 275 HART COMMUNICATOR

A check (✓) indicates the basic configuration parameters. At minimum, these parameters should be verified as part of the configuration and startup procedure.

Table 3-1. The Model 275 HART Communicator Fast Key Sequence

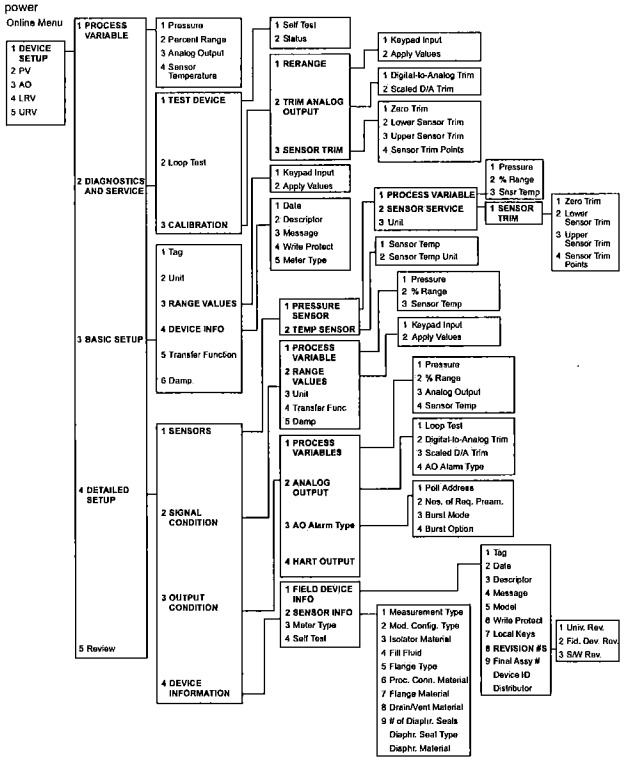
	Function	Fast Key Sequence
	Alarm and Saturation Levels	1, 4, 2, 7
	Analog Output Alarm Type	1, 4, 3, 2, 4
	Burst Mode Control	1, 4, 3, 3, 3
	Burst Operation	1, 4, 3, 3, 3
	Custom Meter Configuration	1, 3, 7, 2
	Custom Meter Value	1, 4, 3, 4, 3
✓	Damping	1, 3, 6
	Date	1, 3, 4, 1
	Descriptor	1, 3, 4, 2
	Digital To Analog Trim (4-20 mA Output)	1, 2, 3, 2, 1
	Disable Local Span/Zero Adjustment	1, 4, 4, 1, 7
	Field Device Information	1, 4, 4, 1
	Full Trim	1, 2, 3, 3
	Keypad Input – Rerange	1, 2, 3, 1, 1
	Local Zero and Span Control	1, 4, 4, 1, 7
	Loop Test	1, 2, 2
	Lower Sensor Trim	1, 2, 3, 3, 2
	Message	1, 3, 4, 3
	Meter Options	1, 4, 3, 4
	Number of Requested Preambles	1, 4, 3, 3, 2
	Poll Address	1, 4, 3, 3, 1
	Poll a Multidropped Transmitter	Left Arrow, 4, 1, 1
✓	Range Values	1, 3, 3
	Rerange	1, 2, 3, 1
	Scaled D/A Trim (4–20 mA Output)	1, 2, 3, 2, 2
	Self Test (Transmitter)	1, 2, 1, 1
	Sensor Info	1, 4, 4, 2
	Sensor Temperature	1, 1, 4
	Sensor Trim Points	1, 2, 3, 3, 5
	Status	1, 2, 1, 1
✓	Tag	1, 3, 1
✓	Transfer Function (Setting Output Type)	1, 3, 5
	Transmitter Security (Write Protect)	1, 3, 4, 4
	Trim Analog Output	1, 2, 3, 2
✓	Units (Process Variable)	1, 3, 2
	Upper Sensor Trim	1, 2, 3, 3, 3
	Zero Trim	1, 2, 3, 3, 1

Figure 3-3. HART Communicator menu tree for Model 3051



NOTE
"3051" will appear in the upper left of the communicator screen when this menu tree is valid.

Figure 3-4. HART Communicator menu tree for low power



REVIEW CONFIGURATION DATA

HART Comm	1, 5

NOTE
Information and procedures in this section that make use of HART Communicator fast key sequences assume that the transmitter and communicator are connected, powered, and operating correctly. If you are not familiar with the HART Communicator refer to the HART Communicator manual, document 00809-0100-4275

HART Communicator

Before you place the transmitter into operation, review the transmitter configuration data below which was set by the factory.

Transmitter Model	Type
Tag	Range
Date	Descriptor
Message	Minimum and Maximum Sensor Limits
Minimum Span	Units
4 and 20 mA points	Output (linear or sq. root)
Damping	Alarm Setting (high, low)
Security Setting (on, off)	Local Zero/Span Keys (enabled, disabled)
Integral Display	Sensor Fill
Isolator Material	Flange (type, material)
O-Ring Material	Drain/Vent
Remote Seal (type, fill fluid, isolator material, number)	Transmitter S/N
Address	Sensor S/N

AMS

Right click on the device and select "Configuration Properties" from the menu. Select the tabs to review the transmitter configuration data.

CHECK OUTPUT

Before performing other transmitter on-line operations, review the digital output parameters to ensure that the transmitter is operating properly and is configured to the appropriate process variables.

Process Variables

HART Comm.	1, 1

HART Communicator

The process variables for the Model 3051 provide the transmitter output, and are continuously updated. The process variable menu displays the following process variables:

- Pressure
- Percent of Range
- Analog Output

The pressure reading in both Engineering Units and Percent of Range will continue to track with pressures outside of the defined range from the lower to the upper range limit of the sensor module. (Previous versions of the software will track with pressure up to 105% of span and remain there as pressure increases.)

NOTE
Regardless of the range points, the Model 3051 will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA points are set to 0 and 10 inH_2O, and the transmitter detects a pressure of 25 inH_2O, it digitally outputs the 25 inH_2O reading and a 250% of span reading. However, there may be up to ±5.0% error associated with output outside of the range points.

AMS

Right click on the device and select "Process Variables..." from the menu.The process variable screen displays the following process variables:

- Pressure
- Percent of range
- Analog output
- Sensor temperature

Sensor Temperature

HART Comm.	1, 1, 4

The Model 3051 contains a temperature sensor just above its pressure sensor in the sensor module. When reading this temperature, keep in mind that this is not a process temperature reading.

HART Communicator

Enter the fast key sequence below "Sensor Temperature" to view the sensor temperature reading.

AMS

Right click on the device and select "Process Variables..." from the menu. "Snsr Temp" is the sensor temperature reading.

BASIC SETUP

Set Process Variable Units

HART Comm.	1, 3, 2

The *PV Unit* command sets the process variable units to allow you to monitor your process using the appropriate units of measure. Select from the following engineering units:

- inH_2O
- bar
- inHg
- mbar
- ftH_2O
- g/cm^2
- mmH_2O
- kg/cm^2
- mmHg
- Pa
- psi
- kPa
- torr
- atm
- inH_2O at 4 °C(1)
- mmH_2O at 4 °C(1)

(1) Not available with low power or previous Model 3051 transmitters.

AMS

Right click on the device and select "Configuration Properties" from the menu. In the Basic Setup tab, use "Unit" drop down menu to select units.

Set Output

HART Comm.	1, 3, 5

Activate the transmitter square root output option to make the analog output proportional to flow. As the input approaches zero, the Model 3051 automatically switches to a linear output in order to ensure a more smooth, stable output near zero. See Figure 3-5.

The transition from linear to square root is not adjustable. It occurs at 0.8% of ranged pressure input or 9% of full-scale flow output in transmitters with Revision 5.2 or higher software. In earlier software, the transition point occurred at 4% of ranged pressure input, or 20% of full scale flow output.

From 0 percent to 0.6 percent of the ranged pressure input, the slope of the curve is unity (y = x). This allows accurate calibration near zero. Greater slopes would cause large changes in output for small changes at input. From 0.6 percent to 0.8 percent, the slope of the curve equals 42 (y = 42x) to achieve continuous transition from linear to square root at the transition point.

HART Communicator

Enter the fast key sequence below "Set Output (Transfer function)."

AMS

Right click on the device and select "Configuration Properties" from the menu.

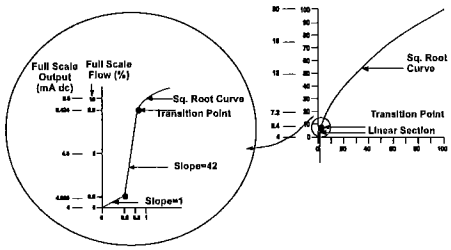
1. In the Basic Setup tab, use "Xfer fnctn" drop down menu to select output, click **Apply**.
2. An "Apply Parameter Modifications" screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Selecting Output Range for Low-Power Output Transmitters

Low power transmitters output either 1–5 V dc or 0.8–3.2 V dc depending on the position of the voltage output jumper. To reposition the voltage output jumper, follow the procedure described on page 2-14.

NOTE
Default low power output is 1–5 V dc. After changing output between 1–5 V and 0.8–3.2 V, perform a low power output trim.

Figure 3-5. Square Root Output Transition Point



NOTE
For a flow turndown of less than 10:1 it is not recommended to perform a square root extraction in the transmitter. Instead, perform the square root extraction in the system.

Rerange

The Range Values command sets the 4 and 20 mA points (lower and upper range values). Setting the range values to the limits of expected readings maximizes transmitter performance. In practice, you may reset the transmitter range values as often as necessary to reflect changing process conditions.

NOTE
Regardless of the range points, the Model 3051 will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA points are set to 0 and 10 inH_2O, and the transmitter detects a pressure of 25 inH_2O, it digitally outputs the 25 inH_2O reading and a 250% percent of span reading. However, there may be up to ±5.0% error associated with output outside of the range points.

Use one of three methods to rerange the transmitter. Each method is unique; examine all three closely before deciding which method to use.

Rerange with a Communicator Only

HART Comm.	1, 2, 3, 1, 1

Reranging using only the communicator is the easiest and most popular way to rerange the transmitter. This method changes the values of the analog 4 and 20 mA points independently without a pressure input.

NOTE
Changing the lower or upper range point results in similar changes to the span.

To rerange using only the communicator, enter the fast-key sequence above, select *Keypad Input*, and follow the on-line instructions. Or enter the values directly from the **HOME** screen.

NOTE
If the transmitter security jumper is in the **ON** position, you will not be able to make adjustments to the zero and span. Refer to "Set Jumpers" on page 2-14 for the appropriate placement of the transmitter security jumper.

Rerange with a Pressure Input Source and a Communicator

HART Comm.	1, 2, 3, 1, 2

Reranging using the communicator and a pressure source or process pressure is a way of reranging the transmitter when specific 4 and 20 mA points are not known. This method changes the values of the analog 4 and 20 mA points.

NOTE
When you set the 4 mA point the span is maintained; when you set the 20 mA point the span changes. If you set the lower range point to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit, and the span is adjusted accordingly.

To rerange using the communicator and a pressure source or process pressure, enter the fast-key sequence above, select *Apply values*, and follow the on-line instructions.

NOTE
If the transmitter security jumper is in the **ON** position, you will not be able to make adjustments to the zero and span. Refer to "Set Jumpers" on page 2-14 for the appropriate placement of the transmitter security jumper.

Rerange with a Pressure Input Source and the Local Zero and Span Buttons

Reranging using the local zero and span adjustments (see Figure 3-6 on page 3-12) and a pressure source is a way of reranging the transmitter when specific 4 and 20 mA points are not known and a communicator is not available.

NOTE
When you set the 4 mA point the span is maintained; when you set the 20 mA point the span changes. If you set the lower range point to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit, and the span is adjusted accordingly.

To rerange the transmitter using the span and zero buttons, perform the following procedure:

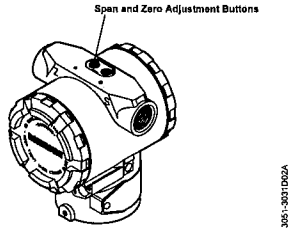
1. Loosen the screw holding the certifications label on top of the transmitter housing, and rotate the label to expose the zero and span buttons (see Figure 3-6 on page 3-12).
2. Using a pressure source with an accuracy three to ten times the desired calibrated accuracy, apply a pressure equivalent to the lower range value to the high side of the transmitter.
3. To set the 4 mA point, press and hold the zero button for at least two seconds, then verify that the output is 4 mA. If a display is installed, it will display ZERO PASS.

NOTE
The zero and span adjustments on previous versions of the transmitter are screws instead of buttons. To activate the zero and span adjustments loosen the screws until they pop up.

4. Apply a pressure equivalent to the upper range value to the high side of the transmitter.
5. To set the 20 mA point, press and hold the span button for at least two seconds, then verify that the output is 20 mA. If a display is installed, it will display SPAN PASS.

NOTE
If the transmitter security jumper is in the **ON** position, or if the local zero and span adjustments are disabled through the software, you will not be able to make adjustments to the zero and span using the local buttons. Refer to "Set Jumpers" on page 2-14 for the proper placement of the transmitter security jumper. Or refer to "The Model 275 HART Communicator Fast Key Sequence" on page 3-4 for instructions on how to enable the span and zero buttons.

Figure 3-6. Local Zero and Span Buttons



After you rerange the transmitter using the span and zero adjustments, it is possible to disable the adjustments to prevent further reranging.

Rerange with AMS only

Right click on the device and select "Configuration Properties" from the menu. In the Basic Setup tab, locate the Analog Output box and perform the following procedure:

1. Enter the lower range value (LRV) and the upper range value (URV) in the fields provided. Click **Apply**.
2. An "Apply Parameter Modifications" screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Rerange with a Pressure Input Source and AMS

Right click on the device, select "Calibrate", then "Apply values" from the menu.

1. Select **Next** after the control loop is set to manual.
2. From the "Apply Values" menu, follow the on-line instructions to configure lower and upper range values.
3. Select **Exit** to leave the "Apply Values" screen.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.

Model 3051C Differential/Gage Pressure Transmitter Range Limits

	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
Units	min	max	min	max	min	max	min	max	min	max
inH_2O	0.5	25	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.03678	1.8389	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH_2O	0.04167	2.08333	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH_2O	12.7	635.5	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.01806	0.903	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00125	0.06227	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	1.2454	62.2723	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm^2	1.26775	63.3875	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm^2	0.00127	0.0635	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	124.545	6227.23	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.12545	6.2272	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	0.93416	46.7082	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00123	0.06146	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE
When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051P Differential/Gage Pressure Transmitter Range Limits

	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
Units	min	max	min	max	min	max	min	max
inH_2O	25	250	100	1000	830.40	8304	5536.0	55360
inHg	1.8389	18.389	7.3559	73.559	61.081	610.81	407.20	4072.04
ftH_2O	2.08333	20.8333	8.3333	83.3333	69.200	691.997	461.3	4613.31
mmH_2O	635.5	6355	2542	25421	21109.5	211095	140730	1407301
mmHg	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
psi	0.903	9.03183	3.6127	36.127	30	300	200	2000
bar	0.06227	0.62272	0.2491	2.491	2.0684	20.6843	13.7895	137.895
mbar	62.2723	622.723	249.089	2490.89	2068.43	20684.3	13789.5	137895
g/cm^2	63.3875	633.875	253.55	2535.45	2105.47	21054.7	14061.4	140614
kg/cm^2	0.0635	0.635	0.254	2.54	2.1092	21.0921	14.0614	140.614
Pa	6216.06	62160.6	24908.9	249089	206843	2068430	1378950	13789500
kPa	6.2272	62.2723	24.9089	249.089	206.843	2068.43	1378.95	13789.5
torr	46.7082	467.082	186.833	1868.33	1551.45	15514.5	10343	103430
atm	0.06146	0.61460	0.2458	2.458	2.0414	20.4138	13.6092	136.092

NOTE
When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051L/3051H Pressure Transmitter Range Limits

	Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
Units	min	max	min	max	min	max	min	max
inH_2O	2.5	250	10	1000	83.040	8304	553.60	55360
inHg	0.18389	18.389	0.73559	73.559	6.1081	610.81	40.720	4072.04
ftH_2O	0.20833	20.8333	0.83333	83.3333	6.9198	691.997	46.13	4613.31
mmH_2O	63.553	6355	254	25421	2110.95	211095	14073	1407301
mmHg	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
psi	0.0902	9.03183	0.36127	36.127	3	300	20	2000
bar	0.00623	0.62272	0.02491	2.491	0.20684	20.6843	1.37895	137.895
mbar	6.22723	622.723	24.9089	2490.89	206.843	20684.3	1378.95	137895
g/cm^2	6.33875	633.875	25.355	2535.45	210.547	21054.7	1406.14	140614
kg/cm^2	0.00635	0.635	0.0254	2.54	0.21092	21.0921	1.40614	140.614
Pa	622.723	62160.6	2490.89	249089	20684.3	2068430	137895	13789500
kPa	0.62272	62.2723	2.49089	249.089	20.6843	2068.43	137.895	13789.5
torr	4.67082	467.082	18.6833	1868.33	155.145	15514.5	1034.3	103430
atm	0.00615	0.61460	0.02458	2.458	0.20414	20.4138	1.36092	136.092

NOTE
When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051T Gage and Absolute Pressure Transmitter Range Limits										
	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
Units	min	max	min	max	min	max	min	max	min	max
inH_2O	8.30397	831.889	41.5198	4159.45	221.439	22143.9	1107.2	110720	55360	276799
inHg	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098	4072.04	20360.2
ftH_2O	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63	4613.31	23066.6
mmH_2O	211.10	21130	1054.60	105460.3	5634.66	563466	28146.1	2814613	1407301	7036507
mmHg	15.5145	1551.45	77.5723	7757.23	413.72	41372	2068.6	206860.0	103430	517151
psi	0.3	30	1.5	150	8	800	40	4000	2000	10000
bar	0.02068	3.06843	0.10342	10.3421	0.55158	55.1581	2.75791	275.7905	137.895	689.476
mbar	20.6843	2068.43	103.421	10342.11	551.581	55158.1	2757.91	275790.5	137895	689476
g/cm^2	21.0921	2109.21	105.461	10546.1	561.459	56145.9	2807.31	280730.6	140614	703067
kg/cm^2	0.02109	2.10921	0.10546	10.5461	0.56246	56.2456	2.81228	281.228	140.614	701.82
Pa	2068.43	206843	10342.1	1034212	55158.1	5515811	275791	27579054	13789500	68947609
kPa	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05	13789.5	68947.6
torr	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7	103430	517151
atm	0.02041	2.04138	0.10207	10.2069	0.54437	54.4368	2.72184	272.1841	136.092	680.46

NOTE
When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Model 3051T Gage and Absolute Pressure Transmitter Range Limits										
	Range 1 Span		Range 2 Span		Range 3 Span		Range 4 Span		Range 5 Span	
Units	min	max	min	max	min	max	min	max	min	max
inH_2O	4.62254	138.399	8.30397	831.889	41.5198	4151.98	221.439	22143.9	1107.2	110720
inHg	0.34002	10.1801	0.61081	61.0807	3.05403	305.403	16.2882	1628.82	81.441	8144.098
ftH_2O	0.38521	11.5333	0.69199	69.3241	3.45998	345.998	18.4533	1845.33	92.2663	9226.63
mmH_2O	117.510	3518.2	211.10	21130	6.35308	635.308	5634.66	563466	28146.1	2814613
mmHg	8.63642	258.575	15.5145	1551.45	1055.47	105547	413.72	41372	2068.6	206860.0
psi	0.16667	5	0.3	30	1.5	150	8	800	40	4000
bar	0.01151	0.344738	0.02068	2.06843	0.10342	10.342	0.55158	55.1581	2.75791	275.7905
mbar	11.5142	344.738	20.6843	2068.43	103.421	10342.1	551.581	55158.1	2757.91	275790.5
g/cm^2	11.74	350.91	21.0921	2109.21	105.27	105.27	561.459	56145.9	2807.31	280730.6
kg/cm^2	0.01174	0.351535	0.02109	2.10921	0.10546	10.546	0.56246	56.2456	2.81228	281.228
Pa	1151.42	34473.8	2068.43	206843	10342.1	1034210	55158.1	5515811	275791	27579054
kPa	1.15142	34.4738	2.06843	206.843	10.3421	1034.21	55.1581	5515.81	275.791	27579.05
torr	8.63642	258.575	15.5145	1551.45	77.5726	7757.26	413.721	413721	2068.6	206859.7
atm	0.01136	0.34023	0.02041	2.04138	0.10207	10.207	0.54437	54.4368	2.72184	272.1841

NOTE
When used with the HART Communicator Model 275 or the Rosemount Model 268 Communicator, ±5% adjustability is allowed on the sensor limit to allow for unit conversions.

Damping

HART Comm.	1, 3, 6

The Damp command changes the response time of the transmitter to smooth variations in output readings caused by rapid changes in input. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the of loop dynamics of your system. The default damping value is 0.4 seconds,(1) and can be reset to any of ten pre-configured damping values between 0 and 25.6 seconds.

AMS

Right click on the device and select "Configuration Properties" from the menu.

1. In the "Basic Setup" tab, enter the damping value in the "Damp" field, click **Apply**.
2. An "Apply Parameter Modifications" screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

LCD DISPLAY

HART Comm.	1, 4, 3, 4

The Meter Options command allows you to customize the LCD display for use in your application. You can configure the display to display the following information:

- Engineering Units
- Percent of Range
- Custom Meter Display
- Alternating between Engineering Units and Percent of Range
- Alternating between Engineering Units and Custom Meter Display

Installed (Arrow down - Factory Default)

- None
- Unknown
- Spcl

NOTE
The user-configurable LCD scale is a feature specific to the current 4–20 mA output transmitters. If you have a previous Model 3051 transmitter, upgrade the transmitter electronics board and LCD display to attain the current functionality.

(1) Model 3051CD0 default damping is 3.2 seconds. Model 3051CD1, with calibrations below 2.5 inH_2O (0,62 kPa), have damping set at 3.2 seconds.

Standard display Configuration

The factory default alternates between Engineering units and % Range (Factory default: INSTALLED = alt % Rnge/Eng units). To change the standard default, follow the following steps:

1. From the communicators main menu select (1) Device Setup (3) Basic Setup, (7) Meter Options.
2. Select (1) Meter Type. Using the up or down arrows scroll up or down until the desired display has been highlighted. Press ENTER (F4), SEND (F2), & HOME (F3).

NOTE
Use the up and down arrow keys to scroll through the meter type selection shown above. (Installed, None, Unknown, and Spcl are the same as Alt % rnge/Eng). These options are only present do backward software compatibility.

AMS

Right click on the device and select "Configuration Properties" from the menu.

1. In the "Local Display" tab, locate the "Meter Type" area. Select the desired options to suit your application needs, click **Apply**.
2. An "Apply Parameter Modification" screen appears, enter desired information and click **OK**.
3. After carefully reading the warning provided, select **OK**.

Custom display Configuration

The user-configurable scale is a feature that enables the LCD display to display flow, level, or custom pressure units. With this feature you can define the decimal point position, the upper range value, the lower range value, the engineering units, and the transfer function.The display can be configured using a Model 275 HART Communicator (see Table A-1 on page 1-3) or AMS.

The user-configurable scale feature can define:

- decimal point position
- upper range values
- lower range values
- engineering units
- transfer function

To configure the display using AMS, click the **LOCAL DISPLAY** tab on the **CONFIGURATION PROPERTIES** screen. To configure the display with a HART communicator, perform the following procedure:

⚠ 1. Connect the communicator to the transmitter. Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed according to intrinsically safe or nonincendive field wiring practices.

2. Change the Meter Type to "Custom Meter" by using the Fast Key sequence under "LCD Display" on page 3-16.
3. Next from the **ONLINE** screen, *Select 1 Device Setup, 3 Basic Setup, 7 Meter Options, 2 Meter Options, 2 Custom Meter Setup*
4. To specify decimal point position:
   a. Select *1 Sel dec pt pos.* Choose the decimal point representation that will provide the most accurate output for your application. For example, when outputting between 0 and 75 GPM, choose *XX.XXX* or use the decimal point examples below:

   XXXXX
   XXXX.X
   XXX.XX
   XX.XXX
   X.XXXX

NOTE:
Make sure the selection has been sent and the decimal point has changed before proceeding to the next step.

   b. F2 SEND
5. To specify a custom upper range value:
   a. Select *2 CM Upper Value.* Type the value that you want the transmitter to read at the 20 mA point.
   b. F2 SEND
6. To specify a custom lower range value:
   a. Select *3 CM Lower Value.* Type the value that you want the transmitter to read at the 4 mA point.
   b. F2 SEND
7. To define custom units:
   a. Select *4 CM Units.* Enter the custom units (five characters maximum) that you want the display to display.
   b. F2 SEND
8. To choose the transmitter transfer function for the display:
   a. Select *5 CM xfer fnct.* Enter the transmitter transfer function for the display. Select *sq root* to display flow units. The custom meter transfer function is independent of the analog output transfer function.
9. Select **F2 SEND** to upload the configuration to the transmitter.

⚠ See "Safety Messages" on page 3-1 for complete warning information.

NOTE:
You must change the meter type to custom meter display, see "LCD Display" on page 3-16. Follow the change standard display cofiguration steps and select custom meter display.

DETAILED SETUP

Failure Mode Alarm and Saturation

Model 3051 transmitters automatically and continuously perform self-diagnostic routines. If the self-diagnostic routines detect a failure, the transmitter drives its output outside of the normal saturation values. The transmitter will drive its output low or high based on the position of the failure mode alarm jumper. See Table 3-2, Table 3-3, and Table 3-4 for failure mode and saturation output levels. To select alarm position, see "Set Jumpers" on page 2-14.

Table 3-2. Standard Alarm and Saturation Values

Level	4–20 mA Saturation	4–20 mA Alarm
Low	3.9 mA	≤ 3.75 mA
High	20.8 mA	≥ 21.75 mA

Table 3-3. NAMUR-Compliant Alarm and Saturation Values

Level	4–20 mA Saturation	4–20 mA Alarm
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.5 mA

Table 3-4. Low-Power Alarm and Saturation Values

Level	1–5 V Saturation	1–5 V Alarm	0.8–3.2 V Saturation	0.8–3.2 V Alarm
Low	0.97 V	≤ 0.95 V	0.78 V	≤ 0.77 V
High	5.20 V	≥ 5.4 V	3.44 V	≥ 4.0 V

NOTE
You can alter the actual transmitter mA output values by performing an analog output trim.

NOTE
When a transmitter is in an alarm condition, the hand-held HART communicator indicates the analog output the transmitter would drive if the alarm condition did not exist. The transmitter will alarm high in the event of failure if the alarm jumper is removed.

Alarm and Saturation Levels for Burst Mode

Transmitters set to burst mode handle saturation and alarm conditions differently.

Alarm Conditions

- Analog output switches to alarm value.
- Primary variable (pressure) is burst with a status bit set.
- Percent of range follows primary variable (pressure).
- Temperature is burst with a status bit set.

Saturation

- Analog output switches to saturation value.
- Primary variable (pressure) is burst normally.
- Temperature is burst normally.

Alarm and Saturation Values for Multidrop Mode

Transmitters set to multidrop mode handle saturation and alarm conditions differently.

Alarm Conditions

- Primary variable (pressure) is sent with a status bit set.
- Percent of range follows primary variable (pressure).
- Temperature is sent with a status bit set.

Saturation

- Primary variable (pressure) is sent normally.
- Temperature is sent normally.

Alarm Level Verification

Transmitters with shrouded design electronics boards (board version 5.3 or later) have increased functionality that allows verification testing of alarm current levels. If you repair or replace the transmitter electronics board, sensor module, or LCD display, verify the transmitter alarm level before you return the transmitter to service. This feature is also useful in testing the reaction of your control system to a transmitter in an alarm state. To verify the transmitter alarm values, perform a loop test and set the transmitter output to the alarm value (see Tables 3-2, 3-3, and 3-4 on page 3-19, and "Loop Test" on page 3-21).

Sensor Temperature Unit

HART Comm.	1, 4, 1, 2, 2

The *Sensor Temperature Output Unit Selection* command selects between Celsius and Fahrenheit units for output of the sensor temperature. The sensor temperature output is accessible via HART only. (The Sensor Temperature Output Units command is not available on previous design transmitters or via AMS.)

DIAGNOSTICS AND SERVICE

The diagnostics and service functions listed here are primarily for use after you install the transmitter in the field. The transmitter test feature is designed to verify that the transmitter is operating properly, and can be performed either on the bench or in the field. The loop test feature is designed to verify proper loop wiring and transmitter output, and should only be performed after you install the transmitter.

Transmitter Test

HART Comm.	1, 2, 1, 1

The transmitter test command initiates a more extensive diagnostics routine than that performed continuously by the transmitter. The transmitter test routine can quickly identify potential electronics problems.

HART Communicator

If the transmitter test detects a problem, messages to indicate the source of the problem are displayed on the communicator screen.

AMS

Right click on the device and select "Diagnostics and Test," then "Self test" from the menu.

1. Click **Next** to acknowledge test results.
2. Select **Finish** to acknowledge the method is complete.

Loop Test

HART Comm.	1, 2, 2

The *Loop Test* command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the transmitter. To do so, either connect the meter to the test terminals on the transmitter terminal block, or shunt the power to the transmitter through the meter at some point in the loop.
2. From the **HOME** screen, select *1 Device Setup, 2 Diagnostics and Service, 2 Loop Test*, to prepare to perform a loop test.
3. Select **OK** after you set the control loop to manual (see "Setting the Loop to Manual" on page 3-2). The communicator displays the loop test menu.
4. Select a discreet milliamp level for the transmitter to output. At the **CHOOSE ANALOG OUTPUT** prompt, select *1 4mA, 2 20mA*, or select *3 other* to manually input a value. IF you are performing a loop test to verify the output of a transmitter, THEN enter a value between 4 and 20 mA. IF you are performing a loop test to verify the transmitter alarm levels, THEN enter the milliamp value representing an alarm state (see Tables 3-2, 3-4, and 3-3 on page 3-19).
5. Check the electrical current meter installed in the test loop to verify that it reads the value you commanded the transmitter to output. IF the readings match, THEN the transmitter and the loop are configured and functioning properly. IF the readings do not match, THEN you may have the current meter attached to the wrong loop, there may be a fault in the wiring, the transmitter may require an output trim, or the electrical current meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen and allows you to choose another output value or to exit loop testing.

AMS

Right click on the device and select "Diagnostics and Test," then "Loop test" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Select desired analog output level. Click **Next**.
3. Click **Next** to acknowledge output being set to desired level.
4. Check the reference meter installed in the test loop to verify that it displays the commanded output value.
   a. If the values match, the transmitter and the loop are configured and functioning properly.
   b. If the values do not match, the current meter may be attached to the wrong loop there may be a fault in the wiring, the transmitter may require an output trim, or the reference meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen to choose another output value or to end loop testing.

5. Select **End** and click **Next** to end loop testing.
6. Select **Next** to acknowledge the loop can be returned to automatic control.
7. Select **Finish** to acknowledge the method is complete.

ADVANCED FUNCTIONS

Saving, Recalling, and Cloning Configuration Data

HART Comm.	left arrow, 1, 2

Use the cloning feature of the Model 275 HART Communicator if you need to configure several Model 3051 transmitters similarly. The cloning process involves configuring a transmitter, saving the configuration data, then sending a copy of the data to a separate transmitter. There are a number of possible procedures to use when saving, recalling, and cloning configuration data. For complete instructions refer to the HART Communicator manual, publication no. 00809-0100-4275. One common method is as follows:

1. Completely configure the first transmitter.
2. Save the configuration data:
   a. Select **F2 SAVE** from the communicator **HOME/ONLINE** screen.
   b. Ensure that the location to which the data will be saved is set to **MODULE**. If it is not, select *1 Location* to set the save location to **MODULE**.
   c. Select *2 Name* to name the configuration data. The default is the transmitter tag number.
   d. Ensure that the data type is set to **STANDARD**. IF the data type is NOT **STANDARD**, THEN select *3 Data Type* to set the data type to **STANDARD**.
   e. Select **F2 SAVE**.
3. Connect and power the receiving transmitter and communicator.
4. Select the back arrow from the **HOME/ONLINE** screen. The HART Communicator menu appears.
5. Select *1 Offline, 2 Saved Configuration, 1 Module Contents* to reach the **MODULE CONTENTS** menu.

AMS

Right click on the device and select "Diagnostics and Test," then "Loop test" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Select desired analog output level. Click **Next**.
3. Click **Next** to acknowledge output being set to desired level.
4. Check the reference meter installed in the test loop to verify that it displays the commanded output value.
   a. If the values match, the transmitter and the loop are configured and functioning properly.
   b. If the values do not match, the current meter may be attached to the wrong loop there may be a fault in the wiring, the transmitter may require an output trim, or the reference meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen to choose another output value or to end loop testing.

5. Select **End** and click **Next** to end loop testing.
6. Select **Next** to acknowledge the loop can be returned to automatic control.
7. Select **Finish** to acknowledge the method is complete.

ADVANCED FUNCTIONS

Saving, Recalling, and Cloning Configuration Data

HART Comm.	left arrow, 1, 2

Use the cloning feature of the Model 275 HART Communicator if you need to configure several Model 3051 transmitters similarly. The cloning process involves configuring a transmitter, saving the configuration data, then sending a copy of the data to a separate transmitter. There are a number of possible procedures to use when saving, recalling, and cloning configuration data. For complete instructions refer to the HART Communicator manual, publication no. 00809-0100-4275. One common method is as follows:

1. Completely configure the first transmitter.
2. Save the configuration data:
   a. Select **F2 SAVE** from the communicator **HOME/ONLINE** screen.
   b. Ensure that the location to which the data will be saved is set to **MODULE**. If it is not, select *1 Location* to set the save location to **MODULE**.
   c. Select *2 Name* to name the configuration data. The default is the transmitter tag number.
   d. Ensure that the data type is set to **STANDARD**. IF the data type is NOT **STANDARD**, THEN select *3 Data Type* to set the data type to **STANDARD**.
   e. Select **F2 SAVE**.
3. Connect and power the receiving transmitter and communicator.
4. Select the back arrow from the **HOME/ONLINE** screen. The HART Communicator menu appears.
5. Select *1 Offline*, *2 Saved Configuration*, *1 Module Contents* to reach the **MODULE CONTENTS** menu.

6. Use the **DOWN ARROW** to scroll through the list of configurations in the memory module, and use the **RIGHT ARROW** to select the configuration you wish to retrieve.
7. Select *1 Edit*.
8. Select *1 Mark All*.
9. Select **F2 SAVE**.
10. Use the **DOWN ARROW** to scroll through the list of configurations in the memory module, and use the **RIGHT ARROW** to select the configuration again.
11. Select *3 Send* to download the configuration to the transmitter.

When finished, the communicator informs you of the status. To configure another transmitter, repeat Steps 3 through 10.

NOTE
The transmitter receiving the cloned data must have the same software version (or later) as the original transmitter.

AMS creating a Reusable Copy

To create a reusable copy of a configuration perform the following procedure:

1. Select View then User Configuration View from the menu bar (or click the toolbar button).
2. In the User Configuration window, right click and select New from the context menu.
3. In the New window, select a device from the list of templates shown, and click **OK**.
4. The template is copied into the User Configurations window, with the tag name highlighted; rename it as appropriate and press **Enter**.

NOTE
A device icon can also be copied by dragging and dropping a device template or any other device icon from AMS Explorer or Device Connection View into the User Configurations window.

The "Compare Configurations" window appears, showing the Current values of the copied device on one side and mostly blank fields on the other (User Configuration) side.

5. Transfer values from the current configuration to the user configuration as appropriate or enter values by typing them into the available fields.
6. Click Apply to apply the values, or click **OK** to apply the values and close the window.

AMS Applying a User Configuration

Any amount of user configurations can be created for the application. They can also be saved, and applied to connected devices or to devices in the Device List or Plant Database.

NOTE
When using AMS Revision 6.0 or later, the device to which the user configuration is applied, bust be the same model type as the one created in the user configuration. When using AMS Revision 5.0 or earlier, the same model type and revision number are required.

To apply a user configuration perform the following procedure:

1. Select the desired user configuration in the User Configurations window.
2. Drag the icon onto a like device in AMS Explorer or Device Connection View. The Compare Configurations window opens, showing the parameters of the target device on one side and the parameters of the user configuration on the other.
3. Transfer parameters from the user configuration to the target device as desired, Click **OK** to apply the configuration and close the window.

Burst Mode

HART Comm.	1, 4, 3, 3, 3

When configured for burst mode, the Model 3051 provides faster digital communication from the transmitter to the control system by eliminating the time required for the control system to request information from the transmitter. Burst mode is compatible with use of the analog signal. Because the HART protocol features simultaneous digital and analog data transmission, the analog value can drive other equipment in the loop while the control system is receiving the digital information. Burst mode applies only to the transmission of dynamic data (pressure and temperature in engineering units, pressure in percent of range, and/or analog output), and does not affect the way other transmitter data is accessed.

Access to information other than dynamic transmitter data is obtained through the normal poll/response method of HART communication. A HART-based communicator or the control system may request any of the information that is normally available while the transmitter is in burst mode. Between each message sent by the transmitter, a short pause allows the HART-based communicator or a control system to initiate a request. The transmitter will receive the request, process the response message, and then continue "bursting" the data approximately three times per second.

HART Communicator

To configure the transmitter for burst mode, perform the following step:

1. From the HOME screen, enter the fast key sequence below "Burst Mode."

AMS

Right click on the device and select "Configuration Properties" from the menu.

1. In the "HART" tab, use the drop down menu to select "Burst Mode ON or OFF." For "Burst option" select the desired properties from the drop down menu. Burst options are as follows:
   - PV
   - % range/current
   - Process vars/crnt
   - Process variables
2. After selecting options click **Apply**.
3. An "Apply Parameter Modification" screen appears, enter desired information and click **OK**.
4. After carefully reading the warning provided, select **OK**.

MULTIDROP COMMUNICATION

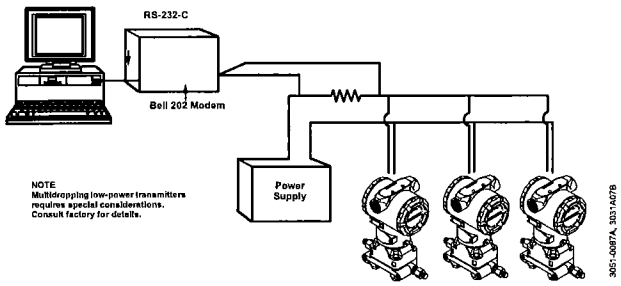
Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated. Many of the Rosemount SMART FAMILY® transmitters can be multidropped. With the HART smart communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines. This feature can greatly reduce wiring costs.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Communication with the transmitters can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each transmitter is identified by a unique address (1–15) and responds to the commands defined in the HART protocol. HART-based communicators can test, configure, and format a multidropped transmitter the same way as a transmitter in a standard point-to-point installation.

Figure 3-7 shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

NOTE
A transmitter in multidrop mode has the analog output fixed at 4 mA. If a display is installed to a transmitter in multidrop mode, it will alternate the display between "current fixed" and the specified display output(s).

Figure 3-7. Typical Multidrop Network



NOTE
The Model 3051 is set to address 0 at the factory, allowing it to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15. This change deactivates the 4–20 mA analog output, sending it to 4 mA. It also disables the failure mode alarm signal, which is controlled by the upscale/downscale jumper position. Failure signals in multidropped transmitters are communicated through HART messages.

Changing a Transmitter Address

HART Comm.	1, 4, 3, 3, 1

To change the address of a multidropped transmitter, follow these fast key sequences. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15, and each transmitter in a multidropped loop must have a unique address.

HART Communicator

1. From the **HOME** screen, enter the fast key sequence below "Changing a Transmitter Address."

AMS

Right click on the device and select "Configuration Properties" from the menu.

1. In the "HART" tab, in "ID" box, enter poll address located in the "Poll addr" box, click **Apply.**
2. An "Apply Parameter Modification" screen appears, enter desired information and click **OK.**
3. After carefully reading the warning provided, select **OK.**

Communicating with a Multidropped Transmitter

HART Comm.	1, 4, 3, 3, 2

HART Communicator

To communicate with a multidropped transmitter, configure the HART Communicator to poll for a non-zero address.

1. From the **HOME** screen, enter the fast key sequence below "Communicating with a Multidropped Transmitter."
2. On the polling menu, scroll down and select "Digital Poll." In this mode, the HART Communicator automatically polls for devices at addresses 0-15 upon start up.

AMS

Click on the HART modem icon and select "Scan All Devices."

Polling a Multidropped Transmitter

HART Comm.	Left arrow, 4, 1

Polling a multidropped loop determines the model, address, and number of transmitters on the given loop.

HART Communicator

1. From the **HOME** screen, enter the fast key sequence below "Polling a Multidropped Transmitter."

NOTE
The HART Communicator Model 275 requires you to use the **UTILITY** menu to perform and autopoll. This menu is available from the **MAIN** menu of the HART Communicator. Press the **LEFT ARROW** to move from the **ONLINE MENU** to the **MAIN** menu. Press *4* from the **MAIN** menu to access the **UTILITY** menu.

AMS

Click on the HART modem icon and select "Scan All Devices."

Section 4 Operation and Maintenance

Calibration ..... page 4-2
Selecting Output Range for Low-Power ..... page 4-20
Detailed Setup ..... page 4-20

OVERVIEW

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

⚠WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

CALIBRATION

Calibrating a smart transmitter is different from calibrating an analog transmitter. The one-step calibration process of an analog transmitter is done in three steps with a smart transmitter:

- **Rerange**—sets the 4 and 20 mA points at the desired pressures;
- **Sensor Trim**—Adjusts the position of the factory characterization curve to optimize the transmitter performance over a specified pressure range or to adjust for mounting effects
- **Analog Output Trim**—Adjusts the analog output to match the plant standard or the control loop.

Smart transmitters operate differently than analog transmitters. A smart transmitter uses a microprocessor that contains information about the sensor's specific characteristics in response to pressure and temperature inputs. A smart transmitter compensates for these sensor variations. The process of generating the sensor performance profile is called factory characterization. Factory characterization also provides the ability to readjust the 4 and 20 mA points without applying pressure to the transmitter.

The trim and rerange functions also differ. Reranging sets the transmitter analog output to the selected upper and lower range points and can be done with or without an applied pressure. Reranging does not change the factory characterization curve stored in the microprocessor. Sensor trimming requires an accurate pressure input and adds additional compensation that adjusts the position of the factory characterization curve to optimize transmitter performance over a specific pressure range.

NOTE
Sensor trimming adjusts the position of the factory characterization curve. It is possible to degrade the performance of the transmitter if the sensor trim is done improperly or with inaccurate equipment. Contact your local Rosemount representative or call Rosemount Customer Central at 800-999-9307 if you have questions.

Table 4-1. Recommended Calibration Tasks

Transmitter	Bench Calibration Tasks	Field Calibration Tasks
3051CD 3051CG 3051L 3051HD 3051HG	Set output configuration parameters: • Set the range points. • Set the output units. • Set the output type. • Set the damping value. *Optional*, perform a full sensor trim. (Accurate pressure source required.) *Optional*, perform an analog output trim. (Accurate multimeter required.)	Reconfigure parameters if necessary. Zero trim the transmitter to compensate for mounting effects or static pressure effects.
3051CA 3051TA 3051TG	Set output configuration parameters: • Set the range points. • Set the output units. • Set the output type. • Set the damping value. *Optional*: Perform a full sensor trim if equipment available (accurate absolute pressure source required), otherwise perform the low trim value section of the full sensor trim procedure. *Optional*: Perform an analog output trim (multimeter required).	Reconfigure parameters if necessary. Perform low trim value section of the full sensor trim procedure to correct for mounting position effects.

NOTE:
A HART communicator is required for all sensor and output trim procedures.

Model 3051C Range 4 and Range 5 transmitters require a special calibration procedure when used in differential pressure applications under high static line pressure (see "Compensating for Line Pressure" on page 4-12).

Model 3051TG Range 5 transmitters use an absolute sensor that requires an accurate absolute pressure source to perform the optional full sensor trim.

Calibration Overview

Complete calibration of the Model 3051 Pressure Transmitter involves the following tasks:

Configure the Analog Output Parameters

Set Process Variable Units (page 3-8)

Set Output Type (page 3-9)

Rerange (page 3-10)

Set Damping (page 3-16)

Calibrate the Sensor

Full Trim (page 4-8)

Zero Trim (page 4-7)

Calibrate the 4–20 mA Output

4–20 mA Output Trim (page 4-10) or

4–20 mA Output Trim Using Other Scale (page 4-11) or

Low-Power 1–5 V dc or Low-Power 0.8–3.2 V dc (page 4-10)

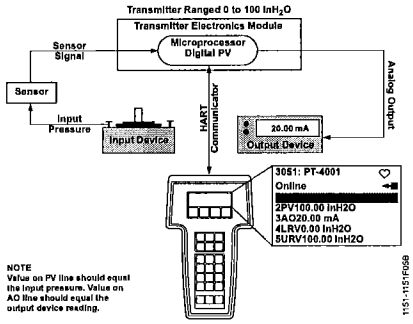
Figure 4-1 illustrates the Model 3051 transmitter data flow. This data flow can be summarized in four major steps:

1. A change in pressure is measured by a change in the sensor output (Sensor Signal).
2. The sensor signal is converted to a digital format that can be understood by the microprocessor (Analog-to-Digital Signal Conversion).
3. Corrections are performed in the microprocessor to obtain a digital representation of the process input (Digital PV).
4. The Digital PV is converted to an analog value (Digital-to-Analog Signal Conversion).

Figure 4-1 also identifies the approximate transmitter location for each calibration task. Note that the data flows from left to right, and a parameter change affects all values to the right of the changed parameter.

Not all calibration procedures should be performed for each Model 3051 transmitter. In addition, some procedures are appropriate for bench calibration but should not be performed during field calibration. Table 4-1 identifies the recommended calibration procedures for each type of Model 3051 transmitter for both bench and field calibration.

Figure 4-1. Transmitter Data Flow with Calibration Options

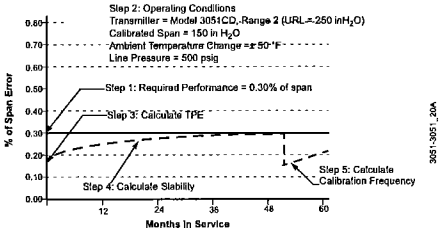


Determining Calibration Frequency

Calibration frequency can vary greatly depending on the application, performance requirements, and process conditions. The following procedure can be used as a guideline to estimate the calibration frequency. Actual calibration frequency should follow plant standard and sound engineering practice.

1. Determine the performance required for your application.
2. Determine the operating conditions.
3. Calculate the Total Probable Error (TPE).
4. Calculate the stability per month.
5. Calculate the calibration frequency.

Figure 4-2. Calculating Calibration Frequency



Sample Calculation

Step 1: Determine the performance required for your application.

Required Performance: 0.30% of span

Step 2: Determine the operating conditions.

Transmitter: Model 3051CD, Range 2 (URL=250 inH_2O)

Calibrated Span: 150 inH_2O

Ambient Temperature Change: ± 50 °F

Line Pressure: 500 psig

Step 3: Calculate total probable error (TPE).

$$TPE = \sqrt{(RefAccuracy)^2 + (TempEffect)^2 + (StaticPressureEffect)^2} = 0.117\% \text{ of span}$$

Where:

Reference Accuracy = ± 0.075% of span

Ambient Temperature Effect =

$$\pm\left(\frac{0.0125 \times URL}{Span} + 0.0625\right) \text{per } 50\ ^\circ F = \pm 0.0833\% \text{ of span}$$

Span Static Pressure Effect(1) =

0.1% reading per 1000 psi = % of range * 0.1% * Cal. Span per 1000 psi = 0.035% of span for line pressure of 500 psig

(1) Zero static pressure effect removed by zero trimming at line pressure, assume reading is 70% of span.

Step 4: Calculate the stability per month.

$$\text{Stability} = \pm\left[\frac{(0.125 \times URL)}{Span}\right]\% \text{ of span for 5 years} = \pm 0.0035\% \text{ of span per month}$$

Step 5: Calculate calibration frequency.

$$\text{Cal. Freq.} = \frac{(\text{Req. Performance} - TPE)}{\text{Stability per Month}} = \frac{(0.3\% - 0.117\%)}{0.0035\%} = 52 \text{ months}$$

Choosing a Trim Procedure

To decide which trim procedure to use, you must first determine whether the analog-to-digital section or the digital-to-analog section of the transmitter electronics is in need of calibration. To do so, refer to Figure 4-1 and perform the following procedure:

1. Connect a pressure source, a HART communicator, and a digital readout device to the transmitter.
2. Establish communication between the transmitter and the communicator.
3. Apply pressure equal to the upper range point pressure (100 in$H_2$0, for example).
4. Compare the applied pressure to the Process Variable (PV) line on the Communicator On-line Menu. IF the PV reading on the communicator does not match the applied pressure, and you are confident that your test equipment is accurate, THEN perform a sensor trim.
5. Compare the Analog Output (AO) line on the communicator on-line menu to the digital readout device. IF the AO reading on the communicator does not match the digital readout device, and you are confident that your test equipment is accurate, THEN perform an output trim.

Sensor Trim

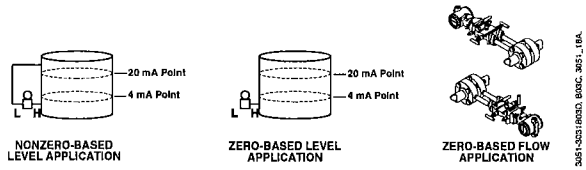
You can trim the sensor using either the full trim or the zero trim function. The trim functions vary in complexity, and their use is application-dependent. Both trim functions alter the transmitter's interpretation of the input signal.

Zero trim is a single-point adjustment. It is useful for compensating for mounting position effects and is most effective when performed with the transmitter installed in its final mounting position. Since this correction maintains the slope of the characterization curve, it should not be used in place of a full trim over the full sensor range.

When performing a zero trim, ensure that the equalizing valve is open and all wet legs are filled to the correct levels.

NOTE
Do not perform a zero trim on Model 3051 Absolute pressure transmitters. A zero trim is zero based, and absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Model 3051 Absolute Pressure Transmitter, perform a low trim within the full sensor trim function. The low trim function provides a "zero" correction similar to the zero trim function but it does not require the input to be zero based.

A full trim is a two-point sensor calibration where two end-point pressures are applied, and all output is linearized between them. You should always adjust the low trim value first to establish the correct offset. Adjustment of the high trim value provides a slope correction to the characterization curve based on the low trim value. The factory-established characterization curve is not changed by this procedure. The trim values allow you to optimize performance over your specified measuring range at the calibration temperature.



Zero Trim

HART Comm.	1, 2, 3, 3, 1

HART Communicator

Calibrate the sensor with a HART Communicator using the zero trim function as follows:

1. Vent the transmitter and attach a communicator to the measurement loop.
2. From the communicator main menu select *1 Device setup, 2 Diagnostics and service, 3 Calibration, 3 Sensor trim, 1 Zero trim* to prepare to adjust the zero trim.

NOTE
The transmitter must be within 3% of true zero (zero based) in order to calibrate it using the zero trim function.

3. Follow the commands provided by the communicator to complete the adjustment of the zero trim.

AMS

Right click on the device and select "Calibrate," then "Zero trim" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Click **Next** to acknowledge warning.
3. Click **Next** after applying appropriate pressure to sensor.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.

Full Trim

HART Comm.	1, 2, 3, 3

NOTE
Use a pressure input source that is at least three times more accurate than the transmitter, and allow the input pressure to stabilize for ten seconds before entering any values.

HART Communicator

To calibrate the sensor with a HART Communicator using the full trim function, perform the following procedure:

1. Assemble and power the entire calibration system including a transmitter, HART Communicator, power supply, pressure input source, and readout device.
2. From the **HOME** screen, enter the fast key sequence below under "Full Trim."
3. Select 2: Lower sensor trim

NOTE
Select pressure input values so that low and high values are equal to or outside the 4 and 20 mA points. Do not attempt to obtain reverse output by reversing the high and low points. The transmitter allows approximately five percent URL deviation from the characterized curve established at the factory.

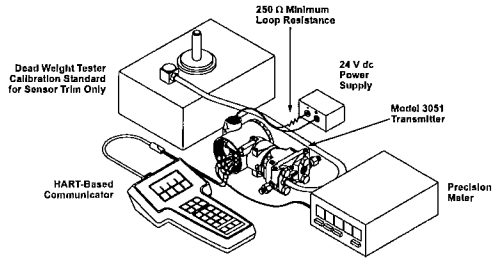
4. Follow the commands provided by the HART Communicator to complete the adjustment of the lower value.
5. Repeat the procedure for the upper value, replacing 2: Lower sensor trim with 3: Upper sensor trim in Step 3.

AMS

Right click on the device and select "Calibrate," then "Sensor trim" from the menu.

1. Select "Lower sensor trim."
2. Click **Next** after setting the control loop to manual.
3. Click **Next** after applying appropriate pressure to sensor.
4. Select **Next** to acknowledge the loop can be returned to automatic control.
5. Select **Finish** to acknowledge the method is complete.
6. Right click on the device and select "Calibrate," select "Sensor trim" from the menu.
7. Select "Upper sensor trim" and repeat steps 2-5.

Figure 4-3. Digital Trim Connection Drawing (4–20 mA Transmitters)



Recall Factory Trim

The *Recall Factory Trim* commands allow the restoration of the as-shipped factory settings of the sensor trim and analog output trim.

NOTE
The Recall Factory Trim commands are not available on previous design transmitters.

Recall Factory Trim — Sensor Trim

HART Comm.	1, 2, 3, 4, 1

Resets the transmitter sensor trim to the as-shipped factory settings. The *Recall Factory Trim—Sensor Trim* command can be useful for recovering from an inadvertent zero trim of an absolute pressure unit.

HART Communicator
Enter the fast key sequence below "Recall Factory Trim — Sensor Trim" to reset the transmitter sensor trim.

Recall Factory Trim — Analog Output

HART Comm.	1, 2, 3, 4, 2

Resets the transmitter analog output trim to the as-shipped factory settings. The *Recall Factory Trim—Analog Output* command can be useful for recovering from an inadvertent zero trim on an absolute pressure transmitter.

HART Communicator
Enter the fast key sequence below "Recall Factory Trim — Analog Output" to reset the analog output trim.

Analog Output Trim

The *Analog Output Trim* commands allow you to adjust the transmitter's current output at the 4 and 20 mA points to match the plant standards. This command adjusts the digital to analog signal conversion (see Figure 4-1 on page 4-4).

Analog Output Trim (Low Power)

HART Comm.	1, 2, 3, 2, 1

The Model 3051 Low-Power Transmitter has two jumper-selectable output ranges: 1–5 V dc and 0.8–3.2 V dc. Positioning this jumper for the desired output range selects the proper coefficients for temperature corrections. The jumper position also sets the output values (1–5 or 0.8–3.2) which are communicated through HART protocol and accessed by a hand held communicator.

However, switching this jumper does not by itself select the new outputs; you must perform the "Digital-to-Analog Trim" procedure above to match the transmitter's output voltages to the new jumper selection.

Digital-to-Analog Trim

HART Comm.	1, 2, 3, 2, 1

HART Communicator

To perform a digital-to-analog trim with a HART communicator, perform the following procedure.

1. From the **HOME** screen, select *1 Device setup*, *2 Diag/Service*, *3 Calibration*, *2 D/A trim*. Select **OK** after you set the control loop to manual (see "Setting the Loop to Manual" on page 3-2).
2. Connect an accurate reference ammeter to the transmitter at the **CONNECT REFERENCE METER** prompt. To do so, connect the positive lead to the positive terminal and the negative lead to the test terminal in the transmitter terminal compartment, or shunt the transmitter power through the reference meter at some point.
3. Select **OK** after connecting the reference meter.
4. Select **OK** at the **SETTING FLD DEV OUTPUT TO 4 MA** prompt. The transmitter outputs 4.00 mA.
5. Record the actual value from the reference meter, and enter it at the **ENTER METER VALUE** prompt. The communicator prompts you to verify whether or not the output value equals the value on the reference meter.
6. Select *1 Yes* if the reference meter value equals the transmitter output value, or *2 No* if it does not.
   IF you select *1 Yes*, THEN proceed to Step 7.
   IF you select *2 No*, THEN repeat Step 5.
7. Select **OK** at the **SETTING FLD DEV OUTPUT TO 20 MA** prompt, and repeat Steps 5 and 6 until the reference meter value equals the transmitter output value.
8. Select **OK** after you return the control loop to automatic control.

AMS

Right click on the device and select "Calibrate," then "D/A Trim" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Click **Next** after connecting the reference meter.
3. Click **Next** at the "Setting fld dev output to 4mA" screen.
4. Record the actual value from the reference meter, and enter it at the "Enter meter value" screen and click **Next**.
5. Select **Yes**, if the reference meter value equals the transmitter output value, or **No** if it does not. Click **Next**.
   a. If Yes is selected, proceed to Step 6.
   b. If No is selected, repeat Step 4.
6. Click **Next** at the "Setting fld dev output to 20mA" screen.
7. Repeat Step 4 - Step 5 until the reference meter equals the transmitter output value.
8. Select **Next** to acknowledge the loop can be returned to automatic control.
9. Select **Finish** to acknowledge the method is complete.

Digital-to-Analog Trim Using Other Scale

HART Comm.	1, 2, 3, 2, 2

The *Scaled D/A Trim* command matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (1 to 5 volts if measuring across a 250 ohm load, or 0 to 100 percent if measuring from a DCS, for example). To perform a scaled D/A trim, connect an accurate reference meter to the transmitter and trim the output signal to scale as outlined in the Output Trim procedure.

NOTE
Use a precision resistor for optimum accuracy. If you add a resistor to the loop, ensure that the power supply is sufficient to power the transmitter to a 20 mA output with the additional loop resistance.

AMS

Right click on the device and select "Calibrate," then "Scaled D/A trim" from the menu.

1. Click **Next** after setting the control loop to manual.
2. Select **Change** to change scale, click **Next**.
3. Enter Set scale-Lo output value, click **Next**.
4. Enter Set scale-Hi output value, click **Next**.
5. Click **Next** to proceed with Trim.
6. Click **Next** after connecting the reference meter.
7. Click **Next** at the "Setting fld dev output to 4 mA" screen.
8. Record the actual value from the reference meter, and enter it at the "Enter meter value" screen and click **Next**.
9. Select **Yes**, if the reference meter value equals the transmitter output value, or **No** if it does not. Click **Next**.
   a. If Yes is selected, proceed to Step 10.
   b. If No is selected, repeat Step 8.
10. Click **Next** at the "Setting fld dev output to 20mA" screen.
11. Repeat Step 8 - Step 9 until the reference meter equals the transmitter output value.
12. Select **Next** to acknowledge the loop can be returned to automatic control.
13. Select **Finish** to acknowledge the method is complete.

Compensating for Line Pressure

Range 4 and 5 Differential Transmitters

Model 3051 Range 4 and Range 5 pressure transmitters require a special calibration procedure when used in differential pressure applications. The purpose of this procedure is to optimize transmitter performance by reducing the effect of static line pressure in these applications. Model 3051 differential pressure transmitters (Ranges 1, 2, and 3) do not require this procedure because the optimization occurs in the sensor.

Applying high static pressure to Model 3051 Range 4 and Range 5 pressure transmitters causes a systematic shift in the output. This shift is linear with static pressure; correct it by performing the Full Trim procedure on page 2-18.

The following specifications show the static pressure effect for Model 3051 Range 4 and Range 5 transmitters used in differential pressure applications:

Zero Effect:
±0.1% of the upper range limit per 1000 psi (6,9 MPa) for line pressures from 0 to 2000 psi (0 to 13,8 MPa)

±0.2% of the upper range limit per 1000 psi (6,9 MPa) for line pressures above 2000 psi (13,8 MPa)

Span Effect:
Correctable to ±0.2% of reading per 1000 psi for line pressures from 0 to 3626 psi.

The systematic span shift caused by the application of static line pressure is –1.00% of reading per 1000 psi for 3051C Range 4 transmitters, and –1.25% of reading per 1000 psi for Range 5 transmitters.

Use the following example to compute corrected input values.

Example
A transmitter with model number 3051CD4 will be used in a differential pressure application where the static line pressure is 1200 psi. The transmitter is ranged so that the output is 4 mA at 500 inH_2O and 20 mA at 1500 inH_2O.

To correct for systematic error caused by high static line pressure, first use the following formulas to determine corrected values for the low trim and high trim.

LT = LRV + S (LRV) P

Where:	LT =	Corrected Low Trim Value
	LRV =	Lower Range Value
	S =	–(Span shift per specification)
	P =	Static Line Pressure

HT = URV + S (URV) P

Where:	HT =	Corrected High Trim Value
	URV =	Upper Range Value
	S =	–(Span shift per specification)
	P =	Static Line Pressure

In this example:

URV =	1500 inH_2O
LRV =	500 inH_2O
P =	1200 psi
S =	± 0.01/1000

To calculate the low trim (LT) value:

LT =	500 + (0.01/1000)(500)(1200)
LT =	506 inH_2O

To calculate the high trim (HT) value:

HT =	1500 + (0.01/1000)(1500)(1200)
HT =	1518 inH_2O

To complete a Model 3051 full trim and enter the corrected values for low trim (LT) and high trim (HT), refer to "Full Trim" on page 4-8.

Enter the corrected input values for low trim and high trim through the communicator keypad after you apply the nominal value of pressure as the transmitter input.

NOTE
After calibrating Model 3051 Range 4 and Range 5 transmitters for high differential pressure applications, rerange the 4 and 20 mA points using the communicator to maintain the systematic static line pressure correction. You may re-zero the 4 mA point at line pressure after installation using the local zero button without affecting the completed calibration.

Diagnostic Messages

In addition to the output, the LCD meter displays abbreviated operation, error, and warning messages for troubleshooting the transmitter. Messages appear according to their priority, with normal operating messages appearing last. To determine the cause of a message, use a Model 275 HART Communicator to further interrogate the transmitter. A description of each LCD diagnostic message follows.

Error

Error messages appear on the LCD meter display to inform you of serious problems effecting the operation of the transmitter. The meter displays an error message until the error condition is corrected, and the analog output is driven to the specified alarm level. No other transmitter information is displayed during an alarm condition.

FAIL[1]
The transmitter CPU board and the sensor module are incompatible. If you encounter this message, contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Fail Module
The sensor module is disconnected or is malfunctioning. Verify that the sensor module ribbon cable is connected to the back of the electronics board. If the ribbon cable is properly connected, there is a problem within the sensor module. Possible sources of problems include:

- Pressure or temperature updates are not being received in the sensor module.
- A non-volatile memory fault that will effect transmitter operation has been detected in the module by the memory verification routine.

Some non-volatile memory faults are user-repairable. Use a Model 275 HART Communicator to diagnose the error and determine if it is repairable. Any error message that ends in "FACTORY" is not repairable. In cases of non user-repairable errors, you must replace the sensor module. See "Disassembly Procedures" on page 5-3 or contact Rosemount Customer Central at 800-999-9307 if you need assistance.

(1) For previous versions of the meter, FAIL MODULE and FAIL ELECT were also grouped into the FAIL message. When dealing with a FAIL message on a previous version meter, review the information in the FAIL MODULE and FAIL ELECT sections as well.

Fail Elect
The transmitter electronics board is malfunctioning due to an internal fault. Some of the FAIL ELECT errors are user-repairable. Use a Model 275 HART Communicator to diagnose the error and determine if it is repairable. Any error message that ends in "FACTORY" is not repairable. In cases of non user-repairable errors, you must replace the electronics board. See "Disassembly Procedures" on page 5-3 or contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Fail Config
A memory fault has been detected in a location that could effect transmitter operation, and is user-accessible. To correct this problem, use a Model 275 HART Communicator to interrogate and reconfigure the appropriate portion of the transmitter memory. Contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Warnings

Warnings appear on the LCD display to alert you of user-repairable problems with the transmitter, or current transmitter operations. Warnings appear alternately with other transmitter information until the warning condition is corrected or the transmitter completes the operation that warrants the warning message.

NOTE
The warning messages on previous versions of the LCD display may vary slightly from those listed here, but they represent the same warning.

Press Limit
The process variable read by the transmitter is outside of the transmitter's range.

Temp Limit
The secondary temperature variable read by the transmitter is outside of the transmitter's range.

Curr Fixed
The transmitter is in multidrop mode. The analog output is not tracking pressure changes.

Curr Saturd
The pressure read by the module is outside of the specified range, and the analog output has been driven to saturation levels.

Loop Test
A loop test is in progress. During a loop test or 4–20 mA trim, the analog output is set to a fixed value. The meter display alternates between the current selected in milliamps and "LOOP TEST."

Xmtr Info
A non-volatile memory fault has been detected in the transmitter memory by the memory verification routine. The memory fault is in a location containing transmitter information. To correct this problem, use a Model 275 HART Communicator to interrogate and reconfigure the appropriate portion of the transmitter memory. This warning does not effect the transmitter operation. Contact Rosemount Customer Central at 800-999-9307 if you need assistance.

Operation

Normal operation messages appear on the LCD meter to confirm actions or inform you of transmitter status. Operation messages are displayed with other transmitter information, and warrant no action to correct or alter the transmitter settings.

Zero Pass
The zero value, set with the local zero adjustment button, has been accepted by the transmitter, and the output should change to 4 mA.

Zero Fail
The zero value, set with the local zero adjustment button, exceeds the maximum rangedown allowed for a particular range, or the pressure sensed by the transmitter exceeds the sensor limits.

Span Pass
The span value, set with the local span adjustment button, has been accepted by the transmitter, and the output should change to 20 mA.

Span Fail
The span value, set with the local span adjustment button, exceeds the maximum rangedown allowed for a particular range, or the pressure sensed by the transmitter exceeds the sensor limits.

LOCAL DSBLD
This message appears during reranging with the integral zero and span buttons and indicates that the transmitter local zero and span adjustments have been disabled. The adjustments may have been disabled by the transmitter security jumper on the transmitter circuit board or through software commands from the Model 275. See "Security (Write Protect)" on page 2-14 for information on the position of the security jumper and information on software lockout.

Write Protect
This message appears if you attempt to change the transmitter configuration data while the security jumper is in the **ON** position. See "Security (Write Protect)" on page 2-14 for more information about the security jumper.

HART Communicator Diagnostics

The following table is a list of messages used by the HART Communicator (HC) and their corresponding descriptions.

Variable parameters within the text of a message are indicated with *<variable parameter>*.

Reference to the name of another message is identified by *[another message]*.

Message	Description
1k snsr EEPROM error-factory ON	Replace the sensor module
1k snsr EEPROM error-user-no out ON	Use the HART communicator to reset the following parameters: remote seal isolator, remote seal fill fluid, flange material, o-ring material, transmitter type, remote seal type, flange type, meter type, number of remote seals.
1k snsr EEPROM error-user ON	Perform a full trim to recalibrate the transmitter.
4k micro EEPROM error-factory ON	Replace the electronics board.
4k micro EEPROM error-user-no out ON	Use the hart communicator to reset the message field.
4k micro EEPROM error-user ON	Use the HART communicator to reset the following parameters: units, range values, damping, analog output, transfer function, tag, scaled meter values. Perform a d/a trim to ensure that the error is corrected.
4k snsr EEPROM error-factory ON	Replace the sensor module.
4k snsr EEPROM error-user ON	Use the HART communicator to reset the temperature units and the calibration type.
Add item for ALL device types or only for this ONE device type.	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	The communicator and the device are not communicating correctly. Check all connections between the communicator and the device and resend the information.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
CPU board not initialized ON	The electronics board is not initialized. Replace the electronics board.
CPU EEPROM write failure ON	Message sent to electronics board from HART signal failed. Replace the electronics board.
Device Busy	The connected device is busy performing another task.
Device Disconnected	The device failed to respond to a command. Check all connections between the communicator and the device and resend the command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HART communicator off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Press the SEND softkey to transfer information from the communicator memory to the device.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device-specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device-specified description edit format.
Ignore next 50 occurrences of status?	Select YES to ignore the next 50 occurrences of device status, or select no to display every occurrence.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.

Message	Description
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incompatible CPU board and module ON	Upgrade the electronics board or the sensor module to the current revision.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Local buttons operator error ON	Illegal pressure applied during zero or span operation. Repeat the process after verifying the correct pressures.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
Module EEPROM write failure ON	Message sent to the module from the HART signal failed. Replace the sensor module.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named "hotkey" defined in the device description for this device.
No pressure updates ON	No pressure updates being received from the sensor module. Verify that the sensor module ribbon cable is attached correctly. Or replace the sensor module.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No temperature updates ON	No temperature updates being received from the sensor module. Verify that the sensor module ribbon cable is attached correctly. Or replace the sensor module.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named "upload_variables" defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hotkey items. Unnecessary items should be deleted to make space available.
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK...	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
ROM checksum error ON	Checksum of transmitter software has detected a fault. Replace the electronics board.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.

Message	Description
Saving data to configuration memory.	Data is being transferred from a device to configuration memory
Sending data to device.	Data is being transferred from configuration memory to a device.
Sensor board not initialized ON	The sensor module electronics board is not initialized. Replace the sensor module.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Upgrade 275 software to access XMTR function. Continue with old description?	The communicator does not contain the most recent Model 3051 Device Descriptors (DDs). Select YES to communicate using the existing DDs. Select NO to abort communication.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

Local Zero and Span (Local Keys) Software Lock Out

To enable this feature, see "Local Span and Zero Control (Local Keys)" on page 4-20.

Physical Removal of Local Zero and Span (Local Keys)

To remove the magnetic buttons used to activate the local zero and span, use a small slotted head screwdriver and pry off the small, plastic cap located under the approval tag. Remove button assemblies and discard.

NOTE
On previous versions of Model 3051, remove the magnetic screws.

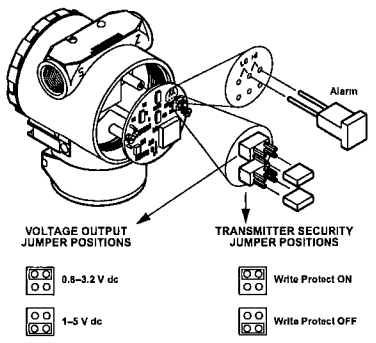
NOTE
Alarm jumper not installed = High Alarm

SELECTING OUTPUT RANGE FOR LOW-POWER

Low power transmitters output either 1–5 V dc or 0.8–3.2 V dc depending on the position of the voltage output jumper. To reposition the voltage output jumper, follow the procedure described on page 2-14.

NOTE
Default low power output is 1–5 V dc. After changing output between 1–5 V and 0.8–3.2 V, perform a low power output trim.

Figure 4-4. Low Power Transmitter Electronics Boards



NOTE
Security jumper not installed = Not Write Protected
Alarm jumper not installed = High Alarm
Voltage output jumper not installed = 1–5 V

DETAILED SETUP

Local Span and Zero Control (Local Keys)

HART Comm.	1, 4, 4, 1, 7

The *Local keys* command allows software control over the use of the local span and zero adjustments. To enable or disable the span and zero adjustment buttons on your transmitter, perform the fast key sequence at left.

NOTE
Disabling the local keys does not disable all transmitter configuration changes. With the local keys disabled, you can still make changes to the transmitter configuration—including range values—using a HART communicator.

Section 5 Troubleshooting

Before Disassembling the Transmitter ..... **page 5-3**
Disassembly Procedures ..... **page 5-3**
Reassembly Procedures ..... **page 5-5**

OVERVIEW

Table 5-1 provides summarized troubleshooting suggestions for the most common operating problems.

If you suspect a malfunction despite the absence of any diagnostic messages on the communicator display, follow the procedures described here to verify that transmitter hardware and process connections are in good working order. Always deal with the most likely and easiest-to-check conditions first.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions can result in death or serious injury.

- Do not remove the transmitter covers in explosive environments when the circuit is live.
- Both transmitter covers must be fully engaged to meet Explosion-Proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure that the instruments in the loop are installed according to intrinsically safe or nonincendive field wiring practices.

⚠CAUTION

Static electricity can damage sensitive components.

- Observe safe handling precautions for static-sensitive components.

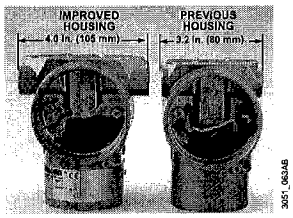
Table 5-1. Model 3051S troubleshooting table

Symptom	Corrective Actions
Transmitter milliamp reading is zero	Verify power is applied to signal terminals
	Check power wires for reversed polarity
	Verify terminal voltage is 10.5 to 42.4 V dc
	Check for open diode across test terminal
Transmitter Not Communicating with HART Communicator	Verify the output is between 4 and 20 mA or saturation levels
	Verify clean DC Power to transmitter (Max AC noise 0.2 volts peak to peak)
	Check loop resistance, 250 Ω minimum (PS voltage -transmitter voltage/loop current)
	Check if unit is addressed properly
Transmitter milliamp reading is low or high	Verify applied pressure
	Verify 4 and 20 mA range points
	Verify output is not in alarm condition
	Verify if 4 – 20 mA output trim is required
Transmitter will not respond to changes in applied pressure	Check test equipment
	Check impulse piping or manifold for blockage
	Verify applied pressure is between the 4 and 20 mA set points
	Verify output is not in alarm condition
	Verify transmitter is not in Loop Test mode
Digital Pressure Variable reading is low or high	Check test equipment (verify accuracy)
	Check impulse piping for blockage or low fill in wet leg
	Verify transmitter is calibrated properly
	Verify pressure calculations for application
Digital Pressure Variable reading is erratic	Check application for faulty equipment in pressure line
	Verify transmitter is not reacting directly to equipment turning on/off
	Verify damping is set properly for application
Milliamp reading is erratic	Verify power source to transmitter has adequate voltage and current
	Check for external electrical interference
	Verify transmitter is properly grounded
	Verify shield for twisted pair is only grounded at one end

BEFORE DISASSEMBLING THE TRANSMITTER

Maintenance procedures differ for improved and previous style transmitter housings. Verify the specific physical characteristics of your transmitter before you begin any maintenance procedures. The width of the conduit entries is the most noticeable physical difference between the improved and the previous style housing (see Figure 5-1).

Figure 5-1. Improved and Previous Styles of the Model 3051 Transmitter Housing



DISASSEMBLY PROCEDURES

⚠ Do not remove the instrument cover in explosive atmospheres when the circuit is live.

Remove the Transmitter from Service

NOTE
Once you have determined a transmitter to be inoperable, remove it from service.

Be aware of the following:

- Isolate and vent the process from the transmitter before removing the transmitter from service.
- Remove all electrical leads and conduit.
- Detach the process flange by removing the four flange bolts and the two alignment screws that secure it.
- Do not scratch, puncture, or depress the isolating diaphragms.
- Clean isolating diaphragms with a soft rag and a mild cleaning solution, and rinse with clear water.
- Whenever you remove the process flange or flange adapters, visually inspect the Teflon O-rings. Replace the O-rings if they show any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them.

The Model 3051C transmitter is attached to the process connection by four bolts and two cap screws. Remove the four bolts and separate the transmitter from the process connection manifold or flange. You can leave the process connection in place and ready for re-installation.

The Model 3051T is attached to the process by a single hex nut process connection. Loosen the hex nut to separate the transmitter from the process. Do not use wrench on neck of transmitter.

Remove the Terminal Block

Electrical connections are located on the terminal block in the compartment labelled "FIELD TERMINALS."

Loosen the two small screws located at the 9 o'clock and 4 o'clock positions, and pull the entire terminal block out to remove it.

NOTE
If removing the terminal block from the housing of a previous version of the transmitter, you will have to manually disconnect the power leads from the rear of the terminal block before completely separating it from the housing.

Remove the Electronics Board

The transmitter electronics board is located in the compartment opposite the terminal side. To remove the electronics board perform the following procedure:

1. Remove the housing cover opposite the field terminal side.
2. ⚠ Loosen the two captive screws that anchor the board to the housing. The electronics board is electrostatically sensitive; observe handling precautions for static-sensitive components.

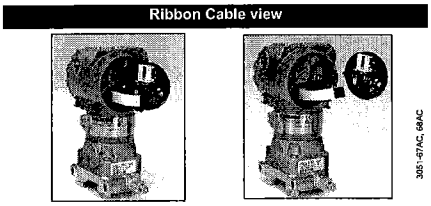
NOTE
If you are disassembling a transmitter with a LCD display, loosen the two captive screws that are visible on the right and left side of the meter display. The two screws anchor the LCD display to the electronics board and the electronics board to the housing.

3. Slowly pull the electronics board out of the housing. With the two captive screws free of the transmitter housing, only the sensor module ribbon cable holds the board to the housing.

NOTE
Previous versions of the electronics board utilize a snap-in power plug and receptacle. Carefully unsnap the power plug from the receptacle to free the board from the power cord.

4. Disconnect the sensor module ribbon cable to release the electronics board from the transmitter.

Figure 5-2. Ribbon Cable view



Remove the Sensor Module from the Electronics Housing

1. Carefully tuck the cable connector completely inside of the internal shroud.

NOTE
Do not remove the housing until after you tuck the cable connector completely inside of the internal shroud. The shroud protects the cable from damage that can occur when you rotate the housing.

2. Loosen the housing rotation set screw with a 9/64-inch hex wrench, and back off one full turn.

IMPORTANT
To prevent damage to the sensor module ribbon cable, disconnect it from the electronics board before you remove the sensor module from the electrical housing.

3. Unscrew the housing from the module, making sure the shroud and sensor cable do not catch on the housing.

IMPORTANT
Make sure the sensor ribbon cable and internal shroud remain completely free of the housing as you rotate it. Damage can occur to the cable if the internal shroud and sensor cable become hung up and rotate with the housing.

REASSEMBLY PROCEDURES

1. Inspect all cover and housing (non-process wetted) O-rings and replace if necessary. Lightly grease with silicone lubricant to ensure a good seal.
2. Carefully tuck the cable connector completely inside the internal shroud. To do so, turn the shroud and cable counterclockwise one rotation to tighten the cable.
3. Lower the electronics housing onto the module. Guide the internal shroud and cable through the housing and into the external shroud.
4. Turn the housing clockwise the fasten it to the module.

IMPORTANT
To prevent damage to the cable connector, watch the cable and shroud as you attach the housing to the module. Make sure the cable connector does not slip out of the internal shroud and begin to rotate with the housing. Reinsert the cable connector into the shroud if it escapes before the housing is fully fastened.

⚠ 5. Thread the housing completely onto the sensor module. The housing must be no more than one full turn from flush with the sensor module to comply with explosion proof requirements.
6. Tighten the housing rotation set screw using a 9/64-inch hex wrench.

⚠ See "Safety Messages" on page 5-1 for complete warning information.

NOTE
Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD meter, an alarm level test is recommended before returning the transmitter to service (see "Alarm Level Verification" on page 3-20).

Attach the Electronics Board

1. Remove the cable connector from its position inside of the internal shroud and attach it to the electronics board.
2. Insert the electronics board into the housing, making sure that the posts from the electronics housing properly engage the receptacles on the electronics board.

NOTE
If you are reassembling a previous version of the electronics board (or placing a new version of the electronics board in a previous version of the housing), attach the snap-in power connection to the receptacle on the board with the black and red wires routed toward the center of the board and below the white reed switch holder.

3. Tighten the captive mounting screws.
4. Replace the electronics housing cover. The transmitter covers must be engaged metal-to-metal to ensure a proper seal and to meet Explosion-Proof requirements.

NOTE
Electronics board revision 5.3.163 or later (all shrouded designs) are able to verify alarm current levels. After replacing the transmitter electronics board, sensor module, or LCD meter, an alarm level test is recommended before returning the transmitter to service (see "Alarm Level Verification" on page 3-20).

Install the Terminal Block

Gently slide the terminal block into place, making sure the posts from the electronics housing properly engage the receptacles on the terminal block. Tighten the captive screws and replace the electronics housing cover. The transmitter covers must be fully engaged to meet Explosionp-Proof requirements.

NOTE
If you are reassembling a previous version of the terminal block, attach the black and red wires to the back side of the block before you insert it into the electronics housing.

Reassemble the Process Sensor Body

1. Visually inspect the Teflon sensor module O-rings. If the O-rings are undamaged, you may reuse them. If the O-rings show signs of damage, such as nicks or cuts, or if there is any doubt about their ability to seal properly, replace them with new O-rings.

NOTE
If you are replacing the O-rings, be careful not to scratch the O-ring grooves or the surface of the isolating diaphragm when removing the damaged O-rings.

2. Install the process flange on the sensor module. To hold the process flange in place, install the two hex head alignment screws. While these screws are not pressure retaining, tighten the hex head alignment screws to 33 in-lbs to ensure proper alignment. Do not overtighten; this will affect the module/flange alignment.
3. Install the appropriate flange bolts.
   a. IF the installation requires a ¼–18 NPT mounting, THEN use four 1.75-inch flange bolts. Go to **step f**.
   b. IF the installation requires a ½–14 NPT mounting, THEN use four 2.88-inch process flange/adapter bolts. EXCEPTION: For gage pressure configurations, use two 2.88-inch bolts and two 1.75-inch bolts. Go to **step d**.
   c. IF the installation uses a three-valve manifold (differential pressure applications only), THEN use four 2.25-inch manifold flange bolts. Go to **step e**.
   d. Hold the flange adapters and adapter O-rings in place while finger-tightening the bolts. Go to **step g**.
   e. Align the process flange with the three-valve manifold.
   f. Finger tighten the bolts.
   g. Tighten the bolts to the initial torque value using a crossed pattern. See Table 5-2 for appropriate torque values.
   h. Tighten the bolts to the final torque value using a crossed pattern. See Table 5-2 for appropriate torque values. When fully tightened, the bolts should extend through the top of the module housing.
   i. If the installation uses a three-valve manifold, then install flange adapters on the process end of the manifold using the 1.75-inch flange bolts supplied with the transmitter.

Table 5-2. Bolt Installation Torque Values

Bolt Material	Initial Torque Value	Final Torque Value
CS-ASTM-A445 Standard	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)
316 SST—Option L4	150 in. lb (17 N-m)	300 in.-lb (34 N-m)
ASTM-A-193-B7M—Option L5	300 in. lb (34 N-m)	650 in.-lb (73 N-m)
Monel—Option L6	300 in.-lb (34 N-m)	650 in.-lb (73 N-m)

4. IF you replaced the Teflon sensor module O-rings, THEN re-torque the flange bolts after installation to compensate for cold flow.
5. Install the drain/vent valve.
   a. Apply sealing tape to the threads on the seat. Starting at the base of the valve with the threaded end pointing toward the installer, apply two clockwise turns of the sealing tape.
   b. Take care to place the opening on the valve so that process fluid will drain toward the ground and away from personnel when the valve is opened.
   c. Tighten the drain/vent valve to 350 in.-lb. (39.54 N-m).

NOTE
After replacing O-rings on Range 1 transmitters and re-installing the process flange, expose the transmitter to a temperature of 185 °F (85 °C) for two hours. Then re-tighten the flange bolts in a cross pattern, and again expose the transmitter to a temperature of 185 °F (85 °C) for two hours before calibration.

Appendix A Reference Information

Performance Specifications ..... **page A-1**
Detailed Performance Specifications ..... **page A-2**
Functional Specifications ..... **page A-6**
Physical Specifications ..... **page A-11**
Dimensional Drawings ..... **page A-13**
Ordering Information ..... **page A-21**
Parts List ..... **page A-35**
Options ..... **page A-45**
HART Protocol C1 Option Configuration Data Sheet ... **page A-50**

PERFORMANCE SPECIFICATIONS

Total Performance is based on combined errors of reference accuracy, ambient temperature effect, and static pressure effect.

Model 3051C (Ranges 2–5), Model 3051T

Reference Accuracy
±0.075% of span

Total Performance
±0.15% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure (CD only), from 1:1 to 5:1 rangedown.

Stability
±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure.

Dynamic Performance Total Response Time ($T_d + T_c$)
HART output: 100 ms

Model 3051CD, Low/Draft Range (Ranges 0–1)

Reference Accuracy
±0.10% of span

Stability
±0.2% of URL for 1 year under reference conditions

Model 3051P—Reference Class

Reference Accuracy
±0.05% of span

Total Performance
±0.10% of span for ±50 °F (28 °C) temperature changes, up to 1000 psi (6,9 MPa) line pressure, from 1:1 to 5:1 rangedown

Stability
±0.125% of URL for 5 years for ±50 °F (28 °C) temperature changes, and up to 1000 psi (6,9 MPa) line pressure

Dynamic Performance Total Response Time ($T_d + T_c$)
100 ms

Model 3051L—Liquid Level

Reference Accuracy
±0.075% of span

Model 3051H—High Process Temperature

Reference Accuracy
±0.075% of span

Stability
±0.1% of URL for 12 months for Ranges 2 and 3
±0.2% of URL for 12 months for Ranges 4 and 5

DETAILED PERFORMANCE SPECIFICATIONS

For zero-based spans, reference conditions, silicone oil fill, SST materials, Coplanar flange (Model 3051C) or 1/2 in.- 18 NPT (Model 3051T) process connections, digital trim values set to equal range points.

Reference Accuracy

Stated reference accuracy includes hysteresis, terminal-based linearity and repeatability.

Model 3051CD Ranges 2–5 and 3051CG
±0.075% of span for spans less than 10:1, accuracy =

$$\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]\% \text{ of Span}$$

Model 3051CD Range 1
±0.10% of span for spans less than 15:1, accuracy =

$$\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]\% \text{ of Span}$$

Model 3051CD Range 0
±0.10% of span for spans less than 2:1, accuracy = ±0.05% of URL

Model 3051T/CA Ranges 1–5
±0.075% of span for spans less than 10:1, accuracy =

$$\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]\% \text{ of Span}$$

Model 3051CA Range 0
±0.075% of span for spans less than 5:1, accuracy =

$$\pm\left[0.025 + 0.01\left(\frac{URL}{Span}\right)\right]\% \text{ of Span}$$

Model 3051H/3051L
±0.075% of span for spans less than 10:1, accuracy =

$$\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]\% \text{ of Span}$$

Model 3051P
±0.05% of span

Ambient Temperature Effect per 50 °F (28 °C)

Model 3051CD/CG
Range 2 - 5: ±(0.0125% URL + 0.0625% span) from 1:1 to 5:1
±(0.025% URL + 0.125% span) from 5:1 to 100:1
Range 1: ±(0.1% URL + 0.25% span) from 1:1 to 30:1
±(0.147% URL + 0.15% span) greater than 30:1
Range 0: ±(0.25% URL + 0.05% span)

Model 3051CA
Range 1 - 4: ±(0.025% URL + 0.125% span) from 1:1 to 30:1
±(0.035% URL + 0.125% span) from 30:1 to 100:1
Range 0: ± (0.1% URL +0.25% span)

Model 3051P
All ranges: ±(0.006% URL + 0.03% span)

Model 3051H
All ranges: ±(0.025% URL + 0.125% span + 0.35 inH_2O)
For spans below 30:1 rangedown:
±(0.035% URL + 0.125% span + 0.35 inH_2O)

Model 3051L
See Rosemount Inc. Instrument Toolkit™ software.

Model 3051T
Ranges 2- 4: ±(0.025% URL + 0.125% span) from 1:1 to 30:1
±(0.035% URL + 0.125% span) from 30:1 to 100:1
Range 5: ±(0.1% URL + 0.15% span)
Range 1: ±(0.025% URL + 0.125% span) from 1:1 to 10:1
±(0.05% URL + 0.125% span) from 10:1 to 100:1

Line Pressure Effect per 1000 psi (6,9 MPa)

Model 3051CD

Zero Error (can be calibrated out at line pressure)
±0.05% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)

For line pressures above 2000 psi (13,7 MPa), see "Compensating for Line Pressure" on page 4-12.

Range 0: ±0.125% of URL/100 psi (6,89 bar)
Range 1: ±0.25% of URL

Span Error
±0.1% of reading
Range 0: ±0.15% of reading/100 psi (6,89 bar)
Range 1: ±0.4% of reading

Model 3051P

Zero Error (can be calibrated out at line pressure)
±0.04% of URL

Span Error
±0.10% of reading

Model 3051HD

Zero Error (can be calibrated out at line pressure)
±0.1% of URL for line pressures from 0 to 2000 psi (0 to 13,7 MPa)
For line pressures above 2000 psi (13,7 MPa), see "Compensating for Line Pressure" on page 4-12.

Span Error
±0.1% of reading

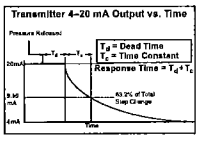
Dynamic Performance

Total Response Time ($T_d + T_c$)[1]:

Model 3051C/P, Ranges 2-5:	100 ms
Range 1:	255 ms
Range 0:	700 ms
Model 3051T:	100 ms
Model 3051H/L:	Consult factory
Dead Time (Td)	45 ms (nominal)
Update Rate	22 times per second

(1) Dead time and update rate apply to all models and ranges; analog output only
(2) Nominal total response time at 75 °F (24 °C) reference conditions.

Figure A-1. Typical Smart Transmitter Response Time



3051-3051_17A

Mounting Position Effects

Model 3051C/P
Zero shifts up to ±1.25 inH_2O (3,11 mbar), which can be calibrated out. No span effect.

Model 3051H
Zero shifts up to ±5 inH_2O (127 mmH_2O), which can be calibrated out. No span effect.

Model 3051L
With liquid level diaphragm in vertical plane, zero shift of up to 1 inH_2O (25,4 mmH_2O).
With diaphragm in horizontal plane, zero shift of up to 5 inH_2O (127 mmH_2O) plus extension length on extended units. All zero shifts can be calibrated out. No span effect.

Model 3051T/CA
Zero shifts up to 2.5 inH_2O (63,5 mmH_2O), which can be calibrated out. No span effect.

Vibration Effect

All Models
Measurement effect due to vibrations is negligible except at resonance frequencies. When at resonance frequencies, vibration effect is less than ±0.1% of URL per g when tested between 15 and 2000 Hz in any axis relative to pipe-mounted process conditions.

Power Supply Effect

All Models
Less than ±0.005% of calibrated span per volt.

RFI Effects

All Models
±0.1% of span from 20 to 1000 MHz and for field strength up to 30 V/m. Shielded cable needed for 30 V/m.

Transient Protection (Option Code T1)

All Models
Meets IEEE Standard 587, Category B
1 kV crest (10 × 1 000 microseconds)
3 kV crest (8 × 20 microseconds)
6 kV crest (1,2 × 50 microseconds)
Meets IEEE Standard 472, Surge Withstand Capability
SWC 2,5 kV crest, 1 MHz wave form
General Specifications:
Response Time: < 1 nanosecond
Peak Surge Current: 5000 amps to housing.
Peak Transient Voltage: 100 V dc.
Loop Impedance: < 25 ohms
Applicable Standards: IEC 801-4, IEC 801-5

NOTE:
Calibrations at 68 °F (20 °C) per ASME Z210.1 (ANSI)

FUNCTIONAL SPECIFICATIONS

Range and Sensor Limits

Table A-1. Model 3051CD, 3051CG, 3051P, 3051L, and 3051H Range and Sensor Limits

Range	Minimum Span		Upper (URL)	Range and Sensor Limits						
				Lower (LRL)						
	Model 3051CD[1], CG, L, H	Model 3051P		Model 3051C Differential	3051C/P[2] Gage	Model 3051P Differential	Model 3051L Differential	Model 3051L Gage	Model 3051H Differential	Model 3051H Gage
0	0.1 inH$_2$O (0,25 mbar)	NA	3.0 inH$_2$O (7,47 mbar)	–3.0 inH$_2$O (–7,47 mbar)	NA	NA	NA	NA	NA	NA
1	0.5 inH$_2$O (1,2 mbar)	NA	25 inH$_2$O (62,3 mbar)	–25 inH$_2$O (–62,3 mbar)	–25 inH$_2$O (–62,3 mbar)	NA	NA	NA	NA	NA
2	2.5 inH$_2$O (6,2 mbar)	25 inH$_2$O (62,3 mbar)	250 inH$_2$O (0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)	–250 inH$_2$O (–0,62 bar)
3	10 inH$_2$O (24,9 mbar)	100 inH$_2$O (0,25 bar)	1000 inH$_2$O (2,49 bar)	–1000 inH$_2$O (–2,49 bar)	0.5 psia (34,5 mbar abs)	–1000 inH$_2$O (–2,49 bar)	–1000 inH$_2$O (–2,49 bar)	0.5 psia (34,5 mbar abs)	–1000 inH$_2$O (–2,49 bar)	0.5 psia (34,5 mbar abs)
4	3 psi (0,20 bar)	30 psi (2,07 bar)	300 psi (20,6 bar)	–300 psi (–20,6 bar)	0.5 psia (34,5 mbar abs)	NA	–300 psi (–20,6 bar)	0.5 psia (34,5 mbar abs)	–300 psi (–20,6 bar)	0.5 psia (34,5 mbar abs)
5	20 psi (1,38 bar)	200 psi (13,8 bar)	2000 psi (137,9 bar)	–2000 psi (–137,9 bar)	0.5 psia (34,5 mbar abs)	NA	NA	NA	–2000 psi (–137,9 bar)	0.5 psia (34,5 mbar abs)

(1) Range 0 only available with Model 3051CD. Range 1 only available with Models 3051CD or 3051CG.
(2) Range 1 not available with Model 3051P.

Table A-2. Range and Sensor Limits

Model 3051CA			
	Range and Sensor Limits		
Range	Minimum Span	Upper (URL)	Lower (LRL)
0	0.167 psia (11,51 mbar)	5 psia (0,34 bar)	0 psia (0 bar)
1	0.3 psia (20,6 mbar)	30 psia (2,07 bar)	0 psia (0 bar)
2	1.5 psia (0,103 bar)	150 psia (10,3 bar)	0 psia (0 bar)
3	8 psia (0,55 bar)	800 psia (55,2 bar)	0 psia (0 bar)
4	40 psia (2,76 bar)	4000 psia (275,8 bar)	0 psia (0 bar)

Model 3051T				
	Range and Sensor Limits			
Range	Minimum Span	Upper (URL)	Lower (LRL)	Lower[1] (LRL) (Gage)
1	0.3 psi (20,6 mbar)	30 psi (2,07 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)
2	1.5 psi (0,103 bar)	150 psi (10,3 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)
3	8 psi (0,55 bar)	800 psi (55,2 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)
4	40 psi (2,76 bar)	4000 psi (275,8 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)
5	2000 psi (137,9 bar)	10000 psi (689,4 bar)	0 psia (0 bar)	–14.7 psig (–1,01 bar)

(1) Assumes atmospheric pressure of 14.7 psig.

Zero and Span Adjustment Requirements (HART and Low Power)

Zero and span values can be set anywhere within the range limits stated in Table A-1 and Table A-2.

Span must be greater than or equal to the minimum span stated in Table A-1 and Table A-2.

Service

Liquid, gas, and vapor applications

4–20 mA (Output Code A)

Output

Two-wire 4–20 mA, user-selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol.

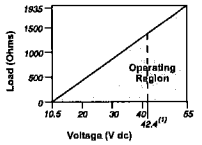
Power Supply

External power supply required. Standard transmitter (4–20 mA) operates on 10.5 to 55 V dc with no load.

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

Max. Loop Resistance = 43.5 (Power Supply Voltage – 10.5)



Communication requires a minimum loop resistance of 250 ohms.

(1) For CSA approval, power supply must not exceed 42.4 V.

Low Power (Output Code M)

Output

Three wire 1–5 V dc or 0.8–3.2 V dc (Option Code C2) user-selectable output. Also user selectable for linear or square root output configuration. Digital process variable superimposed on voltage signal, available to any host conforming to the HART protocol. Low-power transmitter operates on 6–12 V dc with no load.

Power Consumption

3,0 mA, 18–36 mW

Minimum Load Impedance

100 kΩ (V_{out} wiring)

Indication

Optional 5-digit LCD display

Overpressure Limits

Transmitters withstand the following limits without damage:

Model 3051CD/CG
Range 0: 750 psi (51,7 bar)
Range 1: 2000 psig (137,9 bar)
Ranges 2–5: 3626 psig (250 bar)

Model 3051CA
Range 0: 60 psia (4,14 bar)
Range 1: 750 psia (51,7 bar)
Range 2: 300 psia (20,7 bar)
Range 3: 1600 psia (110,3 bar)
Range 4: 6000 psia (413,7 bar)

Model 3051H
All Ranges: 3626 psig (25 MPa)

Model 3051T/TA
Range 1: 750 psi (51,7 bar)
Range 2: 1500 psi (103,4 bar)
Range 3: 1600 psi (110,3 bar)
Range 4: 6000 psi (413,7 bar)
Range 5: 15000 psi (1034,2 bar)

Model 3051PG
Ranges 2-5: 3626 psig (250 bar)

Model 3051PD
Ranges 2 and 3: 2000 psig (13,8 MPa)

For Model 3051L or Level Flange Option Codes FA, FB, FC, FD, FP, and FQ, limit is 0 psia to the flange rating or sensor rating, whichever is lower.

TABLE 1. Model 3051L and Level Flange Rating Limits

Standard	Type	CS Rating	SST Rating
ANSI/ASME	Class 150	285 psig	275 psig
ANSI/ASME	Class 300	740 psig	720 psig
ANSI/ASME	Class 600	1480 psig	1440 psig
At 100 °F (38 °C), the rating decreases with increasing temperature.			
DIN	PN 10–40	40 bar	40 bar
DIN	PN 10/16	16 bar	16 bar
DIN	PN 25/40	40 bar	40 bar
At 248 °F (120 °C), the rating decreases with increasing temperature.			

Static Pressure Limit

Model 3051CD Only
Operates within specifications between static line pressures of 0.5 psia and 3626 psig (4500 psig for Option Code P9).
Range 0: 0.5 psia and 750 psig
Range 1: 0.5 psia and 2000 psig

Model 3051PD Only
Operates within specifications between static line pressures of 0.5 psia and 2000 psig.

Burst Pressure Limits

Burst pressure on Coplanar, traditional, or Model 3051H process flange is 10000 psig (69 MPa).

Burst pressure for the Model 3051T is
Ranges 1–4: 11000 psi (75,8 MPa)
Range 5: 26000 psig (179 MPa)

Failure Mode Alarm

Output Code A
If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 3.75 mA or to 21.75 mA to alert the user. High or low alarm signal is user-selectable by internal jumper.

Output Code M
If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 0.94 V or above 5.4 V to alert the user (below 0.75 V or above 4.4 V for Option C2). High or low alarm signal is user-selectable by internal jumper.

Output Code F and W
If self-diagnostics detect a gross transmitter failure, that information gets passed as a status along with the process variable.

Temperature Limits

Ambient
–40 to 185 °F (–46 to 85 °C)
With integral meter: –4 to 175 °F (–20 to 80 °C)

Storage
–50 to 230 °F (–46 to 110 °C)
With integral meter: –40 to 185 °F (–40 to 85 °C)

Process
At atmospheric pressures and above. See Table A-3

Table A-3. Model 3051 Process Temperature Limits

Model 3051CD, 3051CG, 3051CA, 3051P	
Silicone Fill Sensor[1]	
with Coplanar Flange	–40 to 250 °F (–40 to 121 °C)[2]
with Traditional Flange	–40 to 300 °F (–40 to 149 °C)[2][3]
with Level Flange	–40 to 300 °F (–40 to 149 °C)[2]
with Model 305 Integral Manifold	–40 to 300 °F (–40 to 149 °C)[2]
Inert Fill Sensor[1]	0 to 185 °F (–18 to 85 °C)[4][5]
Model 3051H (Process Fill Fluid)	
D.C.® Silicone 200[1]	–40 to 375 °F (–40 to 191 °C)
Inert[1]	–50 to 350 °F (–45 to 177 °C)
Neobee M-20®[1]	0 to 375 °F (–18 to 191 °C)
Model 3051T (Process Fill Fluid)	
Silicone Fill Sensor[1]	–40 to 250 °F (–40 to 121 °C)[2]
Inert Fill Sensor[1]	–22 to 250 °F (–30 to 121 °C)[2]
Model 3051L Low-Side Temperature Limits	
Silicone Fill Sensor[1]	–40 to 250 °F (–40 to 121 °C)[2]
Inert Fill Sensor[1]	0 to 185 °F (–18 to 85 °C)[4]
Model 3051L High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	–100 to 300 °F (–73 to 149 °C)
D.C. Silicone 704®	60 to 400 °F (15 to 205 °C)
D.C. Silicone 200	–40 to 400 °F (–40 to 205 °C)
Inert	–50 to 350 °F (–45 to 177 °C)
Glycerin and Water	0 to 200 °F (–18 to 93 °C)
Neobee M-20	0 to 400 °F (–18 to 205 °C)
Propylene Glycol and Water	0 to 200 °F (–18 to 93 °C)

(1) Process temperatures above 185 °F (85 °C) require derating the ambient limits by a 1.5:1 ratio (0.6:1 ratio for the Model 3051H).
(2) 220 °F (104 °C) limit in vacuum service; 130 °F (54 °C) for pressures below 0.5 psia.
(3) 3051CD0 process temperature limits are –40 to 212 °F (–45 to 100 °C)
(4) 160 °F (71 °C) limit in vacuum service.
(5) Not available for Model 3051CA.

Humidity Limits
0–100% relative humidity

Turn-On Time
Performance within specifications less than 2.0 seconds after power is applied to the transmitter

Volumetric Displacement
Less than 0.005 in^3 (0,08 cm^3)

Damping
Analog output response to a step input change is user-selectable from 0 to 25.6 seconds for one time constant. This software damping is in addition to sensor module response time.

PHYSICAL SPECIFICATIONS

Electrical Connections
½–14 NPT, PG 13.5, G½, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block.

Process Connections

All Models except 3051L and 3051T
¼–18 NPT on 2⅛-in. centers
½–14 NPT on 2-, 2⅛-, or 2¼-in. centers

Model 3051L
High pressure side: 2-, 3-, or 4-in., ASME B 16.5 (ANSI) Class 150, 300 or 600 flange; 50, 80 or 100 mm, PN 40 or 10/16 flange
Low pressure side: ¼–18 NPT on flange ½–14 NPT on adapter

Model 3051T
¼–18 NPT, ½–14 NPT female, Non-Threaded instrument flange (available in SST for Range 1-4 transmitters only), G½ A DIN 16288 Male (available in SST for Range 1–4 transmitters only), or Autoclave type F-250-C (Pressure relieved ⅝–18 gland thread; ¼ OD high pressure tube 60° cone; available in SST for Range 5 transmitters only).

Process Wetted Parts

Drain/Vent Valves
316 SST, Hastelloy C®, or Monel material (Monel not available with Model 3051L or 3051H)

Process Flanges and Adapters
Plated carbon steel, CF-8M (Cast version of 316 SST, material per ASTM-A743), Hastelloy C, or Monel

Wetted O-rings
Glass-filled TFE (Graphite-filled TFE with isolating diaphragm Option Code 6)

Process Isolating Diaphragms

Isolating Diaphragm Material	3051CD/CG	3051T	3051CA	3051P	3051H
316L SST	•	•	•	•	•
Hastelloy C-276®	•	•	•		•
Monel	•		•		
Tantalum	•				•
Gold-plated *Monel*	•		•		
Gold-plated SST	•		•		

Model 3051L Process-Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process Diaphragms, Including Process Gasket Surface:
316L SST, Hastelloy C-276, or Tantalum

Extension
CF-3M (Cast version of 316L SST, material per ASTM-A743), or Hastelloy C. Fits schedule 40 and 80 pipe.

Mounting Flange
Zinc-cobalt plated CS or SST

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms
316L SST or Hastelloy C-276

Reference Flange and Adapter
CF-3M (Cast version of 316L SST, material per ASTM-A743)

Non-Wetted Parts

Electronics Housing
Low-copper aluminum or CF-3M (Cast version of 316L SST, material per ASTM-A743). NEMA 4X, IP 65, IP 66, IP68

Coplanar Sensor Module Housing
CF-3M (Cast version of 316L SST, material per ASTM-A743)

Bolts
Plated carbon steel per ASTM A449, Type 1. Austenitic 316 SST, ASME B 16.5 (ANSI)/ASTM-A-193-B7M, or Monel

Sensor Module Fill Fluid
Silicone or inert Halocarbon™ (inert not available with Model 3051CA or Model 3051H). Model 3051T uses Fluorinert® FC-43

Process Fill Fluid (Model 3051L and 3051H only)
3051L: Syltherm XLT, D.C. Silicone 704, D.C. Silicone 200, inert, glycerin and water, Neobee M-20 or propylene glycol and water
3051H: inert, Neobee M-20, or D.C. Silicone 200

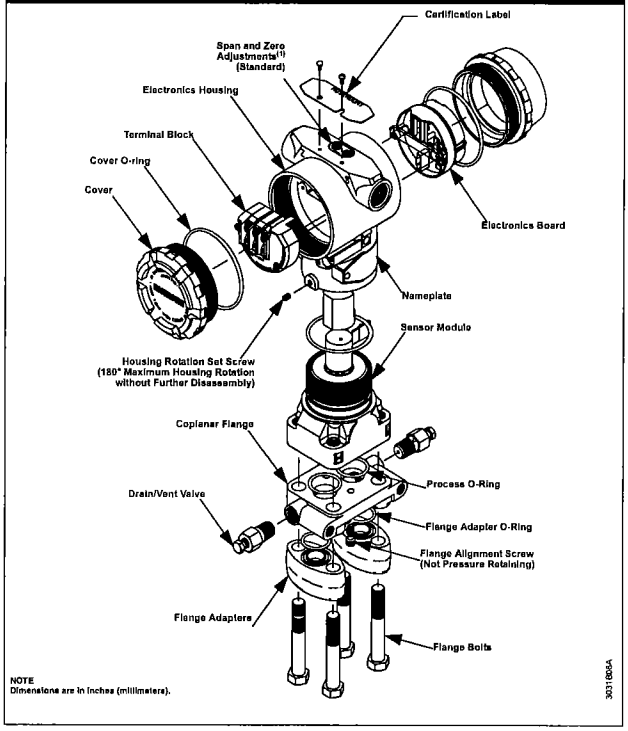
Paint
Polyurethane

Cover O-rings
Buna-N

Shipping Weights
Refer to "Shipping Weights" on page A-49

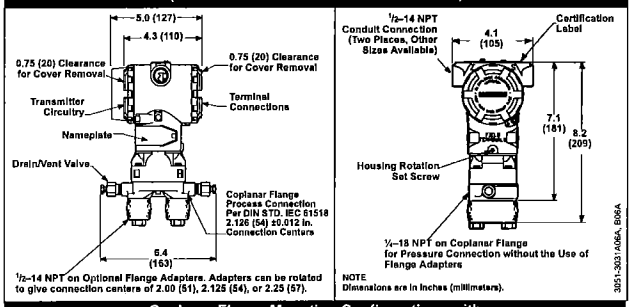
DIMENSIONAL DRAWINGS

Model 3051 Exploded View

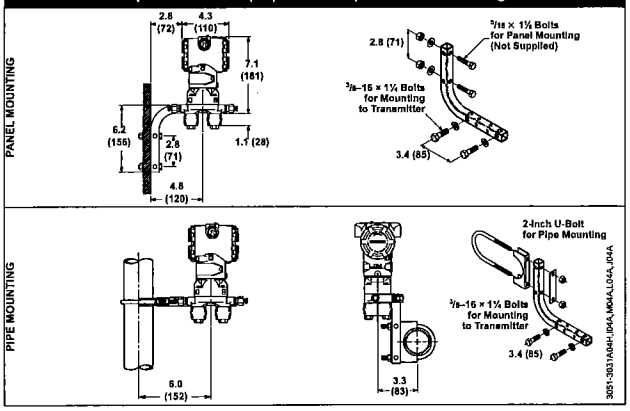


NOTE
Dimensions are in inches (millimeters).

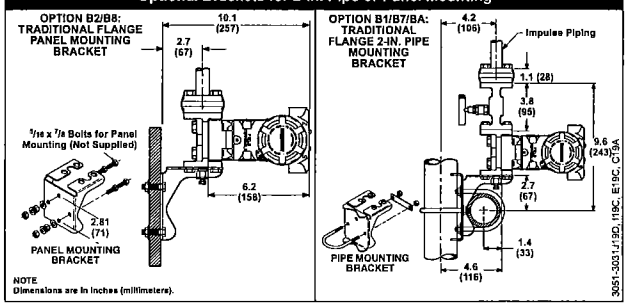
Model 3051C Coplanar Flange Dimensional Drawing (Differential Pressure Transmitter Shown)



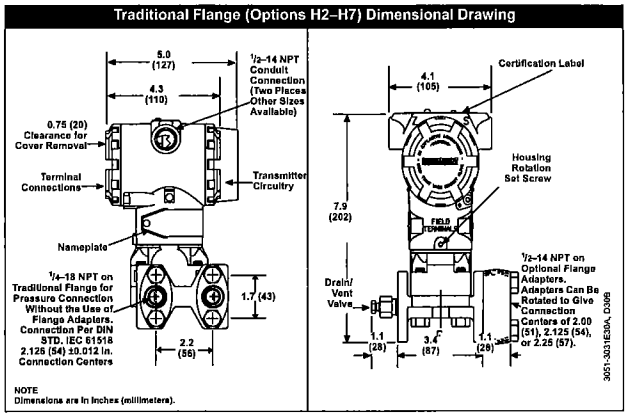
Coplanar Flange Mounting Configurations with Optional Bracket (B4) for 2-in. Pipe or Panel Mounting



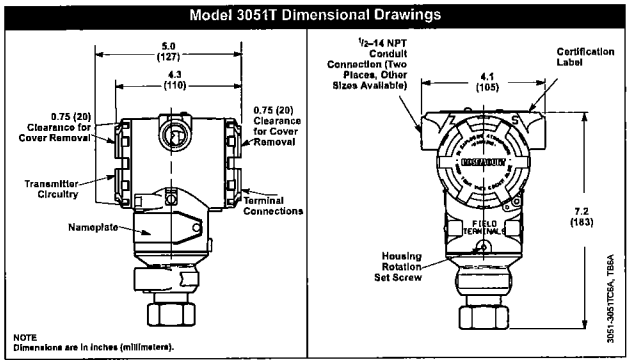
Traditional Flange Mounting Configurations with Optional Brackets for 2-in. Pipe or Panel Mounting



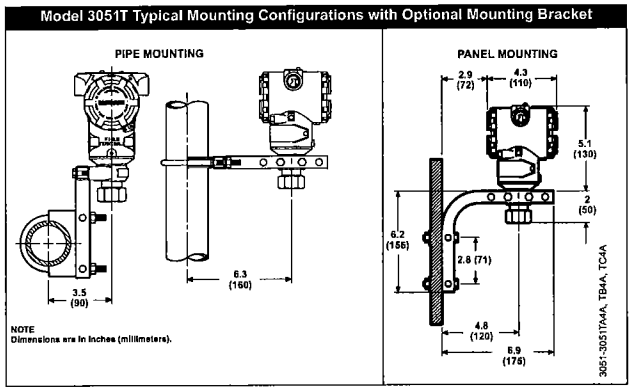
Traditional Flange (Options H2–H7) Dimensional Drawing



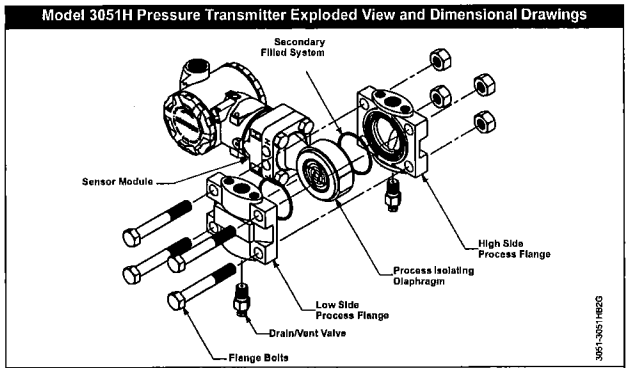
Model 3051T Dimensional Drawings

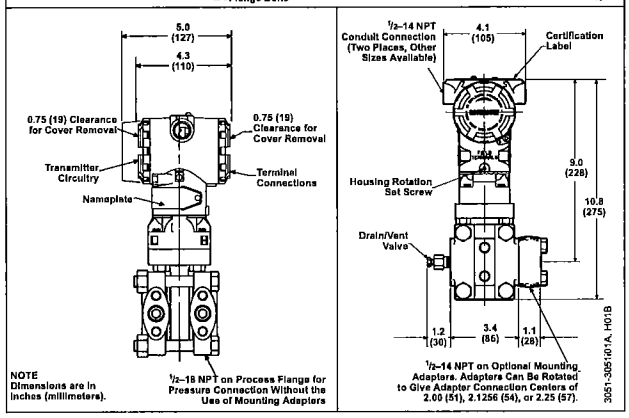


Model 3051T Typical Mounting Configurations with Optional Mounting Bracket

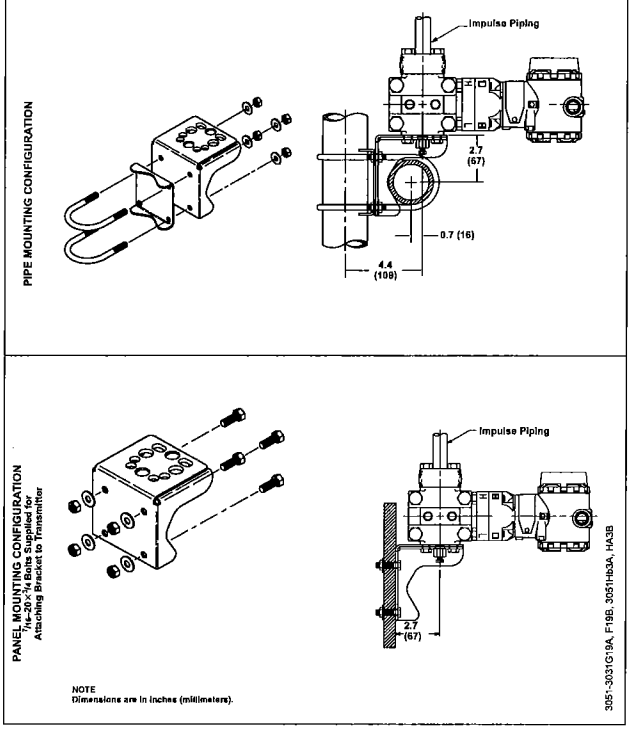


Model 3051H Pressure Transmitter Exploded View and Dimensional Drawings

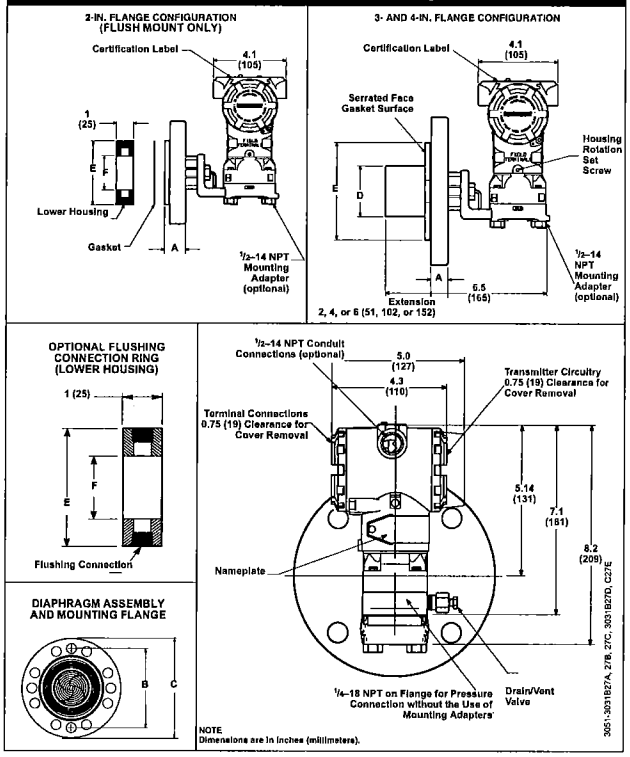




Model 3051H Mounting Brackets for 2-in. Pipe and Panel Mount (Option Code B5/B6)



Model 3051L Dimensional Drawings



Class	Pipe Size	Flange Thickness	Bolt Circle Diameter	Outside Diameter	No. of Bolts	Bolt Hole Diameter	Exten. Diam.[1] D	O.D. Gask. Surf. E	Proc. Side F
ASME B 16.5 (ANSI) 150	2 (51)	1.12 (28)	4.75 (121)	6.0 (152)	4	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.31 (33)	6.0 (152)	7.5 (191)	4	0.75 (19)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.31 (33)	7.5 (191)	9.0 (229)	8	0.75 (19)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 300	2 (51)	1.25 (32)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.50 (38)	6.62 (168)	8.25 (210)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
	4 (102)	1.62 (41)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.2 (158)	4.5 (114)
ASME B 16.5 (ANSI) 600	2 (51)	1.12 (28)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.6 (92)	2.12 (54)
	3 (76)	1.37 (35)	6.62 (168)	8.62 (168)	8	0.88 (22)	2.58 (66)	5.0 (127)	3.5 (89)
DIN PN 10–40	DN 50	26 mm	125 mm	165 mm	4	18 mm	NA	4.0 (102)	2.5 (63)
DIN PN 25/40	DN 80	30 mm	160 mm	200 mm	8	18 mm	65 mm	5.4 (138)	3.7 (94)
	DN 100	30 mm	190 mm	235 mm	8	22 mm	89 mm	6.2 (158)	4.5 (114)
DIN PN 10/16	DN 100	26 mm	180 mm	220 mm	8	18 mm	89 mm	6.2 (158)	4.5 (114)

(1) Tolerances are 0.040 (1,02), –0.020 (0,51)

ORDERING INFORMATION

Model	Transmitter Type (Select One)	CD	CG	CA
3051CD	Differential Pressure Transmitter	•	—	—
3051CG	Gage Pressure Transmitter	—	•	—
3051CA	Absolute Pressure Transmitter	—	—	•

	Model 3051CD	Model 3051CG	Model 3051CA	CD	CG	CA
0[1]	–3 to 3 inH_2O/0.1 inH_2O (–7,5 to 7,5 mbar/0,25 mbar)	Not Applicable	0 to 5 psia/0.167 psia (0 to 0,34 bar/11,5 mbar)	•	—	•
1	–25 to 25 inH_2O/0.5 inH_2O (–62,2 to 62,2 mbar/1,2 mbar)	–25 to 25 inH_2O/0.5 inH_2O (–62,2 to 62,2 mbar/1,2 mbar)	0 to 30 psia/0,3 psia (0 to 2,1 bar/20,7 mbar)	•	•	•
2	–250 to 250 inH_2O/2.5 inH_2O (–623 to 623 mbar/6,2 mbar)	–250 to 250 inH_2O/2.5 inH_2O (–623 to 623 mbar/6,2 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/0,1 bar)	•	•	•
3	–1000 to 1000 inH_2O/10 inH_2O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000inH_2O/10$in H_2O$ (–1,01 to 2,5 bar/25 mbar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)	•	•	•
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)	•	•	•
5	–2000 to 2000 psi/20 psi (–137,9 to 137,9 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 137,9 bar/1,4 bar)	Not Applicable	•	•	—

NOTE: 3051CG lower range limit varies with atmospheric pressure.

Code	Output	CD	CG	CA
A	4–20 mA with Digital Signal Based on *HART* Protocol	•	•	•
M	Low-Power, 1–5 V dc with Digital Signal Based on *HART* Protocol (See Option C2 for 0.8–3.2 V dc) *NOTE: Not available with hazardous locations certification Options Codes I1, N1, E4, K5 and K8.*	•	•	•

Code	Materials of Construction Process Flange Type	Flange Material	Drain/Vent	CD	CG	CA
2	*Coplanar*	SST	SST	•	•	•
3	*Coplanar*	*Hastelloy C*	*Hastelloy C*	•	•	•
4	*Coplanar*	*Monel*	*Monel*	•	•	•
5	*Coplanar*	Plated CS	SST	•	•	•
7	*Coplanar*	SST	*Hastelloy C*	•	•	•
8	*Coplanar*	Plated CS	*Hastelloy C*	•	•	•
0	Alternate Flange—See Options on page A-22			•	•	•

NOTE: Materials of Construction Codes 3, 7, and 8 meet NACE material recommendations per MR 01-75.

Code	Isolating Diaphragm	CD	CG	CA
2	316L SST	•	•	•
3	*Hastelloy C-276* (Meets NACE material recommendations per MR 01-75)	•	•	•
4	*Monel*	•	•	•
5	Tantalum (Available on Model 3051CD and CG, Ranges 2–5 only. Not available on Model 3051CA)	•	•	—
6	Gold-plated *Monel* (Use in combination with O-ring Option Code B.)	•	•	•
7	Gold-plated SST	•	•	•

Code	O-ring			
A	Glass-filled TFE	•	•	•
B	Graphite-filled TFE	•	•	•

Code	Fill Fluid	CD	CG	CA
1	Silicone	•	•	•
2	Inert fill (Halocarbon)	•	•	—

Continued on next page

Code	Housing Material	Conduit Entry Size	CD	CG	CA
A	Polyurethane-covered Aluminum	½–14 NPT	•	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•	•
D	Polyurethane-covered Aluminum	G½	•	•	•
J	SST	½–14 NPT	•	•	•
K	SST	M20 × 1.5 (CM20)	•	•	•
L	SST	PG 13.5	•	•	•
M	SST	G½	•	•	•

Code	Alternate Flange Options (Requires Materials of Construction Code 0)	CD	CG	CA
H2	Traditional Flange, 316 SST, SST Drain/Vent	•	•	•
H3	Traditional Flange, *Hastelloy C*, *Hastelloy C* Drain/Vent	•	•	•
H4	Traditional Flange, *Monel*, *Monel* Drain/Vent	•	•	•
H7	Traditional Flange, 316 SST, *Hastelloy C* Drain/Vent	•	•	•
HJ	DIN Compliant Traditional Flange, SST, 7/16 in. Adapter/Manifold Bolting	•	•	•
HK	DIN Compliant Traditional Flange, SST, 10 mm Adapter/Manifold Bolting	•	•	•
HL	DIN Compliant Traditional Flange, SST, 12mm Adapter/Manifold Bolting (not available on Model 3051CD0)	•	•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount	•	•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount	•	•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount	•	•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount	•	•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount	•	•	•
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount	•	•	•

NOTE: Option Codes H3 and H7 meet NACE material recommendations per MR 01-75.

Code	Integral Mount Manifold Options	CD	CG	CA
S5	Assemble to Model 305 Integral Manifold	•	•	•

Code	Integral Mount Primary Elements (Optional)	CD	CG	CA
S4	Factory Assembly to Rosemount Primary Element (*Annubar* or Model 1195 Integral Orifice)	•	—	—

NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.

Code	Diaphragm Seal Assemblies (Optional) *NOTE: Standard flange and adaptor bolts are austenitic 316 SST.*	CD	CG	CA
S1	One Diaphragm Seal (Direct Mount or Capillary Connection Type)	•	•	•
S2	Two Diaphragm Seals (Direct Mount or Capillary Connection Type)	•	—	—

Code	Optional All Welded Diaphragm Seal Systems (for high vacuum applications) *NOTE: Standard flange and adaptor bolts are austenitic 316 SST.*	CD	CG	CA
S7	One Diaphragm Seal, All-Welded System (Capillary Connection Type)	•	•	•
S8	Two Diaphragm Seals, All-Welded System (Capillary Connection Type)	•	—	—
S0	One Diaphragm Seal, All-Welded System (Direct Mount Connection Type)	•	•	•
S9	Two Diaphragm Seals, All-Welded System (One Direct Mount and One Capillary Connection Type)	•	—	—

Continued on next page

Code	Mounting Bracket Options	CD	CG	CA
B4	*Coplanar* Flange Bracket for 2-in. Pipe or Panel Mounting, all SST	•	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	•	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	•	•	•
B3	Traditional Flange Flat Bracket for 2-in. Pipe Mounting, CS Bolts	•	•	•
B7	B1 Bracket with Series 300 SST Bolts	•	•	•
B8	B2 Bracket with Series 300 SST Bolts	•	•	•
B9	B3 Bracket with Series 300 SST Bolts	•	•	•
BA	SST B1 Bracket with Series 300 SST Bolts	•	•	•
BC	SST B3 Bracket with Series 300 SST Bolts	•	•	•

Code	Product Certification Options	CD	CG	CA
	Hazardous Locations Certifications			
E5	FM Explosion-Proof Approval	•	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•	•
K5	FM Explosion-Proof and Intrinsic Safety Approval	•	•	•
I1	CENELEC Intrinsic Safety and Dust Certification *NOTE: Not available with low-power Option Code M.*	•	•	•
N1	CENELEC Type nL and Dust Certification *NOTE: Not available with low-power Option Code M.*	•	•	•
E8	CENELEC Flame-Proof and Dust Certification	•	•	•
E4	JIS Flame-Proof Certification *NOTE: Not available with low-power Option Code M.*	•	•	•
C5	Measurement Canada Accuracy Approval *NOTE: Limited availability depending on transmitter type and range. Contact your Rosemount representative.*	•	•	•
C6	Canadian Standards Association (CSA) Explosion-Proof and Intrinsic Safety Approval	•	•	•
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval *NOTE: Not available with low-power Option Code M.*	•	•	•
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	•	•	•
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	•	•	•
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals *NOTE: Not available with low-power Option Code M.*	•	•	•
I7	SAA Intrinsic Safety Certification	•	•	•
E7	SAA Flame-Proof Certification	•	•	•
N7	SAA Type N Certification	•	•	•

Code	Bolting Options	CD	CG	CA
L4	Austenitic 316 SST Bolts	•	•	•
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts	•	•	•
L6	*Monel* Bolts	•	•	•

Code	LCD Display (Optional)	CD	CG	CA
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•	•

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Code	Other Options			
Q4	Calibration Data Sheet	•	•	•
Q8	Material Traceability Certification per EN 10204 3.1.B *NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters (Model 3051C), and for the sensor module housing and low-volume Coplanar flange and adapter (Model 3051C with Option Code S1).*	•	•	•
QP	Calibration certification and tamper evident seal	•	•	•
QS	Quality Certification for safety	•	•	•
J1	Local Zero Adjustment Only *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•	•
J3	No Local Zero or Span Adjustment *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•	•
T1	Transient Protection Terminal Block *NOTE: Not available with hazardous locations certification Option Code I1, K5 or K8.*	•	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•	•
C2	0.8–3.2 V dc Output with Digital Signal Based on *HART* Protocol (Output Code M only)	•	•	•
C3	Gage Calibration (Model 3051CA4 only)	—	—	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•	•
P1	Hydrostatic Testing	•	•	•
P2	Cleaning for Special Service	•	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•	•
P4	Calibrate at line pressure *Note: Specify Q48 on order for corresponding certificate*	•	•	•
DF	½ -14 NPT flange adapter(s)— Material determined by flange material	•	•	•
D7	Coplanar Flange Without Drain/Vent Ports	•	•	•
D8	Ceramic Ball Drain/Vents	•	•	•
D9	JIS Process Connection—RC ¼ Flange with RC ¼ Flange Adapter	•	•	•
P9	4500 psig Static Pressure Limit (Model 3051CD Ranges 2–5 only)	•	—	—
V5[2]	External Ground Screw Assembly	•	•	•

Typical Model Number: 3051CD 2 A 2 2 A 1 A B4

(1) Model 3051CD0 is available only with Output Code A, Process Flange Code 0 (Alternate Flange H2, H7, HJ, or HK), Isolating Diaphragm Code 2, O-ring Code A, and Bolting Option L4.
(2) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type	
3051T	Pressure Transmitter	

Code	Pressure Type
G	Gage
A	Absolute

Code	PRESSURE RANGES (RANGE/MIN. SPAN) 3051TG	3051TA
1	–14.7 to 30 psi/0.3 psi (–1,01 to 2,1 bar/20,7 mbar)	0 to 30 psia/0.3 psia (0 to 2,1 bar/20,7 mbar)
2	–14.7 to 150 psi/1.5 psi (–1,01 to 10,3 bar/103,4 mbar)	0 to 150 psia/1.5 psia (0 to 10,3 bar/103,4 mbar)
3	–14.7 to 800 psi/8 psi (–1,01 to 55,2 bar/0,55 bar)	0 to 800 psia/8 psia (0 to 55,2 bar/0,55 bar)
4	–14.7 to 4000 psi/40 psi (–1,01 to 275,8 bar/2,8 bar)	0 to 4000 psia/40 psia (0 to 275,8 bar/2,8 bar)
5	–14.7 to 10000 psi/2000 psi (–1,01 to 689,5 bar/138 bar)	0 to 10000 psia/2000 psia (0 to 689,5 bar/138 bar)

NOTE: 3051TG lower range limit varies with atmospheric pressure.

Code	Output
A	4–20 mA with Digital Signal Based on *HART* Protocol
M	Low-Power 1–5 V dc with Digital Signal Based on *HART* Protocol (See Option Code C2 for 0.8–3.2 V dc Output) *NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K5 or K8.*

Code	Process Connection Style
2A	½–18 NPT Female
2B	½–14 NPT Female
2C	G½ A DIN 16288 Male (Available in SST for Range 1–4 only)
2F	Coned and Threaded, Compatible with Autoclave Type F-250-C
61	Non-threaded Instrument flange (Available in Range 1–4 only)

Code	Isolating Diaphragm	Process Connection Wetted Parts Material
2	316L SST	316L SST
3	*Hastelloy*	*Hastelloy*

NOTE: Meets NACE requirements per MR 01-75.

Code	Fill Fluid
1	Silicone
2	Inert

Code	Housing Material	Conduit Entry Size
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½

Code	Integral Mount Manifold (Optional)
S5	Assemble to Model 306 Integral Manifold (Requires ½ in. process connection code 2B)

Code	Remote Diaphragm Seals Assemblies (Optional)
S1	One remote diaphragm seal (Direct Mount or Capillary Connection Type)

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Code	Mounting Brackets (Optional)
B4	Bracket for 2-in. Pipe or Panel Mounting, All SST
Code	**Product Certifications (Optional)**
	Hazardous Locations Certifications
E5	FM Explosion-Proof Approval
I5	FM Non-incendive and Intrinsic Safety Approval
K5	FM Explosion-Proof and Intrinsic Safety Approval
C5	Measurement Canada accuracy approval *Note: Limited availability depending on transmitter type and range. Contact your Rosemount representative.*
C6	CSA Explosion-Proof and Intrinsic Safety Approval
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval *NOTE: Not available with low-power Option Code M.*
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals *NOTE: Not available with low-power Option Code M.*
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals
I7	SAA Intrinsic Safety Certification
E4	JIS Flame-Proof Certification *NOTE: Not available with low-power Option Code M.*
E7	SAA Flame-Proof Certification
N7	SAA Type n Certification
I1	CENELEC Intrinsic Safety and Dust Certification *NOTE: Not available with low-power Option Code M.*
N1	CENELEC Type nL and Dust Certification *NOTE: Not available with low-power Option Code M.*
E8	CENELEC Flame-Proof and Dust Certification
DW	NSF drinking water approval
Code	**Other Options**
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B *NOTE: This option applies to the process connection only.*
QP	Calibration certification and tamper evident seal
QS	Quality certification for safety
J1	Local Zero Adjustment Only *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*
J3	No Local Zero or Span Adjustment *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)
M6	LCD display for SST Housing (Housing Codes J, K, L and M only)
T1	Transient Protection Terminal Block *NOTE: Not available with hazardous locations certification Option Code I1, K6 or K8.*
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2	0.8–3.2 V dc Output with Digital Signal Based on *HART* Protocol (Output Code M only)
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Low Alarm Configuration *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*
P1	Hydrostatic Testing
P2	Cleaning for Special Service
P3	Cleaning for <1 PPM Chlorine/Fluorine
V5[1]	External Ground Screw Assembly

Typical Model Number: 3051T G 5 F 2A 2 1 A B4

(1) The V5 option is not needed with T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type
3051L	Flange-Mounted Liquid Level Transmitter
Code	**PRESSURE RANGES (RANGE/MIN. SPAN)**
2	–250 to 250 inH_2O/2.5 inH_2O (–0,6 to 0,6 bar/6,2 mbar)
3	–1000 to 1000 inH_2O/10 inH_2O (–2,5 to 2,5 bar/25 mbar)
4	–300 to 300 psi/3 psi (–20,7 to 20,7 bar/0,2 bar)
Code	**Output**
A	4–20 mA with Digital Signal Based on *HART* Protocol
M	Low-Power 1–5 V dc with Digital Signal Based on *HART* Protocol (See Option Code C2 for 0.8–3.2 V dc Output) *NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.*

	HIGH PRESSURE SIDE		
Code	**Diaphragm Size**	**Material**	**Extension Length**
G0	2 in./DN 50	316L SST	Flush Mount Only
H0	2 in./DN 50	*Hastelloy*	Flush Mount Only
J0	2 in./DN 50	Tantalum	Flush Mount Only
A0	3 in./DN 80	316L SST	Flush Mount
A2	3 in./DN 80	316L SST	2 in./50 mm
A4	3 in./DN 80	316L SST	4 in./100 mm
A6	3 in./DN 80	316L SST	6 in./150 mm
B0	4 in./DN 100	316L SST	Flush Mount
B2	4 in./DN 100	316L SST	2 in./50 mm
B4	4 in./DN 100	316L SST	4 in./100 mm
B6	4 in./DN 100	316L SST	6 in./150 mm
C0	3 in./DN 80	*Hastelloy*	Flush Mount
C2	3 in./DN 80	*Hastelloy*	2 in./50 mm
C4	3 in./DN 80	*Hastelloy*	4 in./100 mm
C6	3 in./DN 80	*Hastelloy*	6 in./150 mm
D0	4 in./DN 100	*Hastelloy*	Flush Mount
D2	4 in./DN 100	*Hastelloy*	2 in./50 mm
D4	4 in./DN 100	*Hastelloy*	4 in./100 mm
D6	4 in./DN 100	*Hastelloy*	6 in./150 mm
E0	3 in./DN 80	Tantalum	Flush Mount Only
F0	4 in./DN 100	Tantalum	Flush Mount Only

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	MOUNTING FLANGE		
Code	**Size**	**ASME B 16.5 (ANSI) or DIN Flange Rating**	**Material**
M	2 in.	Class 150	CS
A	3 in.	Class 150	CS
B	4 in.	Class 150	CS
N	2 in.	Class 300	CS
C	3 in.	Class 300	CS
D	4 in.	Class 300	CS
P	2 in.	Class 600	CS
E	3 in.	Class 600	CS
X	2 in.	Class 150	SST
F	3 in.	Class 150	SST
G	4 in.	Class 150	SST
Y	2 in.	Class 300	SST
H	3 in.	Class 300	SST
J	4 in.	Class 300	SST
Z	2 in.	Class 600	SST
L	3 in.	Class 600	SST
Q	DN 50	PN 10-40	CS
R	DN 80	PN 40	CS
S	DN 100	PN 40	CS
V	DN 100	PN 10/16	CS
K	DN 50	PN 10-40	SST
T	DN 80	PN 40	SST
U	DN 100	PN 40	SST
W	DN 100	PN 10/16	SST

Code	**Process Fill-High Pressure Side**	**Temperature Limits**
A	*Syltherm* XLT	–100 to 300 °F (–73 to 135 °C)
C	*D. C. Silicone 704*	60 to 400 °F (15 to 205 °C)
D	*D. C. Silicone 200*	-40 to 400 °F (–40 to 205 °C)
H	Inert (Halocarbon)	–50 to 350 °F (–45 to 177 °C)
G	Glycerine and Water	0 to 200 °F (–17 to 93 °C)
N	*Neobee M-20*	0 to 400 °F (–17 to 205 °C)
P	Propylene Glycol and Water	0 to 200 °F (–17 to 93 °C)

	LOW PRESSURE SIDE			
Code	**Configuration**	**Flange Adapter**	**Diaphragm Material**	**Sensor Fill Fluid**
11	Gage	SST	316L SST	Silicone
21	Differential	SST	316L SST	Silicone
22	Differential	SST	*Hastelloy C-276*	Silicone
2A	Differential	SST	316L SST	Inert (Halocarbon)
2B	Differential	SST	*Hastelloy C-276*	Inert (Halocarbon)
31	Remote Seal	SST	316L SST	Silicone (Requires Option Code S1)
Code	**O-ring Material**			
A	Glass-filled TFE			

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Code	**Housing Material**	**Conduit Entry Size**
A	Polyurethane-covered Aluminum	½–14 NPT
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)
C	Polyurethane-covered Aluminum	PG 13.5
D	Polyurethane-covered Aluminum	G½
J	SST	½–14 NPT
K	SST	M20 × 1.5 (CM20)
L	SST	PG 13.5
M	SST	G½
Code	**Diaphragm Seal Assemblies (Optional)**	
S1	One Diaphragm Seal (requires low pressure side Option Code 31 capillary connection type)	
Code	**Product Certification Options**	
	Hazardous Locations Certifications	
E5	FM Explosion-Proof Approval	
I5	FM Non-incendive and Intrinsic Safety Approval	
K5	FM Explosion-Proof and Intrinsic Safety Approval	
I1	CENELEC Intrinsic Safety and Dust Certification (*NOTE: Not available with low-power Option Code M.*)	
N1	CENELEC Type n and Dust Certification (*NOTE: Not available with low-power Option Code M.*)	
E8	CENELEC Flame-Proof and Dust Certification	
E4	JIS Flame-Proof Certification (*NOTE: Not available with low-power Option Code M.*)	
C6	CSA Explosion-Proof and Intrinsic Safety Approval	
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval *NOTE: Not available with low-power Option Code M.*	
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals *NOTE: Not available with low-power Option Code M.*	
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	
I7	SAA Intrinsic Safety Certification	
E7	SAA Flame-Proof Certification	
N7	SAA Type n Certification	
Code	**Bolt for Flange and Adapters (Optional)**	
L5	ASME B 16.5 (ANSI)/ASTM-A-193-B7M Bolts (Austenitic 316 SST bolts standard)	
Code	**LCD Display Options**	
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	

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Code	Other Options
Q4	Calibration Data Sheet
Q8	Material Traceability Certification per EN 10204 3.1.B *NOTE: This options is available with the diaphragm, upper housing, Coplanar flange, adapter, sensor module housing, lower housing/flushing connection, and extension.*
QP	Calibration certification and tamper evident seal
J1	Local Zero Adjustment Only *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*
J3	No Local Zero or Span Adjustment *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*
T1	Transient Protection Terminal Block *NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.*
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)
C2	0.8–3.2 V dc Output with Digital Signal Based on *HART* Protocol (Output Code M only)
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*
D8	Ceramic Ball Drain/Vents
V5[1]	External Ground Screw Assembly

Code	Lower Housing Flushing Connections: Ring Material	Number	Size	Diaphragm Size: 2 in.	3 in.	4 in.
F1	SST	1	¼	•	•	•
F2	SST	2	¼	•	•	•
F3	*Hastelloy*	1	¼	•	•	•
F4	*Hastelloy*	2	¼	•	•	•
F7	SST	1	½	•	•	•
F8	SST	2	½	•	•	•
F9	*Hastelloy*	1	½	•	•	•
F0	*Hastelloy*	2	½	•	•	•

NOTE: Flushing Codes F3 and F4 are not available with Option Codes A0, B0, and G0.

Typical Model Number:

(1) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type (Select One)	HD	HG
3051HD	Differential Pressure Transmitter for High-Temperature Processes	•	—
3051HG	Gage Pressure Transmitter for High-Temperature Processes	—	•

Code	3051HD	3051HG
2	–250 to 250 inH_2O/2.5 inH_2O (–0,62 to 0,62 bar/6,2 mbar)	–250 to 250 inH_2O/2.5 inH_2O (–0,62 to 0,62 bar/6,2 mbar)
3	–1000 to 1000 inH_2O/10 inH_2O (–2,5 to 2,5 bar/25 mbar)	–407 to 1000 inH_2O/10in H_2O (–1,01 to 2,5 bar/25 mbar)
4	–300 to 300 inH_2O/3 psi (–747 to 747 mbar/0,2 bar)	–14.7 to 300 psi/3 psi (–1,01 to 20,7 bar/0,2 bar)
5	–2000 to 2000 psi/20 psi (–138 to 138 bar/1,4 bar)	–14.7 to 2000 psig/20 psi (–1,01 to 138 bar/1,4 bar)

NOTE: 3051HG lower range limit varies with atmospheric pressure.

Code	Output	HD	HG
A	4–20 mA with Digital Signal Based on *HART* Protocol	•	•
M	Low-Power 1–5 V dc with Digital Signal Based on *HART* Protocol (See Option Code C2 for 0.8–3.2 V dc Output) *NOTE: Not available with hazardous certification Option Codes I1, N1, E4, K6, and K8.*	•	•

Code	PROCESS CONNECTION Process Flange Material	Drain/Vent	HD	HG
2	SST	SST	•	•
7	SST	*Hastelloy*	•	•

NOTE: Process Connection Code 7 meets NACE material recommendations per MR 01-75.

Code	Process Isolating Diaphragm	HD	HG
2	316L SST	•	•
3	*Hastelloy C-276* (Meets NACE material recommendations per MR 01-75)	•	•
5	Tantalum	•	•

Code	O-ring Material	HD	HG
A	Glass-Filled TFE	•	•

Code	Process Fill Fluid	HD	HG
D	*D.C. 200* Silicone	•	•
H	Inert	•	•
N	*Neobee M-20*	•	•

Code	Sensor Module Isolator Material	HD	HG
2	SST	•	•

Code	Sensor Module Fill Fluid	HD	HG
1	Silicone	•	•
2	Inert (Halocarbon)	•	•

Code	Housing Material	Conduit Entry Size	HD	HG
A	Polyurethane-covered Aluminum	½–14 NPT	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•
D	Polyurethane-covered Aluminum	G½	•	•
J	SST	½–14 NPT	•	•
K	SST	M20 × 1.5 (CM20)	•	•
L	SST	PG 13.5	•	•
M	SST	G½	•	•

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Code	Integral Mount Primary Elements (Optional)	HD	HG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annuber/Model 1195 Integral Orifice) *NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 1–4 transmitters only.*	•	—

Code	Mounting Bracket Options	HD	HG
B5	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, CS Bolts	•	•
B6	Universal Mounting Bracket for 2-in. Pipe or Panel Mount, SST Bolts	•	•

Code	Product Certification Options	HD	HG
	Hazardous Locations Certifications		
E5	FM Explosion-Proof Approval	•	•
I5	FM Non-incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion-Proof and Intrinsic Safety Approval	•	•
I1	CENELEC Intrinsic Safety and Dust Certification (*NOTE: Not available with low-power Option Code M.*)	•	•
N1	CENELEC Type n and Dust Certification (*NOTE: Not available with low-power Option Code M.*)	•	•
E8	CENELEC Flame-Proof and Dust Certification	•	•
E4	JIS Flame-Proof Certificaiton (*NOTE: Not available with low-power Option Code M.*)	•	•
C6	CSA Explosion-Proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval (*NOTE: Not available with low-power Option Code M.*)	•	•
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals (*NOTE: Not available with low-power Option Code M.*)	•	•
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flame-Proof Certification	•	•
N7	SAA Type n Certification	•	•

Code	Bolt for Flange and Adapter Options	HD	HG
L4	Austenitic 316 SST Bolts	•	•

Code	LCD Display Options	HD	HG
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•

Code	Other Options	HD	HG
Q4	Calibration Data Sheet	•	•
Q8	Material traceability certification per EN 10204 3.1.B	•	•
QP	Calibration certification and tamper evident seal	•	•
J1	Local Zero Adjustment Only *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•
J3	No Local Zero or Span Adjustment *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•
T1	Transient Protection Terminal Block *NOTE: Not available with hazardous locations certification Option Code I1, K6, or K8.*	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C2	0.8–3.2 V dc Output with Digital Signal Based on *HART* Protocol (Output Code M only)	•	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
DF	½–14 NPT flange adapters—SST	•	•
D8	Ceramic Ball Drain/Vents	•	•
V5[1]	External Ground Screw Assembly	•	•

Typical Model Number: 3051HG 2 A 2 2 A H 2 1 A B5

(1) The V5 option is not needed with the T1 option; external ground screw assembly is included with the T1 option.

Model	Transmitter Type (Select One)	PD	PG
3051PD	Model 3051P *Reference Class* Differential Pressure Transmitter	•	—
3051PG	Model 3051 P *Reference Class* Gage Pressure Transmitter		

Code	Pressure Ranges (Rangjo/Min. Span) Model 3051 PD	Model 3051 PG	PD	PG
2	–250 to 250 inH_2O/25 inH_2O (–0,62 to 0,62 bar/62,3 mbar)	–250 to 250 inH_2O/25 inH_2O (–0,62 to 0,62 bar/6,2 mbar)	•	•
3	–1000 to 1000 inH_2O/100 inH_2O (–2,5 to 2,5 bar/25 mbar)	–407 to 100 inH_2O/100 in H_2O (–1,01 to 2,5 bar/250 mbar)	•	•
4	Not Applicable	–14.7 to 30 psi/30 psi (–1,01 to 20,7 bar/207 mbar)	—	•
5	Not Applicable	–14.7 to 200 psig/200 psi (–1,01 to 138 bar/1,4 bar)	—	•

NOTE: 3051PG lower range limit varies with atmospheric pressure.

Code	Output	PD	PG
A	4–20 mA with Digital Signal Based on *HART* Protocol	•	•

Code	MATERIALS OF CONSTRUCTION Process Flange Type	Flange Material	Drain/Vent	PD	PG
2	*Coplanar*	SST	SST	•	•
0[1]	Alternate Flange—See Alternate Flange Options page A-33.			•	•

Code	Isolating Diaphragm	PD	PG
2	316L SST	•	•

Code	O-ring Material	PD	PG
A	Glass-Filled TFE	•	•

Code	Fill Fluid	PD	PG
1	Silicone	•	•
2	Inert (Halocarbon)	•	•

Code	Housing Material	Conduit Entry Size	PD	PG
A	Polyurethane-covered Aluminum	½–14 NPT	•	•
B	Polyurethane-covered Aluminum	M20 × 1.5 (CM20)	•	•
C	Polyurethane-covered Aluminum	PG 13.5	•	•
D	Polyurethane-covered Aluminum	G½	•	•
J	SST	½–14 NPT	•	•
K	SST	M20 × 1.5 (CM20)	•	•
L	SST	PG 13.5	•	•
M	SST	G½	•	•

Code	Alternate Flange Options (Requires Materials of Construction Code 0)	PD	PG
H2	Traditional Flange, 316 SST Drain/Vent, SST Flange Adapter	•	•
FA	Level Flange, SST, 2 in., ANSI Class 150, Vertical Mount	•	•
FB	Level Flange, SST, 2 in., ANSI Class 300, Vertical Mount	•	•
FC	Level Flange, SST, 3 in., ANSI Class 150, Vertical Mount	•	•
FD	Level Flange, SST, 3 in., ANSI Class 300, Vertical Mount	•	•
FP	DIN Level Flange, SST, DN 50, PN 40, Vertical Mount		
FQ	DIN Level Flange, SST, DN 80, PN 40, Vertical Mount		

Code	Integral Mount Manifold Options	PD	PG
S5	Assemble to Model 305 Integral Manifold	•	•

Code	Integral Mount Primary Elements (Optional)	PD	PG
S4	Factory Assembly to Rosemount Primary Element (Diamond II+Annubar/Model 1195 Integral Orifice) *NOTE: With the primary element installed, the maximum operating pressure will equal the lesser of either the transmitter or the primary element. Option is available for factory assembly to range 2–3 transmitters only.*	•	—

Continued on next page

Code	Mounting Bracket Options	PD	PG
B4	Coplanar Flange Bracket for 2-in. Pipe or Panel Mounting, All SST	•	•
B1	Traditional Flange Bracket for 2-in. Pipe Mounting, CS Bolts	•	•
B2	Traditional Flange Bracket for Panel Mounting, CS Bolts	•	•
B7	B1 Bracket with Series 300 SST Bolts	•	•
B8	B2 Bracket with Series 300 SST Bolts	•	•
BA	SST B1 Bracket with Series 300 SST Bolts	•	•
BC	SST B3 Bracket with Series 300 SST Bolts	•	•
Code	**Product Certification Options**		
	Hazardous Locations Certifications		
E5	FM Explosion-Proof Approval	•	•
I5	FM Non-Incendive and Intrinsic Safety Approval	•	•
K5	FM Explosion-Proof and Intrinsic Safety Approval	•	•
I1	CENELEC Intrinsic Safety and Dust Certification	•	•
N1	CENELEC Type n and Dust Certification	•	•
E8	CENELEC Flame-Proof and Dust Certification	•	•
E4	JIS Flame-Proof Certification	•	•
C6	Canadian Standards Association (CSA) Explosion-Proof and Intrinsic Safety Approval	•	•
K6	Combination of CSA and CENELEC Explosion-Proof and Intrinsic Safety Approval	•	•
K7	Combination of SAA Flame-Proof and Intrinsic Safety Approvals	•	•
K8	Combination of CENELEC Flame-Proof and Intrinsic Safety Approvals	•	•
KB	Combination of FM and CSA Explosion-Proof and Intrinsic Safety Approvals	•	•
I7	SAA Intrinsic Safety Certification	•	•
E7	SAA Flame-Proof Certification	•	•
N7	SAA Type n Certification	•	•
Code	**Other Options**		
Q4	Calibration Data Sheet	•	
Q8	Material Traceability Certification per EN 10204 3.1.B *NOTE: This option is available for the sensor module housing and Coplanar or traditional flanges and adapters.*	•	•
QP	Calibration Certification and Tamper Evident Seal	•	•
L4	Austenitic 316 SST Bolts	•	•
L5	ANSI/ASTM-A-193-B7M Bolts	•	•
L6	*Monel* Bolts	•	•
M5	LCD display for Aluminum Housing (Housing Codes A, B, C, and D only)	•	•
M6	LCD display for SST Housing (Housing Codes J, K, L, and M only)	•	•
J1	Local Zero Adjustment Only *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•
J3	No Local Zero or Span Adjustment *NOTE: Local zero and span adjustments are standard unless Option Code J1 or J3 is specified.*	•	•
T1	Transient Protection Terminal Block *NOTE: Not available with hazardous locations certification Option Code I1.*	•	•
C1	Custom Software Configuration (Completed CDS 00806-0100-4001 required with order)	•	•
C4	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996 *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•
CN	Analog Output Levels Compliant with NAMUR Recommendation NE43, 27-June-1996: Alarm Configuration–Low *NOTE: NAMUR-Compliant operation is pre-set at the factory and cannot be changed to standard operation in the field.*	•	•
P1	Hydrostatic Testing	•	•
P2	Cleaning for Special Service	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•
P4	Calibrate at line pressure *NOTE: Specify Q4B on order for corresponding certificate.*	•	•
DF	½–14 NPT flange adapters—SST	•	•
D7	*Coplanar* Flange Without Drain/Vent Ports	•	•
V5[2]	External Ground Screw Assembly	•	•

Typical Model Number: 3051PD 3 A 2 2 A 1 A B4

(1) NOTE: May impact temperature performance under certain conditions.
(2) The V5 option is not needed with the T1 option, external ground screw assembly is included with the T1 option.

PARTS LIST Item numbers are references to figure callouts (pages 13–19).

Model 3051C Sensor Modules (Min. Span/Range)	Silicone Fill Part Number	Inert Fill Part Number
Note: One spare part is recommended for every 50 transmitters.		
Note: Listed by Range and Process Isolator Order Numbers.		
–3 to 3/0.1 inH2O, Range 0 (includes Traditional SST flange and SST bolts).		
316L SST	03031-1045-0002	03031-1145-0002
–25 to 25 inH$_2$O/0.5 inH$_2$O, Range 1		
316L SST	03031-1045-0012	03031-1145-0012
Hastelloy C-276	03031-1045-0013	03031-1145-0013
Monel	03031-1045-0014	03031-1145-0014
Gold-plated *Monel*	03031-1045-0016	03031-1145-0016
Gold-plated 316 SST	03031-1045-0017	03031-1145-0017
–250 to 250 inH$_2$O/2.5 inH$_2$O, Range 2		
316L SST	03031-1045-0022	03031-1145-0022
Hastelloy C-276	03031-1045-0023	03031-1145-0023
Monel	03031-1045-0024	03031-1145-0024
Tantalum	03031-1045-0025	03031-1145-0025
Gold-plated *Monel*	03031-1045-0026	03031-1145-0026
Gold-plated 316 SST	03031-1045-0027	03031-1145-0027
–1000 to 1000 inH$_2$O/10 inH$_2$O, Range 3		
316L SST	03031-1045-0032	03031-1145-0032
Hastelloy C-276	03031-1045-0033	03031-1145-0033
Monel	03031-1045-0034	03031-1145-0034
Tantalum	03031-1045-0035	03031-1145-0035
Gold-plated *Monel*	03031-1045-0036	03031-1145-0036
Gold-plated 316 SST	03031-1045-0037	03031-1145-0037
–300 to 300 psi/3 psi, Range 4		
316L SST	03031-1045-2042	03031-1145-2042
Hastelloy C-276	03031-1045-2043	03031-1145-2043
Monel	03031-1045-2044	03031-1145-2044
Tantalum	03031-1045-2045	03031-1145-2045
Gold-plated *Monel*	03031-1045-2046	03031-1145-2046
Gold-plated 316 SST	03031-1045-2047	03031-1145-2047
–2000 to 2000/20 psi, Range 5		
316L SST	03031-1045-2052	03031-1145-2052
Hastelloy C-276	03031-1045-2053	03031-1145-2053
Monel	03031-1045-2054	03031-1145-2054
Tantalum	03031-1045-2055	03031-1145-2055
Gold-plated *Monel*	03031-1045-2056	03031-1145-2056
Gold-plated 316 SST	03031-1045-2057	03031-1145-2057

Model 3051C Gage Modules (Min. Span/Range)	Silicone Fill Part Number	Inert Fill Part Number
Note: One spare part is recommended for every 50 transmitters.		
Note: Listed by Range and Process Isolator Order Numbers.		
–250 to 250 inH$_2$O/2.5 inH$_2$O, Range 2		
316L SST	03031-1045-0022	03031-1145-0022
Hastelloy C-276	03031-1045-0023	03031-1145-0023
Monel	03031-1045-0024	03031-1145-0024
Tantalum	03031-1045-0025	03031-1145-0025
Gold-plated *Monel*	03031-1045-0026	03031-1145-0026
Gold-plated 316 SST	03031-1045-0027	03031-1145-0027
–335 to 1000 inH$_2$O/10 inH$_2$O, Range 3		
316L SST	03031-1045-0032	03031-1145-0032
Hastelloy C-276	03031-1045-0033	03031-1145-0033
Monel	03031-1045-0034	03031-1145-0034
Tantalum	03031-1045-0035	03031-1145-0035
Gold-plated *Monel*	03031-1045-0036	03031-1145-0036
Gold-plated 316 SST	03031-1045-0037	03031-1145-0037
–12 to 300 psi/3 psi, Range 4		
316L SST	03031-1045-1042	03031-1145-1042
Hastelloy C-276	03031-1045-1043	03031-1145-1043
Monel	03031-1045-1044	03031-1145-1044
Tantalum	03031-1045-1045	03031-1145-1045
Gold-plated *Monel*	03031-1045-1046	03031-1145-1046
Gold-plated 316 SST	03031-1045-1047	03031-1145-1047
–12 to 2000 psi/20 psi, Range 5		
316L SST	03031-1045-1052	03031-1145-1052
Hastelloy C-276	03031-1045-1053	03031-1145-1053
Monel	03031-1045-1054	03031-1145-1054
Tantalum	03031-1045-1055	03031-1145-1055
Gold-plated *Monel*	03031-1045-1056	03031-1145-1056
Gold-plated 316 SST	03031-1045-1057	03031-1145-1057

Model 3051C Absolute Sensor Modules (Min. Span/Range)	Silicone Fill Part Number	Inert Fill Part Number
Note: One spare part is recommended for every 50 transmitters.		
Note: Listed by Range and Process Isolator Order Numbers.		
0 to 0.167 psia/5 psia, Range 0 (includes Traditional SST flange and SST bolts).		
316L SST	03031-2020-0002	—
Hastelloy C-276	03031-2020-0003	—
Monel	03031-2020-0004	—
Gold-plated *Monel*	03031-2020-0006	—
Gold-plated 316 SST	03031-2020-0007	—
0 to 30 psia/0.3 psia, Range 1		
316L SST	03031-2020-0012	—
Hastelloy C-276	03031-2020-0013	—
Monel	03031-2020-0014	—
Gold-plated *Monel*	03031-2020-0016	—
Gold-plated 316 SST	03031-2020-0017	—
0 to 150/1.5 psia, Range 2		
316L SST	03031-2020-0022	—
Hastelloy C-276	03031-2020-0023	—
Monel	03031-2020-0024	—
Gold-plated *Monel*	03031-2020-0026	—
Gold-plated 316 SST	03031-2020-0027	—
0 to 800 psia/8 psia, Range 3		
316L SST	03031-2020-0032	—
Hastelloy C-276	03031-2020-0033	—
Monel	03031-2020-0034	—
Gold-plated *Monel*	03031-2020-0036	—
Gold-plated 316 SST	03031-2020-0037	—

Model 3051T Sensor Modules[1]	Isolating Diaphragm	Housing Material	Silicone Fill Part Number	Inert Fill Part Number
Gage Sensor Module[2]				
0–0.3/30 psig, Range 1				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3112	03031-3112-1112
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3113	03031-3112-1113
½–14 NPT Female	316L SST	Aluminum	03031-3102-3112	03031-3102-1112
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3113	03031-3102-1113
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3112	03031-3132-1112
¼–18 NPT Female	316L SST	SST	03031-3111-3112	03031-3111-1112
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3113	03031-3111-1113
½–14 NPT Female	316L SST	SST	03031-3101-3112	03031-3101-1112
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3113	03031-3101-1113

Model 3051T Sensor Modules[1]	Isolating Diaphragm	Housing Material	Silicone Fill Part Number	Inert Fill Part Number
Gage Sensor Module(2) 0–1.5/150 psig, Range 2				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3122	03031-3112-1122
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3123	03031-3112-1123
½–14 NPT Female	316L SST	Aluminum	03031-3102-3122	03031-3102-1122
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3123	03031-3102-1123
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3122	03031-3132-1122
¼–18 NPT Female	316L SST	SST	03031-3111-3122	03031-3111-1122
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3123	03031-3111-1123
½–14 NPT Female	316L SST	SST	03031-3101-3122	03031-3101-1122
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3123	03031-3101-1123
Gage Sensor Module(2) 0–8/800 psig, Range 3				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3132	03031-3112-1132
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3133	03031-3112-1133
½–14 NPT Female	316L SST	Aluminum	03031-3102-3132	03031-3102-1132
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3133	03031-3102-1133
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3132	03031-3132-1132
¼–18 NPT Female	316L SST	SST	03031-3111-3132	03031-3111-1132
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3133	03031-3111-1133
½–14 NPT Female	316L SST	SST	03031-3101-3132	03031-3101-1132
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3133	03031-3101-1133
Gage Sensor Module(2) 0-40/4000 psig, Range 4				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3142	03031-3112-1142
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3143	03031-3112-1143
½–14 NPT Female	316L SST	Aluminum	03031-3102-3142	03031-3102-1142
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3143	03031-3102-1143
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3142	03031-3132-1142
¼–18 NPT Female	316L SST	SST	03031-3111-3142	03031-3111-1142
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3143	03031-3111-1143
½–14 NPT Female	316L SST	SST	03031-3101-3142	03031-3101-1142
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3143	03031-3101-1143
Absolute Sensor Module(2) 0–0.3/30 psig, Range 1				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3012	03031-3112-1012
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3013	03031-3112-1013
½–14 NPT Female	316L SST	Aluminum	03031-3102-3012	03031-3102-1012
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3013	03031-3102-1013
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3012	03031-3132-1012
¼–18 NPT Female	316L SST	SST	03031-3111-3012	03031-3111-1012
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3013	03031-3111-1013
½–14 NPT Female	316L SST	SST	03031-3101-3012	03031-3101-1012
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3013	03031-3101-1013

Model 3051T Sensor Modules[1]	Isolating Diaphragm	Housing Material	Silicone Fill Part Number	Inert Fill Part Number
Absolute Sensor Module(2) 0–1.5/150 psig, Range 2				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3022	03031-3112-1022
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3023	03031-3112-1023
½–14 NPT Female	316L SST	Aluminum	03031-3102-3022	03031-3102-1022
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3023	03031-3102-1023
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3022	03031-3132-1022
¼–18 NPT Female	316L SST	SST	03031-3111-3022	03031-3111-1022
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3023	03031-3111-1023
½–14 NPT Female	316L SST	SST	03031-3101-3022	03031-3101-1022
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3023	03031-3101-1023
Absolute Sensor Module(2) 0–8/800 psig, Range 3				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3032	03031-3112-1032
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3033	03031-3112-1033
½–14 NPT Female	316L SST	Aluminum	03031-3102-3032	03031-3102-1032
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3033	03031-3102-1033
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3032	03031-3132-1032
¼–18 NPT Female	316L SST	SST	03031-3111-3032	03031-3111-1032
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3033	03031-3111-1033
½–14 NPT Female	316L SST	SST	03031-3101-3032	03031-3101-1032
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3033	03031-3101-1033
Absolute Sensor Module(2) 0-40/4000 psig, Range 4				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3042	03031-3112-1042
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3043	03031-3112-1043
½–14 NPT Female	316L SST	Aluminum	03031-3102-3042	03031-3102-1042
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3043	03031-3102-1043
G½A DIN 16288 Male	316L SST	Aluminum	03031-3132-3042	03031-3132-1042
¼–18 NPT Female	316L SST	SST	03031-3111-3042	03031-3111-1042
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3043	03031-3111-1043
½–14 NPT Female	316L SST	SST	03031-3101-3042	03031-3101-1042
½–14 NPT Female	*Hastelloy C*	SST	03031-3101-3043	03031-3101-1043
Absolute Sensor Module(2) 0-2000/10000 psig, Range 5				
¼–18 NPT Female	316L SST	Aluminum	03031-3112-3052	03031-3112-1052
¼–18 NPT Female	*Hastelloy C*	Aluminum	03031-3112-3053	03031-3112-1053
½–14 NPT Female	316L SST	Aluminum	03031-3102-3052	03031-3102-1052
½–14 NPT Female	*Hastelloy C*	Aluminum	03031-3102-3053	03031-3102-1053
G½A DIN 16288 Male	316L SST	Aluminum	03031-3122-3052	03031-3122-1052
¼–18 NPT Female	316L SST	SST	03031-3111-3052	03031-3111-1052
¼–18 NPT Female	*Hastelloy C*	SST	03031-3111-3053	03031-3111-1053
½–14 NPT Female	316L SST	SST	03031-3101-3052	03031-3101-1052
½–14 NPT Female	*Hastelloy C*	SST	03031-3121-3053	03031-3121-1053

(1) For Model 3051TG Range 5 spare module, order absolute configuration and perform zero trim for gage calibrations.
(2) One spare part is recommended for every 50 transmitters.

PART DESCRIPTION	PART NUMBER	CD	CG	CA	L	H	T
Electronics Board—Assembly Required							
Improved Standard (4–20 mA/HART protocol)[1]	03031-0001-0002	•	•	•	•	•	•
Improved NAMUR Compliant (4–20 mA/HART protocol)[1]	03031-0001-0003	•	•	•	•	•	•
Low Power (1–5/0.8–3.2 Volts)[1]	03031-0001-1001	•	•	•	•	•	•
Electronics Housing, Covers, Terminal Block		**CD**	**CG**	**CA**	**L**	**H**	**T**
NOTE: See drawings below for Previous and Improved Electronics Boards, Housings, and Terminal Blocks. For information on ordering "Previous Design" spare parts, contact your local Rosemount office. In the U.S., call the Response Center at 1-800-654-7768.							
***Improved* Standard (4–20 mA) Aluminum Housing**							
Electronics Housing without terminal block							
½–14 NPT conduit, includes RFI Filters	03031-0635-0001	•	•	•	•	•	•
M20×1.5 (CM20) conduit, includes RFI filters	03031-0635-0002	•	•	•	•	•	•
PG 13.5 conduit, includes RFI Filters	03031-0635-0003	•	•	•	•	•	•
G½ conduit, includes RFI Fillers	03031-0635-0004	•	•	•	•	•	•
Electronics Cover (includes wiring label)[2]	03031-0292-0001	•	•	•	•	•	•
Standard Terminal Block Assembly[1]	03031-0332-0003	•	•	•	•	•	•
Transient Terminal Block Assy. (Option T1)[2]	03031-0332-0004	•	•	•	•	•	•
Local Zero and Span Kit[1]	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5)[1]	03031-0398-0001	•	•	•	•	•	•
***Improved* Standard (4–20 mA) 316 SST Housing**							
Electronics Housing without Terminal Block							
½–14 NPT conduit, includes RFI Filters	03031-0635-0041	•	•	•	•	•	•
M20×1.5 (CM20) conduit, includes RFI Filters	03031-0635-0042	•	•	•	•	•	•
PG 13.5 conduit, includes RFI Filters	03031-0635-0043	•	•	•	•	•	•
Electronics Cover (includes wiring label)[2]	03031-0292-0002	•	•	•	•	•	•
Standard Terminal Block Assembly[1]	03031-0332-0003	•	•	•	•	•	•
Transient Terminal Block Assy. (Option T1)[2]	03031-0332-0004	•	•	•	•	•	•
Local Zero and Span Kit[1]	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5)[1]	03031-0398-0001	•	•	•	•	•	•
***Improved* Low Power Aluminum Housing**							
Electronics Housing without Terminal Block							
½–14 NPT conduit, includes RFI Filters	03031-0635-0101	•	•	•	•	•	•
Electronics Cover (includes wiring label)[2]	03031-0292-0001	•	•	•	•	•	•
Low Power Terminal Block Assembly[1]	03031-0332-1001	•	•	•	•	•	•
Low Power Transient Terminal Block Assembly (Option T1)[2]	03031-0332-1002	•	•	•	•	•	•
Local Zero and Span Kit[1]	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5)[1]	03031-0398-0001	•	•	•	•	•	•
***Improved* Low Power 316 SST Housing**							
Electronics Housing without Terminal Block							
½–14 NPT conduit, includes RFI Filters	03031-0635-0141	•	•	•	•	•	•
Electronics Cover (includes wiring label)[2]	03031-0292-0002	•	•	•	•	•	•
Low Power Terminal Block Assembly[1]	03031-0332-1001	•	•	•	•	•	•
Low Power Transient Terminal Block Assembly (Option T1)[2]	03031-0332-1002	•	•	•	•	•	•
Local Zero and Span Kit[1]	03031-0293-0002	•	•	•	•	•	•
External Ground Assembly (Option V5)[1]	03031-0398-0001	•	•	•	•	•	•

Flanges		CD	CG	CA	L	H	T
PROCESS FLANGES							
Differential *Coplanar* Flange							
Nickel-plated Carbon Steel	03031-0388-0025	•	—	—	—	—	—
316 SST	03031-0388-0022	•	—	—	—	—	—
Hastelloy C	03031-0388-0023	•	—	—	—	—	—
Monel	03031-0388-0024	•	—	—	—	—	—
Gage/Absolute *Coplanar* Flange							
Nickel-plated Carbon Steel	03031-0388-1025	—	•	•	—	—	—
316 SST	03031-0388-1022	—	•	•	—	—	—
Hastelloy C	03031-0388-1023	—	•	•	—	—	—
Monel	03031-0388-1024	—	•	•	—	—	—
Coplanar Flange Alignment Screw *(package of 2 screws)*	03031-0309-0001	•	•	•	—	—	—
Traditional Flange							
316 SST	03031-0320-0002	•	•	•	—	—	—
Hastelloy C	03031-0320-0003	•	•	•	—	—	—
Monel	03031-0320-0004	•	•	•	—	—	—
Level Flange, Vertical Mount							
2 in., Class 150, SST	03031-0393-0221	•	•	•	—	—	—
2 in., Class 300, SST	03031-0393-0222	•	•	•	—	—	—
3 in., Class 150, SST	03031-0393-0231	•	•	•	—	—	—
3 in., Class 300, SST	03031-0393-0232	•	•	•	—	—	—
DIN, DN 50, PN 40	03031-0393-1002	•	•	•	—	—	—
DIN, DN 80, PN 40	03031-0393-1012	•	•	•	—	—	—
Model 3051H Flanges							
Process Flange	02051-0072-0002	—	—	—	—	•	—
Blank Flange (GP Low Side)	02051-0236-0002	—	—	—	—	•	—
Flange Adapter Union		**CD**	**CG**	**CA**	**L**	**H**	**T**
Nickel-plated Carbon Steel	02024-0069-0005	•	•	•	—	—	—
316 SST	02024-0069-0002	•	•	•	—	—	—
Hastelloy C	02024-0069-0003	•	•	•	—	—	—
Monel	02024-0069-0004	•	•	•	—	—	—
Drain/Vent Valve Kits		**CD**	**CG**	**CA**	**L**	**H**	**T**
Differential Drain/Vent Kits(1)							
316 SST Stem and Seal Kit	01151-0028-0022	•	—	—	—	•	—
Hastelloy C Stem and Seal Kit	01151-0028-0023	•	—	—	—	•	—
Monel Stem and Seal Kit	01151-0028-0024	•	—	—	—	•	—
316 SST Ceramic Ball Drain/Vent Kit	01151-0028-0122	•	—	—	—	•	—
Hastelloy C Ceramic Ball Drain/Vent Kit	01151-0028-0123	•	—	—	—	•	—
Monel Ceramic Ball Drain/Vent Kit	01151-0028-0124	•	—	—	—	•	—
Gage/Absolute Drain/Vent Kits(1)							
316 SST Stem and Seal Kit	01151-0028-0012	—	•	•	•	•	—
Hastelloy C Stem and Seal Kit	01151-0028-0013	—	•	•	•	•	—
Monel Stem and Seal Kit	01151-0028-0014	—	•	•	•	•	—
316 SST Ceramic Ball Drain/Vent Kit	01151-0028-0112	—	•	•	•	•	—
Hastelloy C Ceramic Ball Drain/Vent Kit	01151-0028-0113	—	•	•	•	•	—
Monel Ceramic Ball Drain/Vent Kit	01151-0028-0114	—	•	•	•	•	—

(Each kit contains parts for one transmitter.)

O-Ring Packages		CD	CG	CA	L	H	T
Electronic Housing, Cover (Std. and Meter)[1]	03031-0232-0001	•	•	•	•	•	•
Electronics Housing, Module[1]	03031-0233-0001	•	•	•	•	•	•
Process Flange, Glass-filled *Teflon*[1]	03031-0234-0001	•	•	•	—	—	—
Process Flange, Graphite-filled *Teflon*	03031-0234-0002	•	•	•	—	—	—
Flange Adapter, Glass-filled *Teflon*[1]	03031-0242-0001	•	•	•	—	—	—
Flange Adapter, Graphite-filled *Teflon*	03031-0242-0002	•	•	•	—	—	—
3051H Process Flange, TFE	02051-0167-0001	—	—	—	—	•	—
Mounting Brackets		**CD**	**CG**	**CA**	**L**	**H**	**T**
Coplanar Flange Bracket Kit							
B4 Bracket, SST, 2-in. Pipe Mount, SST Bolts	03031-0189-0003	•	•	•	—	—	—
3051T Bracket Kit							
B4 Bracket, SST, 2-in. Pipe Mount, SST Bolts	02088-0071-0001	—	—	—	—	—	•
Traditional Flange Bracket Kits							
B1 Bracket, 2-in. Pipe Mount, CS Bolts	03031-0313-0001	•	•	•	—	—	—
B2 Bracket, Panel Mount, CS Bolts	03031-0313-0002	•	•	•	—	—	—
B3 Flat Bracket for 2-in. Pipe Mount, CS Bolts	03031-0313-0003	•	•	•	—	—	—
B7 (B1 Style Bracket with SST Bolts)	03031-0313-0007	•	•	•	—	—	—
B8 (B2 Style Bracket with SST Bolts)	03031-0313-0008	•	•	•	—	—	—
B9 (B3 Style Bracket with SST Bolts)	03031-0313-0009	•	•	•	—	—	—
BA (SST B1 Bracket with SST Bolts)	03031-0313-0011	•	•	•	—	—	—
BC (SST B3 Bracket with SST Bolts)	03031-0313-0013	•	•	•	—	—	—
Model 3051H Bracket Kits							
B5 Universal Bracket for 2-in. Pipe and Panel Mount, CS Bolts	03051-1081-0001	—	—	—	—	•	—
B6 Universal Bracket for 2-in. Pipe or Panel Mount, SST Bolts	03051-1081-0002	—	—	—	—	•	—

Bolt Kits		CD	CG	CA	L	H	T
***Coplanar* Flange**							
Flange Bolt Kit (44 mm (1.75 in.))							
Carbon Steel (set of 4)	03031-0312-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0312-0002	•	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0312-0003	•	•	•	—	—	—
Monel	03031-0312-0004	•	•	•	—	—	—
Flange/Adapter Bolt Kit (73 mm (2.88 in.))							
Carbon Steel (set of 4)	03031-0306-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0306-0002	•	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0306-0003	•	•	•	—	—	—
Monel	03031-0306-0004	•	•	•	—	—	—
Manifold/Flange Kit (57 mm (2.25 in.))							
Carbon Steel (set of 4)	03031-0311-0001	•	—	—	—	—	—
316 SST (set of 4)	03031-0311-0002	•	—	—	—	—	—
ANSI/ASTM-A-193-B7M	03031-0311-0003	•	—	—	—	—	—
Monel	03031-0311-0004	•	—	—	—	—	—
Traditional Flange							
Differential Flange and Adapter Bolt Kit (44 mm (1.75 in.))							
Carbon Steel (set of 8)	03031-0307-0001	•	—	—	—	—	—
316 SST (set of 8)	03031-0307-0002	•	—	—	—	—	—
ANSI/ASTM-A-193-B7M	03031-0307-0003	•	—	—	—	—	—
Monel	03031-0307-0004	•	—	—	—	—	—
Gage/Absolute Flange and Adapter Bolt Kit							
Carbon Steel (set of 6)	03031-0307-1001	—	•	•	—	—	—
316 SST (set of 6)	03031-0307-1002	—	•	•	—	—	—
ANSI/ASTM-A-193-B7M	03031-0307-1003	—	•	•	—	—	—
Monel	03031-0307-1004	—	•	•	—	—	—
Manifold/Traditional Flange Bolts							
Carbon Steel	Use bolts supplied with manifold						
316 SST	Use bolts supplied with manifold						
Level Flange, Vertical Mount							
Flange Bolt Kit							
Carbon Steel (set of 4)	03031-0395-0001	•	•	•	—	—	—
316 SST (set of 4)	03031-0395-0002	•	•	•	—	—	—
(Each kit contains bolts for one transmitter.)							
Model 3051H Flange							
Process Flange Bolt Kit, Carbon Steel	02051-0164-0001	—	—	—	—	•	—
FlangeBolt (set of 4)							
Flange Nut (set of 4)							
Adapter Bolts (set of 4)							
Other							
Process Flange Bolt Kit, 316 SST	02051-0164-0002	—	—	—	—	•	—
Bolt for Process Flange (set of 4)							
Nut for Process Flange (set of 4)							
Adapter Bolts (set of 4)							

(1) One spare part is recommended for every 25 transmitters.
(2) One spare part is recommended for every 50 transmitters

Part Description	Part Number	CD	CG	CA	L	H	T
Meter for current Aluminum Housing							
Meter Kit	03031-0193-0101	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
Meter Hardware Only	03031-0193-0103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly Kit	03031-0193-0002	•	•	•	•	•	•
Meter for current 316 SST Housing		**CD**	**CG**	**CA**	**L**	**H**	**T**
Meter Kit [1]	03031-0193-0111	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
Meter Hardware Only	03031-0193-0103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly Kit	03031-0193-0012	•	•	•	•	•	•
Meter for *Previous* Aluminum Housing		**CD**	**CG**	**CA**	**L**	**H**	**T**
Previous Meter Kit [1]	03031-0193-0001	•	•	•	•	•	•
NOTE: Previous Meter Kit includes meter display, captive mounting hardware, 6-pin interconnection header, and cover assembly.							
Improved Kit for Previous Aluminum Housing [1]	03031-0193-1101	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
Previous Meter Hardware Only [1]	03031-0193-0003	•	•	•	•	•	•
NOTE: Previous Meter Hardware includes meter display, captive mounting hardware, and 6-pin interconnection header only.							
Improved Meter for Previous Housing	03031-0193-1103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly Kit	03031-0193-0002	•	•	•	•	•	•
Meter for *Previous* 316 SST Housing		**CD**	**CG**	**CA**	**L**	**H**	**T**
Previous Meter Kit [1]	03031-0193-0011	•	•	•	•	•	•
Improved Kit for Previous SST Housing [1]	03031-0193-1111	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly							
Previous Meter Hardware Only [1]	03031-0193-0003	•	•	•	•	•	•
Improved Meter for Previous Housing [1]	03031-0193-1103	•	•	•	•	•	•
Meter Display							
Captive Mounting Hardware							
10-pin Interconnection Header							
Cover Assembly Kit	03031-0193-0012	•	•	•	•	•	•

OPTIONS

Standard Configuration

Unless otherwise specified, transmitter is shipped as follows:

ENGINEERING UNITS	
Differential/Gage; Absolute/3051T:	inH_2O (Range 0, 1, 2, and 3) psi (Range 4 and 5) psi (all ranges)
4 mA (1 V dc):	0 (engineering units above)
20 mA (5 V dc):	Upper range limit
Output:	Linear
Flange type:	Specified model code option
Flange material:	Specified model code option
O-ring material:	Specified model code option
Drain/vent:	Specified model code option
Integral meter:	Installed or none
Alarm:	Upscale
Software tag:	(Blank)

Custom Configuration HART protocol only (Option Code C1)

If Option Code C1 is ordered, the customer may specify the following data in addition to the standard configuration parameters.

- Output Information
- Transmitter Information
- LCD Dispaly Configuration
- Hardware Selectable Information
- Signal Selection

Refer to the "HART Protocol C1 Option Configuration Data Sheet" on page 50.

Tagging

Three customer tagging options are available:

1. Standard SST hardware tag is wired to the transmitter. Tag character height is 0.125 in. (3,18 mm), 56 characters maximum.
2. Tag may be permanently stamped on transmitter nameplate upon request, 56 characters maximum.
3. Tag may be stored in transmitter memory (30 characters maximum). Software tag is left blank unless specified.

Optional Model 305 or Model 306 Integral Manifolds

Factory assembled to Model 3051C and Model 3051T transmitters. Refer to the following Rosemount document for more information: Product Data Sheet 00813-0100-4733

Optional Three-Valve Manifolds
(Packaged Separately)

Part No.1151-0150-0001
3-Valve Manifold, Carbon Steel

Part No. 1151-0150-0002
3-Valve Manifold, 316 SST

Optional Diaphragm and Sanitary Seals

Refer to Product Data Sheet 00813-0100-4016 or 00813-0201-4016.

Output Information

Output range points must be the same unit of measure. Available units of measure include:

inH2O	inH2O@4 °C[1]	psi	Pa
inHg	ftH2O	bar	kPa
mmH2O	mmH2O@4 °C[1]	mbar	torr
mmHg	g/cm2	kg/cm2	atm

(1) Not available on low power or previous versions.

LCD Display

M5 Digital Meter, 5-Digit, 2-Line LCD

- Direct reading of digital data for higher accuracy
- Displays user-defined flow, level, volume, or pressure units
- Displays diagnostic messages for local troubleshooting
- 90-degree rotation capability for easy viewing

M6 Digital Meter with 316 Stainless Steel Cover

- For use with stainless steel housing option (housing codes J, K, and L)

Local Span and Zero Adjustment

Transmitters ship with local span and zero adjustments standard unless otherwise specified.

- Non-interactive external zero and span adjustments ease calibration
- Magnetic switches replace standard potentiometer adjustments to optimize performance

J1 Local Zero Adjustment Only

J3 No Local Zero or Span Adjustment

Transient Protection

- Integral transient protection terminal block
- Meets IEEE Standard 587, Category B
  1 kV crest (10 × 1 000 microseconds)
  3 kV crest (8 × 20 microseconds)
  6 kV crest (1.2 × 50 microseconds)
- Meets IEEE Standard 472,
  Surge Withstand Capability
  SWC 2,5 kV crest, 1 MHz wave form
- Applicable standards: 61000-4-4, 61000-4-5

T1 Integral Transient Protection Terminal Block

Bolts for Flanges and Adapters

- Options permit bolts for flanges and adapters to be obtained in various materials
- Standard material is plated carbon steel per ASTM A449, Type 1

L4 Austenitic 316 Stainless Steel Bolts

L5 ASTM-A-193-B7M Bolts

L6 *Monel* Bolts

Model 3051C/P Coplanar Flange and Model 3051T Bracket Option

B4 Bracket for 2-in. Pipe or Panel Mounting

- For use with the standard Coplanar flange configuration
- Bracket for mounting of transmitter on 2-in. pipe or panel
- Stainless steel construction with stainless steel bolts

Model 3051H Bracket Options

B5 Bracket for 2-in. Pipe or Panel Mounting

- For use with the Model 3051H Pressure Transmitter for high process temperatures
- Carbon steel construction with carbon steel bolts

B6 B5 Bracket with SST Bolts

- Same bracket as the B5 option with Series 300 stainless steel bolts.

Traditional Flange Bracket Options

B1 Bracket for 2-in. Pipe Mounting

- For use with the traditional flange option
- Bracket for mounting on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B2 Bracket for Panel Mounting

- For use with the traditional flange option
- Bracket for mounting transmitter on wall or panel
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B3 Flat Bracket for 2-in. Pipe Mounting

- For use with the traditional flange option
- Bracket for vertical mounting of transmitter on 2-in. pipe
- Carbon steel construction with carbon steel bolts
- Coated with polyurethane paint

B7 B1 Bracket with SST Bolts

- Same bracket as the B1 option with Series 300 stainless steel bolts

B8 B2 Bracket with SST Bolts

- Same bracket as the B2 option with Series 300 stainless steel bolts

B9 B3 Bracket with SST Bolts

- Same bracket as the B3 option with Series 300 stainless steel bolts

BA Stainless Steel B1 Bracket with SST Bolts

- B1 bracket in stainless steel with Series 300 stainless steel bolts

BC Stainless Steel B3 Bracket with SST Bolts

- B3 bracket in stainless steel with Series 300 stainless steel bolts

Shipping Weights

Table A-4. Transmitter Weights without Options

Transmitter	Add Weight in lb (kg)
Model 3051C/P	6.0 (2,7)
Model 3051L	Table A-7 on page A-49
Model 3051H	13.6 (6,2)
Model 3051T	3.0 (1,4)

Table A-5. Model 3051L Weights without Options

Flange	Flush lb (kg)	2-in. Ext. lb. (kg)	4-in. Ext. lb. (kg)	6-in. Ext. lb. (kg)
2-in., 150	12.5 (5,7)	—	—	—
3-in., 150	17.5 (7,9)	19.5 (8,8)	20.5 (9,3)	21.5 (9,7)
4-in., 150	23.5 (10,7)	26.5 (12,0)	28.5 (12,9)	30.5 (13,8)
2-in., 300	17.5 (7,9)	—	—	—
3-in., 300	22.5 (10,2)	24.5 (11,1)	25.5 (11,6)	26.5 (12,0)
4-in., 300	32.5 (14,7)	35.5 (16,1)	37.5 (17,0)	39.5 (17,9)
2-in., 600	15.3 (6,9)	—	—	—
3-in., 600	25.2 (11,4)	27.2 (12,3)	28.2 (12,8)	29.2 (13,2)
DN 50/PN 40	13.8 (6,2)	—	—	—
DN 80/PN 40	19.5 (8,8)	21.5 (9,7)	22.5 (10,2)	23.5 (10,6)
DN 100/PN 10/16	17.8 (8,1)	19.8 (9,0)	20.8 (9,5)	21.8 (9,9)
DN 100/PN 40	23.2 (10,5)	25.2 (11,5)	26.2 (11,9)	27.2 (12,3)

Table A-6. Transmitter Options Weights

Code	Option	Add lb. (kg)
J, K, L, M	Stainless Steel Housing(T)	3.9 (1,8)
J, K, L, M	Stainless Steel Housing (C, L, H, P)	3.1 (1,4)
M5	LCD Meter for Aluminum Housing	0.5 (0,2)
M6	LCD Meter for SST Housing	1.25 (0,6)
B4	SST Mounting Bracket for *Coplanar* Flange	1.0 (0,5)
B1 B2 B3	Mounting Bracket for Traditional Flange	2.3 (1,0)
B7 B8 B9	Mounting Bracket for Traditional Flange	2.3 (1,0)
BA, BC	SST Bracket for Traditional Flange	2.3 (1,0)
B5 B6	Mounting Bracket for Model 3051H	2.9 (1,3)
H2	Traditional Flange	2.4 (1,1)
H3	Traditional Flange	2.7 (1,2)
H4	Traditional Flange	2.6 (1,2)
H7	Traditional Flange	2.5 (1,1)
FC	Level Flange—3 in., 150	10.8 (4,9)
FD	Level Flange—3 in., 300	14.3 (6,5)
FA	Level Flange—2 in., 150	10.7 (4,8)
FB	Level Flange—2 in., 300	14.0 (6,3)
FP	DIN Level Flange, SST, DN 50, PN 40	8.3 (3,8)
FQ	DIN Level Flange, SST, DN 80, PN 40	13.7 (6,2)

HART PROTOCOL C1 OPTION CONFIGURATION DATA SHEET

★ = Default Value[1]

CONFIGURATION DATA SHEET

Customer: _____ P.O. No.: _____

Model No.: _____ Line Item: _____

SST Tag No.: _____

Software Tag: |_|_|_|_|_|_|_|_|

OUTPUT INFORMATION: (Software Selectable)

4 mA (1, 0.8 Volts) = _____ 0 ★

20 mA (5, 3.2 Volts) = _____ Upper Range Limit ★

Pressure Units = ☐ inH_2O[2]★ ☐ psi [3] ★ ☐ Pa ☐ ftH_2O
☐ inHg ☐ bar ☐ kPa ☐ g/cm^2
☐ mbar ☐ Torr ☐ mmH_2O ☐ inH_2O at 4 °C[5]
☐ Atm ☐ kg/cm^2 ☐ mmHg ☐ mmH_2O at 4 °C [5]

Output = ☐ Linear ★ ☐ Square Root (For DP transmitters only)

Damping[4]= ☐ 0.00 sec. ☐ 0.05 sec. ☐ 0.10 sec. ☐ 0.20 sec. ☐ 0.40 sec.★
☐ 0.80 sec. ☐ 1.60 sec. ☐ 3.20 sec. ☐ 12.8 sec. ☐ 25.6 sec.

TRANSMITTER INFORMATION: (Software Selectable)

Descriptor[4]: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|(16 characters)

Message[4]: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|
(32 characters)

Date[4]: ☐☐/☐☐/☐☐
Day Month Year

Local Span and Zero: ☐Enabled ★ ☐Disabled

(1) Default values may be different outside the U.S.A. Consult your Rosemount Sales Representative for details.
(2) inH20 for CD/CG ranges 1-3
(3) psi for CD/CG range 4 and 5, all CA ranges
(4) C1 option required for configuration of this parameter.
(5) Not available with low power output.

LCD METER CONFIGURATION (Software Adjustable – M5 or M6 option must be specified in model number)

Meter Display Type[4]:

☐ Eng. Units only ☐ Alternate Eng. Units &% of Range ★
☐ % of Range only ☐ Alternate Eng. Units & Custom Display[6]
☐ Custom Display only ☐ Alternate % of Range & Custom Display[6]

Custom Display Configuration: (must be filled out if Custom Display is selected as meter type)

Decimal Point Position (fixed)— indicate decimal point location: $X_{\square}\,X_{\square}\,X^{*}_{\square}\,X_{\square}\,X_{\square}$

Enter Lower Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + − ☐☐☐☐☐☐☐☐☐ +000.00 ★

Enter Upper Range Value (Decimal point must be in the same position as specified above.)

(circle sign) + − ☐☐☐☐☐☐☐☐☐ +100.00 ★

Custom Units—spaces consume A-Z, 0-9, /, *, %, blank

☐☐☐☐☐ %RNGE ★

Custom Display Transfer Function (Independent of Analog Output)

☐ Linear ★ ☐ Square Root

HARDWARE SELECTABLE INFORMATION

Alarm Option: ☐ High ☐ Low

Transmitter Security: ☐ Off ☐ On

Note: Specify C4 Option in model structure when ordering NAMUR-compliant alarm and saturation limits.[6]

SIGNAL SELECTION: (Software Selectable)

☐ 4–20 mA with simultaneous digital signal based on HART protocol★

☐ Burst mode of HART digital process variable [4]

Burst mode output options:
☐ Primary variable in engineering units
☐ Primary variable in percent of range
☐ All dynamic variables in engineering units and the primary variable mA value

☐ Multidrop Communication[4][5] Choose transmitter address[7] (1-15): _____

(4) C1 option required for configuration of this parameter.
(5) Not available with low power output.
(6) This option fixes the transmitter analog output at 4mA.
(7) Default address is 1 if multidrop communication is selected.

Appendix B Product Certifications

Approved Manufacturing Locations ..... **page B-2**
European Directive Information ..... **page B-2**
Ordinary Location Certification for Factory Mutual ..... **page B-3**
Hazardous Locations Certifications ..... **page B-4**
Approval Drawings ..... **page B-9**

OVERVIEW

This Appendix contains information on Approved manufacturing locations, European directive information, Ordinary Location certification, Hazardous Locations Certifications and approval drawings for HART protocol.

SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

Warnings

⚠WARNING

Explosions could result in death or serious injury:

Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review this section of the Model 3051 reference manual for any restrictions associated with a safe installation.

- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- In an Explosion-Proof/Flame-Proof installation, do not remove the transmitter covers when power is applied to the unit.

Process leaks may cause harm or result in death.

- Install and tighten process connectors before applying pressure.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

⚠WARNING

Cable gland and plug must comply with the requirements listed on the certificates.

APPROVED MANUFACTURING LOCATIONS

Rosemount Inc. — Chanhassen, Minnesota, USA

Fisher-Rosemount GmbH & Co. — Wessling, Germany

Emerson Process Management Asia Pacific Private Limited -- Singapore

EUROPEAN DIRECTIVE INFORMATION

ATEX Directive

Rosemount Inc. complies with the ATEX Directive. Specific ATEX Directive Information is located within Appendix B.

Intrinsic safety Ex ia protection type in accordance with EN50 020

- Pressure transmitter with ia type protection shall operate with a certified intrinsic safety power supply only.
- ⚠ Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- Pressure transmitter with intrinsic safety type protection is not valid if it is not connected to an intrinsic safety circuit.
- The Model 3051 with option code T1(1) does not pass the 500V high voltage test and using it with a shunt-diode safety barrier is not allowed. Transmitter without optioncode T1(1) can be tested using the 500V high voltage test.

Flame-Proof enclosure Ex d protection type in accordance with EN50 018

- Pressure transmitter with flameproof enclosure type protection shall only be opened when power is removed.
- ⚠ Closing of entries in the device must be carried out using the appropriate EE d metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
- Do not exceed the energy level, which is stated on the approval label.

Type n protection type in accordance with EN50 021

- The Model 3051 with option code T1(1) does not pass the 500V high voltage test and using it with a shunt-diode safety barrier is not allowed. Transmitter without optioncode T1(1) can be tested using the 500V high voltage test.
- ⚠ Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.

(1) Lightning protection

European Pressure Equipment Directive (PED) (97/23/EC)

Models 3051CA4; 3051CD2, 3, 4, 5 *(also with P9 option)*; 3051HD2, 3, 4, 5 Pressure Transmitters are category III equipment— QS Certificate of Assessment - EC No. PED-H-20

All other Model 3051/3001 Pressure Transmitters — Sound Engineering Practice

Transmitter Attachments: Diaphragm Seal - Process Flange - Manifold — Sound Engineering Practice

Pressure transmitters that are SEP or Category I with Explosion-Proof protection are outside the scope of PED and cannot be marked for compliance with PED.

Mandatory CE-marking for pressure transmitters in accordance with Article 15 of the PED can be found on the transmitter body (CE 0434).

Pressure transmitters categories I – IV, use module H for conformity assessment procedures.

Electro Magnetic Compatibility (EMC)

Installed signal wiring should not be run together and should not be in the same cable tray as AC power wiring.

Device must be properly grounded or earthed according to local electric codes.

To improve protection against signal interference, shielded cable is recommended, see "Connect Wiring and Power Up" on page 2-16 for more information.

Other important guidelines

Only use new, original parts.

To prevent the process medium escaping, do not unscrew or remove process flange bolts, adapter bolts or bleed screws during operation.

When accessories are added to the transmitter, the minimum pressure rating of any component shall not be exceeded.

Maintenance shall only be done by qualified personnel.

ORDINARY LOCATION CERTIFICATION FOR FACTORY MUTUAL

As standard, the transmitter has been examined, tested, and approved to meet basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

HAZARDOUS LOCATIONS CERTIFICATIONS

North American Certifications

Factory Mutual (FM)

E5 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II, Division 1, Groups E, F, and G. Dust-Ignition-Proof for Class III, Division 1. T5 (Ta = 85 °C), Factory Sealed, Enclosure Type 4x

I5 Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 when connected per Rosemount drawing 03031-1019 and 00268-0031 (When used with a HART communicator); Non-incendive for Class I, Division 2, Groups A, B, C, and D.
Temperature Code:T4 (Ta = 40 °C), T3 (Ta = 85 °C),
Enclosure Type 4x
For input parameters see control drawing 03031-1019.

Canadian Standards Association (CSA)

E6 Explosion-Proof for Class I, Division 1, Groups B, C, and D. Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D for indoor and outdoor hazardous locations. Enclosure type 4X, factory sealed

C6 Explosion-Proof and intrinsically safe approval. Intrinsically safe for Class I, Division 1, Groups A, B, C, and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.
Explosion-Proof for Class I, Division 1, Groups B, C, and D.
Dust-Ignition-Proof for Class II and Class III, Division 1, Groups E, F, and G. Suitable for Class I, Division 2 Groups A, B, C, and D hazardous locations. Enclosure type 4X, factory sealed
For input parameters see control drawing 03031-1024.

European Certifications

I1 CENELEC Intrinsic Safety and Dust
Certification No.: BAS 97ATEX1089X ⓔ II 1 GD

EEx ia IIC T5 (Tamb = –60 to +40 °C)
EEx ia IIC T4 (Tamb = –60 to +70 °C)
Dust Rating: T80 °C (Tamb –20 to 40 °C) IP66
CE 1180

CENELEC I1 Input Parameters

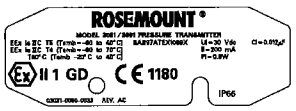
U_i= 30 V
I_i = 200 mA
P_i = 0.9 W
C_i = 0.012 µF
L_i = 0.0

Special conditions for Safe Use (X): When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding the 500V insulation test required by Clause 6.4.12 of EN50020:1994. This must be taken into account when installing the apparatus.

NOTE
a) Pressure transmitter with ia type protection shall operate with a certified intrinsic safety power supply only.
⚠ b) Closing of entries in the device must be carried out using the appropriate EExe or EExn metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
c) Pressure transmitter with intrinsic safety type protection is not valid if it is not connected to an intrinsic safety circuit.

The transmitter complies with category one (highest category) and is allowed to be installed in ZONE 0.

Figure B-1. Approval Ex label example



N1 CENELEC Non-incendive/Type n and Dust
Certification No.: BAS 00ATEX3105X ⓔ II 3 GD

EEx nL IIC T5 (Tamb = –40 to +70 °C)
U_i = 55 Vdc max
Dust rating: T80 °C (Tamb = –20 to 40 °C) IP66

Special Conditions for Safe Use (x): When the optional transient protection terminal block is installed, the apparatus is not capable of withstanding a 500V r.m.s. test to case. This must be taken into account on any installation in which it is used, for example by assuring that the supply to the apparatus is galvanically isolated.

⚠ **E8** CENELEC Flame-Proof and Dust
Certification No.: KEMA 00ATEX2013X ⓔ II 1/2 GD

EEx d IIC T6 (T_{amb} = –50 to 65 °C)
EEx d IIC T5 (T_{amb} = –50 to 80 °C)
Dust rating T90 °C, IP66
CE 1180
Vmax = 55 V dc

Special Conditions for Safe Use (X): This device contains a thin wall diaphragm. Installation, maintenance, and use shall take into account the environmental conditions to which the diaphragm will be subjected. The manufacturer's instructions for installation and maintenance shall be followed in detail to assure safety during its expected lifetime.

NOTE
a) Pressure transmitter with flameproof enclosure type protection shall only be opened when power is removed.
⚠ b) Closing of entries in the device must be carried out using the appropriate EE d metal cable gland and metal blanking plug or any appropriate ATEX approved cable gland and blanking plug with IP66 rating certified by an EU approved certification body.
c) Do not exceed the energy level, which is stated on the approval label.

Figure B-2. Transmitter neck approval label exarnple



Japanese Certifications

E4 JIS Flame-Proof

Certificate	Description
Ex d IIC T5 + G5	
C13432	3051C/L/H/P Differential and Gauge (no meter)
C13433	3051C/L/H/P Differential and Gauge (with meter)
C13434	3051CA (no meter)
C13435	3051CA (with meter)
C13436	3051T (no meter)
C13437	3051T (with meter)
Ex d IIC T6	
C15151	3051C/D/1 4-20 mA HART (no meter)
C15152	3051C/D/1 4-20 mA HART (with meter)
C15155	3051T/G/1 4-20 mA HART, SST Silicone (no meter)
C15156	3051T/G/1 4-20 mA HART, Hast. Silicone (no meter)
C15157	3051T/G/1 4-20 mA HART, SST Silicone (with meter)
C15158	3051T/G/1 4-20 mA HART, Hast. Silicone (with meter)

I4 JIS Intrinsic Safety
Certification No.: C13266
Ex ia IIC T4

Australian Certifications

I7 SAA Intrinsic Safety
Certification No.: AUS EX 1249X

Ex ia IIC T4 (T_{amb} = 70 °C)
Ex ia IIC T5 (T_{amb} = 40 °C)
IP65
When connected per Rosemount drawing 03031-1026

Special Conditions for Safe Use (X):
The apparatus may only be used with a passive current limited power source Intrinsic Safety application. The power source must be such that Po ≤ (Uo * Io) / 4.

Modules using transient protection in the terminal assembly (T1 transient protection models) the apparatus enclosure is to be electrically bonded to the protective earth.

The conductor used for the connection shall be equivalent to a copper conductor of 4 mm² minimum cross-sectional area.

SAA Approved Input Parameters
U_i = 30 V
I_i = 200 mA
I_i = 160 mA (Option Code T1)
P_i = 0.9 W
C_i = 0.01 µF (Output Code A)
C_i = 0.042 µF (Output Code M)
L_i = 10 µH
L_i = 1,05 mH (Output Code A with T1)
L_i = 0,75 mH (Output Code M with T1)

E7 SAA Explosion-Proof (Flame-Proof)
Certification No.: AUS EX 1347X

Ex d IIC T6 (T_{amb} = 40 °C)
Ex d IIC T5 (T_{amb} = 80 °C)
DIP T6 (T_{amb} = 40 °C)
DIP T5 (T_{amb} = 80 °C)
IP65

Special Conditions for Safe Use (x): It is a condition of safe use for transmitter enclosures having cable entry thread other than metric conduit thread that the equipment be utilized with an appropriate certified thread adaptor.

N7 SAA Type n (Non-sparking)
Certification No.: AUS EX 1249X

Ex n IIC T4 (T_{amb} = 70 °C)
Ex n IIC T5 (T_{amb} = 40 °C)
IP65

Special Conditions for Safe Use (x): Where the equipment is installed such that there is an unused conduit entry, it must be sealed with a suitable blanking plug to maintain the IP40 degree of protection. Any blanking plug used with the equipment shall be of a type which requires the use of a tool to effect its removal. Voltage source shall not exceed 60V ac or 75V dc.

Combinations of Certifications

Stainless steel certification tag is provided when optional approval is specified. Once a device labeled with multiple approval types is installed, it should not be reinstalled using any other approval types. Permanently scratch off or mark unused approval types on the approval label.

K5 **E5** and **I5** combination

KB **K5** and **C6** combination

K6 **C6**, **I1**, and **E8** combination

K8 **E8** and **I1** combination

K7 **E7**, **I7**, and **N7** combination

APPROVAL DRAWINGS

Factory Mutual
03031-1019

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA	ADD FIELDBUS	RTC1004088	M.L.M.	5/25/98
AB	ADD PROFIBUS, NONINCENDIVE PARAMETERS	RTC1008389	P.C.S.	7/1/98
AC	ADD FISCO DETAILS	RTC1011731	J.P.W.	1/1/01

ENTITY APPROVALS FOR

3051C 3001C
3051L 3001CL
3051P 3001CH
3051H 3001S
3051CA 3001SL
3051T 3001SH

OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-4
OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 5-6
OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 7-11
ALL OUTPUT CODES NONINCENDIVE SEE SHEETS 12

THE ROSEMOUNT TRANSMITTERS LISTED ABOVE ARE F.M. APPROVED AS INTRINSICALLY SAFE WHEN USED IN CIRCUIT WITH F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED IN THE CLASS I, II, AND III, DIVISION 1 GROUPS INDICATED, TEMP CODE T4. ADDITIONALLY, THE ROSEMOUNT 751 FIELD SIGNAL INDICATOR IS F.M. APPROVED AS INTRINSICALLY SAFE WHEN CONNECTED IN CIRCUIT WITH ROSEMOUNT TRANSMITTERS (FROM ABOVE) AND F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED FOR CLASS I, II, AND III, DIVISION 1, GROUPS INDICATED, TEMP CODE T4.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

CAD MAINTAINED (MicroStation)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE Finish 125

TOLERANCE: .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25]
FRACTIONS ± 1/32 ANGLES ± 2°

DO NOT SCALE PRINT

CONTRACT NO.
DR. MIKE DOSE 03/21/01
CHK'D
APP'D. KELLY OLTH 03/22/01
APP'D. GOVT.

EMERSON. Process Management
ROSEMOUNT
8200 Market Boulevard • Chanhassen, MN 55317 USA

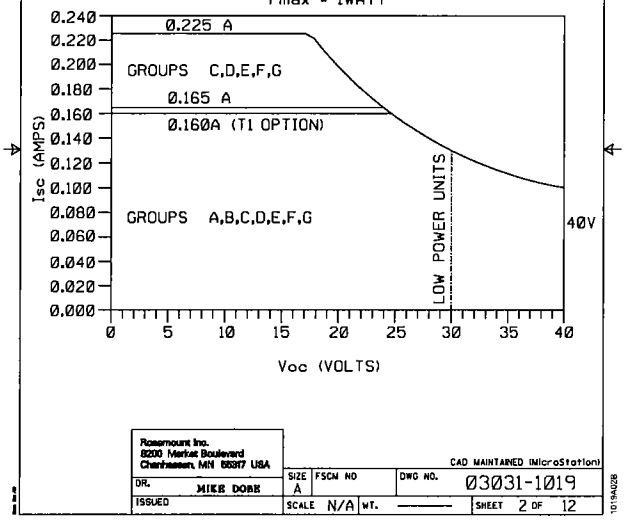
TITLE: INDEX OF I.S. & NONINCENDIVE F.M. FOR 3051C/L/P/H/T AND 3001C/S

SIZE A | FSCM NO | DWG NO. 03031-1019
SCALE N/A | WT. | SHEET 1 OF 12

1019A01B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

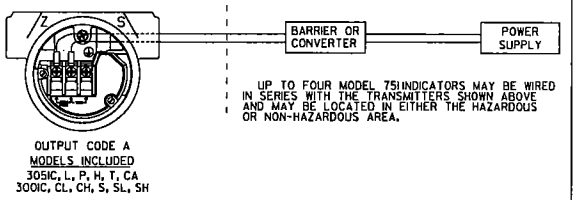
BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODES A & M)



Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ———	SHEET 2 OF 12	1019A028

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

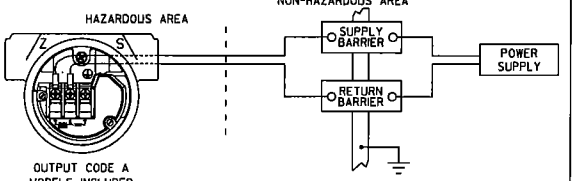
CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL



UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ———	SHEET 3 OF 12	1019A035

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (V_{OC} OR V_T) AND MAX. SHORT CIRCUIT CURRENT (I_{SC} OR I_T) AND MAX. POWER ($V_{OC} \times I_{SC}/4$) OR ($V_T \times I_T/4$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{max}), MAXIMUM SAFE INPUT CURRENT (I_{max}), AND MAXIMUM SAFE INPUT POWER (P_{max}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 165mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
P_{MAX} = 1 WATT	$(V_T \times I_T)$ OR $(V_{OC} \times I_{SC})$ IS LESS THAN OR EQUAL TO 1 WATT
C_i = .01μF	C_A IS GREATER THAN .01μF
L_i =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

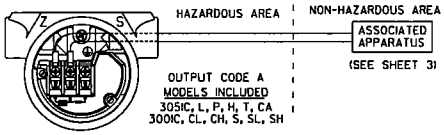
I_{max} = 160mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 160mA
L_i =1.05mH	L_A IS GREATER THAN 1.05mH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 225mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
P_{MAX} = 1 WATT	$(V_T \times I_T)$ OR $(V_{OC} \times I_{SC})$ IS LESS THAN OR EQUAL TO 1 WATT
C_i = .01μF	C_A IS GREATER THAN .01μF
L_i =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

L_i =1.05mH	L_A IS GREATER THAN 1.05mH



(SEE SHEET 3)

OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ———	SHEET 4 OF 12	1019A046

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

FOR OUTPUT CODE M

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 165mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
P_{MAX} = 1 WATT	$(V_T \times I_T)$ OR $(V_{OC} \times I_{SC})$ IS LESS THAN OR EQUAL TO 1 WATT
C_i = .042μF	C_A IS GREATER THAN .042μF
L_i =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

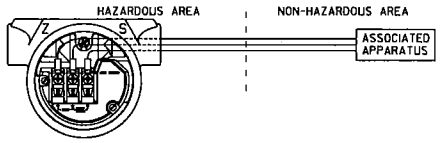
L_i =0.75mH	L_A IS GREATER THAN 0.75mH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 225mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
P_{MAX} = 1 WATT	$(V_T \times I_T)$ OR $(V_{OC} \times I_{SC})$ IS LESS THAN OR EQUAL TO 1 WATT
C_i = .042μF	C_A IS GREATER THAN .042μF
L_i =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

L_i =0.75mH	L_A IS GREATER THAN 0.75mH



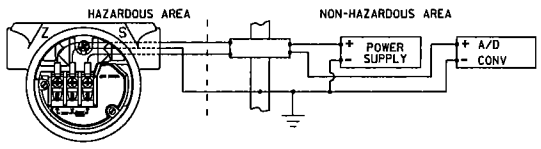
OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

3051C 3051H
3051L 3051CA
3051P 3051T

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ———	SHEET 5 OF 12	1019A058

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

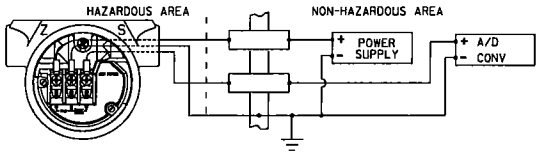
CIRCUIT DIAGRAM 3
ONE DUAL CHANNEL BARRIER



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

3051C	3051H
3051L	3051CA
3051P	3051T

CIRCUIT DIAGRAM 4
TWO SINGLE CHANNEL BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

3051C	3051H
3051L	3051CA
3051P	3051T

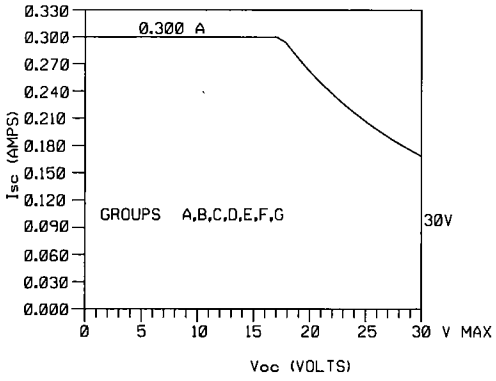
Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)
DR. SANDI MANSON	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ———	SHEET 6 OF 12

1019A06B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

3051 WITH FOUNDATION FIELDBUS OR PROFIBUS.
(OUTPUT CODE F OR W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE F OR W)
Pmax = 1.3 WATT

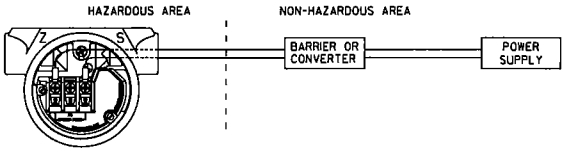


Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ———	SHEET 7 OF 12

1019A07B

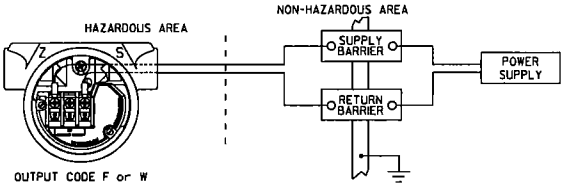
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER; SINGLE OR DUAL CHANNEL



OUTPUT CODE F or W
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE F or W
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ———	SHEET 8 OF 12

1019A08B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

ENTITY CONCEPT APPROVALS

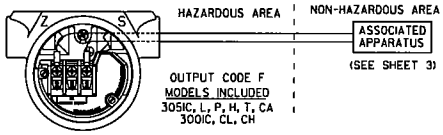
THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (V_{oc} OR V_t) AND MAX. SHORT CIRCUIT CURRENT (I_{sc} OR I_t) AND MAX. POWER ($V_{oc} \times I_{sc}/4$) OR ($V_t \times I_t/4$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{max}), MAXIMUM SAFE INPUT CURRENT (I_{max}), AND MAXIMUM SAFE INPUT POWER (P_{max}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

FOR OUTPUT CODE F or W

CLASS I, DIV. 1, GROUPS A, B, C AND D

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 300mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 300mA
P_{MAX} = 1.3 WATT	$\frac{V_T \times I_T}{4}$ OR $\frac{V_{OC} \times I_{SC}}{4}$ IS LESS THAN OR EQUAL TO 1.3 WATT
C_i = 0 μF	C_A IS GREATER THAN 0 μF
L_i = 0 μH	L_A IS GREATER THAN 0 μH



(SEE SHEET 3)

OUTPUT CODE F
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ———	SHEET 9 OF 12

1019A09B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_i or Vmax), THE CURRENT (I_i or Imax), AND THE POWER (P_i or Pmax) THAT INTRINSICALLY SAVE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o, Voc, or Vt), THE CURRENT (I_o, Isc, or It), AND THE POWER (P_o or Pmax) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_i) AND THE INDUCTANCE (L_i) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO 5nF AND 10µH RESPECTVELY.
ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE (U_o (or Voc or Vt)) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF 50 µA FOR EACH CONNECTED DEVICE) SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R':	15...150 OHM/km
INDUCTANCE PER UNIT LENGTH L':	0.4...1mH/KM
CAPACITANCE PER UNLIT LENGTH C':	80...200nF

C' = C' LINE/LINE +0.5C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
C' = C' LINE/LINE +C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE

TRUNK CABLE LENGTH:	≤1000 m
SPUR CABLE LENGTH:	≤30 m
SPLICE LENGTH:	≤1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

R = 90...100 OHMS C = 2.2µF

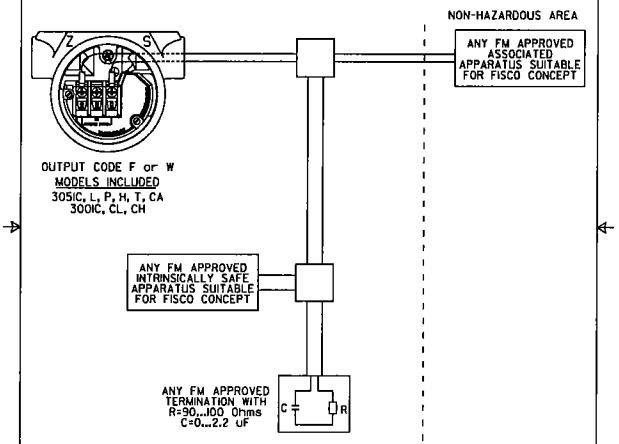
AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

NOTES:
INTRINSICALLY SAFE CLASS I, DIV. 1, GROUPS A, B, C, D

1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

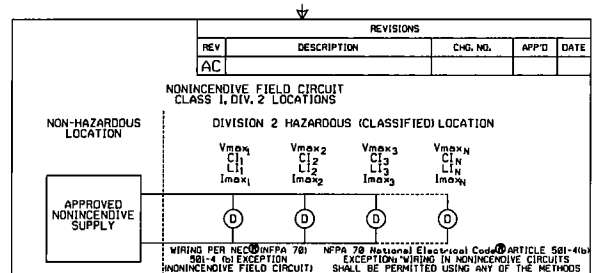
Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019	1019A0108
ISSUED	SCALE N/A	WT. ———	SHEET 10 OF 12	

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				



Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019	1019A0116
ISSUED	SCALE N/A	WT. ———	SHEET 11 OF 12	

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				



IN NORMAL OPERATION
DEVICES CONTROL THROUGH-CURRENT

PARAMETERS	DEVICE	ROSEMOUNT 3051/3001		
			4-20mA / HART	FIELDBUS (F or W)
Voc <=	Minimum of (Vmax1, Vmax2, ... VmaxN)	Vmax	48v	30v
	Imax1>= Iq1+Isignal1	Maximum normal operating current	22mA	27mA
	Imax2>= Iq1+Isignal2	Co	.81µF	8µF
	.	Lo	18µH	8µH
	.			
	.			
	ImaxN>= IqN + IsignalN			
Co <=	Ci1 + Ci2 +... + CiN + Cable			
Lo <=	Li1 + Li2 +... + LiN + Lcable			

ROSEMOUNT 3051 TRANSMITTERS ARE CURRENT CONTROLLERS ON INDIVIDUAL, PARALLEL BRANCHES WITH RESPECT TO THE POWER SUPPLY. IN NONINCENDIVE INSTALLATIONS THE Imax FOR EACH TRANSMITTER IS NOT RELATED TO THE MAXIMUM CURRENT OF THE POWER SUPPLY (Isc) IN THE SAME MANNER AS FOR TRANSMITTER INSTALLED PER I.S. REQUIREMENTS, BECAUSE NONINCENDIVE REQUIREMENTS INCLUDE ONLY NORMAL OPERATING CONDITIONS.

REFERENCE: APPENDIX A7.3 (FM3611)

Imax for an individual device = Iq + Isignal

Iq = Quiescent current through device (Maximum quiescent current for the device)

Isignal = Signaling current through device (Protocol may limit signaling to one device at a time)

Operating Imax = $Iq_1 + Iq_2 + ... + Iq_N + [I_{signal}\ max]$

$[I_{signal}\ max]$ = Max. of $(Isignal_1, Isignal_2, ... IsignalN)$

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. Joe Steffens	SIZE A	FSCM NO	DWG NO. 03031-1019	1019A0128
ISSUED	SCALE N/A	WT. ———	SHEET 12 OF 12	

Canadian Standards Association (CSA)
03031-1024

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA	ADD FIELDBUS	RTC1004232	M.L.M.	5/25/98
AB	ADD PROFIBUS, ENTITY PARAMETERS	RTC1008328	P.C.S.	7/1/98
AC	REM It, Vt FROM ENTITY PARAMETERS	RTC1009279	W.C.R.	7/11/98
AD	ADD FISCO FIELDBUS	RTC1012624	J.P.W.	11/1/02

APPROVALS FOR

3051C	3001C
3051L	3001CL
3051P	3001CH
3051H	3001S
3051CA	3001SL
3051T	3001SH

OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-3
OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 3-4
OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 5-7
OUTPUT CODES A,F,W I.S. ENTITY PARAMETERS SHEET 8-9

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

CAD MAINTAINED (MicroStation)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	EMERSON. Process Management	ROSEMOUNT 8200 Market Boulevard • Chanhassen, MN 55317 USA	
-TOLERANCE- .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°	DR. Mike Dahl 06/27/98	TITLE INDEX OF I.S. CSA FOR 3051C/L/P/H/T & 3001C/S		
	CHK'D			
DO NOT SCALE PRINT	APP'D. OLEN MONZON 6/30/98 APP'D. GOVT.	SIZE A	FSCM NO	DWG NO. 03031-1024
		SCALE N/A	WT. ———	SHEET 1 OF 9

1024A01B

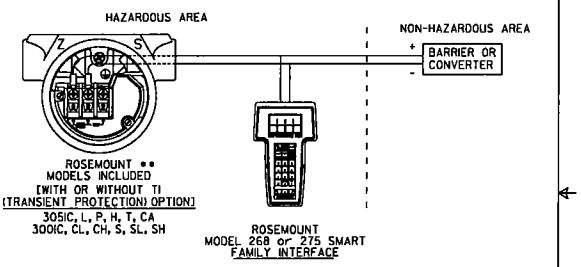
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

CSA INTRINSIC SAFETY APPROVALS

CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE
4-20 mA, ("A" OUTPUT CODE)



** FOR THE LOW POWER OPTION, SEE PAGE 4 FOR THE CIRCUIT CONNECTION WITH BARRIER OR CONVERTER. FOR FIELDBUS OPTIONS("F" or "W" OUTPUT CODE), SEE PAGE 5 FOR PARAMETERS AND CIRCUIT CONNECTION TO BARRIER.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)	
DR. Mike Dube 06/27/98	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ———	SHEET 2 OF 9

1024A02B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

4-20 mA, ("A" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I
CSA APPROVED SAFETY BARRIER	30 V OR LESS *330 OHMS OR MORE * 28 V OR LESS 300 OHMS OR MORE 25 V OR LESS 200 OHMS OR MORE * 22 V OR LESS 180 OHMS OR MORE	GROUPS A, B, C, D
FOXBORO CONVERTER 2AI-I2V-CGB, 2AI-I3V-CGB, 2AS-I3I-CGB, 3A2-I2D-CGB, 3A2-I3D-CGB, 3AD-I3I-CGB, 3A4-I2D-CGB, 2AS-I2I-CGB, 3F4-I2DA		GROUPS B, C, D
CSA APPROVED SAFETY BARRIER	30 V OR LESS 150 OHMS OR MORE	GROUPS C, D

LOW POWER, ("M" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I
CSA APPROVED SAFETY BARRIER	Supply ≤ 28V, ≥300 Ω Return ≤ 10V, ≥47 Ω	GROUPS A, B, C, D
	Supply ≤ 30V, ≥150 Ω Return ≤ 10V, ≥47 Ω	GROUPS C, D

* MAY BE USED WITH ROSEMOUNT MODEL 268 or 275 SMART FAMILY INTERFACE.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)	
DR. Mike Dube	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ———	SHEET 3 OF 9

1024A03B

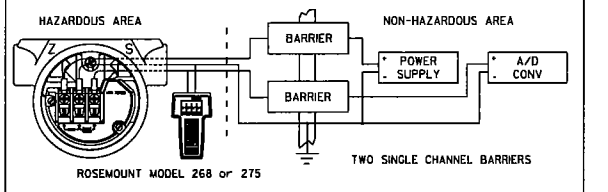
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

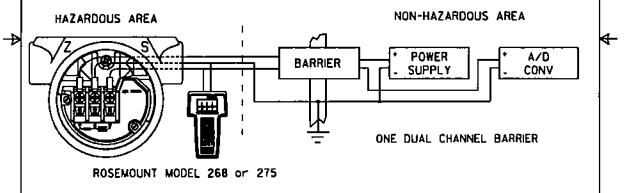
CSA INTRINSIC SAFETY APPROVALS

3051C LOW POWER CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE
LOWPOWER, ("M" OUTPUT CODE)





APPROVED FOR CLASS I, DIVISION I, GROUPS A,B,C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 28 VOLTS OR LESS AND 300 OHMS OR MORE IN +PWR LINE, AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE, OR ONE CSA APPROVED DUAL CHANNEL SAFETY BARRIER WITH IDENTICAL APPROVED SAFETY PARAMETERS CONNECTED IN LIKE MANNER, AS ABOVE.

APPROVED FOR CLASS I, DIVISION I, GROUPS C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 30 VOLTS OR LESS AND 150 OHMS OR MORE IN +PWR LINE AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)	
DR. SANDI MANSON	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ———	SHEET 4 OF 9

1024A04B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FIELDBUS, ("F" or "W" OUTPUT CODE)

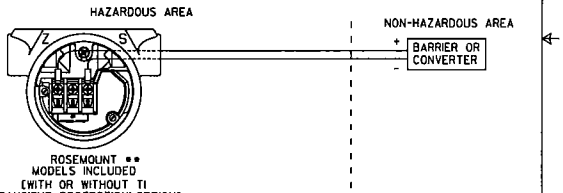
DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I
CSA APPROVED SAFETY BARRIER	30 V OR LESS 300 OHMS OR MORE 28 V OR LESS 235 OHMS OR MORE 25 V OR LESS 160 OHMS OR MORE 22 V OR LESS 100 OHMS OR MORE	GROUPS A, B, C, D

CSA INTRINSIC SAFETY APPROVALS

CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE
FIELDBUS, ("F" or "W" OUTPUT CODE)



WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA		CAD MAINTAINED (MicroStation)	
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ———	SHEET 5 OF 9

1024A05B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_i or Vmax), THE CURRENT (I_i or Imax), AND THE POWER (P_i or Pmax) THAT INTRINSICALLY SAVE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o, Voc, or Vt), THE CURRENT (I_o, Isc, or It), AND THE POWER (Po or Pmax) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_i) AND THE INDUCTANCE (L_i) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO 5nF AND 10μH RESPECTIVELY.
ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE U_o (or Voc or Vt) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF 50 μA FOR EACH CONNECTED DEVICE). SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R':	15...150 OHM/km
INDUCTANCE PER UNIT LENGTH L':	0.4...1mH/KM
CAPACITANCE PER UNLIT LENGTH C':	80...200nF

C' = C' LINE/LINE +0.5C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
C' = C' LINE/LINE +C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE

TRUNK CABLE LENGTH:	≤1000 m
SPUR CABLE LENGTH:	≤30 m
SPLICE LENGTH:	≤1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

R = 90...100 OHMS C = 2.2μF

AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

NOTES:
INTRINSICALLY SAFE CLASS I, DIV. I, GROUPS A, B, C, D

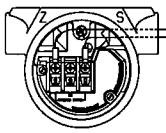
1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ———	SHEET 6 OF 9	1024A06B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

HAZARDOUS (CLASSIFIED) LOCATION
CLASS I, DIVISION 1, GROUPS A,B,C,D
CLASS II, DIVISION 1, GROUPS E,F,G
CLASS III, DIVISION 1

NON-HAZARDOUS AREA



ANY CSA APPROVED ASSOCIATED APPARATUS SUITABLE FOR FISCO CONCEPT

OUTPUT CODE F or W
MODELS INCLUDED
305IC, L, P, H, T, CA
300IC, CL, CH

ANY CSA APPROVED INTRINSICALLY SAFE APPARATUS SUITABLE FOR FISCO CONCEPT

ANY CSA PPROVED TERMINATION WITH R=90...100 Ohms C=0...2.2 uF



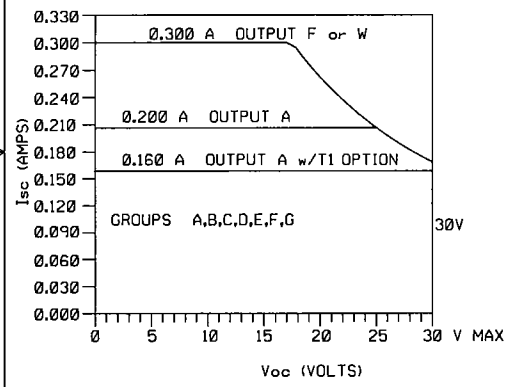
Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ———	SHEET 7 OF 9	1024A07B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

3051 I.S. ENTITY PARAMETERS. (OUTPUT CODE A,F, or W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE A,F, or W)

Pmax = 1.3 WATT OUTPUT F or W
Pmax = 1.0 WATT OUTPUT A



Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. JON STEFFENS	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ———	SHEET 8 OF 9	1024A08B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (Voc) AND MAX. SHORT CIRCUIT CURRENT (Isc) AND MAX. POWER (Voc X Isc/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (Vmax), MAXIMUM SAFE INPUT CURRENT (Imax), AND MAXIMUM SAFE INPUT POWER (Pmax) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (C_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_i) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A

CLASS I, DIV. I, GROUPS A, B, C AND D

V_{MAX} = 30V	V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 200mA	I_{SC} IS LESS THAN OR EQUAL TO 200mA
P_{MAX} = 1 WATT	$\frac{(V_{OC} \times I_{SC})}{4}$ IS LESS THAN OR EQUAL TO 1 WATT
C_i = .0μf	C_a IS GREATER THAN .0μf + C CABLE
L_i =10μH	L_a IS GREATER THAN 10μH + L CABLE

* FOR T1 OPTION:

Imax = 160mA	I_{SC} IS LESS THAN OR EQUAL TO 160mA
L_i =1.05mH	L_a IS GREATER THAN 1.05mH + L CABLE

FOR OUTPUT CODE F or W

CLASS I, DIV. I, GROUPS A, B, C AND D

V_{MAX} = 30V	V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 300mA	I_{SC} IS LESS THAN OR EQUAL TO 300mA
P_{MAX} = 1.3 WATT	$\frac{(V_{OC} \times I_{SC})}{4}$ IS LESS THAN OR EQUAL TO 1.3 WATT
C_i = 0μf	C_a IS GREATER THAN 0μf + C CABLE
L_i = 0μH	L_a IS GREATER THAN 0μH + L CABLE

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA			CAD MAINTAINED (MicroStation)	
DR. JON STEFFENS	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ———	SHEET 9 OF 9	1024A09B

Standards Association of Australia (SAA)
03031-1026

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	AA	UPDATE ENTITY PARAMETERS	RTC1002910	J.D.J.	12/12/97
	AB	ADD FIELDBUS AND PROFIBUS	RTC1006448	J.D.J.	1/26/99

SAA ENTITY CONCEPT APPROVALS

3051C 3001C
3051L 3001CL
3051P 3001CH
3051H 3001S
3051CA
3051T

OUTPUT CODE A (4-20 mA HART) SEE SHEETS 2
OUTPUT CODE M (LOW POWER) SEE SHEETS 3
OUTPUT CODE F / W (FIELDBUS, PROFIBUS) SEE SHEETS 4

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED ABOVE ARE INTRINSICALLY SAFE WHEN USED IN THE CURCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LIST ENTITY PERAMETERS.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

CAD Maintained, (MICROSTATION)

UNLESS OTHERWISE SPECIFIED DIMENSION TO BEDEBURRED REMOVE ALL BURRS AND SHARP EDGES MACHINE SURFACE FINISH 125 -TOLERANCE- .X ± .1 (2.5) .XX ± .02 (0.5) .XXX ± .010 (0.25) FRACTIONS ± 1/32 ANGLES ± 2° DO NOT SCALE PRINT

CONTRACT NO.

DR. Mike Dube 12/30/97
CHK'D
APP'D. GLEN MONZO 5/8/98
APP'D. GOVT.

ROSEMOUNT MEASUREMENT — FISHER-ROSEMOUNT

TITLE: SAA I.S. INDEX FOR 3051 & 3001

SIZE A | FSCM NO | DWG NO. 03031-1026
SCALE N/A | WT. ——— | SHEET 1 OF 4

1026A01B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

OUTPUT CODE "A" (4-20MA / HART)
SAA ENTITY CONCEPT APPROVALS

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED BELOW ARE INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS

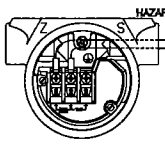
3051C 3051H 3001C 3001S
3051L 3051T 3001CL
3051P 3051CA 3001CH

ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
Vmax = 30V Imax = 200mA Pmax = 0.9W	Voc IS LESS THAN OR EQUAL TO 30V Isc IS LESS THAN OR EQUAL TO 200mA Voc * Isc / 4 IS LESS THAN OR EQUAL TO 0.9W
Ci = 0.01µF Li = 10µH	Ca IS GREATER THAN 0.01 MICROFARADS La IS GREATER THAN 10 MICROHENRIES
FOR TI OPTION ONLY Imax = 180mA Li = 1.05mH	Isc IS LESS THAN OR EQUAL TO 180mA La IS GREATER THAN 1.05 MILLIHENRIES

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

CAD Maintained, (MICROSTATION)

DR. Mike Dube
ISSUED

SIZE A | FSCM NO | DWG NO. 03031-1026
SCALE N/A | WT. ——— | SHEET 2 OF 4

1026A02B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

OUTPUT CODE "M" (LOW POWER)
SAA ENTITY CONCEPT APPROVALS

THE ROSEMOUNT LOW POWER CONFIGURED PRESSURE TRANSMITTERS LISTED BELOW ARE SAA APPROVED AS INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS WITH LOW POWER CONFIGURATION

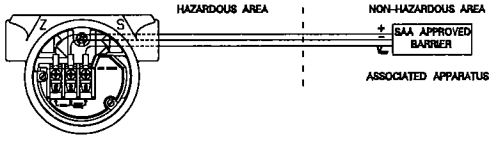
3051C 3051T
3051L 3051CA
3051P
3051H

ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
Vmax = 30V Imax = 200mA Pmax = 0.9W	Voc IS LESS THAN OR EQUAL TO 30V Isc IS LESS THAN OR EQUAL TO 200mA Voc * Isc / 4 IS LESS THAN OR EQUAL TO 0.9W
Ci = 0.042µF Li = 10µH	Ca IS GREATER THAN 0.042 MICROFARADS La IS GREATER THAN 10 MICROHENRIES
FOR TI OPTION ONLY Li = 0.75mH	La IS GREATER THAN 0.75 MILLIHENRIES

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

CAD Maintained, (MICROSTATION)

DR. Mike Dube
ISSUED

SIZE A | FSCM NO | DWG NO. 03031-1026
SCALE N/A | WT. ——— | SHEET 3 OF 4

1026A03B

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1006448		

OUTPUT CODE F / W (FIELDBUS, PROFIBUS)
SAA ENTITY CONCEPT APPROVALS

THE ROSEMOUNT PRESSURE TRANSMITTERS LISTED BELOW ARE INTRINSICALLY SAFE WHEN USED IN THE CIRCUIT WITH SAA APPROVED BARRIERS WHICH MEET THE LISTED ENTITY PARAMETERS.

APPROVED TRANSMITTERS

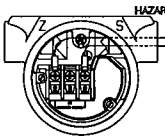
3051C 3051H 3001C 3001S
3051L 3051T 3001CL
3051P 3051CA 3001CH

ENTITY PARAMETER FOR Ex ia IIC T5 CLASS I, ZONE 0 PROTECTION:

APPARATUS PARAMETER	BARRIER PARAMETER
Vmax = 30V Imax = 300mA Pmax = 1.3W	Voc IS LESS THAN OR EQUAL TO 30V Isc IS LESS THAN OR EQUAL TO 300mA Voc * Isc / 4 IS LESS THAN OR EQUAL TO 1.3W
Ci = 0 µF Li = 0µH	Ca IS GREATER THAN 0 MICROFARADS La IS GREATER THAN 0 MICROHENRIES

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURERS FIELD WIRING INSTRUCTIONS AND THE CIRCUIT DIAGRAM SHOWN BELOW.



Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

CAD Maintained, (MICROSTATION)

DR. Mike Dube
ISSUED

SIZE A | FSCM NO | DWG NO. 03031-1026
SCALE N/A | WT. ——— | SHEET 4 OF 4

1026A04B

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY	REVISIONS				
	REV	DESCRIPTION	CHG. NO.	APP'D	DATE
	G	ADD SHT 4&5, DELETE CLASS II &I	T. 636328	R.S.J.	01/01/98
	H	ADD 3051 P/L/H, 3001C CL /CH	636904	K.D.V.	01/26/98
	J	ADD SHT. 6, FIX TBL. 1,	638723	R.S.J.	01/30/98
	K	ADD 3044C	641710	W.R.K.	05/12/98
	L	ADD 3001S & SHT 7 FOR 3051C-LP	642380	G.B.M.	6/13/98
	M	ADD 3095	653145	K.D.V.	4/8/99

THE ROSEMOUNT MODEL 268 SMART FAMILY INTERFACE IS APPROVED BY FACTORY MUTUAL AS INTRINSICALLY SAFE FOR THE CLASS I, DIVISION 1 GROUPS INDICATED WHEN USED IN CIRCUIT WITH THE BARRIERS AND CONVERTERS LISTED BELOW AND THE ROSEMOUNT SMART FAMILY TRANSMITTERS DEPICTED IN THE ACCOMPANYING CIRCUIT DIAGRAMS.

BARRIER MANUFACTURER	MODEL	APPROVED FOR CLASS I DIVISION 1, GROUPS
FOXBORO	2AI-I2V-FGB 2AI-I3V-FGB 2A5-I3I-FGB 3A2-I2D-CS-E/FGB-A 3A2-I3D-CS-E/FGB-A	A,B,C,D
HONEYWELL	38545-000-0110-113-F5B5 38545-000-0110-111/112-F5B5	C,D
MTL	115 122 322 715 722	A,B,C,D
R. STAHL	8901/31-199/100/7 8901/30-199/100/7 8901/31-280/165/7 8901/30-280/165/7	C,D C,D
	[8903/51-200/050/7 [8901/31-086/150/7	A,B,C,D A,B,C,D
	[8901/31-280/165/7 [8901/31-086/150/7	C,D C,D
	9005/01-245/060 9005/01-252/100	A,B,C,D A,B,C,D
TAYLOR	5850FL81200 5851FL81200 1130FF21000 1130FF22000 1135FF21000 1135FF22000	C,D

CAD Maintained, (MICROSTATION).

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm] REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	ROSEMOUNT MEASUREMENT FISHER-ROSEMOUNT	ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA
-TOLERANCE- .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°	DR. MIKE DOBE 2/7/98	TITLE INDEX OF I.S. BARRIER SYSTEMS FOR MOD. 268 SMART FAMILY INTERFACE	
DO NOT SCALE PRINT	CHK'D	SIZE A / FSCM NO / DWG NO. 00268-0031	
	APP'D. K.CARLSON 03/13/98	SCALE / WT. / SHEET 1 OF 7	
	APP'D. GOVT.		

0031401A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (V_T OR V_{OC}) AND MAXIMUM SHORT CIRCUIT CURRENT (I_T OR I_{SC}) AND MAXIMUM OUTPUT POWER ($\frac{V_{OC} \times I_{SC}}{4}$ OR $\frac{V_T \times I_T}{4}$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{MAX}), MAXIMUM SAFE INPUT CURRENT (I_{MAX}) AND MAXIMUM SAFE INPUT POWER (P_{MAX}) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (C_A) AND INDUCTANCE (L_A) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE MAXIMUM UNPROTECTED INTERNAL CAPACITANCE (C_i) AND INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS. THE APPROVED ENTITY CONCEPT PARAMETERS ARE AS FOLLOWS: ARE AS FOLLOWS:

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

INPUT PARAMETERS (CLASS I, DIV. 1, GROUPS A, B, C, D)				
VMAX = 32 VDC				V_T or V_{OC} of barrier must be ≤ 32 Vdc
IMAX = 186 MA				I_T or I_{SC} of barrier must be ≤ 186 mA
CI = 0.01 UF				C_A of barrier must be ≥ 0.01 µF
LI = 1.1 MH				L_A of barrier must be ≥ 1.1 mH
PMAX:	1.1W	0.8W	0.6W	$\frac{V_{OC} \times I_{SC}}{4}$ of barrier must be ≤ specified value.
TEMP CODE	T4A	T5	T6	

OUTPUT PARAMETERS
VOC = 1.5 VD.C.
ISC = 27 MA
C_A = 10.000 UF
L_A = 46 MH

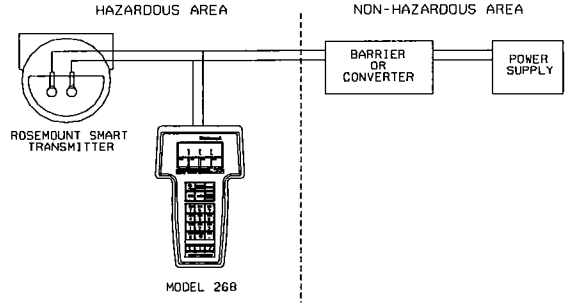
ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. D.PEARSON	SIZE A / FSCM NO / DWG NO. 00268-0031
ISSUED	SCALE N/A / WT. / SHEET 2 OF 7

0031A02A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



ROSEMOUNT SMART TRANSMITTERS

MODEL	1151 SMART
MODEL	3051
MODEL	3051C, 3051P, 3051L, 3051H, 3051CA
MODEL	3044
MODEL	3044C
MODEL	3001C, 3001CL, 3001CH
MODEL	3311
MODEL	3001S, 3001SL, 3001SH
MODEL	3095

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. D.PEARSON	SIZE A / FSCM NO / DWG NO. 00268-0031
ISSUED	SCALE N/A / WT. / SHEET 3 OF 7

0031A03A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

THE MAXIUM ALLOWABLE CONNECTED INDUCTANCE (L_a) OF THE ASSOCIATED APPARATUS IS DETERMINED BY ADDING 27 mA TO THE I_{SC} OF THE BARRIER ($I_m = I_{SC}$ + 27mA AND ENTERING TABLE 1 (SHT 5) AT THE RESULTING VALUE, I_m, OR THE NEXT HIGHER VALUE OF I_m, TO DETERMINE THE L_a, (THE L_a MUST INCLUDE THE L_i OF THE MODEL 268, WHICH IS 1.1mH).

EXAMPLE #1: I_{SC} OF BARRIER = 100mA.

I_m = 100mA + 27mA = 127mA

ENTER TABLE AT I_m = 130mA; L_a = 2.0mH

--WARNING-- BEFORE CONNECTING THE MODEL 268 INTO THE LOOP, DETERMINE THE CONNECTED INDUCTANCE OF THE SYSTEM BY ADDING THE L_i OF THE TRANSMITTER, CABLE, AND MODEL 268. THE SUM MUST BE LESS THAN THE L_a DETERMINED FROM THE TABLE IN ORDER FOR THE MODEL 268 TO BE CONNECTED INTO THE LOOP. IF THE CONNECTED INDUCTANCE IS GREATER THAN THE VALUE DETERMINED FROM THE TABLE, A BARRIER WITH A LOWER I_{SC} MUST BE CHOSEN.

EXAMPLE #2: BARRIER ISC = 41.8mA; BARRIER LA = 20.0mH

IM = 41.8mA + 27mA = 68.8mA;

ENTER TABLE AT 70mA AND READ L_a = 7.5mH

ADD CONNECTED INDUCTANCE OF SYSTEM:

MODEL 268	L_i = 1.1mH
MODEL 3051 TRANSMITTER	L_i = 0.48mH
INDUCTANCE OF LOOP WIRING	1.0mH
TOTAL CONNECTED INDUCTANCE	= 2.58mH

TOTAL CONNECTED INDUCTANCE IS LESS THAN L_a = 7.5 mH AS DETERMINED ABOVE AND IS ALSO LESS THAN THE BARRIER L_a. THE MODEL 268 MAY SAFELY BE CONNECTED INTO THE LOOP. IF THE MODEL 751 INDICATORS ARE USED, THEIR TOTAL INDUCTANCE (LABEL VALUE * NUMBER OF INDICATORS) MUST ALSO BE INCLUDED.

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. S.BARDUSON 30JUL'98	SIZE A / FSCM NO / DWG NO. 00268-0031
ISSUED	SCALE N/A / WT. / SHEET 4 OF 7

0031A04A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

Im (mA)	La ()mH)
150	1.3
145	1.5
140	1.6
130	2.0
120	2.5
110	3.0
100	4.0
90	5.0
85	5.5
80	6.0
75	6.7
70	7.5
65	8.8
62	9.5
60	10.0
57	11.0
55	12.0
50	15.0
45	19.0
40	23.0
35	31.0

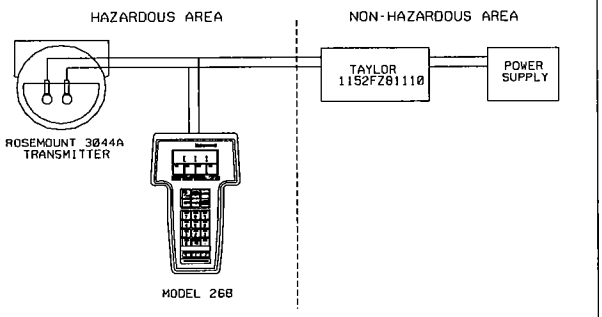
TABLE 1

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA		CAD Maintained, (MICROSTATION).	
DR. S.BARDUSON 30JUL'98	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT.	SHEET 5 OF 7

0031A05A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE

TAYLOR 1152FZ81110 SYSTEM

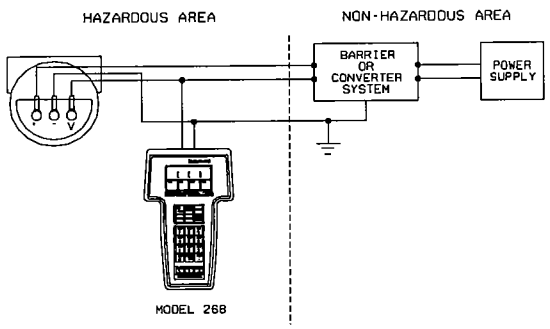


ROSEMOUNT 3044A SMART TRANSMITTERS MAY BE PLACED IN A CLASS I, DIVISION 1, GROUP A, B, C, D HAZARDOUS LOCATION AS SHOWN ABOVE. THE LOOP POWER IS LIMITED BY A TAYLOR 1152FZ81110 INTRINSIC SAFETY BARRIER. THE ROSEMOUNT 268 MAY ALSO BE CONNECTED IN THE LOOP AS SHOWN. FOR CABLE WITH CAPACITANCE OF 60 PF/FT OR LESS AND INDUCTANCE OF .2 UH/FT OR LESS; CABLE LENGTHS OF UP TO 1600 FEET ARE ALLOWED.

TRANSMITTER: ROSEMOUNT 3044A
BARRIER: TAYLOR 1152FZ81110
COMMUNICATOR: ROSEMOUNT 268
CABLE: CMAX = 60 PF/FT
LMAX = .2 UH/FT
MAX. LENGTH = 1600 FT

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA		CAD Maintained, (MICROSTATION).	
DR. C. SCRIBNER 12/21/98	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT.	SHEET 6 OF 7

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



CONNECTION FOR LOW POWER VERSIONS
OF THE FOLLOWING
ROSEMOUNT SMART TRANSMITTERS

MODEL 3051C, 3051P, 3051L, 3051H, 3051CA
MODEL 3001C, 3001CL, 3001CH
MODEL 3001S, 3001SL, 3001SH

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA		CAD Maintained, (MICROSTATION).	
DR. SANDI MANSON 8/8/91	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT.	SHEET 7 OF 7

0031A07A

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Model 3051

Reference Manual
00809-0100-4001, Rev EA
December 2002

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Emerson Process Management

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41074-215-1 pH Transmitter

Solu comp II analyzer 1055
Model 1055-01-11-22
01 Power 115/230 VAC, 50/60hz
11 Mounting: Surface mount
22 Measurement: pH/ORP temp

41074-215-2 pH Probe

pH sensor 385+
Model 385+-02-11
02 Body config: retractable with integral preamplifer
11 Combination electrode: High pH

With Ext Cable, 11 cond, shielded, unprepped, 15ft [Part # 9200273]

ROSEMAOUNT EMERSON PROCESS
LIQUID ANALYTICAL DIVSION

Contact: Rod Abucejo
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DESIGNER FD	DATE 6/7/04	TITLE pH PROBE & TRANSMITTER
CHECKER	DATE	CLIENT JET PROPULSION LAB, NASA
ENGINEER FD	DATE 6/7/04	USFilter Envirex Products Waukesha, WI 800-524-6324
MANAGER RDH	DATE	
FILE:		
SCALE:		

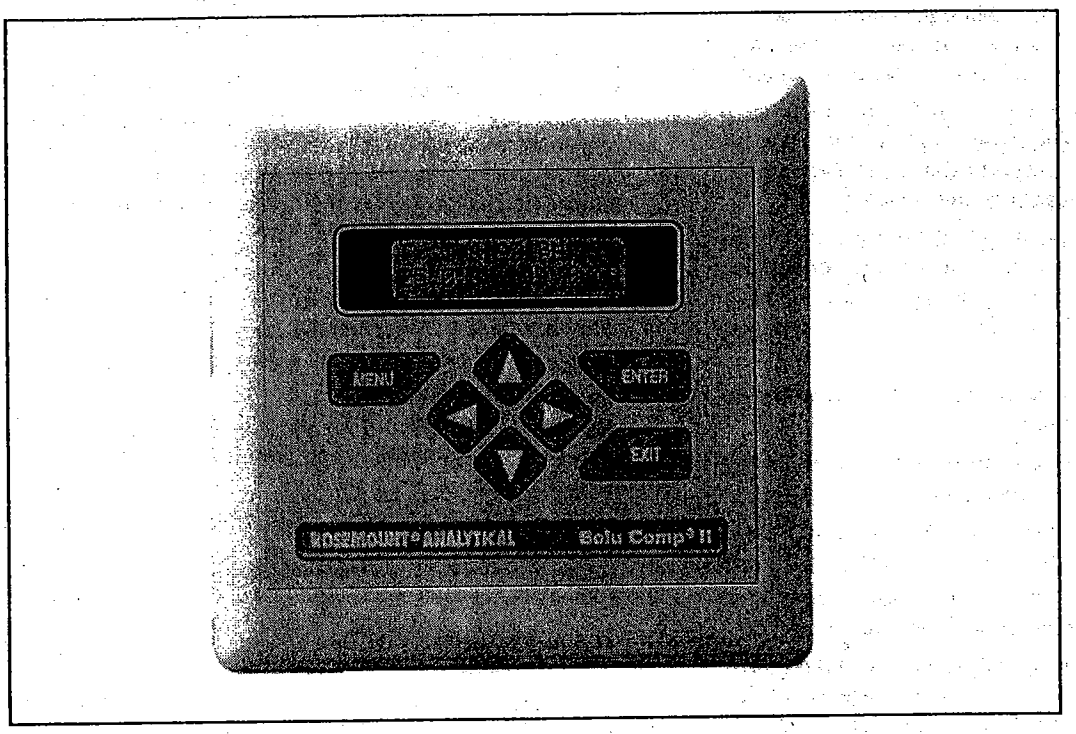
PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-215	1 OF 1	0

Instruction Manual
PN 51-1055pH/rev.F
April 2003

Model Solu Comp® II

Dual Input pH Analyzer

Model Options 1055-22-32 and 1055-22



ROSEMOUNT® Analytical

EMERSON. Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Your purchase from Rosemount Analytical, Inc. has resulted in one of the finest instruments available for your particular application. These instruments have been designed, and tested to meet many national and international standards. Experience indicates that its performance is directly related to the quality of the installation and knowledge of the user in operating and maintaining the instrument. To ensure their continued operation to the design specifications, personnel should read this manual thoroughly before proceeding with installation, commissioning, operation, and maintenance of this instrument. If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.

- Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.
- Ensure that you have received the correct model and options from your purchase order. Verify that this manual covers your model and options. If not, call 1-800-854-8257 or 949-757-8500 to request correct manual.
- For clarification of instructions, contact your Rosemount representative.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Use only qualified personnel to install, operate, update, program and maintain the product.
- Educate your personnel in the proper installation, operation, and maintenance of the product.
- Install equipment as specified in the Installation section of this manual. Follow appropriate local and national codes. Only connect the product to electrical and pressure sources specified in this manual.
- Use only factory documented components for repair. Tampering or unauthorized substitution of parts and procedures can affect the performance and cause unsafe operation of your process.
- All equipment doors must be closed and protective covers must be in place unless qualified personnel are performing maintenance.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.

WARNINGS

RISK OF ELECTRICAL SHOCK

⧈ Equipment protected throughout by double insulation.

- Installation of cable connections and servicing of this product require access to shock hazard voltage levels.
- Main power and relay contacts wired to separate power source must be disconnected before servicing.
- Do not operate or energize instrument with case open!
- Signal wiring connected in this box must be rated at least 240 V.
- Non-metallic cable strain reliefs do not provide grounding between conduit connections! Use grounding type bushings and jumper wires.
- Unused cable conduit entries must be securely sealed by non-flammable closures to provide enclosure integrity in compliance with personal safety and environmental protection requirements. Unused conduit openings must be sealed with NEMA 4X or IP65 conduit plugs to maintain the ingress protection rating (NEMA 4X).
- Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.
- Operate only with front and rear panels fastened and in place over terminal area.
- Safety and performance require that this instrument be connected and properly grounded through a three-wire power source.
- Proper relay use and configuration is the responsibility of the user.

CAUTION

This product generates, uses, and can radiate radio frequency energy and thus can cause radio communication interference. Improper installation, or operation, may increase such interference. As temporarily permitted by regulation, this unit has not been tested for compliance within the limits of Class A computing devices, pursuant to Subpart J of Part 15, of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area may cause interference, in which case the user at his own expense, will be required to take whatever measures may be required to correct the interference.

WARNING

This product is not intended for use in the light industrial, residential or commercial environments per the instrument's certification to EN50081-2.

Emerson Process Management

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Irvine, CA 92606 USA
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Fax: (949) 474-7250

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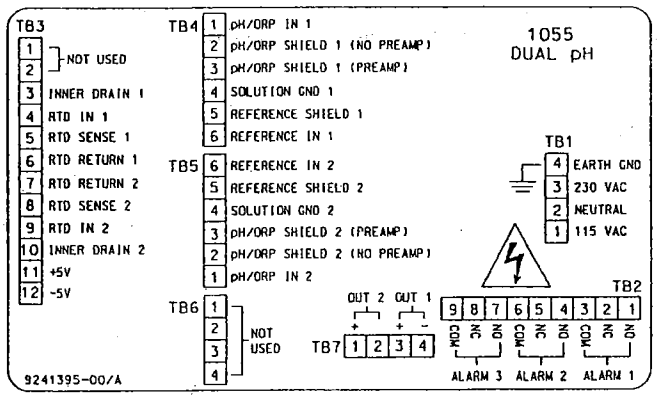
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QUICK START GUIDE

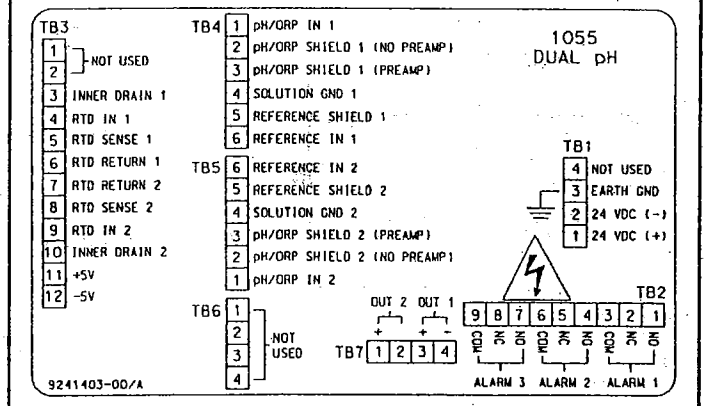
FOR MODEL SOLU COMP II pH/ORP ANALYZER

(Model Options 1055-22-32 and 1055-22)

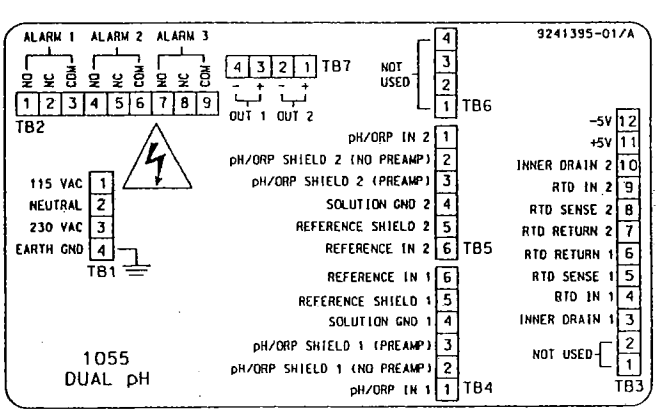
1. Refer to Section 2.0 for installation instructions.
2. Wire pH (or ORP) sensor(s) to the analyzer. See the drawings below. Refer to the sensor instruction sheet for details. Make alarm, output, and power connections as shown below.



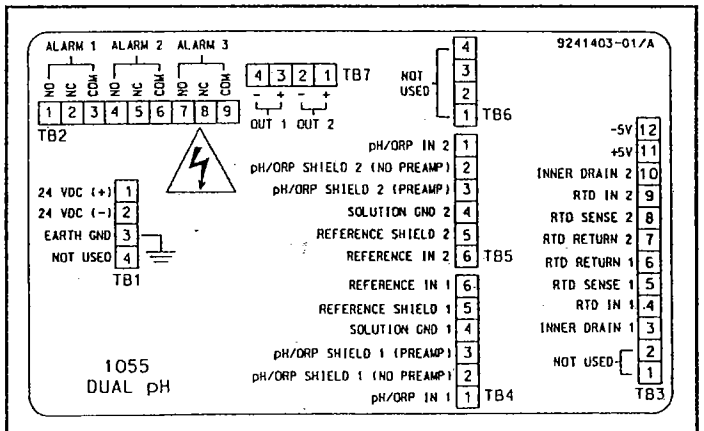
Wiring Connections for Solu Comp II Model 1055-01-10 (Panel Mount with 115/230 Vac Power)



Wiring Connections for Solu Comp II Model 1055-02-10 (Panel Mount with 24 Vdc Power)



Wiring Connections for Solu Comp II Model 1055-01-11 (Surface/Pipe Mounting with 115/230 Vac Power)



Wiring Connections for Solu Comp II Model 1055-02-11 (Surface/Pipe Mounting with 24 Vdc Power)

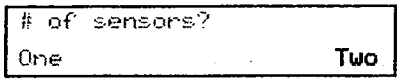
3. Once connections are secured and verified, apply power to the analyzer.

CONTINUED ON THE FOLLOWING PAGE

4. When the analyzer is powered up for the first time, **Quick Start** screens appear. Using **Quick Start** is easy.
   a. A blinking field shows the position of the cursor.
   b. Use the ◄ or ► key to move the cursor left or right. Use the ▲ or ▼ key to increase or decrease the value of a digit. Use the ▲ or ▼ key to move the decimal point.
   c. Press ENTER to store a setting. Press EXIT to leave without storing changes. Pressing EXIT also returns the display to the previous screen.



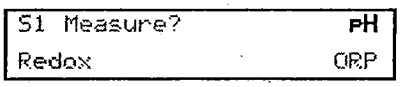
5. Choose the desired language. Choose >> to show more choices.



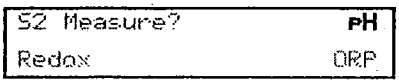
6. Choose the number of sensors wired to the analyzer.

NOTE

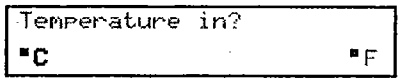
If **One** sensor is selected, only **S1** will be available. **S2** cannot be disabled.



7. Choose the measurement for sensor 1.



8. Choose the measurement for sensor 2.

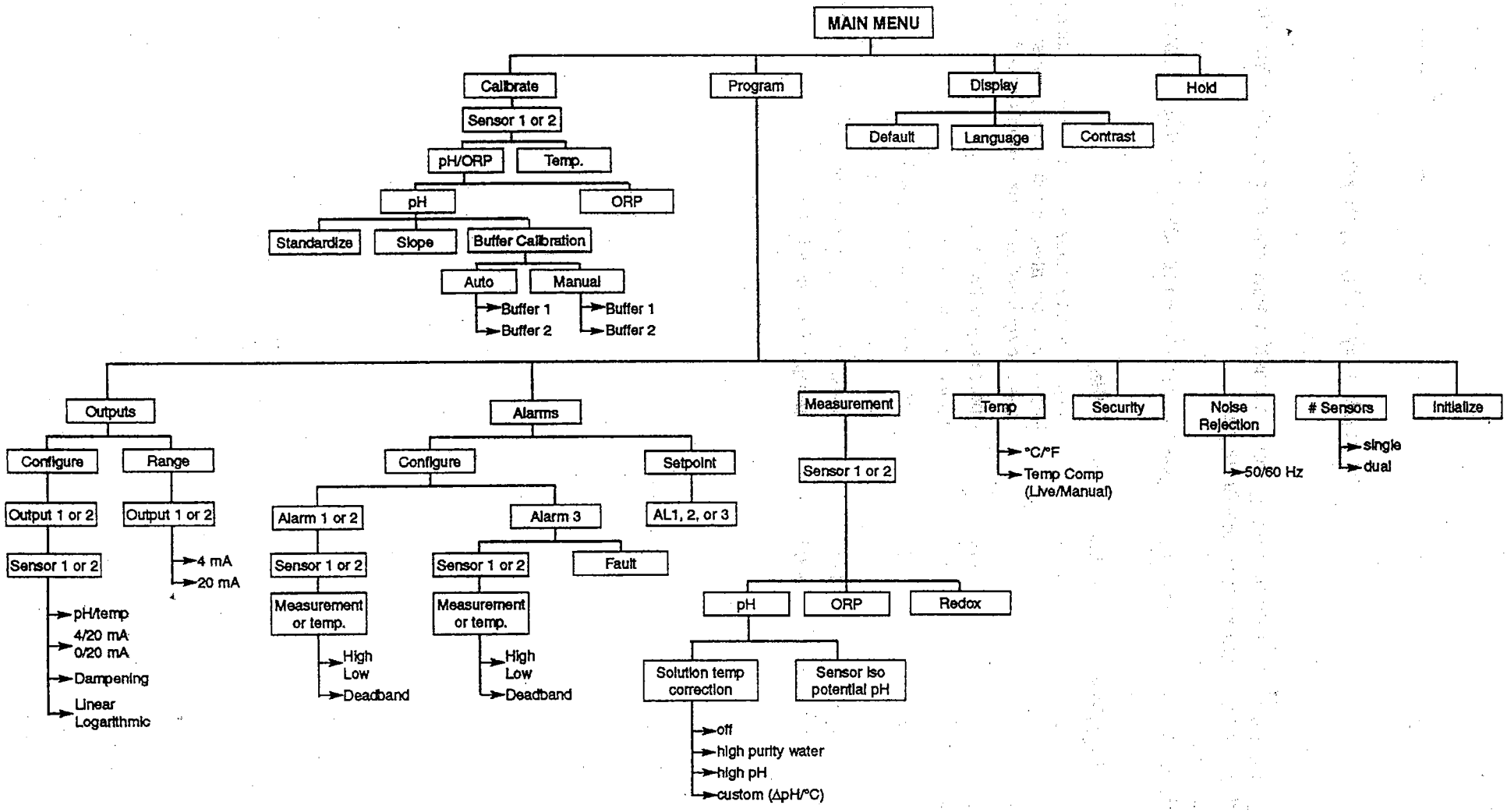


9. Choose temperature units.

10. The main display appears. The outputs and alarms are assigned to default values. To change settings, refer to Section 5.0, Programming the Analyzer. To reinstall factory settings and return to Quick Start, see Section 5.10.

QUICK REFERENCE GUIDE

MENU TREE FOR pH/ORP/REDOX MEASUREMENTS



About This Document

This manual contains instructions for installation and operation of the Solu Comp II Model 1055 Dual Input pH Analyzer.

The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
0	7/00	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering.
A	2/02	Update specs (p. 2).
B	7/02	Added UL specs info
C	9/02	Fixed minor typos throughout
D	10/02	deleted option code -41 reference of p. 3
E	2/03	Revised specs & maintenance info (p. 5, 9, 45, 46)
F	4/03	Update CE specs info (p. 2, 9)

MODEL SOLU COMP II DUAL INPUT pH ANALYZER

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SECTION 1.0. DESCRIPTION AND SPECIFICATIONS

1.1 FEATURES AND APPLICATIONS
1.2 SPECIFICATIONS
1.3 ORDERING INFORMATION AND ACCESSORIES

1.1 FEATURES AND APPLICATIONS

The Solu Comp II analyzers offer the choice of single or dual sensor input with measurement choices of pH/ORP, resistivity/conductivity/TDS, % concentration, ratio conductivity, total and free chlorine, dissolved oxygen, dissolved ozone, flow and temperature. Dual measurement analyzers offer a wide choice of measurement combinations thus reducing the cost per loop and needed panel space.

FIELD COMMISSION OPTION: The Solu Comp II can be ordered with the ability to commission measurements in the field. This added flexibility can greatly reduce the number of spare instruments required for field servicing.

QUICK START PROGRAMMING: Exclusive Quick Start screens appear the first time the Solu Comp II is powered up. Screen prompts direct the user to register the number of sensors, the measurement unit(s) and the language to display. Some measurement specific prompts are also displayed. The measurement loop is ready for use in a matter of minutes.

MENUS: Menu screens for calibrating and registering choices are simple and intuitive. Plain language prompts guide the user through the procedures. There are no service codes to enter before gaining access to menus.

DUAL SENSOR INPUT AND OUTPUT: The Solu Comp II accepts single or dual sensor input. The two 4-20 mA outputs can be independently programmed to correspond to any selected measurement or temperature. Output damping and linear or log output may also be field selected.

ALARMS: The Solu Comp II has three fully programmable alarm relays that can be assigned to any selected measurement or temperature. Alarms can be configured as high, low, or USP 23[1]. The third relay has the additional choice of fault alarm operation. When selected, a fault alarm will activate the relay when a sensor or analyzer fault occurs.

ENCLOSURE: The panel mount version fits standard ½ DIN panel cutouts, and its shallow depth is ideally suited for easy mounting in Hoffman-type enclosures. A panel mount gasket is included to maintain the weather rating of the panel. Surface/pipe mount enclosure includes self-tapping screws for surface mounting. A pipe mounting accessory kit is available for mounting to a 2-inch pipe.

DISPLAY: The two-line, 16-character, back-lit display can be customized to meet user requirements. All operations and descriptive messages can be field selected for English, French, German, Italian, Spanish, or Portuguese. Informative screens, which permit data not shown in the regular display, may be seen at the push of a button.

TEMPERATURE: Most measurements (except ORP and flow) require temperature compensation. The Solu Comp II will automatically recognize either a Pt100 or Pt1000 RTD, normally built into the sensor. When this RTD is present, the Solu Comp II can be set up to display the temperature in °C or °F as well as set any one or more of the alarms and/or outputs to respond to this sensor input. If two measurements with temperature are present either can be chosen for each alarm and output selected.

[1]USP 23 alarm applies to conductivity/resistivity only.

1.2 SPECIFICATIONS - General

Case: ABS. Pipe, surface, and panel mount versions are NEMA 4X/CSA 4 (IP65).

Dimensions

Panel (code -10): 6.10 x 6.10 x 3.72 in. (155 x 155 x 94.5 mm)

Surface/Pipe (code -11): 6.23 x 6.23 x 3.23 in. (158 x 158 x 82 mm); see page 5 for dimensions of pipe mounting bracket.

Conduit openings: Accepts PG13.5 or 1/2 in. conduit fittings

Display: Two line, 16-character, back-lit display. Character height: 4.8 mm. Display can be customized to meet individual requirements. Depending on number of sensors, as many as 14 display screens are available.

Ambient temperature and humidity: 0 to 50°C, (32 to 122°F) RH 5 to 95% (non-condensing)

Note: The analyzer is operable from -20 to 60°C (-4 to 140°F) with some degradation in display performance.

Power:

Code -01: 115/230 Vac ±15%, 50/60 Hz ±6%, 8.0W
Code -02*: 24 Vdc ±15%, 6.0W
Installation Category II

** For +24Vdc Power Supply use only devices meeting NEC Class II or UL recognized (UL 1950).*

⧈ Equipment protected throughout by double insulation.

Hazardous Location:

CSA LR 34186 C US — Class I, Division 2, Groups A, B, C, & D — FM APPROVED

POLLUTION DEGREE 4: Extended Environment Outdoor use where conductive contamination such as rain, snow, or dust may be present. (Hazardous Location only)

Ordinary Location: (-68 only)

UL LISTED

12RN

POLLUTION DEGREE 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

RFI/EMI: EN-61326
LVD: EN-61010-1 CE

Input: Choice of single or dual sensor input with measurement choices of pH/ORP, conductivity/resistivity, toroidal conductivity, flow, chlorine, dissolved oxygen, and dissolved ozone. Field-commissioned units allow user to change measurements on either or both inputs. See combination guide for valid combinations. For contacting conductivity measurements, temperature element must be a Pt 1000 RTD. For other measurements, use either a Pt100 RTD, Pt1000 RTD, or 22k NTC (D.O. only).

Outputs: Two 4-20 mA or 0-20 mA isolated outputs. Continuously adjustable. Linear or logarithmic. Maximum load 600 ohms. Output dampening with time constant of 5 sec is user-selectable.

Alarms: Three alarm relays for process measurement(s) or temperature. Alarm 3 can be configured as a fault alarm, instead of a process alarm. Each relay can be configured independently. Alarm logic (high or low activation or USP 23*) and deadband are user-programmable. The USP 23* alarm can be programmed to activate when the conductivity is within a user-selectable percentage of the limit.

**conductivity/resistivity measurement only*

Relays: Form C, single pole double throw, epoxy sealed

	Resistive	Inductive
28 Vdc	5.0 A	3.0 A
115 Vac	5.0 A	3.0 A
230 Vac	5.0 A	1.5 A

Terminal Connections Rating: 26-14 AWG wire size

Weight/Shipping weight (rounded up to nearest lb or nearest 0.5 kg): 3 lb (1.5 kg)/4 lb (2.0 kg)

CONTACTING CONDUCTIVITY (Codes -20 and/or -30)

Measures conductivity in the range 0 to 20,000 µS/cm. Display choices are conductivity, resistivity, and TDS (total dissolved solids). Three temperature corrections are available: high purity water (dilute sodium chloride), cation conductivity (dilute hydrochloric acid), and adjustable linear temperature coefficient (0 to 5.00%/°C). Temperature correction can be disabled, allowing the analyzer to display raw conductivity.

PERFORMANCE SPECIFICATIONS -

Range	Cell constant (/cm)	Accuracy[1,2]
0.055 - 9.99 µS/cm	0.01	0.9% of reading or ±0.002 µS/cm
10 - 50 µS/cm	0.01	±2% of reading
0.055 - 500 µS/cm	0.1	±2% of reading or ±0.1 µS/cm
0.055 - 5000 µS/cm	1.0	±2% of reading or ±1 µS/cm
0 - 5 mS/cm	1.0	±2% of reading or ±0.001 mS/cm
0 - 20 mS/cm	10	±2% of reading or ±0.01 mS/cm

ANALYZER (CONDUCTIVITY INPUT)

Accuracy (Resistivity):** 0.9% of reading

Accuracy (Temperature):** ±0.1°C between 5°C and 100°C; ±1°C between 101°C and 200°C

Stability: 0.5% of reading/month

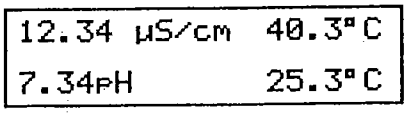
Ambient Temperature Effect: ±0.05% of reading/°C

Output Accuracy: ±0.1 mA

Temperature correction: High purity water (dilute sodium chloride), cation conductivity (dilute hydrochloric acid), linear temperature coefficient (0.0 to 5.00%/°C), or none. High purity water and cation conductivity temperature correction apply between 0 and 100°C. Linear temperature coefficient can be applied between -5 and 200°C.

Measurement Range: 0.0 to 20,000 µS/cm, 0.05 to 20 MΩ-cm, or 0 to 10,000 ppm TDS

Temperature Range: -5°C to 200°C (23°F to 392°F)



[1] whichever is greater
[2] Accuracy values pertain to Endurance Model 400 Series conductivity sensors only

RECOMMENDED SENSORS FOR CONDUCTIVITY:

The Solu Comp II is intended for use with the ENDURANCE Model 400 series conductivity sensor (Pt 1000 RTD).

Model 400 Screw-in/Insertion

Model 400VP Screw-in/Insertion with 6.0 VP connector

Model 401 Screw-in/Insertion (except 401-15)

Model 402 Retractable

Model 402VP Retractable with 6.0 VP connector

Model 403 Sanitary Flanged

Model 403VP Sanitary Flanged with 6.0 VP connector

Model 404 Flow-Through

The analyzer can also be used with Rosemount Analytical conductivity sensor Models 140, 141, 142, and 150 having a Pt 100 RTD.

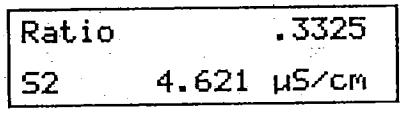
Refer to the table to select the appropriate cell constant.

Range, µS/cm	Cell constant, /cm
0.0 to 50	0.01
5 to 500	0.1
50 to 5,000	1.0
500 to 20,000	10

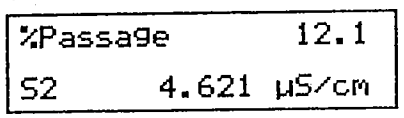
Ratio Conductivity (Codes -20-30):

The dual conductivity Solu Comp II can function as a ratio analyzer or recovery device (% passage or % rejection). Product sensor 2's conductivity reading is always displayed.

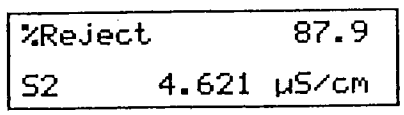
Ratio



%Pass



%Reject



TOROIDAL CONDUCTIVITY (Codes -21 and/or -31)

When used with Model Series 200 Toroidal Conductivity Sensors, display choices are conductivity, resistivity, and percent concentration. The percent concentration selection includes the choice of four common solutions (0-12% NaOH, 0-15% HCl, and 0-25% or 96-100% H_2SO_4). The conductivity-concentration algorithms for these solutions are fully temperature compensated. For other solutions, a simple-to-use menu allows the customer to enter his own data. The analyzer accepts as many as five (5) data points and fits either a linear (two [2] points) or a quadratic function (three [3] or more points) to the data. Reference temperature and linear temperature slope may also be adjusted for optimum results.

RECOMMENDED SENSORS:

Model 222 Flow-through conductivity sensor

Model 225 Clean-in-place conductivity sensor

Model 226 Large bore conductivity sensor

Model 228 Toroidal conductivity sensor

PERFORMANCE SPECIFICATIONS -

Measurement Range: see table below

Accuracy: ± 1% of reading, ± 5 µS/cm

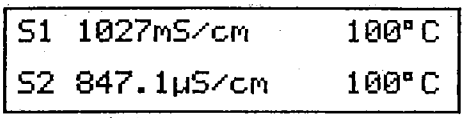
Repeatability: ± 0.25% of reading

Stability: ± 0.25% of output range/month, noncumulative

Ambient Temperature Coefficient: ± 0.01% of reading/°C

Temperature Compensation: -15 to 200°C (5 to 392°F) automatic or manual. Automatic requires a Pt100/1000 RTD

Temperature correction: Linear temperature coefficient (0.0 to 5.00%/°C) neutral salt (dilute sodium chloride) or none



INDUCTIVE SENSORS					
Conductivity Sensor Model Number	226	228	225	222 (1in.)	222 (2 in.)
Cell Constant*	1.0	3.0	3.0	6.0	4.0
Minimum Range	50	250	250	500	500
Maximum Range	1,000,000	2,000,000	2,000,000	2,000,000	2,000,000
* Typical	FULL SCALE MICROSIEMENS/cm				

pH/ORP (Codes -22 and/or -32)

For use with any standard pH or ORP sensor and all Uniloc sensors and junction boxes with built-in diagnostic style preamplifiers, display choices are pH, ORP or Redox. The automatic buffer recognition feature uses stored buffer values and their temperature curves for the most common buffer standards available worldwide. The analyzer will recognize the value of the buffer being measured and perform a self stabilization check on the sensor before completing the calibration. Manual or automatic temperature compensation is keypad selectable. Change in pH due to process temperature can be compensated using a programmable temperature coefficient or isopotential point. Measurement and display of pH glass and reference impedance helps alert the user to sensor maintenance needs.

**reference impedance is suppressed with amperometric/pH combinations (-24, -25, -26)*

PERFORMANCE SPECIFICATIONS - ANALYZER (pH INPUT)

Measurement Range [pH]: 0 to 14 pH

Accuracy: ±0.01 pH

Repeatability: ±0.01 pH

Stability: ±0.01 pH/month, non-cumulative

Temperature Coefficient: ±0.003 pH/°C

Temperature Compensation: Pt100/Pt1000 RTD, Automatic or Manual -15 to 100°C (5 to 212°F)

Temperature Correction: Choose from standard measurement compensation, solution temperature correction for high purity or dilute base solutions, and custom temperature correction.

PERFORMANCE SPECIFICATIONS - ANALYZER (ORP INPUT)

Measurement Range [ORP]: -1400 to +1400 mV

Accuracy: ±2.0 mV

Repeatability: ±1.0 mV

Stability: ±1.0 mV/month, non-cumulative

Temperature Coefficient: ±0.2 mV/°C

Temperature Measurement: -15 to 100°C (5 to 212°F)

Temperature Correction: none required

S1 4.34pH	25° C
S2 12.34pH	27° C

RECOMMENDED SENSORS FOR pH:

Model 320B Flow Through pH
Model 320HP High Purity pH
Model 328A Steam Sterilizable pH
Model 370 and 371 EuroSenz pH
Model 381+ Insertion/Submersion/Flow Through pH
Model 385+ Insertion/Submersion/Retractable pH
Model 389 Insertion/Submersion pH
Model 396 Insertion/Submersion pH
Model 396VP Insertion/Submersion pH with VP 6.0 connector
Model 396P Insertion/Submersion pH
Model 396PVP Insertion/Submersion pH with VP 6.0 connector
Model 396R Retractable pH
Model 396RVP Retractable pH with VP 6.0 connector
Model 397 Quik Disconnect pH
Model 398 Insertion/Submersion pH
Model 398VP Insertion/Submersion with VP 6.0 connector
Model 398R Retractable pH
Model 398RVP Retractable pH with VP 6.0 connector
Model 399 Insertion/Submersion pH
Model Hx338 Steam Sterilizable pH
Model Hx348 Steam Sterilizable pH

RECOMMENDED SENSORS FOR ORP:

Model 330 Flow Through ORP
Model 371 EuroSenz ORP
Model 381+ Insertion/Submersion/Flow Through ORP
Model 385+ Insertion/Submersion/Retractable pH
Model 389 Insertion/Submersion ORP
Model 396P Insertion/Submersion ORP
Model 396PVP Insertion/Submersion ORP with VP 6.0 connector
Model 396R Retractable ORP
Model 398 Insertion/Submersion ORP
Model 398VP Insertion/Submersion with VP 6.0 connector
Model 398R Retractable ORP
Model 398RVP Retractable ORP with VP 6.0 connector

When used with conductivity (-20-32 or -22-30):

Model 320HP High Purity ORP
Model 381+ Insertion/Submersion/Flow Through ORP
Model 385+ Insertion/Submersion/Retractable ORP
Model 396P Insertion/Submersion ORP
Model 396PVP Insertion/Submersion ORP with VP 6.0 connector
Model 396R Retractable ORP
Model 396RVP Retractable ORP with VP 6.0 connector

FLOW
(Standard on all models or stand alone, Code -23 and/or -33)

For use with most pulse signal flow sensors, the Solu Comp II's user selectable units of measure include flow rates in GPM (Gallon per minute), LPM (liters per minute), or m3/hr (cubic meters per hour), and velocity in ft/sec or m/sec. When configured to measure flow, the unit also acts as a totalizer in the chosen unit (gallons, liters, or cubic meters).

Dual flow instruments can be configured as a % recovery device or a flow difference device.

PERFORMANCE SPECIFICATIONS

Frequency Range: 0.5 - 4000 Hz

Flow Rate: 0 - 9999 GPM, LPM, m3/hr

Totalized Flow: 0 - 9,999,999 Gallons; 37,850,000 Liters; 37,850 m3

Accuracy: ±1% (±1.5% from 3000 to 4000 Hz)

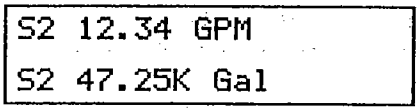
Repeatability: ±1%

RECOMMENDED SENSORS

+GF+ Signet 515 Rotor-X Flow sensor Model 515/8510-XX (PN P51530-PO)

Fluidyne Flow Sensor Model 2300A (PN Hydro-Flow-2300-A-10-5R-3-1-1)

Consult factory for other pulse type sensor compatibility.



FREE AND TOTAL CHLORINE (Code -24)

When used with a chlorine specific membrane-covered amperometric sensor, display choices are free chlorine or total chlorine. (Total chlorine measurement requires the use of the Model SCS921 or other sample conditioning system). Because the permeability of the membrane is a function of temperature, a correction is necessary when the sensor is used at a temperature different from the one at which it was calibrated. The Solu Comp II automatically applies the temperature correction factor. The process temperature is measured by an RTD in the sensor. An input filter allows the user to configure the analyzer for rapid response or low noise. The low noise option is recommended for samples containing less than 0.1 ppm chlorine.

pH is also a factor in the measurement of free chlorine. An aqueous solution of free chlorine is a mixture of hypochlorous acid and hypochlorite ion. The relative amount of each depends on the temperature and pH. Generally, increasing the pH and temperature reduces the amount of hypochlorous acid in the mixture. Because the response of the sensor to hypochlorous acid is greater than its response to hypochlorite, accurate determination of chlorine requires knowledge of the pH and temperature of the sample. If the pH is relatively constant, a fixed pH correction factor can be entered into the analyzer. If the pH is greater than 7 and fluctuates by more than 0.2, continuous measurement of the pH and automatic pH correction is necessary. For automatic pH correction, select code -32 and an appropriate pH sensor.

PERFORMANCE SPECIFICATIONS

Measurement Range: 0-20 ppm (mg/L) chlorine (as Cl_2)

Resolution: 0.001 ppm

Automatic pH Correction (requires Code -32): 5.0 to 9.5 pH

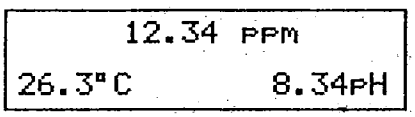
Temperature Correction: Automatic (with Pt100 RTD in sensor) or manual 0-50°C. Can be disabled if desired.

Input filter: time constant 1 - 999 sec

RECOMMENDED SENSORS

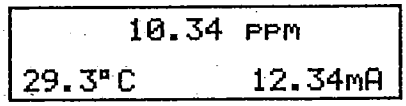
Chlorine: 499A CL-01 Free Chlorine or 499A CL-02 Total Residual Chlorine (requires sample conditioning)

pH: see pH measurement section



DISSOLVED OXYGEN (Code -25)

When used with an oxygen permeable membrane-covered amperometric sensor, display choices are ppb or ppm dissolved oxygen or % saturation. Because the permeability of the membrane is a function of temperature, a correction is necessary when the sensor is used at a temperature different from the one at which it was calibrated. The Solu Comp II automatically applies the temperature correction factor. The process temperature is measured by an RTD in the sensor. Calibrating the analyzer is as simple as exposing the sensor to air and keying in the barometric pressure. If removing the sensor from the process is impractical, the analyzer can also be calibrated against a standard instrument. Solubility correction factors for liquids containing high concentrations of electrolytes can be registered into the analyzer. The Solu Comp II automatically calculates ppb/ppm dissolved oxygen taking into account the high salt concentration.



PERFORMANCE SPECIFICATIONS

Measurement Range: 0-20 ppm (mg/L) dissolved oxygen; 0- 250% saturation

Resolution: 0.01 ppm; 0.1 ppb for 499A TrDO sensor (when O_2 <1.00 ppm); 0.1%

Temperature Correction for Membrane Permeability: Automatic (with Pt100 RTD in sensor) or manual 0-50°C. Can be disabled if desired.

Input filter: 1- 255 samples

RECOMMENDED SENSORS

Model 499A DO Dissolved Oxygen Sensor

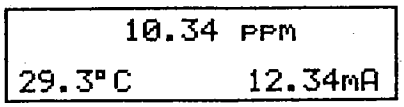
Model Hx438 Steam Sterilizable Dissolved Oxygen Sensor

Model Gx438 Steam Sterilizable Dissolved Oxygen Sensor

Model 499A TrDO Trace Dissolved Oxygen Sensor (soon to be released)

DISSOLVED OZONE (Code -26)

For use with an ozone permeable membrane-covered amperometric sensor. Because the permeability of the membrane is a function of temperature, a correction is necessary when the sensor is used at a temperature different from the one at which it was calibrated. The Solu Comp II automatically applies the temperature correction factor. The process temperature is measured by an RTD in the sensor. The Solu Comp II is calibrated taking a measurement of the ozone level in the process by an independent chemical method and setting the display equal to the measured value. An input filter allows the user to configure the analyzer for rapid response of low noise. The low noise option is recommended for samples containing less than 0.1 ppm dissolved ozone.



PERFORMANCE SPECIFICATIONS

Measurement Range: 0-10 ppm (mg/L)

Resolution: 0.001 ppm dissolved ozone

Temperature Correction for Membrane Permeability: Automatic (with Pt100 RTD in sensor) or manual 0-35°C. Can be disabled if desired.

Input filter: time constant 1 - 999 sec

RECOMMENDED SENSOR

Model 499A OZ Dissolved Ozone Sensor

LOOP SPECIFICATIONS WITH A MODEL 499A OZ SENSOR

Loop Accuracy: ±5% of reading or ± 3 ppb at 25°C, whichever is greater

Repeatability: ±2% of reading at a constant temperature

1.3 ORDERING INFORMATION

The Solu Comp II analyzers offer the choice of single or dual sensor input with measurement choices of pH/ORP, conductivity/resistivity, toroidal conductivity, flow, chlorine, dissolved oxygen, and dissolved ozone. See combination guide (on the following page) for valid combinations. Standard features include two isolated outputs, three alarm relays, customizable two-line display, and temperature correction.

MODEL 1055 SOLU COMP II ANALYZER	
CODE	POWER
01	115/230 Vac, 50/60 Hz
02	24 Vdc

CODE	MOUNTING
10	Panel mounting enclosure
11	Pipe/Surface mounting enclosure (Pipe mounting requires accessory kit PN 23820-00)

CODE	MEASUREMENT 1 (Required Selection)
20	Contacting Conductivity
21	Toroidal Conductivity
22	pH/ORP
23	Flow
24	Chlorine
25	Dissolved Oxygen
26	Ozone

CODE	MEASUREMENT 2 (Optional)
30	Contacting Conductivity
31	Toroidal Conductivity
32	pH/ORP
33	Flow

CODE	OPTIONAL
68	UL Approval

Field Commisssioned Suites option offers the user the ability to commission the Solu Comp II to any valid measurement combination. This feature provides the benefit of a reduction in the number of spare instruments required to meet emergency inventory needs. Please refer to the Suites tables (on the following page) for valid measurement combinations. Suites include a complete set of instrument wiring labels.

MODEL 1055 SOLU COMP II ANALYZER	
CODE	POWER
01	115/230 Vac, 50/60 Hz
02	24 Vdc

CODE	MOUNTING
10	Panel mounting enclosure
11	Pipe/Surface mounting enclosure (Pipe mounting requires accessory kit PN 23820-00)

CODE	FIELD-COMMISSIONED SUITES (Optional) see tables below
S1	Suite 1 - Field Commissioned Measurement (basic)
S1A	Suite 1 - Field Commissioned Measurement (includes amperometric)
S2	Suite 2 - Field Commissioned Measurement (basic)
S2A	Suite 2 - Field Commissioned Measurement (includes amperometric)

CODE	OPTIONAL
DM	Dual Measurement

CODE	OPTIONAL
68	UL Approval

COMBINATION GUIDE

Measurement Choices

Measure 1 \ Measure 2	None	pH/ORP	Flow	Conductivity: Toroid	Conductivity: Contact
pH/ORP					
Contacting conductivity					
Flow					
Toroidal Conductivity					
Dissolved Oxygen					
Chlorine					
Ozone					

Available
Not available

Field Commissioned Measurement Choices Suite 1

	Measure 1 \ Measure 2	None	Dual Measurement (DM): pH/ORP	Dual Measurement (DM): Flow	Dual Measurement (DM): Contacting Conductivity
Basic	pH/ORP				
Basic	Contacting conductivity				
Amperometric	Dissolved Oxygen*				
Amperometric	Chlorine				
Amperometric	Ozone				
	Toroidal Conductivity				

Available
Not available

Field Commissioned Measurement Choices Suite 2

	Measure 1 \ Measure 2	None	Dual Measurement (DM): pH/ORP	Dual Measurement (DM): Flow	Dual Measurement (DM): Conductivity: Toroid	Dual Measurement (DM): Conductivity: Contact
	pH/ORP					
Basic	Flow					
Basic	Contacting conductivity					
Basic	Toroidal Conductivity					
Amperometric	Dissolved Oxygen*					
Amperometric	Chlorine					
Amperometric	Ozone					

Available
Not available

* For D.O. sensors with 22k thermistor, use Suite 1 only.

ACCESSORIES (Weights are rounded up to nearest whole lb or 0.5 kg)

PART NUMBER	DESCRIPTION	WEIGHT	SHIPPING WT.
23820-00	Pipe mounting kit, includes U-bolts, mounting bracket, nuts, washers, and screws (complete)	2 lb (1.0 kg)	4 lb (2.0 kg)
23554-00	Gland fittings, PG 13.5, 5 per package	1 lb (0.5 kg)	2 lb (1.0 kg)
9240048-00	Tag, stainless steel (specify marking)	1 lb (0.5 kg)	1 lb (0.5 kg)
	pH INPUT		
9210012	Buffer Solution, 4.01 pH, 16 oz.	1 lb (0.5 kg)	2 lb (1.0 kg)
9210013	Buffer Solution, 6.86 pH, 16 oz.	1 lb (0.5 kg)	2 lb (1.0 kg)
9210014	Buffer Solution, 9.18 pH, 16 oz.	1 lb (0.5 kg)	2 lb (1.0 kg)
	CONDUCTIVITY INPUT		
SS-1	Conductivity Standard, 1409 µS/cm at 25°C, 1 quart (945 mL)	2 lb (1.0 kg)	4 lb (2.0 kg)
SS-1A	Conductivity Standard, 1409 µS/cm at 25°C, 1 gallon (3785 mL)	9 lb (4.0 kg)	11 lb (5.0 kg)
SS-5	Conductivity Standard, 1000 µS/cm at 25°C, 1 quart (945 mL)	2 lb (1.0 kg)	4 lb (2.0 kg)
SS-5A	Conductivity Standard, 1000 µS/cm at 25°C, 1 gallon (3785 mL)	9 lb (4.0 kg)	11 lb (5.0 kg)
SS-6	Conductivity Standard, 200 µS/cm at 25°C, 1 quart (945 mL)	2 lb (1.0 kg)	4 lb (2.0 kg)
SS-6A	Conductivity Standard, 200 µS/cm at 25°C, 1 gallon (3785 mL)	9 lb (4.0 kg)	11 lb (5.0 kg)
SS-7	Conductivity Standard, 5000 µS/cm at 25°C, 1 quart (945 mL)	2 lb (1.0 kg)	4 lb (2.0 kg)
SS-7A	Conductivity Standard, 5000 µS/cm at 25°C, 1 gallon (3785 mL)	9 lb (4.0 kg)	11 lb (5.0 kg)

SECTION 2.0. INSTALLATION

2.1 UNPACKING AND INSPECTION
2.2 INSTALLATION

2.1 UNPACKING AND INSPECTION

Inspect the shipping container. If it is damaged, contact the shipper immediately for instructions. Save the box. If there is no apparent damage, unpack the container. Be sure all items shown on the packing list are present. If items are missing, notify Rosemount Analytical immediately.

2.2 INSTALLATION

2.2.1 General Information

1. Although the analyzer is suitable for outdoor use, do not install it in direct sunlight or in areas of extreme temperatures.
2. Install the analyzer in an area where vibrations and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the analyzer and sensor wiring at least one foot from high voltage conductors. Be sure there is easy access to the analyzer.
4. **AC power and relay wiring should not enter via top conduit openings and should be kept separated from other wiring in the analyzer after installation.**
5. The analyzer is suitable for panel, pipe, or surface mounting. Refer to the table below.
6. See Section 3.1 for removal of conduit knockouts.

Type of Mounting	Section
Panel	2.2.2
Pipe	2.2.3
Surface	2.2.4

7. To reduce the likelihood of stress on wiring connections, the hinged front panel (-11 models) shall not be removed from the base during wiring installation, and there shall be sufficient wire leads to avoid stress on conductors.
8. For UL-approved models (-68), the clear wiring shield must be installed prior to operation.

2.2.2 Panel Mounting.

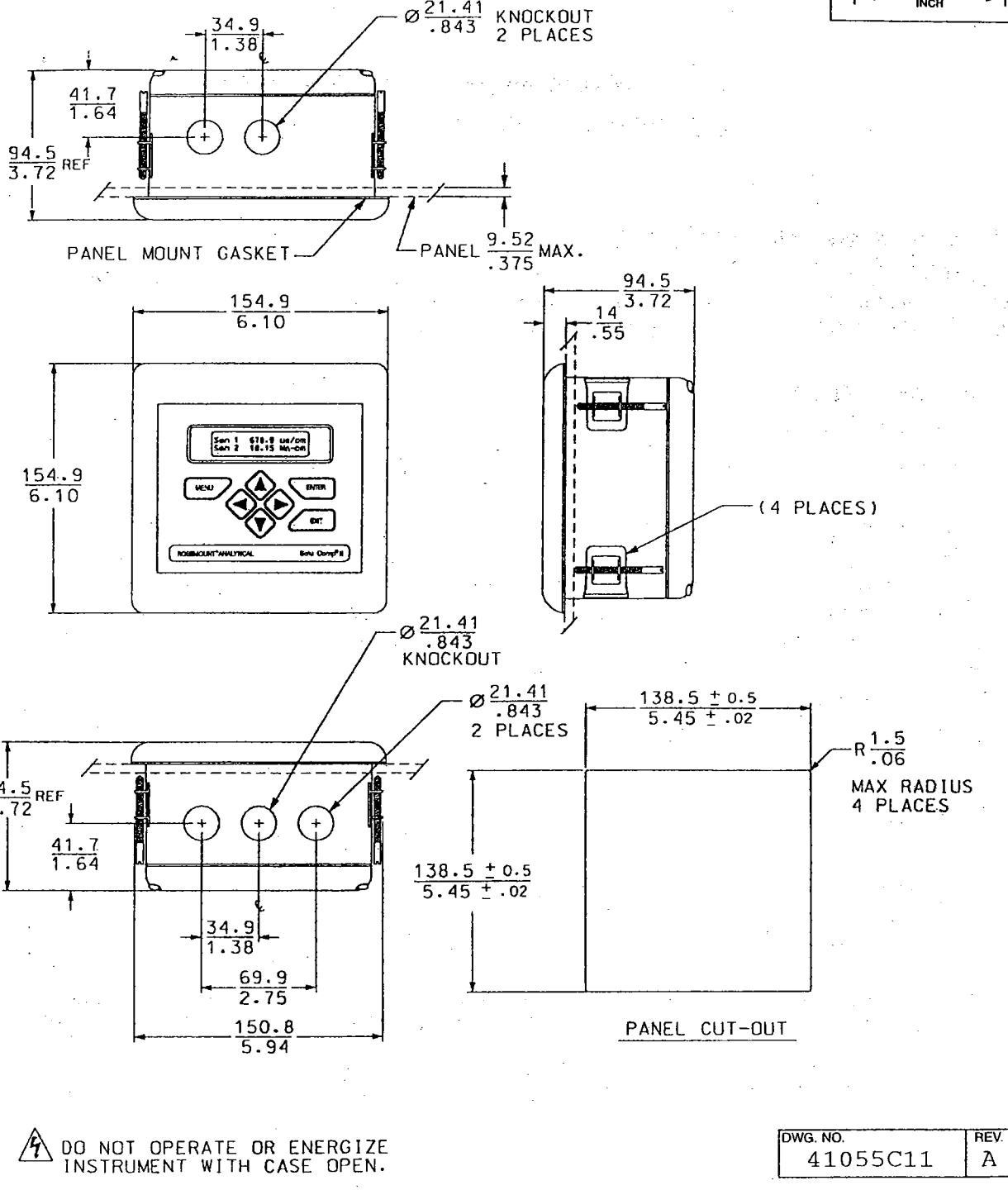


FIGURE 2-1. Panel Mount Installation

Access to the wiring terminals is through the rear cover. Four screws hold the cover in place.

2.2.3 Pipe Mounting.

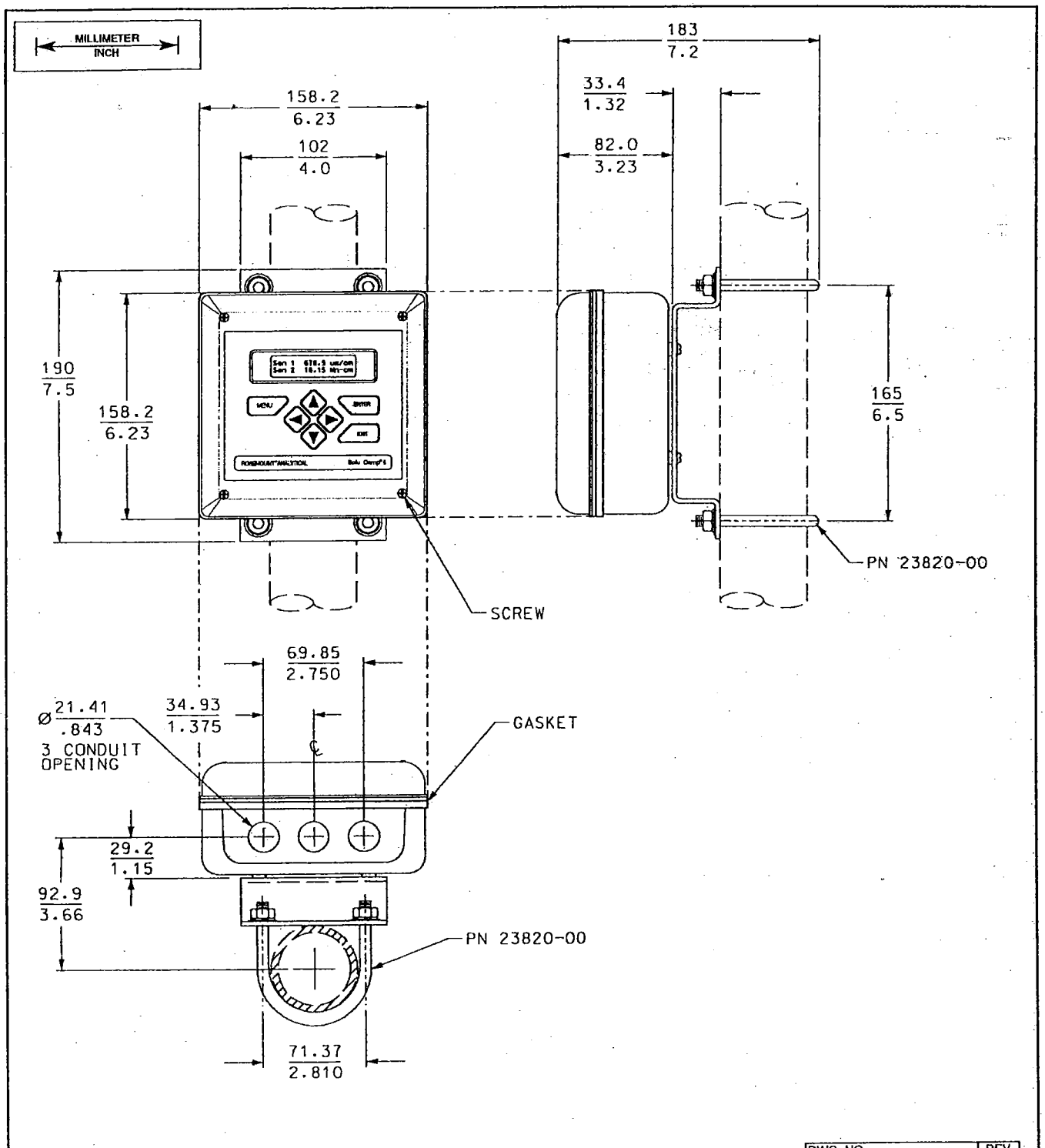


FIGURE 2-2. Pipe Mount Installation

The front panel is hinged at the bottom. The panel swings down for access to the wiring terminals.

2.2.4 Surface Mounting.

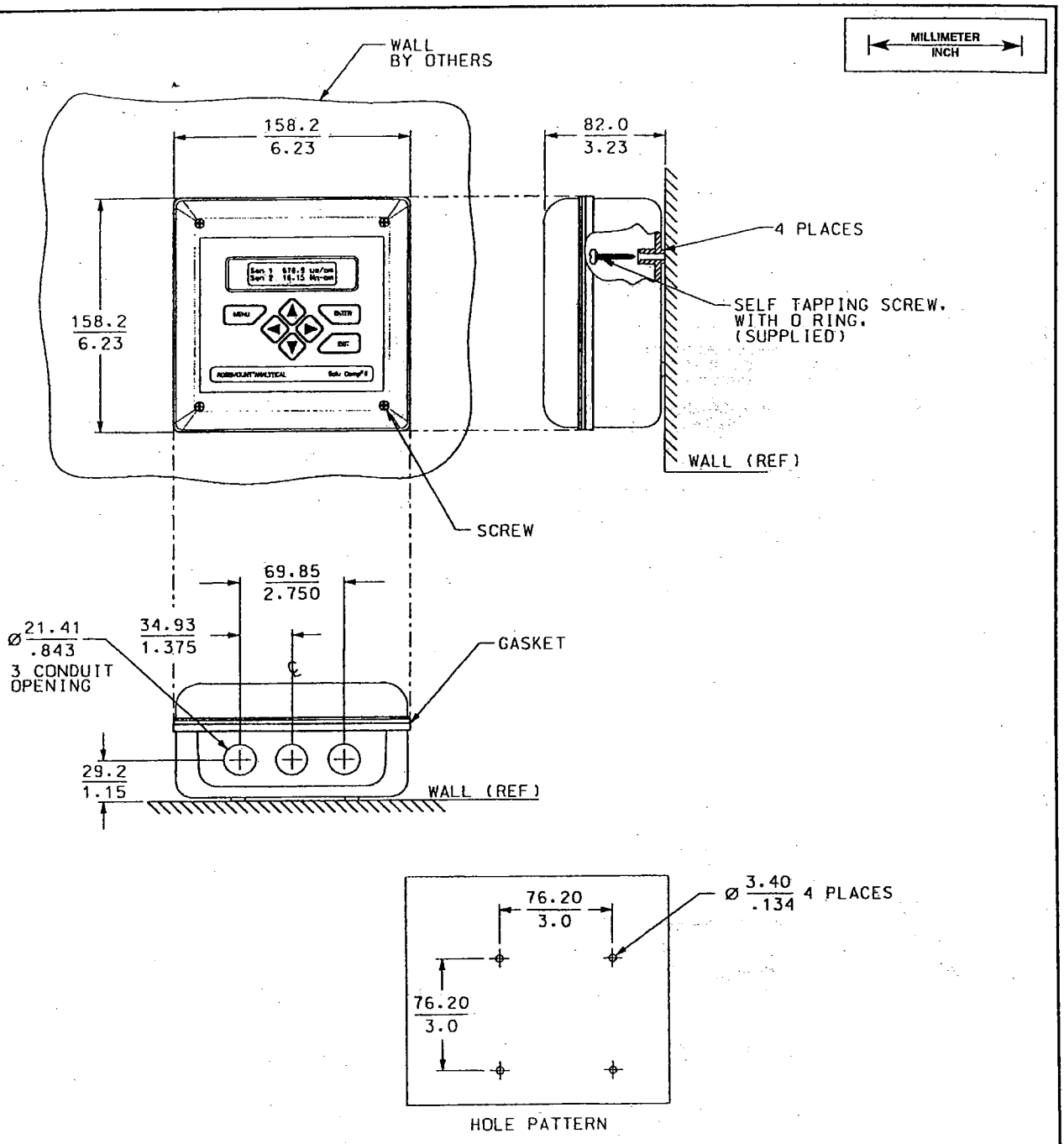


FIGURE 2-3. Surface Mount Installation

The front panel is hinged at the bottom. The panel swings down for access to the wiring terminals.

SECTION 3.0.
WIRING

3.1 PREPARING CONDUIT OPENINGS
3.2 POWER, ALARM, OUTPUT, AND SENSOR CONNECTIONS

3.1 PREPARING CONDUIT OPENINGS

The number of conduit openings and the location depend on the model.

Model	Description	Conduit openings
1055-10	panel mount	two open, three knockouts
1055-11	surface or pipe mount	three open, no knockouts

Conduit openings accept 1/2-inch conduit fittings or PG 13.5 cable glands. To keep the case watertight, block unused openings with NEMA 4X or IP65 conduit plugs.

NOTE

Use watertight fittings and hubs that comply with the requirements of UL514B. Connect the conduit hub to the conduit before attaching the fitting to the analyzer (UL508-26.16).

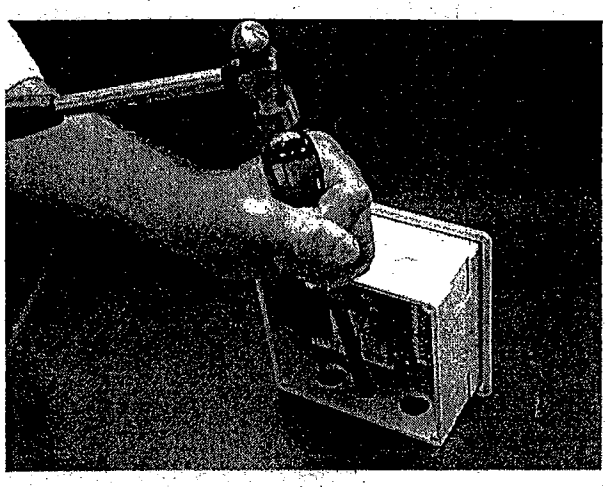


FIGURE 3-1. Removing the Knockouts

Figure 3-1 shows how to remove the knockouts. The knockout grooves are on the outside of the case. Place the screwdriver blade on the inside of the case and align it approximately along the groove. Rap the screwdriver sharply with a hammer until the groove cracks. Move the screwdriver to an uncracked portion of the groove and continue the process until the knockout falls out. Use a small knife blade to remove the flash from the inside of the hole.

3.2 POWER, ALARM, OUTPUT, AND SENSOR CONNECTIONS

The Solu Comp II is available in two mounting configurations.The positions of the power, alarm, output, and sensor terminal blocks are different in each. Refer to the table to find the correct drawing.

For best EMI/RFI protection use shielded output signal cable enclosed in an earth-grounded metal conduit. Connect the shield to earth ground at terminal 4 on TB1.

MODEL	MOUNTING	POWER	FIGURE
1055pH-01-10	Panel	115/230 Vac	3-2
1055pH-02-10		24 Vdc	3-3
1055pH-01-11	Surface/Pipe	115/230 Vac	3-4
1055pH-02-11		24 Vdc	3-5

AC wiring should be 14 gauge or greater. Provide a switch or breaker to disconnect the analyzer from the main power supply. Install the switch or breaker near the analyzer and label it as the disconnecting device for the analyzer.

WARNING: RISK OF ELECTRICAL SHOCK

AC connections and grounding must be in compliance with UL 508 or local electrical code. DO NOT apply power to the analyzer until all electrical connections are verified and secure.

Keep sensor and output signal wiring separate from power wiring. Do not run sensor and power wiring in the same conduit or close together in a cable tray.

Refer to the sensor manual or wiring sheet to identify the sensor wire colors and functions.

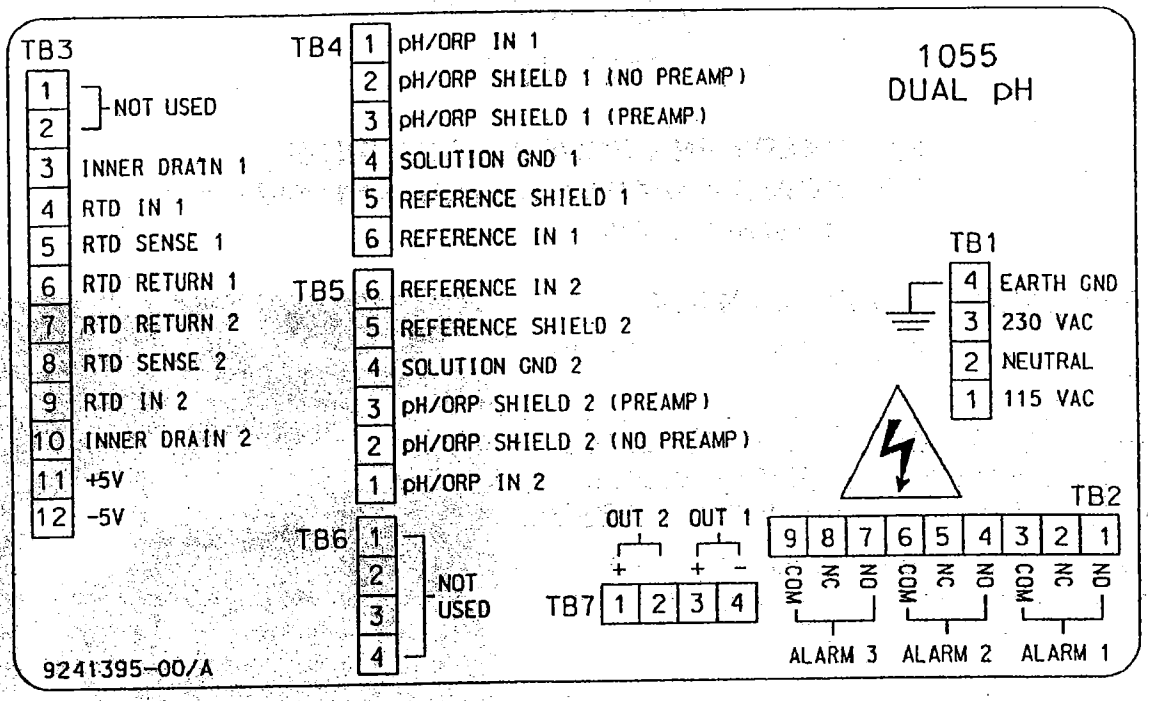


FIGURE 3-2. Wiring Connections for Solu Comp II Model 1055-01-10 (Panel Mount with 115/230 Vac Power)

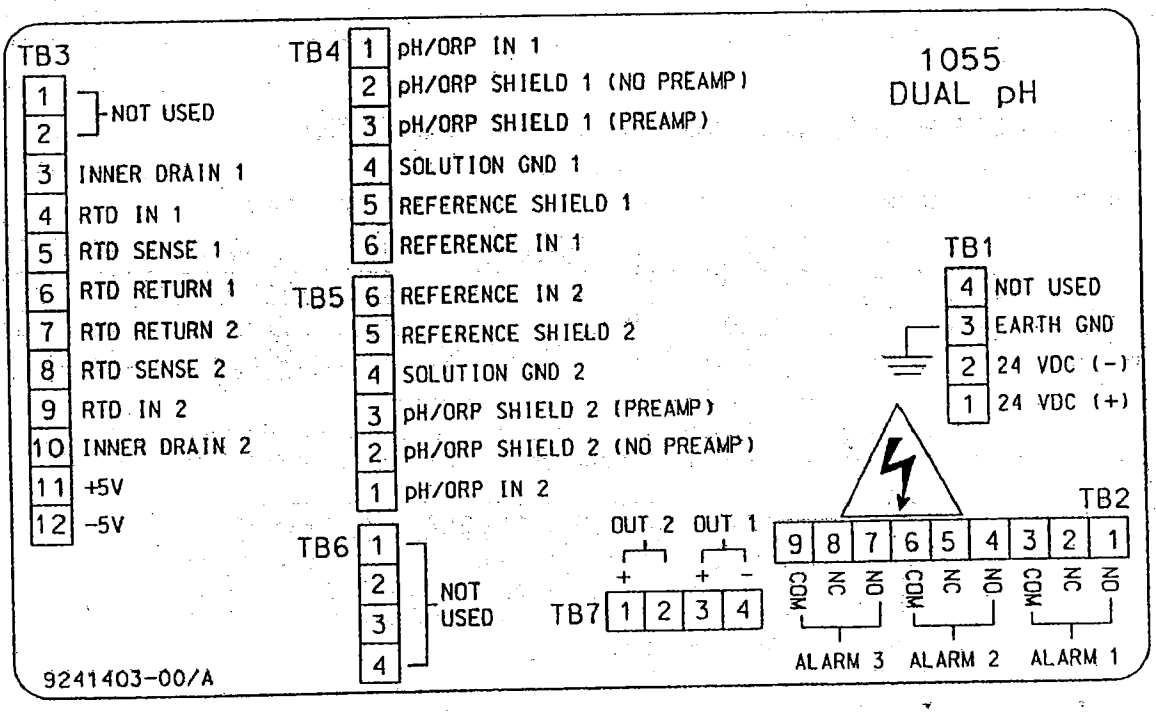


FIGURE 3-3. Wiring Connections for Solu Comp II Model 1055-02-10 (Panel Mount with 24 Vdc Power)

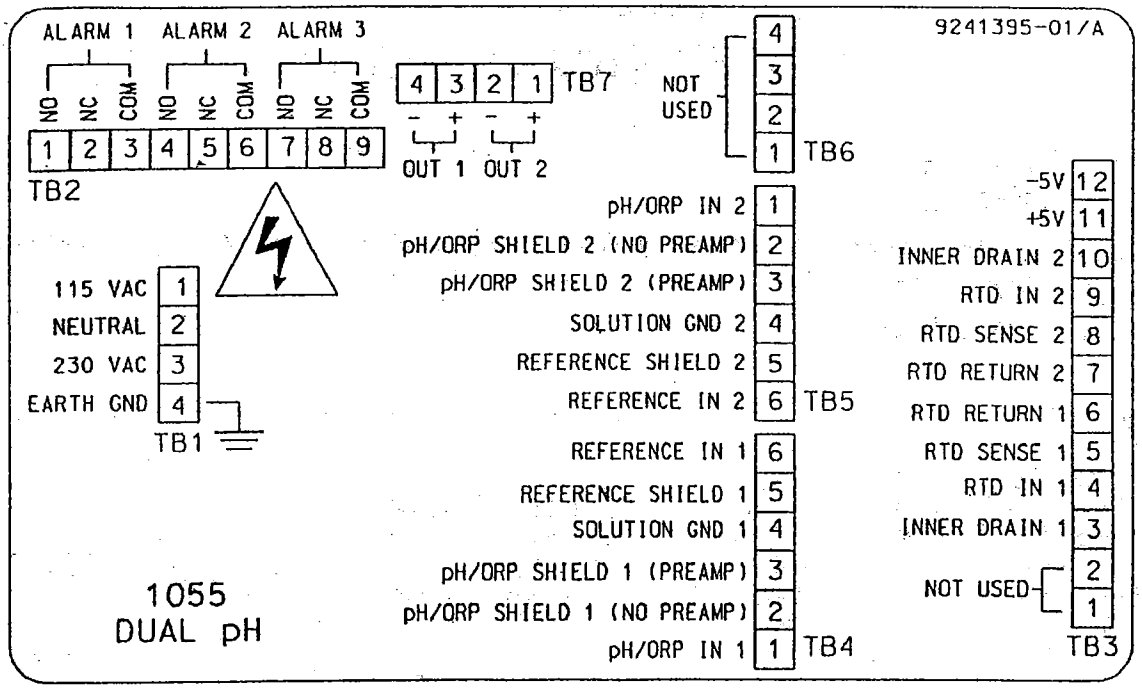


FIGURE 3-4. Wiring Connections for Solu Comp II Model 1055-01-11 (Surface/Pipe Mounting with 115/230 Vac Power)

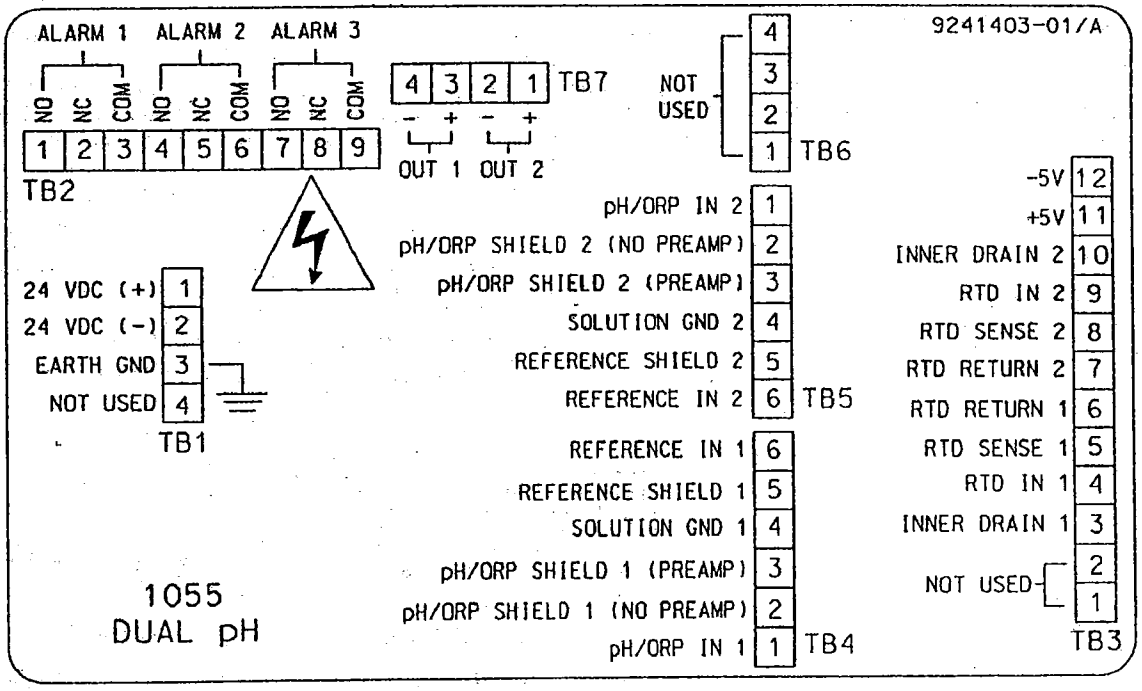


FIGURE 3-5. Wiring Connections for Solu Comp II Model 1055-02-11 (Surface/Pipe Mounting with 24 Vdc Power)

SECTION 4.0
DISPLAY AND OPERATION

4.1 DISPLAY
4.2 KEYPAD
4.3 PROGRAMMING AND CALIBRATING THE SOLU COMP II - TUTORIAL
4.4 SECURITY
4.5 USING HOLD

4.1. DISPLAY

The Solu Comp II has a two-line display. The display can be customized to meet user requirements (see Section 5.11). Figure 4-1 shows some of the displays available during normal operation. View A is the default screen for a single sensor. View B is the default screen for dual sensors.

The Solu Comp II has information screens that supplement the data in the main display. Press ▲ or ▼ to view the information screens. **The last information screen is the software version.**

During calibration and programming, key presses cause different displays to appear. The displays are self-explanatory and guide the user step-by-step through the procedure.

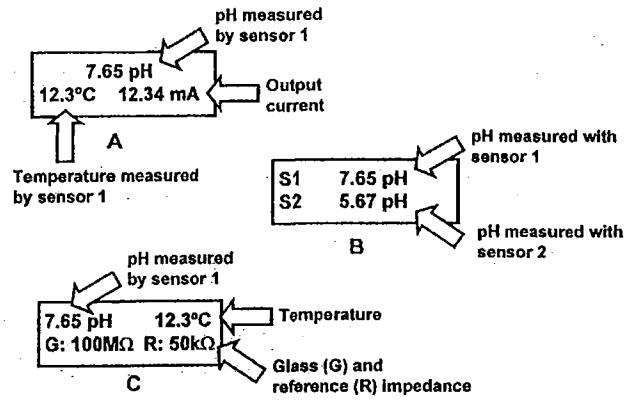


FIGURE 4-1. Displays During Normal Operation

Screen A shows pH, temperature, and current output for sensor 1. Screen B shows pH for sensors 1 and 2. Although screens A and B are the most useful, other screens can be selected. For example, screen C shows the pH, temperature, and glass and reference impedance for sensor 1. If screen C were for sensor 2, S2 would appear in the display. See Section 5.9 for more details.

4.2 KEYPAD

Figure 4-2 shows the Solu Comp II keypad.

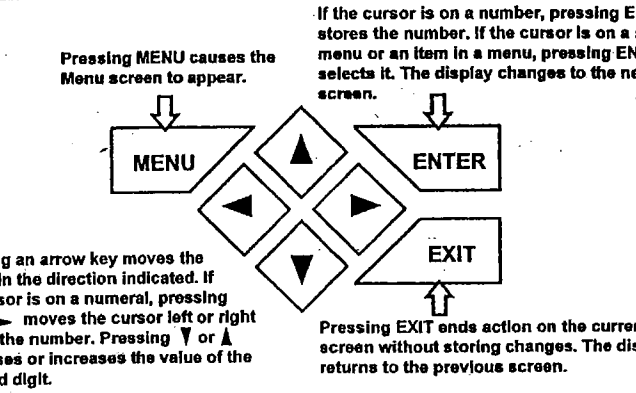


FIGURE 4-2. Solu Comp II Keypad

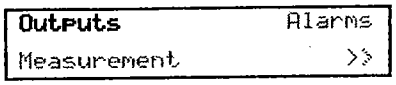
Four arrow keys move the cursor around the screen. A blinking word or numeral show the position of the cursor. The arrow keys are also used to change the value of a numeral. Pressing ENTER stores numbers and settings and moves the display to the next screen. Pressing EXIT returns to the previous screen without storing changes. Pressing MENU always causes the main menu screen to appear. Pressing MENU followed by EXIT causes the main display to appear.

4.3 PROGRAMMING AND CALIBRATING THE SOLU COMP II - TUTORIAL

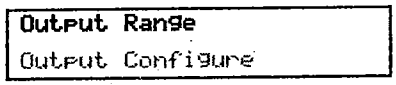
Setting up and calibrating the Solu Comp II is easy. The following tutorial describes how to move around in the programming menus. For practice, the tutorial also describes how to assign conductivity values to the 4 and 20 mA outputs for sensor 1.



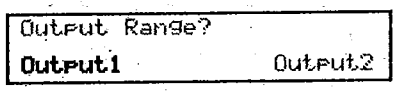




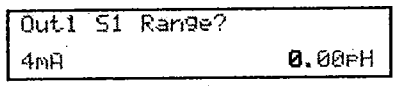
1. If the MENU screen (shown at the left) is not already showing, press MENU. **Calibrate** is blinking, which means the cursor is on **Calibrate**.
2. To assign pH values to current outputs, the **Program** sub-menu must be open. Press ▼. The cursor moves to **Program** (**Program** blinking). Press ENTER. Pressing ENTER opens the **Program** sub-menu.
3. The **Program** sub-menu permits the user to set outputs, alarms, automatic or manual temperature compensation, and a security code. When the sub-menu opens, **Outputs** is blinking, which means the cursor is on Outputs. Press ▼ or ► (or any arrow key) to move the cursor around the display. Move the cursor to >> and press ENTER to cause a second screen with more program items to appear. There are three screens in the **Program** menu. Pressing >> and ENTER in the third screen causes the display to return to the first screen (**Outputs, Alarms, Measurement**).
4. For practice, assign pH values to the 4 and 20 mA outputs for sensor 1. Move the cursor to **Outputs** and press ENTER.



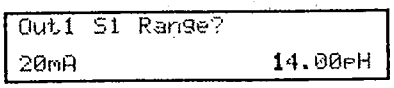
5. The screen shown at left appears. The cursor is on **Output Range** (blinking). Output range is used to assign values to the low and high current outputs. Press ENTER.



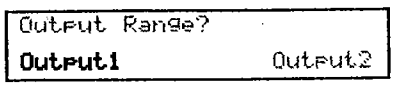
6. The screen shown at left appears. The Solu Comp II has two outputs, output 1 and output 2. Move the cursor to the desired output and press ENTER. For purposes of the example, choose **Output 1**.



7. The screen shown at left appears. **Out1 S1** in the top line means output 1 (**Out1**) is assigned to sensor 1 (**S1**). Either output can be assigned to either sensor (sensor and output assignments are made under the **Output Configure** menu shown in step 5). Use the **Out1 S1 Range?** screen to assign a pH value to the **4 mA** output.
   a. Use the arrow keys to change the pH to the desired value. Press ◄ or ► to move the cursor from digit to digit. Press ▲ or ▼ to increase or decrease the value of the digit. Holding ▲ or ▼ down causes the numeral to continuously scroll up or down.
   b. To move the decimal point, press ◄ or ► until the cursor is on the decimal point. Press ▲ to move the decimal point to the right. Press ▼ to move the decimal point to the left.
   c. Press ENTER to store the setting.



8. The screen shown at left appears. Use this screen to assign a full scale pH value to the **20 mA** output. Use the arrow keys to change the pH to the desired value. Press ENTER to store the setting.



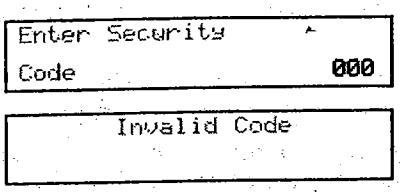
9. The screen shown at left appears. To assign pH values to the low and high currents for output 2, select **Output 2** and follow the prompts.
10. To return to the main menu, press MENU. To return to the main display press MENU then EXIT, or press EXIT repeatedly until the main display appears. To return to the previous display press EXIT.

NOTE
To store values or settings, press ENTER before pressing EXIT.

4.4 SECURITY

4.4.1 How the Security Code Works

Use the security code to prevent accidental or unwanted changes to program settings, displays, and calibration.



1. If a security code has been programmed, pressing MENU causes the security screen to appear.
2. Enter the three-digit security code.
3. If the entry is correct, the main menu screen appears. If the entry is incorrect, the **Invalid Code** screen appears. The **Enter Security Code** screen reappears after 2 seconds.

4.4.2 Bypassing the Security Code

Enter 555. The main menu will open.

4.4.3 Setting a Security Code

See Section 5.6.

4.5 USING HOLD

4.5.1 Purpose

The analyzer output is always proportional to measured pH. To prevent unwanted alarms and improper operation of control systems or dosing pumps, place the analyzer in hold before removing the sensor for calibration and maintenance. Be sure to remove the analyzer from hold once calibration is complete. During hold, both outputs remain at the last value. **Once in hold, the analyzer remains there indefinitely.** While in hold, the screen shown to the left appears periodically.

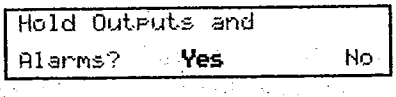


4.5.2 Using the Hold Function

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Hold**.



2. The **Hold Outputs and Alarms ?** screen appears. Choose **Yes** to place the analyzer in hold. Choose **No** to take the analyzer out of hold.
3. The main display screen will appear.

SECTION 5.0
PROGRAMMING THE ANALYZER

5.1 GENERAL
5.2 CHANGING STARTUP SETTINGS
5.3 CONFIGURING AND RANGING THE OUTPUTS
5.4 CONFIGURING ALARMS AND ASSIGNING SETPOINTS
5.5 SELECTING THE TYPE OF MEASUREMENT AND ACTIVATING SOLUTION TEMPERATURE CORRECTION
5.6 CHOOSING TEMPERATURE UNITS AND MANUAL OR AUTOMATIC TEMPERATURE COMPENSATION
5.7 SETTING A SECURITY CODE
5.8 NOISE REJECTION
5.9 SINGLE SENSOR OR DUAL SENSOR INPUT
5.10 RESETTING FACTORY DEFAULT SETTINGS
5.11 SELECTING A DEFAULT SCREEN, LANGUAGE, AND SCREEN CONTRAST

5.1 GENERAL

This section describes how to do the following:

1. configure and assign values to the current outputs
2. configure and assign setpoints to the alarm relays
3. choose pH, ORP, or redox
4. choose temperature units and manual or automatic temperature compensation
5. set a security code
6. tell the analyzer the frequency of the ac power (needed for optimum noise rejection)
7. tell the analyzer the number of sensors being used
8. reset the analyzer to factory calibration and default settings
9. select a default display screen

Default settings are shown in Table 5-1 on the following page. To change a default setting, refer to the section listed in the table. To reset default settings, see Section 5.10.

5.2 CHANGING STARTUP SETTINGS

When the Solu Comp II is powered up for the first time, startup screens appear. The screens prompt the user to identify the number of sensors being used and whether pH, ORP, or redox is being measured. If incorrect settings were entered at startup, enter the correct settings now. To change the number of sensors refer to Section 5.9. To change the measurement, refer to Section 5.5.

FOR BEST RESULTS, ENTER THE NUMBER OF SENSORS BEING USED (SECTION 5.9) AND WHETHER pH, ORP, OR REDOX IS BEING MEASURED (SECTION 5.5) BEFORE MAKING OTHER PROGRAM SETTINGS.

TABLE 5-1. DEFAULT SETTINGS

1. SENSOR-OUTPUT ASSIGNMENTS (pH, ORP, or redox is selected during Quick Start)

Sensor(s)	Output 1	Output 2	Section
Single sensor	pH/ORP/Redox	Temperature	5.3 and 5.9
Dual sensor	pH/ORP/Redox for sensor 1	pH/ORP/Redox for sensor 2	5.3 and 5.9

2. OTHER OUTPUT SETTINGS

Output	Dampening	0 or 4 mA	Mode	Section
1	off	4	linear	5.3
2	off	4	linear	5.3

3. OUTPUT RANGES (pH, ORP, or redox is selected during Quick Start)

Measurement	Range	Section
pH	0 to 14	5.3
ORP/Redox	-1400 to 1400 mV	5.3
Temperature	0 to 100°C	5.3

4. ALARM CONFIGURATION AND SETPOINTS

	Alarm			
	1	2	3	Section
Assigned to	Sensor 1	Sensor 1 (note)	Fault	5.4
High or low	High	High	NA	5.4
Deadband	0	0	NA	5.4
Setpoint (pH)	14 (high); 0 (low)	14 (high); 0 (low)	NA	5.4
Setpoint (ORP/Redox)	1400 mV (high); -1400 mV (low)	1400 mV (high); -1400 mV (low)	NA	5.4

Note: For dual sensor input, alarm 2 is assigned to sensor 2.

5. TEMPERATURE RELATED SETTINGS

		Section
Units	°C	5.6
Automatic temperature compensation	On	5.6
Solution temperature correction	Off	5.5
Isopotential pH	7.00	5.5

6. MISCELLANEOUS SETTINGS

		Section
Language	English	5.11
Hold	off	4.5
Security code	000 (no security code)	5.7
ac power frequency	60 Hz	5.8

5.3 CONFIGURING AND RANGING THE OUTPUTS.

5.3.1 Purpose

The Solu Comp II accepts inputs from two pH or ORP sensors and has two current outputs. This section describes how to configure and range the outputs. **CONFIGURE THE OUTPUTS FIRST.**

1. Configuring an output means
   a. Selecting either a 4-20 mA or 0-20 mA output,
   b. Assigning a sensor and a measurement (pH, ORP, or redox potential) to output 1 and output 2,
   c. Turning on or turning off output current dampening.
   d. Choosing a linear or logarithmic output.
2. Ranging the outputs means assigning values to the low (0 or 4 mA) and high (20 mA) outputs.

5.3.2 Definitions

1. CURRENT OUTPUTS. The analyzer provides either a continuous 4-20 mA or 0-20 mA output current directly proportional to pH, ORP, redox potential, or temperature. The low and high current outputs can be set to any value in the table.

Measurement	Range	Recommended Range
pH	0 to 14	NA
ORP/Redox	-2000 to 2000 mV	NA
Temperature	-99 to 999°C or °F	-5 to 200°C

2. ASSIGNING OUTPUTS. Figure 5-1 shows the ways in which the outputs can be assigned.

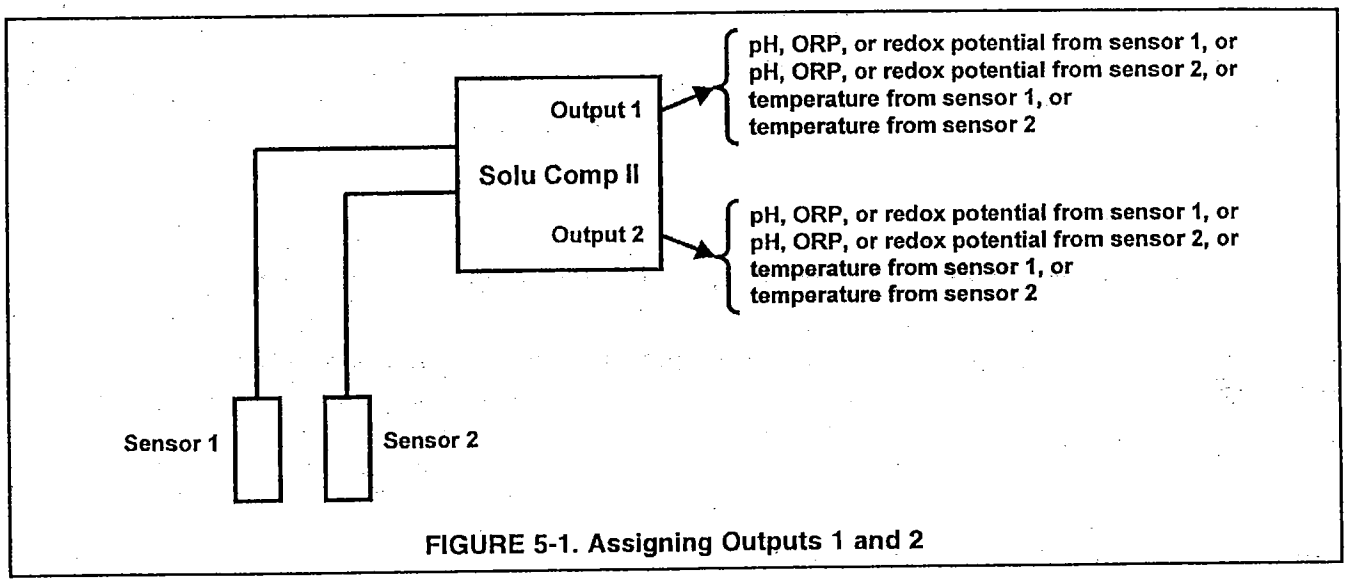
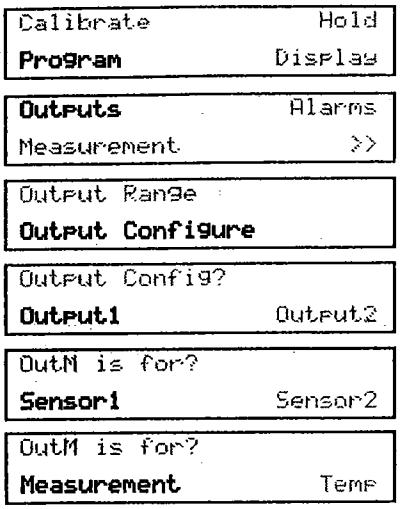


FIGURE 5-1. Assigning Outputs 1 and 2

3. DAMPEN. Output dampening smooths out noisy readings. It also increases the response time of the output. With output dampening the time to reach 63% of final reading following a step change is 5 sec. Output dampening does not affect the response time of the display.
4. MODE. The current output can be made directly proportional to the displayed value (linear mode) or directly proportional to the common logarithm of the displayed value (log mode).

5.3.3. Procedure: Configure Outputs.

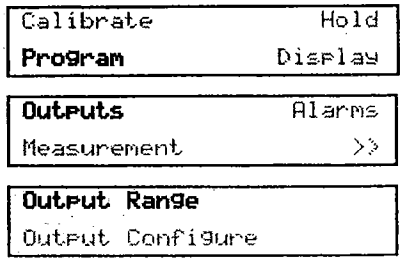
To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Program.**
2. Choose **Outputs.**
3. Choose **Output Configure.**
4. Choose **Output1** or **Output2.**
5. Choose **Sensor1** or **Sensor2.** Either sensor can be assigned to either output.
6. Choose **Measurement** or **Temp.** The output will be pH (or Redox or ORP) if **Measurement** is selected or the temperature if **Temp** is selected.
7. Make the appropriate settings:
   a. Choose **4-20 mA** or **0-20 mA.**
   b. Choose **Yes** or **No** for output dampening.
   c. Choose **Linear** or **Log** output.
8. The display returns to the **Output Config?** screen. Select the other output or press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

5.3.4. Procedure: Assigning Values to the Low and High Current Outputs (Output Ranging)

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Program.**
2. Choose **Outputs.**
3. Choose **Output Range.** Choose **Output1** or **Output2.**
4. Make the appropriate settings.
   a. Assign a value to the low current (**0 mA** or **4 mA**) output.
   b. Assign a value to the high current (**20 mA**) output.
5. The display returns to the **Output Range** screen. Select the other output or press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

5.4 CONFIGURING ALARMS AND ASSIGNING SETPOINTS

5.4.1 Purpose

This section describes how to do the following:

1. assign an alarm relay to a sensor,
2. set the alarm logic to high or low,
3. assign values to the alarm setpoints,
4. set the alarm deadbands.

ALARM RELAYS MUST BE CONFIGURED BEFORE ASSIGNING SETPOINTS.

5.4.2 Definitions

1. ASSIGNING ALARMS. There are three alarms (**AL1**, **AL2**, and **AL3**). Alarms 1 and 2 can be assigned to any sensor. For example, **AL1** and **AL2** can be assigned to sensor 1 with, perhaps, one alarm configured as a high alarm and the other as a low alarm, and **AL3** can be assigned to sensor 2. Alarms are for pH, ORP, redox, or temperature. Alarm 3 can be assigned to either sensor or used as a fault alarm. The fault alarm activates when a fault exists in a sensor or the analyzer.
2. FAULT ALARM. A fault condition exists when the Solu Comp II detects a problem with a sensor or with the analyzer that is likely to cause seriously erroneous readings. If Alarm 3 was programmed as a fault alarm, the alarm 3 relay will activate. The word **Fault** will appear alternately in the display with the reading.
3. ALARM LOGIC, SETPOINTS, AND DEADBANDS. See Figures 5-2 and 5-3.

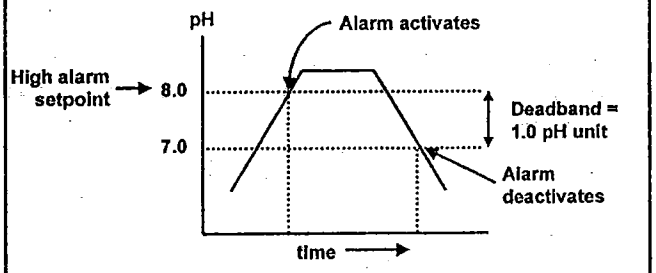


FIGURE 5-2. High Alarm Logic

The alarm activates when the pH exceeds the high setpoint. The alarm remains activated until the reading drops below the value determined by the deadband.

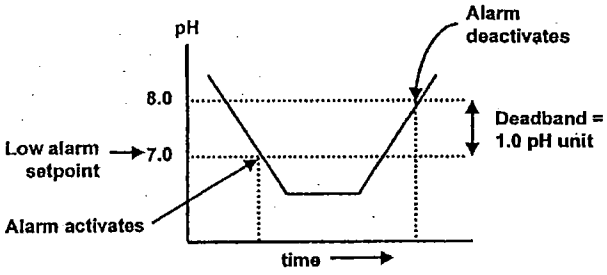


FIGURE 5-3. Low Alarm Logic

The alarm activates when the pH drops below the low setpoint. The alarm remains activated until the reading increases above the value determined by the deadband.

Alarm relays are single pole-double throw (SPDT). When an alarm is activated, the coil is energized.

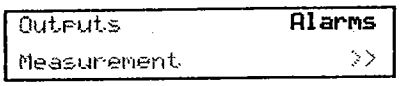
When an alarm activates, **AL1**, **AL2**, or **AL3** (as appropriate) appears periodically in the display.

5.4.3 Procedure: Configuring Alarms

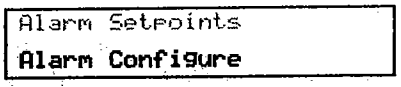
To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



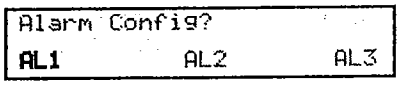
1. Press MENU. The main menu screen appears. Choose **Program**.



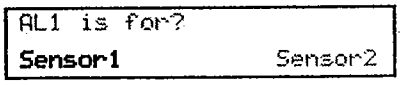
2. Choose **Alarms**.

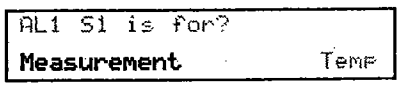


3. Choose **Alarm Configure**.



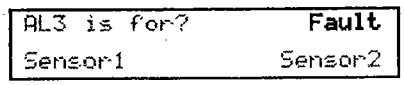
4. Choose Alarm 1 (**AL1**), Alarm 2 (**AL2**), or Alarm 3 (**AL3**).





5. For **AL1** or **AL2**
   a. Choose **Sensor 1** or **Sensor 2**. For a single input configuration, the **Sensor 1 Sensor 2** screen does not appear.
   b. Choose **Measurement** or **Temp**.
   c. Choose **High** or **Low**.
   d. Set the alarm **Deadband**.

6. The display returns to the **Alarm Configure?** screen. Select another alarm or press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

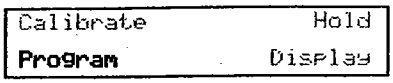


7. For **AL3**
   a. Choose **Sensor1**, **Sensor2**, or **Fault**.
   b. For **Sensor1**, select **High** or **Low** and set the deadband.
   c. Choosing **Fault** means **AL3** will activate when a sensor or analyzer fault exists. There is no user setting to make.

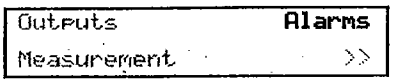
8. The display returns to the **Alarm Configure?** screen. Select another alarm or press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

5.4.4 Procedure: Programming Alarm Setpoints

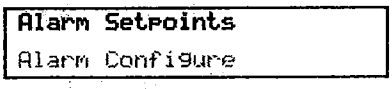
To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



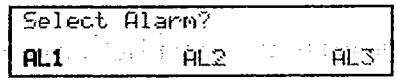
1. Press MENU. The main menu screen appears. Choose **Program**.



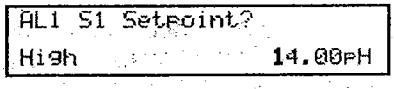
2. Choose **Alarms**.



3. Choose **Alarm Setpoints**.



4. Choose Alarm 1 (**AL1**), Alarm 2 (**AL2**), or Alarm 3 (**AL3**).



5. The display shows the alarm selected (**AL1**) and the configuration. The alarm is for Sensor 1 (**S1**), and the logic is high. Use the arrow keys to change the alarm setpoint.

6. The display returns to the **Select Alarm?** screen. Select another alarm or press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

5.5 SELECTING THE TYPE OF MEASUREMENT AND ACTIVATING SOLUTION TEMPERATURE CORRECTION

5.5.1 Purpose

This section describes how to do the following:

1. Program the Solu Comp II to measure pH, ORP, or redox potential.
2. Select a solution temperature correction.
3. Change the analyzer isopotential point.

5.5.2 Definitions

1. ORP. ORP is oxidation-reduction potential. It is the voltage difference between a noble metal (usually platinum) indicator electrode and a silver/silver chloride reference electrode.
2. REDOX. Redox is redox potential. Redox potential is measured the same way as ORP. The sign of the redox potential is the negative of ORP.
2. SIGN CONVENTION. The ORP of a solution of 0.1 M iron (II) ammonium sulfate and 0.1 M iron (III) ammonium sulfate in 1 M sulfuric acid is positive. The redox potential is negative.
4. SOLUTION TEMPERATURE CORRECTION. The pH of a solution, particularly an alkaline one, is a function of temperature. If the temperature changes, so does the pH, even though the concentration of the acid or base causing the pH remains constant. Solution temperature compensation converts the pH at the measurement temperature to the pH at a reference temperature. The Solu Comp II corrects the pH to a reference temperature of 25°C.

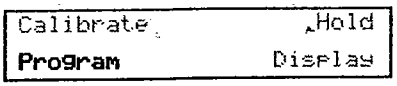
   For an accurate solution temperature correction, the exact composition of the solution must be known. The Solu Comp II has built-in temperature corrections for high purity water and for dilute solutions of a strong base. The analyzer also accepts a custom correction.
5. CUSTOM TEMPERATURE CORRECTION. The custom temperature correction has units of ΔpH/°C. The example shows how the analyzer uses the custom correction. Suppose the pH of the solution being measured decreases 0.022 units for every Celsius degree rise in temperature. The temperature correction is -0.022pH/°C. If the pH at 20°C is 8.95, the corrected pH (at 25°C) is 8.95 + (-0.022)(25 - 20) or 8.84.
6. ISOPOTENTIAL pH. The isopotential pH is the pH at which the cell voltage (the cell is the pH electrode, reference electrode, and solution being measured) is independent of temperature. Most pH cells have isopotential pH reasonably close to 7.00, so the Solu Comp II assumes the cell isopotential pH is 7.00. However, certain specialized electrodes have isopotential pH different from 7.00.

NOTE

Do NOT change the isopotential pH of the transmitter unless you are thoroughly familiar with the role of sensor and analyzer isopotential point in pH measurement, OR the sensor operating instructions specifically state the isopotential pH is a value other than pH 7.00.

5.5.3 Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Program**.



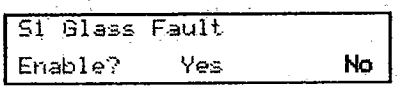
2. Choose **Measurement**.



3. Choose **Sensor 1** or **Sensor 2**. For a single input configuration, the **Sensor 1 Sensor 2** screen does not appear.



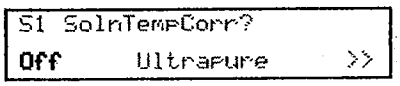
4. Choose **pH, Redox**, or **ORP**.
   If you chose **pH**, do steps 5 through 9.
   If you chose **ORP** or **Redox**, do step 10.



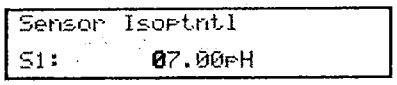
5. Choose **No** if a non-glass pH sensing electrode is being used.



6. Choose **Soln Temp Corr** or **Sensor Isoptntl**.



7. For **Soln Temp Corr**, choose **Off, UltraPure, HighpH**, or **Custom**. For **Custom**, enter the desired temperature coefficient.



8. For **Sensor Isoptntl**, enter the desired sensor isopotential pH. Do not change the sensor isopotential pH unless the sensor is known to have an isopotential pH different from 7.00.

9. The display returns to the screen shown in step 3. Choose **Sensor 2** (conductivity) and follow the prompts.

10. If **Redox** or **ORP** was selected, there are no further settings to make. The display returns to the screen shown in step 3. Choose **Sensor 2** (conductivity) and follow the prompts.

11. The display returns to the screen shown in step 3. Press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

12. If **TDS** was selected, there are no further settings to make.The display returns to the screen shown in step 3. Press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

5.6 CHOOSING TEMPERATURE UNITS AND MANUAL OR AUTOMATIC TEMPERATURE COMPENSATION

5.6.1 Purpose

This section describes how to do the following:

1. Choose temperature display units (°C or °F).
2. Choose automatic or manual temperature compensation.
3. Enter a temperature for manual temperature compensation

5.6.2 Definitions

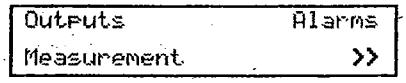
1. AUTOMATIC TEMPERATURE COMPENSATION. The analyzer uses a temperature-dependent factor to convert measured cell voltage to pH. In automatic temperature compensation, the analyzer measures the temperature and automatically calculates the correct conversion factor. For maximum accuracy, use automatic temperature compensation.
2. MANUAL TEMPERATURE COMPENSATION. In manual temperature compensation, the analyzer converts measured voltage to pH using the temperature entered by the user. It does not use the actual process temperature. Do **NOT** use manual temperature compensation unless the process temperature varies no more than about ±2°C or the pH is between 6 and 8. Manual temperature compensation is useful if the sensor temperature element has failed and a replacement sensor is not available. If manual temperature correction is selected, the display will not show the measured temperature. It will show the manually entered value.

5.6.3 Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



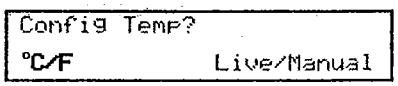
1. Press MENU. The main menu screen appears. Choose **Program**.



2. Choose >>.



3. Choose **Temp**.



4. Choose **°C/F** to change temperature units. Choose **Live/Manual** to turn on (Live) or turn off (Manual) automatic temperature compensation.
   a. If **°C/F** is chosen, select **°C** or **°F** in the next screen.
   b. If **Live/Manual** is chosen, select **Live** or **Manual** for sensor 1 in the next screen.
   c. If **Manual** is chosen, enter the temperature in the next screen. The temperature entered in this step will be used in all subsequent measurements, no matter what the process temperature is.
   d. The display will return to the **Live/Manual** screen for sensor 2. Make the desired selections for sensor 2.

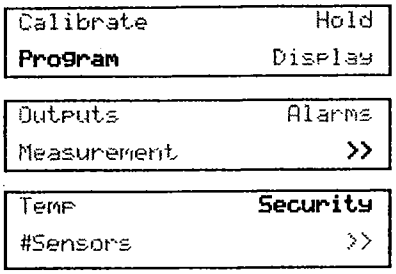
5.7 SETTING A SECURITY CODE

5.7.1 Purpose.

This section describes how to set a security code. The security code prevents program and calibration settings from accidentally being changed. Refer to Section 4.4 for additional information.

5.7.2 Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Program**.
2. Choose >>, then **Security**.
3. Enter a three digit security code. The security code takes effect two minutes after the last key stroke.
4. The display returns to the security menu screen. Press EXIT to return to the previous screen. To return to the main display, press MENU followed by EXIT.

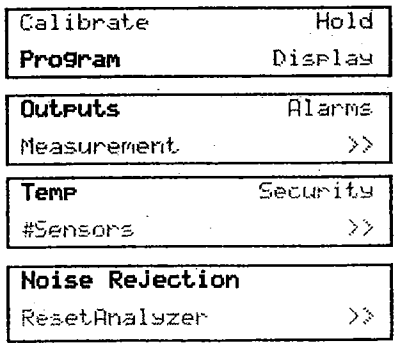
5.8 NOISE REJECTION

5.8.1 Purpose.

For maximum noise rejection, the frequency of the ac power must be entered in the analyzer.

5.8.2. Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



1. Press MENU. The main menu screen appears. Choose **Program**.
2. Choose >>.
3. Choose >>.
4. Choose **Noise Rejection**.
5. Enter the mains frequency, 50 Hz or 60 Hz.
6. The display returns to the **Noise Rejection** screen. To return to the main menu, press EXIT. To return to the main display, press MENU followed by EXIT.

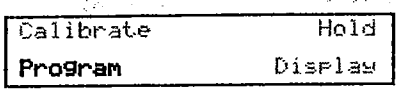
5.9 SINGLE SENSOR OR DUAL SENSOR INPUT

5.9.1 Purpose

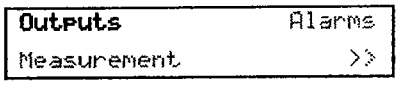
The Solu Comp II accepts input from a single sensor or from two sensors. This section describes how to program the analyzer for single or dual sensors. **COMPLETE THIS SECTION BEFORE DOING OTHER PROGRAMMING.**

5.9.2 Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



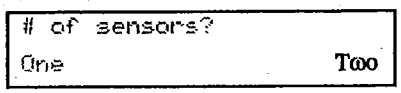
1. Press MENU. The main menu screen appears. Choose **Program.**



2. Choose >>.



3. Choose **#Sensors.**



4. Choose **One** or **Two**. Changing from **Two** to **One** will cause some settings to change.

NOTE

If **One** sensor is selected, only **S1** will be available. **S2** cannot be disabled.

5. The display returns to the **# Sensors** screen. To return to the main menu, press MENU. To return to the main display, press MENU followed by EXIT.

5.10 RESETTING FACTORY DEFAULT SETTINGS

5.10.1 Purpose.

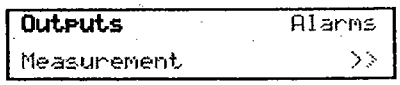
This section describes how to re-install factory default values. The process also clears all fault messages and returns the display to the first quick start screen.

5.10.2. Procedure.

To choose a menu item, move the cursor to the item and press ENTER.
To store a number or setting, press ENTER.



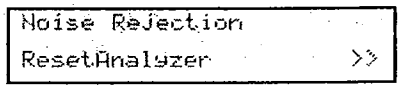
1. Press MENU. The main menu screen appears. Choose **Program.**



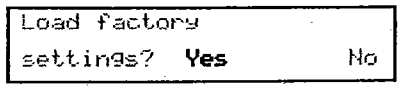
2. Choose >>.



3. Choose >>.



4. Choose **ResetAnalyzer.**



5. Choose **Yes** or No. If **Yes** is selected, previous settings are cleared and the **Quick Start Menu** appears.

5.11 SELECTING A DEFAULT SCREEN, LANGUAGE, AND SCREEN CONTRAST

5.11.1 Purpose

This section describes how to do the following:

1. set a default display screen

   The default display screen is the screen shown during normal operation. The Solu Comp II allows the user to choose from a large number of screens. Which screens are available depends on how the analyzer was configured. The following is an explanation of the abbreviations used in the screens.

   In the display:

   i. **S** means sensor. **S1** is sensor 1, and **S2** is sensor 2. If neither **S1** nor **S2** appears, then the analyzer has been configured for a single sensor input.

   ii. **G** is glass electrode impedance, and **R** is reference electrode impedance.

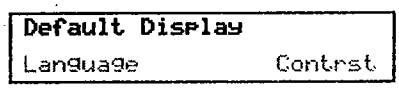
2. select a language
3. change the screen contrast

To choose a menu item, move the cursor to the item and press ENTER.

To store a number or setting, press ENTER.

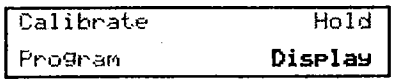
5.11.2 Procedure: Selecting a Display Screen

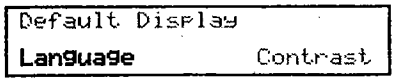




1. Press MENU. The main menu screen appears. Choose **Display**.
2. Choose **Default Display**.
3. Press ▲ or ▼ until the desired display appears. Press ENTER. For an explanation of abbreviations, see Section 5.11.1.
4. The display returns to the screen in step 2. To return to the main menu, press MENU. To return to the main display, press MENU followed by EXIT.

5.11.3 Procedure: Choosing a Language



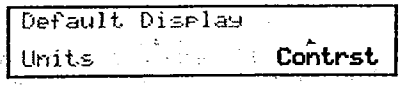


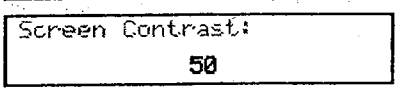


1. Press MENU. The main menu screen appears. Choose **Display**.
2. Choose **Language**.
3. Choose English, Français, Español, Deutsch, Italiano, or Portugues.
4. The display returns to the screen in step 2. To return to the main menu, press MENU. To return to the main display, press MENU followed by EXIT.

5.11.2 Procedure: Changing Screen Contrast







1. Press MENU. The main menu screen appears. Choose **Display**.
2. Choose **Contrst**.
3. Press ▲ or ▼ to increase or decrease the screen contrast. As contrast increases, the number increases.
4. The display returns to the screen shown in step 2. To return to the main menu, press MENU. To return to the main display, press MENU followed by EXIT.

SECTION 6.0
CALIBRATION

6.1 INTRODUCTION
6.2 CALIBRATING TEMPERATURE
6.3 TWO-POINT BUFFER CALIBRATION (AUTO CALIBRATION)
6.4 TWO-POINT BUFFER CALIBRATION (MANUAL CALIBRATION)
6.5 MAKING THE ANALYZER READING MATCH A SECOND INSTRUMENT (STANDARDIZATION)
6.6 ENTERING A KNOWN SLOPE
6.7 ORP CALIBRATION

6.1 INTRODUCTION

The Calibrate Menu allows the user to calibrate the pH, ORP (or redox), and temperature response of the sensor.

For pH sensors, two-point buffer calibration is standard. In auto calibration the Solu Comp II calculates the actual pH of the buffer from the nominal value entered by the user and does not accept calibration data until readings are stable. In manual calibration the user enters buffer values and judges when readings are stable. The pH reading can also be standardized, that is, forced to match the reading from a referee instrument. Finally, if the user knows the electrode slope (at 25°C), he can enter it directly.

The ORP calibration is a single-point calibration against an ORP standard.

6.2 CALIBRATING TEMPERATURE

6.2.1 Purpose

Temperature affects the measurement of pH in three ways.

1. The analyzer uses a temperature dependent factor to convert measured cell voltage to pH. Normally, a slight inaccuracy in the temperature reading is unimportant unless the pH reading is significantly different from 7.00. Even then, the error is small. For example, at pH 12 and 25°C, a 1°C error produces a pH error less than ±0.02.
2. During auto calibration, the Solu Comp II recognizes the buffer being used and calculates the actual pH of the buffer at the measured temperature. Because the pH of most buffers changes only slightly with temperature, reasonable errors in temperature do not produce large errors in the buffer pH. For example, a 1°C error causes **at most** an error of ±0.03 in the calculated buffer pH.
3. The Solu Comp II can be programmed to calculate and display pH at a reference temperature (25°C). The maximum change in solution pH with temperature is about ±0.04 pH/°C, so a 1°C temperature error does introduce a small error. However, the major source of error in solution temperature compensation is using an incorrect temperature coefficient.

Temperature affects the measurement of ORP in a complicated fashion that is best determined empirically.

Without calibration the accuracy of the temperature measurement is about ±0.4°C. Calibrate the sensor/analyzer combination if

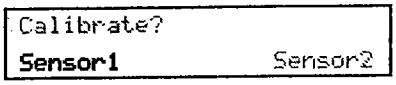
1. ±0.4°C accuracy is not acceptable
2. the temperature measurement is suspected of being in error. Calibrate temperature by making the analyzer reading match the temperature measured with a **standard thermometer**.

6.2.2 Procedure

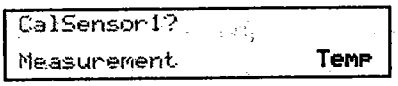
1. Remove the sensor from the process. Place it in an insulated container of water along with a **calibrated thermometer.** Submerge at least the bottom two inches of the sensor. Stir continuously.
2. Allow the sensor to reach thermal equilibrium. For some sensors, the time constant for a change in temperature is 5 min., so it may take as long as 30 min. for temperature equilibration.
3. If the sensor cannot be removed from the process, measure the temperature of a flowing sample taken from a point as close to the sensor as possible. Let the sample continuously overflow an insulated container holding a **calibrated thermometer.**
4. Change the Solu Comp II display to match the **calibrated thermometer** using the procedure below.



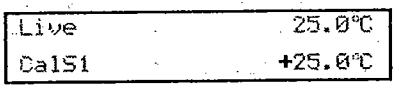
a. Press MENU. The main menu screen appears. Choose **Calibrate.**



b. Choose **Sensor1** or **Sensor2.** For a single input configuration, the **Sensor1 Sensor2** screen does not appear.

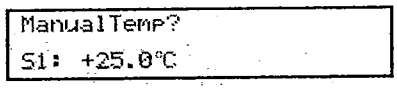


c. Choose **Temp.**

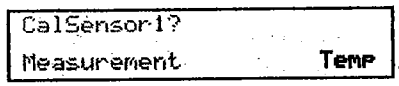


d. If the analyzer was programmed in Section 5.6 to use the actual process temperature, the screen at left will appear. To calibrate the temperature, change the number in the second line to match the temperature measured with the **standard thermometer.** Press ENTER. The display changes to the screen in step f.

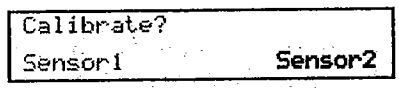
   If the analyzer was programmed to use a temperature entered by the user, the screen shown in step e will appear.



e. If the analyzer was programmed in Section 5.6 to use the temperature entered by the user, the screen at left will appear. Change the temperature to the desired value, then press ENTER. The analyzer will use the temperature entered in this step in all measurements and calculations, no matter what the true temperature is.



f. The screen at left will appear. Press EXIT.



g. Choose the other sensor and enter the temperature.

h. To return to the main display, press MENU followed by EXIT.

6.3 TWO-POINT BUFFER CALIBRATION (AUTO CALIBRATION)

6.3.1 Purpose

1. New sensors must be calibrated before use. Regular recalibration is also necessary.
2. Use auto calibration instead of manual calibration. Auto calibration avoids common pitfalls and reduces errors.

6.3.2 Definitions

1. AUTO CALIBRATION. The analyzer recognizes the buffers and uses temperature-corrected pH values in the calibration. The table lists the buffers the Solu Comp II recognizes.

pH at 25°C (nominal pH)	Standard(s)
1.68	NIST, DIN 19266, JSI 8802, BSI (see note 1)
3.56	NIST, BSI
3.78	NIST
4.01	NIST, DIN 19266, JSI 8802, BSI
6.86	NIST, DIN 19266, JSI 8802, BSI
7.00	(see note 2)
7.41	NIST
9.18	NIST, DIN 19266, JSI 8802, BSI
10.01	NIST, JSI 8802, BSI
12.45	NIST, DIN 19266

Note 1: NIST is National Institute of Standards, DIN is Deutsche Institute für Normung, JSI is Japan Standards Institute, and BSI is British Standards Institute.

Note 2: pH 7 buffer is not a standard buffer. It is a popular commercial buffer in the United States.

The Solu Comp II also measures noise and drift and does not accept calibration data until readings are stable. Calibration data will be accepted as soon as the pH reading is constant to within 0.02 units for 10 seconds. The stability settings cannot be changed.

2. SLOPE AND OFFSET. Once the Solu Comp II successfully completes the calibration, it calculates and displays the calibration slope and offset. The slope is reported as the slope at 25°C. Figure 6-1 defines the terms.

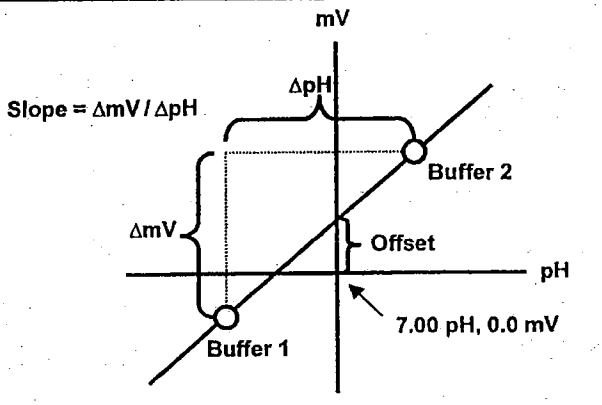


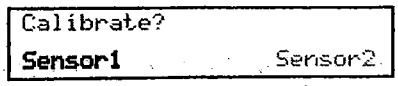
FIGURE 6-1. Calibration Slope and Offset

6.3.3 Procedure

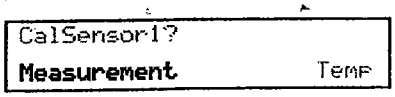
1. Obtain two buffer solutions. Ideally the buffer pH values should bracket the range of pH values to be measured.
2. Remove the sensor from the process liquid. If the process and buffer temperatures are appreciably different, place the sensor in a container of tap water at the buffer temperature. Do not start the calibration until the sensor has reached the buffer temperature. Thirty minutes is usually adequate.
3. Calibrate the sensor by using the procedure on the following page.



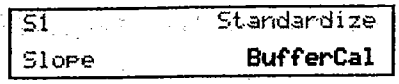
a. Press MENU. The main menu screen appears. Choose **Calibrate**.



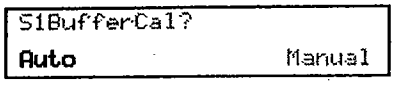
b. Choose **Sensor 1** or **Sensor 2**. For a single input configuration, the **Sensor1 Sensor2** screen does not appear.



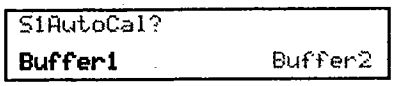
c. Choose **Measurement**.



d. Choose **BufferCal**.



e. Choose **Auto**.



f. Choose **Buffer1**.

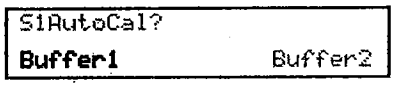
g. Rinse the sensor with water and place it in buffer 1. Be sure the glass bulb and reference junction are completely submerged. Swirl the sensor.



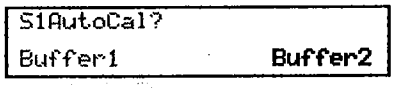
h. The screen at left is displayed until the reading is stable (<0.01 pH change in 10 sec). When the reading is stable, the screen in step i appears. To bypass automatic stabilization, press ENTER at any time.



i. The top line shows the actual reading (**S1Live**). The analyzer also identifies the buffer and displays the nominal buffer value (buffer pH at 25°C). If the displayed value is not correct, press ▲ or ▼ to select the correct value. The nominal value will change, for example, from 7.01 pH to 6.86 pH. Press ENTER.



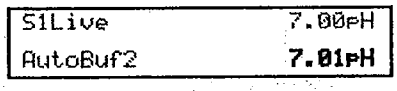
j. The screen shown at left appears.



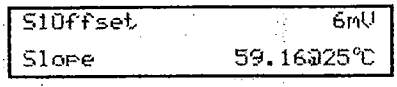
k. Remove the sensor from buffer 1, rinse it with water, and place it in buffer 2. Swirl the sensor. Choose **Buffer2**.



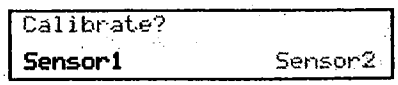
l. The screen at left is displayed until the reading is stable (<0.02 pH change in 10 sec). When the reading is stable, the screen in step m appears. To bypass automatic stabilization, press ENTER at any time.



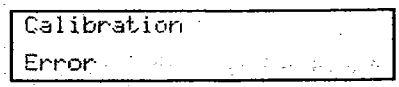
m. The top line shows the actual reading (**S1Live**). The analyzer also identifies the buffer and displays the nominal buffer value (buffer pH at 25°C). If the displayed value is not correct, press ▲ or ▼ to select the correct value. The nominal value will change, for example, from 7.01 pH to 6.86 pH. Press ENTER to accept the nominal value.



n. If the calibration was successful, the analyzer will display the offset and slope (at 25°C).



o. If the calibration was successful and if two sensors are wired to the analyzer, the **Calibrate?** screen appears. Choose the other sensor and repeat steps d through m.



p. If the slope is out of range (less than 45 mV/pH or greater than 60 mV/pH), an error screen appears. The display then returns to step f. Repeat the calibration.

q. To return to the main display, press MENU followed by EXIT.

6.4 TWO-POINT BUFFER CALIBRATION (MANUAL CALIBRATION)

6.4.1 Purpose

1. New sensors must be calibrated before use. Regular recalibration is also necessary.
2. Use manual calibration if non-standard buffers are being used; otherwise, use auto calibration. Auto calibration avoids common pitfalls and reduces errors.

6.4.2 Definitions

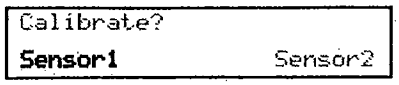
1. MANUAL CALIBRATION. In auto calibration the analyzer recognizes the buffer and uses the temperature-corrected pH value in the calibration. The analyzer also measures noise and drift and does not accept calibration data until readings are stable. During manual calibration, the user must judge when readings are stable and look up and enter the buffer values.
2. SLOPE AND OFFSET. Once the Solu Comp II successfully completes the calibration, it calculates and displays the calibration slope and offset. The slope is reported as the slope at 25ºC. Figure 6-1 defines the terms.

6.4.3 Procedure

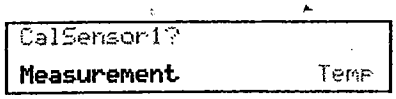
1. Obtain two buffer solutions. Ideally, the buffer pHs should bracket the range of pH values to be measured. Also obtain a thermometer. The pH of most buffer solutions is a function of temperature. To calibrate the sensor properly, the pH of the buffer at the measurement temperature must be entered in the analyzer.
2. Remove the sensor from the process liquid. If the process and buffer temperature are appreciably different, place the sensor in a container of tap water at the buffer temperature. Do not start the calibration until the sensor has reached the buffer temperature. Thirty minutes is usually adequate.
3. Calibrate the sensor using the procedure on the following page.



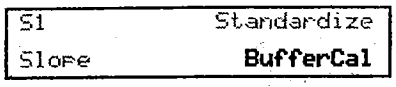
a. Press MENU. The main menu screen appears. Choose **Calibrate**.



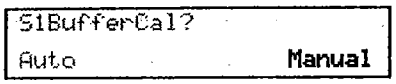
b. Choose **Sensor 1** or **Sensor 2**. For a single input configuration, the **Sensor1 Sensor2** screen does not appear.



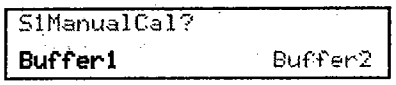
c. Choose **Measurement**.



d. Choose **BufferCal**.

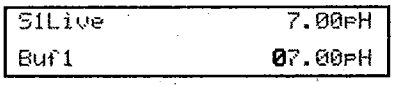


e. Choose **Manual**.

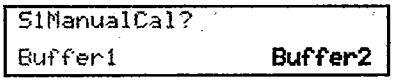


f. Choose **Buffer1**.

g. Rinse the sensor with water and place it in buffer 1. Be sure the glass bulb and junction are completely submerged. Swirl the sensor. Also place a thermometer in the buffer. Press ENTER



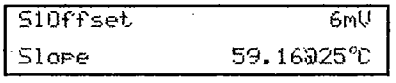
h. The top line shows the actual buffer reading (**S1 Live**). Wait until the reading is stable, then note the temperature. Change the pH in the second line to the pH of the buffer at the measured temperature. Press ENTER.



i. The screen at left appears. Choose **Buffer2**. Rinse the sensor and thermometer with water and place them in buffer 2. Be sure the bulb and junction are submerged. Swirl the sensor.



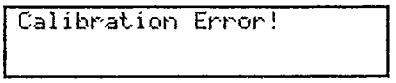
j. The top line shows the actual buffer reading (**S1 Live**). Wait until the reading is stable, then note the temperature. Change the pH in the second line to the pH of the buffer at the measured temperature. Press ENTER.



k. If the calibration was successful, the analyzer will display the offset and slope (at 25°C).



l. If the calibration was successful and if two sensors are wired to the analyzer, the **Calibrate?** screen appears. Choose the other sensor and repeat steps c through j.



m. If the slope is out of range (less than 45 mV/pH or greater than 60 mV/pH), an error screen appears. The display then returns to step g. Repeat the calibration.

n. To return to the main display, press MENU followed by EXIT.

6.5 MAKING THE ANALYZER READING MATCH A SECOND INSTRUMENT (STANDARDIZATION)

6.5.1 Purpose

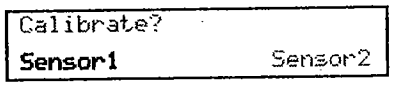
1. The pH measured by the Solu Comp II analyzer can be changed to match the reading from a second or referee instrument. The process of making the two readings agree is called standardization.
2. During standardization, the difference between the two pH values is converted to the equivalent voltage. The voltage, called the reference offset, is added to all subsequent measured cell voltages before they are converted to pH. If a standardized sensor is placed in a buffer solution, the measured pH will differ from the buffer pH by an amount equivalent to the standardization offset.

6.5.2 Procedure

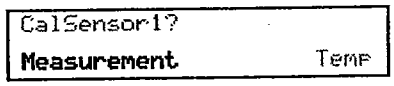
1. Install the sensor in the process liquid.
2. Once readings are stable, measure the pH of the liquid using a referee instrument.
3. Because the pH of the process liquid may change if the temperature changes, measure the pH of the grab sample immediately after taking it.
4. For poorly buffered samples, it is best to determine the pH of a continuously flowing sample from a point as close as possible to the sensor.
5. Standardize the Solu Comp II analyzer by following the steps below.



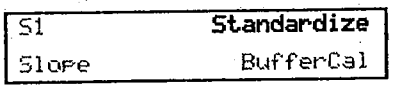
a. Press MENU. The main menu screen appears. Choose **Calibrate**.



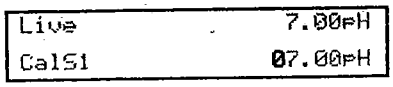
b. Choose **Sensor1** or **Sensor2**. For a single input configuration, the **Sensor1 Sensor2** screen does not appear.



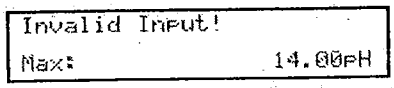
c. Choose **Measurement**.



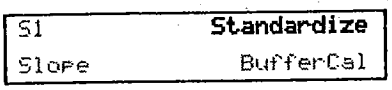
d. Choose **Standardize**.



e. The top line shows the present pH reading. Change the pH reading in the second line to match the referee instrument. Press ENTER.



f. The screen at left appears if the entered pH was greater than 14.00. The display then returns to step e. Repeat the standardization.



g. If the entry was accepted, the screen at left appears. To verify that the new pH was accepted, return to the main display by pressing MENU followed by EXIT.

h. To standardize the second sensor, repeat steps a through e.

i. To return to the main display, press MENU followed by EXIT.

6.6 ENTERING A KNOWN SLOPE VALUE

6.6.1 Purpose

If the electrode slope is known from other measurements, it can be entered directly in the Solu Comp II analyzer. The slope must be entered as the slope at 25°C. To calculate the slope at 25°C from the slope at temperature t°C, use the equation:

$$\text{slope at } 25°C = (\text{slope at } t°C)\ \frac{298}{t°C + 273}$$

Changing the slope overrides the slope determined from the previous buffer calibration.

6.6.2 Procedure

Calibrate Hold Program Display	1. Press MENU. The main menu screen appears. Choose **Calibrate**.
Calibrate? **Sensor1** Sensor2	2. Choose **Sensor1** or **Sensor2**. For a single input configuration, the **Sensor1 Sensor2** screen does not appear.
CalSensor1? **Measurement** Temp	3. Choose **Measurement**.
S1 Standardize **Slope** BufferCal	4. Choose **Slope**.
Changing slope overrides bufcal.	5. The screen at left appears briefly.
pH Slope @ 25°C? S1: 59.16mV/pH	6. Change the slope to the desired value. Press ENTER.
Invalid Input!	7. The slope must be between 45 and 60 mV/pH. If the value entered is outside this range, the screen at left appears.
S1 Standardize **Slope** BufferCal	8. If the entry was accepted, the screen at left appears.
	9. To enter the slope for the other sensor, press EXIT twice. Choose the other sensor and repeat steps 3 through 6.
	10. To return to the main display, press MENU followed by EXIT.

6.7 ORP CALIBRATION

6.7.1 Purpose

1. For process control, it is often important to make the measured ORP agree with the ORP of a standard solution.
2. During calibration, the measured ORP is made equal to the ORP of a standard solution at a single point.

6.7.2 Preparation of ORP standard solutions

ASTM D1498-93 gives procedures for the preparation of iron (II) - iron (III) and quinhydrone ORP standards. The iron (II) - iron (III) standard is recommended. It is fairly easy to make, is not particularly hazardous, and has a shelf life of about one year. In contrast, quinhydrone standards contain toxic quinhydrone and have only an eight-hour shelf life.

Iron (II) - iron (III) standard is available from Rosemount Analytical as PN R508-16OZ. The ORP of the standard solution measured against a silver-silver chloride reference electrode is 476±20mA at 25°C. The redox potential is -476±20mA at 25°C.

6.7.3 Procedure

Calibrate	Hold
Program	Display

1. Press MENU. The main menu screen appears. Choose **Calibrate**.

Calibrate?	
Sensor1	Sensor2

2. Choose **Sensor1** or **Sensor2**. For a single input configuration, the **Sensor1 Sensor2** screen does not appear.

CalSensor1?	
Measurement	Temp

3. Choose **Measurement**.

Live	600mV
CalSN	+0000mV

4. The top line shows the actual ORP or redox potential (**S1Live**). Once the reading is stable, change the number in the second line to the desired value. Press ENTER.

5. The display returns to the Cal Sensor screen. Press EXIT. Choose the other sensor and repeat steps 2 through 4.

SECTION 7.0
MAINTENANCE

7.1 OVERVIEW
7.2 REPLACEMENT PARTS

7.1 OVERVIEW

The Solu Comp II analyzer needs little routine maintenance. The calibration of the analyzer and sensor should be checked periodically. To recalibrate the analyzer and sensor, see Section 6.0.

Clean the analyzer case and front panel by wiping with a clean soft cloth dampened with water **ONLY**. Do not use solvent, like alcohol, that might cause a buildup of static charge.

7.2 REPLACEMENT PARTS

Many components of the analyzer are replaceable. Refer to the table below to find the correct parts diagram.

Model	Description	See Figure
1055pH-10	Panel mounting enclosure	7-1
1055pH-11	Pipe/surface mounting enclosure	7-2

TABLE 7-1. Replacement Parts for Solu Comp II (Panel Mount Version)

Location in Figure 7-1	PN	Description	Shipping Weight
1	23823-00	Panel mounting kit, includes four brackets and four set screws	2 lb/1.0 kg
2	note	Enclosure, front, for panel mount version, includes keypad	
3	33654-00	Gasket, front, for panel mount version	2 lb/1.0 kg
4	note	Screw, 2-56 x 0.187 in., with integral washer	
5	note	Display board, LCD	
6	note	PCB, microprocessor	
7	note	Screw, self-tapping, #4 x 0.375 in.	
8	note	PCB, power supply, 115/230 Vac or 24 Vdc	
9	note	Screw, 4-40 x 0.31 in., with integral washer	
10	33658-00	Gasket, rear cover, for panel mount version	2 lb/1.0 kg
11	note	Enclosure cover, rear, for panel mount version, 115/230 Vac	
11	note	Enclosure cover, rear, for panel mount version, 24 Vdc	
12	note	Self-tapping screws, #6 x 1.25 in.	

Note: Information about circuit boards and size of screws and washers is for information only. Circuit boards, enclosure, display board, and screws and washers cannot be purchased from Rosemount Analytical.
Shipping weights are rounded up to the nearest whole lb or 0.5 kg.

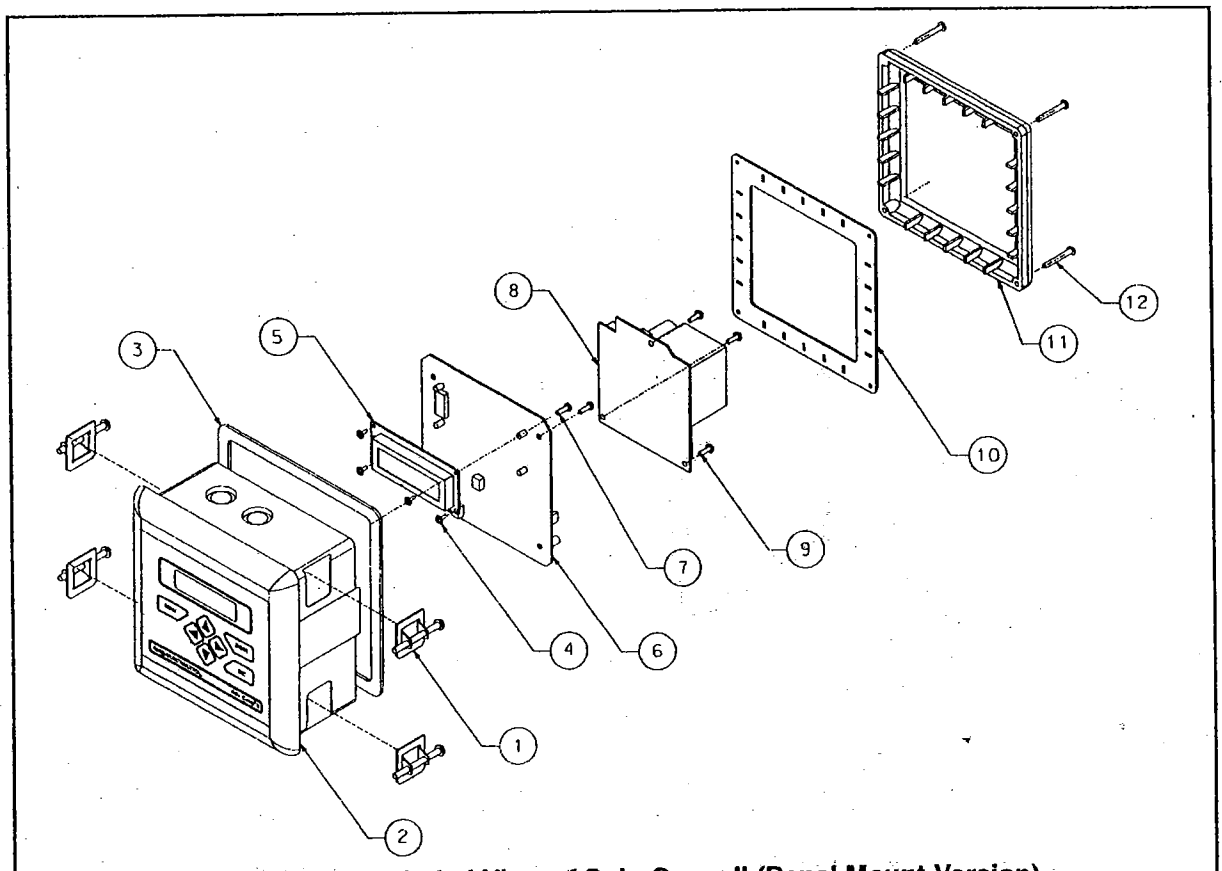


FIGURE 7-1. Exploded View of Solu Comp II (Panel Mount Version)

TABLE 7-2. Replacement Parts for Solu Comp II (Pipe/Surface Mount Version)

Location in Figure 7-2	PN	Description	Shipping Weight
1	note	Screw, 6-32 x 1.38 in.	
2	note	Washer	
3	note	Enclosure, front, for pipe/surface mount version, includes keypad and hinge	
4	33655-00	Gasket for pipe/surface mount version	2 lb/1.0 kg
5	note	Screw, 2-56 x 0.187 in., with integral washer	
6	note	Display board, LCD	
7	note	PCB, microprocessor	
8	note	Self-tapping screw, #4 x 0.375 in.	
9	note	PCB, power supply, 115/230 Vac or 24 Vdc	
10	note	Screw, 4-40 x 0.31 in., with integral washer	
11	note	Enclosure, rear, for pipe/surface mount version, includes standoffs and hinge brackets	
not shown	23833-00	Surface mount kit; consists of four self-tapping screws #6 x 1.75 in. and four O-rings	1 lb/0.5 kg

Note: Information about circuit boards and size of screws and washers is for information only. Circuit boards, enclosure, display board, and screws and washers cannot be purchased from Rosemount Analytical.
Shipping weights are rounded up to the nearest whole lb or 0.5 kg.

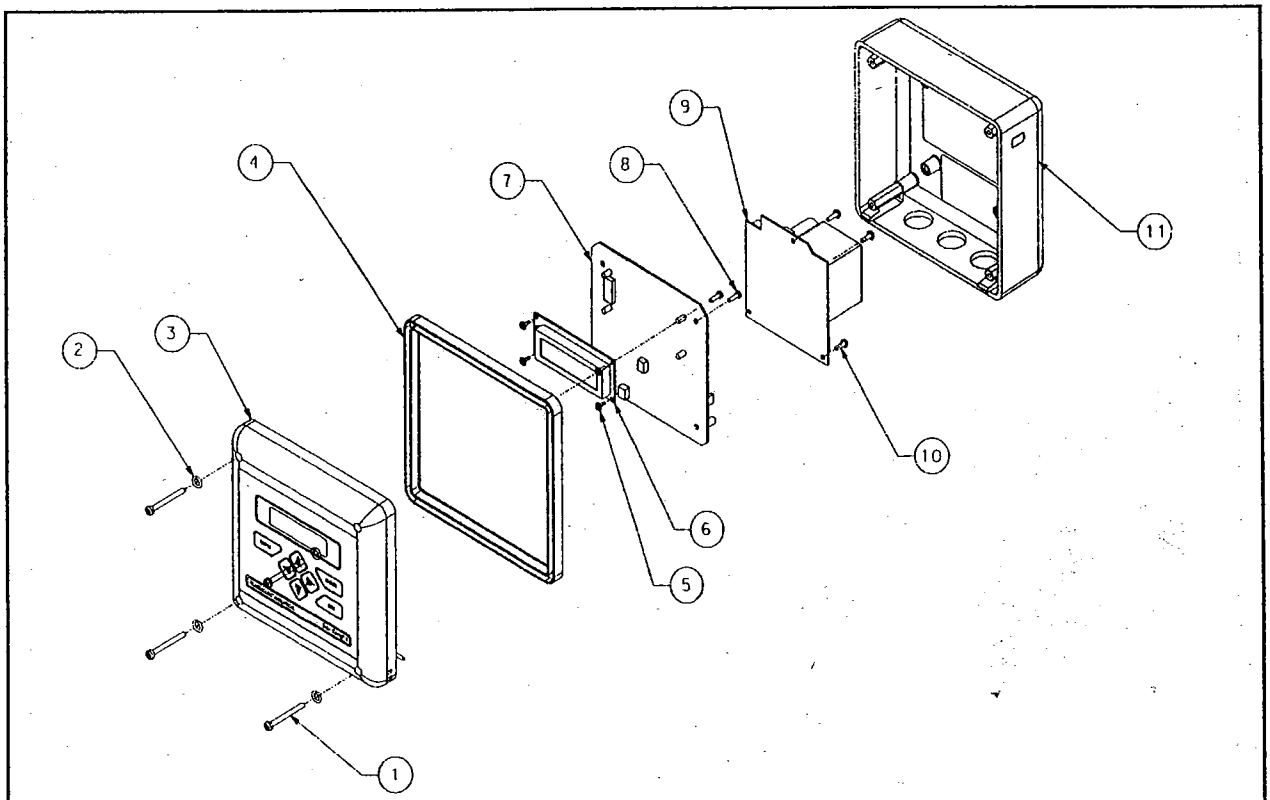


FIGURE 7-2. Exploded View of Solu Comp II (Pipe/Surface Mount Version)

SECTION 8.0
TROUBLESHOOTING

8.1 OVERVIEW
8.2 TROUBLESHOOTING USING FAULT CODES
8.3 TROUBLESHOOTING WHEN NO ERROR MESSAGE IS SHOWING
8.4 SIMULATING INPUTS
8.5 SIMULATING TEMPERATURE
8.6 MEASURING REFERENCE VOLTAGE

8.1 OVERVIEW

The Solu Comp II continuously monitors itself and the sensor for faults. When the analyzer detects a fault, the word *fault* appears in the display alternately with the measurement. If alarm 3 was configured as a fault alarm, the alarm relay will energize. The outputs do not change during a fault condition. They continue to reflect the measured pH, ORP, or temperature. **Press ▲ to display the fault codes.**

8.2 TROUBLESHOOTING USING FAULT CODES

Fault Code	Explanation	See Section
S1 or S2 Out of Range	Absolute value of measured voltage exceeds 2500 mV	8.2.1
S1 or S2 Broken Glass	pH sensitive glass membrane is broken	8.2.2
TC1 Open or TC2 Open	RTD for sensor 1 or sensor 2 is open	8.2.3
TC1 Shorted or TC2 Shorted	RTD for sensor 1 or sensor 2 is shorted	8.2.3
S1 or S2 Sense Line Open	RTD sense line for sensor 1 or sensor 2 is open	8.2.4
EEPROM Failure	EEPROM failure	8.2.5

8.2.1 Absolute Value of Measured Voltage Exceeds 2500 mV

The voltage of a pH cell is usually between 600 mV and -600 mV, and the voltage of an ORP cell is between 2000 and -2000 mV. Readings outside the range -2500 mV to 2500 mV usually indicate a problem with sensor wiring or analyzer electronics.

A. If the sensor is being installed for the first time, check the wiring connections. See Section 3.3. If a junction box is being used, be sure to check all connections at the junction box, too.
B. If the preamplifier is in a junction box, verify that the wires supplying the power (±5 Vdc) to the preamplifier are connected at the analyzer and junction box.
C. Verify that the sensor is completely submerged in the process liquid.

8.2.2 pH Sensitive Glass Membrane is Broken

The Solu Comp II continuously measures the impedance between the sensor solution ground and the inside of the pH-sensing electrode. If the glass membrane is intact, the impedance is normally between 10 MΩ and 1000 MΩ. If the membrane is cracked or broken, the impedance drops below 10 MΩ. If the membrane is cracked or broken, the sensor must be replaced.

8.2.3 RTD for Sensor 1 or Sensor 2 Open or Shorted.

There is an open or short in the sensor RTD or wiring.

A. If sensor is being installed for the first time, check the wiring connections. See Section 3.0.
B. Disconnect the sensor from the analyzer and measure the resistance between the RTD lead wires. See the sensor manual to identify the RTD leads. If there is an open or short circuit, replace the sensor.
C. If there is no open or short, check the analyzer. See Section 8.4.

8.2.4 RTD Sense Line for Sensor 1 or Sensor 2 is Open.

The Solu Comp II measures temperature using a three-wire RTD inside the sensor. See Figure 8-3. The in and return leads connect the RTD to the measuring circuit in the analyzer. A third wire, called the sense line, is connected to the return line. The sense line allows the analyzer to correct for the resistance of the in and return leads and to correct for changes in lead wire resistance with temperature.

A. Verify that all wiring connections are secure.

B. The analyzer can be operated with the sense line open. The measurement will be less accurate because the analyzer can no longer correct for lead wire resistance and for changes in lead wire resistance with ambient temperature. However, if the sensor is to be used at approximately constant temperature, the lead wire resistance error can be eliminated by calibrating the sensor at the measurement temperature. Errors caused by changes in lead wire resistance with changes in ambient temperature cannot be eliminated.To make the error message disappear, connect the RTD sense and return terminals with a jumper.

8.2.5 EEPROM Failure.

Call the factory at (800) 854-8257.

8.3 TROUBLESHOOTING WHEN NO ERROR MESSAGE IS SHOWING.

Problem	See Section
New temperature during calibration more than 2-3°C different from the live reading	8.3.1
Calibration Error warning during two-point calibration	8.3.2
Calibration Error warning during standardization	8.3.3
Invalid Input while manually entering slope	8.3.4
Sensor does not respond to known pH changes	8.3.5
Calibration was successful, but process pH is slightly different from expected value	8.3.6
Calibration was successful, but process pH is grossly wrong and/or noisy	8.3.7
Current output too low	8.3.8
Alarm relays do not operate when alarm setpoint is exceeded	8.3.9
Display is unreadable -- too faint or all pixels dark	8.3.10

8.3.1 Difference Between Solu Comp II and Standard Thermometer is Greater Than 3°C.

If an error message appears during a temperature calibration, check the following:

A. Is the standard thermometer, RTD, or thermistor accurate? General purpose liquid-in-glass thermometers, particularly ones that have been mistreated, can have surprisingly large errors.

B. Is the temperature element in the pH sensor completely submerged in the test liquid?

C. Is the standard temperature sensor submerged to the correct level?

D. Review Section 6.2.2.

8.3.2 Calibration Error During Two-Point Calibration

Once the two-point (manual or automatic) calibration is complete, the Solu Comp II automatically calculates the sensor slope (at 25°). If the slope is greater than 60 mV/pH or less than 45 mV/pH, the analyzer displays the Calibration Error screen and does not update the calibration. Check the following:

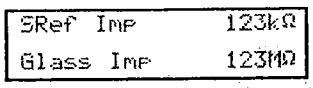
A. Are the buffers accurate? Inspect the buffers for obvious signs of deterioration, such as turbidity or mold growth. Neutral and slightly acidic buffers are highly susceptible to molds. Alkaline buffers (pH 9 and greater), if they have been exposed to air for long periods, may also be inaccurate. Alkaline buffers absorb carbon dioxide from the atmosphere, which lowers the pH. If a high pH buffer was used in the failed calibration, repeat the calibration using a fresh buffer. If fresh buffer is not available, use a lower pH buffer. For example, use pH 4 and 7 buffer instead of pH 7 and 10 buffer.

B. Was adequate time allowed for temperature equilibration? If the sensor was in a process substantially hotter or colder than the buffer, place it in a container of water at ambient temperature for at least 20 minutes before starting the calibration. Using auto calibration avoids calibration errors caused by temperature drift. The analyzer will not update readings until the drift is less than 0.02 pH over 10 seconds.

C. Were correct pH values entered during manual calibration? Using auto calibration eliminates errors caused by improperly entering data.

D. Is the sensor properly wired to the analyzer? Check the sensor wiring including any connections in a junction box. See Section 3.0.

E. Is the sensor dirty or coated? See the sensor instruction manual for cleaning instructions.



F. Is the sensor faulty? With the main display showing, use ▲ or ▼ to scroll through the information screens until the electrode impedance screen (at left) is displayed. Refer to the table for an interpretation of the impedance readings.

REFERENCE IMPEDANCE (**Ref Imp**)	
less than 40 kΩ	Normal reading, reference junction is clean.
between 40 and 140 kΩ	Reference junction is fouled or dirty.
greater than 140 kΩ	Reference junction is blocked or electrolyte is depleted. Sensor has failed.
GLASS IMPEDANCE (**Glass Imp**)	
less than 10 MΩ	Glass bulb is cracked or broken. Sensor has failed.
between 10 and 1000 MΩ	Normal reading.
greater than 1000 MΩ	pH sensor may be nearing the end of its service life.

Another way of checking for a faulty sensor is to replace it with a new one. If the new sensor can be calibrated, the old sensor has failed.

G. Is the analyzer faulty? The best way to check for a faulty analyzer is to simulate pH and temperature inputs. See Section 8.4.

8.3.3 Calibration Error during Standardization.

During standardization, the millivolt signal from the pH cell is increased or decreased to force it to agree with the pH reading from a referee instrument. A unit change in pH requires an offset of about 59 mV. The Solu Comp II limits the offset to ±1400 mV. If the standardization causes an offset greater than ±1400 mV, the analyzer will display the Calibration Error screen. The standardization will not be updated. Check the following:

A. Is the referee pH meter working and properly calibrated? Check the response of the referee sensor in buffers.

B. Is the process sensor working properly? Check the process sensor in buffers.

C. Is the sensor fully immersed in the process liquid? If the sensor is not completely submerged, it may be measuring the pH of the liquid film covering the glass bulb and reference element. The pH of this film may be different from the pH of the bulk liquid.

D. Is the sensor fouled? The sensor measures the pH of the liquid adjacent to the glass bulb. If the sensor is heav-ily fouled, the pH of liquid trapped against the bulb may be different from the bulk liquid.

E. Has the sensor been exposed to poisoning agents (sulfides or cyanides) or has it been exposed to extreme temperature? Poisoning agents and high temperature can shift the reference voltage many hundred millivolts. To check the reference voltage, see Section 8.6.

8.3.4 Invalid Input While Manually Entering Slope.

If the sensor slope is known from other sources, it can be entered directly into the analyzer. The Solu Comp II will not accept a slope (at 25°C) outside the range 45 to 60 mV/pH. See section 8.3.2 for troubleshooting sensor slope problems.

8.3.5 Sensor Does Not Respond to Known pH Changes.

A. Did the expected pH change really occur? If the process pH reading was not what was expected, check the performance of the sensor in buffers. Also, use a second pH meter to verify the change.

B. Is the sensor properly wired to the analyzer?

C. Is the glass bulb cracked or broken? Check the glass electrode impedance. See Section 8.3.2.

D. Is the analyzer working properly. Check the analyzer by simulating the pH input.

8.3.6 Buffer Calibration Is Acceptable, Process pH Is Slightly Different from Expected Value.

Differences between pH readings made with an on-line instrument and a laboratory or portable instrument are normal. The on-line instrument is subject to process variables, for example ground potentials, stray voltages, and orientation effects that may not affect the laboratory or portable instrument. To make the process reading agree with a referee instrument, see Section 6.5.

8.3.7 Calibration Was Successful, but Process pH Is Grossly Wrong and/or Noisy.

Grossly wrong or noisy readings suggest a ground loop (measurement system connected to earth ground at more than one point), a floating system (no earth ground), or noise being brought into the analyzer by the sensor cable. The problem arises from the process or installation. It is not a fault of the analyzer. The problem should disappear once the sensor is taken out of the system. Check the following:

A. Is a ground loop present?
   1. Verify that the system works properly in buffers. Be sure there is no direct electrical connection between the buffer containers and the process liquid or piping.
   2. Strip back the ends of a heavy gauge wire. Connect one end of the wire to the process piping or place it in the process liquid. Place the other end of the wire in the container of buffer with the sensor. The wire makes an electrical connection between the process and sensor.
   3. If offsets and noise appear after making the connection, a ground loop exists.

B. Is the process grounded?
   1. The measurement system needs one path to ground: through the process liquid and piping. Plastic piping, fiberglass tanks, and ungrounded or poorly grounded vessels do not provide a path. A floating system can pick up stray voltages from other electrical equipment.
   2. Ground the piping or tank to a local earth ground.
   3. If noise still persists, simple grounding is not the problem. Noise is probably being carried into the instrument through the sensor wiring.

C. Simplify the sensor wiring.
   1. Disconnect all sensor wires at the analyzer except pH/mV IN, REFERENCE IN, RTD IN and RTD RETURN. See the wiring diagrams in Section xx.xx. If the sensor is wired to the analyzer through a remote junction box containing a preamplifier, disconnect the wires at the sensor side of the junction box.
   2. Tape back the ends of the disconnected wires to keep them from making accidental connections with other wires or terminals.

3. Connect a jumper wire between the RTD RETURN and RTD SENSE terminals (see wiring diagrams in Section 3.2). Connect a second jumper wire between the REFERENCE IN and SOLUTION GROUND terminals.
4. If noise and/or offsets disappear, the interference was coming into the analyzer through one of the sensor wires. The system can be operated permanently with the simplified wiring.

D. Check for extra ground connections or induced noise.

1. If the sensor cable is run inside conduit, there may be a short between the cable and the conduit. Re-run the cable outside the conduit. If symptoms disappear, there is a short between the cable and the conduit. Likely a shield is exposed and touching the conduit. Repair the cable and reinstall it in the conduit.
2. To avoid induced noise in the sensor cable, run it as far away as possible from power cables, relays, and electric motors. Keep sensor wiring out of crowded panels and cable trays.
3. If ground loops persist, consult the factory. A visit from an experienced technician may be required to solve the problem.

8.3.8 Current Output Too Low.

Load resistance is too high. Maximum load is 600 Ω.

8.3.9 Alarm Relays Do Not Work

A. Verify the relays are properly wired.

B. Replace power supply PCB (PN 23818-00)

8.3.10 Display is Unreadable.

While holding down the MENU key, press ▲ or ▼ until the display has the correct contrast.

8.4 SIMULATING INPUTS

8.4.1 General

This section describes how to simulate a pH input into the Solu Comp analyzer. To simulate a pH measurement, connect a standard millivolt source to the transmitter. If the transmitter is working properly, it will accurately measure the input voltage and convert it to pH. Although the general procedure is the same, the wiring details depend on the location of the preamplifier.

8.4.2 Simulating pH input when the preamplifier is in the analyzer.

1. Turn off automatic temperature correction and solution temperature correction. From the Program menu, choose **Temp**. Then choose **Live/Manual** and enter 25°C. See Section 5.6 for details.
2. Disconnect the sensor and connect a jumper wire between the pH IN and REFERENCE IN terminals.
3. From the display menu choose the pH/temperature/mV screen. The measured voltage should be 0 mV and the pH should be 7.00. Because calibration data stored in the analyzer may be offsetting the input voltage, the displayed pH may not be exactly 7.00.
4. If a standard millivolt source is available, disconnect the jumper wire between pH IN and REFERENCE IN and connect the voltage source as shown in Figure 8-1. Be sure to jumper the reference and solution ground terminals.

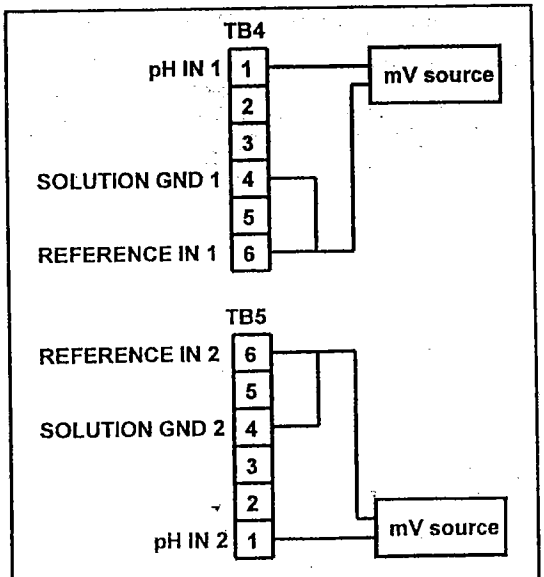


FIGURE 8-1. Simulating Inputs When the Preamplifier is in the Analyzer

5. Calibrate the analyzer using the procedure in Section 6.3. Use 0.0 mV for Buffer 1 (pH 7.00) and -177.4 mV for Buffer 2 (pH 10.00). If the analyzer is working properly it should accept the calibration. The slope should be 59.16 mV/pH and the offset should be zero.
6. To check linearity, return to the main display and the pH/temperature/mV screen. Set the voltage source to the values shown in the table and verify that the pH and millivolt readings match the values in the table.

Voltage (mV)	pH (at 25°)
295.8	2.00
177.5	4.00
59.2	6.00
-59.2	8.00
-177.5	10.00
-295.8	12.00

8.4.3 Simulating pH input when the preamplifier is in a junction box.

The procedure is the same as described in section 8.4.2. Keep the connections between the analyzer and the junction box in place. Disconnect the sensor at the sensor side of the junction box and connect the voltage source as shown in Figure 8-2.

8.4.4 Simulating pH input when the preamplifier is in the sensor.

The preamplifier in the sensor simply converts the high impedance signal into a low impedance signal without amplifying it. To simulate pH values, follow the procedure in Section 8.4.2.

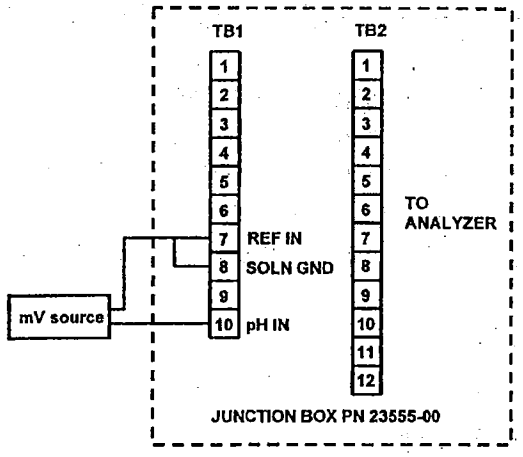


FIGURE 8-2. Simulating pH Input When the Preamplifier is in the Sensor.

8.5 SIMULATING TEMPERATURE

8.5.1 General.

The Solu Comp II accepts either a Pt100 or a Pt1000 RTD in a three-wire configuration. See Figure 8-3.

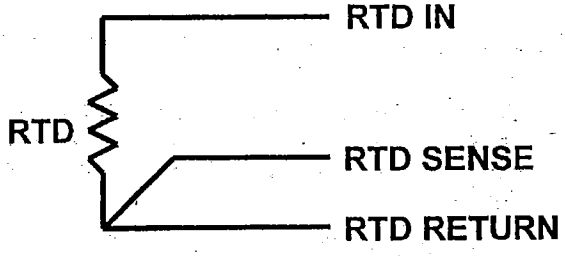


FIGURE 8-3. Three-Wire RTD Configuration.

Although only two wires are required to connect the RTD to the analyzer, using a third (and sometimes fourth) wire allows the analyzer to correct for the resistance of the lead wires and for changes in the lead wire resistance with temperature.

8.5.2 Simulating temperature

To simulate the temperature input, wire a decade box to the analyzer or junction box as shown in Figure 8-4.

To check the accuracy of the temperature measurement, set the resistor simulating the RTD to the values indicated in the table and note the temperature readings. The measured temperature might not agree with the value in the table. During sensor calibration an offset might have been applied to make the measured temperature agree with a standard thermometer. The offset is also applied to the simulated resistance. The Solu Comp II is measuring temperature correctly if the difference between measured temperatures equals the difference between the values in the table to within ±0.1°C.

For example, start with a simulated resistance of 103.9 Ω, which corresponds to 10.0°C. Assume the offset from the sensor calibration was -0.3 Ω. Because of the offset, the analyzer calculates temperature using 103.6 Ω. The result is 9.2°C. Now change the resistance to 107.8 Ω, which corresponds to 20.0°C. The analyzer uses 107.5 Ω to calculate the temperature, so the display reads 19.2°C. Because the difference between the displayed temperatures (10.0°C) is the same as the difference between the simulated temperatures, the analyzer is working correctly.

8.6 MEASURING REFERENCE VOLTAGE

Some processes contain substances that poison or shift the potential of the reference electrode. Sulfide is a good example. Prolonged exposure to sulfide converts the reference electrode from a silver/silver chloride electrode to a silver/silver sulfide electrode. The change in reference voltage is several hundred millivolts. A good way to check for poisoning is to compare the voltage of the reference electrode with a silver/silver chloride electrode known to be good. The reference electrode from a new sensor is best. See Figure 8-5. If the reference electrode is good, the voltage difference should be no more than about 20 mV. A poisoned reference electrode usually requires replacement.

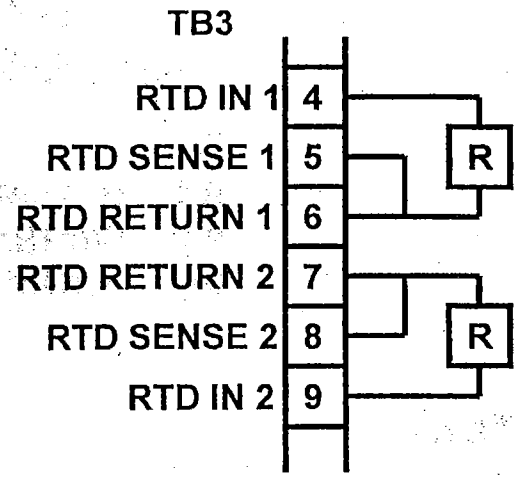


FIGURE 8-4. Simulating RTD Inputs.

Temp. (°C)	Pt 100 (Ω)	Pt 1000 (Ω)
0	100.0	1000
10	103.9	1039
20	107.8	1078
25	109.7	1097
30	111.7	1117
40	115.5	1155
50	119.4	1194
60	123.2	1232
70	127.1	1271
80	130.9	1309
85	132.8	1328
90	134.7	1347
100	138.5	1385

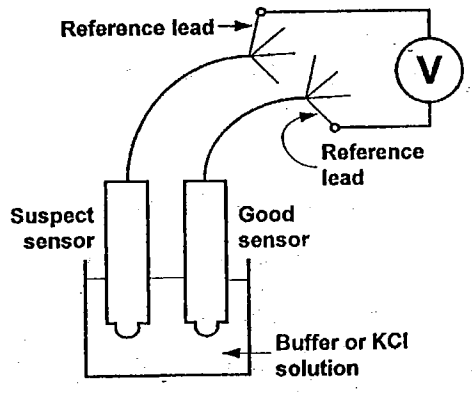


FIGURE 8-5. Checking for a Poisoned Reference Electrode.

Refer to the sensor wiring diagram to identify the reference leads. A laboratory silver/silver chloride electrode can be used in place of the second sensor.

SECTION 9.0
RETURN OF MATERIAL

9.1 GENERAL
9.2 WARRANTY REPAIR
9.3 NON-WARRANTY REPAIR

9.1 GENERAL.

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Before returning a product for repair, call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

9.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your "Letter of Transmittal" (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

   Rosemount Analytical Inc., Uniloc Division
   Uniloc Division
   2400 Barranca Parkway
   Irvine, CA 92606

   Attn: Factory Repair

   RMA No. _____

   Mark the package: Returned for Repair

   Model No. ____

9.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 9.2.

NOTE

Consult the factory for additional information regarding service or repair.

WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606

The shipping container should be marked:

Return for Repair
Model _____

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.

The right people, the right answers, right now.

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1-800-854-8257

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http://www.raihome.com

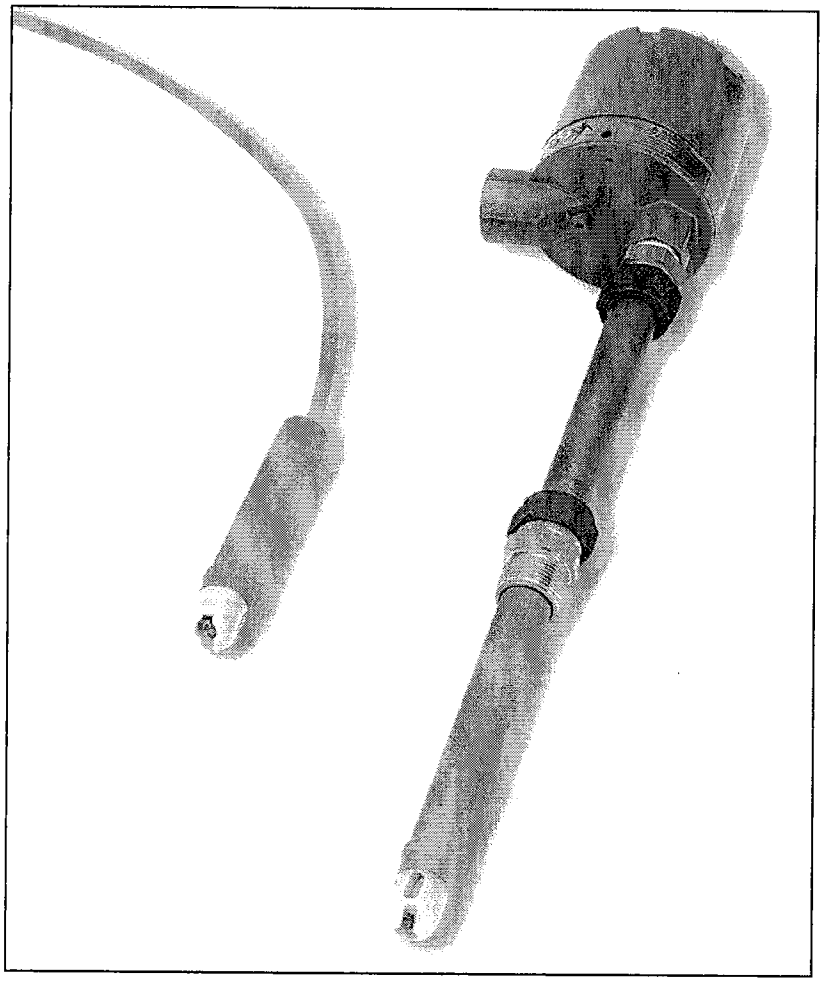
EMERSON.
Process Management

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Instruction Manual
PN 51-385+/rev.C
May 2003

Model 385+

pH/ORP Sensor



ROSEMOUNT® Analytical

EMERSON. Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, telephone 1-800-654-7768 and the requested manual will be provided. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except while maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

DANGER
HAZARDOUS AREA INSTALLATION

Installations near flammable liquids or in hazardous area locations must be carefully evaluated by qualified on site safety personnel. This sensor is not Intrinsically Safe or Explosion Proof.

To secure and maintain an intrinsically safe installation, the certified safety barrier, transmitter, and sensor combination must be used. The installation system must comply with the governing approval agency (FM, CSA or BASEEFA/CENELEC) hazardous area classification requirements. Consult your analyzer/transmitter instruction manual for details.

Proper installation, operation and servicing of this sensor in a Hazardous Area Installation is entirely the responsibility of the user.

WARNING
RETRACTABLE SENSORS

Retractable sensors must not be inserted nor retracted when process pressures are in excess of 64 psig (442kPa).

CAUTION
SENSOR/PROCESS APPLICATION COMPATIBILITY

The wetted sensor materials may not be compatible with process composition and operating conditions. Application compatibility is entirely the responsibility of the user.

About This Document

This manual contains instructions for installation and operation of the Model 385+ pH Sensor.The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
A	2/01	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering.
B	5/02	Drawings updated throughout
C	5/03	Drawing 40385+02 updated to rev. C; added drawing 41055119 — both on page 9.

Emerson Process Management

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MODEL 385+ pH/ORP SENSOR

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MODEL 385+ PH/ORP SENSOR

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SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

- ADVANCED ON-LINE SENSOR DIAGNOSTICS* for use with pH/ORP analyzer/transmitter Models 54, 81, 3081, or 4081.
- RETRACTABLE VERSION allows removal and replacement under pressure without process shutdown.
- LONG-LIFE, TRIPLE JUNCTION REFERENCE ELECTRODE provides longer service life in applications where poisoning ions are present.
- DISPOSABLE TEFZEL[1] AND TITANIUM DESIGN provides maximum chemical resistance and economical advantage where minimum troubleshooting and maintenance downtime are of prime importance.

1.1 FEATURES AND APPLICATIONS

The Rosemount Model 385+ Sensor is designed to provide advanced sensor diagnostics* available with Models 54 pH/ORP, 3081 pH/ORP, 4081 pH/ORP, and 81 pH/ORP (please refer to the respective Product Data Sheet for complete information). These advanced sensor diagnostics provide preventative maintenance by notifying the operator for replacement of an aged sensor or cleaning of a fouled sensor for continuous optimum performance.

The Model 385+ Sensor measures the pH or ORP (Oxidation Reduction Potential) of aqueous solutions in pipelines, open tanks, or ponds. It is suitable for applications where a low cost, industrial, disposable sensor is required. The combination electrode features a peripheral ceramic junction. The triple junction reference cell provides longer life in processes containing sugar, ammonia, chlorides, sulfides or other poisoning ions. The Model 385+ body is constructed of molded, chemically resistant Tefzel in two standard body versions.

The retraction version is housed in a titanium tube, with a plug-in style surface mount preamplifier in a weatherproof junction box. It is designed for use with a standard 1-1/2 in. ball valve assembly for process mounting where a separate sample stream is difficult or impossible to provide. The entire installation process is accomplished without line depressurization and minimal process fluid loss. Upon sensor removal, from the ball valve, maintenance and replacement is easy.

The insertion/submersion version has two body configurations: 25 ft (7.6 m) integral cable and preamplifier; 15 ft (4.5) integral cable for use with remote preamplifier.

1.2 PERFORMANCE SPECIFICATIONS

Measuring Range: pH: AccuGlass™ [1]
ORP: –1400 to 1400 mV

Percent Linearity Over pH Range		
	Option 10	Option 11
0-2 pH	94%	94%
2-12 pH	99%	97%
12-13 pH	97%	98%
13-14 pH	92%	98%

Temperature Compensation: (pH only) 0 to 100°C (32 to 212°F)

1.3 PHYSICAL SPECIFICATIONS

Wetted Materials: Tefzel, titanium, EPDM, 316 SS and Teflon[1] (Code 02), Viton[2], glass, ceramic and (ORP only) platinum.

Maximum Process Pressure and Temperature: 790 KPa abs (100 psig) at 100°C (212°F)

Maximum Pressure at Retraction or Insertion (ball valve version): 542 KPa abs (64 psig)

Process Connections: 1-1/2 in. with ball valve
1 in. without ball valve

Cable: P/N 9200273 (Unprepped) or P/N 23646-01 (Prepped)

Weight/Shipping Weight:
Submersion/insertion: 1.6 lb/2.8 lb 0.7Kg /1.25 Kg
Retraction: 6 lb/11 lb (2.7 Kg/5.0 Kg)
Ball Valve: 5 lb/10 lb (2.25 Kg/4.5 Kg)

[1] Registered trademark of Rosemount Analytical Inc.
[2] Registered trademarks of E.I. du Pont de Nemours & Company
* Patent Pending

1.4 ORDERING INFORMATION

The Model 385+ pH/ORP Sensor: Standard features include a Tefzel sensor body with a triple junction gel filled reference electrode and automatic temperature compensator housed in a titanium tube. The retractable version comes with a weatherproof junction box and preamplifier. The insertion/submersion version has two optional body configurations: integral preamplifier and 25 ft (7.6 m) integral cable, or 15 ft (4.5 m) integral cable for use with remote preamplifier. The 385+ is designed to be used with the Model 54 pH/ORP Analyzer, 3081 pH/ORP Transmitter, 4081 pH/ORP Transmitter, and 81 pH/ORP Transmitter.

MODEL 385+	pH/ORP SENSOR
CODE	BODY CONFIGURATION (Required Selection)
02	Retractable with Sensor-mounted Junction Box, Preamplifier, and Process Connector
03	Insertion/Submersion with Integral Preamplifier and 25 ft (7.6 m) cable
04	Insertion/Submersion for use with Remote Preamplifier and 15 ft (4.5 m) cable

CODE	COMBINATION ELECTRODE (Required Selection)
10	GPLR, General Purpose Low Resistivity
11	High pH
12	ORP (Platinum)

CODE	OPTIONS
21	316 Stainless Steel Ball Valve Kit

385+	– 02	– 10	– 21	EXAMPLE

NOTE:

Option 02 recommended interconnecting cable from sensor to transmitter is Rosemount Analytical P/N 23553-00 (prepped) or P/N 9200258 (unprepped). Specify length.

TABLE 1-1 ACCESSORIES

ACCESSORIES	DESCRIPTION
11275-01	Handrail mounting assembly (Code 03, 04 only)
23550-00	Remote J-Box without preamplifier (Code 02, 03 only)
23555-00	Remote J-Box with preamplifier, (Code 04 only)
23166-00	Process connector, 316SS, insertion/submersion 1 in. MNPT (Code 02, 03, 04)
23166-01	Process connector, titanium, insertion/submersion 1 in. MNPT (Code 02, 03, 04)
9510066	Process connector, Nylon, submersion only, 1 in. MNPT (Code 03, 04)

SECTION 2.0
INSTALLATION

2.1 UNPACKING AND INSPECTION. Inspect the outside of the carton for any damage. If damage is detected, contact the carrier immediately. Inspect the instrument and hardware. Make sure all items in the packing list are present and in good condition. Notify the factory if any part is missing.

NOTE

Save the original packing cartons and materials as most carriers require proof of damage due to mishandling, etc. Also, if it is necessary to return the instrument to the factory, you must pack the instrument in the same manner as it was received. Refer to Section 6.0 for instructions.

WARNING

Glass electrode must be wetted at all times (in storage and in line) to maximize sensor life.

2.2 MECHANICAL INSTALLATION. The Model 385+ is available in two versions, the retraction version (Code 02) and the insertion/submersion version (Code 03, & 04). Please refer to the appropriate section below.

2.2.1 Retraction Option. (Code option -02) The Model 385+ Sensor may be installed through a weldalet or in a pipe tee or "Y", as shown in Figure 2-1, when used with a ball valve. Insert the end of the sensor to a depth sufficient to ensure that the glass bulb is continuously wetted by the process fluid. The Model 385+ can also be inserted directly into the process without the use of a ball valve for applications not requiring continuous operation during sensor maintenance (Figure 2-2). **ALLOW SUFFICIENT ROOM FOR SAFE RETRACTION AND INSERTION OF THE SENSOR. PERSONNEL SHOULD HAVE ROOM FOR STABLE FOOTING WHILE PERFORMING REMOVAL OR INSERTION OF THE SENSOR.**

The sensor must be mounted within 10-90 degrees of the horizontal with the tip pointed downward, thus keeping air bubbles out of the pH sensitive glass bulb. Bubbles settled in the glass bulb disrupt the electrical continuity between the pH sensitive glass and the silver/silver chloride measuring element.

If the retraction version is to be installed without a ball valve follow the installation procedure for insertion service (Section 2.2.2). Perform the following steps for sensor installation through a ball valve:

1. Carefully remove the liquid filled rubber boot which protects the glass electrode and keeps the liquid junction wet during shipping and storage. Discard the liquid and boot. Make sure the lubricated O-ring is in place in the groove inside the male connector on the sensor body (Figure 4-1, item A).

CAUTION

Buffer solution, in the vinyl boot, may cause skin or eye irritation

2. With the male connector on the sensor's body, insert the sensor into the ball valve until it gently touches the closed valve. The molded electrode guard will protect the glass bulb from breakage.
3. Thread the male connector body tightly into the ball valve assembly. DO NOT tighten the hex nut on the male connector body; doing so would not allow the sensor to be inserted through the ball valve.
4. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free of the ball valve assembly. The built-in retraction stop will butt against the shoulder of the male connector if properly installed.

CAUTION

The sensor must be captured by the valve assembly and the male connector so that it cannot be blown free by process pressure if mishandled during insertion or retraction.

5. After confirming that the sensor assembly is properly secured by the valve assembly, the valve may be opened and the sensor positioned into the process at the desired depth and orientation.
6. While holding the sensor in position, tighten the hex nut of the male connector to firmly secure the sensor in place. When the hex nut is tightened, the Teflon ferrule inside the compression fitting clamps the sensor tube. (See Figure 4-2.)

CAUTION

Over tightening the hex nut may damage the ferrule.

NOTE

A stainless steel ferrule is available if the TEFLON ferrule does not inadequately grip. When using the metallic ferrule, care must be taken to avoid over tightening and damaging the sensor tube. If the male connector leaks during insertion or retraction, replace the O-ring in the male connector.

2.2.2 Submersion/Insertion Option. Code Option -03 & -04). Figure 2-3 and Figure 2-4. The Model 385+ Sensor may be installed through a weldalet or a pipe tee or "Y" when used with a process connector (P/N 23166-00-01). For submersion service, a process connector (P/N 23166-00-01 or 9510066) may be used with a water tight 1 in. schedule 80 CPVC or PVDF standpipe conduit. Refer to Figure 2-5. Tapered threads in plastic tend to loosen after installation. It is therefore recommended that TEFLON tape be used on the threads and that the tightness of the connection be checked frequently to assure that no loosening has occurred. The sensor should be installed within 80° of vertical, with the electrode facing down.

2.3 ELECTRICAL INSTALLATION. Make electrical connections as shown on Figures 2-6 through 2-11 using the following guidelines:

1. Pay particular attention to the analyzer or transmitter model number when following details on the wiring diagrams to ensure that the connections are made to the proper terminals.
2. Use Rosemount custom cable PN 9200273.
3. The maximum distance from the sensor to the analyzer is 15 ft without an integral preamplifier.
4. Signal cable should be run in a dedicated conduit and should be kept away from AC power lines.

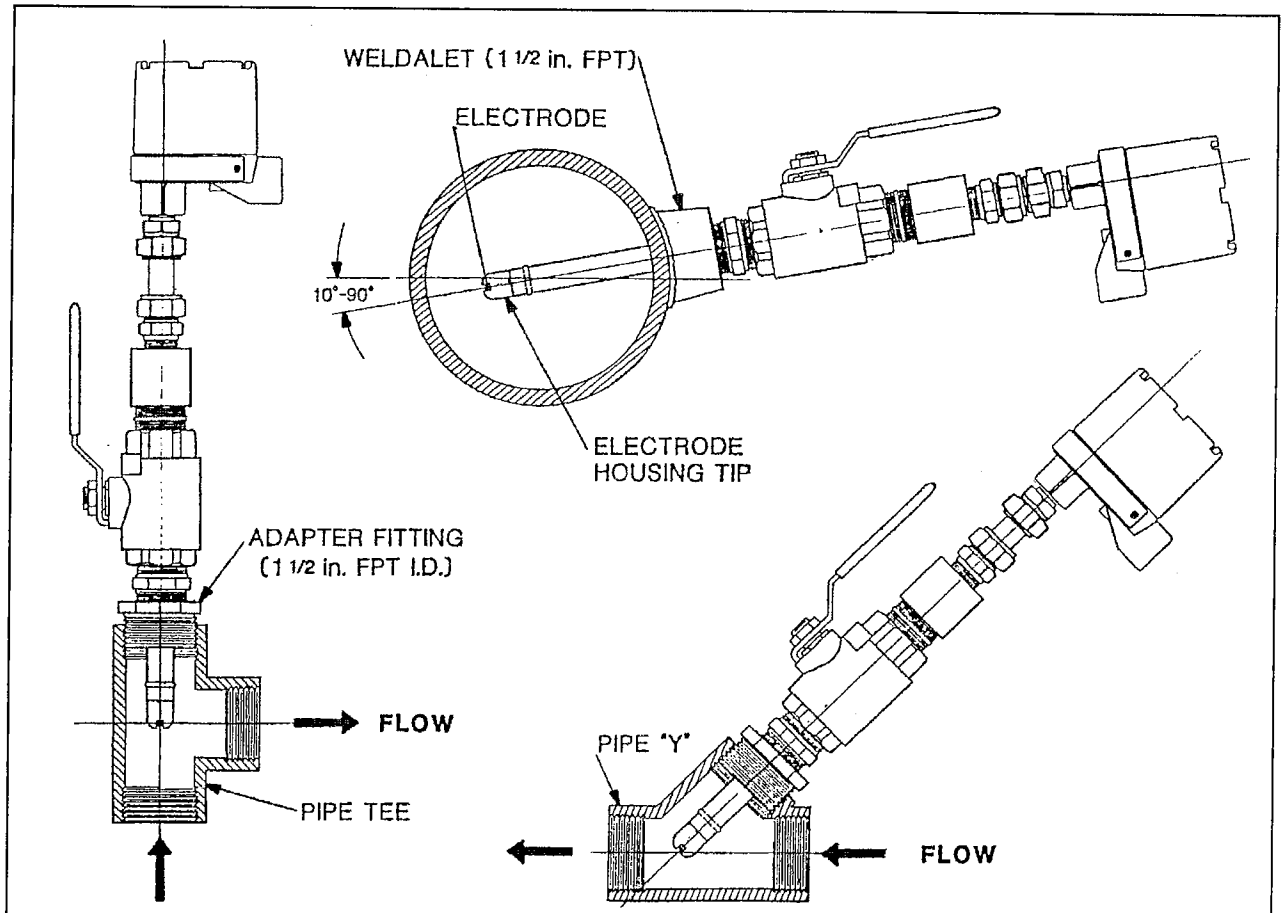
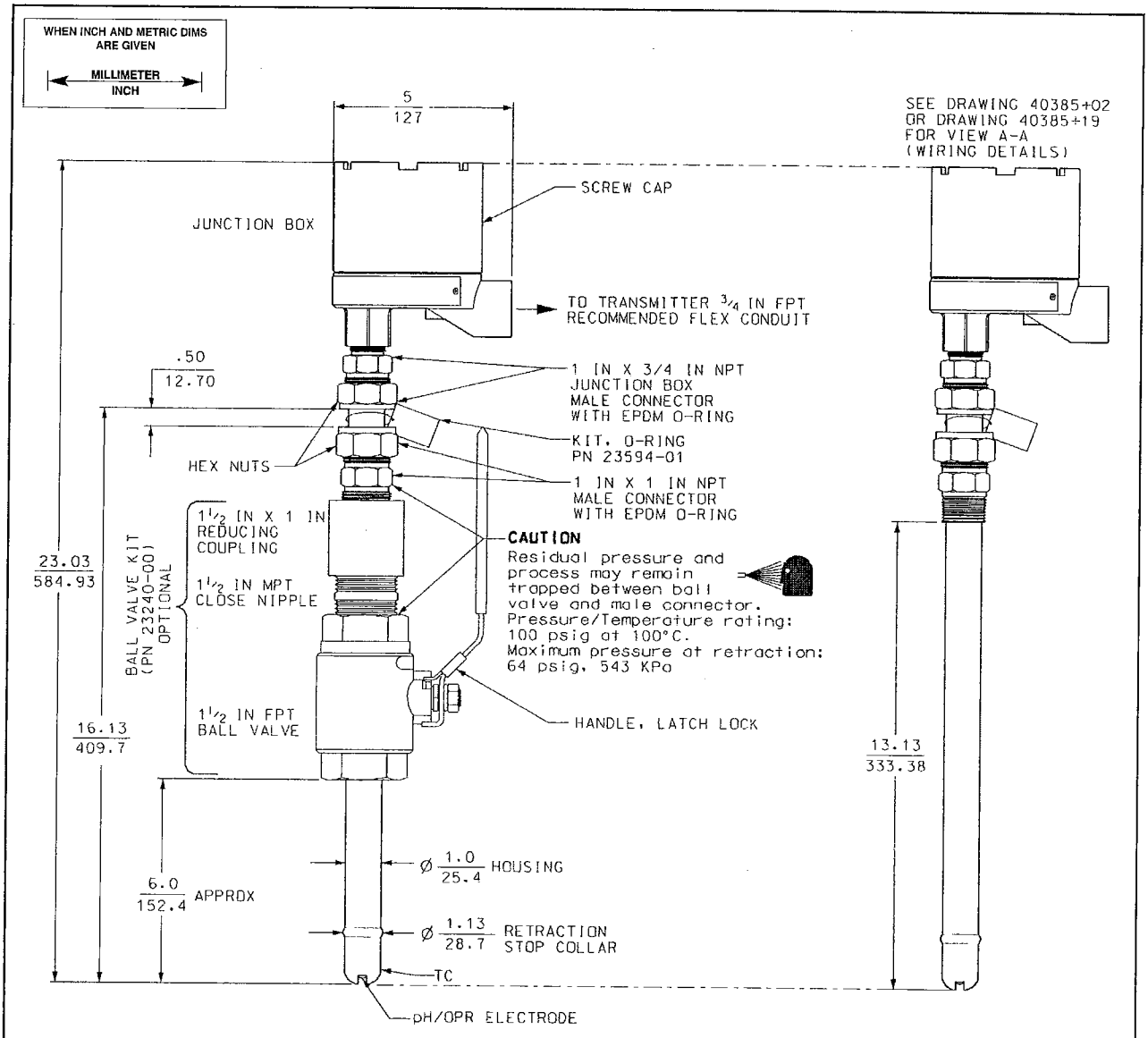


FIGURE 2-1. Typical Mounting Details-Retraction Version



6 WARNING: DO NOT RETRACT SENSOR IF PROCESS PRESSURE EXCEEDS 64 PSIG (543 kpa)

5 WETTED MATERIALS: 316 SST, TITANIUM TEFZEL, VITON, EPDM, GLASS OR PLATINUM.

4 SEE DRAWING NO. 40385+02 OR 40385+19 FOR WIRING DETAILS.

3 WIRING TO J-BOX MUST BE VIA FLEXIBLE CABLE (19 INCH MINIMUM) OR CONDUIT FOR EASE OF SENSOR HOUSING REMOVAL.

2 PROVIDE A MINIMUM 24 INCH CLEARANCE ABOVE JUNCTION BOX FOR SENSOR HOUSING REMOVAL.

DWG. NO.	REV.
40385+01	G

FIGURE 2-2.Dimensional Drawing Retraction Version (Code 02)

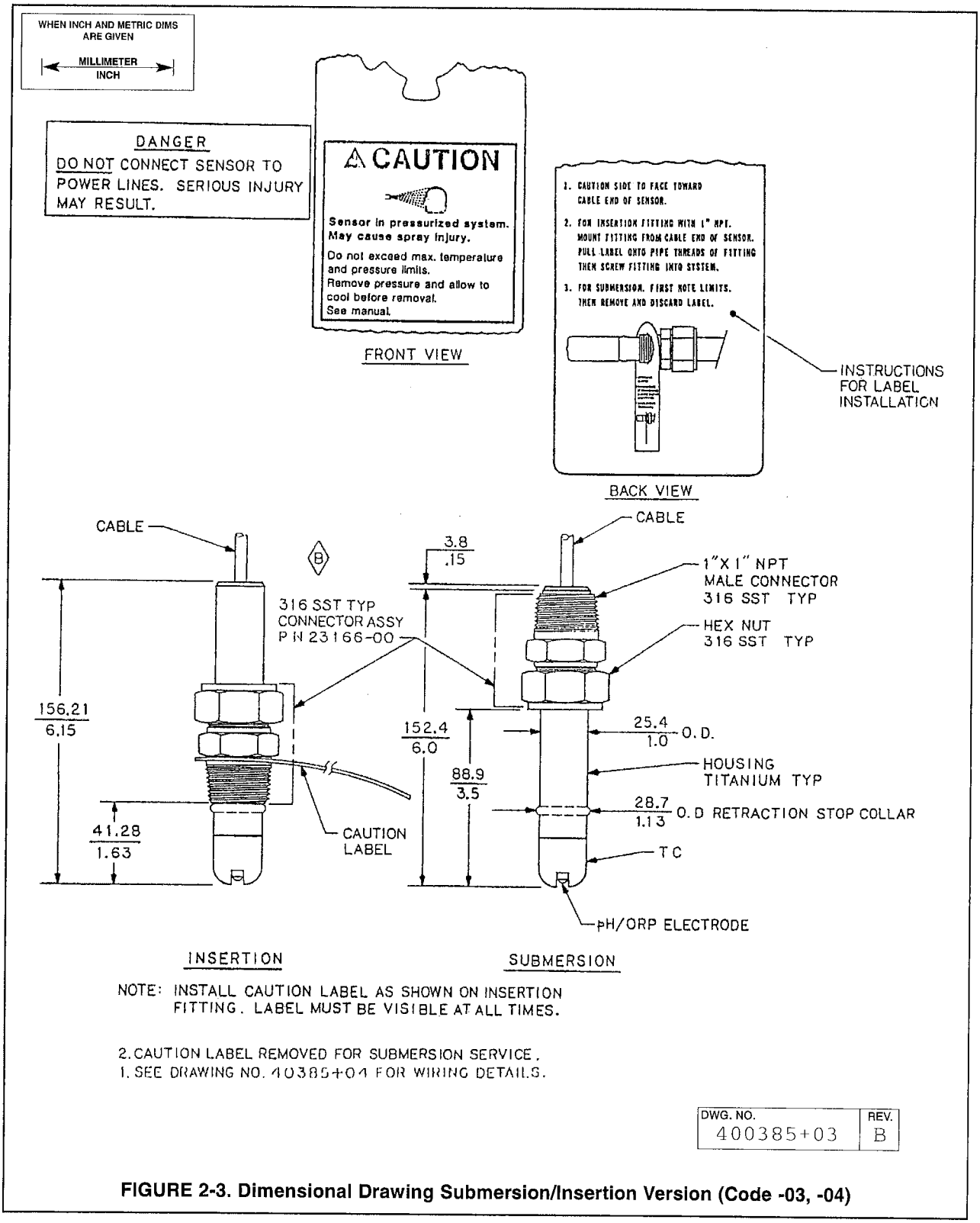


FIGURE 2-3. Dimensional Drawing Submersion/Insertion Version (Code -03, -04)

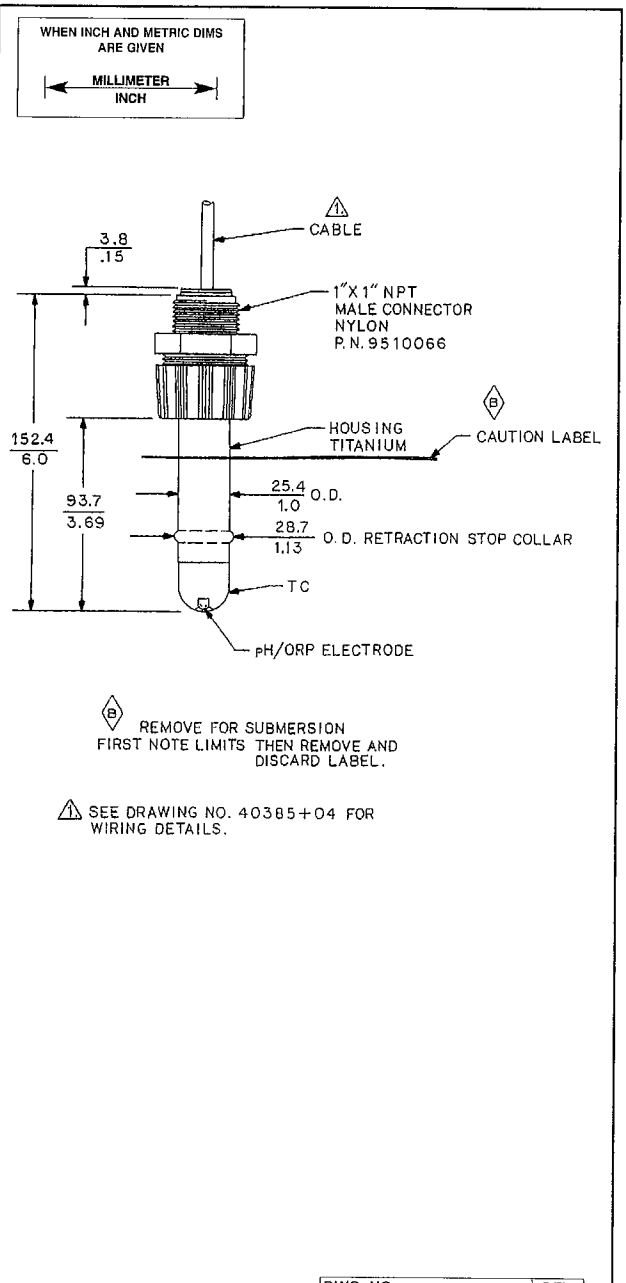


FIGURE 2-4. Submersion Accessory (Code 03, 04)

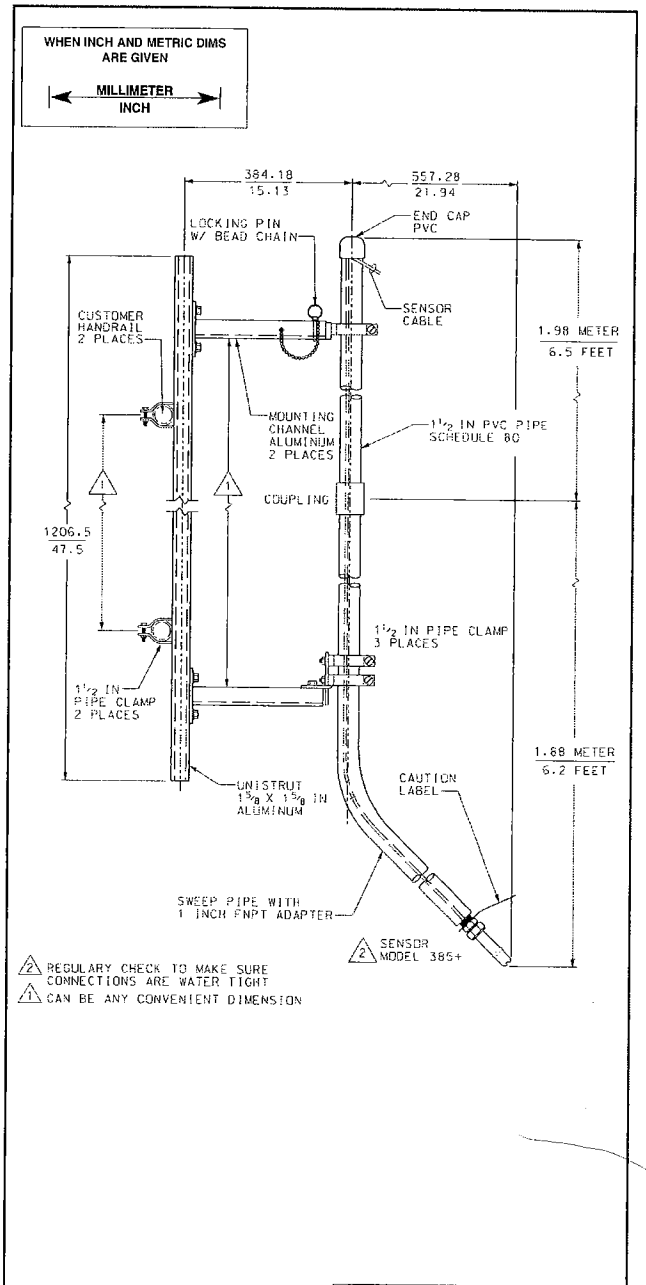


FIGURE 2-5. Submersion Installations, Handrail Mounting Assembly (P/N 11275-01)

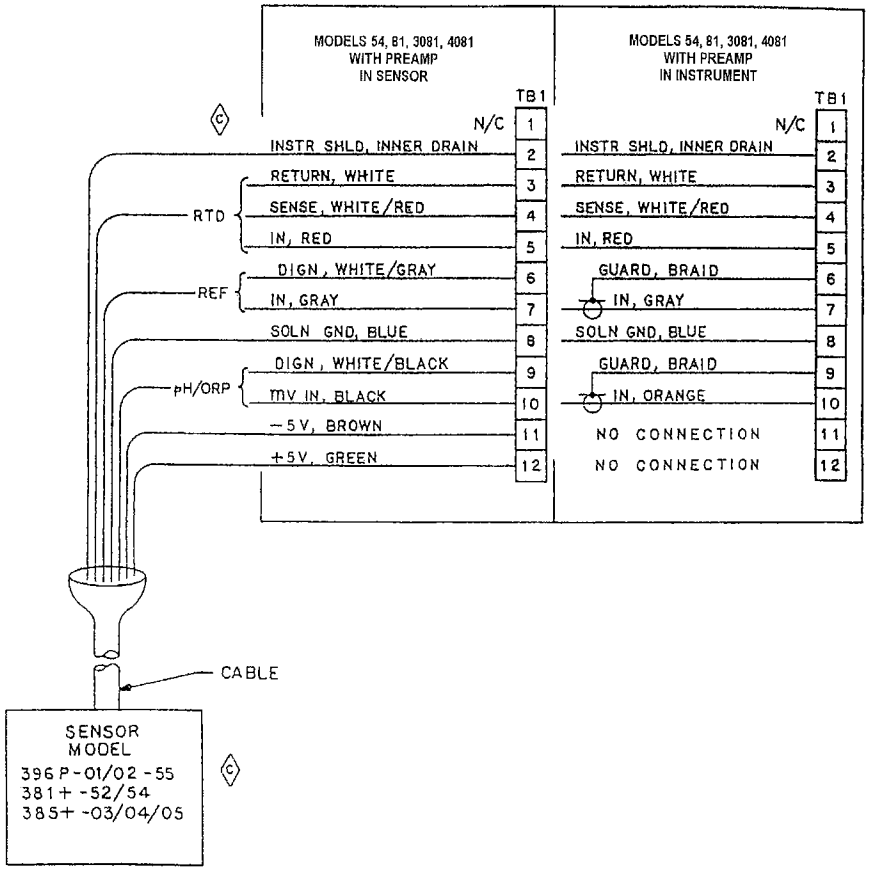


FIGURE 2-6. Wiring Details - Submersion/Insertion (Code 03 & 04)

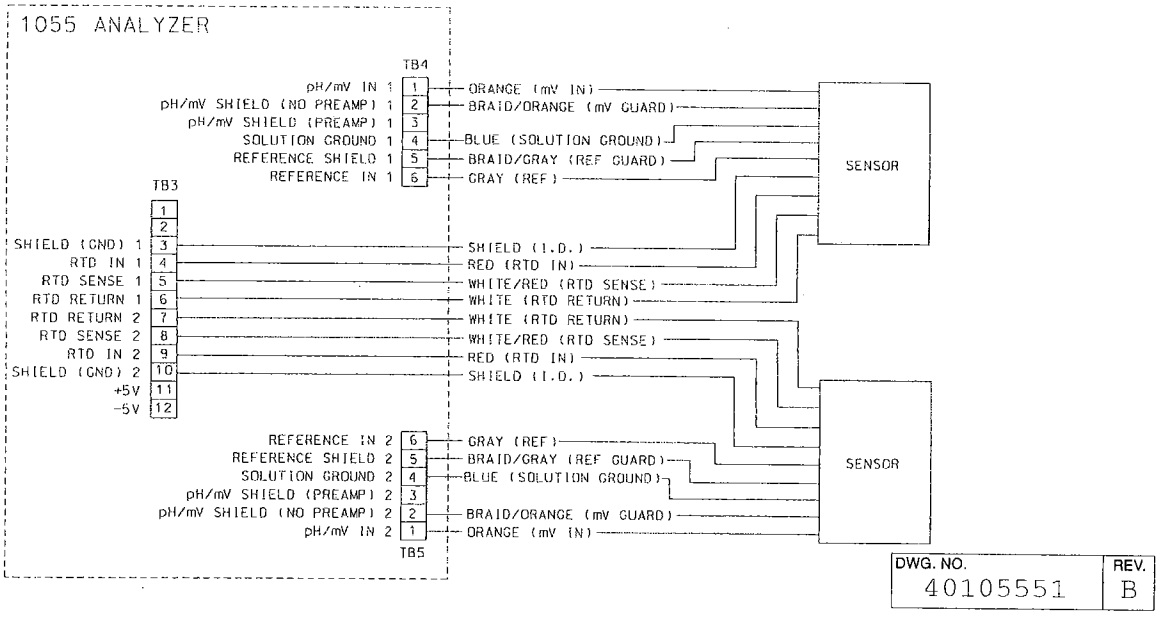


FIGURE 2-7. Wiring Model 385+-04-( ) Sensor to Model 1055-01-10-22-32 Analyzer

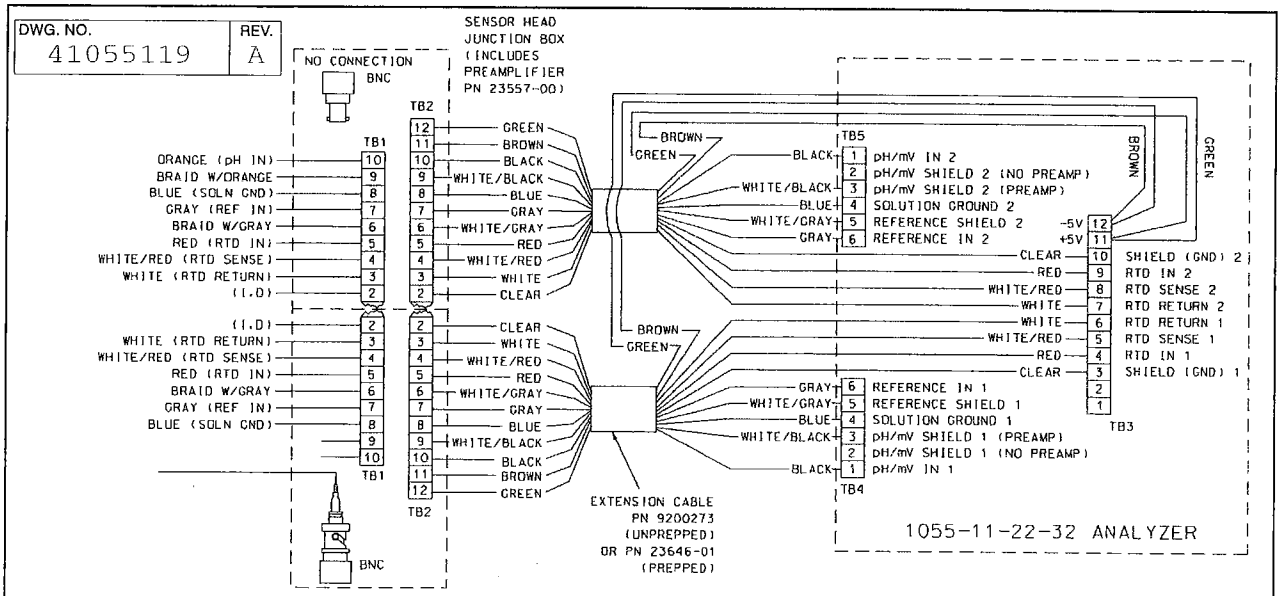


FIGURE 2-8. Wiring Model 385+-02 Sensor to Model 1055-11-22-32 Analyzer through Remote Junction Box

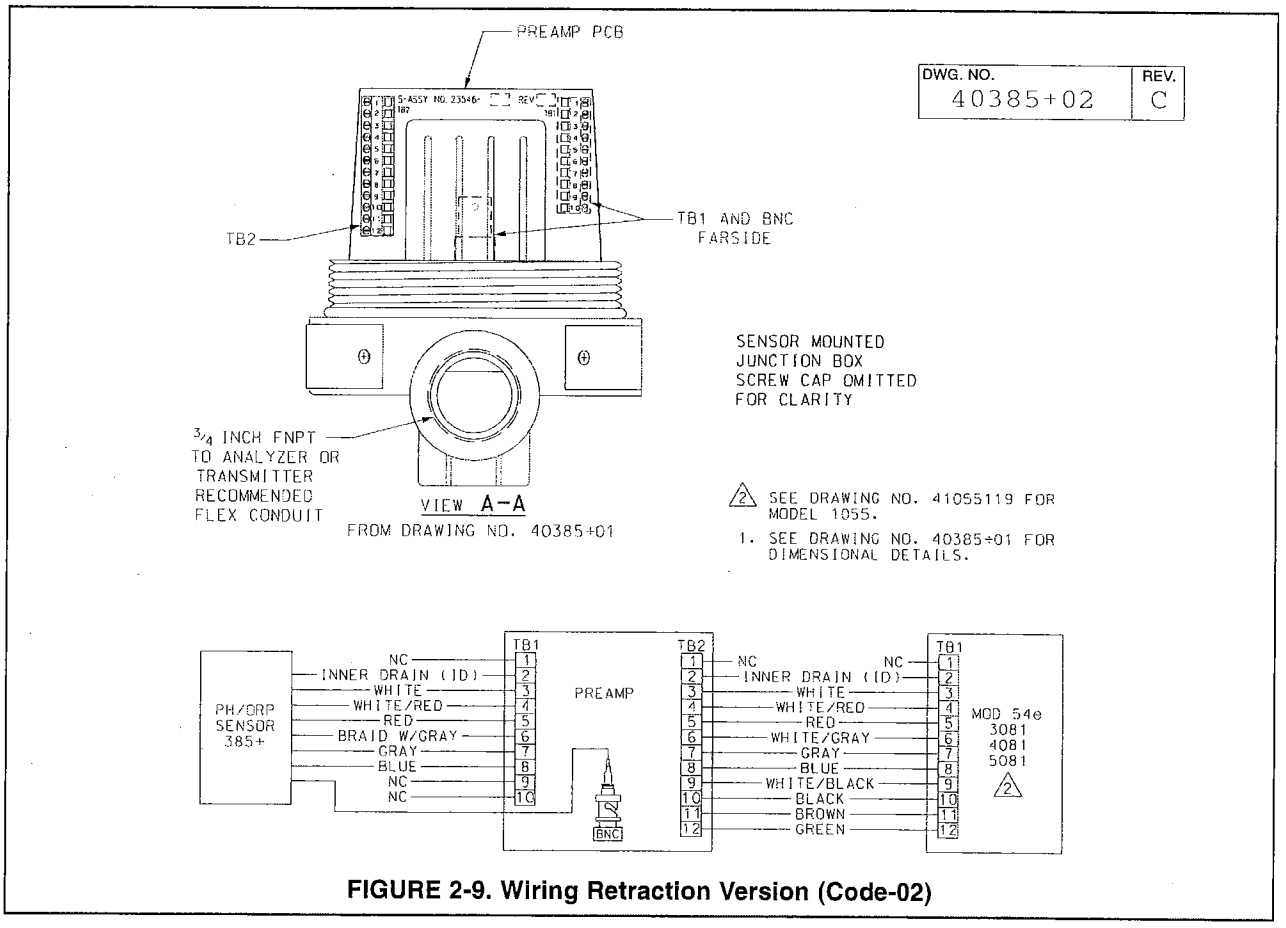


FIGURE 2-9. Wiring Retraction Version (Code-02)

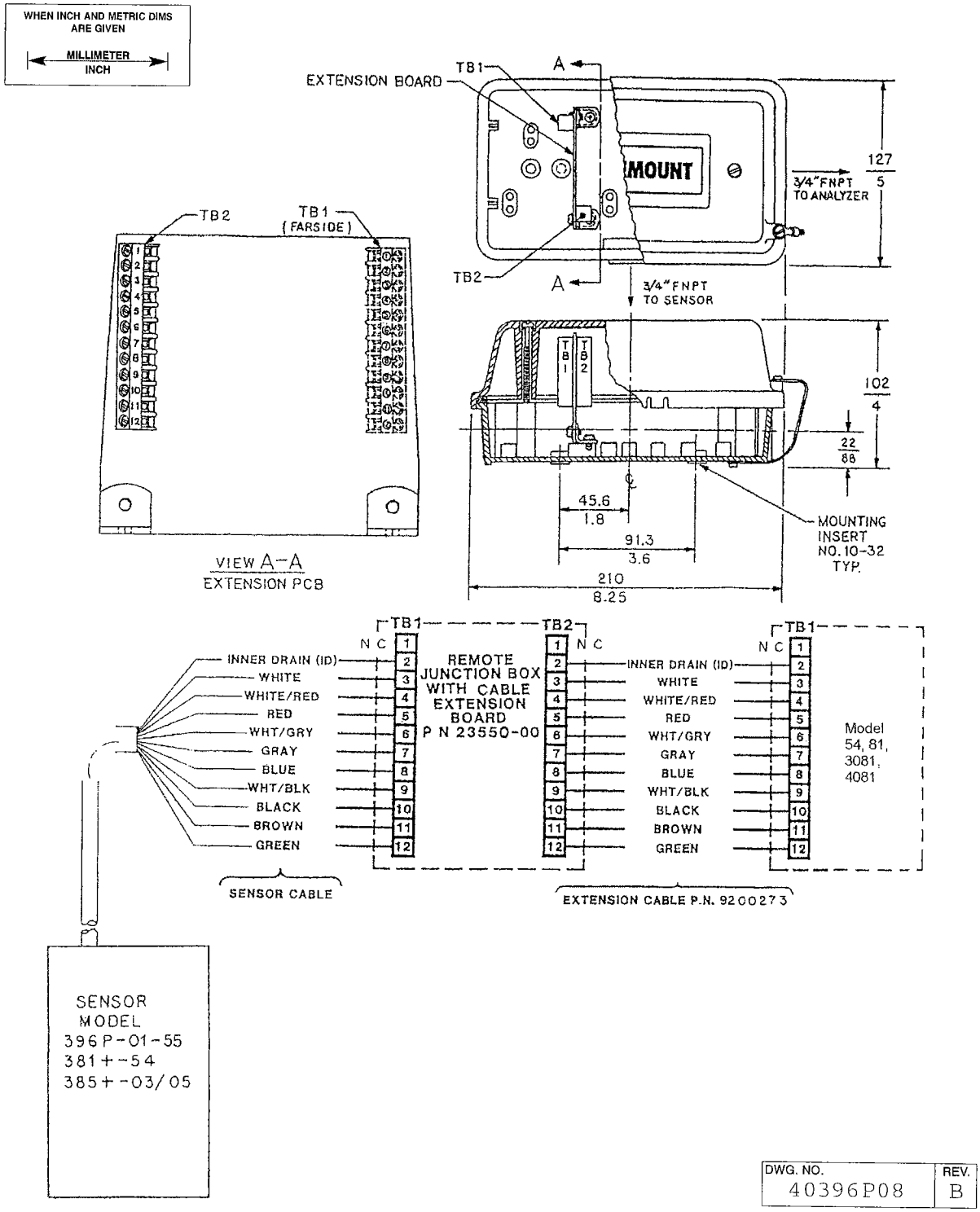


FIGURE 2-10. Wiring Details - Remote J-Box for Extension Cable

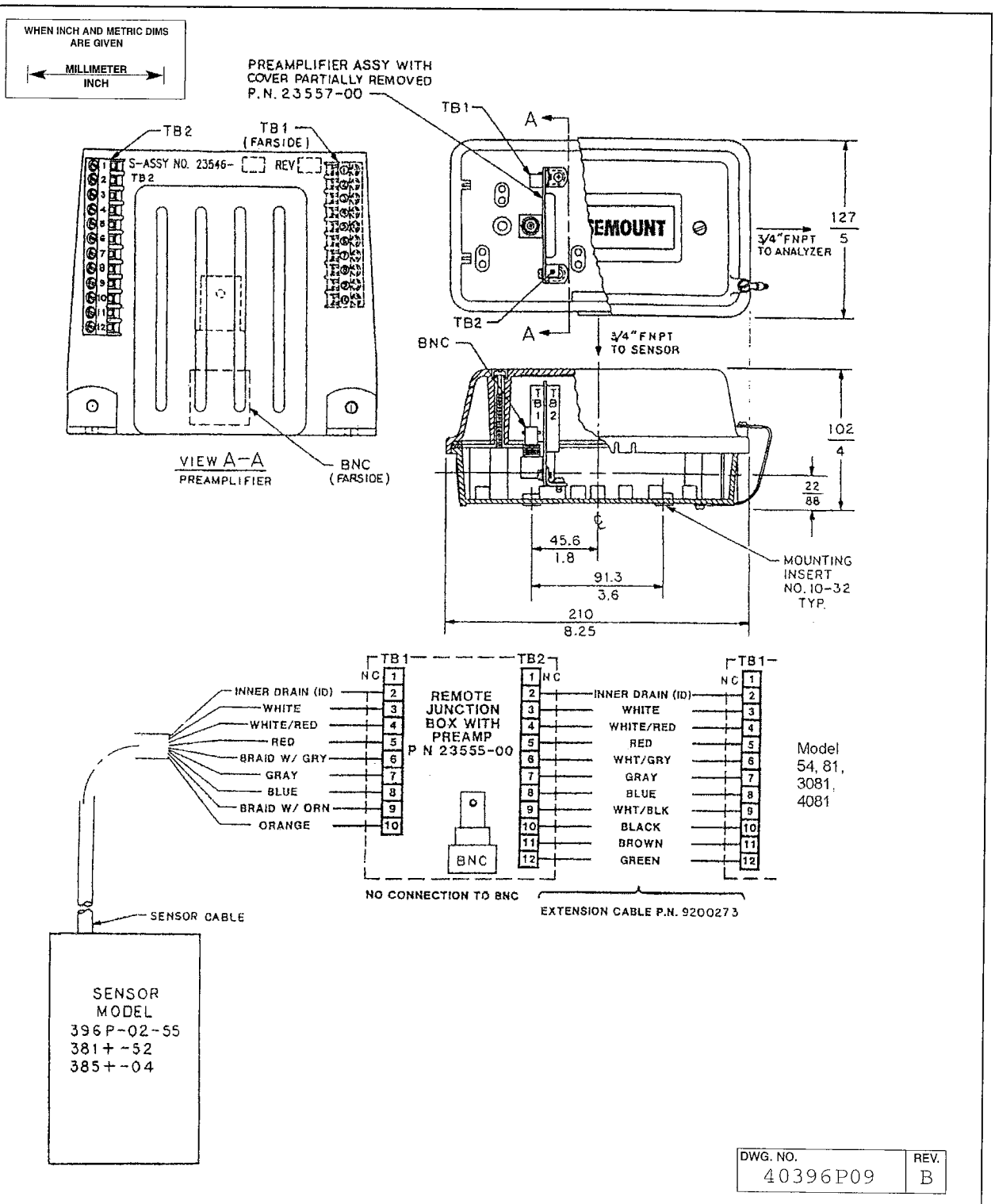


FIGURE 2-11. Wiring Details - Remote J-Box with Preamp

SECTION 3.0
START UP AND CALIBRATION

3.1 START UP. To obtain best accuracy, the sensor must be calibrated as a loop with the analyzer. Please refer to the Model 54 or Model 3081pH instruction manual for proper calibration procedures.

3.2 pH CALIBRATION USING BUFFER SOLUTIONS OR GRAB SAMPLES. The loop may be calibrated with the sensor's measuring tip submersed in standard pH buffer solutions (two point calibration) or with a process grab sample of a known pH value (one point standardization).

3.3 ORP CALIBRATION. An ORP loop is best calibrated using an ORP standard solution.

3.3.1 Quinhydrone Solution.

> **CAUTION**
> The solution used during the following check is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper equipment. Do not let the solution come in contact with skin or clothing. If contact with skin is made, immediately rinse with clean water.

A commonly used ORP standard solution is a saturated quinhydrone solution. This can be made by simply adding a few quinhydrone crystals to either a 4 pH or a 7 pH buffer. Quinhydrone is only sightly soluble so only a few crystals will be required. The solution will have a yellow color. The resulting potentials should be within ±20 millivolts of the value shown in Table 3-1. The ORP value of saturated quinhydrone solution is not stable over long periods of time and therefore new solutions should be made each time they are used.

TABLE 3-1
ORP of Saturated Quinhydrone Solution

	pH 4			pH 7		
TEMPERATURE °C	20	25	30	20	25	30
Millivolt Potential	268	264	260	94	87	80

3.3.2 Ferric-Ferrous Ammonium Sulfate Solution. Although this solution is not as easy to prepare as the quinhydrone solution in Section 3.3.1, it offers a much more stable solution which will maintain its millivolt value for approximately one year when stored in a glass container.

> **CAUTION**
> The solution used during the following check is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper equipment. Do not let the solution come in contact with skin or clothing. If contact with skin is made, immediately rinse with clean water.

To prepare solution, dissolve 39.2 grams of reagent grade ferrous ammonium sulfate [$Fe(SO_4)$ • $(NH)_2SO_4$ • $6H_2O$] and 48.2 grams of reagent grade ferric ammonium sulfate [$FeNH_4(SO_4)_2$ • $12H_2O$] in approximately 700 milliliters of water (distilled water is preferred, but tap water is acceptable). Slowly and carefully add 56.2 milliliters of concentrated sulfuric acid. Add sufficient water to bring the total solution volume up to 1,000 milliliters. This solution (ferric-ferrous ammonium sulfate) will produce a nominal ORP of 476 ±20 mV at 25°C. Some tolerance in mV values is to be expected due to the rather large liquid reference junction potentials which can arise when measuring this strongly acidic and concentrated solution. However, if the measuring electrodes are kept clean and in good operating condition, consistent repeatable calibrations can be achieved.

> **NOTE**
> Most industrial applications have a number of ORP reactions occurring in sequence or simultaneously. There can be several components that are oxidized or reduced by the reagents that are used. Theoretically, the ORP potential is absolute because it is the result of the oxidation-reduction equilibrium. However, the actual measured potential is dependent on many factors, including the condition of the surface of the ORP platinum electrode. Therefore, the sensor should be allowed 1-2 hours to become "conditioned" to the stream to be measured when first setting up or after being cleaned.

SECTION 4.0
MAINTENANCE

4.1 Maintenance. The Model 385+ Sensor is a disposal type sensor and therefore requires only periodic cleaning and calibration. If the sensor has failed, it should be discarded and replaced.

4.2 Sensor Removal. Please refer to the appropriate paragraph for instructions regarding removal of the sensor for periodic maintenance.

4.2.1 Retractable Version (Code-02).

> **WARNING**
> System pressure may cause the sensor to blow out with great force unless care is taken during removal. Make sure the following steps are adhered to.



1. Be certain system pressure at the sensor is below 64 psig (442 kPa) before proceeding with the retraction. It is also recommended that the personnel wear a face shield and have a stable footing. Refer to Figure 4-1.
2. Push in on the sensor using the top of the J-box and slowly loosen the hex nut (B) of the process end male connector (A).

> **CAUTION**
> Do not remove nut at this time.

3. When the hex nut is loose enough, slowly ease the sensor back completely until the retraction stop collar is reached.

> **CAUTION**
> Failure to withdraw the sensor completely may result in damage to the sensor when the valve is closed.

4. Close the ball valve slowly. If there is resistance, the valve may be hitting the sensor. Double check that the sensor has been retracted to the retraction stop collar.

> **WARNING**
> Before removing the sensor from the ball valve, be absolutely certain that the ball valve is fully closed. Leakage from the male connector threads may indicate that the male connector is still under pressure. Leakage through a partially open valve could be hazardous, however with the ball valve closed, some residual process fluid may leak from the connector's pipe threads.



5. The Male Connector Body (A) may now be completely unthreaded from the reducing coupling and the sensor removed for servicing.

> **CAUTION**
> If the male connector leaks during insertion or retraction, replace the O-ring (PN 9550099) in the male connector body (A).

4.2.2 Insertion/Submersion Version (Code -03 & -04).

> **WARNING**
> BEFORE REMOVING THE SENSOR, be absolutely certain that the process pressure is reduced to 0 psig and the process temperature is lowered to a safe level!



Remove the sensor from process for cleaning, calibration or replacement.

4.3 pH Electrode Cleaning. If the electrode is coated or dirty, it may be cleaned as follows:

1. Remove the sensor from process as instructed in Section 4.2.
2. Wipe the glass bulb with a soft, clean, lint free cloth or tissue. If this does not remove the dirt or coating, proceed to step 3. If the sensor appears to be clean, go to step 5.
3. Wash the glass bulb in a strong detergent solution and thoroughly rinse with tap water. If the bulb still appears to have a coating, proceed to step 4.

> **CAUTION**
> The solution used in the following step is an acid and should be handled with care. Follow the directions of the acid manufacturer. Wear the proper protective equipment. Do not let the solution come in contact with skin or clothing. If contact with the skin is made, immediately rinse with clean water.

4. Following the caution above, wash the glass bulb in dilute 5% hydrochloric acid solution and then rinse it thoroughly in tap water. Replace the sensor if it cannot be cleaned. If the glass bulb appears clean, proceed to step 5.

5. Buffer calibrate the sensor (Refer to Section 3.0). If the sensor appears to respond sluggishly to pH change, soaking it overnight in a weak acid solution (5% hydrochloric acid) may improve its response. Be sure to follow the CAUTION above and to rinse the sensor's tip thoroughly with tap water. If the sensor will not calibrate, it must be replaced.

4.4 Platinum Electrode Cleaning. Remove any film or dirt by wiping the electrodes platinum band with a clean, lint free, cloth. If needed, a strong detergent should be used to remove any remaining dirt or film. Platinum electrodes can become poisoned by cyanide or sulfide compounds. However, processes involving these compounds (such as cyanide destruction) will destroy all the cyanides or sulfides before they can react with the platinum. Should poisoning occur, the electrode can be restored to normal operation by polishing the platinum (metallic) surface with moistened baking soda (after a strong detergent wash to remove any film on the platinum surface).

4.5 Sensor Tube Replacement (Code -02). Replacement of the retraction versions sensor tube assembly involves the removal and installation of two sets of male connectors; one at the process end of the sensor, and the other at the junction box end. Refer to Section 4.2 for proper removal of the sensor from process.

1. Remove sensor from process before proceeding. The junction box with attached male connector must be recovered from the old sensor for reuse. Unscrew the junction box cover and set aside. Disconnect electrical connections from printed circuit board inside junction box. Disconnect BNC connector to preamp. Unscrew hex nut (D) from male connector body (C). Separate junction box from used sensor. Set aside.
2. Pry off split ferrule from sensor and set aside for reuse. Remove hex nut (D) and set aside for reuse. Check that the internal O-ring is in place in the male connector body (C) attached to the junction box.
3. Remove hex nut (B) from male connector body (A) at process end of sensor and set aside. Slide the Teflon ferrule and the male connector off sensor in the direction of junction box and set aside. Discard sensor tube.

NOTE

If stainless steel ferrule was used, male connector body (A) will have to be discarded with the sensor tube.

4. Discard used O-ring from male connector body (A). Coat new O-ring with a thin film of the O-ring lubricant provided. Position it in the machined O-ring groove in place of the discarded O-ring.

CAUTION

Make sure lubricant does not contact any part of the sensor tip particularly the glass bulb.

5. Cover the 1in. MNPT pipe threads of the male connector body (A) with TEFLON tape (not provided) to protect them from galling during reinstallation.
6. Pass the wires from the new sensor through the process end male connector (A). Make sure that the beveled edge of the ferrule faces the process end of the sensor. Snug the hex nut (B) to keep it in place. Do not tighten down fully on the hex nut at this time.
7. Pass the wires from the new sensor through the hex nut (D), the split ferrule (from the old sensor), male connector body (C), O-ring, and through the junction box from the "neck" opening and out to the printed circuit board in the junction box. Butt the ferrule's beveled edge and the sensor tube against the junction male connector (C). Screw the hex nut (D) by hand until the tube is "locked" into the male connector body. Make sure that the male connector body (C) is sufficiently tightened. The sensor will "click" into place by pulling the sensor tube away from the junction box, but will not move from side to side or pull clear of the male connector. If the sensor tube is correctly attached to the junction box, wrench tighten hex nut (D) on male connector body (C) (see Figure 4-1). Do not put the sensor tube in a vise or use a pipe wrench to tighten the hardware as these will damage the sensor. If sensor tube is not correctly attached to the junction box, loosen hex nut (D) and repeat.
8. Connect the sensor wires to the terminals on the printed circuit board in the junction box in the manner recommended on the junction box cover, or see Figure 2-4. Reattach the BNC connector to the preamp. Screw on the cover of the junction box.
9. Insert the sensor in the process fitting. Stop it against the closed ball valve. Slide the process-end male connector down the sensor tube to mate with the process fitting. Tighten the male connector into the process fitting.
10. Pull back hard on the sensor assembly, as if trying to remove the sensor, to be certain that the sensor cannot come free from the valve assembly and male connector. The built-in retraction stop collar at the end of the sensor will butt against the shoulder of the male connector.
11. Open ball valve and position the sensor at the desired insertion depth and orientation. Using a crescent or open end wrench, tighten the hex nut (B) to secure the sensor in place.

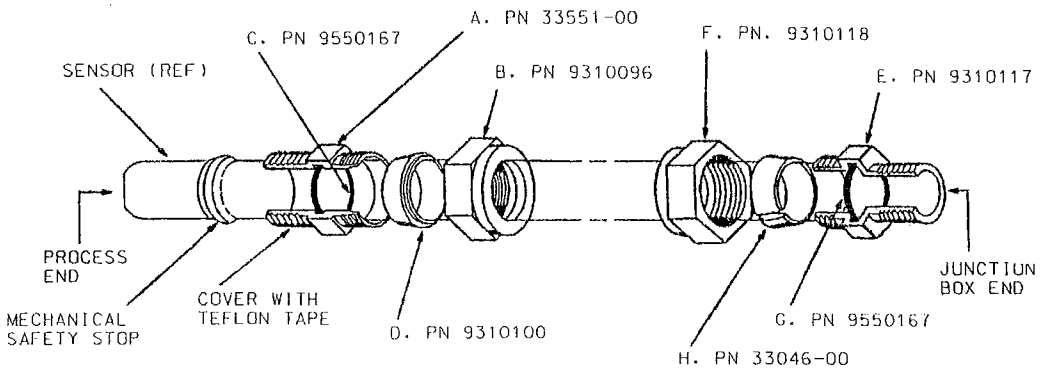
NOTE

A stainless steel ferrule is available if the TEFLON ferrule does not adequately grip. When using the metallic ferrule, be careful and avoid over tightening. This can damage the sensor tube.

CAUTION

If the male connector leaks during insertion or retraction, replace the O-Ring (PN 9550099) in the male connector body (A).

If the sensor is to be stored, the rubber boot should be filled with 7 pH buffer solution and replaced on sensor tip until ready to use.



PROCESS END (A,B,C, & D SOLD TOGETHER AS
SST. PROCESS CONNECTOR KIT PN 23166-00 OR
TITANIUM PROCESS CONNECTOR KIT PN23166-01)

A. MALE CONNECTOR BODY
B. HEX NUT
C. O-RING
D. TEFLON FERRULE (SST. FERRULE AVAILABLE AS PN 9310094)

JUNCTION BOX END (E, F, G, & H SOLD TOGETHER AS
SENSOR HEAD JUNCTION BOX FITTING KIT PN 23472-00)

E. MALE CONNECTOR BODY
F. HEX NUT
G. O-RING
H. SST. SPLIT FERRULE

FIGURE 4-1. Sensor Tube Replacement

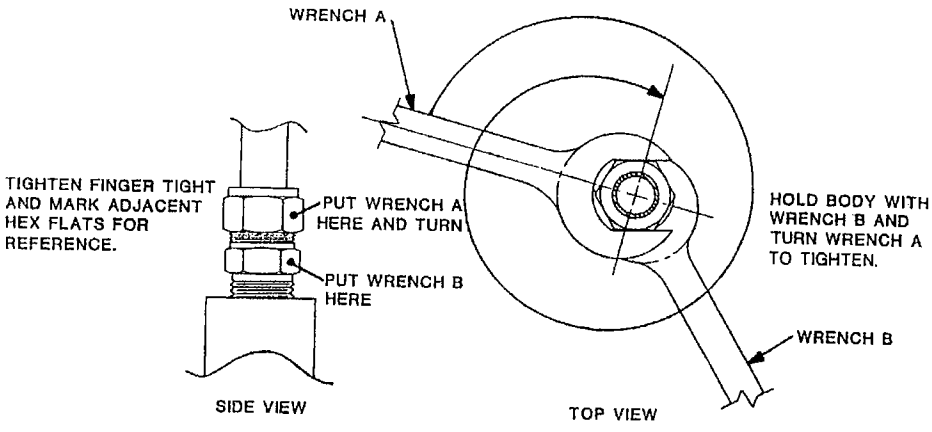


FIGURE 4-2. Male Connector Tightening Diagram

SECTION 5.0
DIAGNOSTICS AND TROUBLESHOOTING

5.1 MODEL 54/3081 pH DIAGNOSTICS. The Model 54 Analyzer and 3081 pH Transmitter automatically searches for fault conditions that would cause an error in the measured pH value. Refer to the respective manual for a complete description of the analyzer's fault conditions.

5.2 TROUBLESHOOTING. Table 5-1, below, lists the diagnostic messages that indicate a possible sensor problem. A more complete description of the problem and a suggested remedy corresponding to each message is also listed.

Table 5-1 Troubleshooting

DIAGNOSTIC MESSAGE 54 3081	DESCRIPTION OF PROBLEM	REMEDY
"Calibration Warning" CALibrAtE	1. Aged glass. 2. Sensor not immersed.	1. Perform buffer calibration. 2. Be sure electrode measuring tip is in process.
"Cracked glass failure" bLASS FAIL	Broken or cracked glass.	Replace Sensor.
"High reference imped" rEF FAIL or rEF WArn	1. Liquid junction coated. 2. Reference Cell gel depleted. 3. Sensor not immersed.	1. Clean sensor; replace if necessary. 2. Replace sensor. 3. Be sure electrode measuring tip is in process.
"Input voltage high" "Input voltage low"	pH input shorted or sensor. miswired.	Check wiring. Replace sensor if necessary.
"Old glass warning" bLoSS WArn	1. Glass electrode worn out. 2. Sensor not immersed.	1. Replace sensor. 2. Be sure electrode measuring tip is in process.
"Reference offset err" (offline only) Std Err	Reference electrode poisoned.	Replace sensor.
"Ref voltage high" "Ref voltage low"	1. Reference shorted or sensor miswired. 2. Sensor not immersed.	Check wiring. Replace sensor if necessary.
"Sensor line open" LInE FAIL	1. Open wire between sensor and analyzer. 2. Interconnecting cable greater than 1000 ft.	1. Check sensor wiring. 2. Relocate analyzer.
"Sensor miswired"	1. Open wire between sensor and analyzer. 2. Bad preamplifier.	1. Check wiring. 2. Replace preamplifier.
"Temp error high" "Temp error low" tEMP HI tEMP LO	1. Open or shorted RTD. 2. Temperature out of range.	1. Replace sensor. 2. Check process temperature.

TABLE 5-2 MODEL 385+ REPLACEMENT PARTS AND ACCESSORIES

P/N	DESCRIPTION	QUANTITY
23166-00	Connector, 1 in. 316 SS, w/O-ring Groove	
23166-01	Connector, 1 in. MNPT, titanium, w/O-ring Groove	
23566-00	Sensor Tube, pH, Pt 100, Titanium, Low Resistance Glass	1
23566-01	Sensor Tube, pH, Pt 100, Titanium, High pH	1
23566-02	Sensor Tube, ORP, Pt 100, Titanium, General Purpose	1
23240-00	Ball Valve Assembly 316 Stainless Steel	
23553-00	Cable, 12 Conductor, Shielded, Prepped.	
23550-00	Junction Box, with extension board	
23555-00	Junction Box, with Preamplifier	
23557-00	Preamplifier, J-box	
33046-00	Ferrule, 1 in. 316 SS, Split	
9200258	Cable, 12 Conductor, Shielded, Unprepped.	
9210012	Buffer Solution, 4.01 pH, 16 oz	1
9210013	Buffer Solution 6.86 pH 16 oz	
9210014	Buffer Solution 9.18 pH 16 oz	1
9310094	Ferrule, 1 in. 316 SS	
9310096	Nut, Swage, 1 in. 316 SS	
9310100	Ferrule, 1 in. TEFLON	1
9510066	Process Connector, Nylon, Submersion, 1 in. MNPT (Code 03, 04)	
9550099	O-ring, 2-214, VITON	1
9550167	O-ring, 2-214, EPDM	
11275-01	Handrail Mounting Assembly	

SECTION 6.0
RETURN OF MATERIAL

6.1 GENERAL.

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Before returning a product for repair, call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

6.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your "Letter of Transmittal" (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

   Rosemount Analytical Inc., Uniloc Division
   Uniloc Division
   2400 Barranca Parkway
   Irvine, CA 92606

   Attn: Factory Repair

   RMA No. _____

   Mark the package: Returned for Repair

   Model No. ____

6.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 6.2.

NOTE

Consult the factory for additional information regarding service or repair.

WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606

The shipping container should be marked:

Return for Repair
Model _____

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.

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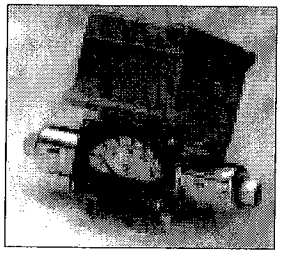
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EMERSON
Process Management

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400 Series Pressure Controls

Types: H400, H402, H403, H400K, H402K, H403K, J400, J402, J403, J400K, J402K, J403K

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warrantees.

GENERAL

Pressure variations are sensed by a bellows, diaphragm or piston sensor which either actuates or de-actuates one, two or three snap-acting switches at a pre-determined set point(s). Set point(s) is adjusted by turning an internal knob and pointer (H types) or internal screw (J types).

Part I - Installation

Tools Needed
Screwdriver
Hammer
Adjustable wrench

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE. IF UNIT IS BEING INSTALLED WHERE HEAVY CONDENSATION IS EXPECTED, VERTICAL MOUNTING (PRESSURE CONNECTION DOWN) IS REQUIRED. DO NOT MOUNT UNIT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

400 Series pressure controls can be mounted in any position, provided the electrical conduit is not facing up. The preferred mounting position is vertical (pressure connection down).

The cast-in knockouts for 3/4" electrical conduit are located on the side and rear of the enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and rapping sharply with a hammer.

Mount the unit via the (2) 1/4" screw clearance holes on the enclosure. See Dimensions. Units may also be mounted via the NPT pressure connection.

ALWAYS HOLD A WRENCH ON THE PRESSURE HOUSING HEX WHEN MOUNTING UNIT. DO NOT TIGHTEN BY TURNING ENCLOSURE. THIS WILL DAMAGE SENSOR AND WEAKEN SOLDER OR WELDED JOINTS.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATE SHOULD NEVER BE EXCEEDED. OVER-LOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

WIRE UNITS ACCORDING TO LOCAL AND NATIONAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Connect conduit to the case and wire directly to the switch terminals according to local and national electrical codes. Bring the wires up to terminals from the rear of the case. (See fig. 1.) If manual reset switch or DPDT options are used, lead wires are supplied, color coded as follows:

	Switch 1	Switch 2
Common	Violet	Yellow
Normally Open	Blue	Orange
Normally Closed	Black	Red

ALLOW ENOUGH SLACK SO AS NOT TO AFFECT SWITCH MOVEMENT WHEN MAKING SETTING ADJUSTMENTS AND ENSURE THAT THE WIRES ARE NOT TOUCHING THE COVER WHEN INSTALLED.

NOTE: For larger wire gauges, a one time shift may be experienced or expected due to space limitations within the enclosure. Verify setpoint after installation.

NOTE: The middle switch assembly is omitted for dual switch controllers. The outer switch assemblies are omitted for single switch controllers. Type "J" controls have internal screw adjustments and type "H" have cam assemblies for internal calibrated adjustments.

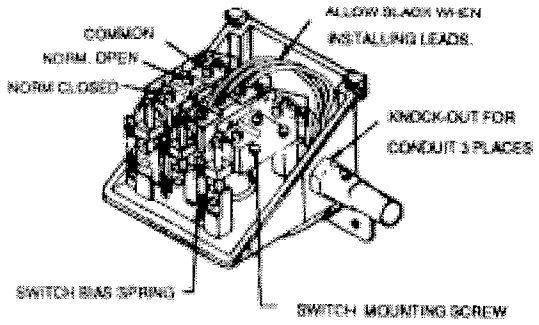


Figure 1

Special Instructions For Vacuum Ranges

On vacuum ranges, the C-NO circuit is closed at sea level conditions. Therefore, increasing vacuum will cause the C-NC circuit to close while decreasing vacuum will cause the C-NO circuit to close. Please make a note of this and wire/adjust the unit accordingly.

Part II - Adjustments

Tools Needed
Screwdriver

NOTE: For set point adjustments and re-calibration, connect control to a calibrated pressure gauge.

Type J400 & J400K

Remove cover. Switch has screw adjustments inside enclosure. Increase gauge pressure until switch transfers. To RAISE the pressure setting turn the screw IN. One full clockwise turn corresponds to 10% of range on diaphragm and piston models, and 20% of range on bellows models. To LOWER pressure setting turn screw OUT. One full counter-clockwise turn corresponds to 10% of range on diaphragm and piston models, and 20% of range on bellows models. When making adjustments, do not exceed the proof pressure rating on nameplate.

Types J402, J403, H402K & J403K

Remove cover, follow same procedure as paragraph above. Switches may be set together or apart, up to 100% of range scales (maximum separation on models 520-535 is defined in Table 1). On dual switch, either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical pressure setting and after changing switch(es) or sensor.

Table 1

Model & Range		Switch Separation (% of Range Span)
520, 530	(-300 to 0" W.C. VAC)	25%
521, 531	(-10 to +10 "wc)	35%
522, 532	(-50 to +50 "wc)	35%
523, 533	(0.5 to 5 "wc)	50%
524, 534	(2.5 to 50" wc)	50%
525, 535	(10 to 250 "wc)	20%
540	(1 to 7 "wc)	95%
541	(2 to 20 "wc)	95%
542	(5 to 50 "wc)	95%
543	(15 to 100 "wc)	95%
544	(2 to 20 psi)	95%
545	(5 to 50 psi)	95%
546	(10 to 100 psi)	95%
547	(20 to 200 psi)	95%

Special Instructions for Models 520-535

When calibrating the Models 520-537, Switch 2 (the right switch as viewed from the front of the control) must be set to the lower pressure value. Use a screwdriver to turn the adjustment screw and obtain the desired actuation pressure for Switch 2. Switch 1 can then be set following the procedure outlined above for other J402 products. Maximum separation between Switch 1 and 2 is defined in Table 1.

Types H400, H402, H403, H400K, H402K & H403

Controls are factory calibrated for maximum accuracy at the dial midpoint. Switches may be set together or apart up to 100% of the range scale. On dual switch models either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when the switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical setting or after changing switch(es) or sensor.

To re-calibrate, turn pointer to desired set point and add gauge pressure until switch transfers. If gauge pressure and set point pressure do not agree, turn zero adjust screw clockwise to raise. Counter-clockwise to lower setting.

Types With Manual Reset (Option 1530)

These optional models incorporate a snap switch that, when actuated, remains tripped until pressure changes and the reset button is manually depressed to the reset position. On multi-switch units, this switch must be set to the highest setting.

Types J400K, J402K, J403K with Option M210

(indicator models 147, 157, S147B, S157B only)

To adjust for maximum accuracy at any desired set point, follow steps 1 - 4 below:

SPAN ADJUSTMENT

1) Remove front window and gasket (four screws) to gain access to span adjustment.
2) Connect control to calibrated pressure source and set to required differential pressure.
3) Using a screw driver, carefully turn span adjustment (See Figure 2) to obtain required indication.
4) Re-mount front gasket and window.

Part III - Replacements

Tools Needed
Screwdriver

USE ONLY FACTORY AUTHORIZED REPLACEMENT PARTS AND PROCEDURES. DISCONNECT ALL LIVE CIRCUITS BEFORE PROCEEDING. COMPONENTS AVAILABLE FOR REPLACEMENT ARE THE SWITCHES. OTHER COMPONENTS FACTORY REPLACEABLE ONLY.

REPLACEMENT OF SWITCH(ES)

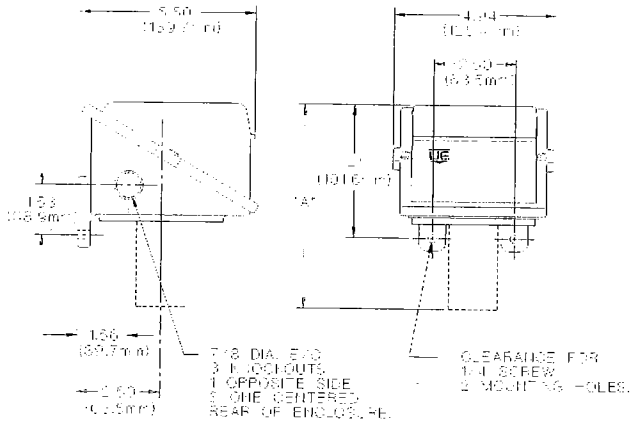
1) Disconnect leadwires.

2) Remove the two mounting screws. On multi-switch controls, first remove switch bias springs (See Figure 1.)

3) Insert replacement switch and replace screws and bias springs.

4) Check switch set point and re-calibrate per PART II if necessary.

Dimensions



Option M210 - Differential Pressure Indication

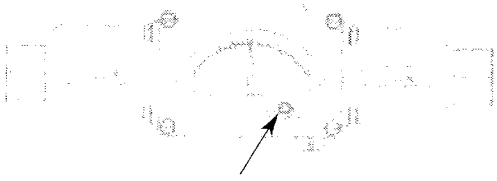
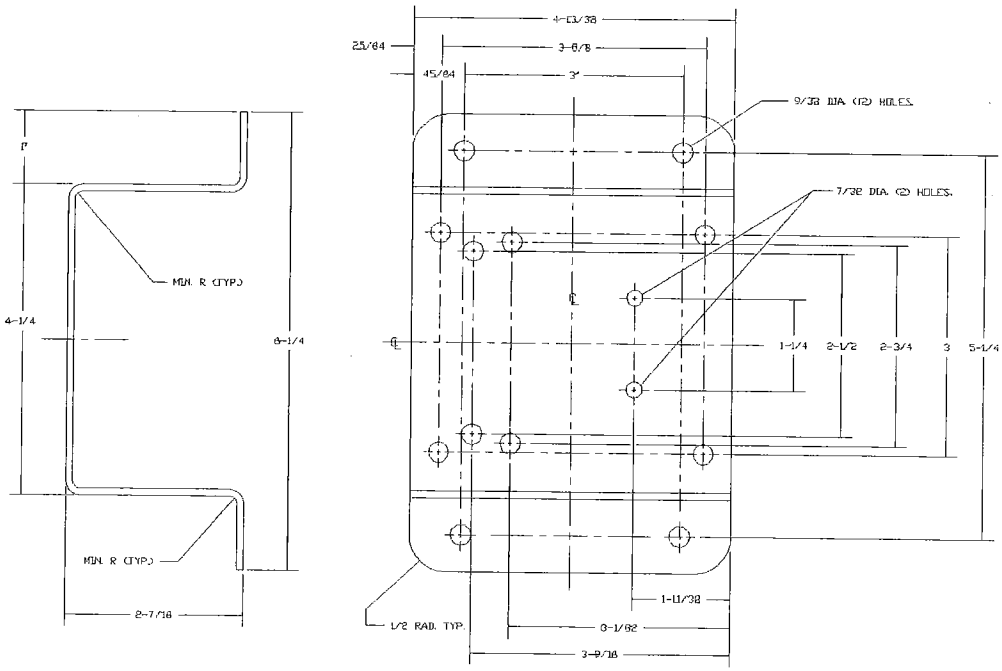


Figure 2

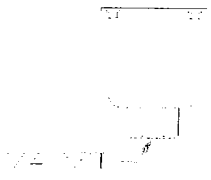
Dimension A							
Models	Inches	mm	NPT	Models	Inches	mm	NPT
Pressure				**Pressure**			
126-164	5.81	146,84	1/4	551, 553-555	4.56	115,88	1/4
S126B-S164B	6.19	157,16	1/2	550, 552	5.03	127,79	1/4
270-376	5.50	139,70	1/4	610-614	6.44	163,58	1/4
440-443, 449, 451, 453, 454	4.28	108,74	1/4	**Differential Pressure**			
448, 450, 452	5.03	127,79	1/4	147-157	6.13	155,57	1/4
520-525	8.62	218,90	1/2	S147B-S157B	6.13	155,57	1/2
530-535	8.12	206,20	1/2	455-559	7.00	178,05	1/4
				540-543	7.90	200,7	1/8
				544-547	8.06	204.7	1/8

Option M449 - Surface Mounting Hardware

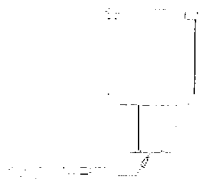
(Models 520-535 only)



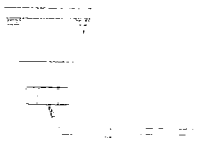
Pressure



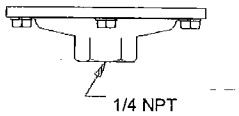
Models 126-164



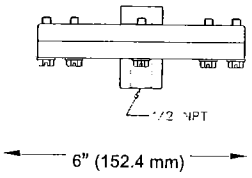
Models S126B-S164B



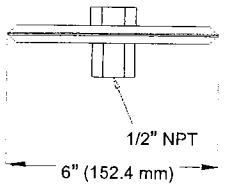
Models 270-376



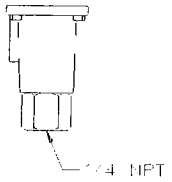
Models 440-555



Models 520-525

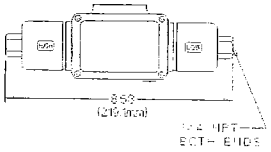


Models 530-535

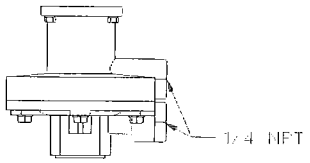


Models 610-614

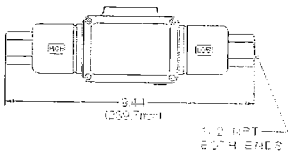
Differential Pressure



Models 147-157



Models 455-559



Models S147B-S157B

RECOMMENDED PRACTICES

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and max temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to proof pressure or max temperature is acceptable on a limited basis (i.e.start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at proof pressure or maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point can not result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point. Check unit immediately.
- Preventative maintenance/periodic testing is necessary for critical applications where damage could endanger property/ personnel.
- For all applications, a factory set unit should be tested before use.

Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, possible on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.

- Use only factory authorized replacement parts and procedures.
- Do not mount unit in ambient temp. exceeding published limits.
- For remote mounted temperature units, capillary lengths beyond 10 feet can increase chance of error, and may require re-calibration of set point and indication.

LIMITED WARRANTY

UE warrants that the product thereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by UE (F.O.B. UE); provided, however, that this warranty applies only to equipment found to be so defective within a period of 12 months after installation by buyer but not to exceed 18 months after delivery by the seller. Except for the limited warranty of repair and replacement stated above, UE disclaims all warranties whatsoever with respect to the product, including all implied warranties of merchantability or fitness for any particular purpose.

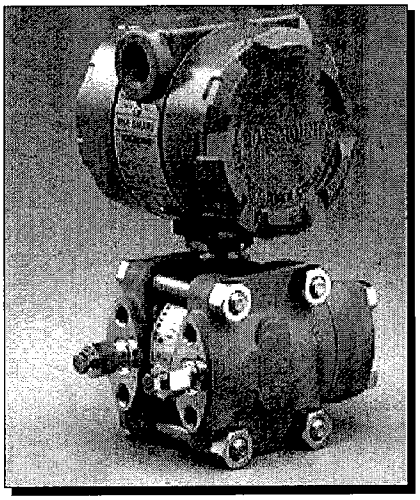
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The sole and exclusive remedy of buyer for any liability or seller for any claim, including incurred in connection with (I) breach of any warranty whatsoever expressed or implied, (II) a breach of contract, (III) a negligent act or acts (or negligent failure to act) committed by seller, or (IV) an act for which strict liability will be imputed to seller, is limited to the limited warranty or repair and replacement stated herein. In no event shall the seller be liable for any special, indirect, consequential or other damages or like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature, incurred by the buyer or any third party.

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00809-0100-4593
English
Rev. BA

Model 1151 Smart Pressure Transmitters



ROSEMOUNT

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Product Manual

Model 1151 Smart Pressure Transmitters

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

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Customer Central: 1-800-999-9307 *(7:00 a.m. to 7:00 p.m. CST)*
Technical support, quoting, and order-related questions.

North American Response Center: 1-800-654-7768 *(24 hours a day – Includes Canada)*
Equipment service needs.

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⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

SNF-0004

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Section 1 Introduction

USING THIS MANUAL

This manual provides information on installation, operation, and maintenance of Rosemount® Model 1151 Smart Pressure Transmitters. The rest of this manual is organized into the following sections:

Section 2–Transmitter Functions
This section describes the Model 1151 software functions, configuration parameters, and other on-line variables.

Section 3–Installation
This section provides mechanical and electrical installation instructions.

Section 4–Troubleshooting
This section provides troubleshooting techniques for diagnostic messages associated with the transmitter.

Section 5–Specifications and Reference Data
This section provides reference and specification data for Model 1151 Smart Pressure Transmitters.

Appendix A–HART® Communicator
This appendix contains a communicator overview, a HART Communicator menu tree for the Model 1151 Smart Pressure Transmitters, and a table of HART Communicator fast key sequences. A table of diagnostic messages associated with this communicator is also included.

Appendix B–Model 268 Communicator
This appendix contains a communicator overview, a Model 268 Communicator menu tree for the Model 1151 Smart Pressure Transmitters, and a table of Model 268 fast key sequences. A table of diagnostic messages associated with this communicator is also included.

Appendix C–Retrofitting the Model 1151 Transmitter
This section describes how the Rosemount Smart Retrofit Kit can be used to retrofit a Model 1151AP, DP, GP, HP, or LT transmitter with 4-20 mA dc linear or square root output.

Appendix D–Approval Drawings
This appendix contains intrinsic safety drawings.

Glossary
This section provides brief definitions of the terms used in this manual.

Index
This section provides a comprehensive index.

MODELS COVERED

This manual provides basic installation, commissioning, and troubleshooting information for the following Rosemount® Model 1151 Smart Pressure Transmitters:

Model 1151DP—Differential Pressure Transmitter
measures differential pressure from 2 inH_2O to 1,000 psi (0.497 to 6895 kPa).

Model 1151HP—Differential Pressure Transmitter for High Line Pressures
provides high line pressure from 10 inH_2O to 300 psi (2.49 to 2068 kPa).

Model 1151GP—Gage Pressure Transmitter
measures gage pressure from 2 inH_2O to 1,000 psi (0.497 to 41369 kPa).

Model 1151AP—Absolute Pressure Transmitter
measures absolute pressure from 10 inH_2O to 1,000 psi (2.49 to 6895 kPa).

Model 1151LT—Flange-Mounted Liquid Level Transmitter
provides precise level and specific gravity measurements from 25 to 2,770 inH_2O (6.2 to 690 kPa) for a wide variety of tank configurations.

Section 2 Transmitter Functions

OVERVIEW

This section contains information on commissioning and operating Model 1151 Smart Pressure Transmitters. Instructions for setting transmitter switches (prior to installation) and explanations of software functions are provided in this section.

Fast key sequences are listed for each software function. Please refer to Appendices A and B for more information on fast key sequences and other communicator operations.

SAFETY MESSAGES

Warnings (⚠)

Procedures and instructions in this section that raise potential safety issues are indicated by a warning symbol (⚠). Refer to the following warning messages before performing an operation preceded by this symbol.

⚠WARNING

Explosions can result in death or serious injury. Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

Commissioning the Transmitter on the Bench

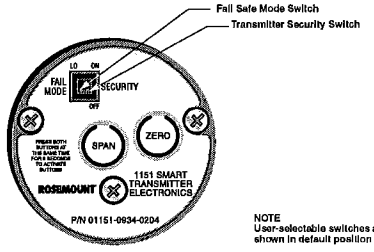
Commissioning consists of testing the transmitter, testing the loop, and verifying transmitter configuration data. Model 1151 Smart Pressure Transmitters may be commissioned either before or after installation. We recommend commissioning the transmitter on the bench before installation. This ensures that all transmitter components are in good working order and heightens familiarity with the device.

To avoid exposing the transmitter electronics to the plant environment after installation, set the failure mode and transmitter security switches during the commissioning stage on the bench.

Setting Hardware Switches

The Model 1151 Smart Pressure Transmitter contains hardware switches that provide user-selectable operation of the failure mode and transmitter security. The switches are located on the electronics assembly just inside the electronics housing cover, as shown in Figure 2-1.

FIGURE 2-1.
Transmitter Switch Locations.



Failure Mode Alarm Switch

As part of its normal operation, the Model 1151 Smart continuously monitors its own operation. This automatic diagnostic routine is a timed series of checks repeated continuously.

The electronics faceplate (Part No. 01151-0934-xxxx) has HI and LO user-selectable failure mode settings. If the diagnostic routine detects a failure in the transmitter in analog output, the transmitter either drives its output below 3.8 mA or above 21.0 mA, depending on the position of the failure mode alarm switch.

NOTE
With multidrop (digital) output, the analog output remains at 4 mA, even when a diagnostic failure is detected. This is true for both the HI and LO fail mode switch settings. A bit is enabled in the digital word to indicate a diagnostic failure.

Transmitter Security (Write-Protection Switch)

Once the transmitter has been configured, it may be desirable to protect the configuration data from changes. The electronics assembly is equipped with a switch labeled SECURITY. Figure 2-1 shows the switch location on the circuit side of the electronics housing. In the ON position, the switch prevents the accidental or deliberate change of configuration data. To enable the sending of configuration data, simply return the transmitter security switch to the OFF position.

NOTE
The transmitter security switch must be in the OFF position before configuration changes can be made to the transmitter configuration.

Commissioning the Model 1151 with a HART-Based Communicator

Before putting the Model 1151 Smart Pressure Transmitter into operation, commission the instrument using a HART-based communicator.

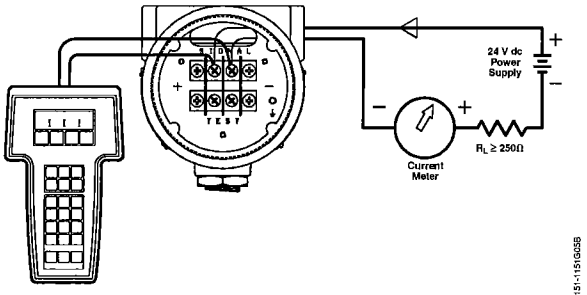
⚠ To commission on the bench, connect a 17 to 45 V dc power supply and a current meter, such as the Rosemount Model 282 Validator. Make connections as shown in Figure 2-2. The power supplied to the transmitter should not drop below the transmitter lift-off voltage. If the transmitter is being configured when the power drops below the lift-off voltage, the configuration information may not be interpreted correctly by the transmitter.

NOTE
To enable communication, a resistance of at least 250 Ω must be present between the communicator loop connection and the power supply.

Wiring Diagrams (Bench Hook-up)

After the bench equipment is connected as shown in Figure 2-2, turn on the HART-based communicator by pressing the ON/OFF key. The communicator will search for a HART-compatible device and will indicate when the connection is made. If the connection is not made, the communicator will indicate that no device was found. If this occurs, refer to **Section 4 Troubleshooting**.

FIGURE 2-2. Bench Hook-up.



NOTE
An alternate location to connect an ammeter is on the set of terminals labeled "TEST." Connect the positive lead of the ammeter to the positive test terminal, and the negative lead of the ammeter to the negative test terminal.

⚠ See "Safety Messages" on page 2-1 for complete warning information.

Testing the Equipment and the Loop

Test functions verify that the transmitter, the communicator, and the loop are in good working order. Testing is recommended whenever component failure or a problem with loop performance is suspected.

Communicator Test

A communicator test is performed to ensure the communicator is working properly. Both the HART Communicator Model 275 and the Rosemount Model 268 Communicator perform self-tests after being turned on. If a problem is detected, the communicator will list a diagnostic message. Refer to Appendices A and B for diagnostic messages associated with the communicator.

Transmitter Test

HART Comm.	1, 2, 1, 1
Model 268	F2, F2

Although the Model 1151 Smart Pressure Transmitter performs continuous self-diagnostics, a more extensive diagnostic routine can be initiated with the transmitter test function. The transmitter test routine can identify an electronics failure.

If the transmitter test detects a problem, messages to indicate the source of the problem are displayed.

Loop Test

HART Comm.	1, 2, 2
Model 268	F2, F3

The loop test allows verification of the output of the transmitter, the integrity of the loop, and the operation of any recorders or similar devices. If commissioning the transmitter on the bench, repeat this test after the transmitter has been installed in the field.

A reminder appears to set the loop to manual. Do so and proceed. The next display selects a discrete milliampere transmitter output level. To command the transmitter to output 4 mA, for example, select 4 mA. Check the current meter installed in the test loop to verify that it reads 4 mA. If so, end the loop test. If the output is not 4 mA, then the receiving meter is malfunctioning or the transmitter requires a digital trim as described on page 2-12.

Review Configuration Data

HART Comm.	1, 5
Model 268	Review Key

Review of the transmitter factory configuration data is recommended.

Checking the Transmitter Output

Process Variable

HART Comm.	2
Model 268	PV

Process variable readings can be obtained in engineering units and milliamperes. If the milliampere display does not agree with the actual loop reading given by a multimeter, a 4–20 mA trim is required.

The last step of start-up and commissioning is to check the transmitter output. Obtain process variable readings in engineering units and milliamperes. If this display does not agree with the actual loop reading given by a multimeter, a 4–20 mA trim is required (see page 2-16).

Range Points

HART Comm.	1, 3, 3
Model 268	F3, F2, F1

The Model 1151 Smart 4 and 20 mA range points can be viewed and edited with these fast key sequences.

Calibration Overview

Complete calibration of the Model 1151 Smart Pressure Transmitter involves the following tasks:

Configuring the Analog Output Parameters

- Setting process variable units (page 2-7)
- Reranging (page 2-7)
- Setting output type (page 2-11)
- Setting damping (page 2-12)

Calibrating the Sensor

- Full trim (page 2-12)
- Zero trim (page 2-13)

Calibrating the 4–20 mA Output

- 4–20 mA output trim (page 2-16) or
- 4–20 mA output trim using other scale (page 2-16)

FIGURE 2-3. Model 1151 Transmitter Data Flow with Calibration Options.

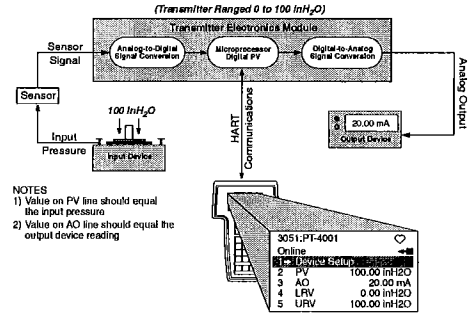


Figure 2-3 illustrates the Model 1151 transmitter data flow. This data flow can be summarized in four major steps:

1. A change in pressure is measured by a change in the sensor output (Sensor Signal).
2. The sensor signal is converted to a digital format that can be understood by the microprocessor (Analog-to-Digital Signal Conversion).
3. Corrections are performed in the microprocessor to obtain a digital representation of the process input (Digital PV).
4. The Digital PV is converted to an analog value (Digital-to-Analog Signal Conversion).

Figure 2-3 also identifies the approximate transmitter location for each calibration task. Note that the data flows from left to right, and a parameter change affects all values to the right of the changed parameter.

Not all calibration procedures should be performed for each Model 1151 transmitter. Furthermore, some procedures are appropriate for bench calibration but should not be performed during field calibration. Table 2-1 identifies the recommended calibration procedures for each type of Model 1151 transmitter for both bench and field calibration.

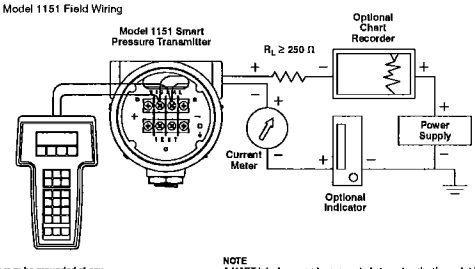
TABLE 2-1. Recommended Calibration Tasks.

Transmitter	Bench Calibration Tasks	Field Calibration Tasks
Standard Calibration Tasks 1151DP 1151GP 1151HP 1151LT	1. Set output configuration parameters: a) Set the Transmitter Range Points. b) Set the Output Units. c) Set the Output Type (linear or square root). d) Set the Damping Value. 2. *Optional:* Perform a Full Sensor Trim —Pressure source required. 3. *Optional:* Perform an Analog Output Trim —Multimeter required.	1) Reconfigure parameters if necessary. 2) Zero trim the transmitter to compensate for mounting position effects or static pressure effects.
1151AP	Standard Bench Calibration, **except step 2:** 2. *Optional:* Perform a Full Sensor Trim if equipment is available (accurate absolute pressure source required); otherwise, perform the Low Trim Value section of Full Sensor Trim procedure.	1) Reconfigure parameters if necessary. 2) Perform Low Trim Value section of Full Sensor Trim procedure to correct for mounting position effects.

NOTE
A HART-based communicator is required for all sensor and output trim procedures.

Wiring Diagrams (Field Hook-up)

FIGURE 2-4. Model 1151 Field Wiring Diagram.



NOTE
Signal Loop may be grounded at any point or left ungrounded.

NOTE
A HART interface may be connected at any termination point in the loop. Signal loop must have 250 ohms minimum load for communications.

Common Functions

The following tasks are a common part of a transmitter commissioning.

Setting the Loop to Manual

When preparing to send or request data that would disrupt the loop or change the output of the transmitter, set the loop to manual. Both the HART Communicator Model 275 and the Rosemount Model 268 will prompt for this setting when necessary. Keep in mind that simply acknowledging this prompter does not set the loop to manual. It is only a reminder; the loop must be set to manual as a separate operation.

Change Non-Output Related Information

The Model 1151 Smart contains several configuration parameters that do not directly affect the transmitter output. These parameters include:

- Date
- Descriptor
- Message
- Meter type

Sending Data to the Transmitter

HART Comm.	Note
Model 268	F3, F4

Whenever transmitter configuration data is updated with a HART-based communicator, the entered data must be sent to the transmitter memory.

NOTE
Depending on the task, an option to enter the data (or end changes and enter the data) will appear at the end of the configuration function. Follow the on-screen prompts to complete the send data function.

Review the transmitter memory to ensure that configuration changes have been entered.

Configure the Analog Output Parameters

Setting Units

HART Comm.	1, 3
Model 268	F3, F2

By setting the output units, a process can be monitored using the specified units. This is important if a plant uses units which differ from those preset by Rosemount Inc. Output units can be selected from among 14 output options:

- inH_20
- inHg
- ftH_20
- mmH_20
- mmHg
- psi
- bar
- mbar
- g/cm^2
- kg/cm^2
- Pa
- kPa
- torr
- atm

Reranging

One of the most common configuration tasks involves reranging the transmitter 4 and 20 mA points.

Reranging matches the transmitter range points with the applied process pressures. It can be performed three ways: using the communicator only, using the communicator and a reference pressure, or using the integral zero and span buttons and a reference pressure.

To decide which method is appropriate, consider the following:

- Reranging with only the communicator changes the analog 4 and 20 mA points independently without a pressure input.

This means that when you change either the 4 or 20 mA setting, you also change the span. For instance:

If the transmitter is ranged so that

4 mA = 0 inH_2O, and
20 mA = 100 inH_2O,

and you change the 4 mA setting to 50 inH_2O using the communicator only, the new settings are:

4 mA = 50 inH_2O, and
20 mA = 100 inH_2O.

Note that the span was also changed from 100 inH_2O to 50 inH_2O, while the 20 mA setpoint remained at 100 inH_2O.

To obtain reverse output, simply set the 4 mA point at a greater numerical value than the 20 mA point. Using the above example, setting the 4 mA point at 100 inH_2O and the 20 mA point at 0 inH_2O will result in reverse output.

NOTE
The 4 and 20 mA output is based on the transmitter's existing digital calibration. Before reranging with the keypad, make sure the transmitter is correctly interpreting the process variable input. To match the transmitter's reading in engineering units to plant standard, use the sensor trim function under "Digital Trim" in this section.

- Reranging with a pressure input and the communicator maintains the same analog span.
- Reranging with a pressure input and the zero and span buttons maintains the same analog span.

For instance, if the transmitter is ranged so that:

4 mA = 0 inH_2O, and
20 mA = 100 inH_2O,

and you then change the 4 mA setting to 50 inH_2O using the communicator (or buttons) and a pressure input, the new settings are:

4 mA = 50 inH_2O
20 mA = 150 inH_2O

The 100 inH_2O span is maintained.

It is also important to note that when using a pressure source, the 4 and 20 mA setpoints are based on the transmitter's interpretation of the pressure input provided. It is possible that when a plant standard is input, the transmitter reads it as a slightly different value. Although the 4 and 20 mA setpoints will operate properly within these applied settings, the transmitter's digital output in engineering units may indicate a slightly different value.

The sensor trim function under "Digital Trim" can be used to match the transmitter's reading in engineering units to your plant standard, thereby eliminating any discrepancy.

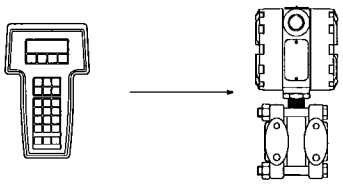
NOTE
Reranging only the 4 mA or the 20 mA with a pressure input will maintain the initial span width.

NOTE
Do not rearing the tranemitter such that the 4 and 20 mA range points—upper range value (URV) and lower range value (LRV)—are outside the high and low digital sensor trim values. To optimize performance, the digital trim span should be equal to or slightly greater than the 4–20 mA span.

Reranging with a Communicator Only

HART Comm.	1, 2, 3, 1, 1
Model 268	F3, F2, F1, F3, F1

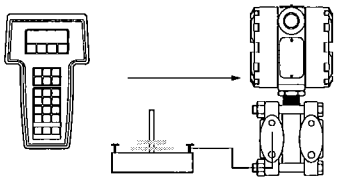
Reranging with the keypad and no pressure input changes the 4 and 20 mA points independently.



Reranging with a Pressure Input Source and a Communicator

HART Comm.	1, 2, 3, 1, 2
Model 268	F3, F2, F1, F3, F2

Reranging with a pressure input source and the communicator or the zero and span buttons allows you to maintain the same analog span.

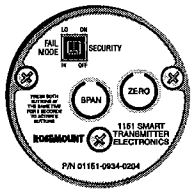


To rerange with a reference pressure, apply the desired pressure input to represent the 4 or 20 mA point. Allow the variable reading to stabilize for approximately ten seconds. Press either the 4 mA or 20 mA to make this pressure value either point.

Reranging Using the Integral Span and Zero Buttons

It is also possible to rerange the transmitter using the span and zero buttons located within the circuit side of the electronics housing on the electronics faceplate, as shown in Figure 2-5.

FIGURE 2-6. Model 1151 Electronics Faceplate.



NOTE
User-selectable switches are shown in default position.

1151-0908A02A

Use the following steps to rerange using the integral span and zero buttons:

1. Using a pressure source with an accuracy three to ten times the desired calibrated accuracy, apply a pressure equivalent to the lower calibrated value to the high side of the transmitter.
2. Remove the circuit side cover to expose the span and zero buttons. Hold both the span and zero buttons down simultaneously for at least five seconds to activate the controls. The buttons remain active for 15 minutes. After 15 minutes the buttons must be reactivated by pressing simultaneously and holding again.
3. Press the zero button for five seconds to set the 4 mA point. Verify that the output is 4 mA.
4. Apply a pressure equivalent to the higher calibrated value to the high side of the transmitter.
5. Press the span button for five seconds to set the 20 mA point. Verify that the output is 20 mA.

NOTE
Both the lower and upper range values must fall within the lower and upper range limits of the sensor module, and meet the minimum and maximum span criteria allowed by the transmitter.

Setting the Output Type

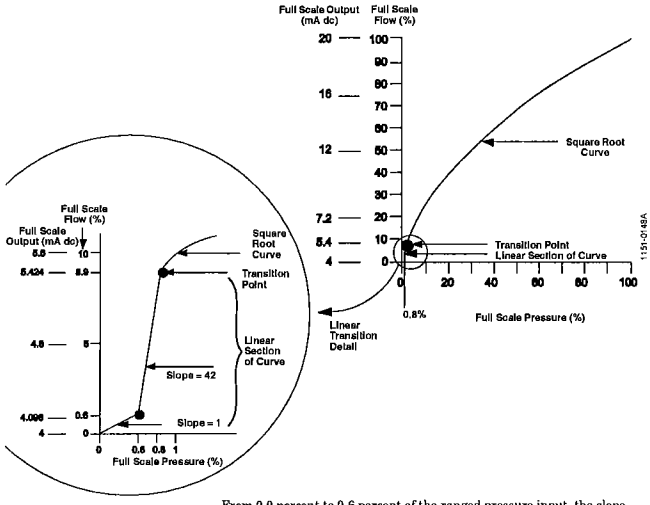
HART Comm.	1, 3, 5
Model 268	F3, F2, F1, F1

When the square root output option is active the Model 1151 analog output is proportional to flow. To avoid the extremely high gain that results as the input approaches zero, the Model 1151 automatically switches to a linear output in order to ensure a more stable output near zero. Figure 2-6 illustrates this transition point.

The transition from linear to square root is not adjustable. It occurs at 0.8% of ranged pressure input or 9.0% of full-scale flow output in transmitters with Revision 5.2. software. In earlier software, the transition point occurred at 4.0% of ranged pressure input, or 20% of full scale flow output.

The transition from linear to square root output is smooth, with no step change or discontinuity in output.

FIGURE 2-6. Square Root Output Transition Point.



From 0.0 percent to 0.6 percent of the ranged pressure input, the slope of the curve is unity ($y = x$). This allows accurate calibration near zero. Greater slopes would cause large changes in output for small changes at input. From 0.6 percent to 0.8 percent, the slope of the curve equals 42 ($y = 42x$) to achieve continuous transition from linear to square root at the transition point.

Setting Damping

HART Comm.	1, 3, 6
Model 268	F3, F2, F2

The Model 1151 Smart Pressure Transmitter has electronic damping that can increase the response time of the transmitter to smooth the output when there are rapid input variations. High damping values filter out process noise, but response time is decreased. Low damping values increase response time, but process noise can also be detected.

For Model 1151 Smart Pressure Transmitter transmitters, damping values may be set in 0.1 second increments from 0 to 16.0 seconds. The factory default damping value is 0.2 seconds (0.4 seconds for Range 3). Damping values for inert-filled sensors are slightly higher.

Calibrate the Sensor

Digital Trim (Sensor Trim and Analog Output Trim)

In order to understand the digital trim function, it is necessary to understand that smart transmitters operate differently from conventional analog transmitters. Smart transmitters are factory characterized, which involves comparing a pressure input with the output of each transmitter's sensor module. The information obtained in the comparison is stored in the sensor module EEPROM during the characterization process. In operation, the transmitter uses this information to produce a process variable output, in engineering units, dependent on the pressure input. The digital trim function allows corrections to be made to this factory-stored curve.

The digital trim procedure is a two-step process. The first step, called sensor trim, consists of matching the digital process variable reading of the transmitter to a precision pressure input. The second step, called 4–20 mA trim, consists of adjusting the output electronics.

This procedure should not be confused with reranging. Although you can still match a pressure input to a 4 or 20 mA output through a reranging function, you have not affected the transmitter's interpretation of that input. A *sensor trim* allows you to alter the transmitter's interpretation of the input signal. *A 4–20 mA analog output trim* allows you to alter the transmitter's conversion of that interpretation into an analog 4–20 mA output.

The transmitter can only be as accurate as the equipment used to perform the digital trim. Use precise equipment under stable, ambient conditions for best results. If such equipment is not available, it may be better to return the transmitter to a local Rosemount service center for verification of the trim values. To eliminate the possibility of over-trimming the transmitter, the Model 1151 will accept only trim values that are within 5 percent of its original characterization.

Sensor Trim

The sensor may be trimmed in two ways: full trim and zero trim. They vary in complexity, and their use is application-dependent.

Full Trim

HART Comm.	1, 2, 3, 3
Model 268	F4, F4, F3, F2, F1

A **full trim** is a two-point sensor calibration where two end-point pressures are applied, and all output is linearized between them. To start the procedure, connect the communicator and a pressure input source of at least three times greater accuracy than the Model 1151 Smart Transmitter as shown in Figure 2-7. Always let the variable stabilize for 10 seconds after application of the pressure source before taking its reading.

NOTE
The Model 1151 Smart Pressure Transmitter allows approximately a 5.0% URL deviation from the characterized curve established at the factory.

NOTE
A full trim requires a pressure source at least three times more accurate than the transmitter. For best accuracy, make sure the applied pressure is equal to or slightly less than the desired 4 mA setpoint, or equal to or slightly greater than the 20 mA setpoint.

The last trim/input values used will be displayed briefly. The engineering units shown match those selected under configuration or in transmitter characterization.

In selecting the pressure input values, the low and high values should be equal to or outside the 4 and 20 mA points. Do not attempt to obtain reverse output by reversing the high and low points.

The low trim value should be trimmed first. This provides a stable reference for additional sensor trim adjustment. Adjustment of the low trim value provides an offset correction to the factory-established characterization curve. Adjustment of the high trim value provides a slope or gain correction to the characterization curve based on the low trim value. In neither case is the factory-established characterization curve changed by this procedure. The trim values allow optimized performance over a specified measuring range at the calibration temperature.

Zero Trim

HART Comm.	1, 2, 3, 3, 1
Model 268	F3, F2, F1, F3, F2

A **zero trim** is a simpler, one-point adjustment. It must be zero-based (in other words, within 3.0% of true zero) and it may be performed when an exact pressure source is not available for the second pressure needed in a full trim.

It is useful for compensating for mounting position effects or for zero shifts due to static pressure in differential pressure applications. However, since this correction maintains the slope of the characterization curve, it should not be used in place of a full trim over the full sensor range.

Zero trim is best performed with the transmitter installed in its final mounting position with static pressure applied (or no pressure for a gage transmitter).

NOTE
Because a zero trim must be zero-based, it generally should not be used with Model 1151 Absolute Pressure Transmitters. Absolute pressure transmitters reference absolute zero. To correct mounting position effects on a Model 1151 Absolute Pressure Transmitter, perform a low trim within the full sensor trim function. The low trim function provides a "zero" correction similar to the zero trim function but it does not require the input to be zero based.

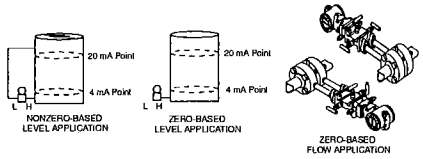
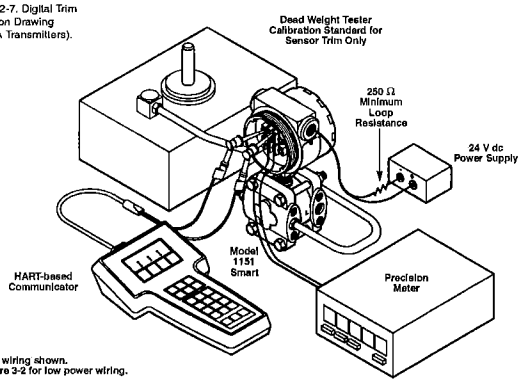


FIGURE 2-7. Digital Trim Connection Drawing (4–20 mA Transmitters).



NOTE
4–20 mA wiring shown.
See Figure 3-2 for low power wiring.

Systematic Error Correction

One feature of full trim is the ability to use it to improve the Model 1151DP or HP performance by correcting for systematic error because of static pressure.

NOTE
Corrections can only be made in linear mode. Switch from square-root mode to linear mode if necessary.

High static pressure causes a systematic span shift in the transmitter. It is linear with static pressure and is easily corrected by performing a *full trim*. Table 2-1 shows the amount of systematic span shift for Range Codes 3 through 8.

Range Code	316L SST	Hastelloy®	Monel
3	−1.75%	−1.0%	−1.00%
4	−0.87%(1)	−0.60%	−0.50%
5	−0.81%(1)	−0.70%	−0.75%
6	−1.45%(1)	−1.45%	−1.45%
7	−1.05%(1)	−1.05%	−1.05%
8	−0.55%	−0.55%	−0.55%

(1) Applies also to Model 1151HP.

Correction for systematic error is made by simply calculating a correction factor for the high trim and low trim and inputting this correction into the transmitter.

The following example illustrates the correction procedure:

A Model 1151DP 4 (Range 4) with 316L SST isolating diaphragms is to be used in an application where the static line pressure is 1,200 psi. The transmitter is reranged (as stated in **Reranging with a Pressure Input Source and a Communicator** on page 2-9) so that the transmitter output is 4 mA at 50 inH_2O and 20 mA at 150 inH_2O.

To correct for systematic error due to static line pressure, use the following formulas to determine a corrected value for Low Trim and High Trim.

Low Trim (LT) = LRV + S (LRV) P

Where LT = Corrected Low Trim Value at Atmosphere
LRV = Lower Range Value at Pressure P = 50 inH_2O
S = –(Span Shift from Table 2-1) = –0.0087/1000 psi
P = Static Line Pressure = 1200 psi

High Trim (HT) = URV + S (URV) P

Where HT = Corrected High Trim Value at Atmosphere
URV = Upper Range Value at Pressure P = 150 inH_2O
S = –(Span shift from Table 2-1) = –0.0087/1000 psi
P = Static Line Pressure = 1200 psi

In this example:

URV = 150 inH_2O

LRV = 50 inH_2O

S = +0.0087/1000 psi

P = 1200

LT = 50 + (0.0087/1000)(50)(1200)

LT = 50.53 inH_2O

HT = 150 + (0.0087/1000)(150)(1200)

HT = 151.58 inH_2O

Entering Corrected Values

To input the corrected values for the Low Trim and High Trim, perform a full trim as explained on page 2-12. When applying the low and high pressure values, edit the pressure reading and enter your corrected Low and High Trim values as in the following example:

Low trim:
Apply—50 inH_2O
Enter—50.53

High trim:
Apply —150 inH_2O
Enter—151.58

Deciding Whether to Trim the D/A Converter

After the microprocessor conditions the sensor signals, it outputs a digital word. The digital-to-analog (D/A) output circuitry converts the word to an analog signal for the 4–20 mA communications line. It may be necessary to check and trim this circuitry after a period of time. The 4–20 mA output trim function can also be used to make adjustments to allow for peculiarities of a particular readout device in the loop.

To determine whether the output must be trimmed, connect the HART-based communicator and a precision milliammeter capable of reading ± 1 micromole in the loop as shown in Figure 2-7.

Next, perform a loop test as described on page 2-4. Follow the loop test procedure and set the transmitter to a 4 mA output. Then check the ammeter. The reading should be within ±3 µA of 4 mA.

Then set the transmitter to a 20 mA output and check the milliammeter. The reading should be within ± 3 µA of 20 mA. The output should be trimmed if the values on the meter exceed this tolerance range.

When trimming the output, adjustments are made to the output circuitry. The appropriate shift will be made for all intermediate points between 4 and 20 mA.

The communicator will allow the D/A converter to be trimmed by using a current meter or voltage meter. When using a current meter, follow the sequence outlined in **4–20 mA Analog Output Trim**. When using a voltage meter or a meter whose display does not read out in 4–20 mA, follow the sequence outlined under **4–20 mA Analog Output Trim Using Other Scale**.

Digital to Analog Converter Trim

It may be necessary to calibrate the current output circuitry after a period of time and use. The 4–20 mA output trim function can also be used to make adjustments to allow for peculiarities of a particular readout device in the loop.

4–20 mA Analog Output Trim

HART Comm.	1, 2, 3, 2, 1
Model 268	F4, F4, F3, F1, F1

A 4–20 mA output trim adjusts the transmitter milliampere output to match a plant's current standard. Use this procedure when trimming the converter using a current meter.

4–20 mA Analog Output Trim Using Other Scale

HART Comm.	1, 2, 3, 2, 2
Model 268	F4, F4, F3, F1, F2

To trim the output using a voltage or other meter, connect the meter across a resistor in the loop. For best accuracy, use a precision resistor. The scaling function may be used if the meter displays other units, such as 0–100%.

NOTE
If a resistor is added to the loop, before proceeding, ensure that the power supply is sufficient to power the transmitter to a 20 mA output with the additional loop resistance.

Advanced Functions

Burst Mode

HART Comm.	1, 4, 3, 4, 3
Model 268	F4, F4, F1

When the Model 1151 Smart is configured for burst mode, it provides faster digital communication from the transmitter to the control system by eliminating the time required for the control system to request information from the transmitter.

Burst mode is compatible with use of the analog signal. Because HART protocol features simultaneous digital and analog data transmission, the analog value can drive other equipment in the loop while the control system is receiving the digital information. Burst mode applies only to the transmission of dynamic data (pressure and temperature in engineering units, pressure in percent of range, and/or analog output in mA or V), and does not affect the way other transmitter data is accessed.

Access to information other than dynamic transmitter data is obtained through the normal poll/response method of HART communication. A HART-based communicator or the control system may request any of the information that is normally available while the transmitter is in burst mode. Between each message sent by the transmitter, a short pause allows the HART-based communicator or a control system to initiate a request. The transmitter will receive the request, process the response message, and then continue "bursting" the data approximately three times per second.

Saving, Recalling, and Cloning Configuration Data

HART Comm.	Left Arrow, 3 (Note)
Model 268	F4, F4, F1

Data that was entered off-line can be stored in the communicator memory and downloaded to other transmitters later. Data also can be copied from a transmitter in order to be sent to other transmitters in a process known as "cloning." This is especially useful if when working with a large number of transmitters that require the same configuration data.

NOTE
The HART Communicator Model 275 requires the use of the Transfer Menu to move data between the transmitter memory and the communicator. This menu is available from the Main Menu of the HART Communicator. Press the left arrow to move from the Online Menu to the Main Menu. Press 3 from the Main Menu to access the Transfer Menu.

A HART-based communicator may be used to transfer data between transmitters of the same model type.

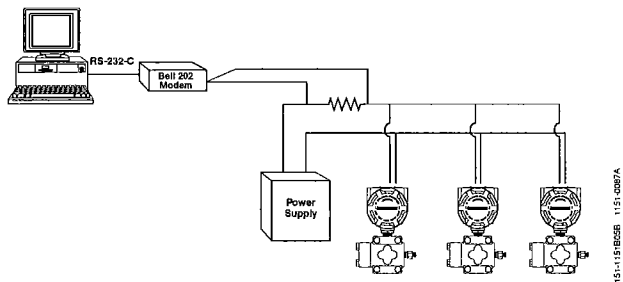
Multidrop Communication

Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated. Many of the Rosemount SMART FAMILY transmitters can be multidropped. With the HART smart communications protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines. Note that burst mode operation is not compatible with multidrop communications.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Multidrop installations are not recommended where intrinsic safety is a requirement. Communication with the transmitters can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each transmitter is identified by a unique address (1-15) and responds to the commands defined in the HART protocol.

Figure 2-8 shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

FIGURE 2-8. Typical Multidrop Network.



HART-based communicators can test, configure, and format a multidropped Model 1151 in the same way as it can a Model 1151 in a standard point-to-point installation.

NOTE
The Model 1151 Smart Pressure Transmitter is set to address 0 at the factory, allowing it to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter address must be changed to a number between 1 and 15 (inclusive). This change deactivates the 4–20 mA analog output, sending it to 4 mA. It also disables the failure mode alarm signal, which is controlled by the upscale/downscale switch.

Changing a Transmitter Address

HART Comm.	1, 4, 3, 4, 1
Model 268	F1, F4, F4, F2, F3

To change the address of a multidropped transmitter, follow these fast key sequences. To activate multidrop communication, the transmitter address must be changed to a number from 1 to 15.

Polling a Multidropped Loop

HART Comm.	Left Arrow, 5, 1 (note)
Model 268	F1, F4, F4, F2, F3

Polling a multidropped loop determines the model, address, and number of transmitters on the given loop.

NOTE
The HART Communicator Model 275 requires the use of the Utility Menu to perform an auto poll. This menu is available from the Main Menu of the HART Communicator. Press the left arrow to move from the Online Menu to the Main Menu. Press 5 from the Main Menu to access the Utility Menu.

FIGURE 2-9. Model 1151S Configuration Data Sheet.

Model 1151
Smart Pressure Transmitters

CONFIGURATION DATA SHEET

Customer _____ P.O. No. _____

Model No. _____ Line Item _____

SST Tag No. _____

Software Tag: _____ (8 characters maximum)

OUTPUT INFORMATION: (Software Selectable)

4 mA = _____ O★ KEY

20 mA = _____ Upper Range Limit★ ★ Default Values; Requires C9 Option

Units = ☐ inH2O★ ☐ psf ☐ Pa ★ inH2O for Ranges 3–5 in.
☐ inHg ☐ bar ☐ kPa ★ psi for Ranges 6–9 in.
☐ ftH2O ☐ mbar ☐ Torr
☐ mmH2O ☐ g/cm² ☐ Atm
☐ mmHg ☐ kg/cm²
Output = ☐ Linear★ ☐ Square Root

Damping = _____ seconds (Damping is electronically adjustable in 0.1 seconds in increments from 0.0 to 16.0 seconds.)

TRANSMITTER INFORMATION: (Software Selectable)

Descriptor: _____ (16 characters maximum)

Message: _____ (32 characters maximum)

Date: (numeric)(alphabetic)(numeric) Day Month Year

Integral Meter:	☐ Installed	☐ None			
Flange Material:	☐ 316 SST	☐ *Hastelloy C*	☐ *Monel*	☐ Carbon Steel	☐ Special
O-ring Material:	☐ *Viton*	☐ Buna-N	☐ Ethylene-Propylene		
	☐ *Teflon*	☐ Special			
Isolator Material:	☐ 316 SST	☐ *Hastelloy C*	☐ *Monel*		
	☐ Tantalum	☐ Gold/*Monel*	☐ Special		
Sensor Fluid:	☐ Silicone	☐ Inert			
Drain/Vent Valves:	☐ 316 SST	☐ *Hastelloy C*	☐ *Monel*	☐ Carbon Steel	☐ Special
Remote Seal Type:	☐ No Seal	☐ CTW	☐ EFW		
	☐ PFW	☐ RFW	☐ RTW		
	☐ SCW	☐ SSW	☐ Special		
Remote Seal Fill Fluid	☐ No Seal	☐ Silicone	☐ *Syltherm 800*		
	☐ Inert	☐ Glycerin/H2O	☐ Prop Gly/H2O		
	☐ *Neobee M-20*	☐ Special			
Remote Seal Isolr Matl:	☐ No Seal	☐ 316 SST	☐ *Hastelloy C*		
	☐ Tantalum	☐ Special			
Number of Remote Seals:	☐ No Seal	☐ One	☐ Two		

HARDWARE SELECTABLE INFORMATION:

Failure Mode: ☐ High ☐ Low
Transmitter Security: ☐ Off ☐ On

SIGNAL SELECTION:

☐ 4–20 mA with simultaneous digital signal based on *HART* protocol
☐ Burst mode of *HART* digital process variable(1)
Burst mode output options:
☐ Primary variable in engineering units
☐ Primary variable in percent of range
☐ All dynamic variables in engineering units and the primary variable mA value
☐ Multidrop Communication(2)(3)
Choose transmitter address (1-15): _____

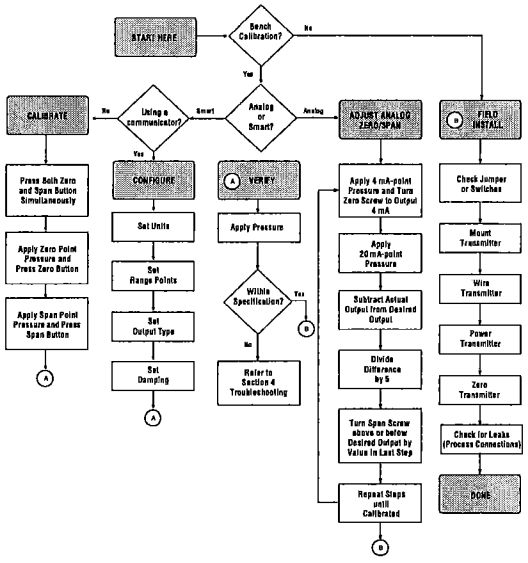
(1) These options are available with Revision 5.1 and greater software.
(2) This option fixes the transmitters analog output at 4 mA.
(3) Default transmitter address is 1 if multidrop communication is selected.

Section 3 Installation

OVERVIEW

This section is designed to guide you through a successful Model 1151 installation. This section contains an installation flow chart; safety messages; general, mechanical, mounting, and electrical installation information; as well as installation guidance for optional parts. Dimensional drawings for each Model 1151 variation and mounting configuration are included.

FIGURE 3-1. Model 1151 Installation Flowchart.



SAFETY MESSAGES

Warnings (⚠)

Procedures and instructions in this section that raise potential safety issues are indicated by a warning symbol (⚠). Refer to the following warning messages before performing an operation preceded by this symbol.

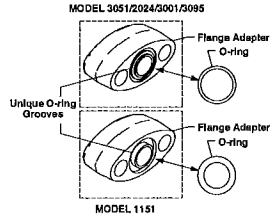
⚠WARNING

- Explosions can result in death or serious injury. Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practice.
- Process leaks can cause death or serious injury. Install and tighten all four flange bolts before applying pressure, or process leakage may result. Attempting to remove the flange bolts while the transmitter is in service may cause process fluid leaks.
- All explosion-proof, flameproof, and dust-ignition-proof installations require insertion of conduit plugs in all unused openings with a minimum of 40 ft-lb (54 N-m) of torque. This will maintain five full threads of engagement.
- When adding a meter option to a Model 1151 with an Option Code R1 or R2 terminal block, make sure to change to cemented meter covers with a glass window. Make sure a sticker is located inside the cover that indicates a "cemented cover." This cover is required to maintain explosion-proof approval.
- Explosions can cause death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.
- Explosions can cause death or serious injury. To meet hazardous location requirements, any transmitter with a tag specifying Option Codes I5, I1, N1, I8, I7, or N7 requires an intrinsically safe analog meter (Part Nos. 01151-2614-0004 through 0009) or an LCD meter (Part Nos. 01151-1300-1000, 01151-1300-1001, 01151-1351-1000, or 01151-1351-1001).

⚠WARNING

Failure to install flange adapter O-rings can cause process leaks, which can result in death or serious injury.

There are two styles of Rosemount flange adapters, each requiring a unique O-ring, as shown below. Each flange adapter is distinguished by its unique groove.



Use only the O-ring designed to seal with the corresponding flange adapter.

Refer to the Spare Parts List on page 5-19 for the part numbers of the flange adapters and O-rings designed for the Model 1151 Pressure Transmitter.

GENERAL CONSIDERATIONS

The accuracy of a flow, pressure, or level measurement depends on proper installation of the transmitter and impulse piping. The piping between the process and transmitter must accurately transmit process pressure to the transmitter. Mount the transmitter close to the process and use a minimum of piping to achieve best accuracy. However, keep in mind the need for easy access, safety of personnel, practical field calibration, and a suitable transmitter environment.

In general, install the transmitter so as to minimize vibration, shock, and temperature fluctuations.

Installations in food, beverage, and pharmaceutical processes may require sanitary seals and fittings. Regulations may dictate special installation requirements to maintain sanitation and cleanability. See Product Data Sheet 00813-0100-4016 for more information about sanitary pressure instruments from Rosemount Inc.

Access Requirements

When choosing an installation location and position, take into account the need for access to the transmitter.

Process Flange Orientation

Orient the process flanges to enable process connections to be made. For safety reasons, orient the drain/vent valves so that process fluid is directed down and away from technicians when the valves are used. This can be accomplished by pointing the hole in the outside valve body downward and away.

Housing Rotation

⚠CAUTION

Do not rotate the transmitter housing more than 90 degrees without disconnecting the header board. Exceeding 90 degrees rotation will damage the internal sensor module wiring.

The electronics housing is designed to be rotated up to 90 degrees in order to provide field access to the two housing compartments. (If rotating the housing more than 90 degrees is necessary, follow the transmitter disassembly procedures in **Section 4 Troubleshooting**.) To rotate the housing up to 90 degrees, loosen the housing lock nut and turn the housing not more than 90 degrees from the orientation shown in Figure 3-2.

NOTE
Seal module threads with Loctite® 222 before retightening housing lock nut (see **Connecting the Electrical Housing to the Sensor** on page 4-6.

Terminal Side of Electronics Housing

Mount the transmitter so that the terminal side of the housing is accessible by providing:

- A ¾-inch clearance for cover removal with no meter
- A 3-inch clearance for cover removal with a meter installed

If practical, provide approximately 6 inches clearance so that a meter may be installed later. The terminal side is marked on the nameplate located on the side of the transmitter.

Circuit Side of Electronics Housing

The circuit compartment should not routinely need to be opened when the unit is in service. However, provide 6 inches clearance, if possible, to allow access to the integral zero and span buttons or for on-site maintenance. The circuit side of the housing is marked on the nameplate located on the side of the transmitter.

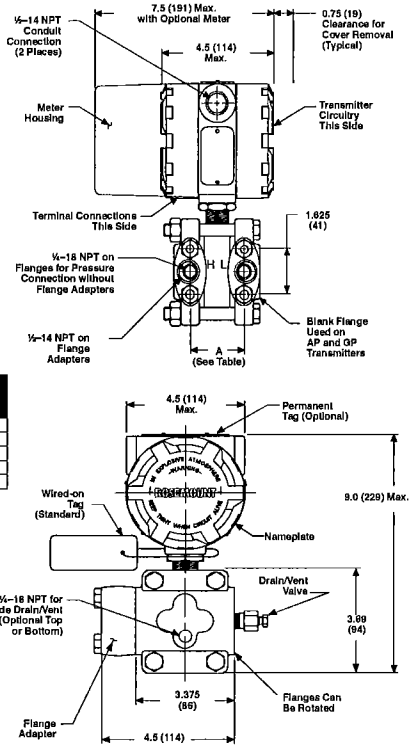
Exterior of Electronics Housing

The Model 1151 Smart Pressure Transmitter uses the same housing as the analog Model 1151. For this reason, integral span and zero screws—non-functional on the Model 1151 Smart Pressure Transmitter—are located under the nameplate on the side of the transmitter.

MECHANICAL CONSIDERATIONS

Rosemount Model 1151 Transmitters may be panel-mounted, wall-mounted, or attached to a 2-inch pipe through an optional mounting bracket. Figures 3-2 and 3-3 show the transmitter dimensions.

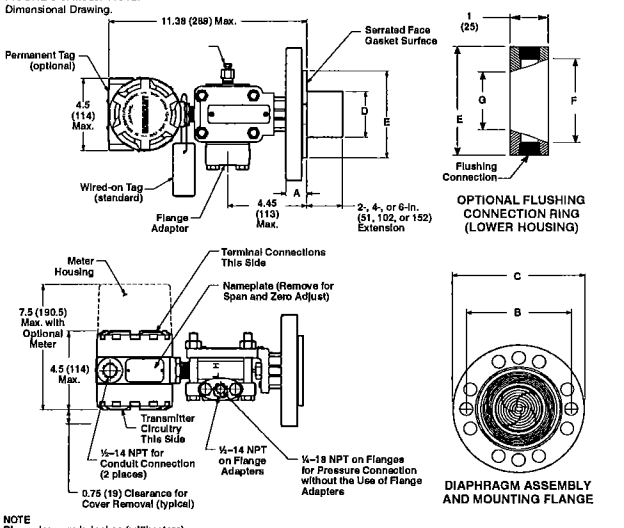
FIGURE 3-2. Model 1151AP, DP, GP, and HP Dimensional Drawings.



Range	Flange Distance "A" Center to Center	
	Inches	mm
3, 4, 5	2.125	54
6, 7	2.188	56
8	2.250	57
9	2.281	58
0	2.328	59

NOTE
Dimensions are in inches (millimeters).

FIGURE 3-3. Model 1151LT Dimensional Drawing.



NOTE
Dimensions are in inches (millimeters).

TABLE 3-1. Model 1151LT Dimensional Specifications.

Class	Pipe Size	Flange Thickness A	Bolt Circle Diameter B	Outside Diameter C	No. of Bolts	Bolt Hole Diameter	Exten. Diam. D (1)	O.D. Gask. Surf. E	Lower Housing	
									Xmtr Side F	Proc. Side G
ANSI 150	2 (51)	1.12 (28)	4.75 (121)	6.0 (152)	4	0.75 (19)	NA	3.75 (95)	2.9 (74)	2.16 (55)
	3 (76)	1.31 (33)	6.0 (152)	7.5 (190)	4	0.75 (19)	2.58 (65)	5.0 (127)	3.11 (79)	3.11 (79)
	4 (102)	1.31 (33)	7.5 (190)	9.0 (228)	8	0.75 (19)	3.5 (89)	6.81 (173)	4.06 (103)	4.06 (103)
ANSI 300	2 (51)	1.25 (32)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.75 (95)	2.9 (74)	2.16 (55)
	3 (76)	1.50 (38)	6.62 (168)	8.25 (209)	8	0.88 (22)	2.58 (65)	5.0 (127)	3.11 (79)	3.11 (79)
	4 (102)	1.62 (41)	7.88 (200)	10.0 (254)	8	0.88 (22)	3.5 (89)	6.81 (173)	4.06 (103)	4.06 (103)
ANSI 600	2 (51)	1.12 (28)	5.0 (127)	6.5 (165)	8	0.75 (19)	NA	3.75 (95)	2.9 (74)	2.16 (55)
	3 (76)	1.37 (35)	6.62 (168)	6.62 (168)	8	0.88 (22)	2.58 (65)	5.0 (127)	3.11 (79)	3.11 (79)
DIN PN10-40	DN 50	26 mm	125 mm	165 mm	4	18 mm	NA	95 mm	74 mm	55 mm
DIN PN 25/40	DN 80	30 mm	160 mm	200 mm	8	18 mm	65 mm	127 mm	79 mm	79 mm
	DN 100	30 mm	190 mm	235 mm	8	22 mm	89 mm	173 mm	103 mm	103 mm
DIN PN 10/16	DN 100	26 mm	180 mm	220 mm	8	18 mm	89 mm	173 mm	103 mm	103 mm

(1) Tolerances are 0.040 (1.02), –0.020 (0.51).

MOUNTING CONSIDERATIONS

The Model 1151 Smart Pressure Transmitter weighs 12 lb. (5.4 kg) without a meter and 15 lb. (6.8 kg) with a meter. This weight must be securely supported. The transmitter is calibrated in an upright position at the factory. If this orientation is changed during mounting, the zero point will shift by an amount equivalent to the liquid head caused by the mounting position. **Full Trim** on page 2-12 describes how to correct this shift.

NOTE
Do not plug the low side with a solid plug. Plugging the low side will cause an output shift.

Mounting Requirements (for Steam, Liquid, Gas)

The following information applies to steam, liquid, and gas installations.

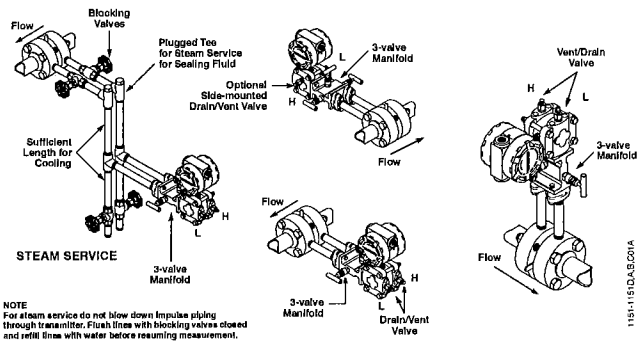
Taps

Tap placement location is dependent on the type of process being measured, and on whether the transmitter has side drain/vent valves:

- For liquid flow measurement, place taps to the side of the line to prevent sediment deposits, and mount the transmitter beside or below these taps so gases can vent into the process line and away from the transmitter.
- For gas flow measurement, place taps in the top or side of the line and mount the transmitter beside or above the taps so liquid will drain away from the transmitter.
- For steam flow measurement, place taps to the side of the line with the transmitter mounted below them to ensure that the impulse piping stays filled with condensate.
- For transmitters with side drain/vent valves, place taps to the side of the line. (See **Drain/Vent Valves** on page 3-8 for mounting position of drain/vent valves).

See Figure 3-4 for a diagram of these arrangements.

FIGURE 3-4. Steam, Liquid, and Gas Service Installation Diagrams.



NOTE
For steam service do not blow down impulse piping through transmitter. Flush lines with blocking valves closed and refill lines with water before resuming measurement.

Drain/Vent Valves

Drain/vent valve orientation is also dependent on the process being measured:

- For liquid service, mount the side drain/vent valve upward to allow the gases to vent.
- For gas service, mount the drain/vent valve down to allow any accumulated liquid to drain.

To change the drain/vent valve orientation from top to bottom, rotate the process flange 180 degrees.

Impulse Piping

The piping between the process and the transmitter must accurately transfer the pressure in order to obtain accurate measurements. In this pressure transfer, there are five possible sources of error:

- Leaks
- Friction loss (particularly if purging is used)
- Trapped gas in a liquid line
- Liquid in a gas line
- Temperature-induced or other density variation between the legs

The best location for the tranamitter in relation to the process pipe depends on the process itself. Consider the following general guidelines in determining transmitter location and placement of impulse piping:

- Keep impulse piping as short as possible.
- Slope the impulse piping at least 1 inch per foot (8 centimeters per meter) upward from the transmitter toward the process connection for liquid.
- Slope the impulse piping at least 1 inch per foot (8 centimeters per meter) downward from the transmitter toward the process connection for gas.
- Avoid high points in liquid lines and low points in gas lines.
- Make sure both impulse legs are the same temperature.
- Use impulse piping large enough to avoid friction effects and prevent blockage.
- Vent all gas from liquid piping legs.
- For steam service, fill impulse piping with water to prevent contact of live steam with the transmitter.

⚠CAUTION

Steam or other elevated temperature processes can cause damage to the sensor. Do not allow the temperature inside the process flanges to exceed the transmitter limit of 220 °F (104 °C).

- When using a sealing fluid, fill both piping legs to the same level.
- When purging is necessary, make the purge connection close to the process taps and purge through equal lengths of the same size pipe. Avoid purging through the transmitter.
- Keep corrosive or hot process material out of direct contact with the sensor module and flanges.
- Prevent sediment deposits in the impulse piping.
- Keep the liquid head balanced on both legs of the impulse piping.

Process Connections

⚠ **Flange Adaptors:**

Model 1151AP, DP, GP, and HP process connections on the transmitter flanges are ¼–18 NPT. Flange adapters are supplied with standard ½–14 NPT Class 2 connections. The flange adapters allow users to disconnect from the process by removing the flange adapter bolts. Use plant-approved lubricant or sealant when making the process connections. Figure 3-2 shows the distance between pressure connections. This distance may be varied ±1/2 in. (3.2 mm) by rotating one or both of the flange adapters.

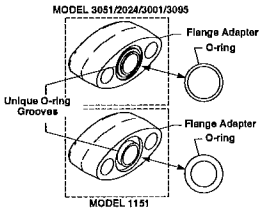
On open vessels, the low-side process flange is open to atmosphere and should be mounted with the threaded hole pointed down. On closed vessels, this connection is used for the dry or wet leg.

High-pressure-side process connections for the Model 1151LT Transmitter are offered with 2-, 3-, or 4-in., Class 150, 300, or 600 flanges; DN 50 (PN 10-40), DN 80 (PN 25/40), or DN 100 (PN 10/16, 25/40). Low-pressure-side process connections for the Model 1151LT Transmitter are offered with ¼–18 NPT on the flange, and ½–14 NPT on the adapter.

O-rings:

The two styles of Rosemount flange adapters (Model 1151 and Model 3051/2024/3001/3095) each require a unique O-ring (see Figure 3-5). Use only the O-ring designed for the corresponding flange adaptor.

FIGURE 3-5. O-Rings.



⚠ When compressed, Teflon® O-rings tend to "cold flow," which aids in their sealing capabilities.

NOTE
Teflon® O-rings should be replaced if the flange adapter is removed.

Tightening the Seal:

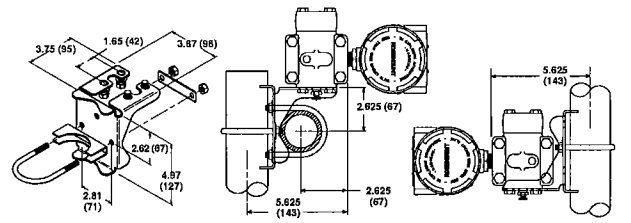
To ensure a tight seal on the flange adapters or a three-valve manifold, first finger-tighten both bolts, then wrench-tighten the first bolt to approximately 29 ft-lbs (39 N-m). Wrench-tighten the second bolt to approximately 29 ft-lbs (39 N-m).

⚠ See "Safety Messages" on page 3-2 for complete warning information.

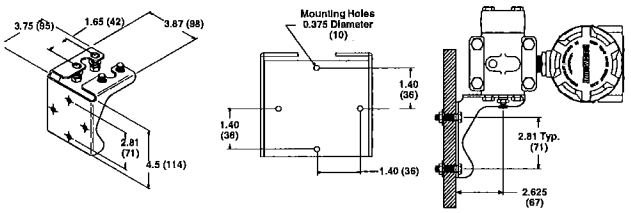
Mounting Brackets

Optional mounting brackets permit mounting the transmitter to a wall, a panel, or a 2-inch horizontal or vertical pipe. Figure 3-6 illustrates some typical configurations this mounting brackets.

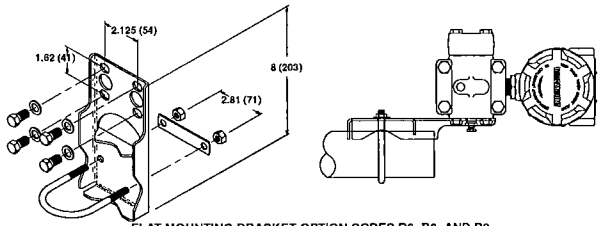
FIGURE 3-6. Mounting Bracket Options.



MOUNTING BRACKET OPTION CODES B1, B4, AND B7.



PANEL MOUNTING BRACKET OPTION CODES B2 AND B5



FLAT MOUNTING BRACKET OPTION CODES B3, B8, AND B9

NOTE
Dimensions are in inches (millimeters).

ELECTRICAL CONSIDERATIONS

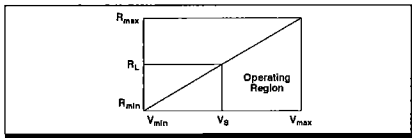
NOTE
Make sure all electrical installation is in accordance with national and local code requirements.

Power Supply

The dc power supply should provide power with less than 2% ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, and related pieces. The resistance of intrinsic safety barriers, if used, must be included.

To use the Rosemount Model 282 Loop Validator to power the loop, connect the Model 282 Validator leads at the set of terminal screws labeled "Signal." Figure 3-7 illustrates power supply load limitations for the transmitter.

FIGURE 3-7. Power Supply Load Limitations.



Elec. Code	V_{min}	V_{max}	R_{min}	R_{max}	R_L at Supply Voltage (V_s)
S[1]	12	45	0	1650	$R_L = 43.5(V_s - 12)$

(1) A minimum of 250 Ω is required for communication. Low power minimum load impedance: 100 kΩ.

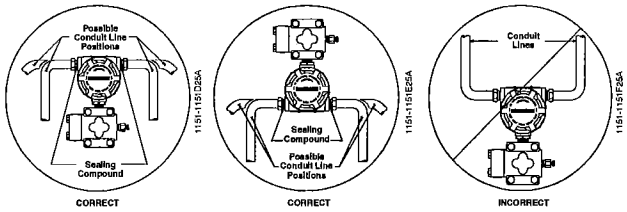
Conduit Installation

⚠CAUTION

If all connections are not sealed, excess moisture accumulation can damage the transmitter. Make sure to mount the transmitter with the electrical housing positioned downward for drainage. To avoid moisture accumulation in the housing, install wiring with a drip loop, and ensure the bottom of the drip loop is mounted lower than the conduit connections or the transmitter housing.

Recommended conduit connections are shown in Figure 3-8.

FIGURE 3-8. Conduit Installation Diagrams.



Wiring

⚠CAUTION

Do not connect the power signal wiring to the test terminals. Voltage may burn out the reverse-polarity protection diode in the test connection. If the test diode is destroyed, then the transmitter can still be operated without local indication by jumping the test terminals.

High voltage (greater than 50 V and greater than 0.005 amperes) can cause damage to the transmitter. Do not apply high voltage to the test terminals.

The signal terminals and test terminals are located in a compartment of the electronics housing that is separate from the transmitter electronics. The nameplate on the side of the transmitter indicates the locations of both of these compartments. The upper pair of terminals are the signal terminals and the lower pair are the test terminals. The test terminals have the same 4–20 mA output as the signal terminals and are only for use with the optional integral meter or for testing.

NOTE
An alternate location to connect an ammeter is on the set of terminals labelled "TEST." Connect the positive lead of the ammeter to the positive test terminal, and the negative lead of the ammeter to the negative test terminal.

⚠ To make connections, remove the cover on the side marked "Terminal" on the nameplate. All power to the transmitter is supplied over the signal wiring. Connect the lead that originates at the positive side of the power supply to the terminal marked "+" and the lead that originates at the negative side of the power supply to the terminal marked "–" as shown in Figure 3-9. No additional wiring is required.

Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment.

For improved performance against EMI/RFI effects, refer to page 3-19 for information on transient protection terminal blocks.

Shielded cable should be used for best results in electrically noisy environments.

NOTE
When conduit lines are used, signal wiring need not be shielded, but twisted pairs should be used for best results. Wiring must be 24 AWG or larger and not exceed 5,000 feet (1500 meters).

NOTE
A minimum loop resistance of 250 Ω is required to communicate with a hand-held HART-based communicator. With 250 Ω of loop resistance, the transmitter requires a minimum of 17 volts to output 20 mA. If a single power supply is used to power more than one Model 1151 Smart transmitter, the power supply used, and circuitry common to the transmitters, should not have more than 20 Ω of impedance at 1200 Hz.

Grounding

⚠ Use the following techniques to properly ground the transmitter signal wiring and case:

Signal Wiring

Signal wiring may be grounded at any one point on the signal loop or may be left ungrounded. The negative terminal of the power supply is a recommended grounding point.

Transmitter Case

The transmitter case must be grounded in accordance with national and local electrical codes. The most effective transmitter case grounding method is a direct internal connection to earth ground with minimal impedance. The transmitter case may also be grounded through the process or conduit connections.

Internal Ground Connection: Inside the field terminals side of the electronics housing is the internal ground connection screw. This screw is identified by a ground symbol: ⏚.

NOTE
Grounding the transmitter case via threaded conduit connection may not provide sufficient ground continuity.

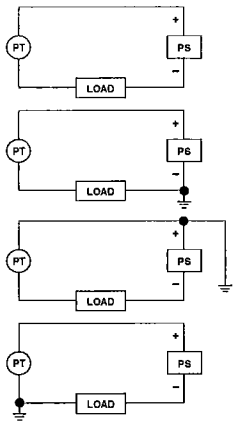
NOTE
The transient protection terminal block (page 3-19) does not provide transient protection unless the transmitter case is properly grounded. Use the preceding guidelines to ground the transmitter case. Do not run the transient protection ground wire with signal wiring as the ground wire may carry excessive current if a lightning strike occurs.

Grounding Effects

The capacitance sensing module requires alternating current to generate a capacitance signal. This alternating current is developed in an oscillator circuit with a frequency of approximately 32 kHz. This signal is capacitor-coupled to transmitter-case ground through the sensing module. Because of this coupling, a voltage may be imposed across the load, depending on the choice of grounding. See Figure 3-9.

Impressed voltage, which is seen as high frequency noise, will have no effect on most instruments. Computers with short sampling times in circuits will detect a significant noise signal, which should be filtered out by using a large capacitor (1 μF) or by using a 32 kHz LC filter across the load. Computers that are wired and grounded, as shown in Figure 3-9, are negligibly affected by this noise and do not need filtering.

FIGURE 3-9. Effects of Grounding on Accuracy for Fast Sample Computers.



Ungrounded System
Impressed Voltage: 12 to 22 mV_{p-p}, 32 kHz
Effect: 0.01% of span, max.

Ground Between Negative Side of Power Supply and Load
Impressed Voltage: 35 to 60 mVp-p, 32 kHz
Effect: 0.03% of span, max.

Ground Between Positive Side of Transmitter and Power Supply
Impressed Voltage: 35 to 60 mVp-p, 32 kHz
Effect: 0.03% of span, max.

Ground Between Negative Terminal of Transmitter and Load
Impressed Voltage: 500 to 600 mVp-p, 32 kHz
Effect: 0.27% of span, max.

*The effect caused by the impressed voltage on a computer with a sampling time of 100 microseconds using a 2 to 10 volt signal.

Hazardous Locations Certifications

⚠ The Model 1151 was designed with an explosion-proof housing and circuitry suitable for intrinsically safe and nonincendive operation. Factory Mutual explosion-proof certification is standard for the Model 1151 Smart Transmitter. Individual transmitters are clearly marked with a tag indicating the approvals they carry. Transmitters must be installed in accordance with all applicable codes and standards to maintain these certified ratings. Refer to **Hazardous Locations Certifications** on page 5-2 for information on these approvals.

Environmental Requirements

Mount the transmitter in an environment that has minimal ambient temperature change. The transmitter electronics temperature operating limits are –40 to 185 °F (–40 to 85 °C). **Section 5 Specifications and Reference Data** lists the sensing element operating limits. Mount the transmitter so that it is not susceptible to vibration and mechanical shock and does not have external contact with corrosive materials.

INSTALLATION OPTIONS

Mounting Brackets

(OPTION CODES B1–B7 AND B9)

Optional mounting brackets available with the Model 1151 allow mounting to a 2-inch pipe or panel. Figure 3-6 shows bracket dimensions and mounting configurations for the various bracket options.

Pipe Mounting Brackets

Option Codes B1, B4, and B7 are sturdy, polyurethane-painted brackets designed for 2-inch pipe mounting. Option Code B1 is constructed of carbon steel with carbon steel bolts. Option Code B4 is the same bracket as Option Code B1, with 316 SST bolts. Option Code B7 is also the same bracket as Option Code B1 with a 316 SST bracket and 316 SST bolts.

Panel Mounting Brackets

Option Codes B3, B6, and B9 are flat brackets designed for 2-inch pipe mounting. Option Code B3 is constructed of carbon steel with a carbon steel U-bolt. Option Codes B6 and B9 are the same bracket configuration as Option Code B3. Option Code B6 provides 316 SST bolts and Option Code B9 provides a 316 SST bracket and 316 SST bolts.

Analog Meters

⚠ Option Codes M1–M3 and M6 provide local indication of the transmitter output in a variety of scaling configurations with an indicator accuracy of ±2 percent. The plug-in mounting configuration allows for simple installation and removal of the analog meters. The meter scaling options are shown below.

- M1 Linear analog meter, 0–100% scale
- M2 Square-root analog meter, 0–100% flow scale
- M3 Special scaling analog meter, (specify range)
- M6 Square-root analog meter, 0–100% flow scale

⚠ See "Safety Messages" on page 3-2 for complete warning information.

LCD Meters

The LCD meter Option Codes, M4 and M7–M9, provide a highly accurate local display of the process variable. A variety of scaling configurations are available and listed as follows:

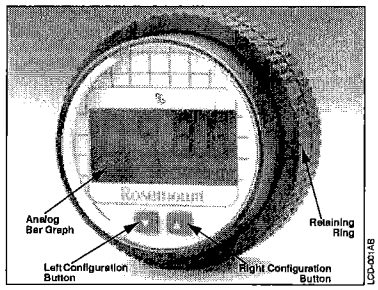
- M4 Linear LCD meter, 0 to 100%
- M7 Special scale LCD meter (specify range, mode, and engineering units)
- M8 Square-root LCD meter, 0 to 100%
- M9 Square-root LCD meter, 0 to 10%

LCD Meter Configuration

The Rosemount LCD meter plugs directly into the Model 1151 Smart Pressure Transmitter to provide a highly accurate digital display of the process variable. This manual explains the configuration and assembly of the LCD meter and includes the applicable functional, performance, and physical specifications. This meter adds no voltage drop in the 4–20 mA current loop when connected directly across the transmitter test terminals.

The LCD meter may be configured to meet specific requirements by using the left and right calibration buttons located on the meter face as shown in Figure 3-10. The analog bar graph is also shown in Figure 3-10. The 20-segment bar graph is factory calibrated and represents 4–20 mA directly.

FIGURE 3-10. LCD Meter.



No calibration equipment is required to configure the LCD meter, but between 4 and 20 mA must be flowing through the loop. The actual value of the current is not significant. In addition, meter configuration does not affect the transmitter/loop current. Use the following meter configuration procedure to properly configure the LCD meter:

Remove the Cover

1. Unscrew the retaining ring shown in Figure 3-10 and lift the transparent cover off of the housing.

NOTE
The LCD meter time-out is approximately 16 seconds. If keys are not pressed within this period, the indicator reverts to reading the current signal.

Position the Decimal Point and Select the Meter Function

2. Press the left and right configuration buttons simultaneously and release them immediately.
3. To move the decimal point to the desired location, press the left configuration button.
4. To scroll through the mode options, press the right configuration button repeatedly until the desired mode is displayed. See Table 3-2.

TABLE 3-2. LCD Meter Modes.

Options	Relationship between Input Signal and Digital Display
L in	Linear
L inF	Linear with five-second filter
Srt	Square root
SrtF	Square root with five-second filter

Square root function only relates to the digital display.
The bar graph output remains linear with the current signal.
Square root response
The digital display will be proportional to the square root of the input current where 4 mA=0 and 20 mA=1.0, scaled per the calibration procedure. The transition point from linear to square root is at 25% of full scale flow.
Filter response operates upon "present input" and "input received in the previous five second interval" in the following manner:

$$\text{Display} = (0.75 \times \text{previous input}) + (0.25 \times \text{present input})$$

This relationship is maintained provided that the previous reading minus the present reading is less than 25% of full scale.

Store the Information

5. Press both configuration buttons simultaneously for two seconds. The meter displays "----" for approximately 7.5 seconds while the information is being stored.

Set the Display Equivalent to a 4 mA Signal.

6. Press the left button for two seconds.
7. To set the display numbers to a lower value, press the left configuration button, and to set the display numbers to a higher value, press the right configuration button. Set the numbers between –999 and 1000.
8. To store the information, press both configuration buttons simultaneously for two seconds.

Set the Display Equivalent to a 20 mA Signal

9. Press the right button for two seconds.
10. To set the display numbers to a lower value, press the left configuration button, and to set the display numbers to a higher value, press the right configuration button. Set the numbers between –999 and 9999. The sum of the 4 mA point and the span must not exceed 9999.
11. To store the information, press both configuration buttons simultaneously for two seconds. The LCD meter is now configured.

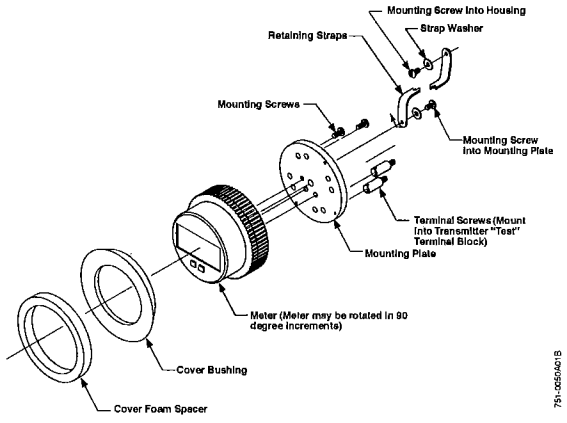
Replace the Cover

12. Make sure the rubber gasket is seated properly, replace the transparent cover, and replace the retaining ring.

LCD Meter Assembly

Figure 3-11 shows the mounting hardware required to properly install the LCD meter on a transmitter or in the field signal indicator. This mounting hardware may also be used with the Rosemount universal (analog) meter.

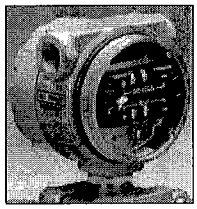
FIGURE 3-11. LCD Meter Exploded View.



Terminal Blocks

The terminal block options can increase the Model 1151 Pressure Transmitter's ability to withstand electrical transients induced by lightning, welding, heavy electrical equipment, or switch gears. The Model 1151 Pressure Transmitter, with the integral transient protection option, meets the standard performance specifications as outlined in this product manual. In addition, the transient protection circuitry meets IEEE Std 587, Category B, and IEEE Std 472, Surge Withstand Capability.

FIGURE 3-12. Transient Protection and Filter Terminal Block (Code R1).



1151-0224A

Transient Protection and Filter Terminal Block (Option Code R1)

Option Code R1 provides EMI/RFI protection and the benefit of integral transient protection. This terminal block can be ordered as a spare part to retrofit existing Model 1151 Transmitters with Option Code R2.

Terminal Block Installation

Use a phillips and a flat-blade screwdriver and the following steps to install a retrofitable transient protection terminal block:

1. Turn off all power to the Model 1151 on which the terminal block is being installed.
2. ⚠ Unscrew the transmitter terminal-side (indicated on the housing nameplate) cover (on the high side of the transmitter) exposing the standard terminal block.
3. Disconnect wiring to the terminal block.
4. Remove the single grounding screw and the two signal terminal screws, with terminal eyelet washers, from the standard terminal block.
5. Set the retrofitable transient protection terminal block into the housing, making sure the ground and signal terminals are properly aligned.
6. Insert the short mounting screws with washers in the mounting holes and tighten the terminal block to the transmitter.
7. Turn the transient protector grounding sleeve, located in the grounding hole, just enough to stabilize the unit on the transmitter. Overtightening the grounding sleeve will shift the terminal block out of alignment.
8. Insert the long grounding screw with the square washer into the grounding hole and tighten.
9. Connect the positive power supply wire to the transient protector terminal screw labeled "+ SIGNAL", and the negative power supply wire to the terminal screw labeled "- SIGNAL."
10. Attach the supplied label to the terminal side transmitter cover.
11. ⚠ Replace the terminal side cover on the transmitter.

⚠ See "Safety Messages" on page 3-2 for complete warning information.

Section 4 Troubleshooting

OVERVIEW

Table 4-1 provides summarized troubleshooting suggestions for the most common operating problems.

If you suspect a malfunction despite the absence of any diagnostic messages on the communicator display, follow the procedures described here to verify that transmitter hardware and process connections are in good working order. Always deal with the most likely and easiest-to-check conditions first.

SAFETY MESSAGES

Warnings (⚠)

Procedures and instructions in this section that raise potential safety issues are indicated by a warning symbol (⚠). Refer to the following warning messages before performing an operation preceded by this symbol.

⚠WARNING

- Isolate a failed transmitter from its pressure source as soon as possible. Pressure that may be present could cause death or serious injury to personnel if the transmitter is disassembled or ruptures under pressure.
- Explosions can cause death or serious injury. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.
- Explosions can cause death or serious injury. Do not break the housing seal in explosive environments. Breaking the housing seal invalidates the explosion-proof housing rating.
- Process leaks can cause death or serious injury. An incorrectly installed backup ring can destroy the o-ring and cause process leaks. Install the backup ring using the following procedure.
- Exposure to hazardous substances can cause death or serious injury. If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned goods.
- Explosions can cause death or serious injury. Do not disassemble the glass in the meter cover in explosive atmospheres. Disassembling the glass in the meter cover invalidates the explosion-proof meter rating.

⚠WARNING

- The following performance limitations may inhibit efficient or safe operation. Critical applications should have appropriate diagnostic and backup systems in place. Pressure transmitters contain an internal fill fluid. It is used to transmit the process pressure through the isolating diaphragms to the pressure sensing element. In rare cases, oil leak paths in oil-filled pressure transmitters can be created. Possible causes include physical damage to the isolator diaphragms, process fluid freezing, isolator corrosion due to an incompatible process fluid, etc. A transmitter with an oil fill fluid leak can continue to perform normally for a period of time. Sustained oil loss will eventually cause one or more of the operating parameters to exceed published specifications while a small drift in operating point output continues. Symptoms of advanced oil loss and other unrelated problems include:
  - Sustained drift rate in true zero and span or operating point output or both
  - Sluggish response to increasing or decreasing pressure or both
  - Limited output rate or very nonlinear output or both
  - Change in output process noise
  - Noticeable drift in operating point output
  - Abrupt increase in drift rate of true zero or span or both
  - Unstable output
  - Output saturated high or low

TABLE 4-1. Troubleshooting Symptoms and Corrective Action.

Symptom	Potential Source	Corrective Action
Transmitter does not communicate with the Model 275	Loop Wiring	Check for a minimum of 250 Ω resistance between the power supply and the communicator connection. Check for adequate voltage to the transmitter. (If the communicator is connected and 250 Ω resistance is properly in the loop, then the loop requires a minimum of 17 volts to operate.) Check for intermittent shorts, open circuits, and multiple grounds. Specify the transmitter by tag number. See the display sequence below.
	I.S. Barrier	Refer to appropriate I.S. Barrier documentation.
High Output	Primary Element	Check for restrictions at primary element.
	Impulse Piping	Check for leaks or blockage. Ensure that blocking valves are fully open. Check for entrapped gas in liquid lines and for liquid in dry lines. Ensure that the density of fluid in impulse lines is unchanged. Check for sediment in transmitter process flanges.
	Power Supply	Check the power supply output voltage at the transmitter. It should be 12 to 45 V dc.
	Transmitter Electronics	Connect the Model 268 and enter the XMTR TEST mode to determine any electronic failures. Make sure that post connectors are clean. If the electronics are still suspect, substitute new electronics.
	Sensing Element	The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly. Check for obvious defects, such as a punctured isolating diaphragm or fill fluid loss, and contact the Rosemount National Response Center at 1-800-THE-RSMT (1-800-654-7768).

TABLE 4-1. (continued).

Symptom	Potential Source	Corrective Action
Erratic Output	Loop Wiring	Check for adequate voltage to the transmitter. It should be 12 to 45 V dc with no load. Check for intermittent shorts, open circuits and multiple grounds. **⚠CAUTION** Do not use over 45 volts to check the loop, or damage to the transmitter electronics may result. Connect the Model 275 and enter the LOOP TEST mode to generate signals of 4 mA, 20 mA, and user-selected values.
	Process Pulsation	Adjust the electronic damping with the Model 275.
	Transmitter Electronics	Connect the communicator and perform a transmitter test to determine any electronic failures. Make sure the post connectors are clean. If the electronics are still suspect, substitute new electronics.
	Impulse Piping	Check for entrapped gas in liquid lines and for liquid in dry lines.
Low Output or No Output	Primary Element	Check the insulation and condition of primary element. Note any changes in process fluid properties that may affect output.
	Loop Wiring	Check for adequate voltage to the transmitter. It should be 12 to 45 V dc. Check the milliamp rating of the power supply against the total current being drawn for all transmitters being powered. Check for shorts and multiple grounds. Check for proper polarity at the signal terminal. Check loop impedance. Check whether the transmitter is in multidrop mode, thus locking the output at 4 mA. Connect the communicator and perform a loop test. **⚠CAUTION** Do not use over 45 volts to check the loop, or damage to the transmitter electronics may result. Check wire insulation to detect possible shorts to ground.
	Impulse Piping	Ensure that the pressure connection is correct. Check for leaks or blockage. Check for entrapped gas in liquid lines. Check for sediment in the transmitter process flange. Ensure that blocking valves are fully open and that bypass valves are tightly closed. Ensure that density of the fluid in the impulse piping is unchanged.
	Transmitter Electronics	Connect the communicator and check the sensor limits to ensure calibration adjustments are within the sensor range. Connect the communicator and perform a transmitter test to determine electronics failure. Make sure the post connectors are clean. If the electronics are still suspect, substitute new electronics.
	Sensing Element	The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly. Check for obvious defects, such as punctured isolating diaphragm or fill fluid loss, and contact Rosemount National Response Center at 1-800-THE-RSMT(1-800-654-7768).
Transmitter Does Not Characterize Properly	Pressure Source/Correction	Check for restrictions or leaks. Check for proper leveling or zeroing of the pressure source. Check weights/gauge to ensure proper pressure setting. Determine if the pressure source has sufficient accuracy. (The pressure source should be at least three times more accurate that the Model 1151 Smart.)

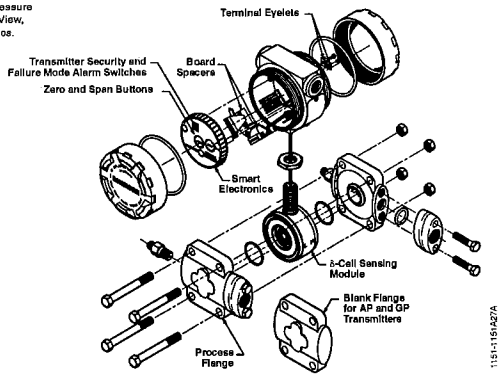
TABLE 4-1. (continued).

Symptom	Potential Source	Corrective Action
Transmitter Does Not Characterize Properly	mA Meter	Determine if the mA meter is functioning properly.
	Power Supply	Check the power supply output voltage at transmitter. It should be 12 to 45 V dc with no load. Check for a minimum of 250 Ω resistance between the Model 268 and the power supply.
	Transmitter Electronics	Connect the communicator and perform a transmitter test to determine any electronic failures. Make sure the post connectors are clean. If electronics are still suspect, substitute with new electronics.
	Sensing Element	The sensing element is not field repairable and must be replaced if found to be defective. See "Disassembly procedure" later in this section for instructions on disassembly. Check for obvious defects, such as punctured isolating diaphragm or fill fluid loss, and contact Rosemount National Response Center at 1-800-THE-RSMT(1-800-654-7768).

0Disassembly Procedure

⚠ Read the following information carefully before you disassemble a transmitter. General information concerning the process sensor body, electrical housing, and a procedure for their separation follow. Figure 4-1 shows an exploded view of the transmitter.

FIGURE 4-1. Differential Pressure (DP) Transmitter Exploded View, Shown with Smart Electronics.



Process Sensor Body

Be aware of the following:

- The transmitter should be removed from service before disassembling the sensor body.
- Process flanges can be detached by removing the four large bolts.

⚠CAUTION

Do not scratch, puncture, or depress the isolating diaphragms. Damaging the isolating diaphragms can inhibit transmitter performance.

- Isolating diaphragms may be cleaned with a soft rag, mild cleaning solution, and clear water rinse.

⚠CAUTION

Do not use chlorine or acid solutions to clean the diaphragms. Damaging the isolating diaphragms can inhibit transmitter performance.

- Flange adapters and process flanges may be rotated or reversed for mounting convenience.

Electrical Housing

⚠ Electrical connections are located in a compartment identified as TERMINAL SIDE on the nameplate. The signal and test terminals are accessible by unscrewing the cover on the terminal side. The terminals are permanently attached to the housing and must not be removed, or the housing seal between compartments will be broken.

To remove the smart electronics, refer to Appendix C Retrofitting the Model 1151 Transmitter, and reverse the installation sequence described in steps 10 through 15.

Removing the Sensor from the Electrical Housing

1. Unscrew the cover on the field terminal side of the transmitter.
2. Disconnect the power source from the transmitter.
3. Remove the smart electronics and header board.
4. Loosen the lock nut.

⚠CAUTION

Do not damage the isolating diaphragms when unscrewing the sensor module. Damaging the isolating diaphragms can inhibit transmitter performance.

5. The threaded connection has a sealing compound on it and will initially be tight. Unscrew the sensing module from the electronics housing, being careful not to damage the sensor leads. Carefully pull the header assembly board through the hole.

The sensing module is a welded assembly and cannot be further disassembled.

Reassembly Procedure

Follow these procedures carefully to ensure proper reassembly.

Preliminary Precaution

Inspect all O-rings and replace if necessary. Lightly grease with silicone oil to ensure a good seal. Use halocarbon grease for inert fill options.

Connecting the Electrical Housing to the Sensor

⚠
1. Insert the header assembly board through the electronics housing.
2. Use a sealing compound (Loctite 222—Small Screw Threadlocker) on the threads of the sensor module to ensure a watertight seal on the housing.
3. Screw the sensor module into the electrical housing making sure that at least five threads are engaged. Be careful not to damage or twist the sensor leads.
4. Align the sensor module with the high and low pressure sides oriented for convenient installation.
5. Tighten the lock nut.

Electrical Housing

The smart electronics and header board can easily be installed in the electrical housing. Steps 10 through 15 in **Appendix C Retrofitting the Model 1151 Transmitter** describe this assembly.

⚠CAUTION

An already characterized transmitter requires recharacterization whenever the sensor module or smart electronics are replaced. Failure to recharacterize can inhibit transmitter performance. (See Appendix C Retrofitting the Model 1151 Transmitter.)

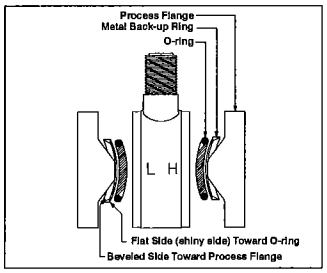
Process Sensor Body

All HP transmitters and GP Range 9 and 10 transmitters require metal backup rings to ensure O-ring integrity. Figure 4-2 illustrates the position and orientation of the metal backup rings. (Backup rings are not required on AP or DP transmitters or GP Range 3-8 transmitters.)

NOTE
Handle the backup ring carefully, as it is fragile. Examine the ring carefully. One side is beveled, while the other side is flat. The flat side appears more shiny when viewed from above.

1. Clean the sealing surfaces carefully.
2. Place the module on a flat surface, "H" side up.
3. Place the greased flange O-ring around the isolator and push it into the cavity.

FIGURE 4-2. Detail Showing Process O-ring and Backup Ring Installation of Module Seal for Model 1151HP and GP Range 9 (GP Range 10 Requires Only One O-ring and Backup O-ring).



⚠ 4. For all HP transmitters and GP transmitters Ranges 9 and 10, place the backup ring, shiny side down, on top of the O-ring. This places the flat side of the backup ring against the O-ring.
5. Carefully place the flange on top of the module, beveled side down so that the beveled flange surface mates with the beveled surface of the backup ring.
6. Keeping the flange and module together, turn them over so the "L" side is up. Repeat Steps 3 through 5. As before, the flat side of the backup ring must rest against the O-ring.
7. Insert the four flange bolts.

8. Tighten the nuts finger tight, making sure the flanges remain parallel. The transmitter may now be moved without disturbing the O-rings.
   a. Tighten one bolt until the flanges seat.
   b. Torque down the bolt diagonally across.
   c. Torque down the first bolt.
   d. Torque down the two remaining bolts.
   e. Inspect the flange-to-sensor seating to be sure that the flanges are not cocked.
   f. Check that all four bolts are tightened to approximately 33 ft-lb (39 Nm).
9. Recalibrate the transmitter.

Optional Plug-in Meters

The optional indicating meters available for Rosemount Model 1151 transmitters are listed in **Section 5 Specifications and Reference Data**. Please be aware of the following information while assembling the meter assembly. Refer to Table 5-12 on page 5-19 for part references.

- The meter may be rotated in 90-degree increments for convenient reading.
- ⚠ If the meter cover is removed for any reason, be sure the O-ring is in place between the cover and housing before reattachment. To maintain an explosion-proof condition, the glass in the meter cover should not be disassembled for any reason.

Sensor Module Checkout

The sensor module is not field repairable and must be replaced if found to be defective. If no obvious defect is observed (such as a punctured isolating diaphragm or fill fluid loss), the sensor module can be checked as follows.

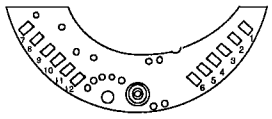
1. Carefully pull the header assembly board off of the post connectors. Rotate the board 180 degrees about the axis formed by the connecting leads. The sensor module and electronics housing can remain attached for checkout.
2. Check internal diode loops, forward and reverse bias: one loop is on pins one and two, the other is on pins three and four. See Figure 4-3. Loop resistance values should be nearly equal.

NOTE
Do not touch the transmitter housing when checking resistances, or a faulty reading can result.

3. Check the resistance between the sensor module housing and pins one through four. This checks the resistance between both capacitor plates and the sensing diaphragm, which is grounded to the housing. This resistance should be greater than 10 MΩ
4. Check the resistance between pin eight and the sensor module to ensure that the module is grounded. Resistance should be zero.

NOTE
The above procedure does not completely test the sensor module. If circuit board replacement does not correct the abnormal condition, and no other problems are obvious, replace the sensor module.

FIGURE 4-3. Header Board Connections.



Returning Rosemount Products and/or Materials

To expedite the return process, call the Rosemount National Response Center using our 800-654-RSMT (7768) toll-free number. This center, available 24 hours a day, will assist you with any needed information or materials.

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. For safety reasons, the center will also ask for the name of the process material the product was last exposed to.

⚠ The National Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Section 5

Specifications and Reference Data

FUNCTIONAL SPECIFICATIONS

Service
Liquid, gas, and vapor applications.

Ranges
Minimum span equals the upper range limit (URL) divided by rangedown. Rangedown varies with the output code (see Table 5-2).

TABLE 5-1. Model 1151 Transmitter Range Availability by Model (URL = Upper Range Limit).

Range Code	Model 1151 Ranges (URL)	DP	HP	GP	DP/GP/Seals	AP	LT
2	6 inH$_2$0 (1.49 kPa)	NA	NA	NA	NA	NA	NA
3	30 inH$_2$0 (7.46 kPa)	•	NA	•	NA	NA	NA
4	150 inH$_2$0 (31.08 kPa)	•	•	•	•	•	•
5	750 inH$_2$0 (186.4 kPa)	•	•	•	•	•	•
6	100 psi (689.5 kPa)	•	•	•	•	•	•
7	300 psi (2068 kPa)	•	•	•	•	•	NA
8	1,000 psi (6895 kPa)	•	NA	•	NA	•	NA
9	3,000 psi (20684 kPa)	NA	NA	•	NA	NA	NA
0	6,000 psi (41369 kPa)	NA	NA	•	NA	NA	NA

TABLE 5-2. Rangeability.

Output Code	Minimum Span	Maximum Span
S (DP and GP, SST, Range 3–8) S (All others)	URL/15 URL/6	2 × URL[1] 2 × URL[1]

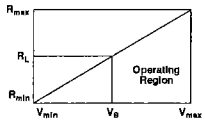
(1) Transmitter is capable of measuring from –URL to URL.

Outputs

Code S, Smart
4–20 mA dc, user selectable for linear or square root output. Digital process variable superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol.

Power Supply
External power supply required. Transmitter operates on:

12 to 45 V dc with no load for Output Code S. Where:



Code	V_{min}	V_{max}	R_{min}	R_{max}	R_L at Supply Voltage (V_s)
S[1]	12	45	0	1650	R_L = 43.5 (V_s–12)

(1) A minimum of 250 ohms is required for communication.

Span and Zero

Output Code S
Span and zero may be accessed with local adjustments or remotely via a HART-based communicator.

Hazardous Locations Certifications
Stainless steel certification tag is provided.

Factory Mutual (FM) Approvals
FM Explosion Proof tag is standard. Appropriate tag will be substituted if optional certification is selected.

Default Explosion Proof: Class I, Division 1, Groups B, C, and D. Dust-Ignition Proof: Class II, Division 1, Groups E, F, and G. Suitable for use in: Class III, Division 1. Indoor and outdoor use. NEMA 4X. Factory Sealed.

I5 Intrinsic Safety and Non-incendive Approvals: FM certifications optional for specific Classes, Divisions, and Groups when connected in accordance with the FM entity approvals (see Table 5-3). Factory Sealed.

K5 Combination of Explosion Proof, Intrinsic Safety, and Non-incendive Approvals.

TABLE 5-3. FM Entity Approvals.

1151 Parameters	Equipment Associated Parameters	FM Approved for Class I, II, III, Division 1 and 2 Groups A	B	C–G
V_{Max} = 40 V I_{Max} = 165 mA C_i = 0 (Standard) C_i = 0.024 µF (Smart) C_i = 0.010 µF (Standard w/R Option) C_i = 0.034 µF (Smart w/R Option) L_i = 0 (Standard) L_i = 20 µH (w/R Option)	$V_{OC} \leq$ 40 V $I_{SC} \leq$ 165 mA $C_A >$ 0 $C_A >$ 0.024 µF $C_A >$ 0.010 $C_A >$ 0.034 $L_A >$ 0 $L_A >$ 20 µH	•	•	•
V_{Max} = 40 V I_{Max} = 225 mA C_i = 0 (Standard) C_i = 0.024 µF (Smart) L_i = 0	$V_{OC} \leq$ 40 V $I_{SC} \leq$ 225 mA $C_A >$ 0 $C_A >$ 0.024 µF $L_A >$ 0	NA	NA	•

Canadian Standards Association (CSA) Approvals

E6 Explosion proof for Class I, Division 1, Groups C and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1 Hazardous Locations. Certified for Class I, Division 2, Groups A, B, C, and D; CSA enclosure 4. Factory sealed.

I6 Intrinsic Safety Approvals CSA certifications optional for specific Classes, Divisions, and Groups when connected in accordance with the CSA barrier selection table, Table 5-4. Not available with Output Code G.

C6 Combination of I6 and E6, CSA Explosion Proof and Intrinsic Safety Approval. Factory Sealed.

K6 CSA/CENELEC Explosion-Proof and Intrinsic Safety Approval.

TABLE 5-4. CSA Barrier Selection.

Barrier Manufacturer/Model	CSA Approved for Class I, Division 1 and 2 Groups A	B	C	D
Any CSA Approved Barrier ≤ 30 V, ≥ 330 Ω or ≤ 28 V, ≥300 Ω or ≤22 V, ≥ 180 Ω	•	•	•	•
Foxboro Converters 2AS-I3I-CGB, 2AI-I3V-CGB, 2AI-12V-CGB, 2AS-I2I-CGB, 3A2-I2D CS-E/CGB-A, 3F4-I2DAI CS-E/CGB-A, 3AD-I3IA CS-E/CGB-A, 3A2-I3D CS-E/CGB-A, and 3A4-I2DA CS-E/CGB-A	NA	•	•	•
Any CSA Approved Barrier ≤ 30 V, ≥ 150 Ω	NA	NA	•	•

Standards Association of Australia (SAA)

E7 Flameproof Certification
Ex d IIB T6; DIP T6; IP 65.
Class I, Zone 1.

Special Conditions: For transmitters having NPT or PG cable entry threads, an appropriate flameproof thread adaptor shall be used to facilitate application of certified flameproof cable glands.

I7 Intrinsic Safety Certification
Smart: Ex ia IIC T6; Class I, Zone 0.

Special Conditions: Observe barrier/entity parameters during installation.

N7 Type N
Ex n IIC T6 (T_{amb} = 40 °C).
Ex n IIC T5 (T_{amb} = 70 °C).
Class I, Zone 2.

Special Conditions: The equipment must be connected to a supply voltage which does not exceed the rated voltage. The enclosure end caps must be correctly fitted whilst the equipment is energized.

CESI/CENELEC Flameproof Certification
E8 90.C.016: EEx d IIC T6 (without meter).
90.C.017: EEx d IIB + H_2 T6 (with meter).
IP 65.

CESI/CENELEC Intrinsic Safety Certification
I8 EEx ia IIC T6 (T_{amb} = 40 °C); (P_{max} = 0.75 W).
EEx ia IIC T5 (T_{amb} = 55 °C); (P_{max} = 1.00 W).
EEx ia IIC T4 (T_{amb} = 80 °C); (P_{max} = 1.00 W).

BASEEFA/CENELEC Intrinsic Safety Certification
I1 Smart: Ex ia IIC T5 (T_{amb} = 40 °C).
EEx ia IIC T4 (T_{amb} = 80 °C).

Special Conditions: When transient protection terminal options (R1 or R9) are installed, the transmitter must be supplied from a galvanically isolated i.s. barrier.

BASEEFA Type N (Non-Incendive) Certification
N1 Smart
Ex N II T5 (T_{amb} = -40 °C to 50 °C); U_n = 45 V.
Ex N II T4 (T_{amb} = -40 °C to 80 °C); U_n = 45 V.

Special Conditions: The apparatus must be installed in accordance with BS 5345: Part 7: 1979 and be earthed by means of enclosure earth terminal.

Schweizerischer Elektrotechnischer Verein (SEV) Intrinsic Safety Certification

IC Smart
EEx ia IIC T5 (T_{amb} = 40 °C).
EEx ia IIC T4 (T_{amb} = 80 °C).

TABLE 5-5. International Entity Approvals.

SAA (Australia)		SEV (Switzerland)		CESI (Italy)		BASEEFA (United Kingdom)	
U_i = 30 V		U_{max} = 29.4 V	Analog	U_i = 30 V	Smart	U_{maxin} = 28 V dc	Analog
I_i = 200 mA		I_{max} = 215 mA	Analog	I_i = 200 mA	Smart	I_{maxin} = 120 mA	Analog
C_i = 0.034 µF		P_{max} = 0.36 W (T6)	Analog	P_i = 0.75 W (T6)	Smart	U_{maxin} = 30 V dc	Smart
L_i = 20 µH		P_{max} = 0.66 W (T5)	Analog	P_i = 1.0 W (T5 and T4)	Smart	I_{maxin} = 125 mA	Smart
		P_{max} = 0.95 W (T4)	Analog	C_i = 0.01 µF	Smart	W_{maxin} = 0.67 W (T5)	Smart
		C_{int} = 0	Analog	L_i = 20 µH	Smart	W_{maxin} = 1.0 W (T4)	Smart
		U_{max} = 30 V	Smart			C_{eq} = 0.034 µF	Smart
		I_{max} = 125 mA	Smart	U_i = 30 V	Code R9	L_{eq} = 20 µH	Smart
		P_{max} = 670 mA	Smart	I_i = 200 mA	Code R9		
		C_{int} = 0.22 µF	Smart	P_i = 1.0 W	Code R9		
		L_{int} = 0 (Digital Meter)	Smart	C_i = 8 nF	Code R9		
		L_{int} = 0.7 mH (Analog Meter)	Smart	L_i = 20 µH	Code R9		

Zero Elevation and Suppression

Output Code S
Zero elevation and suppression must be such that the lower range value is greater than or equal to the (–URL) and the upper range value is less than or equal to the (+URL). The calibrated span must be greater than or equal to the minimum span.

Temperature Limits

Ambient
–40 to 185 °F (–40 to 85 °C).

Process *At atmospheric pressures and above.*

TABLE 5-6. Model 1151 Temperature Limits.

Models 1151DP, HP, AP, GP, LT	
Silicone Fill Sensor	–40 to 220 °F (–40 to 104 °C)
Inert Fill Sensor	0 to 160 °F (–18 to 71 °C)
Model 1151LT High-Side Temperature Limits (Process Fill Fluid)	
Syltherm® XLT	–100 to 300 °F (–73 to 149 °C)
D.C.® Silicone 704	60 to 400 °F (15 to 205 °C)
D.C. Silicone 200	–40 to 400 °F (–40 to 205 °C)
Inert	–50 to 350 °F (–45 to 177 °C)
Glycerin and Water[1]	0 to 200 °F (–18 to 93 °C)
Neobee M-20®[2]	0 to 400 °F (–18 to 205 °C)
Propylene Glycol and Water[2]	0 to 200 °F (–18 to 93 °C)
Syltherm 800	–50 to 400 °F (–45 to 205 °C)

(1) Not suitable for vacuum service.
(2) Not compatible with Buna-N or Ethylene-Propylene O-ring material.

NOTE
When specifying Option Codes W4 and W6, sensing element operating temperatures are 32 to 200 °F (0 to 93 °C) for silicone fill and 32 to 160 °F (0 to 71 °C) for inert fill.

Storage
–60 to 185 °F (–51 to 85 °C).

Static Pressure Limits

Transmitters operate within specifications between the following limits:

Model 1151DP
0.5 psia to 2,000 psig (3.45 kPa to 13790 kPa).

Model 1151HP
0.5 psia to 4,500 psig (3.45 kPa to 31027 kPa).

Model 1151AP
0 psia to the URL.

Model 1151GP
0.5 psia (3.45 kPa) to the URL.

Model 1151LT
Limit is 0.5 psia (3.45 kPa) to the flange rating or sensor rating, whichever is lower.

Overpressure Limits

Transmitters withstand the following limits without damage:

Model 1151DP
0 psia to 2,000 psig (0 to 13790 kPa).

Model 1151HP
0 psia to 4,500 psig (0 to 31027 kPa).

Model 1151AP
0 psia to 2,000 psia (0 to 13790 kPa).

Model 1151GP:
Ranges 3–8: 0 psia to 2,000 psig (0 to 13790 kPa).
Range 9: 0 psia to 4,500 psig (31027 kPa).
Range 0: 0 psia to 7,500 psig (51710 kPa).

Model 1151LT:
Limit is 0 psia to the flange rating or sensor rating, whichever is lower.

TABLE 5-7. Model 1151LT and Level Flange Rating Limits.

Standard	Class	Carbon Steel Rating	Stainless Steel Rating
ANSI	150	285 psig[1]	275 psig[1]
ANSI	300	740 psig[1]	720 psig[1]
ANSI	600	1,480 psig[1]	1,440 psig[1]
DIN	PN 10–40	40 bar[2]	40 bar[2]
DIN	PN 10/16	16 bar[2]	16 bar[2]
DIN	PN 25/40	40 bar[2]	40 bar[2]

(1) At 100 °F (38 °C), the rating decreases with increasing temperature.
(2) At 248 °F (120 °C), the rating decreases with increasing temperature.

Burst Pressure Limit

All models: 10,000 psig (68.95 MPa) burst pressure on the flanges.

Humidity Limits

0 to 100% relative humidity.

Volumetric Displacement

Less than 0.01 in^3 (0.16 cm^3).

Failure Mode Alarm

When not in multidrop mode, self-diagnosis detects a gross transmitter failure, the analog signal will be driven below 3.9 mA or above 21 mA to alert the user. High or low alarm signal is user selectable.

Level	4–20 mA Saturation Value	4–20 mA Alarm Value
Low	3.9 mA	3.8 mA
High	20.8 mA	21.75 mA

Transmitter Security

Activating the transmitter security function prevents changes to the transmitter configuration, including local zero and span adjustments. Security is activated by an internal switch.

Overpressure Alarm

If the sensor detects a negative overpressure value, the analog signal will be driven to 3.9 mA. If the sensor detects a positive overpressure value, the analog signal is driven to 20.8 mA.

Damping

Numbers given are for silicone fill fluid at room temperature. The minimum time constant is 0.2 seconds (0.4 seconds for Range 3). Inert-filled sensor values would be slightly higher.

Output Code S:
Time constant is adjustable in 0.1 second increments from minimum to 16.0 seconds.

Turn-on Time

Maximum of 2.0 seconds with minimum damping. Low power output is within 0.2% of steady state value within 200 ms after application of power.

PERFORMANCE SPECIFICATIONS

(Zero-based calibrated ranges, reference conditions, silicone oil fill, 316 SST isolating diaphragms.)

Accuracy

Output Code S:
Ranges 3 through 8, DP and GP transmitters:
±0.1% of calibrated span for spans from 1:1 to 10:1 of URL.
Between 10:1 and 15:1 of URL,

$$\text{accuracy} = \pm\left[0.02\left(\frac{\text{URL}}{span}\right) - 0.1\right]\% \text{ of calibrated span}$$

All other ranges and transmitters:
±0.25% of calibrated span.

Output Code S, square root mode:

$$\pm\left[0.2 + 0.05 \times \frac{\text{URL}}{span}\right]\% \text{ of calibrated flow span}$$

Stability

Output Code S:
±0.1% of URL for six months for DP and GP Ranges 3 through 8. (±0.25% for all other ranges and transmitters.)

Temperature Effect

Output Code S [–20 to 185 °F (–29 to 85 °C)]:
For DP and GP transmitter Range 4 through 8:
Zero Error = ±0.2% URL per 100 °F (56 °C)
Total Error = ±(0.2% URL + 0.18% of calibrated span) per 100 °F; double the effect for other ranges and transmitters.

Static Pressure Effect

DP Transmitters:
Zero Error: ±0.25% of URL for 2,000 psi (13790 kPa) or ±0.5% for Range 3, correctable through rezeroing at line pressure.

Span Error: Correctable to ±0.25% of input reading per 1,000 psi (6895 kPa), or to ±0.5% for Range 3. For Output Code J, the span error is correctable to ±0.125% of output reading per 1,000 psi, or to ±0.25% for Range 3.

HP Transmitters:
Zero Error: ±2.0% of URL for 4,500 psi (31027 kPa), correctable through rezeroing at line pressure.

Span Error: Correctable to ±0.25% of input reading per 1,000 psi (6895 kPa).
For Output Code J, the span error is correctable to ±0.125% of output reading per 1,000 psi, or to ±0.25% for Range 3.

Vibration Effect

0.05% of URL per g to 200 Hz in any axis.

Power Supply Effect

Output Code S:
Less than 0.005% of output span per volt.

Load Effect

Output Code S:
No load effect other than the change in power supplied to the transmitter.

EMI/RFI Effect

Output shift of less than 0.1% of span when tested to SAMA PMC 33.1 from 20 to 1000 MHz and for field strengths up to 30 V/m (covers on).

Mounting Position Effect

Zero shift of up to 1 inH_2O (0.24 kPa) that can be calibrated out.

PHYSICAL SPECIFICATIONS

Electrical Connections

½–14 NPT conduit with screw terminals and integral test jacks compatible with miniature banana plugs (Pomona 2944, 3690, or equivalent). The communicator connections are fixed to the terminal block on smart transmitters.

Process Connections

Model 1151DP, HP, GP, AP
¼–18 NPT on 2.125-in. (54-mm) centers on flanges for Ranges 3, 4, and 5.

¼–18 NPT on 2.188-in. (56-mm) centers on flanges for Ranges 6 and 7.

¼–18 NPT on 2.250-in. (57-mm) centers on flanges for Range 8.

½–14 NPT on adaptors.

For Ranges 3, 4, and 5, flange adaptors can be rotated to give centers of 2.0 in. (51 mm), 2.125 in. (54 mm), or 2.250 in. (57 mm).

Model 1151LT
High pressure side: 2-, 3-, or 4-in., Class 150, 300 or 600 flange; 50, 80, or 100 mm, PN 40 or 10/16 flange.

Low pressure side: ¼–18 NPT on flange. ½–14 NPT on adapter.

Process Wetted Parts

Isolating Diaphragms
316L SST, Hastelloy C-276, Monel, gold-plated Monel, or Tantalum. See ordering table for availability per model type.

Drain/Vent Valves
316 SST, Hastelloy C-276, or Monel. See ordering table for availability per model type.

Process Flanges and Adaptors
Plated carbon steel, 316 SST, Hastelloy C, or Monel. See ordering table for availability per model type.

Wetted O-rings
Viton®(1) (other materials also available). With gold-plated Monel diaphragms (diaphragm Code _6), special fluorocarbon O-rings are supplied.

(1) For enhanced sealing performance below 0 °F, consult factory.

Model 1151LT Process Wetted Parts

Flanged Process Connection (Transmitter High Side)

Process diaphragms, including process gasket surface
316L SST, Hastelloy C-276, or Tantalum.

Extension
316 SST or Hastelloy C-276. Fits schedule 40 and 80 pipe.

Mounting Flange
Cadmium-plated CS or SST.

Reference Process Connection (Transmitter Low Side)

Isolating Diaphragms
316L SST, Hastelloy C-276, or tantalum.

Reference Flange and Adapter
CF-8M (Cast version of 316 SST, material per ASTM-A743).

Non-wetted Materials

Fill Fluid
Silicone oil or inert fill.

Bolts and Bolting Flange (GP and AP only)
Plated carbon steel.

Electronics Housing
Low-copper aluminium. NEMA 4X.

Cover O-rings
Buna-N.

Paint
Polyurethane.

Weight
12 lb (5.4 kg) for AP, DP, GP, and HP tranamitters, excluding options.

TABLE 5-8. Flange Weights with Model 1151LT Transmitter.

Flange[1]	Flush Mount	2-inch (50mm) Extension	4-inch (100mm) Extension	6-inch (150mm) Extension
2-in., Class 150	18 (8.2)	N/A	N/A	N/A
3-in., Class 150	23 (10.4)	25 (11.3)	26 (11.8)	27 (12.3)
4-in., Class 150	29 (13.2)	32 (14.5)	34 (15.4)	36 (16.3)
2-in., Class 300	20 (9.1)	N/A	N/A	N/A
3-in., Class 300	28 (12.7)	30 (13.6)	31 (14.1)	32 (14.5)
4-in., Class 300	38 (17.2)	41 (18.6)	43 (19.5)	45 (20.4)
2-in., Class 600	22 (10.0)	N/A	N/A	N/A
3-in., Class 600	31 (14.1)	33 (15.0)	34 (15.4)	35 (15.9)
DN 50, PN10-40	20 (9.1)	N/A	N/A	N/A
DN 80, PN 25/40	25 (11.3)	27 (12.3)	28 (12.7)	29 (13.2)
DN 100, PN 10/16 DN	25 (11.3)	28 (12.7)	30 (13.6)	32 (14.5)
100, PN 25/40	29 (13.2)	32 (14.5)	34 (15.4)	36 (16.3)

(1) Stainless steel flange weights are listed.

ORDERING INFORMATION

TABLE 5-9. Model 1151 Differential, High Line, Gage and Absolute Pressure Transmitters.

Model	Transmitter Type (select one)	DP	HP	GP	AP
1151DP	Differential Pressure Transmitter	•	—	—	—
1151HP	Differential Pressure Transmitter for High Line Pressures	—	•	—	—
1151GP	Gage Pressure Transmitter	—	—	•	—
1151AP	Absolute Pressure Transmitter	—	—	—	•

Key: • Applicable; — Not applicable

Code	Pressure Ranges (URL) (select one)—For Rangeability, see below	DP	HP	GP	AP
3	30 inH$_2$O (7.46 kPa)	•	—	•	—
4	150 inH$_2$O (37.3 kPa)	•	•	•	•
5	750 inH$_2$O (186.4 kPa)	•	•	•	•
6	100 psi (689.5 kPa)	•	•	•	•
7	300 psi (2068 kPa)	•	•	•	•
8	1,000 psi (6895 kPa)	•	—	•	•
9	3,000 psi (20684 kPa)	—	—	•	—
0	6,000 psi (41369 kPa)	—	—	•	—

Rangeability

Output Code	Min.Span
S (DP and GP, SST, Range 3–5; HP, SST, Range 4–7)	URL/15
S (all others)	URL/6
E, G, J	URL/6
L	URL/1.1
M	URL/2

Code	Transmitter Output (select one)	DP	HP	GP	AP
S	4–20 mA/Digital, Smart/Variable Damping	•	•	•	•
E	4–20 mA, Linear, Analog/Variable Damping	•	•	•	•
G	10–50 mA, Linear, Analog/Variable Damping	•	•	•	•
J	4–20 mA, Square Root, Analog/Variable Damping	•	•	—	—
L	0.8 to 3.2 V, Linear, Low Power/Fixed Damping	•	•	•	•
M	1 to 5 V, Linear, Low Power/Fixed Damping	•	•	•	•

Code	MATERIALS OF CONSTRUCTION[1] Flanges/Adapters	Drain/Vents	Diaphragms	Fill Fluid	DP	HP	GP[2]	AP
52	Nickel-plated Carbon Steel	316 SST	316L SST	Silicone	•	•	•	•
53	Nickel-plated Carbon Steel	316 SST	*Hastelloy C-276*	Silicone	•	•	•	•
54	Nickel-plated Carbon Steel	316 SST	*Monel*	Silicone	•	•	•	•
55	Nickel-plated Carbon Steel	316 SST	Tantalum	Silicone	•	—	•	—
56	Nickel-plated Carbon Steel	316 SST	Gold-plated *Monel*	Silicone	•	—	•	—
12	Cadmium-plated Carbon Steel	316 SST	316L SST	Silicone	•	•	•	•
22	316 SST	316 SST	316L SST	Silicone	•	•	•	•
23	316 SST	316 SST	*Hastelloy C-276*	Silicone	•	•	•	•
24	316 SST	316 SST	*Monel*	Silicone	•	•	•	•
25	316 SST	316 SST	Tantalum	Silicone	•	—	•	—
26	316 SST	316 SST	Gold-plated *Monel*	Silicone	•	—	•	—
33[3]	*Hastelloy C*	*Hastelloy C-276*	*Hastelloy C-276*	Silicone	•	•	•	•
34	*Hastelloy C*	*Hastelloy C-276*	*Monel*	Silicone	•	—	•	—
35	*Hastelloy C*	*Hastelloy C-276*	Tantalum	Silicone	•	—	•	—

(1) Bolts and conduit plugs are plated carbon steel.
(2) On GP and AP transmitters, the low-side flange is plated carbon steel. For a stainless-steel low-side flange, order process connection Option Code D6.
(3) These selections meet NACE material recommendations per MR 01-75.

TABLE 5-9. (continued).

Code	MATERIALS OF CONSTRUCTION[1] Flanges/Adapters	Drain/Vents	Diaphragms	Fill Fluid	DP	HP	GP[2]	AP
36	*Hastelloy C*	*Hastelloy C-276*	Gold-plated *Monel*	Silicone	•	—	•	—
43	*Monel*	*Monel*	*Hastelloy C-276*	Silicone	•	•	•	•
44	*Monel*	*Monel*	*Monel*	Silicone	•	•	•	•
45	*Monel*	*Monel*	Tantalum	Silicone	•	—	•	—
46	*Monel*	*Monel*	Gold-plated *Monel*	Silicone	•	—	•	—
73[3]	316 SST	*Hastelloy C-276*	*Hastelloy C-276*	Silicone	•	•	•	•
83[3]	Nickel-plated Carbon Steel	*Hastelloy C-276*	*Hastelloy C-276*	Silicone	•	•	•	•
5A	Nickel-plated Carbon Steel	316 SST	316L SST	Inert	•	—	•	—
5B	Nickel-plated Carbon Steel	316 SST	*Hastelloy C-276*	Inert	•	—	•	—
5C	Nickel-plated Carbon Steel	316 SST	*Monel*	Inert	•	—	•	—
5D	Nickel-plated Carbon Steel	316 SST	Tantalum	Inert	•	—	•	—
1A	Cadmium-plated Carbon Steel	316 SST	316L SST	Inert	•	—	•	—
2A	316 SST	316 SST	316L SST	Inert	•	—	•	—
2B	316 SST	316 SST	*Hastelloy C-276*	Inert	•	—	•	—
2D	316 SST	316 SST	Tantalum	Inert	•	—	•	—
3B	*Hastelloy C*	*Hastelloy C-276*	*Hastelloy C-276*	Inert	•	—	•	—
3D	*Hastelloy C*	*Hastelloy C-276*	Tantalum	Inert	•	—	•	—
4B	*Monel*	*Monel*	*Hastelloy C-276*	Inert	•	—	•	—
4C	*Monel*	*Monel*	*Monel*	Inert	•	—	•	—
4D	*Monel*	*Monel*	Tantalum	Inert	•	—	•	—
7B[3]	316 SST	*Hastelloy C-276*	*Hastelloy C-276*	Inert	•	—	•	—
8B[3]	Nickel-plated Carbon Steel	*Hastelloy C-276*	*Hastelloy C-276*	Inert	•	—	•	—

(1) Bolts and conduit plugs are plated carbon steel.
(2) On GP and AP transmitters, the low-side flange is plated carbon steel. For a stainless-steel low-side flange, order process connections Option Code D6.
(3) These selections meet NACE material recommendations per MR 01-75.

TABLE 5-9. (continued).

Code	Mounting Brackets (optional - select one)	DP	HP	GP	AP
B1	Bracket, 2-in. Pipe Mount	•	•	•	•
B2	Bracket, Panel Mount	•	•	•	•
B3	Bracket, Flat, 2-in. Pipe Mount	•	•	•	•
B4	B1 Bracket w/Series 316 SST Bolts	•	•	•	•
B5	B2 Bracket w/Series 316 SST Bolts	•	•	•	•
B6	B3 Bracket w/Series 316 SST Bolts	•	•	•	•
B7	316 SST B1 Bracket with 316 SST Bolts	•	•	•	•
B9	316 SST B3 Bracket with 316 SST Bolts	•	•	•	•

Code	Meters (optional - select one)	DP	HP	GP	AP
M1[1]	Analog Scale, Linear Meter, 0–100%	•	•	•	•
M2[2]	Analog Scale, Square Root Meter, 0–100% Flow	•	•	—	—
M3[1]	Analog Scale, Linear Meter, Special Scale	•	•	•	•
M4[1]	LCD Meter, Linear Meter, 0–100%, User Selectable	•	•	•	•
M6[2]	Analog Scale, Square Root Meter, 1–10√	•	•	—	—
M7[3]	LCD Meter, Linear Meter, Special Configuration	•	•	•	•
M8[4]	LCD Meter Square Root Meter, 0–100% Flow	•	•	—	—
M9[4]	LCD Meter, Square Root Meter, 0–10√	•	•	—	—

(1) Not available with Output Codes I, or M, or Option Codes Zx, V2, or V3.
(2) Not available with Output Codes J, L, M, or Option Codes Zx, V2, or V3.
(3) Not available with Output Codes G, I, L, M, or Option Codes Zx, V2, or V3.
(4) Not available with Output Codes G, J, L, M, or Option Codes Zx, V2, or V3.

TABLE 5-9. (continued).

Code	Certifications (optional - select one)	DP	HP	GP	AP
E6	Canadian Standards Association (CSA) Explosion-Proof Approval	•	•	•	•
I5[1]	Factory Mutual (FM) Non-incendive and Intrinsic Safety Approval	•	•	•	•
K5	Factory Mutual (FM) Explosion-Proof and Intrinsic Safety Combination	•	•	•	•
I6[1]	Canadian Standards Association (CSA) Intrinsic Safety Approval	•	•	•	•
C6[2]	Industry and Science Canada (ISC) Approval (Available in Canada Only)	•	•	•	•
C8[1]	Combination of I6 and E6; CSA Explosion-Proof and Intrinsic Safety Approval (Requires 42.4 V dc max. power supply)	•	•	•	•
K6	CSA/CENELEC Explosion-Proof and Intrinsic Safety Approval	•	•	•	•
E4	Japanese Industrial Standards (JIS) Flameproof Certification	•	•	•	•
E7	Standards Association of Australia (SAA) Flameproof Certification	•	•	•	•
E8	CESI/CENELEC Flameproof Certification	•	•	•	•
I1[3]	BASEEFA Intrinsic Safety Certification	•	•	•	•
I7[4]	Standards Association of Australia (SAA) Intrinsic Safety Certification	•	•	•	•
I8[5]	CESI/CENELEC Flameproof Certification	•	•	•	•
N1[6]	BASEEFA Type N Certification	•	•	•	•
N7	Standards Association of Australia (SAA) Nonincendive Safety Approval	•	•	•	•
IC[3]	Schweizerischer Elektrochnischer Verein (SEV) Intrinsic Safety Certification	•	•	•	•
Q4	Calibration Data Sheet	•	•	•	•
Q8[7]	Material Traceability per EN 10204 3.1B	•	•	•	•
		•	•	•	•

NOTE: FM explosion-proof approval is standard

Code	Housing	DP	HP	GP	AP
H1[8]	SST Non-wetted Parts on Transmitter without Meter	•	•	•	•
H2[8]	SST Non-wetted Parts on Transmitter with Meter	•	•	•	•
H3	SST Housing, Covers, Conduit Plug, Lock-nut, without Meter	•	•	•	•
H4	SST Housing, Covers, Conduit Plug, Lock-nut, with Meter	•	•	•	•
C1	PG 13.5 Conduit Threads (Available in Germany Only)	•	•	•	•
C2	M20 Conduit Threads (Available in Germany Only)	•	•	•	•
J1	G½ Conduit Threads	•	•	•	•

Code	Terminal Blocks	DP	HP	GP	AP
R1	Integral Transient Protection (Only available with Option Code S and E electronics)	•	•	•	•

Code	Bolts for Flanges and Adapters (optional - select one)	DP	HP	GP	AP
L3	ASTM A193-B7 Flange and Adapter Bolts	•	•	•	•
L4	316 SST Flange and Adapter Bolts	•	•	•	•
L5	ASTM A193-B7M Flange and Adapter Bolts	•	•	•	•

(1) Not available with Output Code G or Option Code Zx.
(2) Not available with Option Codes M1–M9.
(3) Not available with Output Codes G, J, L, M, or Option Code Zx.
(4) Not available with Output Code G or Option Code Zx.
(5) Not available with Output Codes G, J, L, M, S, or Option Code Zx.
(6) Not available with Output Codes G, L, M, or Option Code Zx.
(7) This option is available for the transmitter flange and adapters.
(8) Option includes SST housing, covers, conduit plug, locknut, L4 bolting, and D6 low side blank flange for GP and AP transmitters. Option Codes L4 and D6 parts are included with housing Option Codes H1 and H2.

TABLE 5-9. (continued).

Code	Process Connections (optional[1])	DP	HP	GP	AP
D1	Side Drain/Vent, Top — 316 SST	•	•	•	•
	Hastelloy C-276	•	•	•	•
	Monel	•	•	•	•
D2	Side Drain/Vent, Bottom — 316 SST	•	•	•	•
	Hastelloy C-276	•	•	•	•
	Monel	•	•	•	•
D3	Process Adapters Deleted — 316 SST	•	•	•	•
	Hastelloy C	•	•	•	•
	Monel	•	•	•	•
D4	Conformance to DIN 19213 and DIN 50049 3.1B Ranges 3, 4, 5 (Available in Germany Only)	•	•	•	•
D5	Conformance to DIN 19213 and DIN 50049 3.1B Ranges 6, 7, 8, without ¼ NPT Threads or Drain/Vent Valve Connections (Available in Germany Only)	•	•	•	•
D6	316 SST Low Side Blank Flange	—	—	•	•
D9	JIS Process Connection–RC ¼ Flange with RC ½ Flange Adapter — Carbon Steel	•	•	•	•
	316 SST	•	•	•	•
	Hastelloy C	•	•	•	•
	Monel	•	•	•	•
G1	DIN Spacing (Single Entry Port, No Side V/D Hole Flange)	•	•	•	•
G2	DIN Spacing (Single Entry Port, Two Side V/D Hole Flange)	•	•	•	•
G3	DIN Spacing (Dual Entry Port, No Side V/D Hole Flange)	•	•	•	•
G4	DIN Spacing (Dual Entry Port, One Top Side V/D Hole Flange)	•	•	•	•
G5	DIN Spacing (Dual Entry Port, One Bottom Side V/D Hole Flange)	•	•	•	•
G6	DIN Spacing (Dual Entry Port, Two Side V/D Hole Flange)	•	•	•	•
K1[2]	*Kynar* insert, ½–16 NPT	•	—	•	•
K2[2]	*Kynar* insert, ½–14 NPT	•	—	•	•
S1[3]	Attachment of One Remote Seal - See PDS 00813-0100-4016	•	—	•	—
S2[3]	Attachment of Two Remote Seals - See PDS 00813-0100-4016	•	—	—	—
S4[4]	Attachment of Integral Orifice Assembly - See PDS 00813-0100-4686	•	•	—	—

(1) Allowable combinations are: D1, D3, D6; D2, D3, D6; and D6, S1.
(2) The maximum working pressure on this option is 300 psig. Available only with materials of construction Option Codes 1x or 2x.
(3) This option may only be used on Ranges 4–8.
(4) This option has a maximum static pressure rating of 3,000 psi, and is available for factory assembly only without associated piping and is available only for Ranges 2, 3, 4, and 5.

TABLE 5-9. (continued).

Code	Wetted O-ring Material	DP	HP	GP	AP
W2	Buna-N	•	•	•	•
W3	Ethylene-Propylene	•	•	•	•
W4	*Aflas*	•	•	•	•
W5[1]	Spring-loaded *Teflon*	•	—	•	•
Code	**Procedures**	**DP**	**HP**	**GP**	**AP**
C9[7]	Software Configuration	•	•	•	•
P1[3]	Hydrostatic Testing, 150% Maximum Working Pressure	•	•	•	•
P2[4]	Cleaning for Special Service	•	•	•	•
P3	Cleaning for <1 PPM Chlorine/Fluorine	•	•	—	—
P4	Calibrate at Line Pressure	•	•	—	•
P5	Calibrate at Specific Temperature	•	•	•	•
P7[5]	Improved Temperature Coefficient	•	•	•	—
P8[6]	Calibrate to 0.1% Accuracy	•	•	•	—
Code	**Outputs**	**DP**	**HP**	**GP**	**AP**
V1[7]	Reverse Output	—	—	•	—
V2[8]	4–20 mV Test Signal	•	•	•	•
V3[8]	20–100 mV Test Signal	•	•	•	•
Z1[9]	4-wire, 0–20 mA Output	•	•	•	•
Z2[9]	4-wire, 0–16 mA Output	•	•	•	•
Z3[9]	4-wire, 0–10 mA Output	•	•	•	•

Typical Model Number: 1151DP 4 S 52 B3 M1

(1) Contains a Hastelloy spring that is wetted by the process; consult factory for Teflon O-ring without a spring.
(2) Available with Output Code S only.
(3) Hydrostatic testing for Range 0, 125% maximum working pressure.
(4) Fluorotube® grease on wetted O-rings.
(5) Not available on Range 10; limited to 1,500 psi on Range 9; not applicable with Output Code S.
(6) Available only with stainless steel isolators and for span of 10 inH2O and greater; not applicable with Output Code S; available only with Output Codes E, G, L, or M; not available on AP or DR transmitters.
(7) Reverse output option is not needed with smart electronics; configured via HART-based communicator.
(8) Not available with Output Codes L or M.
(9) Not available with Option Codes Mx, Vx, Ix, or Ex, or Output Codes G, L, M, or S.

TABLE 5-10. Model 1151LT Flange Mounted Liquid Level Transmitter.

Model	Product Description
1151LT	Alphaline Flange-Mounted Liquid Level Transmitter

Code	Range	Rangeability	
		Output Code	Min. Span
4	0–25 to 0–150 inH2O (0–635 to 0–3,810 mmH2O)	S	URL/15
5	0–125 to 0–750 inH2O (0–3,175 to 0–19,050 mmH2O)	E, G	URL/6
6	0–471 to 0–2,770 inH2O (0–11.96 to 0–70.36 mmH2O)		

Code	Output
S	1151 Smart 4–20 mA dc Electronics (see PDS 00813-0100-4593)
E	4–20 mA dc, with Adjustable Damping
G	10–50 mA dc, with Adjustable Damping

Code	Size	Material	Extension Length
G0	2 in./DN 50	316L SST	Flush Mount Only
H0	2 in./DN 50	*Hastelloy C-276*	Flush Mount Only
J0	2 in./DN 50	Tantalum	Flush Mount Only
A0	3 in./DN 80	316L SST	Flush Mount
A2	3 in./DN 80	316L SST	2 in./50 mm
A4	3 in./DN 80	316L SST	4 in./100 mm
A6	3 in./DN 80	316L SST	6 in./150 mm
B0	4 in./DN 100	316L SST	Flush Mount
B2	4 in./DN 100	316L SST	2 in./50 mm
B4	4 in./DN 100	316L SST	4 in./100 mm
B6	4 in./DN 100	316L SST	6 in./150 mm
C0	3 in./DN 80	*Hastelloy C-276*	Flush Mount
C2	3 in./DN 80	*Hastelloy C-276*	2 in./50 mm
C4	3 in./DN 80	*Hastelloy C-276*	4 in./100 mm
C6	3 in./DN 80	*Hastelloy C-276*	6 in./150 mm
D0	4 in./DN 100	*Hastelloy C-276*	Flush Mount
D2	4 in./DN 100	*Hastelloy C-276*	2 in./50 mm
D4	4 in./DN 100	*Hastelloy C-276*	4 in./100 mm
D6	4 in./DN 100	*Hastelloy C-276*	6 in./150 mm
E0	3 in./DN 80	Tantalum	Flush Mount Only
F0	4 in./DN 100	Tantalum	Flush Mount Only

When specifying these option codes, a lower housing must be selected from the flushing connection options Table 5-11.

NOTE
Extension diameters are sized to fit Schedule 80 pipe. Consult factory for Schedule 40 pipe.

Code	MOUNTING FLANGE Size	Rating		Material	Applicable with these High Pressure Side Diaphragm Sizes
M	2 in.	Class 150	ANSI	CS	2 in./DN 50
A	3 in.	Class 150		CS	3 in./DN 80
B	4 in.	Class 150		CS	4 in./DN 100
N	2 in.	Class 300		CS	2 in./DN 50
C	3 in.	Class 300		CS	3 in./DN 80
D	4 in.	Class 300		CS	4 in./DN 100
P	2 in.	Class 600		CS	2 in./DN 50
E	3 in.	Class 600		CS	3 in./DN 80
X	2 in.	Class 150		SST	2 in./DN 50
F	3 in.	Class 150		SST	3 in./DN 80
G	4 in.	Class 150		SST	4 in./DN 100
Y	2 in.	Class 300		SST	2 in./DN 50
H	3 in.	Class 300		SST	3 in./DN 80
J	4 in.	Class 300		SST	4 in./DN 100
Z	2 in.	Class 600		SST	2 in./DN 50
L	3 in.	Class 600		SST	3 in./DN 80
Q	DN 50	PN 10-40	DIN	CS	2 in./DN 50
R	DN 80	PN 40		CS	3 in./DN 80
S	DN 100	PN 40		CS	4 in./DN 100
V	DN 100	PN 10/16		CS	4 in./DN 100
K	DN 50	PN 10-40		SST	2 in./DN 50
T	DN 80	PN 40		SST	3 in./DN 80
U	DN 100	PN 40		SST	4 in./DN 100
W	DN 100	PN 10/16		SST	4 in./DN 100

TABLE 5-10. (continued).

Code	SENSOR MODULE AND LOW-SIDE MATERIALS OF CONSTRUCTION Low-Side Flange and Adapter	Drain/Vent Valves	Low-Side Isolator Diaphragm	Low-Side Fluid Fill
52	Nickel-plated CS	316 SST	316L SST	Silicone
12	Cadmium-plated CS	316 SST	316L SST	Silicone
55	Nickel-plated CS	316 SST	Tantalum	Silicone
22	316 SST	316 SST	316L SST	Silicone
23	316 SST	316 SST	*Hastelloy C-276*	Silicone
25	316 SST	316 SST	Tantalum	Silicone
33	*Hastelloy C*	*Hastelloy C-276*	*Hastelloy C-276*	Silicone
35	*Hastelloy C*	Hastelloy *C-276*	Tantalum	Silicone
1A	Cadmium-plated CS	316 SST	316L SST	Inert
5D	Nickel-plated CS	316 SST	Tantalum	Inert
2A	316 SST	316 SST	316L SST	Inert
2B	316 SST	316 SST	*Hastelloy C-276*	Inert
2D	316 SST	316 SST	Tantalum	Inert
3B	*Hastelloy C*	*Hastelloy C-276*	*Hastelloy C-276*	Inert
3D	*Hastelloy C*	*Hastelloy C-276*	Tantalum	Inert

Code	Process Fill—High Pressure Side	Temperature Limits
A	*Syltherm* XLT	–100 to 300 °F (–73 to 135 °C)
C	*D. C.* Silicone 704	60 to 400 °F (15 to 205 °C)
D	*D. C.* Silicone 200	–40 to 400 °F (–40 to 205 °C)
F	Inert	–50 to 350 °F (–45 to 177 °C)
G	Glycerin and Water	0 to 200 °F (–17 to 93 °C)
N	*Neobee M-20*	0 to 400 °F (–17 to 205 °C)
P	Propylene Glycol and Water	0 to 200 °F (–17 to 93 °C)
S	*Syltherm* 800	–50 to 400 °F (–45 to 205 °C)

TABLE 5-10. (continued).

Code	Options (see complete approvals descriptions)
S1[7]	One Remote Seal Selected from PDS 00813-0100-4016
	METERS
M1[5]	Linear Meter, 0–100% Scale
M3[6]	Special Scale Meter, Specify Range
M4[5]	LCD Meter, 0–100%
M7[6]	LCD Meter, Linear, Special Configuration
	HAZARDOUS LOCATIONS CERTIFICATIONS
E6	Canadian Standards Association (CSA) Explosion-Proof Approval
I5[7]	Factory Mutual (FM) Non-incendive and Intrinsic Safety Approval
K5	Factory Mutual (FM) Explosion-Proof and Intrinsic Safety Combination
I6[1]	Canadian Standards Association (CSA) Intrinsic Safety Approval
C6[4]	Industry and Science Canada (ISC) Approval (Available in Canada Only)
C8[1]	Combination of I6 and E6; CSA Explosion-Proof and Intrinsic Safety Approval (Requires 42.4 V dc max. power supply)
K6	CSA/CENELEC Explosion-Proof and Intrinsic Safety Approval
E4	Japanese Industrial Standards (JIS) Flameproof Certification
E7	Standards Association of Australia (SAA) Flameproof Certification
E8	CESI/CENELEC Flameproof Certification
I1[5]	BASEEFA Intrinsic Safety Certification
I7[1]	Standards Association of Australia (SAA) Intrinsic Safety Certification
I8[4]	CESI/CENELEC Flameproof Certification
N1[7]	BASEEFA Type N Certification
N7	Standards Association of Australia (SAA) Nonincendive Safety Approval
IC[7]	Schweizerischer Elektrochnischer Verein (SEV) Intrinsic Safety Certification
	OTHER OPTIONS
W5	Copper O-ring for Vacuum Service (Nonwetted)
Q4	Calibration Data Sheet
Q8[3]	Material Traceability per EN 10204 3.1B
V1	Reverse Output
V2	4–20 mV Test Signal
V3	20–100 mV Test Signal
Z1[5]	4-wire, 0–20 mA Output
Z2[5]	4-wire, 0–16 mA Output
Z3[5]	4-wire, 0–10 mA Output
F_	Select One Code from Flushing Connections Lower Housing Option Table 5-11.

NOTE
FM explosion-proof approval is standard.

TABLE 5-11. Flushing Connections Lower Housing Options. • available — not available

Code	Flushing Connection Ring Material (Lower Housing)	Flushing Connections	Size	Diaphragm Size 2-in.	3-in.	4-in.
F1	SST	1	½-18 NPT	•	•	•
F2	SST	2	¼-18 NPT	•	•	•
F3[1]	*Hastelloy C-276*	1	¼-18 NPT	•	•	•
F4[1]	*Hastelloy C-276*	2	¼-18 NPT	•	•	•
FA	SST	0	—	•	—	—
FC[2]	*Hastelloy C-276*	0	—	•	—	—
F7	SST	1	½-14 NPT	•	•	•
F8	SST	2	½-14 NPT	•	•	•
F9	*Hastelloy C-276*	1	½-14 NPT	•	•	•
F0	*Hastelloy C-276*	2	½-14 NPT	•	•	•

(1) Not available with high pressure side Option Codes A0, B0, and G0.
(2) Not available with high pressure side Option Code G0.

Typical Model Number: 1151LT 4 S A0 A 52 D F1

(1) For welded capillary assemblies, order sensor module and low-side materials of construction Option Code 22 (refer to PDS 00813-0100-4016 for more information).
(2) Not available with Option Codes Zx, V2, or V3.
(3) Not available with Output Code G or Option Code Zx.
(4) Not available with Option Codes M1–M9.
(5) Not available with Output Codes G, J, L, M, or Option Code Zx.
(6) Not available with Output Codes G, J, L, M, S, or Option Code Zx.
(7) Not available with Output Codes G, L, M, or Option Code Zx.
(8) Available for the diaphragm, upper housing, flange, adapter, extension, and lower housing.
(9) Not available with Option Codes Mx, Vx, Ix, or Ex, or Output Codes G, L, M, or S.

General Notes

The listed prices are dimensionless. Apply the appropriate multiplication factor to calculate the price in a specific currency. All prices are F.O.B. our plant at Chanhassen, Minnesota. The prices are exclusive of all sales and use taxes.

Minimum order is 600 (dimensionless price).

Tagging

The transmitter will be tagged, at no charge, in accordance with customer requirements. All tags are stainless steel. The standard tag is wired to the transmitter. Tag character height is 0.125 in. (0.318 cm). A permanently attached tag is available upon request.

Calibration

Transmitters are factory calibrated to customer's specified range. If calibration is not specified, the transmitters are calibrated at maximum range. Calibration is performed at ambient temperature and pressure.

Standard Accessories

All models are shipped with flange adapters, drain/vent valves, and one instruction manual per shipment.

Optional Three-valve Manifolds

Part No. 01166-0073-0001:
3-valve manifold, carbon steel for DP (Ranges 6–9), HP (Ranges 6–7). (Anderson, Greenwood & Co., M4AVIC-TR-68).

Part No. 01151-0150-0002:
3-valve manifold, 316 SST with carbon steel bolts for DP (Ranges 6–9), HP (Ranges 6–7). (Anderson, Greenwood & Co., M4AVIC-TR-68).

Parts List

Item numbers are references to figure callouts (page 5-26).

TABLE 5-12. Model 1151 DP, HP, GP, and AP Alphaline Pressure Transmitters.

Electronics – One spare part recommended for every 25 transmitters.		
Part Description	**Item No.**	**Part Number**
9 **Smart Output Code**		
Smart Retrofit Kit[1]		01151-0935-0001
Smart Transmitter Electronics[2]	24	01151-0934-0204
Board Spacer Kit (pkg of 12)	25	01151-0813-0001
Terminal Eyelet Kit (pkg of 12)		01151-0814-0001
Standoff Kit (pkg of 12)		01151-0815-0001
Cover[2]		01151-1045-0001
Cover O-ring (pkg of 12)		01151-0033-0003
Sensor Modules (Silicone Fill)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Range 3 DP, GP (30 in H_2O)	19	
316L SST		01151-0011-0032
Hastelloy C-276		01151-0011-0033
Monel		01151-0011-0034
Tantalum		01151-0011-0035
Gold-plated *Monel*		01151-0011-0036
Range 4 DP, GP (150 in H_2O)	19	
316L SST		01151-0011-0042
Hastelloy C-276		01151-0011-0043
Monel		01151-0011-0044
Tantalum		01151-0011-0045
Gold-plated *Monel*		01151-0011-0046
Range 4 HP (150 in H_2O)	19	
316L SST		01151-0112-0042
Hastelloy C-276		01151-0112-0043
Monel		01151-0112-0044
Range 4 AP (11 in H_gA)	19	
316L SST		01151-0054-0042
Hastelloy C-276		01151-0054-0043
Monel		01151-0054-0044

(1) Kit contains enough parts for one transmitter and includes the smart transmitter electronics, board spacers, terminal eyelets, standoffs, cover, and cover O-ring.
(2) Package contains quantity required for one transmitter.

TABLE 5-12. (continued).

Sensor Modules (Silicone Fill)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Range 5 DP, GP (750 in H_2O)	19	
316L SST		01151-0011-0052
Hastelloy C-276		01151-0011-0053
Monel		01151-0011-0054
Tantalum		01151-0011-0055
Gold-plated *Monel*		01151-0011-0056
Range 5 HP (750 in H_2O)	19	
316L SST		01151-0112-0052
Hastelloy C-276		01151-0112-0053
Monel		01151-0112-0054
Range 5 AP (55 in H_gA)	19	
316L SST		01151-0054-0052
Hastelloy C-276		01151-0054-0053
Monel		01151-0054-0054
Range 6 DP (100 psid)	19	
316L SST		01151-0041-0062
Hastelloy C-276		01151-0041-0063
Monel		01151-0041-0064
Tantalum		01151-0041-0065
Gold-plated *Monel*		01151-0041-0066
Range 6 GP (100 psig)	19	
316L SST		01151-0041-0162
Hastelloy C-276		01151-0041-0163
Monel		01151-0041-0164
Tantalum		01151-0041-0165
Gold-plated *Monel*		01151-0041-0166
Range 6 HP (100 psid)	19	
316L SST		01151-0112-0062
Hastelloy C-276		01151-0112-0063
Monel		01151-0112-0064
Range 6 AP (100 psia)	19	
316L SST		01151-0054-0062
Hastelloy C-276		01151-0054-0063
Monel		01151-0054-0064
Range 7 DP (300 psid)	19	
316L SST		01151-0041-0072
Hastelloy C-276		01151-0041-0073
Monel		01151-0041-0074
Tantalum		01151-0041-0075
Gold-plated *Monel*		01151-0041-0076
Range 7 GP (300 psig)	19	
316L SST		01151-0041-0172
Hastelloy C-276		01151-0041-0173
Monel		01151-0041-0174
Tantalum		01151-0041-0175
Gold-plated *Monel*		01151-0041-0176
Range 7 HP (300 psid)	19	
316L SST		01151-0112-0072
Hastelloy C-276		01151-0112-0073
Monel		01151-0112-0074
Range 7 AP (300 psia)	19	
316L SST		01151-0054-0072
Hastelloy C-276		01151-0054-0073
Monel		01151-0054-0074
Range 8 DP (1,000 psid)	19	
316L SST		01151-0041-0082
Hastelloy C-276		01151-0041-0083
Monel		01151-0041-0084
Tantalum		01151-0041-0085
Gold-plated *Monel*		01151-0041-0086

TABLE 5-12. (continued).

Sensor Modules (Silicone Fill)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Range 8 GP (1,000 psig)	19	
316L SST		01151-0041-0182
Hastelloy C-276		01151-0041-0183
Monel		01151-0041-0184
Tantalum		01151-0041-0185
Gold-plated *Monel*		01151-0041-0186
Range 8 AP (1,000 psia)	19	
316L SST		01151-0054-0082
Hastelloy C-276		01151-0054-0083
Monel		01151-0054-0084
Range 9 GP (3,000 psig)	19	
316L SST		01151-0112-0092
Hastelloy C-276		01151-0112-0093
Monel		01151-0112-0094
Range 10 GP (6,000 psig)	19	
316L SST		01151-0112-0002
Hastelloy C-276		01151-0112-0003
Monel		01151-0112-0004
Sensor Modules (Inert Fill)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Range 3 DP, GP (30 in H_2O)	19	
316L SST		01151-0230-0032
Hastelloy C-276		01151-0230-0033
Monel		01151-0230-0034
Tantalum		01151-0230-0035
Gold-plated *Monel*		01151-0230-0036
Range 4 DP, GP (150 in H_2O)	19	
316L SST		01151-0230-0042
Hastelloy C-276		01151-0230-0043
Monel		01151-0230-0044
Tantalum		01151-0230-0045
Gold-plated *Monel*		01151-0230-0046
Range 5 DP, GP (750 in H_2O)	19	
316L SST		01151-0230-0052
Hastelloy C-276		01151-0230-0053
Monel		01151-0230-0054
Tantalum		01151-0230-0055
Gold-plated *Monel*		01151-0230-0056
Range 6 DP (100 psid)	19	
316L SST		01151-0230-0062
Hastelloy C-276		01151-0230-0063
Monel		01151-0230-0064
Tantalum		01151-0230-0065
Range 6 GP (100 psig)	19	
316L SST		01151-0230-0162
Hastelloy C-276		01151-0230-0163
Monel		01151-0230-0164
Tantalum		01151-0230-0165
Range 7 DP (300 psid)	19	
316L SST		01151-0230-0072
Hastelloy C-276		01151-0230-0073
Monel		01151-0230-0074
Tantalum		01151-0230-0075

TABLE 5-12. (continued).

Sensor Modules (Inert Fill)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Range 7 GP (300 psig)	19	
316L SST		01151-0230-0172
Hastelloy C-276		01151-0230-0173
Monel		01151-0230-0174
Tantalum		01151-0230-0175
Range 8 DP (1,000 in psid)	19	
316L SST		01151-0230-0082
Hastelloy C-276		01151-0230-0083
Monel		01151-0230-0084
Tantalum		01151-0230-0085
Range 8 GP (1,000 in psig)	19	
316L SST		01151-0230-0182
Hastelloy C-276		01151-0230-0183
Monel		01151-0230-0184
Tantalum		01151-0230-0185
Housings, Covers, Flanges, And Valves – One spare part recommended for every 25 transmitters.		
Part Description	**Item No.**	**Part Number**
Electronics Housing	7	01151-0050-0007
Electronics Housing for R1 Option without Terminal Block		01151-2594-0001
Transient Terminal Block Assembly (Optional R1)		01151-2591-0003
Electronics Cover	1	01151-1045-0001
Process Flange	17	
Nickel-plated Carbon Steel		01151-0236-0005
Cadmium-plated Carbon Steel		01151-0236-0001
316 SST		01151-0213-0002
Hastelloy C-276		01151-0213-0004
Monel		01151-0213-0003
Process Flange for Side Drain/Vent Valve		
Nickel-plated Carbon Steel		01151-0236-0015
Cadmium-plated Carbon Steel		01151-0236-0011
316 SST		01151-0213-0012
Hastelloy C-276		01151-0213-0014
Monel		01151-0213-0013
Blank Flange	23	
Cadmium-plated Carbon Steel		90043-0046-0001
Flange Adapter	21	
Nickel-plated Carbon Steel		01151-0211-0005
Cadmium-plated Carbon Steel		90001-0033-0001
316 SST		01151-0211-0002
Hastelloy C-276		01151-0211-0004
Monel		01151-0211-0003
DP and HP Valve Stem and Seat, 316 SST[1]	14,15	01151-0028-0022
GP and AP Valve Stem and Seat, 316 SST[1]	14,15	01151-0028-0012
DP and HP Valve Stem and Seat, 316 SST, *Hastelloy C*[1]	14,15	01151-0028-0023
GP and AP Valve Stem and Seat, 316 SST, *Hastelloy C*[1]	14,15	01151-0028-0013
DP and HP Valve Stem and Seat, 316 SST, *Monel*[1]	14,15	01151-0028-0024
GP and AP Valve Stem and Seat, 316 SST, *Monel*[1]	14,15	01151-0028-0014
Plug, 316 SST (used with side drain/vent)		C50245-0002
Plug, *Hastelloy C* (used with side drain/vent)		01151-0063-0001
Plug, *Monel* (used with side drain/vent)		01151-0063-0002

(1) Package contains quantity required for one transmitter.

TABLE 5-12. (continued).

Hardware–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Adjustment Kit		01151-0028-0001
Adjustment Screw	10	
O-ring for Adjustment Screw	11	
Retaining Ring	12	
O-ring for Adjustment Screw (pkg of 12)	11	01151-0032-0001
O-ring for Electronics Cover (pkg of 12)	2	01151-0033-0003
O-ring for Process Flange, *Viton* (pkg of 12)	18	01151-0034-0020
O-ring for Process Flange, *Viton* and Backup Ring (pkg of 4)	18	01151-0034-0014
O-ring for Process Flange, Buna-N (pkg of 12)	18	01151-0034-0002
O-ring for Process Flange, Buna-N and Backup Ring (pkg of 4)	18	01151-0034-0016
O-ring for Process Flange, Ethylene-propylene (pkg of 12)	18	01151-0034-0004
O-ring for Process Flange, Ethylene-propylene and Backup Ring (pkg of 4)	18	01151-0034-0015
O-ring for Process Flange, *Aflas* (pkg of 4)[1]	18	01151-0034-0019
O-ring for Flange, *Teflon* with *Hastelloy C* Spring (pkg of 4)	18	01151-0034-0021
O-ring for Flange Adapter, *Viton* (pkg of 12)	20	01151-0035-0009
O-ring for Flange Adapter, Buna-N (pkg of 12)	20	01151-0035-0002
O-ring for Flange Adapter, Ethylene-propylene (pkg of 12)	20	01151-0035-0004
O-ring for Flange Adapter, *Aflas* (pkg of 12)[2]	20	01151-0035-0008
O-ring for Flange Adapter Process, *Teflon* (pkg of 12)	20	01151-0035-0003

(1) Kit contains enough parts for two differential or four gage/absolute transmitters. Backup rings are included.
(2) Part number is for package of 12 O-rings–only two required per transmitter.

TABLE 5-12. (continued).

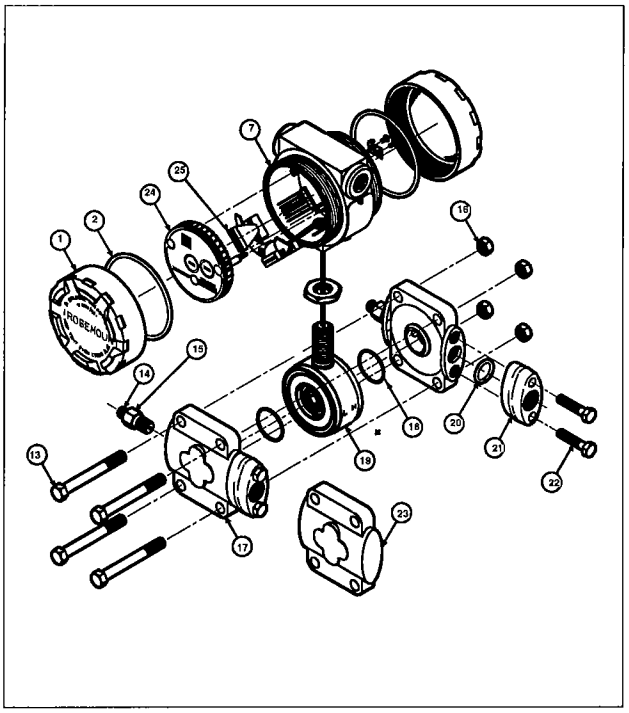
Hardware (continued)–One spare part recommended for every 50 transmitters.		
Part Description	**Item No.**	**Part Number**
Electronics Assembly Hardware[1]		01151-0030-0001
Standoff	8	
Standoff	5	
Screw	9	
Screw	3	
Locknut		
DP and HP Flange Kits, Carbon Steel[1]		01151-0031-0001
Bolt for Flange Adapter	22	(DP & HP Ranges 3–7)
Bolt for Process Flange	13	or
Nut for Process Flange	16	01151-0031-0034
		(DP Range 8)
GP and AP Flange Kits, Carbon Steel[1]		01151-0031-0002
Bolt for Flange Adapter, Carbon Steel	22	(AP Ranges 4–7,
Bolt for Process Flange, Carbon Steel	13	GP Ranges 3–7)
Nut for Process Flange, Carbon Steel	16	or
		01151-0031-0035
		(AP & GP Range 8)
		or
		01151-0031-0003 (GP Range 9)
		or
		01151-0031-0019
		(GP Range 0)
DP and HP Flange Kits, 316 SST[1]		01151-0031-0023
Bolt for Flange Adapter	22	(DP & HP Ranges 3–7)
Bolt for Process Flange	13	or
Nut for Process Flange	16	01151-0031-0038
		(DP Range 8)
GP and AP Flange Kits, 316 SST[1]		01151-0031-0024
Bolt for Flange Adapter, 316 SST	22	(AP Ranges 4–7,
Bolt for Process Flange, 316 SST	13	GP Ranges 3–7)
Nut for Process Flange, 316 SST	16	or
		01151-0031-0039
		(AP & GP Range 8)
		or
		01151-0031-0025 (GP Range 9)
		or
		01151-0031-0026
		(GP Range 0)
DP and HP Flange Kits, ANSI 193-B7[1]		01151-0031-0012
Bolt for Flange Adapter	22	(DP & HP Ranges 3–7)
Bolt for Process Flange	13	or
Nut for Process Flange	16	01151-0031-0036
		(DP Range 8)
GP and AP Flange Kits, ANSI 193-B7[1]		01151-0031-0013
Bolt for Flange Adapter, ANSI 193-B7	22	(AP Ranges 4–7,
Bolt for Process Flange, ANSI 193-B7	13	GP Ranges 3–7)
Nut for Process Flange, ANSI 193-B7	16	or
		01151-0031-0037
		(AP & GP Range 8)
		or
		01151-0031-0014 (GP Range 9)
		or
		01151-0031-0022
		(GP Range 0)

(1) Package contains quantity required for one transmitter.

TABLE 5-12. (continued).

Indicating Meters (Select approved meter kits for use in intrinsically safe and/or Type N installations)		
Part Description	**Item No.**	**Part Number**
Analog Meter Kit, 4–20 mA dc, Linear Scale[1]	NA	01151-1046-0007
Analog Meter Kit, 4–20 mA dc, Square Root, 0-100% Flow		01151-1046-0009
Analog Meter Kit, 10–50 mA dc, Linear Scale[1]		01151-1046-0011
Analog Meter Kit, 10–50 mA dc, Square Root, 0–100% Flow		01151-1046-0013
Approved Analog Meter Kit, 4–20 mA dc, Linear Scale[1]		01151-2615-0007
Approved Analog Meter Kit, 4–20 mA dc, Square Root, 0-100% Flow		01151-2615-0009
Approved Analog Meter Kit, 10–50 mA dc, Linear Scale[1]		01151-2615-0011
Approved Analog Meter Kit, 10–50 mA dc, Square Root, 0–100% Flow		01151-2615-0013
LCD Meter Kit, Linear, 0–100% Flow		01151-1046-0019
LCD Meter Kit, Square Root, 0–100% Flow		01151-1046-0021
Analog Meter, 4–20 mA dc, Linear Scale		01151-0687-0004
Analog Meter, 4–20 mA dc, Square Root, 0–100% Flow		01151-0687-0005
Analog Meter, 4–20 mA dc, Square Root, 0–10 √		01151-0687-0008
Analog Meter, 10–50 mA dc, Linear Scale		01151-0687-0006
Analog Meter, 10–50 mA dc, Square Root, 0–100% Flow		01151-0687-0007
Analog Meter, 10–50 mA dc, Square Root, 0–10 √		01151-0687-0009
Approved Analog Meter, 4–20 mA dc, Linear Scale		01151-2614-0004
Approved Analog Meter, 4–20 mA dc, Square Root, 0–100% Flow		01151-2614-0005
Approved Analog Meter, 4–20 mA dc, Square Root, 0–10 √		01151-2614-0008
Approved Analog Meter, 10–50 mA dc, Linear Scale		01151-2614-0006
Approved Analog Meter, 10–50 mA dc, Square Root, 0–100% Flow		01151-2614-0007
Approved Analog Meter, 10–50 mA dc, Square Root, 0–10 √		01151-2614-0009
Special Scale for Analog Meter		See note (1) below
LCD Meter, Linear, 0–100%		01151-1300-1000
LCD Meter, Square Root, 0–100% Flow		01151-1300-1001
LCD Meter, Special Configuration[2]		01151-1351-1000
LCD Meter Engineering Unit Labels		01161-1351-1001
Mounting Hardware and Cover Assembly Kit		01151-1046-0005
Mounting Hardware Kit		01151-1046-0006
Cover Assembly Kit		01151-1047-0001
O-ring for Cover (pkg of 12)		01151-0033-0003
Mounting Brackets		
Part Description	**Item No.**	**Part Number**
B1—Right-angle Bracket for 2-in. Pipe Mounting	NA	01151-0036-0001
B2—Right-angle Bracket for Panel Mounting		01151-0036-0004
B3—Flat Bracket for 2-in. Pipe Mounting		01151-0036-0005
B4—Bracket for 2-in. Pipe with Series 300 SST Bolts		01151-0036-0003
B5—Bracket for Panel with Series 300 SST Bolts		01151-0036-0006
B6—Flat Bracket for 2-in. Pipe with Series 300 SST Bolts		01151-0036-0007
B7—316 SST B1 Bracket with SST Bolts		01151-0036-0021
B8—316 SST B3 Bracket with SST Bolts		01151-0036-0022

(1) Meter kit includes meter, mounting hardware, and cover assembly. For meters with special scaling, order the appropriate meter and specify the scale desired. Mounting hardware and cover assembly must be ordered separately.
(2) To order a meter with a special configuration, order the appropriate meter and indicate configuration desired. To order a special configuration LCD meter kit, order the meter, and the mounting hardware and cover assembly kit separately.



1151-1151-4279

FIGURE 5-1. Model 1151 Smart Pressure Transmitter Exploded View.

Parts List

Item numbers are references to figure callouts (page 5-29).

TABLE 5-13. Model 1151LT Flange-Mounted Liquid Level Pressure Transmitter.

Part Description	Item No.	Part Number	Spares Category[1]
Diaphragm and Sensor Module Assembly	13	See Note Below	B
Flange Adapter Union			
Cadmium-plated Carbon Steel	21	90001-0033-0001	
316 SST		01151-0211-0002	
Hastelloy C		01151-0211-0004	
Valve Stem and Seal, 316 SST	18, 19	01151-0028-0012	
Plug, 316 SST (used with side drain/vent)		C50246-0002	A
Valve Stem and Seal, *Hastelloy C*	18, 19	01151-0028-0013	
Plug, *Hastelloy C* (used with side drain/vent)		C50246-0202	A
Bolt for Flange Adaptor			
Cadmium-plated Carbon Steel	20	01151-0031-0002	
316 SST	20	01151-0031-0024	
ANSI 193-B7	20	01151-0031-0013	
O-ring for Flange Adapter			
Viton (pkg of 12)	22	01151-0035-0009	
Buna-N (pkg of 12)	22	01151-0035-0002	
Aflas (pkg of 4)	22	01151-0035-0008	
Ethylene-Prop. (pkg of 12)	22	01161-0035-0004	
SMART OUTPUT CODE – See next page for details	—	01151-0935-0001	B
Electronics Housing	7	01151-0060-0007	
Electronics Cover	1	01151-1045-0001	
Adjustment Screw, Retaining Ring, and O-ring for Adjustment Screw	2	01151-0029-0001	
O-ring for Electronics Cover [1]		01161-0033-0003	
Electronics Assembly Hardware			
Standoff			
Standoff		01151-0030-0001	
Screw			
Screw			
Locknut			

(1) Rosemount recommends one spare part for every 25 transmitters in Category A, and one spare part for every 50 transmitters in Category B.

NOTE
The Diaphragm and Sensor Module Assembly is an oil filled system and must be serviced using the proper equipment. Contact your nearest Rosemount Service facility should it become necessary to replace or service this assembly. A complete Diaphragm and Sensor Module Assembly including the mounting flange can be ordered by specifying a complete transmitter model number from PPL 00814-0100-4526, adding "T740" to end of the model number, and deducting $300 from the list price of the complete transmitter. (The "T740" eliminates the electronic housing and electronic circuit boards.) For example, 1151LT 4 E A0 A 12 D T740 list price 7 455 (price as of January 31, 1996) less 1 705 = $ 750 (dimensionless prices).

TABLE 5-13. (continued).

S Output Code (Smart) Part/Kit Description	Item No.	Part Number
Smart Retrofit Kit[1]		01151-0935-0001
Smart Transmitter Electronics[2]	24	01151-0934-0204
Board Spacer Kit (pkg of 12)	26	01151-0813-0001
Terminal Eyelet Kit (pkg of 12)		01151-0814-0001
Standoff Kit (pkg of 12)		01151-0815-0001
Cover[2]		01151-1045-0001
Cover O-ring (pkg of 12)		01151-0033-0003
Indicating Meters Part Description		**Part Number**
Analog Meter Kit, 4–20 mA dc, Linear Scale[3]		01151-1046-0007
Analog Meter Kit, 10–50 mA dc, Linear Scale[3]		01151-1046-0011
Approved Analog Meter Kit, 4–20 mA dc, Linear Scale[1]		01151-2615-0007
Approved Analog Meter Kit, 10–50 mA dc, Linear Scale[1]		01151-2615-0011
LCD Meter Kit, Linear, 0–100% Flow		01151-1046-0019
Analog Meter, 4–20 mA dc, Linear Scale		01151-0687-0004
Analog Meter, 10–50 mA dc, Linear Scale		01151-0687-0006
Approved Analog Meter, 4–20 mA dc, Linear Scale		01151-2614-0004
Approved Analog Meter, 10–50 mA dc, Linear Scale		01151-2614-0006
Special Scale for Analog Meter		See note (3) below
LCD Meter, Linear, 0–100%		01151-1300-1000
LCD Meter, Special Configuration[4]		01151-1351-1000
LCD Meter Engineering Unit Labels		01151-1351-1001
Mounting Hardware and Cover Assembly Kit		01151-1046-0005
Mounting Hardware Kit		01151-1046-0006
Cover Assembly Kit		01151-1047-0001
O-ring for Cover (pkg of 12)		01161-0033-0003

(1) Kit contains enough parts for one transmitter and includes the smart transmitter electronics, board spacers, terminal eyelets, standoffs, cover, and cover O-rings.
(2) Kit contains enough parts for one transmitter.
(3) Meter kit includes meter, mounting hardware, and cover assembly. For meters with special scaling, order the appropriate meter and specify the scale desired. Mounting hardware and cover assembly must be ordered separately.
(4) To order a meter with a special configuration, order the appropriate meter and indicate configuration desired. To order a special configuration LCD meter kit, order the meter, and the mounting hardware and cover assembly kit separately

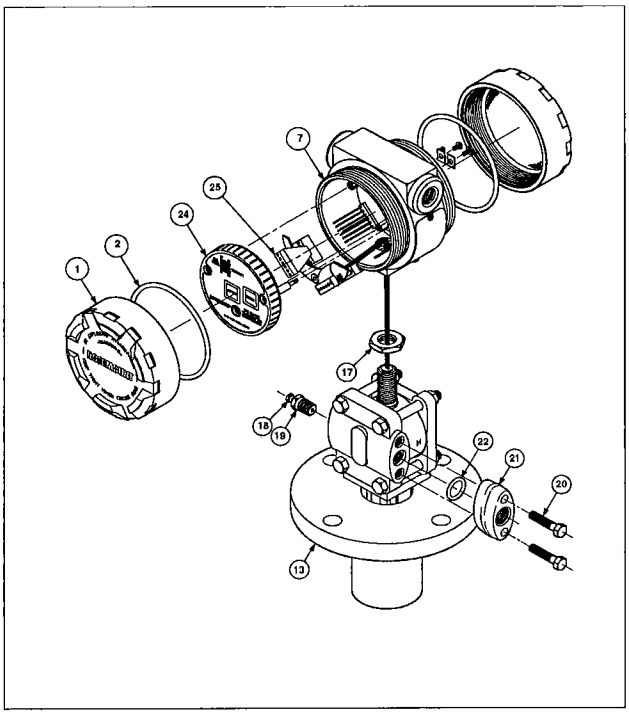


FIGURE 5-2. Model 1151LT Pressure Transmitter Exploded View (Analog Shown).

SPECIFICATIONS AND REFERENCE DATA FOR OPTIONS

LCD Meter Specifications

Input Signal
4–20 mA dc.

Meter Indication
4-digit LCD showing –999 to 9999. A 20-segment bar graph directly represents the 4–20 mA current.

Scaling/Calibration
4 mA Point Limits: –999 to 1000.

Span limits: 0200 to 9999.
The sum of the 4 mA point and span must not exceed 9999.
Adjustments are made using non-interactive zero and span buttons.

Hazardous Locations Certifications
Approved for use with Rosemount Models 444, 751, 1135, 1144, and 1151.

Overload Limitation
666 mA.

Temperature Limits
Storage: –40 to 85 °C (–40 to 185 °F).
Operating: –20 to 70 °C (–4 to 158 °F).

Between temperatures –40 to –20 °C (–40 to –4 °F), the loop is intact and the meter is not damaged.

Humidity Limitation
0 to 95% non-condensing relative humidity.

Update Period
750 ms.

Response Time
Responds to changes in input within a maximum of two update periods. If the filter is activated, then the display responds to the change within nine update periods.

Digital Display Resolution
0.05% of calibrated range ±1 digit.

Analog Bar Graph Resolution
0.05% of calibrated range.

Indication Accuracy
0.25% of calibrated range ±1 digit.

Stability
Over Time: 0.1% of calibrated range ±1 digit per 6 months.

Temperature Effect
0.01% of calibrated range per °C on zero.
0.02% of calibrated range per °C on span over the operating temperature range.

Power Interrupt
All calibration constants are stored in EEPROM memory and are not affected by power loss.

Failure Mode
LCD meter failure will not affect transmitter operation.

Under/Over Range Indication
Input current < 3.5 mA: Display blank.
Input current > 22.0 mA: Display flashes 112.5% of full scale value or 9999, whichever is less.

Meter Size
2¼-inch diameter face with ½-inch high characters.

Terminal Block Specifications

Hazardous Locations Certifications
Approved for use with I5, K5, I6, C6, E6, E8, I8(1), I1(1), and N1 approved transmitters.

Materials of Construction
Noryl® plastic.

Loop Resistance
6 Ω

Transient Protection Limits
IEEE 587 Category B

6 kV Crest (1.2 × 50 µs).

3 kA Crest (8 × 20 µs).

6 kV (0.5 µs at 100 kHz).

IEEE 472
SWC 2.5 kV Crest, 1 MHz waveform.

Accuracy Specification
Same as specified electronics accuracy when transmitter is calibrated with installed retrofitable Transient Protection Terminal Block.

(1) When the transient version of the filter module is used in an intrinsically safe installation, supply transmitter from a galvanically isolated barrier.

Appendix A HART® Communicator

INTRODUCTION

This appendix provides basic communicator information on the HART Communicator Model 275 when used with a Model 1151 Smart Pressure Transmitter.

Included in this appendix are a menu tree, a table of fast key sequences, and information on using the HART Communicator.

For more complete information on the HART Communicator, refer to the HART Communicator Product Manual 00809-0100-4275.

This brief appendix will familiarize you with the HART Communicator but is not meant to replace the HART Communicator product manual.

SAFETY MESSAGES

Warnings (⚠)

Procedures and instructions in this section that raise potential safety issues are indicated by a warning symbol (⚠). Refer to the following warning messages before performing an operation preceded by this symbol.

⚠WARNING

Explosions can result in death or serious injury. Do not make connections to the serial port or NiCad recharger jack in an explosive atmosphere.

⚠WARNING

Explosions can result in death or serious injury. Before connecting the HART Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

FIGURE A-1. HART Communicator Menu Tree for the Model 1151.

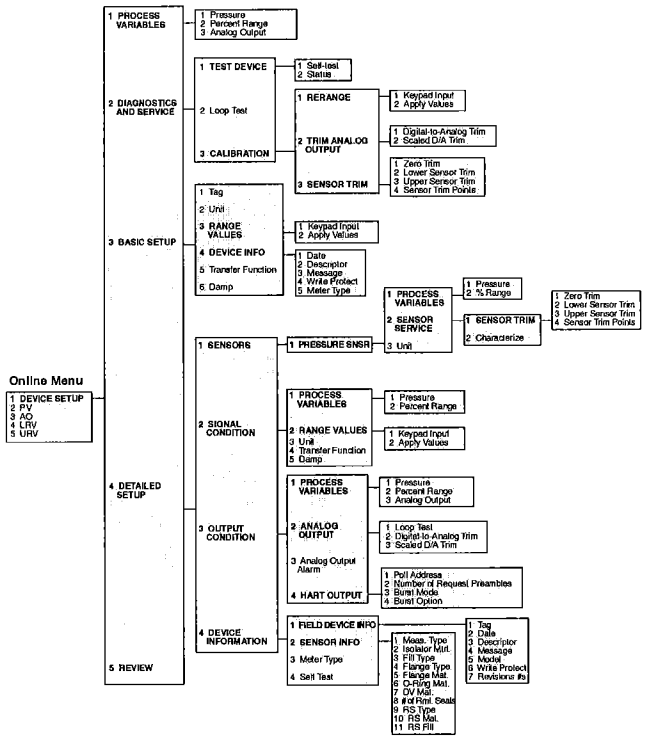


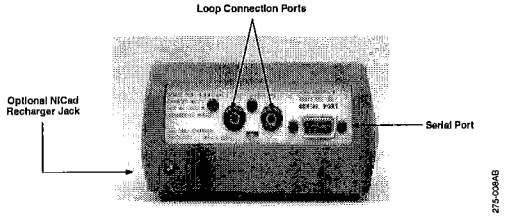
TABLE A-1. HART Fast Key Sequences for the Model 1151.

Function	HART Communicator Fast Key Sequences
Analog Output	3
Analog Output Alarm	1, 4, 3, 3
Burst Mode Control	1, 4, 3, 4, 3
Burst Operation	1, 4, 3, 4, 4
Calibration	1, 2, 3
Characterize	1, 4, 1, 1, 2, 2
Damping	1, 3, 6
Date	1, 3, 4, 1
Descriptor	1, 3, 4, 2
Digital-to-Analog Trim (4–20 mA Output)	1, 2, 3, 2, 1
Field Device Information	1, 4, 4, 1
Full Trim	1, 2, 3, 3
Keypad Input	1, 2, 3, 1, 1
Loop Test	1, 2, 2
Lower Range Value	4, 1
Lower Sensor Trim	1, 2, 3, 3, 2
Message	1, 3, 4, 3
Meter Type	1, 3, 4, 5
Number of Requested Preambles	1, 4, 3, 4, 2
Percent Range	1, 1, 2
Poll Address	1, 4, 3, 4, 1
Pressure	2
Range Values	1, 3, 3
Rerange	1, 2, 3, 1
Scaled D/A Trim (4–20 mA Output)	1, 2, 3, 2, 2
Self-Test (Transmitter)	1, 2, 1, 1
Sensor Information	1, 4, 4, 2
Sensor Trim Points	1, 2, 3, 3, 4
Status	1, 2, 1, 2
Tag	1, 3, 1
Transfer Function (Setting Output Type)	1, 3, 5
Transmitter Security (Write Protect)	1, 3, 4, 4
Trim Analog Output	1, 2, 3, 2
Units (Process Variable)	1, 3, 2
Upper Range Value	5, 2
Upper Sensor Trim	1, 2, 3, 3, 3
Zero Trim	1, 2, 3, 3, 1

CONNECTIONS AND HARDWARE

⚠ The HART Communicator Model 275 can interface with a transmitter from the control room, the instrument site, or any wiring termination point in the loop through the rear connection panel as shown in Figure A-2. To communicate, connect the HART Communicator in parallel with the instrument or load resistor. The connections are non-polarized.

FIGURE A-2. Rear Connection Panel with Optional NiCad Recharger Pack.



NOTE
The HART Communicator needs a minimum of 250 ohms resistance in the loop to function properly. The HART Communicator does not measure loop current directly.

⚠ See "Safety Messages" on page A-1 for complete warning information.

FIGURE A-3. Bench Hook-up (Smart Transmitters).

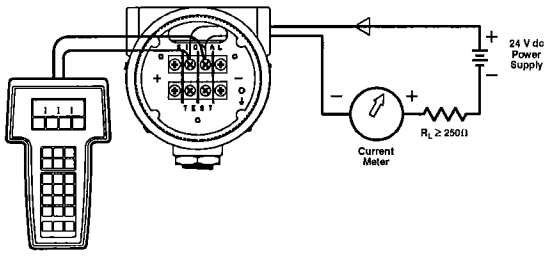
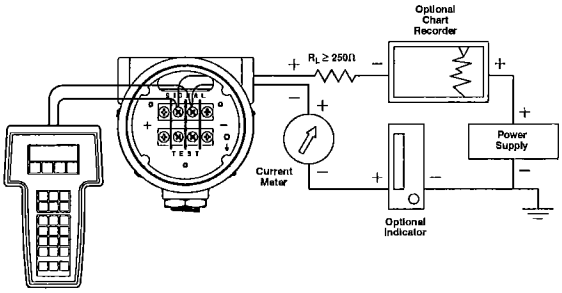


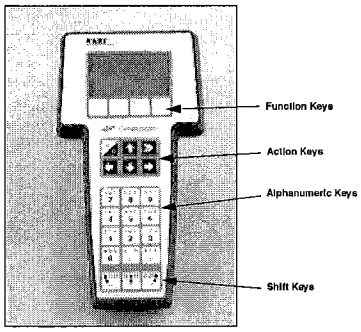
FIGURE A-4. Field Hook-up (Smart Transmitters).



COMMUNICATOR KEYS

The keys of the HART Communicator include action, function, and alphanumeric and shift keys.

FIGURE A-5. The HART Communicator.



Action Keys

As shown in Figure A-5, the action keys are the six blue, white, and black keys located above the alphanumeric keys. The function of each key is described as follows:

ON/OFF Key
Use this key to power the HART Communicator. When the communicator is turned on, it searches for a transmitter on the 4–20 mA loop. If a device is not found, the communicator displays the message, "No Device Found. Press OK."

If a HART-compatible device is found, the communicator displays the Online Menu with device ID and tag.

Directional Keys
Use these keys to move the cursor up, down, left, or right. The right arrow key also selects menu options, and the left arrow key returns to the previous menu.

HOT Key
Use this key to quickly access important, user-selectable options when connected to a HART-compatible device. Pressing the Hot Key turns the HART Communicator on and displays the Hot Key Menu. See Customizing the Hot Key Menu in the HART Communicator manual for more information.

Function Keys

Use the four software-defined function keys, located below the LCD, to perform software functions. On any given menu, the label appearing above a function key indicates the function of that key for the current menu. As you move among menus, different function key labels appear over the four keys. For example, in menus providing access to on-line help, the HELP label may appear above the F1 key. In menus providing access to the Online Menu, the HOME label may appear above the F3 key. Simply press the key to activate the function. See your HART Communicator manual for details on specific function key definitions.

Alphanumeric and Shift Keys

The alphanumeric keys (Figure A-6) perform two functions: the fast selection of menu options and data entry.

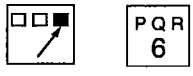
FIGURE A-6. HART Communicator Alphanumeric and Shift Keys.



Data Entry
Some menus require data entry. Use the alphanumeric and shift keys to enter all alphanumeric information into the HART Communicator. If you press an alphanumeric key alone from within an edit menu, the bold character in the center of the key appears. These large characters include the numbers 0 through 9, the decimal point (.), and the dash symbol (—).

To enter an alphabetic character, first press the shift key that corresponds to the position of the letter you want on the alphanumeric key. Then press the alphanumeric key. For example, to enter the letter R, first press the right shift key, then the "6" key (see Figure A-7). Do not press these keys simultaneously, but one after the other.

FIGURE A-7. Data Entry Key Sequence.



HART FAST KEY SEQUENCES

HART fast key sequences provide quick on-line access to transmitter variables and functions. Instead of stepping your way through the menu structure using the action keys, you can press a HART fast key sequence to move from the Online Menu to the desired variable or function. On-screen instructions guide you through the rest of the screens.

HART Fast Key Example

HART fast key sequences are made up of the series of numbers corresponding to the individual options in each step of the menu structure. For example, from the Online Menu you can change the **Date**. Following the menu structure, press 1 to reach **Device Setup**, press 3 for **Basic Setup**, press 4 for **Device Info**, press 5 for **Date**. The corresponding HART fast key sequence is 1,3,4,5.

HART fast keys are operational only from the Online Menu. If you use them consistently, you will need to return to the Online Menu by pressing HOME (F3) when it is available. If you do not start at the Online Menu, the HART fast key sequences will not function properly.

Use Table A-1, an alphabetical listing of every on-line function, to find the corresponding HART fast key sequences. These codes are applicable only to Model 1151 transmitters and the HART Communicator.

MENUS AND FUNCTIONS

The HART Communicator is a menu driven system. Each screen provides a menu of options that can be selected as outlined above, or provides direction for input of data, warnings, messages, or other instructions.

Main Menu

When the HART Communicator is turned on, one of two menus will appear. If the HART Communicator is connected to an operating loop, the communicator will find the device and display the Online Menu (see below). If it is not connected to a loop, the communicator will indicate that no device was found. When you press OK (F4), it will display the Main menu.

The Main menu provides the following options:

- *Offline*—The Offline option provides access to offline configuration data and simulation functions.
- *Online*—The Online option checks for a device and if it finds one, brings up the Online Menu.
- *Transfer*—The Transfer option provides access to options for transferring data either from the HART Communicator (memory) to the transmitter (device) or vice versa. Transfer is used to move off-line data from the HART Communicator to the transmitter, or to retrieve data from a transmitter for off-line revision.

NOTE
Online communication with the transmitter automatically loads the current transmitter data to the HART Communicator. Changes in on-line data are made active by pressing SEND (F2). The transfer function is used only for off-line data retrieval and sending.

- *Frequency Device*–The Frequency Device option displays the frequency output and corresponding pressure output of current-to-pressure transmitters.
- *Utility*–The Utility option provides access to the contrast control for the HART Communicator LCD screen and to the autopoll setting used in multidrop applications.

Once selecting a Main menu option, the HART Communicator provides the information you need to complete the operation. If further details are required, consult the HART Communicator manual.

Online Menu

The Online Menu can be selected from the Main menu as outlined above, or it may appear automatically if the HART Communicator is connected to an active loop and can detect an operating transmitter.

NOTE
The Main menu can be accessed from the Online Menu. Press the left arrow action key to deactivate the on-line communication with the transmitter and to activate the Main menu options.

When configuration variables are reset in the on-line mode, the new settings are not activated until the data are sent to the transmitter. Press SEND (F2) when it is activated to update the process variables of the transmitter.

On-line mode is used for direct evaluation of a particular meter, re-configuration, changing parameters, maintenance, and other functions.

DIAGNOSTIC MESSAGES

The following pages contain a list of messages used by the HART Communicator (HC) and their corresponding descriptions.

Variable parameters within the text of a message are indicated with *<variable parameter>*.

Reference to the name of another message is identified by *[another message]*.

Message	Description
Add item for ALL device types or only for this ONE device type.	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command not implemented	The connected device does not support this function.
Communication error	Either a device sends back a response indicating that the message it received was unintelligible, or the HC cannot understand the response from the device.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
Device busy	The connected device is busy performing another task.
Device disconnected	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data cannot be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HC off and lose the unsent data.
Display value of variable on hot key menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hot key menu if the item being added to the hot key menu is a variable.
Download data from configuration memory to device	Prompts user to press SEND softkey to initiate a memory to device transfer.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device-specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device- specified description edit format.
Ignore next 50 occurrences of status?	Asked after displaying device status. Softkey answer determines whether next 50 occurrences of device status will be ignored or displayed.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.

Message	Description
Mark as read only variable on hot key menu?	Asks whether the user should be allowed to edit the variable from the hot key menu if the item being added to the hot key menu is a variable.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No device found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hot key menu available for this device.	There is no menu named "hot key" defined in the device description for this device.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No UPLOAD_VARIABLES in ddl for this device	There is no menu named "upload_variables" defined in the device description for this device. This menu is required for offline configuration.
No valid items	The selected menu or edit display contains no valid items.
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hot key configuration. Delete unnecessary items.	There is no more memory available to store additional hot key items. Unnecessary items should be deleted to make space available.
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK...	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.

Message	Description
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

Appendix B Model 268 Communicator

INTRODUCTION

This appendix provides basic communicator information on the Rosemount Model 268 SMART FAMILY Interface when used with a Model 1151 Smart Pressure Transmitter.

Included in this appendix are a menu tree, a table of fast key sequences, and information on using the Rosemount Model 268 SMART FAMILY Interface.

FIGURE B-1. 268 Menu Tree.

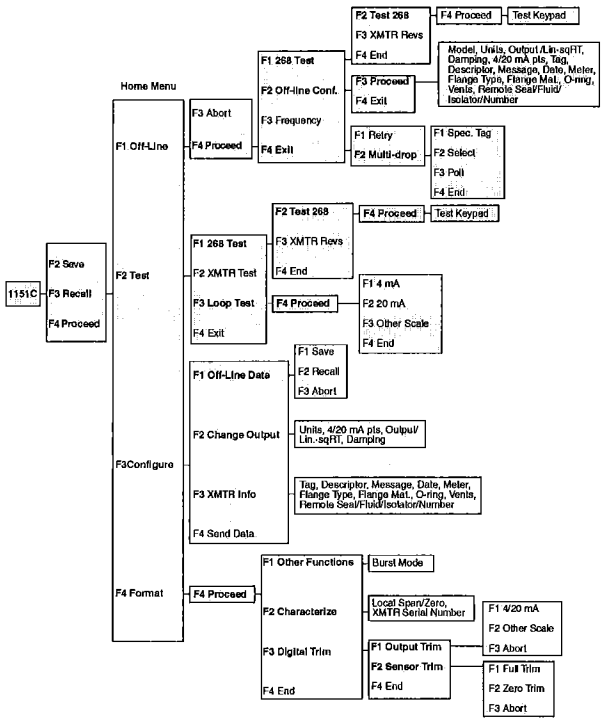


TABLE B-2. Model 268 Fast Key Equivalents.

Function	Model 268 Fast Key Sequences
Analog Output	F3, F2
Analog Output Alarm	Not Applicable
Burst Mode Control	F4, F4, F1
Burst Operation	Not Applicable
Calibration	Not Applicable
Characterization	F4, F4, F2
Damping	F3, F2, F2
Date	F3, F3, (F1 x 3)
Descriptor	F3, F3, F1
Digital To Analog Trim (4–20 mA Output)	F4, F4, F3
Disable Local Span/Zero Adjustment	F4, F4, F1
Field Device Information	F3, F3
Full Trim	F4, F4, F3, F2, F1
Keypad Input (Trim Points)	F3, F2, F1
Loop Test	F2, F3
Lower Range Value	Process Variable Key, F2
Lower Sensor Trim	F4, F4, F3, F2, F1, F2
Message	F3, F3, F1, F1
Meter Type	F3, F3, (F1 x 4)
Number Of Requested Preambles	Not Applicable
Percent Range	Not Applicable
Poll Address	F1, F4, F4, F2, F3
Pressure	Process Variable Key
Range Values	F3, F2, F1
Remange	F4, F4, F3, F1, F1
Scaled D/A Trim (4–20 mA Output)	F4, F4, F3, F1, F2
Self Test (Transmitter)	F2, F2
Sensor Information	F3, F3
Sensor Temperature	Process Variable Key, F3
Sensor Trim Points	F3, F2, F1
Status	Not Applicable
Tag	F3, F3
Transfer Function (Setting Output Type)	F3, F2, F1, F1
Transmitter Security (Write Protect)	Not Applicable
Trim Analog Output	F4, F4, F3, F1
Units (Process Variable)	F3, F2
Upper Range Value	Process Variable Key, F2
Upper Sensor Trim	F4, F4, F3, F2, F1, F3
Zero Trim	F4, F4, F3, F2, F2

CONNECTIONS AND HARDWARE

The Model 268 can communicate with a transmitter from the control room, the transmitter site, or any other wiring termination point in the loop. To communicate, it must be connected in parallel with the transmitter; the connections are non-polarized.

FIGURE B-3. Bench Hook-up (Smart Transmitters).

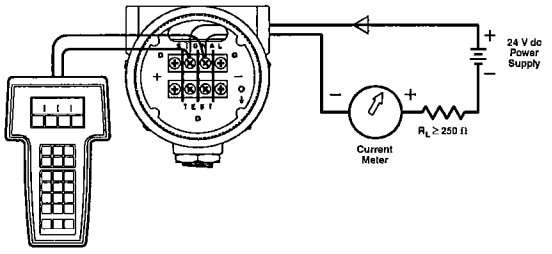
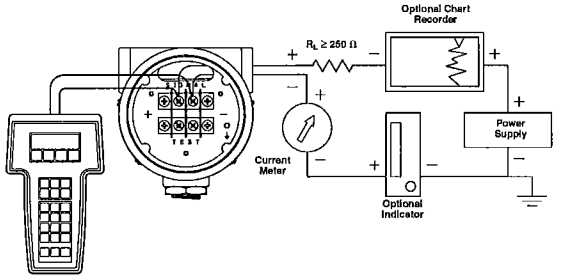


FIGURE B-4. Field Hook-up (Smart Transmitters).



COMMUNICATOR KEYS

The keys of the Model 268 include the dedicated, alphanumeric and shift, and function keys that vary depending on the task being performed. The dedicated key functions are always the same

Dedicated Keys

On/Off

Use this key to turn the unit on and off. When the Model 268 is turned ON, it searches for a transmitter in the 4–20 mA loop. If no transmitter is found, the Model 268 offers the opportunity to try again, select "MULT DROP" or "OFF-LINE".

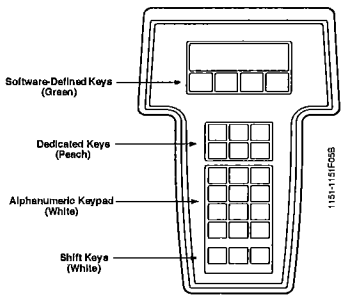
Process Variable

Use the Process Variable key to display up-to-date process variable readings from the transmitter in engineering units, milliamps, pulse rate, and shedding rate. It also displays totalized flow.

Review

The Review key allows you to step through all the information currently held in the four memory locations of the transmitter and Model 268 — SAFE MEM, OFLN MEM, WORK REG, and XMTR MEM.

FIGURE B-5. Model 268 Communicator.



Help

Use the Help key to explain the software-defined key functions (F1-F4) in detail.

Restart

Use the Restart key to initiate communication with a transmitter while the Model 268 is still turned on. Upon connection to a new transmitter, pressing this key loads information from the new transmitter into the Model 268 working register.

Previous Function

The Previous Function key returns you to the previous decision level and allows you to select a different software-defined key function.

Alphanumeric and Shift Keys

Some menus require data entry. Use the alphanumeric and shift keys to enter all alphanumeric information into the Model 268.

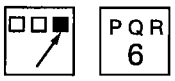
FIGURE B-6. Model 268 Communicator Alphanumeric and Shift Keys.



If you press an alphanumeric key alone from within an edit menu, the bold character in the center of the key appears. These characters include the numbers 0 through 9, the decimal point (.), and the dash symbol (–).

To enter an alphabetic character, first press the shift key that corresponds to the position of the letter you want on the alphanumeric key. Then press the alphanumeric key. For example, to enter the letter R, first press the right shift key, then the "6" key (see Figure B-7). Do not press these keys simultaneously, but one after the other.

FIGURE B-7. Data Entry Key Sequence.



Function Keys

Use the four software-defined function keys, located below the LCD, to perform software functions. On any given menu, the label appearing above a function key indicates the function of that key for the current menu. As you move among menus, different function key labels appear over the four keys.

FAST KEY SEQUENCES

The Model 268 fast key sequences provide quick on-line access to transmitter variables and functions. Instead of stepping your way through the menu structure, you can press a fast key sequence to move from the Home Menu to the desired variable or function. On-screen instructions guide you through the rest of the screens.

Fast Key Sequence Conventions

The fast key sequences for the Model 268 use the following conventions for their identification:

F1, F2, F3, F4–Refer to each function key located directly below the LCD on the Model 268.

(F2 x 7)–Means to push the F2 key seven consecutive times.

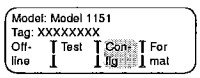
Process Variable–Refers to the dedicated key located below the function keys on the Model 268.

To return to the Home Menu, use the function keys to exit the current task and press the PREVIOUS FUNCTION (dedicated key) as many times as necessary.

The fast key sequences are applicable only from the Home Menu. The Home Menu lists the model and tag, and labels the four function keys Offline, Test, Configure and Format (see Figure B-8). After completing a task, return to the Home Menu if you intend to use the fast key sequences. Fast key sequences will not work from any other Model 268 screen.

NOTE
Certain tasks require that you set the control loop to manual control before completing them. Fast key sequences often include a warning to return the loop to manual.

FIGURE B-8. Model 268 Home Screen.



To return to the Home Menu, use the function keys to exit the current task and press PREVIOUS FUNCTION as many times as necessary. When the Home Menu appears, you can use another fast key sequence to reach a desired task.

NOTE
Certain tasks require that you set the control loop to manual control before completing them. Fast key sequence steps often include the warning to return the loop to manual. If the loop is not in manual control, be sure to watch for this screen. If it comes up during the fast key sequence, set the loop to manual before continuing with the task.

Fast Key Sequence Examples

Date

To change the date following the menu structure, you would start at the Home Menu and press F3 for **Configure,** F3 for **XMTR Info,** and F1 three times in a row to reach the Date function. The fast key sequence is F3, F3, [F1 x 3].

Loop Test

To perform the Loop Test, start at the Home Menu and press F2 for Test, F3 for Loop Test, and F4 for Proceed (after the loop is set to manual). The Function Key Sequence is F2, F3, F4.

DIAGNOSTICS MESSAGES

The following table provides a guide to diagnostic messages of the Model 268.

Message	Description
CAUTION–Progressing will clear Offln Mem	Off-line Memory is cleared for new information.
Data saved in OFLN Mem for downloading	Off-line configuration data are saved in the Off-line Memory and can be downloaded or sent to the flowmeter at an appropriate time.
Different XMTR type connected–XMTR Mem not changed	The flowmeter did not accept data sent because the data is meant for a different type of transmitter.
End of list	
ERR–filter auto adjust	The low pass filter auto-adjust sequence error occurs under the following conditions: • no flow in pipe • erratic flowrate • filter tracking disabled Remedy conditions and repeat function.
ERR–Hard/software is not compatible	
ERR–Not in output mode	
ERR–Not XMTR command	The flowmeter does not understand the command sent by the Model 268. Press F4, RESTART to restart the flowmeter, or press F3 to suppress the error message and REVIEW the software revision level. You may need to contact the Rosemount Service Center.
ERR–Out of range	
ERR–PV out of limits	
ERR–Update failure	
ERR–Value was too hi	
ERR–Value was too lo	
ERR–XMTR fault	
ERR–XMTR will not support command	The flowmeter does not understand the Model 268 command. Press F4, RESTART or press F3, REVIEW to review the software revision level of the flowmeter. Check compatibility.
ERR–268 Data err	
Errors Detected–XMTR Mem not changed	The flowmeter did not accept data because it contained nonpermissible values. Data errors must be corrected and the data sent again.
FAILURE–Electronics	
Gen failure–No. 1	
Making changes permanent–PLEASE WAIT	Data is being sent to the flowmeter and the flowmeter is accepting the data.
No data modified to send	Data with no changes is being sent. Press F4 to continue.
No data saved in OFLN Mem	There are no data in the Off-line Memory to review.

Message	Description
No data saved in SAFE Mem	There are no data in the Safe Memory to review.
Offn Mem not compatible with WORK REGS–Data not transferred	The data stored in Off-line Memory and Working Register are from different kinds of transmitters, or the Off-line Memory is empty. Press F4, REVIEW, F2 to see the data in Off-line Memory and connect the Model 268 to similar transmitter.
SAFE Mem from diff XMTR than WORK REGS–Data not transferred	Data in the Safe Memory and Working Register are from different transmitters. Press F4, REVIEW, F1 and find the flowmeter serial number. Connect the Model 268 to the flowmeter with that serial number and press RESTART.
SAFE Mem not compatible with WORK REGS–Data not transferred	The unique identifier in the Safe Memory and the transmitter are different. Press F4, REVIEW, F1 to see the data in the Safe Memory. Connect the Model 268 to the matching transmitter and press RESTART.
The XMTR has returned an error	
WARN–Used nearest legal table value	The value entered has too many decimal places. The Model 8800 defaults to the closest value available.
WARN–Value at limit reverse direction	The entered value is beyond the upper or lower limit. Adjust to a value within the limits.
WARN–Value entered is illegal, re-enter	The Model 268 will not accept the entered value. Enter an acceptable value (see relevant section in manual).
WARN–Value out of limits, altered by 268, re-check data	The Model 268 could not store the entered value so it changed to the maximum allowable value. Check the new value.
WARNING–Analog output outside range points	
WARNING–Control loop should be in manual	Before sending the data that could affect the 4–20 mA output signal, set the loop to manual control. After it is set, press F4.
WARNING–Data transmission error	Previous communication between Model 268 and the flowmeter was not successful. If this message appears repeatedly, check the loop for a source of noise that could corrupt the signal.
WARNING–Loop may be returned to auto	After completing a communication that required the loop to be set in manual, you may return the loop to automatic control.
WARNING–Match xmtr S/N to nameplate S/N	Check to be sure that the entered flowmeter serial number is the same as that on the flowmeter nameplate.
WARNING–Not on line	The key you have pressed is not applicable for off-line configuration tasks.
WARNING–Process has been aborted	Indicates that the self-test has been aborted by pressing any key.
WARNING–PV out of range	
WARNING–Some of the changes were not saved in the xmtr mem	Flowmeter did not receive all configuration changes. Note differences in configuration data and reconfigure the flowmeter accordingly.
WARNING–This address already being used	Another transmitter is already using the entered multi-drop address. Enter a new address.

Message	Description
WARNING–This will erase work reg	Data in the Working Register will be replaced with data from a another location.
WARNING–XMTR/268 not in communication	Model 268 did not get answer from flowmeter: • Check connections • Check that power is reaching flowmeter • Check for minimum 250 ohms resistance in loop
WARNING–XMTR in output mode	During start-up and restart, the transmitter milliamp output does not reflect the process variable. Press F4.
WARNING–XMTR is not communicating	Model 268 did not get answer from flowmeter: • Check connections • Check that power is reaching flowmeter • Check for minimum 250 ohms resistance in loop
WARNING–268 does not know this XMTR	Model 268 recognizes a Rosemount transmitter in the loop but cannot communicate with it. The message usually indicates a software revision level incompatibility between the Model 268 and the transmitter.
XMTR Mem diff than WORK Regs–XMTR not changed	Data in the Working Register and in the flowmeter have different unique identifiers. The Model 268 was probably connected to different flowmeter without RESTART or power-off/power-on sequence. Press RESTART to erase the Working Register or save the Working Register to the Off-line Memory and download to the proper flowmeter at a later time.
XMTR Security: On–XMTR will not accept changes to Memory	
XMTR still busy	Flowmeter is running a computational or diagnostic routine and cannot respond to the Model 268 instructions. Press the PREVIOUS FUNCTION key to cancel.
XXXX=YYYY ERR–Illegal value	
XXXX=YYYY ERR–Out of range	
XXXX=YYYY ERR–Span too small	
XXXX=YYYYERR–Valu was too hi	
XXXX=YYYYERR–Valu was too lo	
XXXX=YYYYERR–LRV too hi	
XXXX=YYYYERR–LRV too lo	
XXXX=YYYYERR–LRV & URV out limits	
XXXX=YYYYERR–URV too hi	
XXXX=YYYYERR–URV too lo	
XXXX=YYYY ERR–268 data err	
268 Failure–No. 1	
268 Failure–No. 2	
268 Test: FAIL	

Appendix C Retrofitting the Model 1151 Transmitter

INTRODUCTION

This section describes how the Rosemount Smart Retrofit Kit can be used to retrofit a Model 1151AP, DP, GP, HP, or LT transmitter with 4-20 mA dc linear or square root output.

NOTE
The Model 1151DR (Draft Range) Transmitter cannot be retrofitted with the 1151-0935-0001 Retrofit Kit. In addition, Model 1151 transmitters with serial numbers below 10,000 and approximately 2,000 Model 1151 AP Range Code 4 Transmitters with serial numbers between 1,318,500 and 1,690,000 may experience some degradation in performance from temperature effect if retrofitted. Therefore, retrofitting of these transmitters is not recommended.

SAFETY MESSAGES

Warnings (⚠)

Procedures and instructions in this section that raise potential safety issues are indicated by a warning symbol (⚠). Refer to the following warning messages before performing an operation preceded by this symbol.

⚠WARNING

- Explosions can result in serious injury or death. Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendiary field wiring practices.
- Toxic processes can result in serious injury or death. Transmitter can contain residue process. Use appropriate safety precautions when opening drain vents or disconnecting a transmitter from a process.
- DO NOT attempt to loosen drain vent valves or disconnect the transmitter from the process without taking precautionary measures.
- Install and tighten all four process adapter bolts or drain vent valves before applying pressure.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

RETROFITTING OVERVIEW

The procedure for retrofitting a transmitter is divided into three parts:

1. Removing the analog electronics assembly.
2. Installing the smart electronics kit.
3. Characterizing the retrofitted transmitter.

Two tools are required to remove the analog electronics and to install the smart electronics:

- Flat-bladed screwdriver
- ¼-in. nut driver or wrench

The following equipment is needed to characterize the retrofitted transmitter:

- A Rosemount Model 275 or Model 268 HART Communicator with SMART FAMILY® Interface
- An accurate pressure source, preferably 0.025% accuracy or better
- A 250 ohm resistor

The Smart Retrofit Kit, P/N 01151-0935-0001, contains the following items:

Quantity	Description
1	Smart electronic assembly
1	Electronics cover
1	Cover O-ring
2	Terminal eyelets
2	Board spacers
2	Standoffs

REMOVING THE ANALOG ELECTRONICS ASSEMBLY

⚠CAUTION

Use proper earth grounding techniques when handling the smart electronics assembly. The smart electronics assembly is potentially sensitive to electric static discharge.

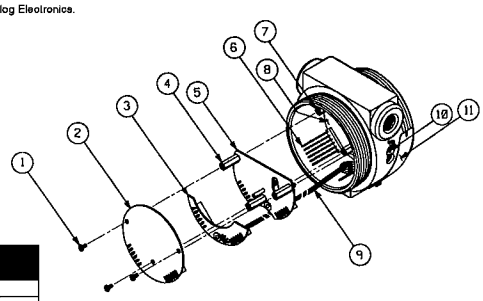
The vast majority of installed Model 1151 Transmitters have either "E" (4–20 mA linear) or "J" (4–20 mA square root) output codes. The transmitter output code is part of the model number on the transmitter nameplate. It is the eighth character from the left for AP, DP, GP, and HP, and LT transmitters.

Example: (1151DP4 E 12M1)

The following steps describe how to remove the analog electronics assembly from transmitters with "E" or "J" output codes for smart retrofitting. However, they can also be used as guidelines for retrofitting transmitters with "A" or "C" output codes. This process requires opening the electronics compartment on the circuit side of the transmitter and removing the amplifier or amplifier/squaring assembly, standoffs, and the calibration board.

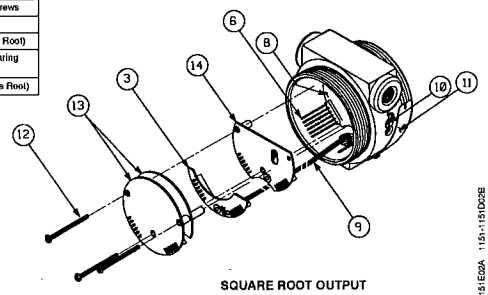
NOTE
Numbers in parentheses indicate parts shown in Figure C-1.

FIGURE C-1. Model 1151 Analog Electronics.



LINEAR OUTPUT

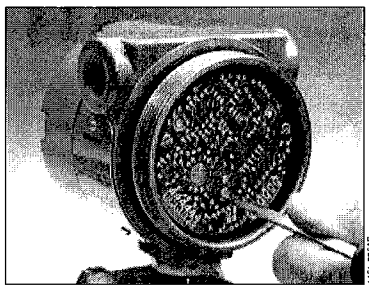
Ref. No.	Part Description
1	Retainer Screws (Linear)
2	Amplifier Board (Linear)
3	Header Board Assembly
4	Standoff Screws (Linear)
5	Calibration Board (Linear)
6	Bayonet Connector Pins
7	Standoff Screws (Linear)
8	Sensor Module Electronics
9	Wiring
10	Zero and Span Adjust Screws
11	Housing Cover
12	Retainer Screws (Square Root)
13	Two-board Amplifier/Squaring Assembly (Square Root)
14	Calibration Board (Square Root)



SQUARE ROOT OUTPUT

1151-1151E09A 1151-1151D02B

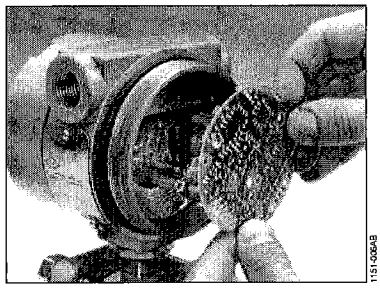
1. Ensure that power is removed from the transmitter before beginning the retrofit procedure.
2. Remove the cover from the circuit side of the transmitter.
3. Remove the three retainer screws (1 or 12).



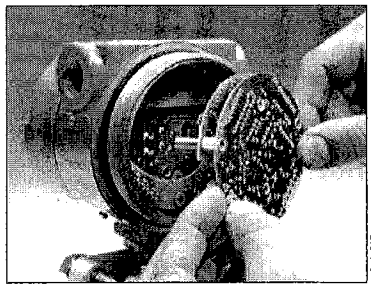
1151-005A5

See "Safety Messages" on page C-1 for complete warning information.

4. Pull the amplifier board (2) or amplifier/squaring assembly (13) directly off the bayonet connectors (6).

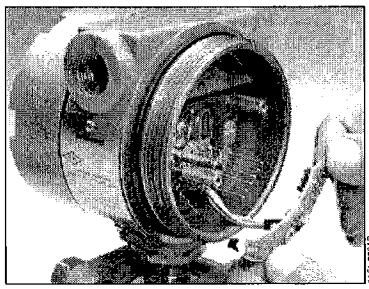


1151-006A5



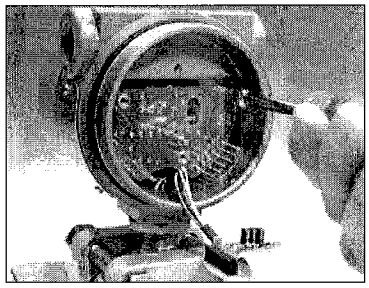
1151-007A5

5. Pull the header board assembly (3) off the bayonet connectors. The header board must be reinserted. Do not cut the wires (9) or remove the header board.



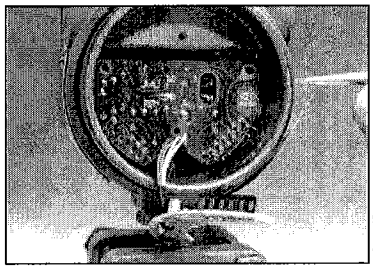
1151-008A5

6. If the transmitter has linear output electronics, remove the three standoffs (4). Use a ¼-in. nut driver or wrench.

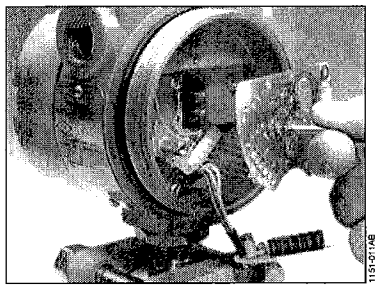


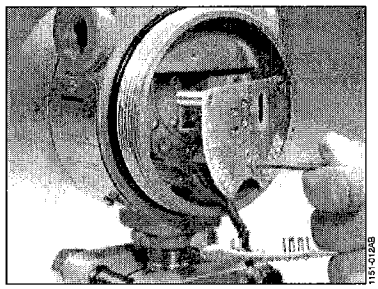
1151-009A5

7. Align the zero and span adjust screws (10) so that the potentiometer blades are perpendicular to the board.

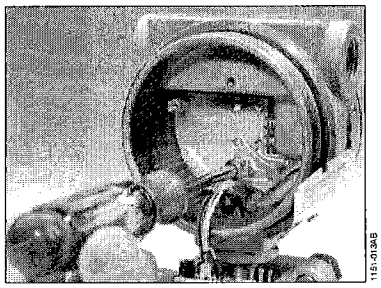


8. For linear output models, grip the calibration board (5) by the interface pin. For square root output modes insert a retainer screw into the threaded rivet for use as a handle. Pull out the calibration board. (Removing the calibration board disables the conventional zero and span screws.)





Insert the standoffs (7), if necessary. The transmitter is now ready to receive the plug-in smart electronics assembly.



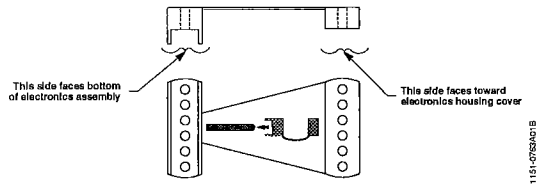
INSTALLING THE SMART RETROFIT KIT

Installing the smart retrofit electronics kit in the transmitter requires installing plastic spacers to accommodate the retrofit kit and securing the retrofit electronics. After the retrofit kit has been installed, it is necessary to attach eyelets to the terminal side of the transmitter. The eyelets enable hook-up with a HART-based communicator (see Figure C-2).

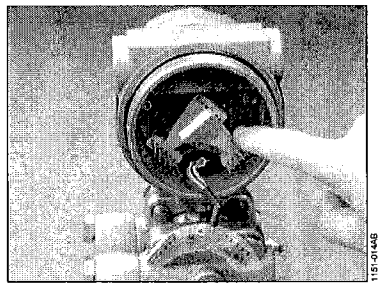
⚠CAUTION

Use proper earth grounding techniques when handling the smart electronics assembly. The smart electronics assembly is potentially sensitive to electric static discharge.

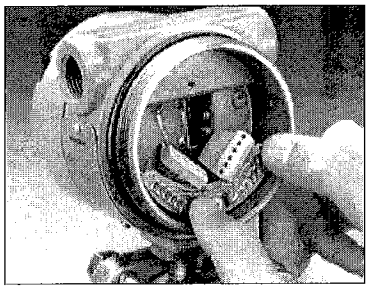
FIGURE C-2. Spacer Assembly.



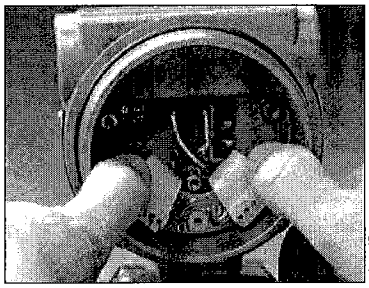
1. Slide the bottom half of one spacer over one of the rows of bayonet connectors. Then repeat the procedure for the other row.



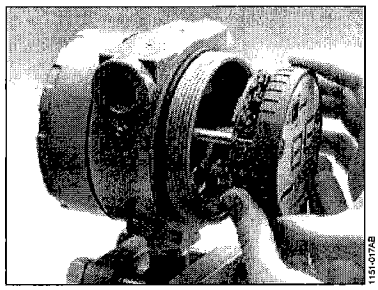
2. Align the header board with the bayonet connector pins, and slide the header board halfway down the pins.



3. Align the tops of both spacers with the bayonet connector pins, and slide them down the pins, pushing firmly on both the spacers and the header board to seat the board.



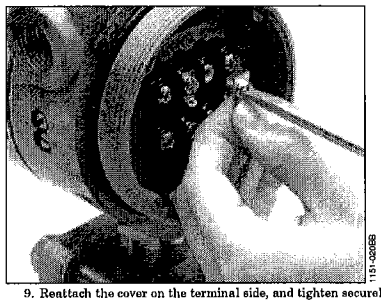
4. Align the smart electronics assembly with the bayonet connector pins, making sure all pins line up with the proper receptacles. Next, push the assembly slowly inward until it is fully seated.



5. Tighten the three captive screws on the smart electronics assembly to secure it in place.
6. Attach the electronics cover provided in the smart retrofit kit, and tighten securely.
7. Remove the cover from the terminal side of the transmitter.

Two eyelets that fit under the + and – signal terminal screws are provided to facilitate connections to HART-based communicator. The signal terminal is the upper block as indicated on the transmitter housing.

8. Remove the signal terminal + and – screws. Attach an eyelet to each screw, and reinsert the screws.



9. Reattach the cover on the terminal side, and tighten securely.

See "Safety Messages" on page C-1 for complete warning information.

CHARACTERIZATION

The transmitter is now ready to be characterized. Characterization is a one-time calibration of the sensor in the Model 1151 Transmitter. During characterization, known pressures are applied to the sensor, and corresponding digital values are stored in the EEPROM located in the smart transmitter electronics. The microprocessor uses these values to make linearization corrections. The digital-to-analog converter then converts the corrected digital signal into a 4–20 mA dc output. The Model 1151 Transmitter will stay in high alarm (approximately 22 mA output) until the characterization sequence is completed.

NOTE
The transmitter must be re-characterized if either the sensor module or the smart transmitter electronics are repaired or replaced.

Before Characterizing the Transmitter

1. Be prepared to answer the following questions:
   - Module type (AD, DP, HP, LT) on the transmitter S/N tag?
   - Module range on the transmitter module tag?
   - Pressure units on your pressure source?
   - Serial number on the transmitter S/N tag?
2. Connect the pressure source.
3. Remove the terminal side cover of the Model 1151 Smart Pressure Transmitter.
4. Connect power supply leads to the terminal block. Apply power to the transmitter.

NOTE
Failure to use accurate equipment may result in a transmitter that cannot meet its accuracy specification.

Characterizing with a Model 275 Communicator

1. Connect the Rosemount Model 275 HART communicator electrical connections to the SIGNAL terminal block. The Model 275 connections are not polarity sensitive.
2. Turn the Model 275 on by pushing the I/O button.
3. Follow the Model 275 menus to characterize:
   - Device setup
   - Detailed setup
   - Sensor
   - Pressure sensor
   - Sensor service
   - Characterize
4. Follow the instructions on the screen.
5. Verify the new transmitter configuration:
   - Tag
   - Range points
   - Linear/square root
   - Damping
6. Verify that the Fail Safe Mode Switch and the Transmitter Security Switch on the smart electronics circuit board are correct.
7. Attach the electronics cover and tighten.
8. Put the transmitter back in service.

See "Safety Messages" on page C-1 for complete warning information.

Characterization with a Model 268 Communicator

1. Connect the Rosemount Model 268 HART Communicator electrical connections to the SIGNAL terminal block. The Model 268 connections are not polarity sensitive.
2. Turn the Model 268 on by pushing the I/O button.
3. Follow the Model 268 menus to characterize:
   - Proceed
   - Format
   - Proceed
   - Charize
4. Follow the instructions on the screen.
5. Verify the new transmitter configuration:
   - Tag
   - Range points
   - Linear/square root
   - Damping
6. Verify that the Fail Safe Mode Switch and the Transmitter Security Switch on the smart electronics circuit board are correct.
7. Attach the electronics cover and tighten.
8. Put the transmitter back in service.

See "Safety Messages" on page C-1 for complete warning information.

Appendix D Approval Drawings

Index of intrinsically safe barrier systems and entity parameters for Models 444, 1135, 1144, 1151, and 2051 transmitters and Model 751 Field Indicators (Drawing Number 01151-0214, Rev. U), pages D-2 through D-7.

Index of intrinsically safe C.S.A. barrier systems for Model 1151 transmitters (Drawing Number 01151-2575, Rev. C), pages D-8 through D-10.

Index of intrinsically safe barrier systems and entity parameters for the Model 268 SMART FAMILY Interface (Drawing Number 00268-0031, Rev M), pages D-11 through D-17.

Index of intrinsically safe barrier systems and entity parameters for the Model 275 HART Communicator (Drawing Number 00275-0081, Rev B), pages D-18 through D-23.

Index of intrinsically safe C.S.A. barrier systems for the Model 275 HART Communicator (Drawing Number 00275-0082, Rev A), page D-24.

REVISIONS					
LTR	DESCRIPTION	ECO NO	REV BY	APPR	DATE
P	Change entity parameters (Fm on re-exam) correct 444 Ci	637376	GFG	LCA	9/24/90
R	Add 1151 Low Power Barrier System, Model 751 Li to 0	638105		MCR	11/27/90
T	1135, 1144, 1151 Li TO Ø	639039	SVC	MCR	12/21/90
U	1151 Li TO 20; Ci .01 AND .034	651426	SVC	KDH	10/11/92
V	751 Li TO Ø	662242		95E	11/17/93

CONTENTS

ENTITY APPROVALS	SHEETS 2 THRU 4
APPROVED PARAMETERS	SHEETS 2 THRU 3
CONNECTION DIAGRAMS	SHEET 4

MASTER

APPROVED SOURCES OF SUPPLY	
MFG	MFG PART NO

Material purchased to this Rosemount Specification Control Drawing shall be required to meet all the specifications of this drawing. Any mention of manufacturer's part number within this drawing is for reference only. This is necessary to ensure design control of Rosemount's end product. It is Rosemount's intent to purchase your standard material whenever possible.

SPECIFICATION CONTROL DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
DECIMALS FRACTIONS
.X ± .1 1/32
.XX ± .02 ANGLES
.XXX ± .010 ±2°

PREPARED BY: Nancy May 9/24/90
CHECKED BY: KGH
APPROVED BY QC:
APPROVED BY ENG: K. E. Hansen 9/24/90
APPROVED BY PURCH:
FINAL APPROVAL ES

ROSEMOUNT® Measurement Control Analytical Valves

TITLE: INDEX OF INTRINSICALLY SAFE BARRIER SYSTEMS & ENTITY PARAMETERS FOR 444, 1135, 1144, 1151, & 2051 TRANSMITTERS AND 751 FIELD INDICATORS

SIZE A | CAGE IDENT NO 04274 | DRAWING NO 01151-0214

SCALE None | W/M Each | SHEET 1 OF 2

ENTITY CONCEPT APPROVALS

The entity concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in combination as a system. The approved values of maximum open circuit voltage (V_{OC} or V_T) and maximum short circuit current (I_{SC} or I_T) for the associated apparatus must be less than or equal to the maximum safe input voltage (V_{MAX}) and input current (I_{MAX}) of the intrinsically safe apparatus. In addition, the approved maximum allowable connected capacitance (C_A) and inductance (L_A) of the associated apparatus must be greater than the maximum unprotected internal capacitance (C_i) and inductance (L_i) of the intrinsically safe apparatus. The approved entity concept parameters are as follows:

Model 444

Class I, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_i = 0.044μF	C_A is greater than 0.044IF
L_i = 0	L_A is greater than 0

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_i = 0.044μF	C_A is greater than 0.044IF
L_i = 0	L_A is greater than 0

Model 751

Class I, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_i = 0	C_A is greater than 0
L_i = 0	L_A is greater than 0

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_i = 0	C_A is greater than 0
L_i = 0	L_A is greater than 0

Rosemount Inc. MINNEAPOLIS, MINNESOTA				
DR.	REV A	FSCM NO.	DRAWING NO. 01151-0214	
ISSUE	SCALE: NONE	WT.	SHEET 2 OF 6	

MASTER

Model and 1151

Class I, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_i(1151 Std) = 0	C_A is greater than 0
C_i(Smart 1151) = 0.024μF	C_A is greater than 0.024μF
C_i(1151 Std w/R Option) = 0.010μF	C_A is greater than 0.010μF
C_i(1151 Smart w/R_Option) = 0.034μF	C_A is greater than 0.034μF
L_i(1151 Std) = 0	L_A is greater than 0
L_i(1151 w/R_ Option) = 20μH	L_A is greater than 20μH

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_i(1151 Std) = 0	C_A is greater than 0
C_i(Smart 1151) = 0.024μF	C_A is greater than 0.024μF
C_i(1151 Std w/R Option) = 0.010μF	C_A is greater than 0.010μF
C_i(1151 Smart w/R_Option) = 0.034μF	C_A is greater than 0.034μF
L_i(1151 Std) = 0	L_A is greater than 0
L_i(1151 w/R_ Option) = 20μH	L_A is greater than 20μH

Model 2051

Class I, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_i = 0.012μF	C_A is greater than 0.012IF
L_i = 480μH	L_A is greater than 480IH

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_i = 0.012μF	C_A is greater than 0.012IF
L_i = 480μH	L_A is greater than 480IH

Rosemount Inc. MINNEAPOLIS, MINNESOTA				
DR.	REV A	FSCM NO.	DRAWING NO. 01151-0214	
ISSUE	SCALE: NONE	WT.	SHEET 3 OF 6	

Model 1135

Class I, Div. 1, Groups A and B

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_I = 0.008µF	C_A is greater than 0.008IF
L_I = 0	L_A is greater than 0

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_I = 0.008µF	C_A is greater than 0.008IF
L_I = 0	L_A is greater than 0

Model 1144

Class I, Div. 1, Groups A and B

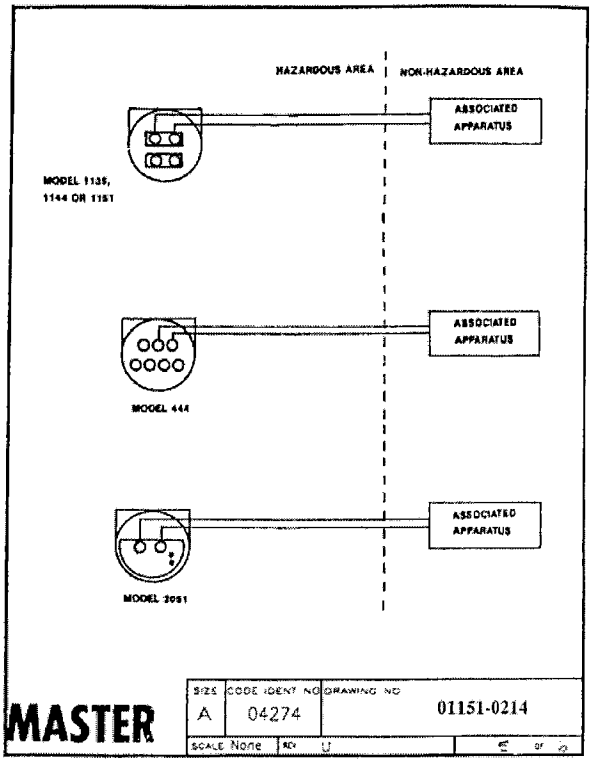
V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 165 mA	I_{SC} or I_T is less than or equal to 165 mA
C_I = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

Class I, Div. 1, Groups C and D

V_{MAX} = 40V	V_{OC} or V_T is less than or equal to 40V
I_{MAX} = 225 mA	I_{SC} or I_T is less than or equal to 225 mA
C_I = 0	C_A is greater than 0
L_I = 0	L_A is greater than 0

MASTER

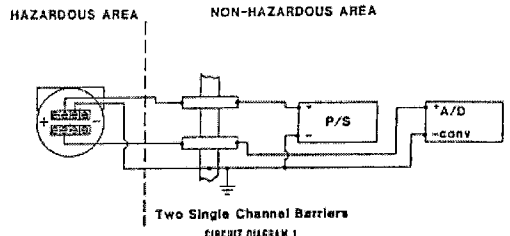
Rosemount Inc. MINNEAPOLIS, MINNESOTA			
DR.	SIZE A	FSCM NO.	DRAWING NO. 01151-0214
ISSUE	SCALE: NONE	WT.	SHEET 4 OF 6



MASTER

SIZE A	CODE IDENT NO 04274	DRAWING NO 01151-0214	
SCALE None	REV U		SHEET 5 OF 6

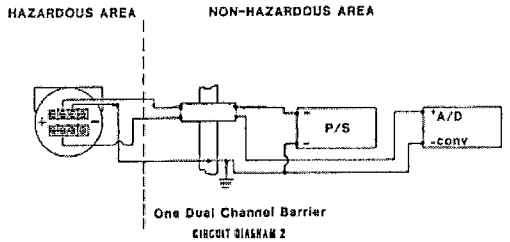
1151 — L & M CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS



Two Single Channel Barriers

CIRCUIT DIAGRAM 1

(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



One Dual Channel Barrier

CIRCUIT DIAGRAM 2

MASTER

SIZE A	CODE IDENT NO 04274	DRAWING NO 01151-0214	
SCALE NONE	REV U		SHEET 6 OF 6

PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY
BY DATE

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
A	NEW RELEASE	646666	W.C.R.	04/01/92
B	150 ohms was 120 ohms	650816	J.J.B.	10/13/92
C	150 ohms was 120 ohms (SHT 3)	652195	J.J.B.	1/20/93

CSA INTRINSICALLY SAFE APPROVAL

Exia
Intrinsically Safe /Securite Intrinseque

THE ROSEMOUNT MODEL 1151 PRESSURE TRANSMITTER IS APPROVED BY CSA AS INTRINSICALLY SAFE FOR THE CLASS I, DIVISION 1 GROUPS AS INDICATED WHEN USED WITH THE BARRIERS AND CONVERTERS LISTED BELOW AND CONNECTED AS SHOWN IN THE ACCOMPANYING DIAGRAMS.

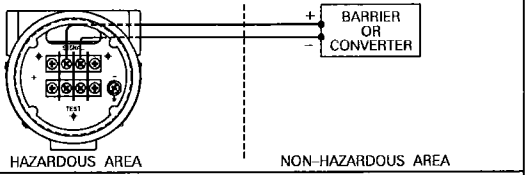
DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV. 1
CSA Approved Safety Barrier	30 V or less, 330 ohms or more 28 V or less, 300 ohms or more 22 V or less, 180 ohms or more	Groups A, B, C, D
Foxboro Converter 2AS-EI-CGB, 3A0-EIA CS-E /CGB-A 2AI-EV-CGB, 3A2-EIO CS-E /CGB-A 2AS-FI-CGB, 3A4-FIOA CS-E /CGB-A 3F4-EIOAI CS-E /CGB-A		Groups B, C, D
CSA Approved Safety Barrier	30 V or less 150 ohms or more	Groups C, D

THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.

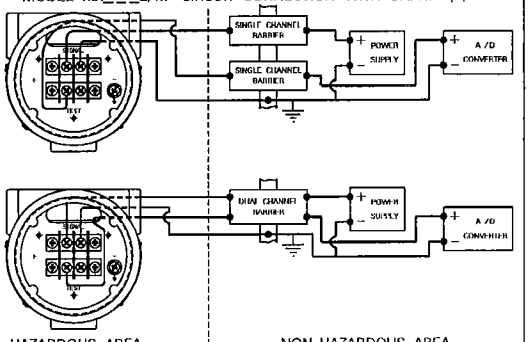
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 - TOLERANCES - DECIMALS .X±.1 .XX±.02 .XXX±.010 FRACTIONS ±1/32 ANGLES ±2° DO NOT SCALE PRINT	CONTRACT NO.	ROSEMOUNT Measurement Control Analytical Talkin — Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	
	DR. S.CAPAUL 03/18/92	TITLE INDEX OF CSA INTRINSICALLY SAFE BARRIER SYSTEMS FOR MODEL 1151 TRANSMITTERS	
	CHK'D W.C.RAUTH 04/01/92		
	APP'D. W.C.RAUTH 04/01/92		
	APP'D. GOVT.	SIZE A / FSCM NO / DWG NO. 01151-2575	
		SCALE N/A WT. —	SHEET 1 OF 3

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
C		652195		

MODEL 1151 CIRCUIT CONNECTION WITH BARRIER OR CONVERTER



MODEL 1151___L, M CIRCUIT CONNECTION WITH BARRIER(S)



Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. S.CAPAUL 03/28/92	SIZE A	FSCM NO	DWG NO. 01151-2575
ISSUED	SCALE NONE	WT. ———	SHEET 2 OF 3

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
C		652195		

MODEL 1151___L, M CIRCUIT CONNECTION WITH BARRIER(S)
(CONTINUED)

APPROVED FOR CLASS I, DIVISION 1, GROUPS A, B, C, D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS: ONE WITH APPROVED SAFETY PARAMETERS OF 28 VOLTS OR LESS AND 300 OHMS OR MORE IN +POWER LINE, AND THE OTHER WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN +OUTPUT LINE.

-OR-

ONE CSA APPROVED DUAL CHANNEL SAFETY BARRIER WITH IDENTICAL APPROVED SAFETY PARAMETERS CONNECTED IN LIKE MANNER.

APPROVED FOR CLASS I, DIVISION 1, GROUPS C, D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS; ONE WITH APPROVED SAFETY PARAMETERS OF 30 VOLTS OR LESS AND 150 OHMS OR MORE IN +POWER LINE AND THE OTHER WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN +OUTPUT LINE.

Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. S.CAPAUL 03/28/92	SIZE A	FSCM NO	DWG NO. 01151-2575
ISSUED	SCALE N/A	WT. ———	SHEET 3 OF 3

PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY
BY ——— DATE ———

REVISIONS			
REV	DESCRIPTION	CHG. NO.	APP'D / DATE
G	ADD SHT 4&5, DELETE CLASS II &III,	636328	B.S.J. 05/25/93
H	ADD 3051 P/L/M, 3081C CL /CH	636984	K.D.V. 09/25/92
J	ADD SHT. 6, FIX TBL. 1,	638723	B.S.J. 08/02/93
K	ADD 3044C	641710	W.R.K. 05/13/93
L	ADD 3001S & SHT 7 FOR 3051C-LP	642388	G.E.M. 07/07/93
M	ADD 3095	653145	K.D.V. 4/8/93

THE ROSEMOUNT MODEL 268 SMART FAMILY INTERFACE IS APPROVED BY FACTORY MUTUAL AS INTRINSICALLY SAFE FOR THE CLASS I, DIVISION 1 GROUPS INDICATED WHEN USED IN CIRCUIT WITH THE BARRIERS AND CONVERTERS LISTED BELOW AND THE ROSEMOUNT SMART FAMILY TRANSMITTERS DEPICTED IN THE ACCOMPANYING CIRCUIT DIAGRAMS.

BARRIER MANUFACTURER	MODEL	APPROVED FOR CLASS I DIVISION 1, GROUPS
FOXBORO	2AI-I2V-FGB 2AI-I3V-FGB 2AS-I3I-FGB 3A2-I2D-CS-E/FGB-A 3A2-I3D-CS-E/FGB-A	A,B,C,D
HONEYWELL	38545-000-0110-113-F585 38545-000-0110-111/112-F585	C,D
MTL	115 122 322 715 722	A,B,C,D
R. STAHL	8901/31-199/100/7 8901/30-199/100/7 8901/31-280/165/7 8901/30-280/165/7	C,D C,D
	8903/51-200/050/7 8901/31-086/150/7	A,B,C,D A,B,C,D
	8901/31-280/165/7 8901/31-086/150/7	C,D C,D
	9005/01-245/060 9005/01-252/100	A,B,C,D A,B,C,D
TAYLOR	5850FL81200 5851FL81200 1130FF21000 1130FF22000 1135FF21000 1135FF22000	C,D

THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125 - TOLERANCES - DECIMALS .X±1 .XX±.02 .XXX±.010 FRACTIONS ±1/32 ANGLES ±2° DO NOT SCALE PRINT	CONTRACT NO.	ROSEMOUNT Measurement Control Analytical Valves	Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA
	DR. MIKE DOBE 2/7/90	TITLE INDEX OF I.S. BARRIER SYSTEMS FOR MOD. 268 SMART FAMILY INTERFACE	
	CHK'D		
	APP'D. K.CARLSON 03/13/90	SIZE A	FSCM NO	DWG NO. 00268-0031
	APP'D. GOVT.	SCALE	WT. ———	SHEET 1 OF 7

FORM NO. 80651A-1 REV. C

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM, THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (V_T OR V_{OC}) AND MAXIMUM SHORT CIRCUIT CURRENT (I_T OR I_{SC}) AND MAXIMUM OUTPUT POWER ($V_{MAX} \times I_{MAX}$ OR $\frac{V_{MAX} \times I_{MAX}}{4}$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{MAX}), MAXIMUM SAFE INPUT CURRENT (I_{MAX}) AND MAXIMUM SAFE INPUT POWER (P_{MAX}) OF THE INTRINSICALLY SAFE APPARATUS, IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (C_A) AND INDUCTANCE (L_A) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE MAXIMUM UNPROTECTED INTERNAL CAPACITANCE (C_i) AND INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS. THE APPROVED ENTITY CONCEPT PARAMETERS ARE AS FOLLOWS: ARE AS FOLLOWS:

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

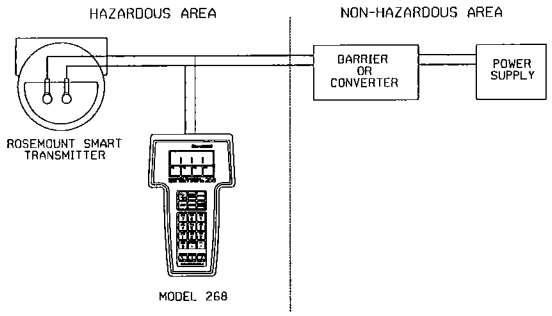
INPUT PARAMETERS (CLASS 1, DIV. 1, GROUPS A, B, C, D)				
V_{max} = 32 Vdc				V_T or V_{OC} of barrier must be ≤ 32 Vdc
I_{max} = 186 mA				I_T or I_{SC} of barrier must be ≤ 186 mA
C_i = 0.01 µF				C_A of barrier must be ≥ 0.01 µF
L_i = 1.1 mH				L_A of barrier must be ≥ 1.1 mH
P_{max}:	1.1W	0.8W	0.6W	$\frac{V_{OC} \times I_{SC}}{4}$ of barrier must be ≤ specified value.
Temp code	T4A	T5	T6	

OUTPUT PARAMETERS
V_{OC} = 1.5 Vd.c.
I_{SC} = 27 mA
C_A = 10,000 µF
L_A = 46 mH

Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. D.PEARSON	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ———	SHEET 2 OF 7

FORM NO. 80651A-1 REV. C

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



ROSEMOUNT SMART TRANSMITTERS

MODEL	1151 SMART
MODEL	3051
MODEL	3051C, 3051P, 3051L, 3051H, 3051CA
MODEL	3044
MODEL	3044C
MODEL	3001C, 3001CL, 3001CH
MODEL	3311
MODEL	3001S, 3001SL, 3001SH
MODEL	3095

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA

Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. D.PEARSON	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ———	SHEET 3 OF 7

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

THE MAXIUM ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS IS DETERMINED BY ADDING 27 mA TO THE Isc OF THE BARRIER (Im=Isc + 27mA AND ENTERING TABLE 1 (SHT 5) AT THE RESULTING VALUE, Im, OR THE NEXT HIGHER VALUE OF Im, TO DETERMINE THE La, (THE La MUST INCLUDE THE L_i OF THE MODEL 268, WHICH IS 1.1mH).

EXAMPLE *1: Isc OF BARRIER = 100mA.

Im = 100mA + 27mA = 127mA

ENTER TABLE AT Im = 130mA; La = 2.0mH

--WARNING-- BEFORE CONNECTING THE MODEL 268 INTO THE LOOP, DETERMINE THE CONNECTED INDUCTANCE OF THE SYSTEM BY ADDING THE L_i OF THE TRANSMITTER, CABLE, AND MODEL 268. THE SUM MUST BE LESS THAN THE La DETERMINED FROM THE TABLE IN ORDER FOR THE MODEL 268 TO BE CONNECTED INTO THE LOOP. IF THE CONNECTED INDUCTANCE IS GREATER THAN THE VALUE DETERMINED FROM THE TABLE, A BARRIER WITH A LOWER Isc MUST BE CHOSEN.

EXAMPLE *2: BARRIER ISC = 41.8mA; BARRIER LA = 20.0mH

IM = 41.8mA + 27mA = 68.8mA;

ENTER TABLE AT 70mA AND READ La = 7.5mH

ADD CONNECTED INDUCTANCE OF SYSTEM:

MODEL 268	L_i = 1.1mH
MODEL 3051 TRANSMITTER	L_i = 0.48mH
INDUCTANCE OF LOOP WIRING	1.0mH
TOTAL CONNECTED INDUCTANCE	= 2.58mH

TOTAL CONNECTED INDUCTANCE IS LESS THAN La = 7.5 mH AS DETERMINED ABOVE AND IS ALSO LESS THAN THE BARRIER La. THE MODEL 268 MAY SAFELY BE CONNECTED INTO THE LOOP. IF THE MODEL 751 INDICATORS ARE USED, THEIR TOTAL INDUCTANCE (LABEL VALUE • NUMBER OF INDICATORS) MUST ALSO BE INCLUDED.

S.BARDUSON 30JUL'98	SIZE A	FSCM NO	DWG NO. 00268-0031
	SCALE N/A	WT. ———	SHEET 4 OF 7

FORM NO. 80651A-1 REV. C

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

Im (mA)	La (mH)
150	1.3
145	1.5
140	1.6
130	2.0
120	2.5
110	3.0
100	4.0
90	5.0
85	5.5
80	6.0
75	6.7
70	7.5
65	8.8
62	9.5
60	10.0
57	11.0
55	12.0
50	15.0
45	19.0
40	23.0
35	31.0

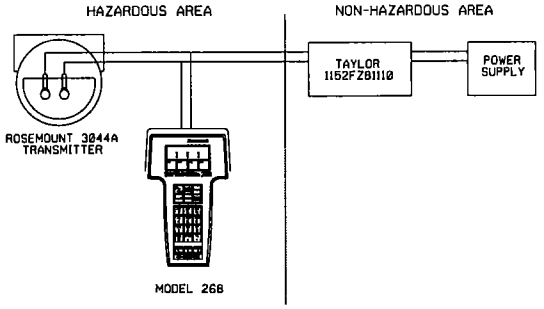
TABLE 1

Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. S.BARDUSON 30JUL'98	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ———	SHEET 5 OF 7

FORM NO. 80651A-1 REV. C

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE

TAYLOR 1152FZ81110 SYSTEM



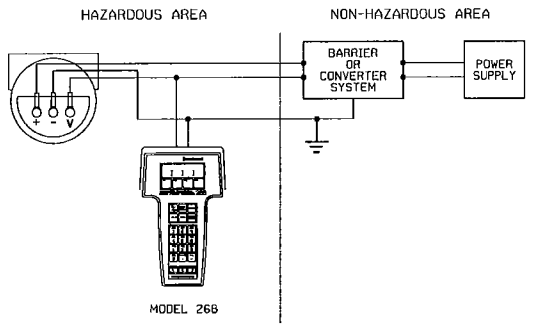
ROSEMOUNT 3044A SMART TRANSMITTERS MAY BE PLACED IN A CLASS I, DIVISION I, GROUP A, B, C, D HAZARDOUS LOCATION AS SHOWN ABOVE. THE LOOP POWER IS LIMITED BY A TAYLOR 1152FZ81110 INTRINSIC SAFETY BARRIER. THE ROSEMOUNT 268 MAY ALSO BE CONNECTED IN THE LOOP AS SHOWN. FOR CABLE WITH CAPACITANCE OF 60 pF/ft OR LESS AND INDUCTANCE OF .2 uH/ft OR LESS; CABLE LENGTHS OF UP TO 1600 FEET ARE ALLOWED.

TRANSMITTER: ROSEMOUNT 3044A
BARRIER: TAYLOR 1152FZ81110
COMMUNICATOR: ROSEMOUNT 268
CABLE: Cmax = 60 pF/ft
Lmax = .2 uH/ft
MAX. LENGTH = 1600 ft

Rosemount Inc. 12001 Technology Drive Eden Prairie, MN 55344 USA	THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.		
DR. C. SCRIBNER 12/21/98	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ———	SHEET 6 OF 7

FORM NO. 80651A-1 REV. C

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



CONNECTION FOR LOW POWER VERSIONS
OF THE FOLLOWING
ROSEMOUNT SMART TRANSMITTERS

MODEL 3051C, 3051P, 3051L, 3051H, 3051CA
MODEL 3001C, 3001CL, 3001CH
MODEL 3001S, 3001SL, 3001SH

Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

THIS DRAWING WAS CREATED ON CAD. DRAWING IS ARCHIVED ON MAGNETIC TAPE FOR ECO CHANGES.

DR. SANDI MANSON 8/8/91
ISSUED

SIZE A | FSCM NO | DWG NO. 00268-0031
SCALE N/A | WT. ——— | SHEET 7 OF 7

FORM NO. 80651A-1REV. C

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A	NEW RELEASE	654533	B.S.J.	8/30/93
B	CHG Vmax & C_i	657178	B.S.J.	12/13/93

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CONTRACT NO.
DR. C.SCRIBNER 8/2/93
CHK'D
APP'D. B.S.J.UNK 8/30/93
APP'D. GOVT.

ROSEMOUNT® Measurement Control Analytical Values
Rosemount Inc.
12001 Technology Drive
Eden Prairie, MN 55344 USA

TITLE: INDEX OF I.S. BARRIER SYSTEMS FOR MOD. 275 HART® COMMUNICATOR

SIZE A | FSCM NO | DWG NO. 00275-0081
SCALE | WT. ——— | SHEET 1 OF 6

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
B		657178		

FM ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPRATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (V_T OR V_{OC}) AND MAXIMUM SHORT CIRCUIT CURRENT (I_T OR I_{SC}) FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{MAX}) AND MAXIMUM SAFE INPUT CURRENT (I_{MAX}) OF THE INTRINSICALLY SAFE APPARATUS, IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (C_A) AND INDUCTANCE (L_A) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE MAXIMUM UNPROTECTED INTERNAL CAPACITANCE (C_i) AND INDUCTANCE (L_i) OF THE INTRINSICALLY SAFE APPARATUS. THE APPROVED ENTITY CONCEPT PARAMETERS ARE AS FOLLOWS:

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

INPUT PARAMETERS (CLASS I, DIV. 1, GROUPS A, B, C, D)	
Vmax = 30 Vdc	V_T or V_{OC} of barrier must be ≤ 30 Vdc
Imax = 300 mA	I_T or I_{SC} of barrier must be ≤ 300 mA
C_i = 0.07μF	C_A of barrier must be ≥ 0.07 μF
L_i = 0 mH	L_A of barrier must be ≥ 0 mH
OUTPUT PARAMETERS	
V_{OC} = 1.7 Vd.c.	
I_{SC} = 32 mA	

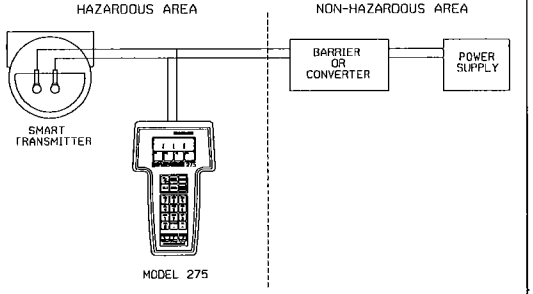
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THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS IS DETERMINED BY ADDING 32 mA TO THE Isc OF THE BARRIER (Im=Isc + 32mA) AND ENTERING TABLE 1 (SHT 5) AT THE RESULTING VALUE, Im, OR THE NEXT HIGHER VALUE OF Im, TO DETERMINE THE La.

EXAMPLE #1: Isc OF BARRIER = 100mA. (GROUP A)

Im = 100mA + 32mA = 132mA

ENTER TABLE AT Im = 140mA; La = 1.60mH

--WARNING-- BEFORE CONNECTING THE MODEL 275 INTO THE LOOP, DETERMINE THE CONNECTED INDUCTANCE OF THE SYSTEM BY ADDING THE L_1 OF THE TRANSMITTER AND CABLE. THE SUM MUST BE LESS THAN THE La DETERMINED FROM THE TABLE IN ORDER FOR THE MODEL 275 TO BE CONNECTED INTO THE LOOP. IF THE CONNECTED INDUCTANCE IS GREATER THAN THE VALUE DETERMINED FROM THE TABLE, A BARRIER WITH A LOWER Isc MUST BE CHOSEN.

EXAMPLE #2: BARRIER ISC = 41.8mA; BARRIER LA = 20.0mH

IM = 41.8mA + 32mA = 73.8mA;

ENTER TABLE AT 80mA AND READ La = 6.0mH

ADD CONNECTED INDUCTANCE OF SYSTEM:

MODEL 3051 TRANSMITTER	L_1 = 0.48mH
INDUCTANCE OF LOOP WIRING	1.0mH
TOTAL CONNECTED INDUCTANCE	= 1.48mH

TOTAL CONNECTED INDUCTANCE IS LESS THAN La = 6.0 mH AS DETERMINED ABOVE AND IS ALSO LESS THAN THE BARRIER La. THE MODEL 275 MAY SAFELY BE CONNECTED INTO THE LOOP. IF THE MODEL 751 INDICATORS ARE USED, THEIR TOTAL INDUCTANCE (LABEL VALUE * NUMBER OF INDICATORS) MUST ALSO BE INCLUDED.

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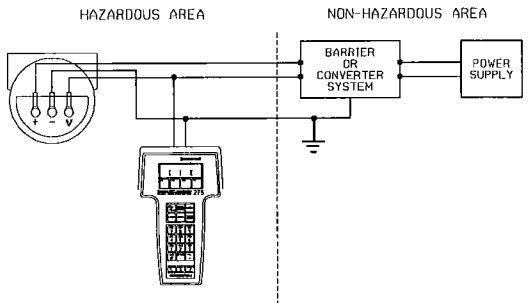
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Im	La (mH)		
(mA)	GROUPS A & B	GROUP C	GROUP D
300	0.20	1.80	3.20
280	0.21	2.00	3.70
270	0.23	2.20	3.90
260	0.25	2.50	4.30
250	0.27	2.70	4.60
240	0.30	3.00	5.00
220	0.40	3.20	5.90
200	0.50	4.00	7.20
180	0.60	5.00	8.80
170	0.80	5.50	9.90
160	1.00	6.20	11.20
150	1.30	7.00	12.70
140	1.60	8.00	14.60
130	2.00	9.00	16.90
120	2.50	10.00	19.80
110	3.00	12.00	23.60
100	4.00	15.00	28.50
90	5.00	18.00	35.10
85	5.50	20.00	39.30
80	6.00	22.00	44.40
75	6.70	25.00	50.50
70	7.50	28.00	57.90
65	8.80	34.00	67.10
62	9.50	37.00	73.70
60	10.00	40.00	78.70
57	11.00	43.00	87.10
55	12.00	48.00	93.50
50	15.00	56.00	113.10
45	19.00	70.00	139.40
40	23.00	87.00	176.30
35	31.00	110.00	229.90
32	36.00	135.00	274.80
30	40.00	150.00	312.40
28	46.00	170.00	358.40
25	58.00	210.00	449.00
23	68.00	250.00	530.10
21	82.00	300.00	635.30
20	90.00	330.00	700.00

TABLE 1

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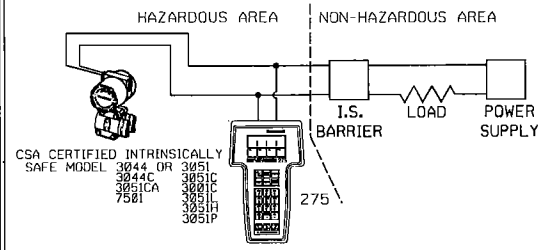
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CSA INTRINSIC SAFETY APPROVALS
MODEL 275 CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS

"Exia"
INTRINSICALLY SAFE/SECURITE INTRINSEQUE



INTRINSICALLY SAFE FOR USE IN CLASS I, DIVISON 1, GROUPS A,B,C AND D HAZARDOUS LOCATIONS WHEN CONNECTED TO CSA CERTIFIED INTRINSIC SAFETY BARRIERS AS INDICATED IN THE ABOVE CONNECTION DIAGRAM. CERTIFIED INTRINSIC SAFETY BARRIERS ARE LISTED BELOW.

30V MAX, 330 OHMS MIN
28V MAX, 300 OHMS MIN
22V MAX, 180 OHMS MIN

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	DR. C.SCRIBNER 6/2/93	TITLE 275 CSA INTRINSICALLY SAFE CONFIGURATION	
	CHK'D		
	APP'D.	SIZE A	FSCM NO	DWG NO. 00275-0082
	APP'D. GOVT.	SCALE NONE	WT. ———	SHEET 1 OF 1

Glossary

Some of the terms used in this manual relate specifically to the operation of Rosemount transmitters, hand-held communicators, and other Rosemount products. The following list provides brief definitions. See the sections listed for additional information.

Analog Output Trim — Digital trim operation that allows adjustment of the output electronics to conform to the plant standard of current. Three types of analog output trim are available: 4–20 mA output trim, 4–20 mA other scale, and low power.

Cloning — Off-line operation that uses a HART-based communicator to copy configuration data from one transmitter to one or more other transmitters that require the same data.

Commissioning — Functions performed with the HART-based communicator and the transmitter that test the transmitter and test the loop, and verify transmitter configuration data.

Configuration — Process of setting parameters that determine how the transmitter operates.

Damping — Output function that increases the response time of the transmitter to smooth the output when there are rapid input variations.

Descriptor — Sixteen-character field for additional identification of the transmitter, its use, or location. The descriptor is stored in the transmitter and can be changed using the HART-based communicator.

Digital Trim — Format function that allows you to adjust the transmitter characterization for purposes of digital calibration to plant standards. Digital trim includes two separate operations: sensor trim and analog output trim.

Failure Mode Alarm — Transmitter function that drives the analog output to a jumper-selectable high or low value in the event of an electronics failure.

Factory Characterization — Factory process during which each sensor module is subjected to pressures and temperatures covering the full operating range. The sensor module memory stores data generated from this process for use by the microprocessor in correcting the transmitter output during operation.

Full Trim — Sensor trim function in which two accurate, end-point pressures are applied and all output is linearized between them. The selected end points should always be equal to or outside the LRV and URV.

HART (Highway Addressable Remote Transducer) Protocol — Communications standard that provides simultaneous analog and digital signal transmission between control rooms and field devices such as transmitters. All Rosemount SMART FAMILY products communicate using the HART protocol.

Lower Range Limit (LRL) — Lowest value of the measured variable that the transmitter can be configured to measure.

Lower Range Value (LRV) — Lowest value of the measured variable that the analog output of the transmitter is currently configured to measure.

Multidropping — The connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

Reranging — Configuration function that changes the transmitter 4 and 20 mA settings.

Send Data — HART-based communicator command that transfers configuration data from the hand-held communicator's memory to the transmitter memory.

Sensor Trim — Digital trim function that allows you to adjust the digital process variable reading to a precise pressure input. Zero trim and full trim are the two sensor trim functions.

Smart — Term used to describe instruments that are microprocessor-based and feature advanced communications capabilities.

SMART FAMILY — Rosemount pressure, temperature, level, and flow instruments with microprocessor-based digital electronics.

Span — Algebraic difference between the upper and lower range values.

Tag — Eight-character field for identifying the transmitter. The tag is stored in the transmitter and can be changed using the Model 268 Communicator and the transmitter information function.

Transmitter Address — Unique number (1-15) used to identify a multidropped transmitter. Transmitters that are not multidropped have 0 as an address.

Transmitter Security — Jumper-selectable feature that prevents accidental or deliberate changes to configuration data.

Upper Range Limit (URL) — Highest value of the measured variable that the transmitter can be configured to measure.

Upper Range Value (URV) — Highest value of the measured variable that the analog output of the transmitter is currently configured to measure.

Zero Trim — A zero-based, one-point adjustment used in differential pressure applications to compensate for mounting position effects or zero shifts caused by static pressure.

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ACCESSORIES:

1-INLET FILTER
1-INLET SILENCER
1-DISCHARGE SILENCER
1-DISCHARGE PRESSURE GAUGE 0-15PSI
1-DISCHARGE TEMPERATURE GAUGE 0-400°F
1-CHECK VALVE
1-FLEX CONNECTOR FOR BLOWER DISCHARGE

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LAKE VILLA, IL 60046
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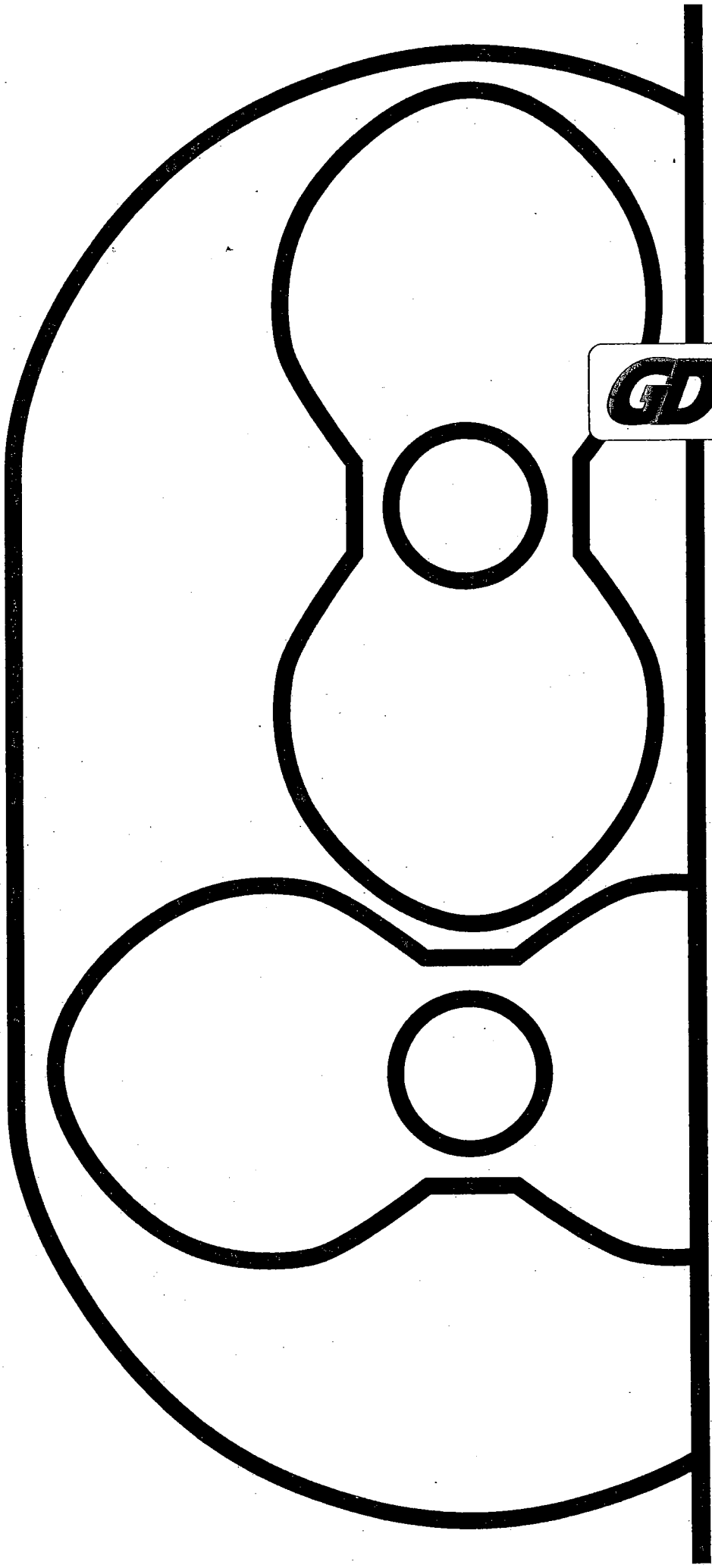
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2" – 5" GEAR DIAMETER

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SB–7–621
Version 04
October, 2003

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INSTRUCTIONS FOR DETERMINING BLOWER CONFIGURATION

1. Face the blower drive shaft.
2. In a **VERTICAL** configuration, air flow is horizontal.
3. In a **HORIZONTAL** configuration, air flow is vertical.
4. In a vertical configuration, a **BOTTOM HAND** exists when the drive shaft is below the horizontal center line of the blower. A **TOP HAND** exists when the drive shaft is above the horizontal center line of the blower.
5. In a horizontal configuration, a **RIGHT HAND** exists when the drive shaft is to the right of the vertical center line of the blower. A **LEFT HAND** exists when the drive shaft is to the left of the vertical center line of the blower.

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For pricing and ordering information, contact your nearest AUTHORIZED FACTORY DISTRIBUTOR.

When ordering parts, specify Blower **MODEL** and **SERIAL NUMBER** (see nameplate on unit).

Rely upon the knowledge and experience of your AUTHORIZED DISTRIBUTOR and let them assist you in making the proper parts selection for your blower.

For the location of your local authorized Gardner Denver blower distributor refer to the yellow pages of your phone directory or contact:

Gardner Denver Blower Division
100 Gardner Park
Peachtree City, GA 30269
Phone: (770) 632–5000
(800) 982–3009
Fax: (770) 486–5629

GARDNER DENVER LUBRICANT ORDER INFORMATION

Re–order Part Numbers for Factory–Recommended Lubricants.

Gear End

AEON PD Synthetic Lubricant or AEON PD–Food Grade Synthetic Lubricant

AEON PD Synthetic Lubricant

Description	Part Number
1 Quart	28G23
Case/12Quarts	28G24
5 Gallon Pail	28G25
55 Gallon Drum	28G28

AEON PD–Food Grade Synthetic Lubricant

Description	Part Number
1 Quart	28H97
Case/12Quarts	28H98
5 Gallon Pail	28H99
55 Gallon Drum	28H100

Drive End

AEON PD Grease

Description	Part Number
Case/10 Tubes	28H283

Call your local Sutorbilt Distributor to place your order for Gardner Denver lubricants. Your Authorized Gardner Denver Distributor is:

Mc Kenna Engineering 310-763-7929

* Jerry *

If you need to locate your nearest distributor, please call Customer Service at (770) 632–5000 or (800) 982–3009.

FOREWORD

Sutorbilt® blowers are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

⚠ DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard–related.

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious. Some general safety precautions are given below:

⚠ DANGER

Failure to observe these notices could result in injury to or death of personnel.

- **Keep fingers and clothing away from blower inlet and discharge ports, revolving belts, sheaves, drive coupling, etc.**
- **Do not use the air discharge from this unit for breathing – not suitable for human consumption.**
- **Do not loosen or remove the oil filler plug, drain plugs, covers, or break any connections, etc., in the blower air or oil system until the unit is shut down and the air pressure has been relieved.**
- **Electrical shock can and may be fatal.**
- **Blower unit must be grounded in accordance with the National Electrical Code. A ground jumper equal to the size of the equipment ground conductor must be used to connect the blower motor base to the unit base.**
- **Open main disconnect switch, tag and lockout before working on the control.**
- **Disconnect the blower unit from its power source, tag and lockout before working on the unit – the machine may be automatically controlled and may start at any time.**

⚠ WARNING

Failure to observe these notices could result in damage to equipment.

- **Stop the unit if any repairs or adjustments on or around the blower are required.**
- **Disconnect the blower unit from its power source, tag and lockout before working on the unit – the machine may be automatically controlled and may start at any time.**
- **Do not exceed the rated maximum speed shown on the nameplate.**
- **Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.**

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SUTORBILT LEGEND SERIES BLOWERS
MATRIX/MENU

NOTICE TO CUSTOMER – To find the construction options for your blower unit, FILL IN THE BALANCE OF LETTERS OR NUMBERS FROM YOUR UNIT NAMEPLATE

	G	A				P	
COLUMN NUMBER:	1	2	3	4	5	6	7

FOLLOW THE LINE DOWN AND OVER FROM EACH SPACE THUS FILLED IN TO FIND THE APPROPRIATE CONSTRUCTION OPTION WITH WHICH YOUR MACHINE IS EQUIPPED.

COLUMN 1 – BASIC DESIGNATOR

COLUMN 2 – PRODUCT FAMILY

COLUMN 3 – GEAR DIAMETER

A.	2"	F.	6"
B.	3"	G.	7"
C.	4"	H.	8"
E.	5"		

COLUMN 4 – CASE LENGTH

- L – Low Pressure
- M – Medium Pressure
- H – High Pressure

COLUMN 5 – CONFIGURATION

- A. Vertical–Top Hand–Central Timed
- B. Vertical–Bottom Hand–Central Timed
- C. Horizontal–Left Hand–Central Timed
- D. Horizontal–Right Hand–Central Timed

COLUMN 6 – DESIGN VERSION

COLUMN 7 – ADDITIONAL DESCRIPTION

- A. Lip Seal
- B. Mechanical Seal

INTRODUCTION
YOUR KEY TO TROUBLE FREE SERVICE

Thank you for investing in Sutorbilt quality. The Sutorbilt reputation for rugged dependability has been earned by over 50 years of service in demanding, industrial operations where downtime cannot be tolerated and efficient blower performance is expected.

Your Sutorbilt blower is a precision engineered blower that has been carefully manufactured and thoroughly tested at the state-of-the-art Gardner Denver Blower Factory in Sedalia, Missouri.

As with other precision machinery, there are several relatively simple installation, operation and maintenance procedures that you must observe to assure optimum blower performance. There is no guesswork in the manufacture of your highly advanced Sutorbilt blower and there must be none in preparing the blower to get the job done in the field.

The purpose of this manual is to help you properly install, operate and maintain your Sutorbilt blower. It is essential that you review all sections of this manual in preparation for installing your blower. Follow the instructions carefully and you will be rewarded with trouble–free Sutorbilt service . . . year in and year out.

WHERE TO CALL FOR SUTORBILT BLOWER ASSISTANCE:

For prompt professional Sutorbilt service always contact your authorized Sutorbilt Distributor first. If you do not know your authorized Sutorbilt Distributor, contact the numbers below for immediate assistance.

SUTORBILT CUSTOMER SERVICE	(770) 632–5000
SUTORBILT FACTORY SERVICE DEPARTMENT	(770) 632–5000

SUTORBILT HEADQUARTERS:
GARDNER DENVER BLOWER DIVISION
100 GARDNER PARK
PEACHTREE CITY, GA 30269
PHONE: (770) 632–5000 FAX: (770) 486–5629

IMPORTANT SUTORBILT TELEPHONE NUMBERS

YOUR AUTHORIZED SUTORBILT DISTRIBUTOR

NAME: _____

TELEPHONE: _____

FAX: _____

CONTACT: _____

THANKS . . . FOR THE PRIVILEGE OF SERVING YOU WITH DEPENDABLE SUTORBILT QUALITY.

SECTION 1
EQUIPMENT CHECK

Before uncrating, check the packing slip carefully to be sure all the parts have been received. All accessories are listed as separate items on the packing slip, and small important accessories such as relief valves can be overlooked or lost. After every item on the packing slip has been checked off, uncrate carefully.

NOTICE

Register a claim with the carrier for lost or damaged equipment.

⚠ WARNING

Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

STORAGE

Your Sutorbilt Blower was packaged at the factory with adequate protection to permit normal storage for up to six (6) months.

If the unit is to be stored under adverse conditions or for extended periods of time, the following additional measures should be taken to prevent damage.

1. Store the blower in a clean, dry, heated (if possible) area.
2. Make certain inlet and discharge air ports are tightly covered to prevent foreign material from entering the air box.
3. All exposed, non–painted surfaces should be protected against rust and corrosion.
4. Provide adequate protection to avoid accidental mechanical damage.
5. In high humidity or corrosive environments, additional measures may be required to prevent rusting of the blower internal surfaces.
6. To prevent rusting of gears, bearings, etc., the oil reservoirs may be filled with normal operating oil.

⚠ CAUTION

Before running the blower, drain the oil and replace to the proper operating level with clean, fresh lubricant.

7. Rotate the blower shaft (10 to 25 turns) weekly during storage. Inspect the blower shaft (near the shaft seal area) monthly and spray with rust inhibitor if needed.
8. For long term storage (over six (6) months), contact Sutorbilt Customer Service for recommendations.

REMOVING PROTECTIVE MATERIALS

The shaft extension is protected with rust inhibitor which can be removed with any standard solvent.

⚠ CAUTION

Follow the safety directions of the solvent manufacturer.

Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start–up.

The internal surfaces of all Sutorbilt units are mist sprayed with a rust preventative to protect the machine during shipment. Remove this film upon initial startup, using any commercial safety solvent. Position the blower so that the inlet and discharge connections are in the vertical position (vertical airflow). On vertically mounted units, it will be necessary to lay the unit on its side supporting the ends of the unit so as not to restrict the port on the bottom side. Place a shallow pan on the under side of the unit. With the blower disconnected from power, spray the solvent in the top port, rotating the impellers by spinning the shaft manually. Continue this procedure until the unit is visibly clean.

⚠ WARNING

Rotating components will cause severe injury in case of personal contact. Keep hands and loose clothing away from blower inlet and discharge ports.

SECTION 2
INSTALLATION

LOCATION

If possible, install the blower in a well lit, clean, dry place with plenty of room for inspection and maintenance.

FOUNDATIONS

For permanent installations we recommend concrete foundations be provided, and the equipment should be grouted to the concrete. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each. Before grouting, equipment must be leveled, free of all strains, and anchored so no movement will occur during setting of grout. After grout has completely hardened, a recheck is necessary to compensate for shrinkage, etc. If required, add shims under blower feet after final tightening of foundation anchor bolts to remove strain from the blower housing.

Where jack screws or wedges are used during grouting, they must be backed off or removed before final tightening of anchor bolts.

Where a concrete foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members, restricting movement and vibration.

MOUNTING CONFIGURATIONS

The blower flex–mount design enables horizontal and vertical mounting configurations with top or bottom hand, right or left hand shaft positioning. The units are center timed allowing rotation in either direction (refer to FIGURE 1). If converting a blower from vertical to horizontal, or horizontal to vertical mounting configuration, additional mounting feet will be required.

REPOSITIONING THE MOUNTING FEET:

1. Position the mounting feet to the desired location and snug the capscrew.
2. Place the blower on its feet on a flat surface.
3. Loosen mounting feet capscrews and level unit up. The bench or blower base flatness should be within .002 of an inch.

NOTICE

If the unit is not flat within .002 of an inch, it will be necessary to shim the blower feet at installation.

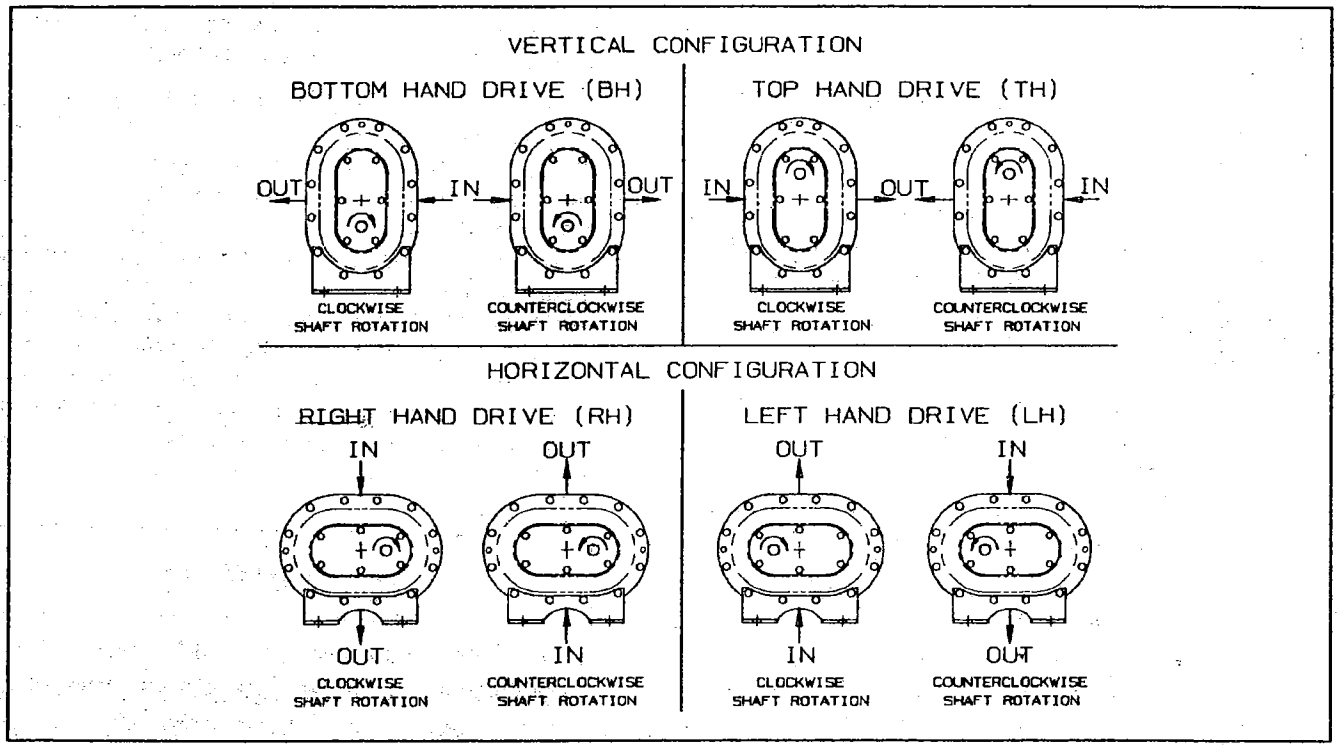


FIGURE 1 – BLOWER MOUNTING CONFIGURATIONS

4. Secure the mounting feet capscrews to the torque value in FIGURE 25, page 24.

NOTICE

When changing mounting configuration, it may be necessary to reposition vent plug (B), and drain plug (A). Refer to FIGURE 3, page 7, for correct location.

DRIVE INSTALLATION

When selecting a V–belt drive, check to be sure the shaft overhung load limitation is not exceeded. Refer to FIGURE 2, page 5, for overhung load calculations and limitations.

Belt drives must be carefully aligned. Motor and blower pulleys must be parallel to each other and in the same plane within 1/32 inch. Belt tension should be carefully adjusted to the belt manufacturer's recommendation using a belt tension gauge. Check tension frequently during the first day of operation.

⚠ WARNING

Overtightening belts leads to heavy bearing loads and premature failure.

On the direct connected units, alignment and lubrication of couplings to specifications of the coupling manufacturer is very important. When mounted drives are supplied from the factory, proper alignment has been established before shipment. However, during shipping, handling and installation, it is likely that the alignment has been disturbed and final adjustment must be made before startup.

⚠ WARNING

Exceeding overhung load limitations leads to unwarrantable premature bearing failure and shaft breakage.

The location of the sheave on the blower shaft greatly affects the stress in the shaft. The optimum blower sheave positioning is as close as possible to the blower drive cover, not to exceed dimension "C" in Drive Shaft Illustration, FIGURE 2, page 5.

The calculated shaft moment must not exceed the maximum allowable moment listed in Maximum Allowable Moment Chart, FIGURE 2, page 5. If the calculated shaft moment exceeds the maximum allowable moment:

- Increase Sheave Diameters to Reduce Belt Pull
- Use Jackshaft Drive
- Use Direct Coupled or Gearbox Drive

To calculate shaft moment for a given V–Belt Drive Arrangement:

1. Use the formula for Calculation of Belt Pull, FIGURE 2, page 5, to calculate belt pull. Refer to Arc of Contact Factor Chart, FIGURE 2, page 5.
2. Insert the calculated belt pull into the formula for Calculation of Shaft Moment, FIGURE 2, page 5, to arrive at the calculated shaft moment.

PIPING

Inlet and discharge connections on all blowers are large enough to handle maximum volume with minimum friction loss. Reducing the pipe diameter on either inlet or discharge will only create additional line loss and increase the overall pressure differential.

Excessive weight of piping and fittings will cause internal misalignment and premature wear. Never allow the blower to carry the weight of the pipe. If possible, a spool or sleeve-type expansion joint should be installed between the unit and the piping. Where a flexible connection is not practical, the weight of the rigid connection must be separately supported.

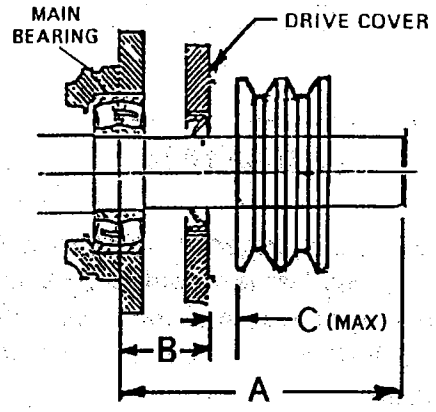
All system piping must be cleaned internally before connecting to the blower.

⚠ WARNING

Sutorbilt blowers are shipped dry from the factory. Do not attempt to operate the blower before following proper lubrication instructions. Permanent damage to the gears, bearings and seals will occur.

Gear Diameter (Inches)	Dimensions (Inches)			Maximum Allowable Moment (LB–IN)
	A	B	C (Max)	
2	2.76	.80	.38	146
3	2.88	.85	.38	385
4	3.49	1.10	.38	490
5	3.90	1.40	.38	1245

MAXIMUM ALLOWABLE MOMENT



DRIVE SHAFT ILLUSTRATION

Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac
0.000	1.000	0.250	0.966	0.500	0.926	0.750	0.879	1.000	0.823	1.250	0.751
0.025	0.997	0.275	0.962	0.525	0.922	0.775	0.874	1.025	0.816	1.275	0.742
0.050	0.994	0.300	0.958	0.550	0.917	0.800	0.869	1.050	0.810	1.300	0.734
0.075	0.990	0.325	0.954	0.575	0.913	0.825	0.864	1.075	0.803	1.325	0.725
0.100	0.987	0.350	0.951	0.600	0.908	0.850	0.858	1.100	0.796	1.350	0.716
0.125	0.983	0.375	0.947	0.625	0.904	0.875	0.852	1.125	0.789	1.375	0.706
0.150	0.980	0.400	0.943	0.650	0.899	0.900	0.847	1.150	0.782	1.400	0.697
0.175	0.977	0.425	0.939	0.675	0.894	0.925	0.841	1.175	0.774	1.425	0.687
0.200	0.973	0.450	0.935	0.700	0.889	0.950	0.835	1.200	0.767		
0.225	0.969	0.475	0.930	0.725	0.884	0.975	0.829	1.225	0.759		

ARC OF CONTACT FACTORS

$$\text{Belt Pull} = \left[\frac{2.5 - Ac}{Ac}\right]\left[\frac{125954 \times Hp \times S.F.}{D \times RPM}\right]$$

Key:
- Ac = Arc of Contact Factor (Refer to Arc of Contact Factors Chart above)
- Hp = Blower Horsepower for Operating Conditions
- S.F. = Actual Drive Service Factor
- D = Blower Sheave Pitch Diameter in Inches
- RPM = Blower Sheave Speed
- Z = $\left[\frac{\text{Large Sheave Pitch Diameter (in)} - \text{Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}\right]$

CALCULATION OF BELT PULL

$$\text{Shaft Moment (LB–IN)} = \text{Belt Pull} \times \left[B + C + \left(\frac{\text{Sheave Width}}{2}\right)\right]$$

CALCULATION OF SHAFT MOMENT

FIGURE 2 – BELT DRIVE OVERHUNG LOAD CALCULATIONS

AIR FILTERS AND FILTER SILENCERS

⚠ WARNING

Servicing the air filters is one of the most important maintenance operations to be performed to insure long blower life.

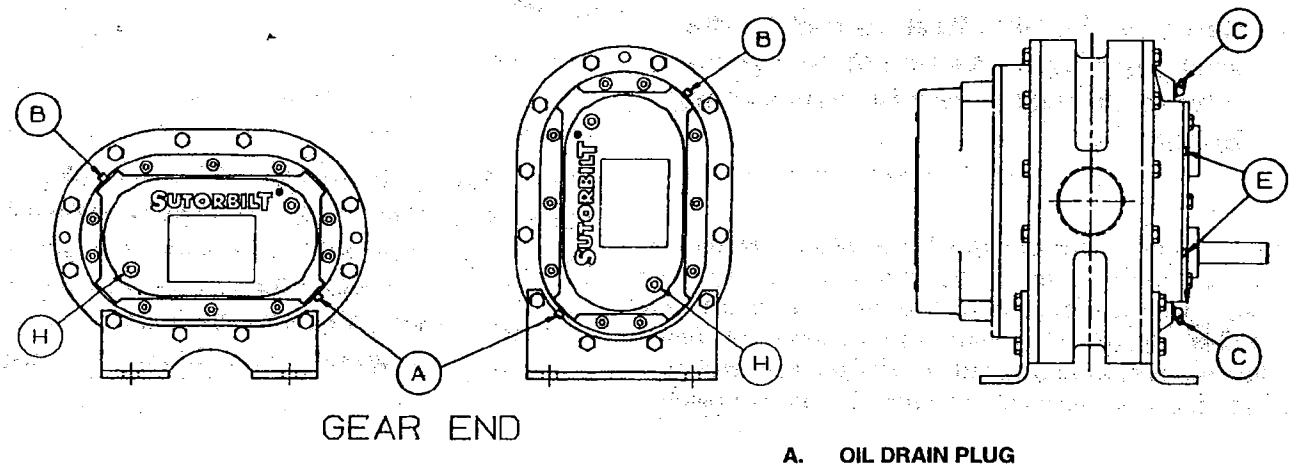
Servicing frequency of filter elements is not time predictable. A differential pressure indicator, with a continuous gauge reading, should be installed across the inlet filter. It will tell how much of the service life of the filter element has been used. It will also eliminate both premature filter servicing and premature blower failure due to a plugged filter when the filter pressure drop is used to establish maintenance points.

In all cases refer to the filter manufacturer's service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models.

NOTICE

No matter what type of filter is used, always make sure all seats, gaskets, clamps and hose connections on the filter and inlet line are absolutely air tight. Each time the filter is serviced, inspect interior of the blower for dirt.

SECTION 3
LUBRICATION



A. OIL DRAIN PLUG
B. VENT PLUG / BREATHER / OIL FILL
C. GREASE FITTINGS
E. GREASE VENTS
H. OIL LEVEL PLUG / GAUGE

FIGURE 3 – LUBRICATION

DRIVE END LUBRICATION

Drive end bearings are grease lubricated at the factory with Lithium Complex based grease. **For relubrication, use Gardner Denver AEON PD Grease, Part Number 28H283.** AEON PD Grease is a high temperature, high performance grease that is formulated with antiwear additives to provide superior service under the severe operating conditions of positive displacement blowers. It contains rust inhibitors which provide excellent protection against rust and corrosion.

Order AEON PD Grease from your Sutorbilt Distributor or call Gardner Denver Customer Service at 800–982–3009 (770–632–5000) to find your nearest distributor.

If you choose not to use AEON PD Grease, select a compatible base grease. The grease should be NLGI Grade 2 EP, contain rust inhibitors, and be suitable for blower discharge temperatures up to 350° F (177° C). Completely clean or purge the factory–filled grease from the blower. **Do not mix different types of grease as they may not be compatible. Substitutions may cause early bearing failure.**

Re–grease bearings every 500 hours of operation. Lubricate each bearing through the grease fittings located at C in FIGURE 3 (2 places). When re–greasing, the old grease will be forced out of the vents (E in FIGURE 3). To prevent damage to seals, these vents must be open at all times.

⚠ WARNING

Do not over–grease bearings as this could cause premature bearing failure.

GEAR END LUBRICATION

At the gear end, the timing gear teeth are lubricated by being partially submerged in oil. The gear teeth serve as oil slingers for gear end bearings.

Approximate oil sump capacities are listed in FIGURE 4, page 8.

RECOMMENDED LUBRICANT

Gear Diameter	Vertical	Horizontal
2"	1/4 PT.	1/2 PT.
3"	1/3 PT.	2/3 PT.
4"	3/4 PT.	1 PT.
5"	1 PT.	2–1/4 PT.

FIGURE 4 – APPROXIMATE OIL CAPACITIES

The factory recommended lubricant is AEON PD Synthetic Lubricant. AEON PD is formulated especially for positive displacement blowers to provide maximum protection at any temperature. One filling of AEON PD will last a minimum of 4 times longer than a premium mineral oil, depending on actual operating conditions. AEON PD contains a special additive package designed for greater rust and corrosion protection.

Order AEON PD from your Sutorbilt Distributor or call Gardner Denver Customer Service at 800–982–3009 (770–632–5000) to find your nearest distributor. A food–grade formula is also available. Part numbers are listed below.

AEON PD Lubricant

Description	Part Number
1 Quart	28G23
Case/12Quarts	28G24
5 Gallon Pail	28G25
55 Gallon Drum	28G28

AEON PD Food Grade Lubricant

Description	Part Number
1 Quart	28H97
Case/12Quarts	28H98
5 Gallon Pail	28H99
55 Gallon Drum	28H100

FIGURE 5 – AEON PD SYNTHETIC LUBRICANT

NOTICE

Machines are shipped without oil in the sump. Do not operate before adding lubricant.

LUBRICATION INSTRUCTIONS

Filling Procedure (For 2" and 3" sizes)
Refer to FIGURE 3, page 7. Remove the oil level plug (H) and the square head vented oil fill plug (B) from the gear cover. Add oil to the gear case until oil drips out of the oil level hole (H). Secure plugs in their correct location.

Filling procedure (For 4" and 5" sizes)
Refer to FIGURE 3, page 7. Remove the breather (B) from the gear cover. Add oil to the gear case until oil reaches the center of the oil level gauge (H). Secure breather (B) in the gear cover.

Add fresh oil as required to maintain proper level. The oil level should be at the middle of the sight glass when the machine is not operating.

⚠ WARNING

Do not overfill as this will tend to cause excessive heating of the gears and may damage the unit.

AEON PD Synthetic Lubricant should be drained after 6000 hours of operation. Re–fill with fresh AEON PD oil. If mineral oil is used, perform the above oil–change maintenance every 1500 hours. Recommended service intervals are for normal blower operating conditions. Severe operating conditions may warrant more frequent oil changes. Laboratory analysis of lubricant should be used to help determine the optimum oil change interval.

For best performance and equipment protection, use AEON PD Synthetic Lubricant, which has been specifically formulated for positive displacement blowers. If you choose not to use AEON PD Synthetic Blower Lubricant, select an oil with rust and oxidation inhibitors, anti–foam additives, and the viscosities listed in FIGURE 6, page 9. Do not use an oil that contains EP-additives.

NOTICE

Flush the oil whenever a change is made from one type of oil to another.

Drain the current lubricant as thoroughly as possible. Refill with the new lubricant. Fill to normal level of the blower, which is at the middle of the sight glass when the machine is not operating. Run the blower for one hour. Shut off the blower and drain the lubricant completely. Refill the blower again with the new lubricant.

Blower Discharge Temperature	Ambient Temperature			
	Less than10° F *	10° F to 32° F **	32° F to 90° F	Greater than 90° F
Less than 32° F (0° C)	ISO 100 ‡	ISO 100 ‡		
32° F to 100° F (0° C to 38° C)	ISO 100 ‡	ISO 100 ‡	ISO 150 ‡	
100° F to 225° F (38° C to 105° C)	ISO 100 ‡	ISO 100 ‡	ISO 150 ‡	ISO 220 ‡
225° F to 300° F (105° C to 149° C)	ISO 150 ‡	ISO 150 ‡	ISO 220 ‡	ISO 220 ‡
Greater than 300° F (149° C)			*** ‡	*** ‡

* For ambient temperatures less than 10° F, but not less than –20° F, the use of oil sump heaters, heated enclosures or synthetic lubricant is required.

** For ambient temperatures 10° F to 32° F, the use of oil sump heaters, heated enclosures or synthetic lubricant is recommended.

*** The lubricant viscosity must be 70 SUS minimum at the lubricant operating temperature.

The pour point of the lubricant should be at least 5° to 10° F below the minimum expected ambient temperature.

For continuous operation, where the lubricant temperature exceeds 200° F, synthetic lubricant is recommended.

‡ The recommended operating range for AEON PD Synthetic Lubricant.

FIGURE 6 – LUBRICATION RECOMMENDATION

SECTION 4
OPERATION

Future operating problems can be avoided if proper precautions are observed when the equipment is first put into service.

Before starting under power, the blower should be turned over by hand to make certain there is no binding, or internal contact.

Each size blower has limits on pressure differential, running speed, and discharge temperature which must not be exceeded. These limits are shown in the following tabulation.

⚠ WARNING

Operating beyond the specified operating limitations will result in damage to the unit.

It is important that the pressures and temperatures are measured directly at the ports of the blower to avoid error that may be caused by intervening pipe runs, fittings, etc.

Relief valves should be used to protect against excessive pressure or vacuum conditions. These valves should be tested at initial startup to be sure they are adjusted to relieve at or below the maximum pressure differential rating of the blower.

NOTICE

Relief valves should be placed as close as possible to the blower inlet or discharge.

In some instances, pressure may be relieved at a lower point than the blower maximum in order to protect the motor or the equipment served by the blower.

Discharge temperature switches are recommended to protect against excessive inlet restriction or inlet temperatures. Check valves in the discharge line on pressure blowers and in the inlet line on vacuum blowers are recommended to protect the blower from motoring backwards when shut down under load.

LIMITATIONS

For information regarding limitations, refer to FIGURE 7, below.

MAXIMUM OPERATING LIMITATIONS

SIZE	RPM	PRESSURE PSI	VACUUM IN HG	DISCHARGE TEMPERATURE °F
2LP	5275	7	14	285
2MP	5275	12	15	315
3LP	3600	7	14	260
3MP	3600	12	15	280
3HP	3600	15	16	320
4LP	3600	7	14	260
4MP	3600	10	16	285
4HP	3600	15	16	310
5LP	2850	7	14	260
5MP	2850	13	16	280
5HP	2850	15	16	300

DO NOT EXCEED THESE LIMITS

NOTICE

Blower speed, line losses, elevation, and increased inlet temperatures will affect the maximum operating limitations.

FIGURE 7 – MAXIMUM OPERATING LIMITATIONS

BLOWER STARTUP CHECKLIST

This startup procedure should be followed during the initial installation and after any shutdown periods or after the blower has been worked on or moved to a new location. It is suggested that the steps be followed in sequence and checked off (✓) in the boxes provided.

☐ 1. Check the unit and all piping for foreign material and clean if required.

☐ 2. Check the flatness of the feet and the alignment of the drive. Feet that are bolted down in a bind can cause case distortion and internal rubbing. Misaligned V-drives can cause the impellers to rub against the headplates and cause a reduction in the volumetric efficiency of the unit. Misaligned couplings can ruin bearings.

☐ 3. If blower is V–belt driven, check the belt tension and alignment. Over-tensioned belts create heavy bearing loads which leads to premature failure.

☐ 4. Be sure adequate drive guards are in place to protect the operator from severe personal injury from incidental contact.

☐ 5. Check the unit for proper lubrication. Proper oil level cannot be overemphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating and can ruin gears and cause other damage. Insure drive end bearings are greased.

☐ 6. With motor locked out, turn the drive shaft by hand to be certain the impellers do not bind.

☐ 7. "Jog" the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.

☐ 8. The internal surfaces of all Sutorbilt units are mist sprayed with a rust preventive to protect the machine during the shipping and installation period. This film should be removed prior to start–up.

☐ 9. Start the unit and operate 15 minutes at no load. During this time, check for hot spots and other indications of interference.

☐ 10. Apply the load and observe the operation of the unit for one hour. Check frequently during the first day of operation.

☐ 11. If malfunctions occur, do not continue to operate. Problems such as knocking impellers can cause serious damage if the unit is operated without correction.

SAFETY PRECAUTIONS

1. Do not operate blower with open inlet or outlet port.
2. Do not exceed specified vacuum or pressure limitations.
3. Do not operate above or below recommended blower speed range.
4. Blower is not to be used where non–sparking equipment is specified.
5. Do not operate without belt guard or coupling shield.

⚠ WARNING

Do not exceed sheave or coupling manufacturers' rim speed limit.

6. The blower and blower discharge piping may be extremely hot and can cause skin burns on contact.

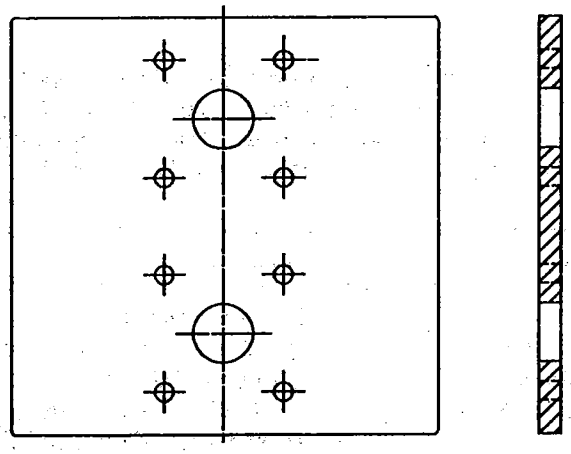
TROUBLE SHOOTING

No matter how well the equipment is designed and manufactured, there may be times when servicing will be required due to normal wear, the need for adjustment, or various external causes. Whenever equipment needs attention, the operator or repairman should be able to locate the cause and correct the trouble quickly. The Trouble Shooting Chart below is provided to assist the mechanic in those respects.

PROBLEM	POSSIBLE CAUSES	SOLUTION
Knocking	1. Unit out of time.	1. Retime impellers.
	2. Distortion due to improper mounting or pipe strains.	2. Check mounting alignment and relieve pipe strains.
	3. Excessive pressure differential.	3. Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary.
	4. Worn gears.	4. Replace timing gears.
	5. Worn bearings.	5. Replace bearings.
Excessive blower temperature.	1. Too much oil in gear case.	1. Reduce oil level.
	2. Too low operating speed.	2. Increase blower speed.
	3. Dirty air Filter	3. Clean or replace air filter.
	4. Clogged filter or muffler.	4. Remove cause of obstruction.
	5. Excessive pressure differential.	5. Reduce pressure differential across the blower.
	6. Worn impeller clearances.	6. Replace impeller.
	7. Internal contact.	7. Correct clearances.
Impeller end or tip drag.	1. Insufficient assembled clearances.	1. Correct clearances.
	2. Case or frame distortion.	2. Check mounting and pipe strain.
	3. Excessive operating pressure.	3. Remove cause.
	4. Excessive operating temperature.	4. Remove cause.
Lack of volume.	1. Slipping belts.	1 Tighten belts.
	2. Worn clearances.	2. Re-establish proper clearances.
	3. Dirty air Filter	3. Clean or replace air filter.
Excessive bearing or gear wear.	1. Improper lubrication.	1. Correct lubrication level. Replace dirty oil.
Loss of oil.	1. Headplate, gear case or drive cover vents plugged.	1. Clean vents.
	2. Worn seal.	2. Replace seals.

SECTION 5
SPECIAL TOOLS REQUIRED

ORDER SPECIAL TOOLS BY PART NUMBER. SEE PAGE i FOR ORDERING INSTRUCTIONS.



Unit Size	Part Number
2"	200GAA340
3"	201GAA340
4"	202GAA340
5"	203GAA340

FIGURE 8 – PULLER PLATE

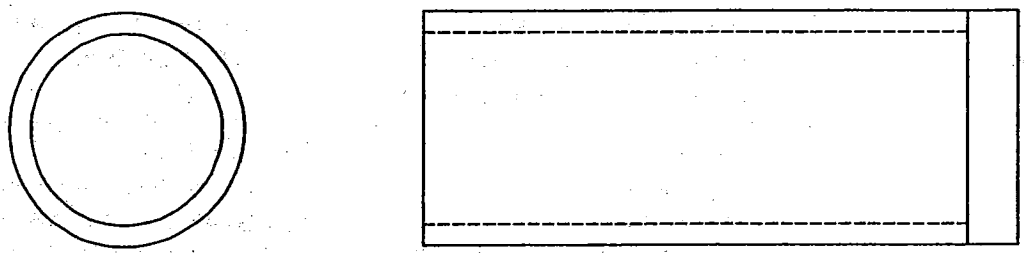
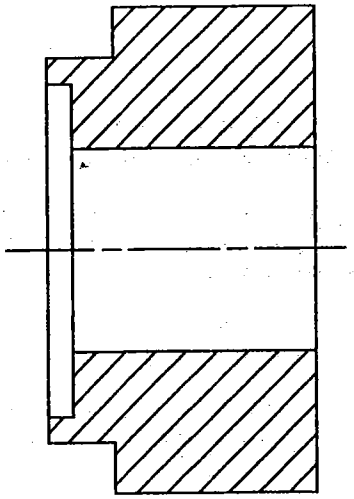
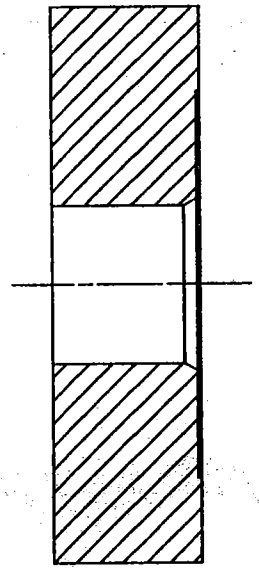


FIGURE 9 – GEAR DRIVER – 208GAA074



Unit Size	Part Number
2"	204GAA074
3"	205GAA074
4"	206GAA074
5"	207GAA074

FIGURE 10 – MECHANICAL SEAL INSTALLATION TOOL



Unit Size	Part Number
2"	200GAA074
3"	201GAA074
4"	202GAA074
5"	203GAA074

FIGURE 11 – BEARING PRESS TOOL – MECHANICAL SEAL UNITS

SECTION 6
DISASSEMBLY INSTRUCTIONS

NOTICE

Numbers in parentheses ( ) refer to key numbers in assembly drawings on pages 25, 27, 29 and 31.

1. Drain oil from gear case by removing drain plug (4).
2. Remove the socket head bolts (5) from the gear cover (3).
3. Remove the gear cover from the gear headplate.

NOTICE

The cover and gear headplate gasket tends to bond tightly to both surfaces. After socket head bolt removal, it is sometimes necessary to take a ball peen hammer and a blunt chisel and drive off the cover.

IMPORTANT:

MARK ALL PARTS WITH A CENTER PUNCH SO THEY CAN BE REASSEMBLED IN THE SAME POSITION (IMPELLERS, HEADPLATES, AND GEARS).

4. If the timing gears appear undamaged, the gear backlash must be checked to see if the gears can be salvaged.
   A. Mount a magnetic base dial indicator on the gear headplate (see FIGURE 12).
   B. Lock one impeller stationary by wedging a feeler gauge between the impeller and the headplate.
   C. The tip of the indicator should be placed at the center of the contact surface on a tooth of the gear on the free shaft.
   D. Rock the impeller back and forth by hand and read the total rotational movement to the nearest .0005 inches. Do this at four gear mesh positions 90 degrees apart.
   E. Permissable gear backlash is shown below.

GEAR DIA.	GEAR BACKLASH
2"	.0015 – .0025
3"	.0015 – .0025
4"	.0015 – .0025
5"	.002 – .003

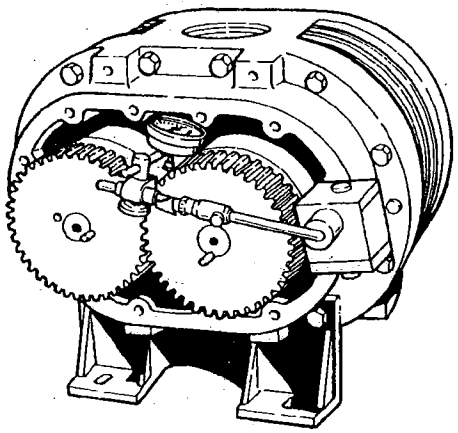


FIGURE 12

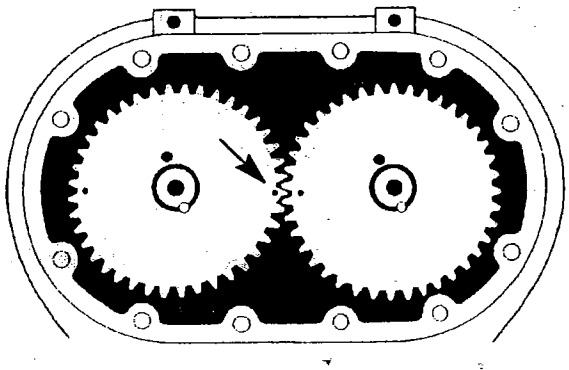


FIGURE 13

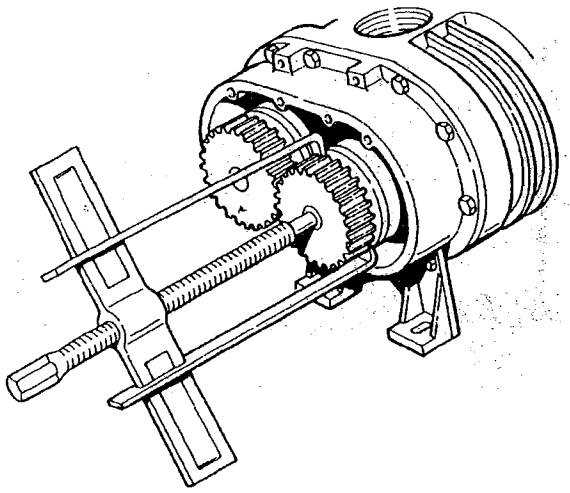


FIGURE 14

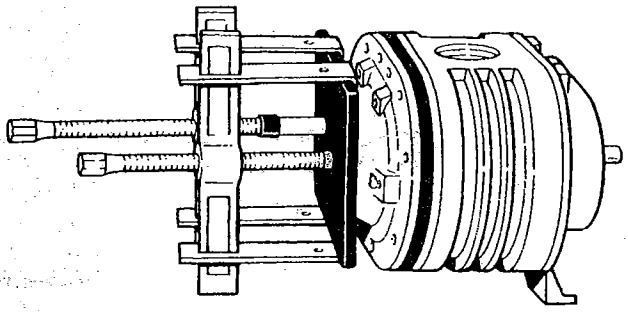


FIGURE 15

NOTICE

If backlash is above the specified limit, the gears are not necessarily unusable. Excessive play could be caused by worn bearings.

5. If timing gears appear to be reusable, matchmark timing gear toothmesh by making small punch marks on the ends of meshing gear teeth with a pin punch and hammer (see FIGURE 13, page 15). The impeller tip to valley (throat) and the case to headplates should also be match marked to facilitate blower reassembly.

6. Using a gear puller, remove timing gears. The taper pin should back out with the gear as the gear is being removed (see FIGURE 14). Use caution not to damage gear teeth with puller if gears are to be used again.

NOTICE

Blowers with mechanical seals have two wavy washers (28) located between the bearings and the cover on the drive end.

7. Remove the socket head cap screws (30) from the drive end bearing cover (29) and remove the cover. Drive shaft oil seal (31) should come free when cover is removed.

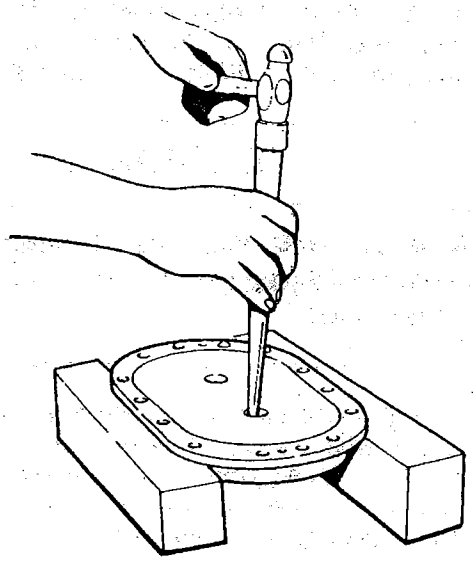


FIGURE 16

8. Remove mounting foot (17) from the drive headplate (24) by removing the capscrews (16).

9. Remove the capscrews (21) which secure the drive headplate (24) to the impeller case (22).

10. Using the puller plate shown on page 13, bolt to the drive headplate using the tapped holes used to secure the drive cover.

11. Install a gear puller to each shaft and attach puller arms to the plate. Turn each puller only half a revolution at a time keeping the advance of the shafts as uniform as possible (see FIGURE 15). After the headplate has been removed, detach the puller plate.

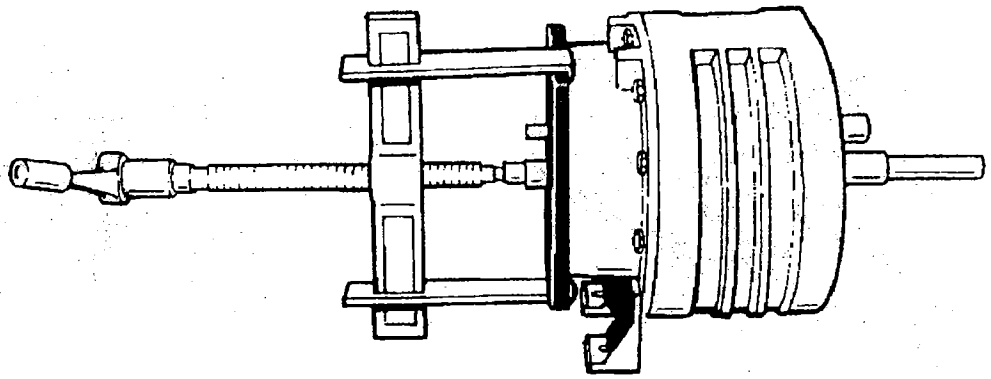


FIGURE 17

12. Remove the two drive end bearings (15) from the drive headplate (24) using a ball peen hammer and punch (see FIGURE 16, page 16).

⚠ CAUTION

Exercise care not to damage the headplate bearing bores when removing bearings.

13. The grease seals can now be driven out of the drive headplate with hammer and punch (see FIGURE 16, page 16). Discard the seals as they will not be reused. Replace grease seals each time the headplate is removed.

NOTICE

Seals and bearings should be replaced during overhaul as a matter of service policy.

14. Remove the four cap screws (10), which fasten the bearing retainers (12) to the gear headplate.

15. Attach puller plate to the gear headplate using the tapped holes used to secure the bearing retainers.

16. Install a gear puller to one of the shafts and attach puller arms to the plate (see FIGURE 17).

17. Remove mounting foot (17) from the gear headplate by removing 4 capscrews (16).

18. Push the impeller shaft through the gear headplate and remove the impeller assembly (23) (see FIGURE 17). Remove the other impeller assembly following the same procedure.

19. Remove the cap screws (21) securing the gear headplate to the impeller case. Located near each dowel pin on the headplate is a threaded hole. Insert a 5/16–18 UNC capscrew into each of the threaded holes. Tighten the screws evenly until the headplate separates from the impeller case.

20. Remove the two gear end bearings (14) from the gear headplate (18) as done in step 12.

21. Remove the oil seals (15) from gear headplate (19) as done in step 13.

SECTION 7
ASSEMBLY INSTRUCTIONS

NOTICE

Numbers in parentheses ( ) refer to key numbers in assembly drawings on pages 25, 27, 29 and 31.

1. Make sure all metallic parts are clean and free of any nicks or burrs.

2. Lubricate the outside diameter of the lip seal (15) with a light oil or grease. Install seals in both the drive headplate (24) and gear headplate (18). The seal lip should always face towards the bearing or lubricant. New seals should be installed each time the headplate is removed.

NOTICE

Make sure seals are fully seated. Use extreme care when installing.

MECHANICAL SEALS ONLY

A. Lightly coat the headplate bores with assembly lubricant.

B. Refer to FIGURE 18. Install mechanical seal (A) into the headplate bore (C) using a press and the correct driver shown on page 14. Drive the seal securely on to its seat.

⚠ CAUTION

Use extreme care when installing seals in the headplate bores. Do not attempt to install the mechanical seals without the use of a press. Blows from a hammer or mallet can damage the fragile seal surface. Too much force can crush the seal casing. Make certain the seal is properly seated and undamaged before proceeding.

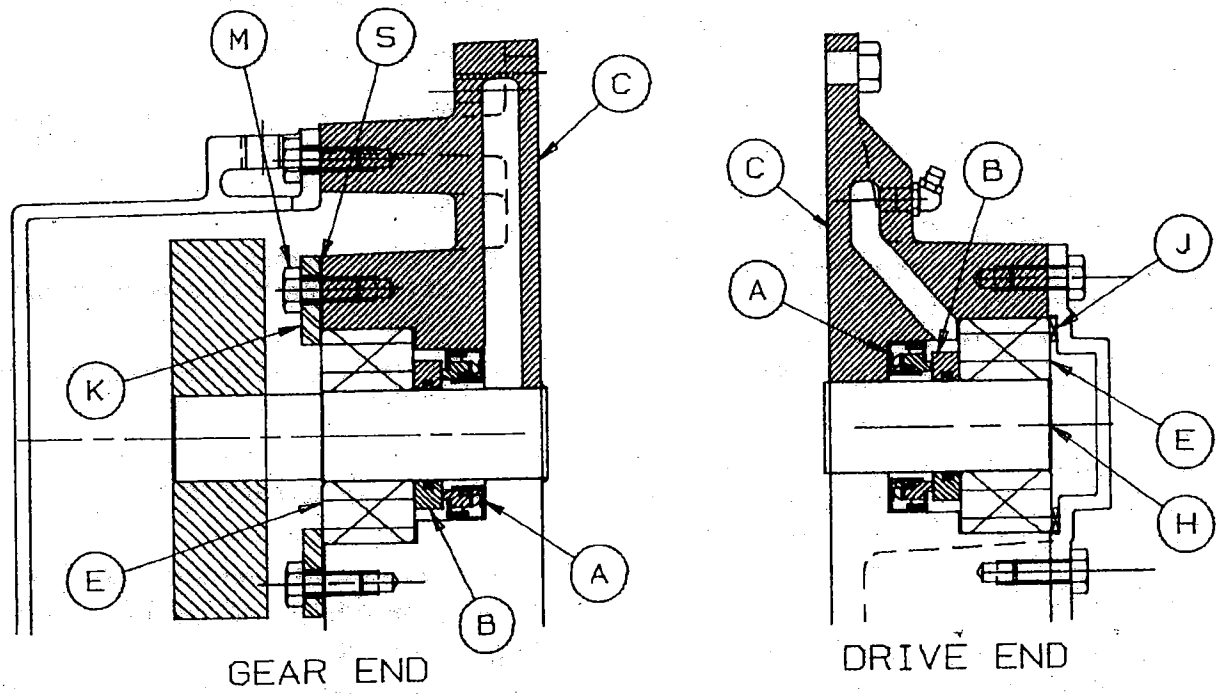


FIGURE 18

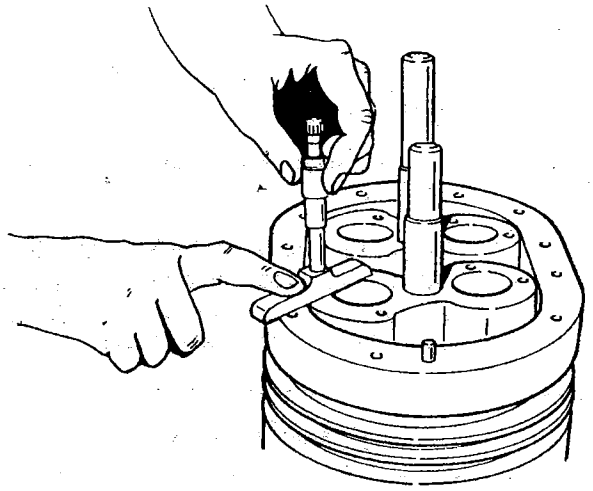


FIGURE 19

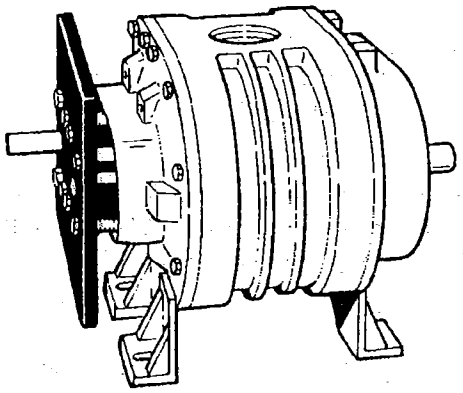


FIGURE 20

3. Assemble gear headplate (18) and mounting foot (17) to the impeller case with cap screws (21) and where the mounting foot is secured to the headplate use capscrews (16). The two positioning dowel pins (19) will ensure proper alignment of the headplate and impeller case. Also secure lifting lugs using capscrews (21) (see exploded assembly drawing page 25). Torque capscrews alternately and evenly. Refer to FIGURE 25, page 24, for torque specifications.

4. Apply a light oil or grease on the shaft seal areas and the bearing areas. Insert impellers into the gear headplate using the same headplate bores as used in the original assembly.

⚠ CAUTION

Seals are delicate; use extreme care when installing impeller shafts in the headplate bores. A piece of light shim stock wrapped around the shaft keyway will prevent cutting the seal lip.

5. Position blower so that impellers are vertical, with the drive end on top. It will be necessary to use blocks in order for the unit to set level. Measure the total end clearance using a depth micrometer (see FIGURE 19).

   If total clearance is not within the limits specified in FIGURE 21, page 20, it may be necessary to shim the case to obtain the proper total end clearance. The shim should be placed between the drive headplate and impeller case.

NOTICE

If more than .007" shim is required, put .007" on the drive end and the remaining on the gear end.

6. Assemble drive headplate (24) to impeller case as done in step 3 with the gear headplate. If shims were required, place shims between drive headplate and impeller case.

MECHANICAL SEALS ONLY

A. Refer to FIGURE 18, page18. Lightly coat the impeller shaft (H) and the inside diameter of the mating ring (B) with assembly lubricant.

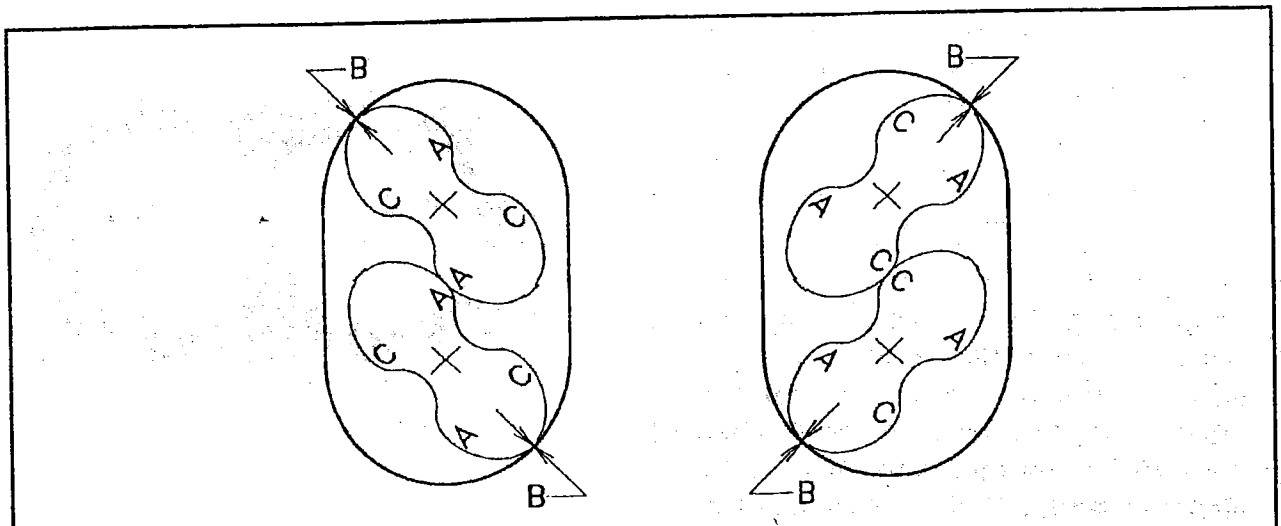
B. Install the mating ring (B) on the shaft only far enough to get the bearing (E) started on the shaft.

C. Lightly lubricate the bearing inner race (E) with a light oil or grease.

⚠ CAUTION

Do not drive the mating ring down to the mechanical seal, as this can damage the seal.

D. Using a press, install the bearing on the shaft with the bearing driver shown on page 14.



	2M	2L	3H	3M	3L	4H	4M	4L	5H	5M	5L
TOTAL END CLEARANCE	.003–.005		.004–.006			.004–.006			.006–.009		
IMPELLER TO GEAR HEADPLATE	.0015–.0025		.002–.003			.002–.003			.003–.004		
IMPELLER TIMING (A–A) (C–C)	.004–.006		.005–.007			.007–.009			.007–.009		
RADIAL CLEARANCE (B–B)	.004–.0055		.004–.006			.003–.005			.004–.006		

FIGURE 21

The bearing driver will position the mating ring (B) to the correct depth with respect to the mechanical seal (A).

7. Apply a light oil to the drive headplate bearing bore, bearing inside diameter, and shaft seat. Install the drive end bearings (14) as far as possible without force.

8. Attach the puller plate shown on page 13 to the drive headplate using the tapped holes used to secure the drive cover (see FIGURE 20, page 19). Tighten the bolts so that the advance of the bearings stay as uniform as possible. Bearings should be pressed until flush with the drive headplate.

9. Lubricate the gear end bearing fits with a light oil as described previously. Install gear end bearings (14) as far as possible without force. Use the plate, used to install the drive end bearings, to press the bearings on the shafts as described in Step 8. Press bearings into the gear headplate until completely seated in the bearing bore.

NOTICE

Bearings will not be flush with gear headplate bores when completely seated.

10. Impellers should now be checked for free axial movement by hitting the ends of the impeller shafts with the palm of your hand.

11. Push the impellers against the gear headplate and recheck the total end clearance between the drive headplate and the impellers (see FIGURE 21).

    A. If total end clearance is insufficient, loosen impeller case to headplate bolts on either headplate, and move the headplate away from the case far enough to insert a paper shim in the amount equal to the insufficient clearance. Retighten case bolts and again check the total end clearance. Refer to FIGURE 21 for correct clearance.

    B. Excessive end clearances normally will require new impeller assemblies, but in some

circumstances the impeller case can be removed and reduced in width by machining off the amount of excess clearance.

⚠ CAUTION

These impeller–to–impeller and impeller–to–case clearances are extremely critical. Even though the blower may turn freely by hand when cold, under operating conditions, the parts expand, and the rotors are subject to slight deflection.

If the clearances are not sufficient, the impellers may contact each other or the housing with destructive results. If the clearances are too great, the blower may not develop the pressure or airflow that is required to perform its function.

12. Impeller tip to case clearance should be checked at this time by inserting the correct thickness feeler gauge between the tip and the case and rotating the impeller (see FIGURE 21, page 20). Repeat the procedure on both impellers.

NOTICE

When checking the tip to case clearance, move the feeler gauge over the entire length of the impeller to ensure that the tips do not bind along their length.

13. INSTALLING THE TIMING GEARS

A. Apply a light grease, or oil, on the shaft area where the timing gear will be positioned.

B. Place feeler stock in the amount of 1/3 of the total end clearance between drive headplate and both impellers. This will stop the impellers from contacting the headplate while the gears are being driven on.

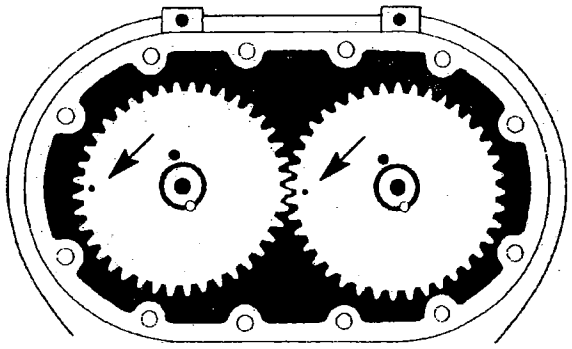


FIGURE 22

⚠ CAUTION

If installing gears on a blower containing mechanical seals, a press must be used to drive the gears on the shafts. Blows from a hammer or mallet will damage the seal.

C. Secure the bearing retainer plate (12) to the gear headplate using capscrews (10). Refer to FIGURE 25, page 24, for torque specifications.

D. If reusing the timing gears, the gears should be returned to their original positions. Use taper pin holes and matchmarks for correct positioning.

NOTICE

Replacement gears have minimum backlash marks on the outside diameter of the gear face. These marks should be located 180 degrees from each other (see FIGURE 22).

E. Using the driving tool shown on page 13, drive one gear flush with the end of the shaft and replace taper pin (8) by rereaming original hole if the movement between the shaft and gear was negligible. If rereaming fails to eliminate edges set up by retiming, drill and ream a new hole approximately 90° from the

original hole. Control the depth of the taper pin, leaving approximately 1/8 in. taper pin protruding beyond the gear and end of shaft.

NOTICE

If gears are being replaced, taper pin holes must be drilled after the gears are correctly positioned.

⚠ CAUTION

Be careful not to let cuttings drop behind the gears and contaminate the bearings.

F. Place impellers in the position shown in FIGURE 21, page 20. Check to be sure impellers are in correct position as previously match marked.

G. Drive the mating gear on the other shaft within 1/2" of being flush with the end of the shaft.

H. Refer to diagram in FIGURE 21, page 20. Use feeler gauges to check clearances between impeller lobes at positons A–A and C–C. Add the clearances, and divide the total clearance evenly between A–A and C–C.

I. If the lobe clearance is not equal between A–A and C–C, the impellers require shifting relative to the gears. Insert a feeler gauge .010 inch larger than required clearance between the impellers at the tight spot and rotate the impellers wedging the feeler gauge between the lobes. Place the driving tool against the gear that is not flush with the end of the shaft, and strike the driver with a quick blow. This will drive the gear further onto the shaft, causing it to turn relative to the shaft due to the torque value set–up by the oversized feeler gauge wedged between the impeller lobes. Adjust so that the clearance at A–A is equal to C–C within .001 inch. Clearances must be checked on both sides of each impeller lobe over the entire length. This procedure may require repeating several times until the impeller lobe clearance is equal on both sides.

NOTICE

The gear used for adjustment should be flush with its mate on completion of the timing.

J. Check gear backlash four places at 90 degree intervals as described in the disassembly procedure (Item 4).

NOTICE

If any of the four gear backlash readings are not within the specified limits, the gears must be replaced.

14. After timing adjustments are completed, insert taper pin between the shaft and adjustment gear by rereaming original hole if movement between the shaft and gear was negligible. If reaming fails to eliminate the edges due to slight misalignment, drill and ream a new hole approximately 90° from the original hole.

NOTICE

Replacement gears are not drilled. These holes must be drilled after the gears are in the proper position and the unit retimed.

15. **SETTING IMPELLER END CLEARANCES**

Refer to FIGURE 23, page 23. The outer races of the gear end bearings are clamped against the headplate (F) by the bearing retainer (B).

This is referred to as the "fixed end". The interference fit between the shaft and the bearing inner race (H) keeps the shaft from moving axially. Adjustment is by movement of the shaft through the gear end bearing inner race (H).

A. Check the total end clearance by adding the clearance between the impellers and the drive headplate to the clearance between the impellers and the gear headplate.

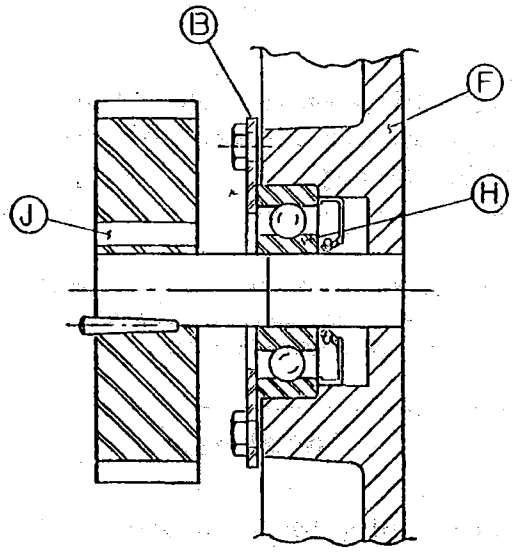


FIGURE 23

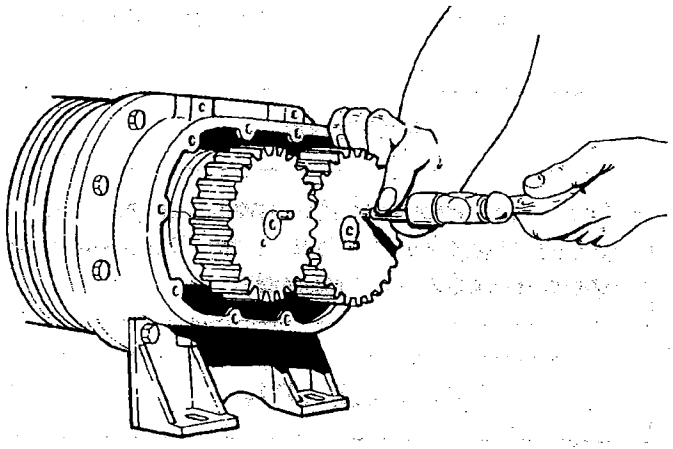


FIGURE 24

NOTICE

Check the clearance over the entire width of the impeller and consider the tightest spot.

B. Divide the total end clearance by 3 and distribute approximately 1/3 on the gear end and the remaining 2/3 on the drive end.

C. To move the impeller assembly toward the drive end, lightly tap the shaft at the gear end with a soft face mallet.

D. To set the fixed end, insert the feeler gauge in the amount specified in FIGURE 21, page 20, between the headplate and the impeller at the gear end.

E. Insert a mild steel or soft metal rod thru the small hole in the gear (9). Tap lightly until the feeler gauge is snug. Adjust both impellers using the same procedure. Rotate the impellers checking for clearance through a complete revolution (see FIGURE 24).

SETTING IMPELLER END CLEARANCE WITH MECHANICAL SEALS

Refer to FIGURE 18, page 18. The gear end bearings are held in position by the force created by the wavy spring (J) on the drive end and the bearing retainer (K) on the gear end. This is referred to as the fixed end. The interference fit between the shaft (H) and the bearing inner race (E) keeps the shaft from moving axially.

End clearance adjustment is by movement of the bearing retainer (K). Tightening the bearing retainer screws (M) moves the bearing to load the wavy spring (J), and the impeller is forced toward the drive end. Relaxing the screws allows the wavy spring to return the impeller toward the gear end.

A. Assemble drive cover to drive headplate. Refer to Step 16 with the exception of the use of wavy springs (J) installed between the drive end bearings and the drive cover.

B. Back out retainer screws (M) until both impellers are tight against the gear headplate.

C. With feeler gauge, measure the clearance between each impeller and the drive headplate. This value is the total end clearance.

D. Measure the clearance between the gear headplate and bearing retainer (K) at point (S).

E. Subtract 1/3 of the total end clearance from the clearance measured at point (S). This value is the amount of shim (13) that should be placed between the retainer and the headplate at point (S).

F. Tighten the bearing retainer screws (M) to the torque value given in FIGURE 25, page 24. With the retainer screws secure, approximately 1/3 of the total end clearance should be on the gear end and the remaining 2/3 on the drive end.

16. Replace drive shaft grease seal (31) in the drive end cover (29). The seal lip should always face towards the bearing or lubricant. Pack bearing cavities with recommended grease and secure drive cover with capscrews (30) to drive headplate. Refer to FIGURE 25 for torque specifications.

⚠ CAUTION

Exercise care not to damage the seal lip as it passes over the shaft keyway.

17. Assemble the gear cover (3) and gasket (7) to the gear headplate (18) using capscrews (5). Tighten the capscrews alternately and evenly. Refer to FIGURE 25 for torque specifications.

18. Place the blower on its feet on a flat surface. Loosen cap screws (16) and level the unit up. The bench or blower base flatness should be within .002 of an inch. Re–tighten cap screws (16) to the specification in FIGURE 25.

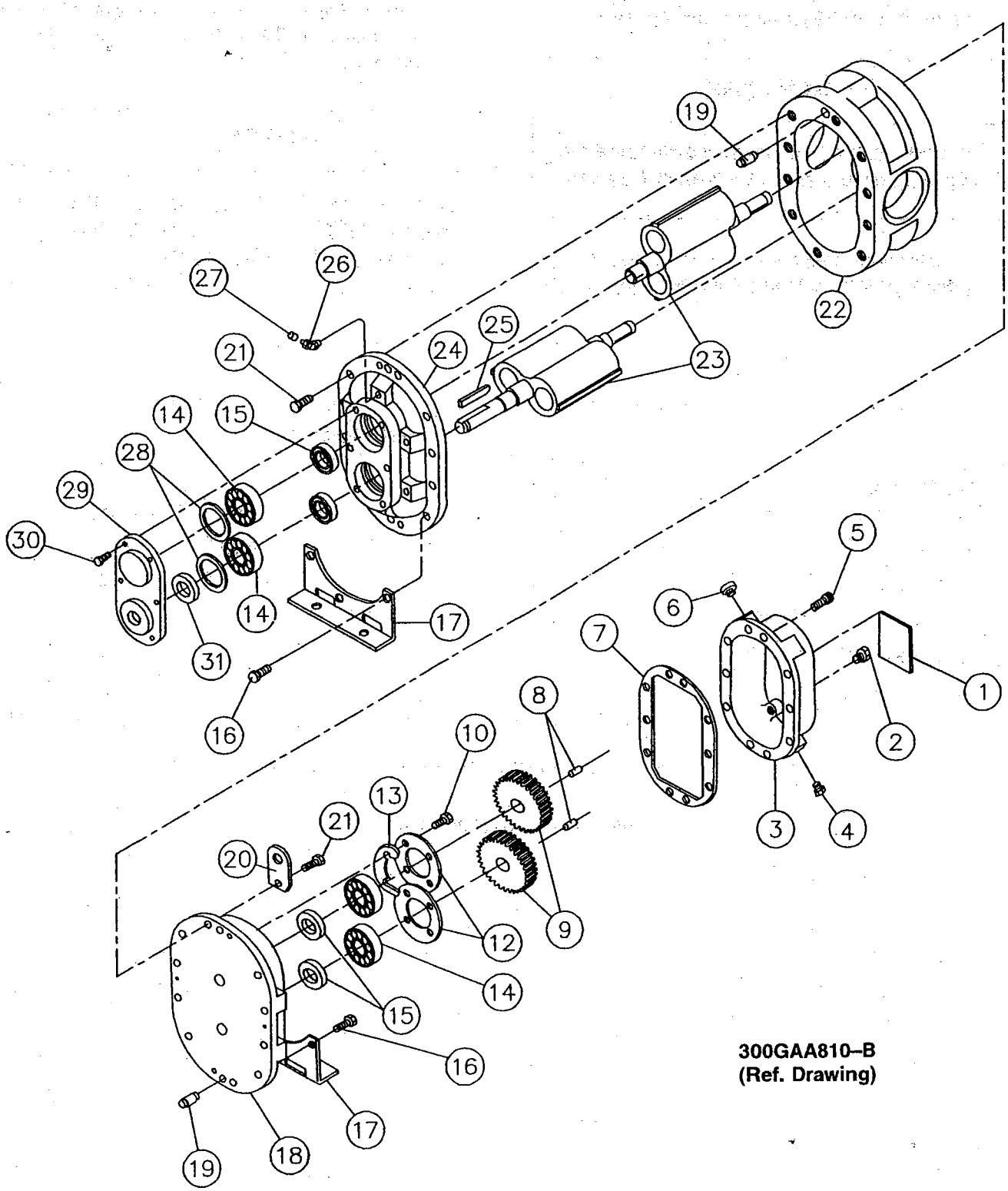
NOTICE

If the unit is not flat within .002 of an inch, it will be necessary to shim the blower feet at installation.

FASTENERS	GEAR DIAMETER			
	2	3	4	5
CAPSCREW (21)	13 – 17	23 – 30	23 – 30	23 – 30
CAPSCREW (16)	13 – 17	23 – 30	23 – 30	23 – 30
SOCKET HD CAPSCREW (5)	6 – 8	6 – 8	13 – 17	13 – 17
SOCKET HD CAPSCREW (30)	6 – 8	6 – 8	13 – 17	6 – 8
CAPSCREW (10)	6 – 8	6 – 8	13 – 17	13 – 17

NOTE: ( ) DENOTES ITEMS IN EXPLODED VIEW DRAWINGS ON PAGES 25, 27, 29, AND 31.

FIGURE 25 – TORQUE (FT–LBS)



300GAA810–B
(Ref. Drawing)

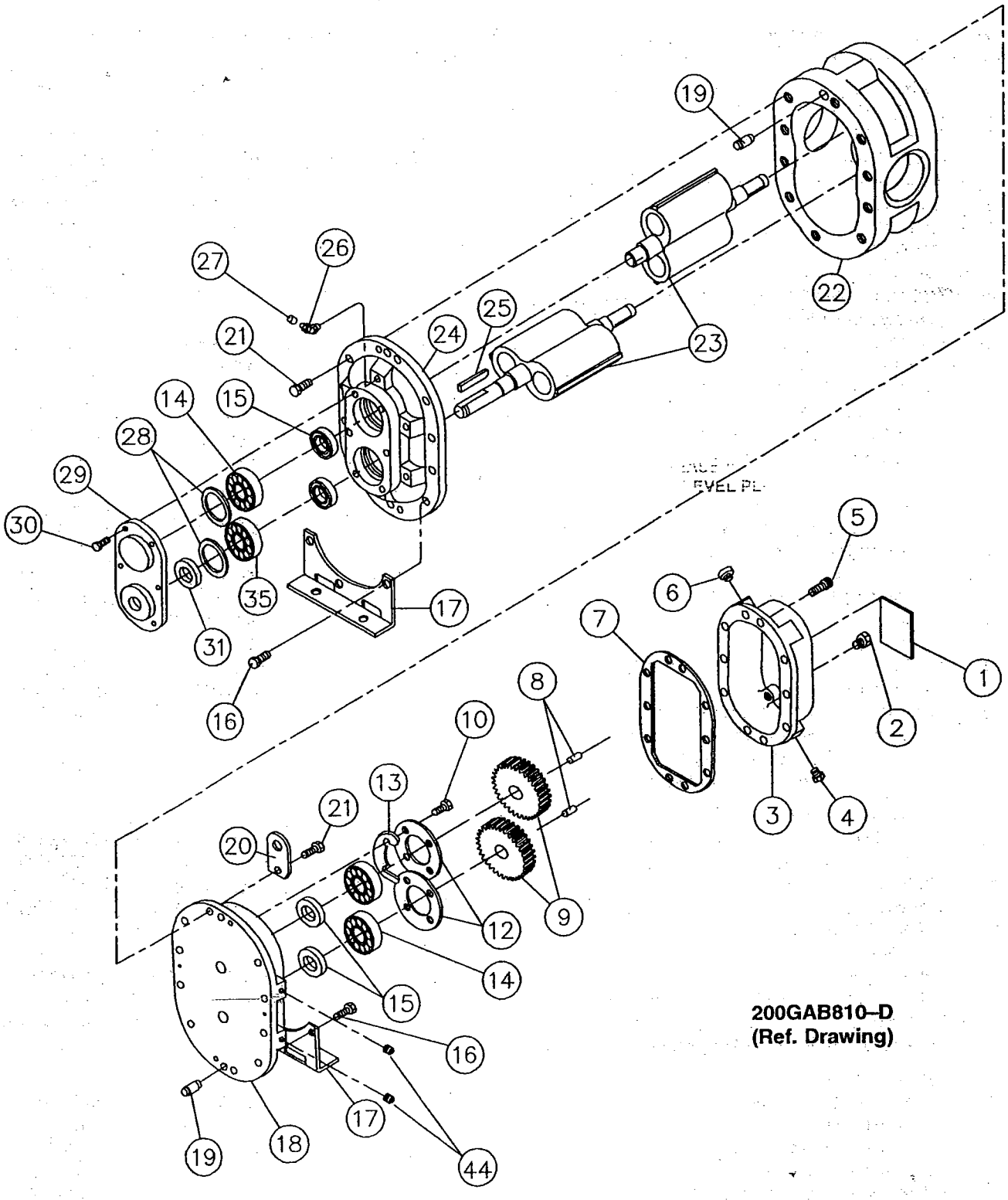
Order by Part Number and Description. Reference Numbers are for your convenience only.

	Ref. No.	Description	No. Req'd	MODEL GAA Size – 2M GAAM_P_	Size – 2L GAAL_P_
	1	NAMEPLATE	1	302GAA496	302GAA496
	2	OIL LEVEL PLUG...	2	64AC1	64AC1
	3	GEAR CASE	1	900893022801	900893022801
	4	DRAIN PLUG	1	64AC1	64AC1
	5	SCREW–GEAR CASE TO BEARING HOUSING	6	75LM224	75LM224
	6	VENT PLUG	1	900639650102	900639650102
o	7	GASKET GEAR CASE	1	200GAA715	200GAA715
o	8	TAPER PIN.	2	62V73	62V73
	9	TIMING GEAR GROUP	1	200GAA6008	200GAA6008
o	10	SCREW–BEARING RETAINER TO BEARING HOUSING	8	75A185N	75A185N
	12	BEARING RETAINER.	2	900892021801	900892021801
+	13	SHIM SET	1	900891022900	900891022900
o	14	BEARING.	4	12BA142	12BA142
o	15	MAIN SEAL–PER APPLICATION BELOW			
		LIP SEAL VERSION	4	60DD713	60DD713
		MECHANICAL SEAL VERSION	4	900871020002	900871020002
	16	SCREW–FOOT TO BEARING HOUSING	6	75A34	75A34
	17	FOOT GROUP			
		VERTICAL FOOT GROUP	1	GAA81896	GAA81896
		HORIZONTAL FOOT GROUP	1	GAA81897	GAA81897
	18	HOUSING–BEARING (GEAR END)			
		LIP SEAL	1	900894021001	900894021001
		MECHANICAL SEAL	1	204GAA006	204GAA006
	19	DOWEL PIN	4	62M48	62M48
	20	LIFTING LUG..	2	200GAA451	200GAA451
	21	SCREW–BEARING HOUSINGS TO IMPELLER CASE	14	75A34	75A34
	22	IMPELLER CASE.	1	900894021201	900894021401
	23	SHAFT ASSEMBLY GROUP (SEAL VENTS)	1	GAA81899	GAA81898
		SHAFT ASSEMBLY GROUP CONSISTS OF:			
		(1) ASSEMBLY SHAFT – LONG			
		(1) ASSEMBLY SHAFT – SHORT			
	24	HOUSING–BEARING (DRIVE)			
		LIP SEAL	1	900894020801	900894020801
		MECHANICAL SEAL	1	205GAA006	205GAA006
	25	DRIVE KEY	1	900891023101	900891023101
	26	GREASE FITTING	2	911659990606	911659990606
	27	GREASE FITTING CAP	2	40P58	40P58
+	28	WAVY SPRING	2	78W65	78W65
	29	DRIVE COVER	1	900893021701	900893021701
	30	SCREW–DRIVE COVER TO BEARING HOUSING	6	75A185N	75A185N
o	31	DRIVE SEAL	1	900639010802	900639010802
*+	42	PLUGS REQUIRED WITH MECHANICAL SEAL	6	64AC1	64AC1
		SHIM–IMPELLER CASE			
		PAPER (.0015/.0020)	0	202GAA732	202GAA732
		PAPER (.003)	0	200GAA732	200GAA732
		ALUMINUM (.010)	0	201GAA732	201GAA732
	o	OVERHAUL KIT LIP SEAL	0	200GAA6010	200GAA6010
	o	OVERHAUL KIT MECHANICAL SEAL	0	201GAA6010	201GAA6010

* NOT SHOWN

o OVERHAUL KITS CONSIST OF BEARINGS, SEALS, GASKET, SHIMS, TAPER PINS AND BEARING RETAINER SCREWS.

\+ MECHANICAL SEAL UNITS ONLY.



200GAB810–D
(Ref. Drawing)

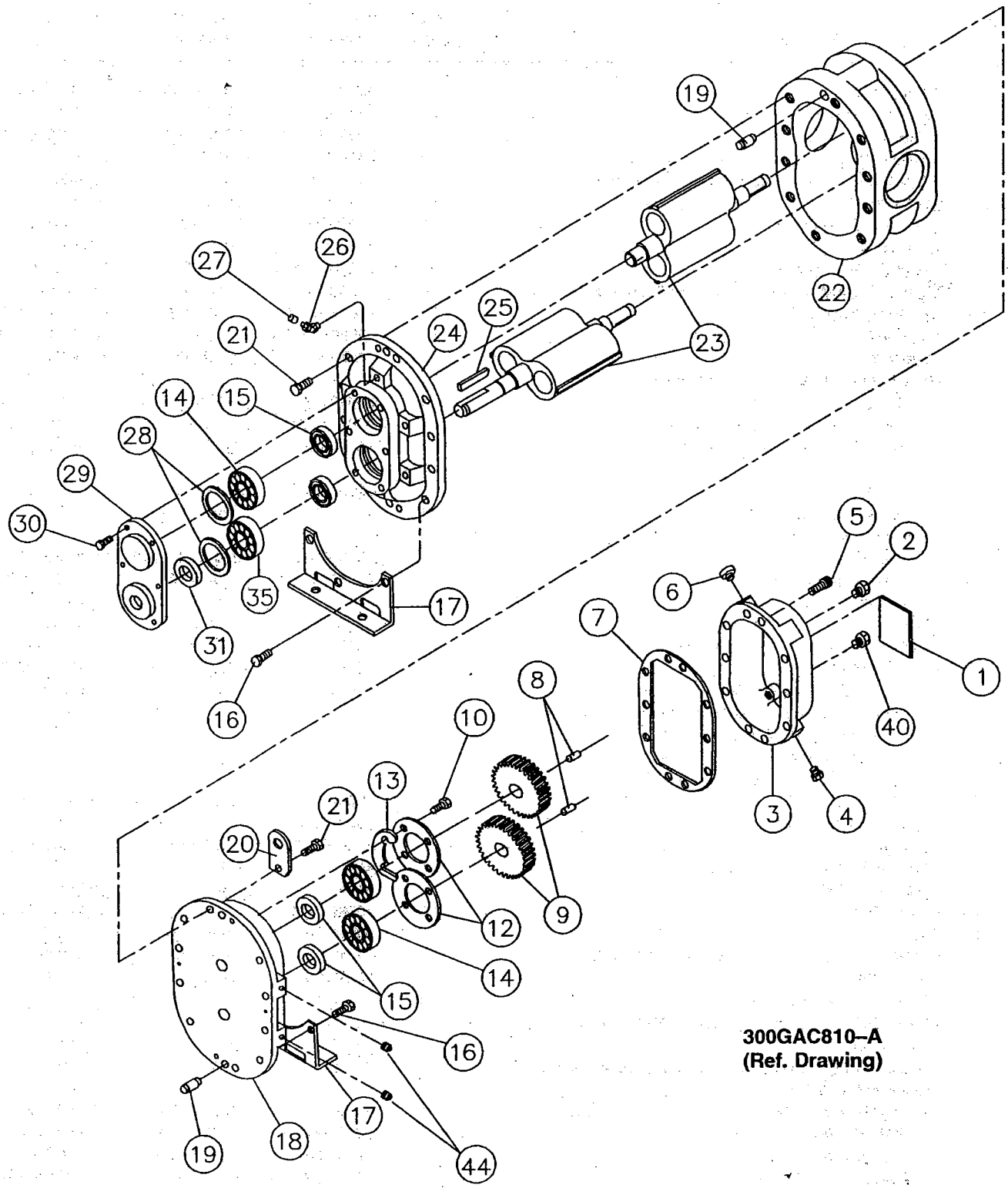
Order by Part Number and Description. Reference Numbers are for your convenience only.

	Ref. No.	Description	No. Req'd	MODEL GAB Size – 3H GABH_P_	Size – 3M GABM_P_	Size – 3L GABL_P_
	1	NAMEPLATE	1	302GAA496	302GAA496	302GAA496
	2	OIL LEVEL PLUG.	2	64AC2	64AC2	64AC2
	3	GEAR CASE	1	900873032901	900873032901	900873032901
	4	DRAIN PLUG.	1	64AC2	64AC2	64AC2
	5	SCREW–GEAR CASE TO BEARING HOUSING	10	75LM224	75LM224	75LM224
	6	BREATHER.	1	5L306	5L306	5L306
o	7	GASKET GEAR CASE	1	200GAB715	200GAB715	200GAB715
o	8	TAPER PIN	2	62V58	62V58	62V58
	9	TIMING GEAR GROUP	1	201GAB6008	201GAB6008	201GAB6008
o	10	SCREW–BEARING RETAINER TO BEARING HOUSING	8	75A185N	75A185N	75A185N
	12	BEARING RETAINER	2	900883031401	900883031401	900883031401
+	13	SHIM SET	1	900881032200	900881032200	900881032200
o	14	BEARING.	3	12BA143	12BA143	12BA143
o	15	MAIN SEAL–PER APPLICATION BELOW				
		LIP SEAL VERSION	4	900891030601	900891030601	900891030601
		MECHANICAL SEAL VERSION	4	900871020003	900871020003	900871020003
	16	SCREW–FOOT TO BEARING HOUSING	8	655ED050	655ED050	655ED050
	17	FOOT GROUP				
		VERTICAL FOOT GROUP	1	GAB81903	GAB81903	GAB81903
		HORIZONTAL FOOT GROUP	1	GAB81904	GAB81904	GAB81904
	18	HOUSING–BEARING (GEAR END)				
		LIP SEAL	1	900873033301	900873033301	900873033301
		MECHANICAL SEAL	1	900883030101	900883030101	900883030101
	19	DOWEL PIN	4	62M48	62M48	62M48
	20	LIFTING LUG	2	200GAA451	200GAA451	200GAA451
	21	SCREW–BEARING HOUSINGS TO IMPELLER CASE	16	655ED040	655ED040	655ED040
	22	IMPELLER CASE	1	900873034301	900873033801	900873034201
	23	SHAFT ASSEMBLY GROUP	1	GAB81905	GAB81907	GAB81906
		SHAFT ASSEMBLY GROUP CONSISTS OF:				
		(1) ASSEMBLY SHAFT – LONG				
		(1) ASSEMBLY SHAFT – SHORT				
	24	HOUSING–BEARING (DRIVE END)				
		LIP SEAL	1	900873033501	900873033501	900873033501
		MECHANICAL SEAL	1	900883030301	900883030301	900883030301
	25	DRIVE KEY	1	900639910304	900639910304	900639910304
	26	GREASE FITTING	2	40E9	40E9	40E9
	27	GREASE FITTING CAP	2	40P58	40P58	40P58
+	28	WAVY SPRING	2	900669170203	900669170203	900669170203
	29	DRIVE COVER	1	900873033701	900873033701	900873033701
	30	SCREW–DRIVE COVER TO BEARING HOUSING	6	75LM224	75LM224	75LM224
o	31	DRIVE SEAL	1	60DD725	60DD725	60DD725
o	35	BEARING DRIVE END DRIVE SHAFT	1	12BA153	12BA153	12BA153
*+	42	PLUGS REQUIRED WITH MECHANICAL SEAL (Drive End)	4	64AC1	64AC1	64AC1
	44	SCREW–SET	2	76F92	76F92	76F92
*+	46	PLUGS REQUIRED WITH MECHANICAL SEAL (Gear End)	2	64AC2	64AC2	64AC2
		SHIM–IMPELLER CASE				
		PAPER (.0015/.0020)	0	202GAB732	202GAB732	202GAB732
		PAPER (.003)	0	200GAB732	200GAB732	200GAB732
		ALUMINUM (.010)	0	201GAB732	201GAB732	201GAB732
	o	OVERHAUL KIT LIP SEAL	0	203GAB6010	203GAB6010	203GAB6010
	o	OVERHAUL KIT MECHANICAL SEAL	0	204GAB6010	204GAB6010	204GAB6010

* NOT SHOWN

o OVERHAUL KITS CONSIST OF BEARINGS, SEALS, GASKET, SHIMS, TAPER PINS AND BEARING RETAINER SCREWS.

\+ MECHANICAL SEAL UNITS ONLY.



300GAC810–A
(Ref. Drawing)

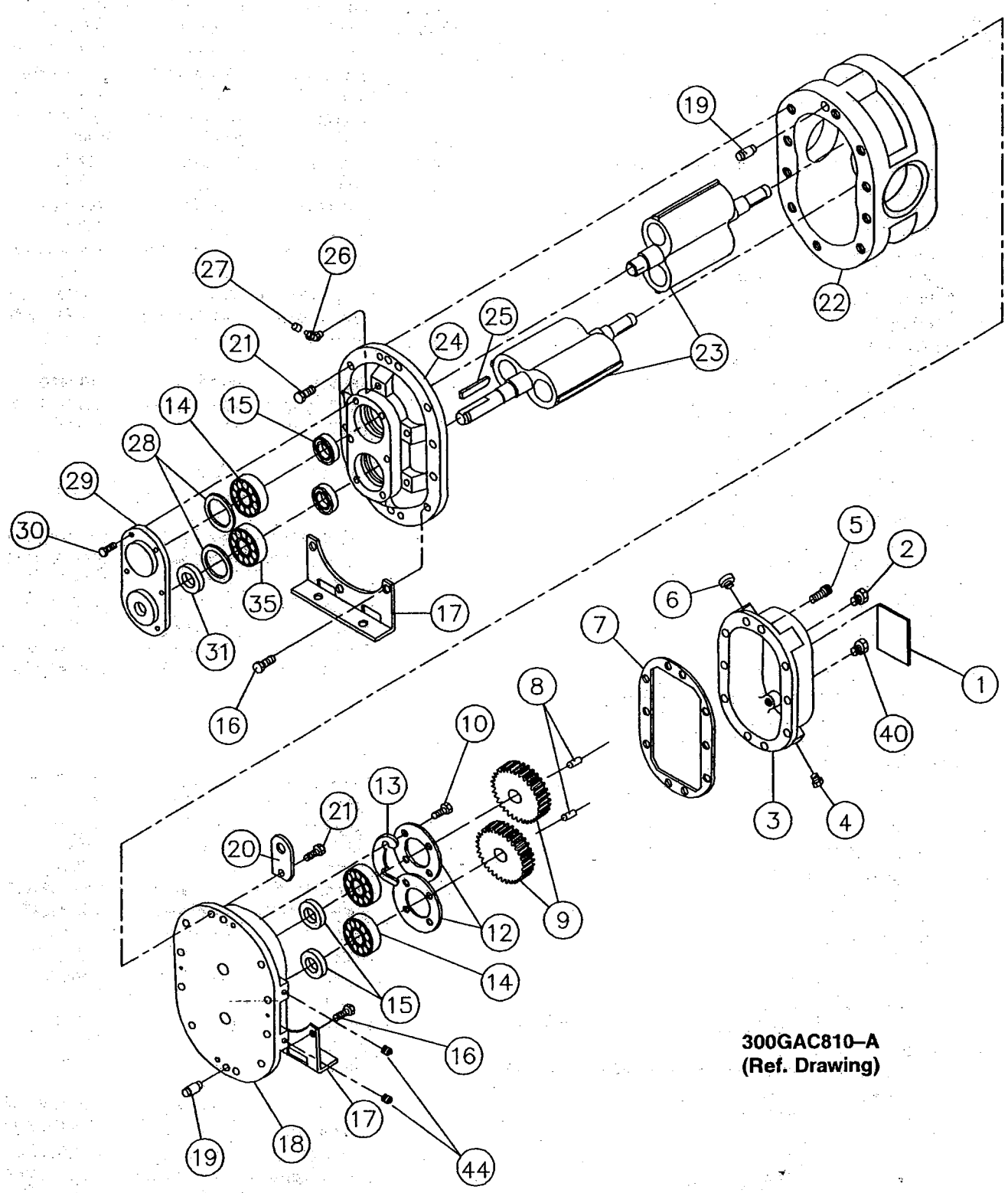
Order by Part Number and Description. Reference Numbers are for your convenience only.

	Ref. No.	Description	No. Req'd	MODEL GAC Size – 4H GACH_P_	Size – 4M GACM_P_	Size – 4L GACL_P_
	1	NAMEPLATE	1	302GAA496	302GAA496	302GAA496
	2	PLUG FOR ALTERNATE OIL LEVEL CONN.	1	64AC3	64AC3	64AC3
	3	GEAR CASE	1	900883040701	900883040701	900883040701
	4	DRAIN PLUG	1	64AC2	64AC2	64AC2
	5	SCREW–GEAR CASE TO BEARING HOUSING	12	75LM113	75LM113	75LM113
	6	BREATHER	1	5L306	5L306	5L306
o	7	GASKET GEAR CASE	1	200GAC715	200GAC715	200GAC715
o	8	TAPER PIN	2	62V58	62V58	62V58
	9	TIMING GEAR GROUP	1	200GAC6008	200GAC6008	200GAC6008
o	10	SCREW–BEARING RETAINER TO BEARING HOUSING	8	75A33N	75A33N	75A33N
	12	BEARING RETAINER	2	900883040201	900883040201	900883040201
+	13	SHIM SET	1	900881042900	900881042900	900881042900
o	14	BEARING	3	12BA144	12BA144	12BA144
o	15	MAIN SEAL–PER APPLICATION BELOW				
		LIP SEAL VERSION	4	60DD630	60DD630	60DD630
		MECHANICAL SEAL VERSION	4	900871020004	900871020004	900871020004
	16	SCREW–FOOT TO BEARING HOUSING	8	655ED050	655ED050	655ED050
	17	FOOT GROUP				
		VERTICAL FOOT GROUP	1	GAC81911	GAC81911	GAC81911
		HORIZONTAL FOOT GROUP	1	GAC81912	GAC81912	GAC81912
	18	HOUSING–BEARING (GEAR END)				
		LIP SEAL	1	900883040501	900883040501	900883040501
		MECHANICAL SEAL	1	900883041601	900883041601	900883041601
	19	DOWEL PIN	4	62M48	62M48	62M48
	20	LIFTING LUG.	2	200GAA451	200GAA451	200GAA451
	21	SCREW–BEARING HOUSINGS TO IMPELLER CASE	16	655ED040	655ED040	655ED040
	22	IMPELLER CASE	1	900883042201	900883041801	900883042001
	23	SHAFT ASSEMBLY GROUP	1	208GAC4028	207GAC4028	206GAC4028
		SHAFT ASSEMBLY GROUP CONSISTS OF:				
		(1) ASSEMBLY SHAFT – LONG				
		(1) ASSEMBLY SHAFT – SHORT				
	24	HOUSING–BEARING (DRIVE END)				
		LIP SEAL	1	300GAC006	300GAC006	300GAC006
		MECHANICAL SEAL	1	900883041201	900883041201	900883041201
	25	DRIVE KEY	1	900639910304	900639910304	900639910304
	26	GREASE FITTING	2	40E9	40E9	40E9
	27	GREASE FITTING CAP	2	40P58	40P58	40P58
+	28	WAVY SPRING.	2	900669170304	900669170304	900669170304
	29	DRIVE COVER	1	900883040301	900883040301	900883040301
	30	SCREW–DRIVE COVER TO BEARING HOUSING	8	75LM113	75LM113	75LM113
o	31	DRIVE SEAL	1	60DD716	60DD716	60DD716
o	35	BEARING–ROLLER	1	12BA154	12BA154	12BA154
	40	GAUGE–OIL LEVEL	1	40P34	40P34	40P34
*+	42	PLUGS REQUIRED WITH MECHANICAL SEAL (Drive End)	4	64AC1	64AC1	64AC1
	44	SCREW–SET	2	76F92	76F92	76F92
*+	46	PLUGS REQUIRED WITH MECHANICAL SEAL (Gear End)	2	64AC2	64AC2	64AC2
		SHIM–IMPELLER CASE				
		PAPER (.0015/.0020)	0	202GAC732	202GAC732	202GAC732
		PAPER (.003)	0	200GAC732	200GAC732	200GAC732
		ALUMINUM (.010)	0	201GAC732	201GAC732	201GAC732
	o	OVERHAUL KIT LIP SEAL.	0	202GAC6010	202GAC6010	202GAC6010
	o	OVERHAUL KIT MECHANICAL SEAL	0	203GAC6010	203GAC6010	203GAC6010

* NOT SHOWN

o OVERHAUL KITS CONSIST OF BEARINGS, SEALS, GASKET, SHIMS, TAPER PINS AND BEARING RETAINER SCREWS.

\+ MECHANICAL SEAL UNITS ONLY.



300GAC810–A
(Ref. Drawing)

Order by Part Number and Description. Reference Numbers are for your convenience only.

	Ref. No.	Description	No. Req'd	MODEL GAE Size – 5H GAEH_P_	Size – 5M GAEM_P_	Size – 5L GAEL_P_
	1	NAMEPLATE	1	301GAE496	301GAE496	301GAE496
	2	PLUG FOR ALTERNATE OIL LEVEL CONN.	1	64AC3	64AC3	64AC3
	3	GEAR CASE	1	900883051001	900883051001	900883051001
	4	DRAIN PLUG	1	64AC2	64AC2	64AC2
	5	SCREW–GEAR CASE TO BEARING HOUSING	12	75LM113	75LM113	75LM113
	6	VENT PLUG	1	5L306	5L306	5L306
o	7	GASKET GEAR CASE	1	200GAE715	200GAE715	200GAE715
o	8	TAPER PIN	2	62V58	62V58	62V58
	9	TIMING GEAR GROUP	1	201GAE6008	201GAE6008	201GAE6008
o	10	SCREW–BEARING RETAINER TO BEARING HOUSING	8	75A33N	75A33N	75A33N
	12	BEARING RETAINER.	2	900883050501	900883050501	900883050501
+	13	SHIM SET	1	900881052900	900881052900	900881052900
o	14	BEARING	3	8500397	8500397	8500397
o	15	MAIN SEAL–PER APPLICATION BELOW				
		LIP SEAL VERSION	4	60DD714	60DD714	60DD714
		MECHANICAL SEAL VERSION	4	900871020005	900871020005	900871020005
	16	SCREW–FOOT TO BEARING HOUSING	8	655ED050	655ED050	655ED050
	17	FOOT GROUP				
		VERTICAL FOOT GROUP	1	GAE81922	GAE81922	GAE81922
		HORIZONTAL FOOT GROUP	1	GAE81923	GAE81923	GAE81923
	18	HOUSING–BEARING (GEAR END)				
		LIP SEAL	1	900883052101	900883052101	900883052101
		MECHANICAL SEAL	1	900883050301	900883050301	900883050301
	19	DOWEL PIN.	4	62M48	62M48	62M48
	20	LIFTING LUG	2	200GAA451	200GAA451	200GAA451
	21	SCREW–BEARING HOUSINGS TO IMPELLER CASE	24	655ED040	655ED040	655ED040
	22	IMPELLER CASE	1	900883051701	900883051801	900883051901
	23	SHAFT ASSEMBLY GROUP	1	207GAE4028	206GAE4028	205GAE4028
		SHAFT ASSEMBLY GROUP CONSISTS OF:				
		(1) ASSEMBLY SHAFT – LONG				
		(1) ASSEMBLY SHAFT – SHORT				
	24	HOUSING–BEARING (DRIVE END)				
		LIP SEAL	1	206GAE006	206GAE006	206GAE006
		MECHANICAL SEAL	1	207GAE006	207GAE006	207GAE006
	25	DRIVE KEY	1	900639910305	900639910305	900639910305
	26	GREASE FITTING	2	911659990606	911659990606	911659990606
	27	GREASE FITTING CAP	2	40P58	40P58	40P58
+	28	WAVY SPRING	2	900669170405	900669170405	900669170405
	29	DRIVE COVER	1	900883050401	900883050401	900883050401
	30	SCREW–DRIVE COVER TO BEARING HOUSING	8	75LM113	75LM113	75LM113
o	31	DRIVE SEAL	1	60DD726	60DD726	60DD726
o	35	BEARING–ROLLER	1	12BA155	12BA155	12BA155
	40	GAUGE–OIL LEVEL	1	40P34	40P34	40P34
*+	42	PLUGS REQUIRED WITH MECHANICAL SEAL (Drive End)	4	64AC1	64AC1	64AC1
	44	SCREW–SET	4	76F92	76F92	76F92
*+	46	PLUGS REQUIRED WITH MECHANICAL SEAL (Gear End)	4	64AC2	64AC2	64AC2
		SHIM–IMPELLER CASE				
		PAPER (.0015/.0020)	0	202GAE732	202GAE732	202GAE732
		PAPER (.003)	0	200GAE732	200GAE732	200GAE732
		ALUMINUM (.010)	0	201GAE732	201GAE732	201GAE732
		OVERHAUL KIT LIP SEAL	0	200GAE6010	200GAE6010	200GAE6010
		OVERHAUL KIT MECHANICAL SEAL	0	203GAE6010	203GAE6010	203GAE6010

* NOT SHOWN

o OVERHAUL KITS CONSIST OF BEARINGS, SEALS, GASKET, SHIMS, TAPER PINS AND BEARING RETAINER SCREWS.

\+ MECHANICAL SEAL UNITS ONLY.

Gardner Denver

100 GARDNER PARK
PEACHTREE CITY, GA 30269
TEL: (770) 632–5000 FAX: (770) 486–5629

WARRANTY

SUTORBILT BLOWERS

SUTORBILT LEGEND SERIES

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with normal practice and with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted directly to the manufacturer.

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 18 months from date of initial use or 24 months from date of shipment to the first purchaser, whichever occurs first.

Any disassembly or partial disassembly of the blower, or failure to return the "unopened" blower per Company instructions, will be cause for denial of warranty.

OTHER COMPONENTS

All other components are warranted for 12 months from date of initial use or 18 months from date of shipment to first purchaser, whichever comes first.

The Company reserves the right to withdraw the Warranty where evidence indicates application outside the stated performance area, or where there is evidence of abuse.

LABOR TRANSPORTATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel, for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.

Labor costs in excess of the Company rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

Transportation of Company's choice, within the continental United States, is covered by this warranty for replacement of any blower which in the Company's judgement proved not to be as warranted. For user locations outside the continental United States, the Company will provide transportation, by the carrier of its choice to and from the nearest Authorized Distributor and the Company's designated facility. The Company may require the return of any blower claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

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Gardner Denver

For additional information, contact your local representative or

Gardner Denver Blower Division

100 Gardner Park, Peachtree City, GA 30269

Toll Free 800-543-7736

Phone 770-632-5000 • Fax 770-486-5629

E-mail: blowersmktg@gardnerdenver.com

Visit our web site: www.gardnerdenver.com

For Parts Information, Contact:

Gardner Denver Blower Division Customer Service

Phone 770-632-5000 • Fax 770-486-5629

Specifications subject to change without notice

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41074-203-1

TEE STRAINER WITH BOLTED COVER

GLENTECH 10" MODEL 850.
10" FLANGED INLET AND OUTLET.
304SS BODY, 316SS SCREEN.
DESIGN FLOW 1300GPM@15PSIG.
HORIZONTAL RUN & BRANCH. DRAIN AT LOWEST POINT ON BLIND BRANCH FLANGE. 1" FNPT DRAINCOUPLING CONNECTION. $\frac{1}{2}$"FNPT VENT COUPLING CONNECTION ON TOP OF TEE.
HARDWARE TO BE SS TO INCLUDE NUT, BOLT, WASHERS, AND LOCK WASHER FOR EACH FLANGE BOLT HOLE CONVOLUTED SCREEN.
SCREEN: $\frac{1}{8}$" MESH
SERVICE: WASTE WATER SG=1.02, VISC=0.5-3.0 cP, T=40-110°F, pH RANGE = 4-10
TSS=0-100 mg/L INCLUDING GRANULAR ACTIVATED CARBON & BIOSOLIDS
TDS=100-400 mg/L

GLENTECH, INC.
46 FOURTH STREET
SOMERVILLE, NJ 08876
PH: 908-685-2205
FAX: 908-685-1626

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DESIGNER FD	DATE 2/26/04	
CHECKER	DATE	
ENGINEER FD	DATE 2/26/04	
MANAGER RDH	DATE	
FILE:		
SCALE:		

TITLE TEE STRAINER

CLIENT JET PROPULSION LAB, NASA

USFilter

Envirex Products
Waukesha, WI
800-524-6324

PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-203	1 OF 1	0

Glentech, Inc.

GLENTECH MODEL 850

Tee Strainer

46 Fourth Street, Somerville, NJ 08876 Telephone # (908) 685-2205

Glentech, Inc.

OPERATION

Tee strainers in line provide the lowest pressure drop of any strainer. This is due to the flow of either gas or liquid being directed in an undiverted direction.

The cover on the tee strainer can be placed upward or under the pipe.

Benefits: Upward is easier to remove cover, however, some debris may remain in the bottom of the pipe. With the cover under the pipeline, the unit can be drained flushing most of the debris out through the blow down port. When the cover is removed, debris from the dirty side of the strainer does not migrate to the clean side.

Tee strainers having a delta-p gage and switch will determine when a basket becomes dirty. Differential pressure should not be greater than 10 PSI. At a 10 PSI drop, the gage is indicating the flow rate has diminished and the basket is becoming dirty.

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Glentech, Inc.

Installation

1. Make sure the strainer flow direction is identified and unit arrows face downstream.
2. Two bolts should be placed in the bottom position of each line flange.
3. Gaskets can now be inserted between the line flanges.
4. Stud bolts should be tightened using standard torque values and proper sequence.

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Glentech, Inc.

Maintenance

1. Keep basket clean for best performance.

   Cleaning the basket:

   - Strainer pressure must be relieved.
   - A liquid strainer should be isolated via valves on both sides of strainer.
   - When pressure is at atmosphere, cover flanged can be removed. Care should be taken not to damage the gasket.
   - Using a soft brush and a hose with a moderate pressure can clean the basket.
   - Return basket to the tee strainer, replace gasket and secure cover.
   - When the cover is tight, normal flow may be resumed.

2. Maintain extra gaskets for blind covers and o-rings for quick open covers.

3. A spare basket allows for shorter downtime in production.

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GOULDS PUMPS

Waste Water Pumps
Dewatering, Effluent and Sewage
Installation and Operation Manual



Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Control Model Number: _____

Dealer: _____

Dealer Phone No. _____

Date of Purchase: _____ Installation: _____

Current Readings at Startup:

1Ø	3Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

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Goulds Pumps
ITT Industries

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a SAFETY ALERT SYMBOL. When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that WILL cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that CAN cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that CAN cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING All electrical work must be performed by a qualified technician. Always follow the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes. Code questions should be directed to your local electrical inspector. Failure to follow electrical codes and OSHA safety standards may result in personal injury or equipment damage. Failure to follow manufacturer's installation instructions may result in electrical shock, fire hazard, personal injury or death, damaged equipment, provide unsatisfactory performance, and may void manufacturer's warranty.

⚠ WARNING Standard units are not designed for use in swimming pools, open bodies of water, hazardous liquids, or where flammable gases exist. These fluids and gases may be present in containment areas. Tank or wetwell must be vented per local codes.

Only pumps specifically Listed for Class 1, Division 1 are allowable in hazardous liquids and where flammable gases may exist. *See specific pump catalog bulletins or pump nameplate for all agency Listings.*

⚠ WARNING Disconnect and lockout electrical power before installing or servicing any electrical equipment. Many pumps are equipped with automatic thermal overload protection which may allow an overheated pump to restart unexpectedly.

⚠ CAUTION All three phase (3Ø) control panels for submersible pumps must provide Class 10, quick-trip, overload protection.

PRE-INSTALLATION CHECKS

Open all cartons and inspect for shipping damage. Report any damage to your supplier or shipping carrier immediately.

Important: Always verify that the pump nameplate Amps, Voltage, Phase, and HP ratings match your control panel and power supply.

Many of our sewage pumps are oil-filled. If there are any signs of oil leakage or if the unit has been stored for an extended period check the oil level in the motor dome and the seal housing, if so equipped.

Check the motor cover oil level through the pipe plug on top of the unit. The motor chamber oil should just cover the motor. Do not overfill, leave room for expansion!

To check the seal housing oil level, where used, lay the unit on its side with the fill plug at 12 o'clock. Remove the plug. The oil should be within ½" (13mm) of the top. If low, refill with an ASTM 150 turbine oil. Replace the plug.

Oil is available in 5 gallon cans through our distributors. You can also source oil locally at motor repair shops. Typical oil brands are: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 and Mobil DTE Light.

Check the strain relief nut on power cable strain assemblies. Power cables should be torqued to 75 in. lbs. for #16 cables and 80 in. lbs. for all other cable assemblies. Seal/heat sensor cables, where used, should be torqued to 75 in. lbs.

Warranty does not cover damage caused by connecting pumps and controls to an incorrect power source (voltage/phase supply).

Record the model numbers and serial numbers from the pumps and control panel on the front of this instruction manual for future reference. Give it to the owner or affix it to the control panel when finished with the installation.

LIFTING OF PUMP

⚠ WARNING



Hazardous voltage can shock, burn or cause death.

DO NOT LIFT, CARRY OR HANG PUMP BY THE ELECTRICAL CABLES. DAMAGE TO THE ELECTRICAL CABLES CAN CAUSE SHOCK, BURNS OR DEATH.

Lift the pump with an adequately sized chain or cable attached to the lifting eye bolt. DO NOT damage electrical and sensor cables while raising and lowering unit.

OPTIONAL SLIDE RAIL OR LIFT-OUT SYSTEM

In many effluent and sewage basins or lift stations it is advisable to install the pump on a slide rail system or on a lift-out adapter to facilitate installation and removal for inspection and/or service. Most codes do not allow personnel to enter a wetwell without the correct protective equipment and training. Slide rails are designed to allow easy removal of the pump without the need for entry into the wetwell or need to disturb piping. The slide rail or lift-out adapter should locate the pump opposite the influent

opening preventing stagnate areas where solids can settle. The basin or pit must be capable of supporting the weight of the pump and slide rail. The pit floor must be flat.

NOTICE: FOLLOW THE INSTRUCTIONS THAT ARE PROVIDED WITH THE SLIDE RAIL ASSEMBLY.

PIPING

Discharge piping should be no smaller than the pump discharge diameter and kept as short as possible, avoiding unnecessary fittings to minimize friction losses.

Install an adequately sized check valve matched to the solids handling capability of the pump to prevent fluid backflow. Backflow can allow the pump to "turbine" backwards and may cause premature seal and/or bearing wear. If the pump is turning backwards when it is called on to start the increased torque may cause damage to the pump motor and/or motor shaft and some single-phase pumps may actually run backwards.

Install an adequately sized gate valve **AFTER** the check valve for pump, plumbing and check valve maintenance.

Important – Before pump installation. Drill a 3/16" (4.8mm) relief hole in the discharge pipe. It should be located within the wetwell, 2" (51mm) above the pump discharge but below the check valve. The relief hole allows any air to escape from the casing. Allowing liquid into the casing will insure that the pump can start when the liquid level rises. Unless a relief hole is provided, a bottom intake pump could "air lock" and will not pump water even though the impeller turns.

All piping must be adequately supported, so as not to impart any piping strain or loads on the pump.

The pit access cover must be of sufficient size to allow for inspection, maintenance and crane or hoist service.

WIRING AND GROUNDING

Important notice: Read Safety Instructions before proceeding with any wiring.

⚠ Use only stranded copper wire to pump/motor and ground. The ground wire must be at least as large as the power supply wires. Wires should be color coded for ease of maintenance and troubleshooting.

⚠ Install wire and ground according to the National Electrical Code (NEC), or the Canadian Electrical Code, as well as all local, state and provincial codes.

⚠ Install an all leg disconnect switch where required by code.

⚠ Disconnect and lockout electrical power before performing any service or installation.

⚠ The electrical supply voltage and phase must match all equipment requirements. Incorrect voltage or phase can cause fire, motor and control damage, and voids the warranty.

⚠ All splices must be waterproof. If using splice kits follow manufacturer's instructions.

⚠ WARNING Select the correct type and NEMA grade junction box for the application and location. The junction box must insure dry, safe wiring connections.

⚠ WARNING Seal all controls from gases present which may damage electrical components.

⚠ WARNING Hazardous voltage

FAILURE TO PERMANENTLY GROUND THE PUMP, MOTOR AND CONTROLS BEFORE CONNECTING TO POWER CAN CAUSE SHOCK, BURNS OR DEATH.

SELECTING AND WIRING PUMP CONTROL PANELS AND SWITCHES

FLOAT SWITCH TYPES

There are two basic float switch designs; single-action and wide-angle. Single-action switches operate over a range of 15° so they open and close quickly. Wide-angle floats operate over a 90° swing with the tether length between the float body and the pivot point controlling the On-Off range. The design determines how many floats are required with different systems or controls.

Floats may be normally open (NO) for pump down applications or to empty a tank. Normally closed (NC) switches are used to pump up or to fill a tank.

A single-action control switch may be used only with a control panel, never direct connected to a pump.

The wide-angle, pump down switches may be used as direct connected pump switches or as control switches.

SETTING THE FLOAT SWITCHES

There are no absolute rules for where to set the float switches, it varies from job to job.

Suggested Rules to Follow:
All floats should be set below the Inlet pipe!

Off Float: Best: set so the water level is always above the top of the pump (motor dome). **Next Best:** set so the water level is not more than 6" below the top of the pump.

On Float: set so the volume of water between the On and Off floats allows pumps of 1½ HP and under to operate for 1 minute minimum. Two (2) HP and larger pumps should run a minimum of 2 minutes. Basin literature states the gallons of storage per inch of basin height.

Lag/Alarm Float(s): should be staggered above the Off and On floats. Try to use most of the available storage provided by the basin, save some space for reserve storage capacity. *See Diagrams and Charts in Float Switch Chart Section.*

PANEL WIRING DIAGRAMS

Our control panels are shipped with instructions and wiring diagrams. Use those instructions in conjunction with this IOM. Electrical installation should be performed only by qualified technicians. Any problem or questions pertaining to another brand control must be referred to that control supplier or manufacturer. Our technical people have no technical schematics or trouble shooting information for other companies' controls.

ALARMS

We recommend the installation of an alarm on all Waste Water pump installations. Many standard control panels come equipped with alarm circuits. If a control panel is not used, a stand alone high liquid level alarm is available. The alarm alerts the owner of a high liquid level in the system so they can contact the appropriate service personnel to investigate the situation.

SINGLE PHASE PUMPS
Single phase (1Ø) pumps may be operated using a piggyback or hard wired float switch, a contactor, or a Simplex or Duplex control panel. *See Figures 1, 2 and 5.*

All 1/3 and 1/2 HP, 115 or 230 volt pumps, and some 3/4 and 1 HP pumps, are supplied with plug style power cords. They may be plugged into piggyback float switches for simple installations. It is allowable to remove the plugs in order to hardwire or connect to a Simplex or Duplex controller. Removing the plug neither voids the warranty nor violates the agency Listings. *See Figure 5.*

⚠ WARNING



Hazardous voltage can shock, burn or cause death.

PLUG-CONNECTED UNITS MUST BE CONNECTED TO A PROPERLY GROUNDED, GROUNDING TYPE RECEPTACLE.

ON NON-PLUG UNITS, DO NOT REMOVE CORD AND STRAIN RELIEF. DO NOT CONNECT CONDUIT TO PUMP.

Pumps with bare lead power cords can be hard-wired to a float switch, wired to a 1Ø contactor, a Simplex controller or a Duplex controller. Always verify that the float switch is rated for the maximum run amperage, maximum starting amperage, and the HP rating on the pump. Single-phase waste water pumps contain on-winding overloads, unless noted on the pump nameplate. *See Figures 1 and 2.*

THREE PHASE PUMPS:
As a Minimum a 3Ø pump requires a 3 pole circuit breaker/fused circuit, an across the line magnetic starter rated for the pump HP, and ambient compensated Quick Trip Class 10 overloads.

SINGLE AND THREE PHASE CONTROL PANELS:
Control panels are available as Simplex (controls 1 pump) or Duplex (controls 2 pumps). Our standard SES Series Panels are available with many standard features and can be built with our most popular options. We also custom build panels which offer many more design options than the SES panels. Custom control panels are available in many different configurations. Custom panel quote requests may be forwarded to Customer Service through any authorized distributor.

Our "SES" Duplex panels feature a solid-state printed circuit board design with standard high level alarm circuits. Other standard features are: an auxiliary dry alarm contact for signaling a remote alarm and float switch position indicator lights. Our 3Ø panels have built-in, adjustable, Class 10 overloads. The adjustable overloads on all our 3Ø panels mean less labor for the installer and no need to order specific overloads. Most SES panels are in stock for immediate delivery.

On pumps equipped with seal fail and/or heat (high temperature) sensors it is recommended that you use our control panel with the appropriate options. The pump sensors do not function without a seal fail relay or terminal connection in the control panel and a warning device such as a bell, horn or light.

Seal Failure Circuit - Some dual seal pumps are equipped with a standard, built-in seal failure circuit, which may also be called a moisture detection circuit. This circuit must be connected to a control panel with an optional seal fail relay. The panel must be special ordered with the seal fail relay and alarm. There are also stand alone seal fail panels such as the A4-3 or A4-4 available as standard items. The pumps can be identified by an extra control cable exiting the motor cover. The cable contains two wires, a black wire, connects to panel "terminal" going to "probe"; and a white wire, connects to the panel "terminal" going to the relay ground. Do not connect to the panel ground screw. *Follow the wiring instructions supplied with the panel.*

Heat Sensor and Seal Failure Circuit - Some pumps are equipped with a seal fail and normally closed, on-winding high temperature thermostats (heat sensors). The pumps have a control cable with four (4) leads, black (probe) and green (relay ground) for the seal fail circuit and red and white for the high temperature circuit. Connect the high temperature (heat sensor) circuit to the panel terminal strip as indicated on the panel drawing using the red and white wires. The high temperature panel circuit is also an optional item which you must specifically order when you order your control panel. The high temperature circuit is different from the Class 10 overloads which are always required on three phase pumps. *Follow the wiring instructions supplied with the panel.*

INSTALLATION

Connect the pump(s) to the slide rail pump adapters or to the discharge piping. Slide rail bases should be anchored to the wetwell floor.

Complete all wiring per the control panel wiring diagrams and NEC, Canadian, state, provincial and/or local codes. This a good time to check for proper rotation of the motors/impellers.

⚠ DANGER



Hazardous Machinery

DO NOT PLACE HANDS IN PUMP SUCTION WHILE CHECKING MOTOR ROTATION. TO DO SO WILL CAUSE SEVERE PERSONAL INJURY.

Always verify correct rotation. Correct rotation is indicated on the pump casing. Three phase motors are reversible. It is allowable to bump or jog the motor for a few seconds to check impeller rotation. It is easier to check rotation before installing the pump. Switch any two power leads to reverse rotation.

Lower the pump(s) into the wetwell.

Check to insure that the floats will operate freely and not contact the piping.

OPERATION

Once the piping connections are made and checked you can run the pumps.

Piggyback Switch Operation – Plug the piggyback switch into a dedicated grounded outlet and then plug the pump into the switch. Test the pump by filling the wetwell until the pump goes On. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Check the operating range to insure a minimum one minute run time and that the pump goes Off in the correct position.

Control Panel Operation – Fill the wetwell with clear water.

Use the pump H-O-A (Hand-Off-Automatic) switches in Hand to test the pumps. If they operate well in Hand proceed to test Automatic operation. If the pumps run but fail to pump, they are probably air locked, drill the relief holes per the instructions in the Piping Section.

Place Control Panel switch(es) in Automatic position and thoroughly test the operation of the ON, OFF, and Alarm floats by filling the wetwell with clear water. **Important:** Failure to provide a Neutral from the power supply to a 1Ø, 230 volt Control Panel will not allow the panel control circuit to operate. The Neutral is necessary to complete the 115 volt control circuit.

Check voltage and amperage and record the data on the front of this manual for future reference. Compare the amperage readings to the pump nameplate maximum amperage. If higher than nameplate amperage investigate cause. Operating the pump off the curve, i.e. with too little head or with high or low voltage will increase amperage. The motor will operate properly with voltage not more than 10% above or below pump nameplate ratings. Performance within this range will not necessarily be the same as the published performance at the exact rated nameplate frequency and voltage. Correct the problem before proceeding. Three phase unbalance is also a possible cause. *See Three Phase Power Unbalance and follow the instructions.*

Reset the Alarm circuit, place pump switch(es) in the Automatic position and Control Switch in ON position. The system is now ready for automatic operation.

Explain the operation of the pumps, controls and alarms to the end user. Leave the paperwork with the owner or at the control panel if in a dry, secure location.

FLOAT SWITCH AND PANEL CHART

The purpose of this chart is to show the required switch quantities and the function of each switch in a typical waste water system. The quantities required vary depending on the switch type, single-action or wide-angle. Switch quantities also vary by panel type: simplex with and without alarms, and duplex with alarms.

Duplex Panels using single-action switches:

Three Float Panel Wiring

SW1	Bottom	Pumps Off
SW2	Middle	1st Pump On
SW3	Top	2nd Pump & Alarm On

Four Float Panel Wiring ②

SW1	Bottom	Pumps Off
SW2	2nd	1st Pump On
SW3	3rd	2nd Pump On
SW4	Top	Alarm On

Duplex Panels using wide-angle switches:

Three Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Top	2nd Pump & Alarm On

Four Float Panel Wiring

SW1	Bottom	1st Pump On/Both Off
SW2	Middle	2nd Pump On
SW3	Top	Alarm On

Simplex Panel using single-action switches:

Simplex Panel with Alarm ①

SW1	Bottom	Pump Off
SW2	Middle	Pump On
SW3	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Bottom	Pump Off
SW2	Top	Pump On

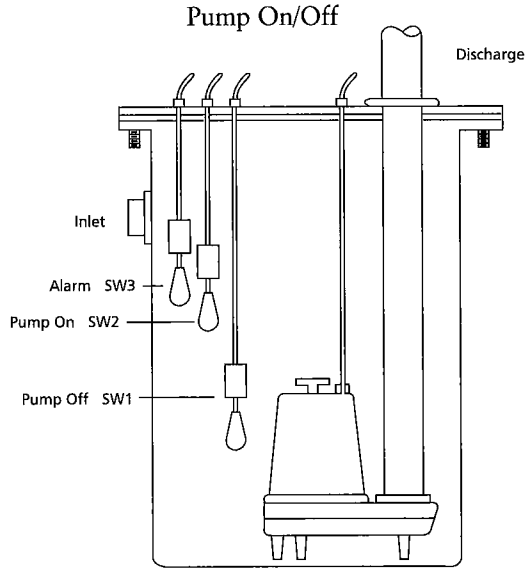
Simplex Panel using wide-angle switches:

Simplex Panel with Alarm

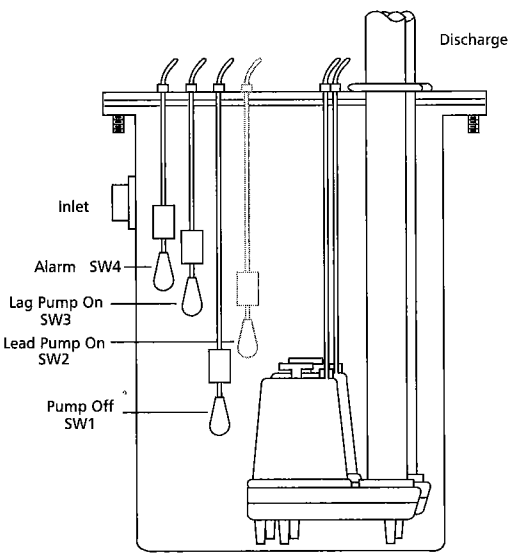
SW1	Bottom	Pump On/Off
SW2	Top	Alarm On/Off

Simplex Panel with No Alarm

SW1	Pump On/Off



Simplex ①



Duplex ②

THREE PHASE POWER UNBALANCE

A full three phase supply consisting of three individual transformers or one three phase transformer is recommended. "Open" delta or wye connections using only two transformers can be used, but are more likely to cause poor performance, overload tripping or early motor failure due to current unbalance.

Check the current in each of the three motor leads and calculate the current unbalance as explained 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 the three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.

To calculate percent of current unbalance:

A. Add the three line amp 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.

Current unbalance should not exceed 5% at service factor 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 source.

Contact your local power company to resolve the imbalance.

	Hookup 1			Hookup 2			Hookup 3		
Starter Terminals	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤
Motor Leads	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Example:

T3-R = 51 amps	T2-W = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-W = 49 amps
T2-W = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

INSULATION RESISTANCE READINGS

Normal Ohm and Megohm Values between all leads and ground

Condition of Motor and Leads	Ohm Value	Megohm Value
A new motor (without drop cable).	20,000,000 (or more)	20 (or more)
A used motor which can be reinstalled in well.	10,000,000 (or more)	10 (or more)
Motor in well. Readings are for drop cable plus motor.		
New motor.	2,000,000 (or more)	2 (or more)
Motor in good condition.	500,000 - 2,000,000	.5 - 2
Insulation damage, locate and repair.	Less than 500,000	Less than .5

Insulation resistance varies very little with rating. Motors of all HP, voltage and phase ratings have similar values of insulation resistance.

Insulation resistance values above are based on readings taken with a megohmmeter with a 500V DC output. Readings may vary using a lower voltage ohmmeter, consult factory if readings are in question.

This table was reprinted through the courtesy of Franklin Electric.

Engineering data for specific models may be found in your catalog and on our website (address is on the cover).

Control panel wiring diagrams are shipped with the control panels. Please use the control panel drawings in conjunction with this instruction manual to complete the wiring.

PUMP CONSTRUCTION			
Minimum Submergence		**Maximum Fluid Temperature**	
Continuous Duty	Fully Submerged	Continuous Operation	104° F 40° C
Intermittent Duty	6" Below Top of Motor	Intermittent Operation	140° F 60° C

Pumpmaster and Pumpmaster Plus - Hard Wired

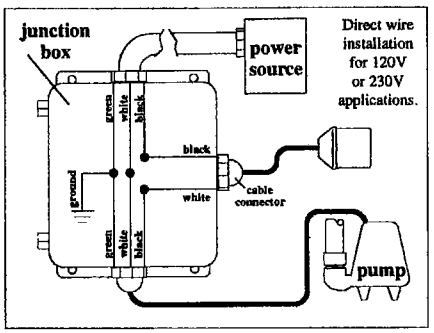


Fig. 1

Single-Action Float Switch "Typical" Installation

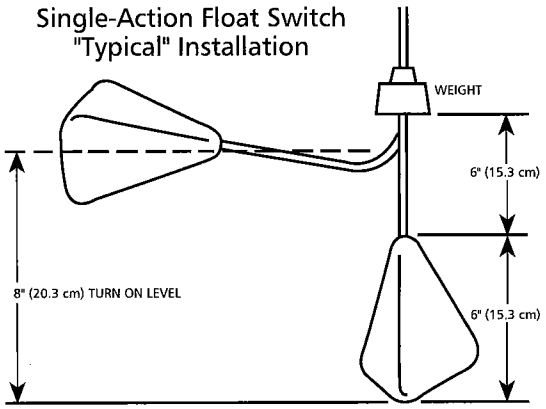


Fig. 4

Double Float - Hard Wired

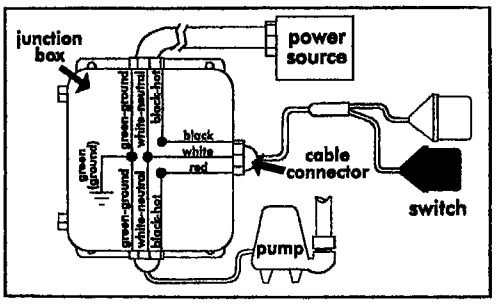


Fig. 2

Wide-Angle Float Switch

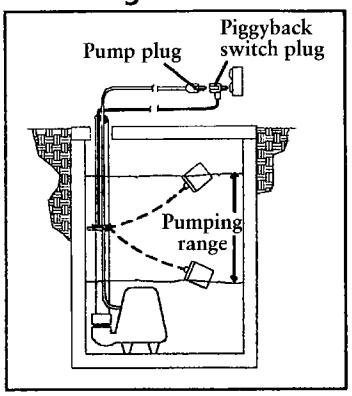


Fig. 5

Determining Pumping Range

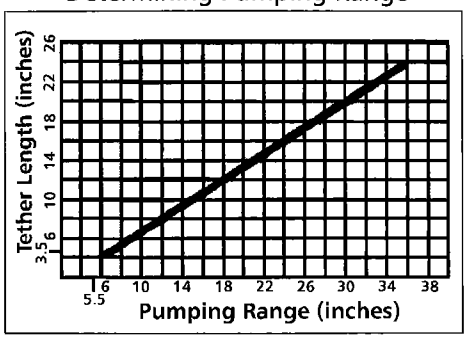


Fig. 3

Three Phase Connection Diagram

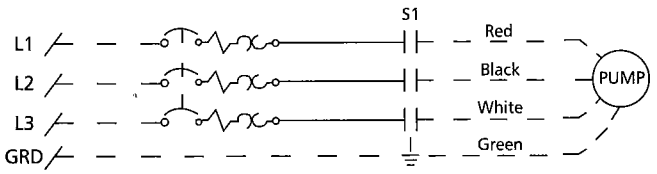
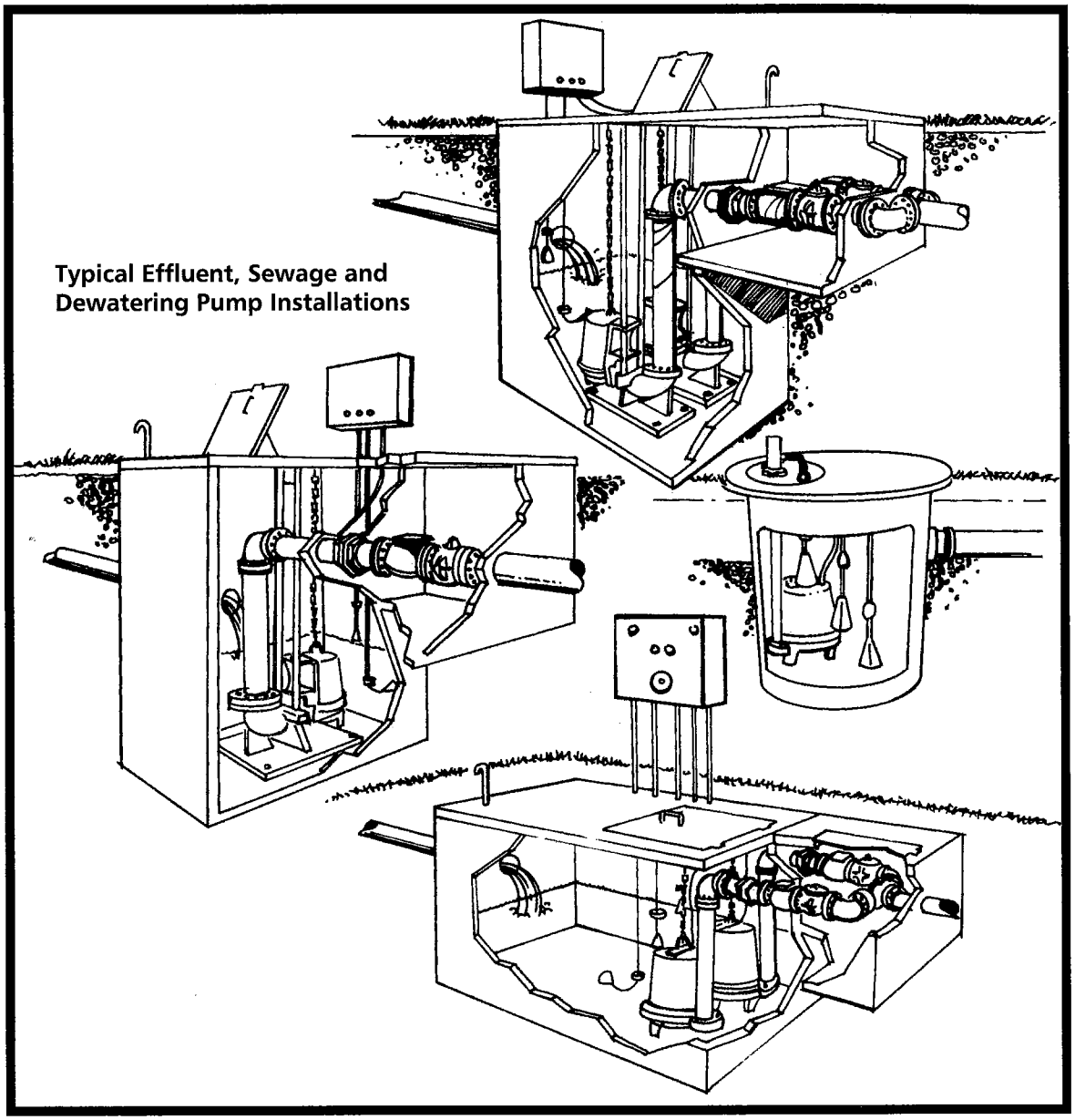


Fig. 6


Typical Effluent, Sewage and
Dewatering Pump Installations

⚠WARNING
Hazardous voltage

FAILURE TO DISCONNECT AND LOCKOUT ELECTRICAL POWER BEFORE ATTEMPTING ANY SERVICE CAN CAUSE SHOCK, BURNS OR DEATH.

SYMPTOM	PROBABLE CAUSE	RECOMMENDED ACTION
MOTOR NOT RUNNING **NOTE:** If circuit breaker "OPENS" repeatedly, **DO NOT** reset. Call qualified electrician.	Motor thermal protector tripped.	Allow motor to cool. Insure minimum pump submergence. Clear debris from casing and impeller.
	Open circuit breaker or blown fuse.	Determine cause, call a qualified electrician.
a) Manual operation	Pump impeller binding or jammed. Power cable is damaged. Inadequate electrical connection in control panel.	Check motor amp draw. If two or more times higher than listed on pump nameplate, impeller is locked, motor bearings or shaft is damaged. Clear debris from casing and impeller, consult with dealer. Resistance between power leads and ground should read infinity. If any reading is incorrect, call a qualified electrician.
b) Automatic operation	No neutral wire connected to control panel.	Inspect control panel wiring. Call a qualified electrician.
	Inadequate electrical connection in control panel.	With switch disconnected, check continuity while activating liquid level switch. Replace switch, as required.
NOTE: Check the pump in manual mode first to confirm operation. If pump operates, the automatic control or wiring is at fault. If pump does not operate, see above.	Defective liquid level switch.	Allow liquid level to rise 3" to 4" (76 mm - 101 mm) above turn-on level.
	Insufficient liquid level to activate controls.	Untangle cords and insure free operation.
	Liquid level cords tangled.	
PUMP WILL NOT TURN OFF	Liquid level cords tangled.	Untangle cords and insure free operation.
	Pump is air locked.	Shut off pump for approximately one minute, then restart. Repeat until air lock clears. If air locking persists in a system with a check valve, a 3/16" (4.8 mm) hole may be drilled in the discharge pipe approximately 2" (51 mm) above the discharge connection.
	Influent flow is matching pump's discharge capacity.	Larger pump may be required.
LITTLE OR NO LIQUID DELIVERED BY PUMP	Check valve installed backwards, plugged or stuck closed.	Check flow arrow on valve and check valve operation.
	Excessive system head.	Consult with dealer.
	Pump inlet plugged.	Inspect and clear as required.
	Improper voltage or wired incorrectly.	Check pump rotation, voltage and wiring. Consult with qualified electrician.
	Pump is air locked.	See recommended action, above.
	Impeller is worn or damaged.	Inspect impeller, replace as required.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
PUMP CYCLES CONSTANTLY	Discharge check valve inoperative.	Inspect, repair or replace as required.
	Sewage containment area too small.	Consult with dealer.
	Liquid level controls defective or improperly positioned.	Inspect, readjust or replace as required.
	Influent excessive for this size pump.	Consult with dealer.

GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

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Goulds Pumps

ITT Industries

GOULDS PUMPS

Bombas para aguas residuales, para extracción de agua, para efluente y para alcantarillado

Manual de instalación y funcionamiento

Información del propietario

Número de modelo de la bomba: _____

Número de serie de la bomba: _____

Número de modelo del control: _____

Agente: _____

No. telefónico del agente: _____

Fecha de compra: _____ Instalación: _____

Lecturas actuales en el momento de la puesta en marcha:

1Ø		3Ø		L1-2	L2-3	L3-1
Amperios:	____	Amperios:	____	____	____	____
Voltios:	____	Voltios:	____	____	____	____

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INSTRUCCIONES DE SEGURIDAD

PARA EVITAR LESIONES PERSONALES GRAVES O AÚN FATALES Y SERIOS DAÑOS MATERIALES, LEA Y SIGA TODAS LAS INSTRUCCIONES DE SEGURIDAD EN EL MANUAL Y EN LA BOMBA.

ESTE MANUAL HA SIDO CREADO COMO UNA GUÍA PARA LA INSTALACIÓN Y OPERACIÓN DE ESTA UNIDAD Y SE DEBE CONSERVAR JUNTO A LA BOMBA.



Éste es un SÍMBOLO DE ALERTA DE SEGURIDAD. Cuando vea este símbolo en la bomba o en el manual, busque una de las siguientes palabras de señal y esté alerta a la probabilidad de lesiones personales o daños materiales.

⚠ PELIGRO Advierte los peligros que CAUSARÁN graves lesiones personales, la muerte o daños materiales mayores.

⚠ ADVERTENCIA Advierte los peligros que PUEDEN causar graves lesiones personales, la muerte o daños materiales mayores.

⚠ PRECAUCIÓN Advierte los peligros que PUEDEN causar lesiones personales o daños materiales.

AVISO: INDICA INSTRUCCIONES ESPECIALES QUE SON MUY IMPORTANTES Y QUE SE DEBEN SEGUIR.

EXAMINE BIEN TODAS LAS INSTRUCCIONES Y ADVERTENCIAS ANTES DE REALIZAR CUALQUIER TRABAJO EN ESTA BOMBA.

MANTENGA TODAS LAS CALCOMANÍAS DE SEGURIDAD.

⚠ ADVERTENCIA Todo el trabajo eléctrico debe ser realizado por un técnico calificado. Siempre siga el Código Eléctrico de EE.UU. (NEC) o el Código Eléctrico Canadiense, además de todos los códigos locales, estatales y provinciales. Las preguntas acerca del código deben ser dirigidas al inspector eléctrico local. Si se hace caso omiso a los códigos eléctricos y normas de seguridad de OSHA, se pueden producir lesiones personales o daños al equipo. Si se hace caso omiso a las instrucciones de instalación del fabricante, se puede producir electrochoque, peligro de incendio, lesiones personales o aún la muerte, daños al equipo, rendimiento insatisfactorio y podría anularse la garantía del fabricante.

⚠ ADVERTENCIA Las unidades estándar no están diseñadas para usarse en albercas, masas abiertas de agua, líquidos peligrosos o donde existan gases inflamables. Estos fluidos y gases podrían estar presentes en áreas de contención. El tanque o pozo debe ser ventilado de acuerdo con los códigos locales.

En lugares con líquidos inflamables o donde pudiese haber gases inflamables sólo deben usarse bombas específicamente clasificadas para áreas de Clase 1, División 1. *Consulte los boletines de catálogos de bombas específicas o la placa de identificación de la bomba con respecto a las listas de agencias.*

⚠ ADVERTENCIA Desconecte y bloquee la corriente eléctrica antes de instalar o dar servicio a cualquier equipo eléctrico. Muchas bombas están equipadas con protección automática contra la sobrecarga térmica, la cual podría permitir que una bomba demasiado caliente rearranque inesperadamente.

⚠ PRECAUCIÓN Todos los paneles de control trifásicos (3Ø) para bombas sumergibles deben incluir protección contra sobrecarga de Clase 10, de disparo rápido.

VERIFICACIONES PRELIMINARES A LA INSTALACIÓN

Abra todas las cajas e inspeccione el equipo para determinar si se ocasionaron daños durante el envío. Notifique cualquier daño a su proveedor o a la compañía de transporte de inmediato.

Importante: Siempre verifique que las clasificaciones de corriente, tensión, fase y potencia en la placa de identificación de la bomba correspondan con las del panel de control y fuente de alimentación.

Muchas de nuestras bombas para alcantarillado están llenas con aceite. Si hay alguna señal de fuga de aceite o si la unidad estuvo almacenada durante largo tiempo, verifique el nivel de aceite en la cúpula del motor y la caja del sello, en caso de haberla.

Verifique el nivel de aceite de la cubierta del motor a través del tapón de la tubería en el extremo superior de la unidad. El aceite en la cámara del motor debe cubrir apenas el motor. ¡No llene en exceso, deje espacio para expansión!

Para verificar el nivel de aceite de la caja del sello, en caso que se use, coloque la unidad de lado con el tapón de llenado en la posición de las 12:00 horas. Retire el tapón. El aceite debe estar a menos de ½ pulg. (13 mm) del borde superior. Si el nivel está bajo, agregue aceite para turbinas ASTM 150. Reinstale el tapón.

Puede obtenerse aceite en latas de 5 galones de nuestros distribuidores. También puede obtener aceite a nivel local en talleres de reparación de motores. Las marcas típicas de aceite son: Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 y Mobil DTE Light.

Inspeccione la tuerca de alivio de tensión en los conjuntos de protección contra tirones de los cables de alimentación. Torsión de los cables de alimentación: 75 pulg.-lbs. para cables #16 y 80 pulg.-lbs. para todos los otros tipos de cable. La torsión de los cables de sensores de sello/calor, cuando se usen, debe ser de 75 pulg.-lbs.

La garantía no cubre daños causados por conectar bombas y controles a la fuente de energía incorrecta (fuente de tensión/fase).

Anote los números de modelos y números de serie de las bombas y del panel de control en la sección delantera de este manual de instrucciones para referencia futura. Entregue el manual al propietario o adjúntelo al panel de control una vez finalizada la instalación.

LEVANTAMIENTO DE LA BOMBA

⚠ ADVERTENCIA



La tensión peligrosa puede causar electrochoque, quemaduras o la muerte.

NO LEVANTE NI TRANSPORTE NI CUELGUE LA BOMBA DE LOS CABLES ELÉCTRICOS. EL DAÑO A LOS CABLES ELÉCTRICOS PUEDE PRODUCIR ELECTROCHOQUE, QUEMADURAS O AÚN LA MUERTE.

Levante la bomba con una cadena o cable de tamaño adecuado conectado al perno de ojo de levantamiento. NO dañe los cables eléctricos o de los sensores al subir y bajar la unidad.

RIEL CORREDIZO O SISTEMA DE LEVANTAMIENTO OPCIONAL

En muchos estanques de efluente y aguas negras o estaciones de levantamiento se recomienda instalar la bomba en un sistema de riel corredizo o sobre un adaptador de levantamiento para facilitar la instalación y retiro para inspección y/o servicio. La mayoría de los códigos no permiten que el personal entre al pozo sumidero sin el equipo de protección y la capacitación correctos. Los rieles corredizos están diseñados para facilitar el retiro de la bomba sin necesidad de entrar al pozo o perturbar la tubería. El riel corredizo o el adaptador de levantamiento debe situar la bomba opuesta a la abertura para el líquido de entrada, evitando las áreas estancadas donde pudiesen asentarse sólidos. El estanque o fosa debe ser capaz de soportar el peso de la bomba y del riel de deslizamiento. El piso de la fosa debe ser plano.

AVISO: SIGA LAS INSTRUCCIONES INCLUIDAS CON EL CONJUNTO DEL RIEL CORREDIZO.

TUBERÍAS

La tubería de descarga no debe ser más pequeña que el diámetro de descarga de la bomba y debe mantenerse lo más corta posible, evitando los accesorios innecesarios para reducir al mínimo las pérdidas por fricción.

Instale una válvula de retención de tamaño adecuado que corresponda con la capacidad de manejo de sólidos de la bomba para evitar el contraflujo de fluido. El contraflujo puede hacer que la bomba "gire" en dirección inversa, produciendo un desgaste prematuro del sello y/o del cojinete. Si la bomba gira en sentido inverso al arrancar, el aumento de torsión puede dañar el motor y/o el eje del motor de la bomba y algunas bombas monofásicas hasta podrían funcionar en sentido inverso.

Instale una válvula de compuerta de tamaño adecuado **DESPUÉS** de la válvula de retención para facilitar el mantenimiento de la bomba, las tuberías y la válvula de retención.

Importante – antes de instalar la bomba. Perfore un orificio de alivio de 3/16 pulg. (4.8 mm) en la tubería de descarga. Debe situarse dentro del pozo, a 2 pulg. (51 mm) sobre la descarga de la bomba, pero debajo de la válvula de retención. El orificio de alivio permite el escape de aire de la carcasa. Al permitir que entre líquido a la carcasa se asegura que la bomba pueda arrancar cuando el nivel de líquido aumente. A menos que se proporcione un orificio de alivio, una bomba de toma inferior podría "obstruirse con aire" y no bombear agua, a pesar de que el impulsor gire.

Todas las tuberías deben estar apoyadas correctamente, de modo que no se apliquen esfuerzos o cargas de las tuberías a la bomba.

La cubierta de acceso a la fosa debe ser de tamaño suficiente para permitir realizar el servicio de inspección, mantenimiento y levantamiento con grúa o montacargas.

CABLEADO Y CONEXIÓN A TIERRA

Aviso importante: Lea las instrucciones de seguridad antes de proseguir con el cableado.

⚠ Use únicamente alambre trenzado de cobre para la bomba/motor y la conexión a tierra. El alambre de conexión a tierra debe ser al menos del mismo tamaño que los alambres de la fuente de alimentación. Los alambres deben codificarse con colores para facilitar el mantenimiento y la identificación y resolución de problemas.

⚠ Instale los cables y la conexión a tierra de acuerdo con el Código Eléctrico de EE.UU. (NEC) o el Código Eléctrico Canadiense, además de los códigos locales, estatales y provinciales.

⚠ Instale un desconectador de todos los circuitos donde el código lo requiera.

⚠ Desconecte y bloquee la corriente eléctrica antes de instalar o dar servicio.

⚠ La tensión y fase de la fuente de alimentación debe corresponder con todos los requerimientos del equipo. La tensión o fase incorrecta puede producir incendio, daño al motor o a los controles y anula la garantía.

⚠ Todos los empalmes debe ser impermeables. Si utiliza juegos de empalme, siga las instrucciones del fabricante.

⚠ ADVERTENCIA Seleccione una caja de conexiones NEMA del tipo correcto para la aplicación y ubicación. La caja de conexiones debe garantizar conexiones de cableado seguras y secas.

⚠ ADVERTENCIA Selle todos los controles de los gases presentes que pudiesen dañar los componentes eléctricos.

⚠ ADVERTENCIA
Tensión peligrosa

LA FALLA DE CONECTAR A TIERRA PERMANENTEMENTE LA BOMBA, EL MOTOR Y LOS CONTROLES, ANTES DE CONECTAR LA CORRIENTE ELÉCTRICA, PUEDE CAUSAR ELECTROCHOQUE, QUEMADURAS O LA MUERTE.

SELECCIÓN Y CABLEADO DE LOS INTERRUPTORES Y PANELES DE CONTROL DE LA BOMBA

TIPOS DE INTERRUPTORES DE FLOTADOR

Hay dos tipos de diseños de interruptor de flotador: de acción simple y de ángulo amplio. Los interruptores de acción simple funcionan en un rango de 15°, de manera que pueden abrirse y cerrarse con rapidez. Los flotadores de ángulo amplio funcionan con un giro de 90° con el largo de la traba entre el cuerpo del flotador y el punto de pivote controlando al rango de encendido-apagado. El diseño determina cuántos flotadores se requieren con los diferentes sistemas o controles.

Los flotadores pueden estar normalmente abiertos (NO) para aplicaciones de reducción de nivel o para vaciar un tanque. Los interruptores normalmente cerrados (NC) se utilizan para aumentar el nivel o para llenar un tanque.

Un interruptor de control de acción simple sólo puede usarse con un panel de control, pero nunca directamente conectado a una bomba.

Los interruptores de ángulo ancho de reducción de nivel pueden usarse como interruptores directamente conectados a la bomba o como interruptores de control.

INSTALACIÓN DE LOS INTERRUPTORES DE FLOTADOR

No hay reglas absolutas acerca de dónde instalar los interruptores de flotador, varía de trabajo a trabajo.

Reglas sugeridas a seguir:
¡Todos los flotadores deben instalarse debajo de la tubería de entrada!

Flotador de apagado: Primera preferencia: instálelo de manera que el nivel del agua quede siempre sobre el extremo superior de la bomba (cúpula del motor). Segunda preferencia: instálelo de manera que el nivel del agua quede a no más de 6 pulg. por debajo del extremo superior de la bomba.

Flotador de encendido: instálelo de manera que el volumen de agua entre los flotadores de encendido y apagado permita bombas de 1½ HP y menores funcionar al menos 1 minuto. Las bombas de dos (2) HP y mayores deben funcionar al menos 2 minutos. La literatura sobre estanques establece los galones de almacenaje por pulgada de altura del estanque.

Flotador(es) de retardo/alarma: deben escalonarse sobre los flotadores de apagado y encendido. Trate de utilizar la mayoría del almacenaje disponible ofrecido por el estanque, ahorre espacio para la capacidad de almacenaje de reserva. *Consulte los diagramas y tablas en la Sección de Tablas de Interruptores de Flotador.*

DIAGRAMAS DE CABLEADO DEL PANEL

Nuestros paneles de control se envían con instrucciones y diagramas de cableado. Utilice dichas instrucciones en conjunto con este manual de instrucciones (IOM). La instalación eléctrica debe ser realizada por técnicos calificados únicamente. Cualquier problema o preguntas con respecto al control de otras marcas debe dirigirse a ese proveedor o al fabricante del control. Nuestro personal técnico no tiene diagramas esquemáticos técnicos o información de identificación y resolución de problemas de los controles de otras compañías.

ALARMAS

Recomendamos la instalación de una alarma en todas las bombas para aguas residuales. Muchos paneles de control estándar vienen equipados con circuitos de alarma. Si no se usa un panel de control, se ofrece una alarma por alto nivel de líquido independiente. La alarma alerta al propietario acerca de una situación de alto nivel de líquido en el sistema, de manera que pueda comunicarse con el personal de servicio apropiado para que investigue la situación.

BOMBAS MONOFÁSICAS

Las bombas monofásicas (1Ø) pueden operarse utilizando un interruptor de flotador en tándem o de conexión directa, un contactador o un panel de control simple o doble. *Ver las Figuras 1,2 y 5.*

Todas las bombas de ⅓ y ½ HP, de 115 ó 230 voltios y algunas bombas de ¾ y de 1 HP están equipadas con cables de alimentación estilo enchufe. Pueden enchufarse a interruptores de flotador en tándem para instalaciones sencillas. Se permite quitar los enchufes para conectar directamente o conectar a un controlador simple o doble. El retiro del enchufe no anula la garantía ni viola las aprobaciones de las agencias. *Ver la figura 5.*



LAS UNIDADES CON ENCHUFE DEBEN CONECTARSE A UN TOMACORRIENTES TIPO TIERRA CONECTADO CORRECTAMENTE A TIERRA.

EN EL CASO DE UNIDADES SIN ENCHUFE, NO QUITE EL CABLE NI EL PROTECTOR CONTRA TIRONES. NO CONECTE EL TUBO-CONDUCTO A LA BOMBA.

Las bombas con cables de alimentación con conductores desnudos pueden conectarse directamente a un interruptor de flotador, cablearse a un contactador de 1 fase, a un controlador simple o doble. Siempre verifique que el interruptor de flotador esté clasificado para el amperaje de funcionamiento máximo, amperaje de arranque máximo y la capacidad nominal de potencia de la bomba. Las bombas monofásicas para aguas residuales contienen sobrecargas de devanado de encendido, a menos que se especifique lo contrario en la placa de identificación de la bomba. *Ver las Figuras 1 y 2.*

BOMBAS TRIFÁSICAS:

Como mínimo, una bomba trifásica requiere un cortacircuitos/ circuito con fusible trifásico, un arrancador magnético en la línea clasificado para la potencia de la bomba y sobrecargas Clase 10, de disparo rápido y compensación ambiental.

PANELES DE CONTROL MONOFÁSICOS Y TRIFÁSICOS:

Los paneles de control pueden ser simples (controlan 1 bomba) o dobles (controlan 2 bombas): Nuestros paneles Serie SES se ofrecen con muchas características estándar y pueden construirse con nuestras opciones más populares. También construimos paneles de acuerdo con las especificaciones del cliente, los cuales ofrecen muchas más opciones que los paneles SES. Los paneles de control construidos de acuerdo con las especificaciones del cliente se ofrecen en muchas configuraciones diferentes. Las solicitudes de cotizaciones para paneles a la medida pueden enviarse a Servicio a los Clientes mediante nuestro distribuidor autorizado.

Nuestros paneles "SES" dobles presentan un diseño de tablero de circuito impreso de estado sólido con circuitos de alarmas de alto nivel estándar. Otras características estándar son: un contacto de alarma seco auxiliar para señalizar una alarma remota y luces indicadoras de posición del interruptor de flotador. Nuestros paneles trifásicos tienen sobrecargas Clase 10 incorporadas y ajustables. Las sobrecargas ajustables en todos nuestros paneles trifásicos significa menos trabajo para el instalador y la eliminación de la necesidad de ordenar sobrecargas específicas. La mayoría de los paneles SES se mantienen en inventario para entrega inmediata.

En el caso de bombas equipadas con sensores de falla de sello y/o sensores de calor, se recomienda que use su panel de control con las opciones apropiadas. Los sensores de la bomba no funcionan sin un relé de falla de sello o una conexión terminal en el panel de control y un dispositivo de alarma tal como una campana, bocina o luz.

Circuito de falla de sello – Algunas bombas de sello doble están equipadas con un circuito de falla de sello que también se denomina circuito de detección de humedad. Este circuito debe estar conectado a un panel de control con un relé de falla de sello opcional. El panel debe ordenarse especialmente con el relé de falla de sello y la alarma. También hay paneles de falla de sello independientes como los A4-3 o A4-A disponibles como artículos estándar. Las bombas pueden identificarse por un cable de control adicional que sea de la tapa del motor. El cable contiene dos alambres, un alambre negro que se conecta al "terminal" del panel que va a la "sonda", y un alambre blanco que se conecta al "terminal" del panel que va a la tierra del relé. No los conecte al tornillo de tierra del panel. *Siga las instrucciones de cableado incluidas con el panel.*

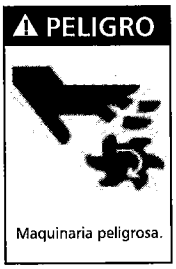
Sensor de calor y circuito de falla de sello – Algunas bombas están equipadas con termostatos de falla de sello y de alta temperatura, de devanado de encendido, normalmente cerrados (sensores de calor). Las bombas tienen un cable de control con cuatro (4) conductores: negro (sonda) y verde (tierra del relé) para el circuito de falla del sello y rojo y blanco para el circuito de alta temperatura. Conecte el circuito de alta temperatura (sensor de calor) a la regleta de terminales del panel, tal como se indica en el dibujo del panel, con los

alambres rojo y blanco. El circuito del panel de alta temperatura también es un artículo opcional que debe ordenar específicamente cuando ordene su panel de control. El circuito de alta temperatura es diferente de las sobrecargas Clase 10 que son siempre requeridas en las bombas trifásicas. *Siga las instrucciones de cableado incluidas con el panel.*

INSTALACIÓN

Conecte la(s) bomba(s) a los adaptadores de riel corredizo o a la tubería de descarga. Las bases del riel corredizo deben anclarse al piso del pozo.

Todas las conexiones deben realizarse de acuerdo con los diagramas de cableado del panel de control, el código eléctrico de EE.UU., el código canadiense y los códigos estatales, provinciales y/o locales. Éste es un buen momento para verificar la rotación apropiada de los motores/impulsores.



NO COLOQUE LAS MANOS EN LA SUCCIÓN DE LA BOMBA MIENTRAS VERIFICA LA ROTACIÓN DEL MOTOR. EL HACERLO PRODUCIRÁ GRAVES LESIONES PERSONALES.

Siempre verifique la rotación correcta. La rotación correcta se indica en la carcasa de la bomba. Los motores trifásicos son reversibles. Se permite arrancar brevemente o en marcha lenta el motor durante unos segundos para verificar la rotación del impulsor. Es más fácil verificar la rotación antes de instalar la bomba. Intercambie dos de los conductores de potencia cualquiera para invertir la rotación.

Baje la(s) bomba(s) al pozo sumidero.

Inspeccione para verificar que los flotadores funcionen libremente y que no hagan contacto con la tubería.

OPERACIÓN

Una vez que se hayan hecho y verificado las conexiones de las tuberías, se pueden poner en funcionamiento las bombas.

Operación de interruptor en tándem – Enchufe el interruptor en tándem a un tomacorrientes dedicado conectado a tierra y luego enchufe la bomba al interruptor. Pruebe la bomba llenando el pozo hasta que la bomba se active. Si las bombas funcionan pero no bombean, probablemente estén obstruidas con aire; perfore los orificios de alivio de acuerdo con las instrucciones en la Sección de Tuberías.

Verifique el intervalo de operación para asegurar un tiempo de funcionamiento mínimo de un minuto y que la bomba se apague en la posición correcta.

Operación del panel de control – Llene el pozo con agua limpia.

Utilice los interruptores H-O-A (manual – apagado – automático) de la bomba en la posición manual para probar las bombas. Si funcionan bien en la posición manual, pruebe la posición automática. Si las bombas funcionan pero no bombean, probablemente estén obstruidas con aire; perfore los orificios de alivio de acuerdo con las instrucciones en la Sección de Tuberías.

Coloque el (los) interruptor(es) del panel de control en la posición automática y pruebe minuciosamente el funcionamiento de los flotadores de ÈNCENDIDO, APAGADO y alarma llenando el pozo con agua limpia. **Importante:** Si no se proporciona un neutro desde la fuente de alimentación a un panel de control monofásico de 230 voltios, el circuito de control del panel no operará. Es necesario el neutro para completar el circuito de control de 115 voltios.

Verifique la tensión y la corriente y anote los datos en la sección delantera de este manual para referencia futura. Compare las lecturas de amperaje con el amperaje máximo indicado en la placa de identificación de la bomba. Si es más alto que el amperaje de la placa de identificación, investigue la causa. Si la bomba se hace funcionar fuera de la curva; es decir, con demasiado poca carga o con tensión alta o baja, aumentará el amperaje. El motor funcionará correctamente con tensión no más de un 10% por encima o por debajo de las clasificaciones en la placa de identificación de la bomba. El rendimiento dentro de este rango no será necesariamente igual al rendimiento publicado a la frecuencia y tensión exactas indicadas en la placa de identificación. Corrija el problema antes de continuar. También es posible que la causa sea un desbalance trifásico. *Consulte la sección de Desbalance de potencia trifásica y siga las instrucciones.*

Reposicione el circuito de alarma, coloque el (los) interruptor(es) de la bomba en posición automática y el interruptor de control en la posición de encendido. Ahora la unidad está lista para la operación automática.

Explique la operación de las bombas, controles y alarmas al usuario final. Entregue la documentación al propietario o déjela en un lugar seco y seguro en el panel de control.

TABLA DEL PANEL E INTERRUPTORES DE FLOTADOR

El propósito de esta tabla es mostrar las cantidades de interruptores requeridas y la función de cada interruptor en un sistema de aguas residuales típicas. Las cantidades requeridas varían dependiendo del tipo de interruptor: de acción simple o de ángulo amplio. Las cantidades de interruptores varían también de acuerdo con el tipo de panel: simple con y sin alarmas y doble con alarmas.

Paneles dobles utilizando interruptores de acción simple:

Cableado del panel de tres flotadores

SW1	Fondo	Bombas apagadas
SW2	Medio	Primera bomba del medio encendida
SW3	Extremo superior	Segunda bomba y alarma encendidas

Cableado del panel de cuatro flotadores ②

SW1	Fondo	Bombas apagadas
SW2	Segundo	Primera bomba encendida
SW3	Tercero	Segunda bomba encendida
SW4	Extremo superior	Alarma encendida

Paneles dobles utilizando interruptores de ángulo amplio:

Cableado del panel de tres flotadores

SW1	Fondo	Primera bomba encendida/ ambas apagadas
SW2	Extremo superior	Segunda bomba y alarma encendidas

Cableado del panel de cuatro flotadores

SW1	Fondo	Primera bomba encendida/ ambas apagadas
SW2	Medio	Segunda bomba encendida
SW3	Extremo superior	Alarma encendida

Paneles simples utilizando interruptores de acción simple:

Panel simple con alarma ①

SW1	Fondo	Bomba apagada
SW2	Medio	Bomba encendida
SW3	Extremo superior	Alarma encendida/apagada

Panel simple sin alarma

SW1	Fondo	Bomba apagada
SW2	Extremo superior	Bomba encendida

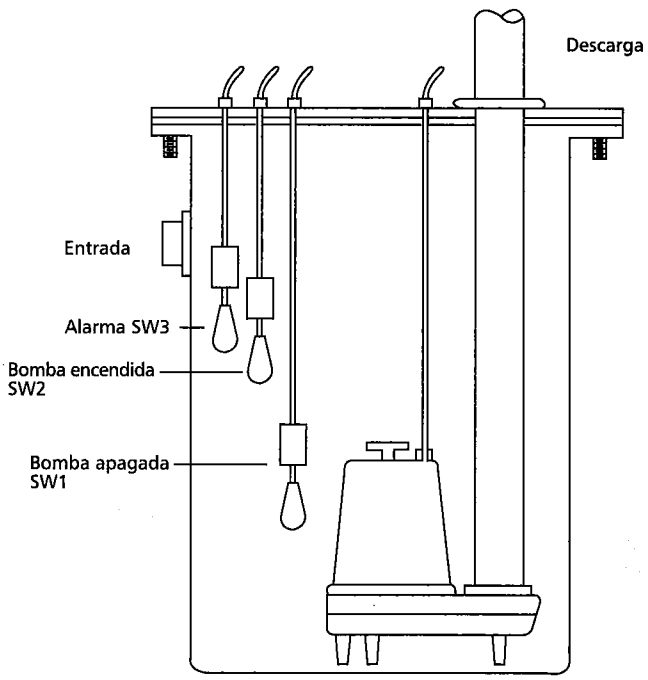
Paneles simples utilizando interruptores de ángulo amplio:

Panel simple con alarma

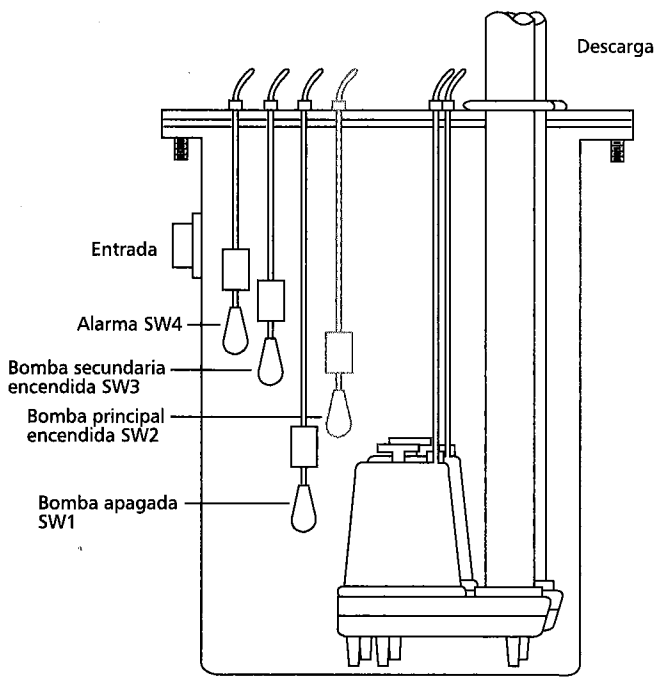
SW1	Fondo	Bomba encendida/apagada
SW2	Extremo superior	Alarma encendida/apagada

Panel simple sin alarma

SW1		Bomba encendida/apagada



Simple ①



Doble ②

DESBALANCE DE POTENCIA TRIFÁSICA

Se recomienda un suministro trifásico completo incluyendo tres transformadores individuales o un transformador trifásico. Se pueden usar conexiones en estrella o en triángulo "abierto" empleando sólo dos transformadores, pero hay más posibilidad de que produzcan un rendimiento inadecuado, disparo por sobrecarga o falla prematura del motor debido al desbalance de corriente.

Mida la corriente en cada uno de los tres conductores del motor y calcule el desbalance de corriente en la forma que se explica abajo.

Si el desbalance de corriente es del 2% o menos, deje los conductores tal como están conectados. Si el desbalance de corriente es de más del 2%, hay que verificar las lecturas de corriente en cada derivación empleando cada una de las tres conexiones posibles. Enrolle los conductores del motor en el arrancador en la misma dirección para evitar una inversión del motor.

Para calcular el porcentaje de desbalance de corriente:

A. Sume los tres valores de corriente de línea.

B. Divida la suma por tres, con lo cual se obtiene la corriente promedio.

C. Seleccione el valor de corriente más alejado de la corriente promedio (ya sea alto o bajo).

D. Determine la diferencia entre este valor de corriente (más alejado del promedio) y el promedio.

E. Divida la diferencia por el promedio. Multiplique el resultado por 100 para determinar el porcentaje de desbalance.

El desbalance de corriente no debe exceder el 5% con la carga del factor de servicio o el 10% con la carga de entrada nominal. Si el desbalance no puede corregirse enrollando los conductores, la causa del desbalance debe determinarse y corregirse. Si, en las tres conexiones posibles, la derivación más alejada del promedio está en el mismo conductor de potencia, entonces la mayoría del desbalance proviene de la fuente de potencia.

Contacte a la compañía de electricidad local para solucionar el desbalance.

	Conexión 1			Conexión 2			Conexión 3		
Terminales del arrancador	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
	T	T	T	T	T	T	T	T	T
Conductores del motor	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Ejemplo:

T3-R = 51 amps	T2-W = 50 amps	T1-B = 50 amps
T1-B = 46 amps	T3-R = 48 amps	T2-W = 49 amps
T2-W = 53 amps	T1-B = 52 amps	T3-R = 51 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
÷ 3 = 50 amps	÷ 3 = 50 amps	÷ 3 = 50 amps
— 46 = 4 amps	— 48 = 2 amps	— 49 = 1 amps
4 ÷ 50 = .08 or 8%	2 ÷ 50 = .04 or 4%	1 ÷ 50 = .02 or 2%

LECTURAS DE RESISTENCIA DEL AISLAMIENTO

Valores normales en ohmios y megaohmios entre todos los conductores y tierra

Condición del motor y los conductores	Valor en ohmios	Valor en Megaohmios
Un motor nuevo (sin cable de bajada).	20,000,000 (o más)	20 (o más)
Un motor usado que puede reinstalarse en el pozo.	10,000,000 (o más)	10 (o más)
Motor en el pozo. Las lecturas son para el cable de bajada más el motor.		
Motor nuevo.	2,000,000 (o más)	2 (o más)
El motor está en buenas condiciones.	500,000 - 2,000,000	.5 - 2
Daño de aislamiento, localícelo y repárelo.	Menos de 500,000	Menos de 0.5

La resistencia del aislamiento varía muy poco con la clasificación. Los motores de todas las clasificaciones de potencia, tensión y fase tienen valores similares de resistencia de aislamiento.

Los valores de resistencia de aislamiento anteriores están basados en lecturas obtenidas con un megaohmiómetro con salida de 500 V CC. Las lecturas pueden variar utilizando un ohmiómetro de tensión más baja; consulte con la fábrica si tiene dudas acerca de las lecturas.

Esta tabla se reimprimió como cortesía de Franklin Electric.

Los datos de ingeniería para modelos específicos pueden encontrarse en su catálogo y en nuestro sitio Web (dirección en la cubierta).

Los diagramas de cableado del panel de control se envían con los paneles de control. Utilice los dibujos del panel de control junto con este manual de instrucciones para completar el cableado.

CONSTRUCCIÓN DE LA BOMBA

Sumersión mínima	
Servicio continuo	Sumergida totalmente
Servicio intermitente	6 pulg. por debajo del extremo superior del motor

Temperatura máxima del fluido	
Operación continua	104° F 40° C
Operación intermitente	140° F 60° C

Pumpmaster y Pumpmaster Plus - Cableado directo

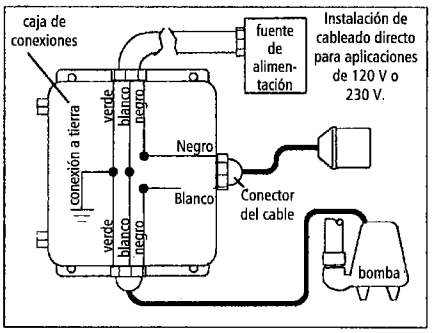


Fig. 1

Flotador doble – de cableado directo

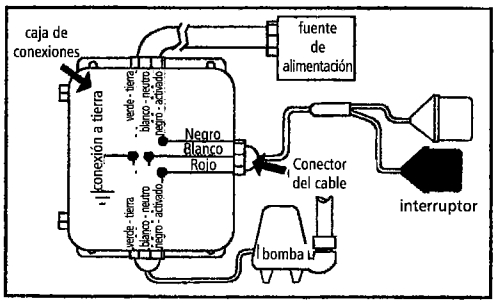


Fig. 2

Determinación del rango de bombeo

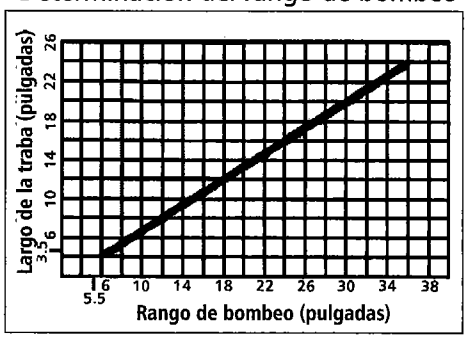


Fig. 3

Interruptor de flotador de acción simple Instalación "típica"

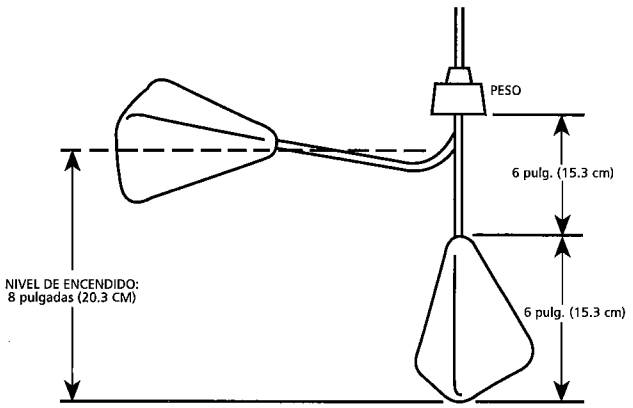


Fig. 4

Interruptor de flotador de ángulo amplio

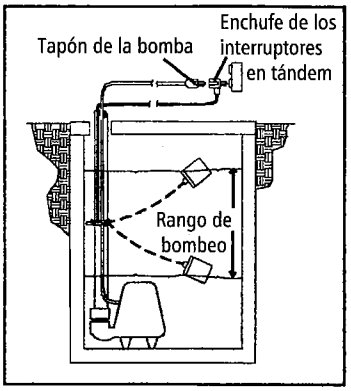


Fig. 5

Diagrama de conexión trifásica

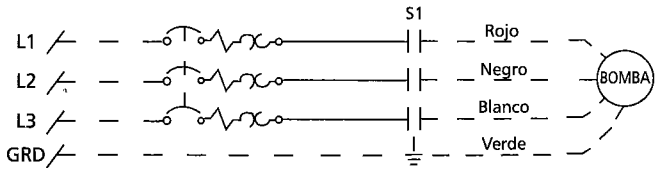


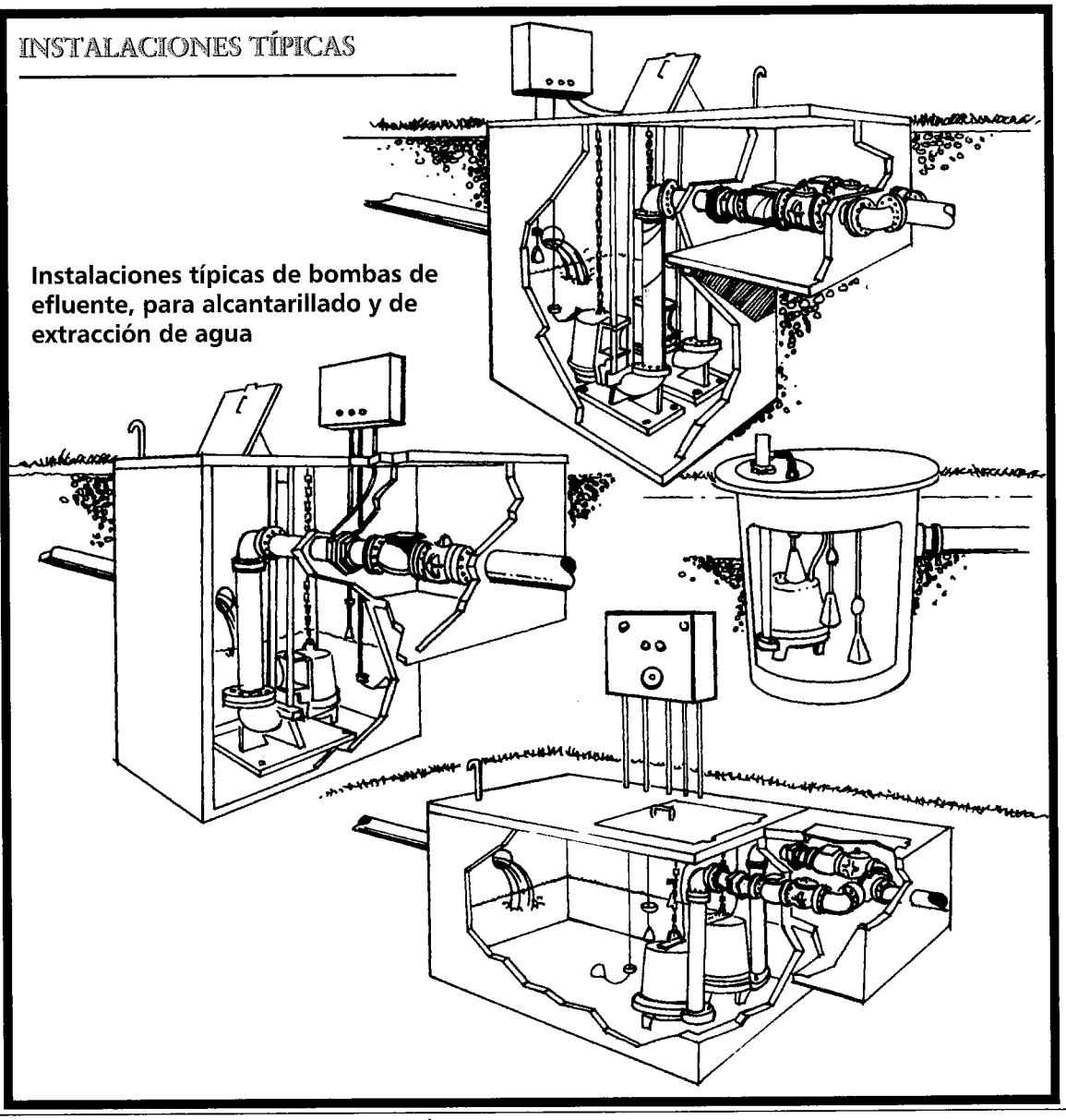
Fig. 6

⚠ADVERTENCIA Tensión peligrosa

LA FALLA DE DESCONECTAR Y BLOQUEAR LA CORRIENTE ELÉCTRICA ANTES DE INTENTAR CUALQUIER SERVICIO, PUEDE CAUSAR ELECTROCHOQUE, QUEMADURAS O LA MUERTE.

SÍNTOMA	CAUSA PROBABLE	ACCIÓN RECOMENDADA
EL MOTOR NO ESTÁ FUNCIONANDO **NOTA:** Si el cortacircuitos se "ABRE" repetidamente, **NO** lo reposicione. Llame a un electricista calificado.	Se disparó el protector térmico del motor	Deje que se enfríe el motor. Asegure la sumersión mínima de la bomba. Limpie los residuos de la carcasa y el impulsor.
	Cortacircuitos abierto o fusible quemado.	Determine la causa, llame a un electricista calificado.
	Impulsor de la bomba rozando o atascado.	Determine el consumo de corriente del motor. Si es dos veces más alto que el indicado en la placa de identificación de la bomba, el impulsor está trabado, los cojinetes del motor o el eje está dañado. Limpie los residuos de la carcasa y el impulsor, consulte con el agente.
a) Operación manual	El cable de alimentación está dañado.	
	Conexiones eléctricas inadecuadas en el panel de control.	
b) Operación automática	No hay alambre neutro conectado al panel de control.	La resistencia entre los conductores de alimentación y tierra debe indicar infinito. Si alguna lectura es incorrecta, llame a un electricista calificado.
	Conexiones eléctricas inadecuadas en el panel de control.	Inspeccione las conexiones del panel de control. Llame a un electricista calificado.
NOTA: Inspeccione la bomba en modo manual primero para confirmar el funcionamiento. Si la bomba funciona, el control automático o el cableado está defectuoso. Si la bomba no funciona, vea arriba.	Interruptor de nivel de líquido defectuoso para activar los controles.	Con el interruptor desconectado, verifique la continuidad mientras activa el interruptor de nivel de líquido. Reemplace el interruptor, según se requiera.
	Nivel de líquido insuficiente para activar los controles.	Deje que el nivel de líquido aumente de 3 a 4 pulgadas (76 mm –101 mm) sobre el nivel de activación.
	Cordones de los sensores de nivel de líquido enredados.	Desenrede los cordones y asegure el funcionamiento libre.
LA BOMBA NO SE APAGA	Cordones de los sensores de nivel de líquido enredados.	Desenrede los cordones y asegure el funcionamiento libre.
	La bomba está atascada con aire.	Apague la bomba durante aproximadamente un minuto y arránquela nuevamente. Repita hasta que se despeje la obstrucción de aire. Si la obstrucción de aire persiste en un sistema con tubo con válvula de retención, puede perforarse un agujero de 3/16 pulg. (4.8 mm) en el tubo de descarga aproximadamente a 2 pulgadas (51 mm) de la conexión de descarga.
	El flujo de líquido entrante coincide con la capacidad de descarga de la bomba.	Podría requerirse una bomba más grande.
LA BOMBA ENTREGA POCO O NADA DE LÍQUIDO	La válvula de retención está instalada invertida, está obstruida o atascada en posición cerrada.	Verifique la flecha de flujo en la válvula y verifique el funcionamiento de ésta.
	Carga excesiva del sistema.	Consulte con el agente.
	Entrada a la bomba obstruida.	Inspeccione y despeje, según sea requerido.
	Tensión incorrecta, o conectada incorrectamente.	Verifique la rotación, la tensión y las conexiones de la bomba. Consulte con un electricista calificado.
	La bomba está atascada con aire.	Consulte la acción recomendada, arriba.
	El impulsor está gastado o dañado.	Inspeccione el impulsor, reemplácelo según sea necesario.
	Los controles de nivel de líquido están defectuosos o instalados incorrectamente.	Inspeccione, reajuste o reemplace, según sea requerido.
LA BOMBA CICLA CONSTANTEMENTE	La válvula de retención de la descarga no funciona.	Inspeccione, repare o reemplace, según sea requerido.
	El área de contención de aguas negras es demasiado pequeña.	Consulte con el agente.
	Los controles de nivel de líquido están defectuosos o instalados incorrectamente.	Inspeccione, reajuste o reemplace, según sea requerido.
	Cantidad excesiva de líquido entrante para una bomba de este tamaño.	Consulte con el agente.

INSTALACIONES TÍPICAS



Instalaciones típicas de bombas de efluente, para alcantarillado y de extracción de agua

GARANTÍA LIMITADA DE GOULDS PUMPS

Esta garantía es aplicable a todas las bombas para sistemas de agua fabricadas por Goulds Pumps. Toda parte o partes que resultaren defectuosas dentro del período de garantía serán reemplazadas, sin cargo para el comerciante, durante dicho período de garantía. Tal período de garantía se extiende por doce (12) meses a partir de la fecha de instalación, o dieciocho (18) meses a partir de la fecha de fabricación, cualquiera se cumpla primero.

Todo comerciante que considere que existe lugar a un reclamo de garantía deberá ponerse en contacto con el distribuidor autorizado de Goulds Pumps del cual adquiriera la bomba y ofrecer información detallada con respecto al reclamo El distribuidor está autorizado a liquidar todos los reclamos por garantía a través del Departamento de Servicios a Clientes de Goulds Pumps.

La presente garantía excluye:

(a) La mano de obra, el transporte y los costos relacionados en los que incurra el comerciante;
(b) los costos de reinstalación del equipo reparado;
(c) los costos de reinstalación del equipo reemplazado;
(d) daños emergentes de cualquier naturaleza; y
(e) el reembolso de cualquier pérdida causada por la interrupción del servicio

A los fines de esta garantía, los términos "Distribuidor", "Comerciante" y "Cliente" se definen como sigue:

(1) "Distribuidor" es aquel individuo, sociedad, corporación, asociación u otra persona jurídica que opera en relación legal entre Goulds Pumps y el comerciante para la compra, consignación o contratos de venta de las bombas en cuestión.
(2) "Comerciante" es todo individuo, sociedad, corporación, asociación u otra persona jurídica que en el marco de una relación legal realiza negocios de venta o alquiler-venta (leasing) de bombas a clientes.
(3) "Cliente" es toda entidad que compra o que adquiere bajo la modalidad de leasing las bombas en cuestión de un comerciante. El término "cliente" puede significar un individuo, sociedad, corporación, sociedad de responsabilidad limitada, asociación o cualquier otra persona jurídica con actividades en cualquier tipo de negocios.

LA PRESENTE GARANTÍA SE EXTIENDE AL COMERCIANTE ÚNICAMENTE.

Goulds Pumps

ITT Industries

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GOULDS PUMPS

Pompes à eaux usées
Assèchement, effluents et eaux d'égout

Manuel d'installation et d'utilisation

Informations pour le propriétaire

Numéro de modèle de la pompe : _____

Numéro de série de la pompe : _____

N° de modèle du tableau de commande : _____

Détaillant : _____

N° de téléphone du détaillant : _____

Date d'achat : _____ d'installation : _____

Courant mesuré au démarrage :

1Ø	3Ø	L1-2	L2-3	L3-1
A : _____	A :	_____	_____	_____
V : _____	V :	_____	_____	_____

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Goulds Pumps

ITT Industries

CONSIGNES DE SÉCURITÉ

AFIN DE PRÉVENIR LES BLESSURES GRAVES OU MORTELLES ET LES DOMMAGES MATÉRIELS IMPORTANTS, LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ FIGURANT DANS LE MANUEL ET SUR LA POMPE.

LE PRÉSENT MANUEL A POUR BUT DE FACILITER L'INSTALLATION ET L'UTILISATION DE LA POMPE ET DOIT ÊTRE CONSERVÉ PRÈS DE CELLE-CI.



Le symbole ci-contre est un SYMBOLE DE SÉCURITÉ employé pour signaler les mots-indicateurs dont on trouvera la description ci-dessous. Sa présence sert à attirer l'attention afin d'éviter les blessures et les dommages matériels.

⚠ DANGER Prévient des risques qui VONT causer des blessures graves, la mort ou des dommages matériels importants.

⚠ AVERTISSEMENT Prévient des risques qui PEUVENT causer des blessures graves, la mort ou des dommages matériels importants.

⚠ ATTENTION Prévient des risques qui PEUVENT causer des blessures ou des dommages matériels.

AVIS : SERT À ÉNONCER LES DIRECTIVES SPÉCIALES DE GRANDE IMPORTANCE QUE L'ON DOIT SUIVRE.

LIRE SOIGNEUSEMENT CHAQUE DIRECTIVE ET AVERTISSEMENT AVANT D'EFFECTUER TOUT TRAVAIL SUR LA POMPE.

N'ENLEVER AUCUNE DÉCALCOMANIE DE SÉCURITÉ.

⚠ AVERTISSEMENT L'installation électrique doit être entièrement effectuée par un technicien qualifié. Il faut toujours suivre les prescriptions du code provincial ou national de l'électricité et les règlements locaux. Adresser toute question relative au code à un inspecteur en électricité. Le non-respect du code et des politiques de santé et de sécurité au travail peut entraîner des blessures et des dommages matériels. L'inobservation des directives d'installation fournies par le fabricant peut se traduire par un choc électrique, un incendie, des blessures ou la mort, ainsi que par des dommages matériels, des performances non satisfaisantes et l'annulation de la garantie du fabricant.

⚠ AVERTISSEMENT Les pompes standard ne sont pas conçues pour les piscines, l'eau libre, les liquides dangereux ni les endroits pouvant contenir des gaz inflammables. Ces fluides peuvent être présents dans les installations de confinement (puits collecteurs, réservoirs ou fosses humides). On doit aérer ces installations suivant les codes locaux.

Seules les pompes de classe 1, division 1, peuvent servir dans les liquides dangereux et les endroits pouvant contenir des gaz inflammables. *Le nom des organismes de normalisation pertinents figure sur la plaque signalétique de la pompe ou dans les feuillets du catalogue décrivant les pompes en question.*

⚠ AVERTISSEMENT Verrouiller la source de courant en position ouverte avant de procéder à l'installation ou à l'entretien de tout dispositif électrique. Le protecteur thermique de certains moteurs de pompe coupe le courant lorsqu'il y a surcharge thermique et le rétablit automatiquement, redémarrant ainsi la pompe inopinément.

⚠ ATTENTION Chaque tableau de commande triphasé pour pompe submersible doit assurer une protection rapide de classe 10 contre la surcharge.

VÉRIFICATIONS AVANT INSTALLATION

Ouvrir tous les cartons et vérifier si le matériel est endommagé. Signaler immédiatement tout dommage au fournisseur ou au transporteur.

Important : on doit toujours vérifier si les valeurs nominales inscrites sur la plaque signalétique (intensité, tension, puissance et nombre de phases) conviennent au tableau de commande et à la source de courant.

Le compartiment moteur d'un bon nombre de nos pompes à eaux d'égout est rempli d'huile isolante. S'il y a des traces d'huile sur la pompe ou si cette dernière a été entreposée longtemps, vérifier le niveau d'huile du compartiment et, si la pompe en est dotée, du logement de garniture.

Enlever le bouchon de l'orifice de remplissage du compartiment moteur (sur le dessus de celui-ci), puis vérifier le niveau d'huile par l'orifice. L'huile devrait seulement recouvrir le moteur. Ne pas trop en mettre pour que l'huile puisse se dilater !

Pour vérifier le niveau d'huile du logement de garniture, mettre la pompe sur le côté, le bouchon de remplissage en haut, puis enlever le bouchon. Le niveau de l'huile devrait être à tout au plus 13 mm (½ po) du haut. Au besoin, utiliser de l'huile pour turbines ASTM 150, puis remettre le bouchon.

On peut se procurer de l'huile isolante en contenants de 5 gallons US chez nos distributeurs. On peut aussi en acheter chez un réparateur de moteurs électriques. Les marques d'huiles types sont : Shell Turbo 32, Sunoco Sunvis 932, Texaco Regal R&O 32, Exxon Nuto 32 et Mobil DTE Light.

Vérifier si l'écrou presse-garniture du serre-câble d'alimentation est suffisamment serré. Le couple de serrage est de 75 lbf·po pour les câbles de calibre 16 et de 80 lbf·po pour tout autre câble. Il est cependant de 75 lbf·po pour les câbles de capteur de chaleur ou d'humidité.

La garantie ne couvre pas les dommages dus au branchement de la pompe et du tableau de commande à une source de courant dont la tension ou le nombre de phases sont inappropriés.

Inscrire à titre documentaire les numéros de modèle et de série de la pompe ainsi que le numéro de modèle du tableau de commande dans les Informations pour le propriétaire. Une fois l'installation achevée, remettre le manuel au propriétaire ou l'attacher au tableau de commande.

LEVAGE DE LA POMPE



NE PAS LEVER, TRANSPORTER NI SUSPENDRE LA POMPE PAR LE CÂBLE D'ALIMENTATION : L'ENDOMMAGEMENT DU CÂBLE POURRAIT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

Lever la pompe par son boulon à œil ou sa poignée avec un filin ou une chaîne de grosseur appropriée. **NE PAS** endommager le câble d'alimentation ni celui des capteurs durant la manutention de la pompe.

SYSTÈME DE LEVAGE OPTIONNEL À RAIL DE GUIDAGE OU À ADAPTATEUR COULISSANT

Dans le cas de bon nombre de cuves à effluents et de postes de relèvement d'eaux d'égout, il est conseillé de monter la pompe sur un rail de guidage ou avec un adaptateur coulissant pour pouvoir descendre, retirer, inspecter et entretenir celle-ci plus facilement. La plupart des codes n'autorisent pas le personnel à entrer dans une fosse humide sans la formation ni l'équipement protecteur appropriés. Le rail et l'adaptateur sont conçus pour faciliter la mise en place et la sortie de la pompe, et ce, sans disjoindre la tuyauterie. Le rail et l'adaptateur devraient être placés de façon à ce que la pompe soit face à l'orifice d'arrivée de l'influent pour empêcher la formation de zones de stagnation et, ainsi, de dépôts. Le fond du puits collecteur ou de la cuve doit être plat et suffisamment résistant pour supporter le poids de la pompe et du rail de guidage.

AVIS : SUIVRE LES DIRECTIVES FOURNIES AVEC LE RAIL DE GUIDAGE.

TUYAUTERIE

Afin de réduire les pertes de charge (par frottement) au minimum, la tuyauterie de refoulement devrait être aussi courte que possible et dépourvue d'accessoires et de raccords superflus. Son diamètre devrait être au moins égal à celui de l'orifice de refoulement de la pompe.

Prévenir le retour du liquide : poser sur le tuyau de refoulement un clapet de non-retour de calibre convenant à la grosseur des solides que la pompe peut laisser passer. Le retour du liquide peut faire tourner la pompe en sens inverse, provoquant ainsi l'usure prématurée des garnitures mécaniques et des roulements. S'il y a « rotation en sens inverse » au moment du démarrage, le couple accru produit peut abîmer le moteur ou l'arbre de pompe, ou les deux, et même forcer certaines pompes monophasées à continuer à tourner en sens inverse.

Poser **EN AVAL** (après) du clapet de non-retour un robinet-vanne de calibre approprié pour permettre l'entretien de la pompe, de la tuyauterie et du clapet.

Important : avant d'installer la pompe et afin de prévenir la formation de poches d'air dans celle-ci, percer un trou-purgeur d'air de 4,8 mm (3⁄16 po) dans le tuyau de refoulement, à environ 51 mm (2 po) au-dessus de l'orifice de refoulement de la pompe, mais avant le clapet de non-retour et à l'intérieur de la fosse humide. On permettra ainsi au liquide d'entrer dans la pompe par gravité, surtout si l'orifice d'aspiration est situé en dessous, et préviendra la formation de poches d'air qui empêcheraient le pompage du liquide même si la roue de la pompe tourne.

La tuyauterie doit être supportée correctement pour n'appliquer sur la pompe aucune charge pouvant la déformer.

Couvercles et trappes de visite doivent être assez grands pour permettre l'inspection et l'entretien de la pompe ainsi que l'emploi d'un dispositif de levage.

CÂBLAGE ET MISE À LA TERRE

Avis important : lire les Consignes de sécurité avant de procéder au câblage.

⚠ N'utiliser que du fil torsadé en cuivre pour la mise à la terre et l'alimentation du moteur. Le calibre du fil de terre doit être au moins égal à celui des fils d'alimentation du moteur, et les fils devraient tous être chromocodés pour faciliter l'entretien et le diagnostic des anomalies.

⚠ Poser le fil de terre et les autres fils suivant les prescriptions du code provincial ou national de l'électricité.

⚠ Installer un sectionneur tout conducteur si le code l'exige.

⚠ Verrouiller la source de courant en position ouverte avant de procéder à l'installation ou à l'entretien de la pompe.

⚠ Le nombre de phases et la tension d'alimentation doivent convenir à tout l'équipement. Un nombre de phases et une tension inappropriés annulent la garantie et peuvent causer un incendie et des dommages au moteur et au tableau de commande.

⚠ Chaque jonction de fils doit être étanche. Si l'on emploie un nécessaire de jonction (« *kit* »), suivre les directives du fabricant.

⚠ AVERTISSEMENT — Choisir la boîte de jonction du type et de la classe NEMA convenant au type et au lieu d'utilisation. La boîte doit assurer une jonction de fils sûre et étanche.

⚠ AVERTISSEMENT — Étancher les commandes afin d'empêcher les gaz d'en détériorer les composants.

⚠ AVERTISSEMENT
Tension dangereuse

OMETTRE LA MISE À LA TERRE PERMANENTE DE LA POMPE, DU MOTEUR ET DES COMMANDES AVANT LE BRANCHEMENT À LA SOURCE DE COURANT PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

SÉLECTION ET CÂBLAGE DES CONTACTEURS ET DES TABLEAUX DE COMMANDE

TYPES DE CONTACTEURS À FLOTTEUR

Deux types de contacteurs à flotteur sont normalement utilisés : à simple effet ou à grand déplacement angulaire. Le type détermine le nombre de contacteurs requis avec les différents systèmes et tableaux de commande. Les contacteurs à simple effet fonctionnent dans un angle de 15° et s'ouvrent et se ferment donc rapidement. La longueur du câble (la distance entre le point pivot du câble et le boîtier du contacteur) des contacteurs à grand

déplacement angulaire (90°) régit les niveaux démarrage-arrêt de la pompe.

Les contacteurs à flotteur peuvent être du type normalement ouvert (NO) pour le vidage (fosses ou réservoirs) et du type normalement fermé (NF) pour le remplissage.

Les contacteurs à simple effet doivent être connectés seulement aux tableaux de commande, jamais directement aux pompes.

Les contacteurs à grand déplacement angulaire pour le vidage peuvent être branchés aux pompes comme aux tableaux de commande.

RÉGLAGE DES CONTACTEURS À FLOTTEUR

Il n'existe pas de règle absolue pour le réglage des contacteurs à flotteur, lequel peut varier d'une installation à l'autre.

Règles suggérées :
Tous les contacteurs à flotteur devraient être placés sous l'orifice d'arrivée de l'influent !

Contacteur d'arrêt : (1er choix) — le régler pour que le niveau du liquide soit toujours au-dessus du compartiment moteur. **(2e choix)** — le régler pour que le niveau du liquide ne puisse être à plus de 6 po sous le dessus du compartiment moteur.

Contacteur de démarrage : le régler pour que la plage de pompage permette aux pompes de 1½ hp ou moins de fonctionner pendant au moins une (1) minute. Les pompes de 2 hp et plus devraient fonctionner durant au moins deux (2) minutes. Le catalogue donne la capacité de chaque cuve en gallons US par pouce de hauteur.

Contacteur(s) de pompe secondaire et d'alarme : s'il n'y en a qu'un, le placer plus haut que les contacteurs d'arrêt et de démarrage, et, s'il y en a deux, on devrait en outre les décaler (v. les illustrations dans la section *Tableaux de commande et fonction des contacteurs à flotteur*). Essayer d'utiliser tout l'espace de stockage disponible de la cuve, mais prévoir un espace de réserve.

SCHÉMAS DE CÂBLAGE DES TABLEAUX DE COMMANDE

Des directives et des schémas de câblage sont fournis avec nos tableaux de commande. Utiliser les directives en question conjointement avec celles du présent manuel. L'installation électrique ne doit être effectuée que par des techniciens qualifiés. Adresser toute question relative aux autres marques de tableau de commande au fournisseur ou au fabricant de ces marques. Notre personnel technique ne dispose pas des schémas ni des informations de dépannage des autres marques.

DISPOSITIFS D'ALARME

Il est recommandé de poser un dispositif d'alarme dans toute installation à pompe(s) à eaux usées. De nombreux tableaux de commande standard en sont munis. S'il n'y a pas de tableau de commande, on peut employer un dispositif d'alarme niveau haut, autonome, qui se déclenchera si le liquide atteint un niveau trop élevé, avertissant ainsi le personnel d'entretien, qui apportera alors les correctifs appropriés.

POMPES MONOPHASÉES

Les pompes monophasées peuvent être utilisées avec un contacteur à flotteur simple ou double à fiche-prise ou à raccordement fixe, avec un contacteur ordinaire ou avec un tableau de commande pour pompe simple ou double. *Voir les fig. 1, 2 et 5.*

Toutes les pompes de 1/3 et de 1/2 hp (115 ou 230 V), ainsi que certaines pompes de 3/4 et de 1 hp, sont munies d'un cordon d'alimentation à fiche pouvant être branchée sur la fiche-prise du contacteur à flotteur s'il s'agit d'une installation à pompe simple. On peut enlever la fiche du cordon d'alimentation et connecter celui-ci par raccordement fixe à un tableau de commande pour pompe simple ou double. L'enlèvement de la fiche n'annulera pas la garantie ni l'enregistrement auprès des organismes de normalisation pertinents. *Voir la fig. 5.*



LES POMPES CONNECTÉES PAR FICHE DOIVENT L'ÊTRE À UNE PRISE AVEC TERRE MISE À LA TERRE CORRECTEMENT.

S'IL S'AGIT D'UNE POMPE SANS FICHE, NE PAS ENLEVER LE CORDON D'ALIMENTATION NI SON SERRE-CÂBLE NI CONNECTER UN CONDUIT À LA POMPE.

Les pompes dont le bout des fils du cordon d'alimentation est dénudé peuvent être branchées par raccordement fixe à un contacteur à flotteur, à un contacteur ordinaire monophasé ou à un tableau de commande pour pompe simple ou double. On doit toujours s'assurer que le contacteur à flotteur convient à l'intensité de marche, à l'intensité maximale au démarrage et à la puissance nominales de la pompe. Sauf indication contraire sur la plaque signalétique, les pompes monophasées pour eaux usées sont munies d'une protection d'enroulement contre les surcharges. *Voir les fig. 1 et 2.*

POMPES TRIPHASÉES

Les pompes triphasées nécessitent au moins un démarreur magnétique à branchement direct convenant à la puissance nominale de la pompe, un circuit à fusible(s) ou à disjoncteur tripolaire, ainsi que des limiteurs de surcharge rapides de classe 10 compensés en fonction des conditions ambiantes.

TABLEAUX DE COMMANDE MONOPHASÉS ET TRIPHASÉS

Les tableaux de commande viennent en deux versions : pour pompe simple ou pour pompe double. Nos tableaux de la série SES offrent de nombreuses fonctions standard auxquelles on peut ajouter nos options les plus populaires. En outre, nous fournissons des tableaux sur demande dont les fonctions sont beaucoup plus nombreuses que celles de la série SES. Les tableaux faits sur demande sont offerts en versions variées. On peut adresser toute demande de prix pour ce type de tableau au service à la clientèle (*Customer Service*) par l'entremise d'un distributeur agréé.

Nos tableaux de commande pour pompe double de la série SES possèdent un circuit imprimé muni d'un circuit d'alarme niveau haut standard. Il existe d'autres accessoires standard : contacts d'alarme secs auxiliaires signalant les alarmes à distance et voyants indicateurs de position pour contacteurs à flotteur. Des limiteurs de surcharge réglables de classe 10 sont intégrés dans nos tableaux de commande triphasés, éliminant ainsi du travail pour l'installateur et l'obligation de commander des limiteurs particuliers. La plupart des tableaux de la série SES sont en stock et prêts à livrer.

Avec les pompes à capteurs de chaleur et d'humidité (décèle les défaillances de garniture), il est recommandé d'utiliser notre tableau de commande et les accessoires optionnels appropriés. Ces capteurs ne fonctionneront pas si le tableau de commande n'est pas équipé du relais, du bornier et de l'avertisseur (sonnerie ou voyant) appropriés.

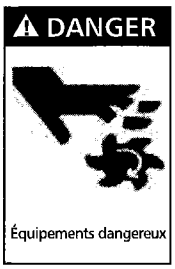
Circuit de détection des défaillances de garniture — certaines pompes à double garniture comportent un circuit de détection intégré pour les défaillances de garniture, décelées par un capteur d'humidité. Il faut relier le circuit au relais en option monté dans le tableau de commande. On doit commander le tableau expressément avec le relais et l'avertisseur précités. Il existe aussi des tableaux standard (A4-3 et A4-4) séparés pour la détection des défaillances de garniture. Les pompes à capteur d'humidité se distinguent par le câble de capteur supplémentaire sortant de l'enveloppe de moteur. Le câble possède deux conducteurs, à brancher dans le tableau : le noir à la borne réservée au capteur (« *probe* ») et le blanc à la borne terre (« *ground* ») destinée au relais (pas sur la vis de terre du tableau). *Suivre les directives de câblage fournies avec le tableau.*

Circuits de détection de chaleur et des défaillances de garniture — des pompes sont munies d'un circuit de détection des défaillances de garniture à capteurs d'humidité, ainsi que d'un circuit de détection de chaleur à thermostats (capteurs de chaleur) normalement fermés pour hautes températures montés sur l'enroulement. Ces pompes ont un câble à quatre (4) conducteurs, à brancher dans le tableau : le noir à la borne pour le capteur (« *probe* ») et le vert à celle de terre (« *ground* ») du relais du circuit du capteur d'humidité ; et le rouge et le blanc aux bornes pour le circuit du capteur de chaleur, selon le schéma de câblage du tableau. Comme le circuit du capteur de chaleur est optionnel, on doit le commander expressément avec le tableau, et il fonctionne différemment des limiteurs de surcharge de classe 10 qui sont toujours requis sur les pompes triphasées. *Suivre les directives de câblage fournies avec le tableau.*

INSTALLATION

Fixer à la ou aux pompes le raccord rapide pour le rail de guidage, l'adaptateur coulissant ou la tuyauterie de refoulement. Le pied d'assise du rail devrait être assujetti au fond de la fosse humide par des boulons d'ancrage.

Effectuer le câblage selon les schémas de câblage des tableaux de commande, les prescriptions du code provincial ou national de l'électricité et les règlements locaux. À ce stade-ci, il est suggéré de vérifier le sens de rotation de l'arbre de moteur ou de la roue.



ÉVITER LES BLESSURES GRAVES : NE PAS S'INTRODUIRE LES DOIGTS DANS L'ORIFICE D'ASPIRATION DE LA POMPE PENDANT LA VÉRIFICATION DU SENS DE ROTATION.

On doit toujours vérifier si la pompe tourne dans le sens indiqué sur le corps de pompe, ce qui est plus facile à faire avant l'installation de la pompe. Les moteurs triphasés peuvent tourner dans les deux sens. Il est donc permis de les mettre en marche, puis de les arrêter immédiatement tout en en observant le sens de rotation. Pour inverser celui-ci, intervertir deux des fils d'alimentation du moteur.

Descendre la ou les pompes dans la fosse humide.

S'assurer que les contacteurs à flotteur peuvent bouger librement, mais sans pouvoir atteindre la tuyauterie.

MISE EN MARCHE

Une fois le raccordement de la tuyauterie achevé et vérifié, on peut mettre la ou les pompes en marche.

Vérification du fonctionnement des contacteurs à flotteur à fiche-prise — brancher d'abord la fiche-prise du contacteur sur une prise de courant indépendante mise à la terre, puis la prise de la pompe sur la fiche-prise du contacteur. Essayer la pompe en remplissant d'eau la fosse humide jusqu'à ce que la pompe démarre. Si le débit de la pompe est faible ou nul, c'est qu'il y a probablement présence d'air dans la pompe. Percer alors un trou-purgeur d'air selon les indications de la section Tuyauterie.

Vérifier la durée de fonctionnement de la pompe pour s'assurer qu'elle est d'au moins une minute et que la plage de pompage est correcte.

Vérification du fonctionnement du tableau de commande — remplir d'eau la fosse humide.

Essayer d'abord la pompe en mode manuel en plaçant le commutateur « *Hand-Off-Auto* » (manuel-arrêt-automatique) du tableau de commande à *Hand*. Si la pompe fonctionne bien, l'essayer en mode automatique. Si le débit de la pompe est faible ou nul, c'est qu'il y a probablement présence d'air dans la pompe. Percer alors un trou-purgeur d'air selon les indications de la section Tuyauterie.

Faire fonctionner la pompe en mode automatique (*Auto*) et vérifier minutieusement le fonctionnement des contacteurs de démarrage, d'arrêt et d'alarme en remplissant d'eau la fosse humide. **Important :** omettre de brancher le fil neutre de la source de courant à tout tableau de commande alimenté en courant monophasé de 230 V empêchera le circuit de commande du tableau de fonctionner. Le neutre est nécessaire pour alimenter (115 V) le circuit de commande.

Mesurer l'intensité et la tension du courant au démarrage et les inscrire à titre documentaire dans les Informations pour le propriétaire. Comparer l'intensité mesurée à l'intensité maximale indiquée sur la plaque signalétique de la pompe. Si l'intensité mesurée est supérieure, en chercher la cause. L'utilisation de la pompe hors de sa courbe de performances, c.-à-d. à une hauteur de charge trop faible ou à une tension trop basse ou trop haute, augmentera l'intensité du courant. Le moteur fonctionnera correctement si sa tension d'alimentation se situe dans les limites suivantes : tension nominale (plaque signalétique) ± 10 %. Les performances obtenues dans ces limites ne seront pas forcément identiques à celles de la courbe de performances correspondant aux valeurs de courant nominales inscrites sur la plaque signalétique. Apporter les correctifs nécessaires avant de continuer. Le déséquilibre du courant triphasé peut en outre altérer les performances. *Si c'est le cas, suivre les directives de la section Déséquilibre du courant triphasé.*

Réarmer le dispositif d'alarme, puis mettre la pompe en mode automatique (*Auto*) et le circuit de commande du tableau sous tension (interrupteur « *Control On-Off* » à *On*). Le système est maintenant prêt à fonctionner automatiquement.

Expliquer le fonctionnement de la pompe et des dispositifs de commande et d'alarme à l'utilisateur, puis lui laisser la documentation ou l'attacher au tableau de commande s'il est installé dans un endroit sec, fermé.

TABLEAUX DE COMMANDE ET FONCTION DES CONTACTEURS À FLOTTEUR

L'objet de la présente section est d'indiquer le nombre de contacteurs à flotteur requis et le rôle de chacun dans les systèmes d'évacuation des eaux usées types. Le nombre varie selon le type de contacteur : à simple effet ou à grand déplacement angulaire, mais aussi selon le type de tableau de commande : pour pompe simple avec ou sans alarme ou pour pompe double avec alarme.

Tableaux de commande pour pompe double à contacteurs à simple effet :

Trois contacteurs à flotteur

SW1	Inférieur	Pompes hors fonction
SW2	Intermédiaire	1re pompe en fonction
SW3	Supérieur	2e pompe et alarme en fonction

Quatre contacteurs à flotteur ②

SW1	Inférieur	Pompes hors fonction
SW2	Deuxième (du bas)	1re pompe en fonction
SW3	Troisième (du bas)	2e pompe en fonction
SW4	Supérieur	Alarme en fonction

Tableaux de commande pour pompe double à contacteurs à grand déplacement angulaire :

Trois contacteurs à flotteur

SW1	Inférieur	1re pompe en fonction ou les deux hors fonction
SW2	Supérieur	2e pompe et alarme en fonction

Quatre contacteurs à flotteur

SW1	Inférieur	1re pompe en fonction ou les deux hors fonction
SW2	Intermédiaire	2e pompe en fonction
SW3	Supérieur	Alarme en fonction

Tableaux de commande pour pompe simple à contacteurs à simple effet :

Trois contacteurs à flotteur avec alarme ①

SW1	Inférieur	Pompe hors fonction
SW2	Intermédiaire	Pompe en fonction
SW3	Supérieur	Alarme en fonction ou hors fonction

Deux contacteurs à flotteur sans alarme

SW1	Inférieur	Pompe hors fonction
SW2	Supérieur	Pompe en fonction

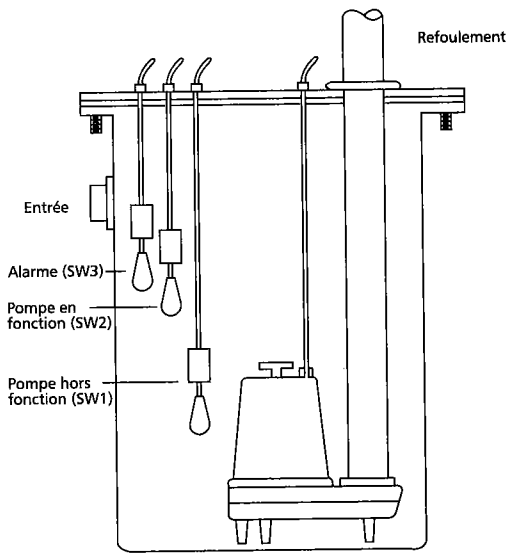
Tableaux de commande pour pompe simple à contacteurs à grand déplacement angulaire :

Deux contacteurs à flotteur avec alarme

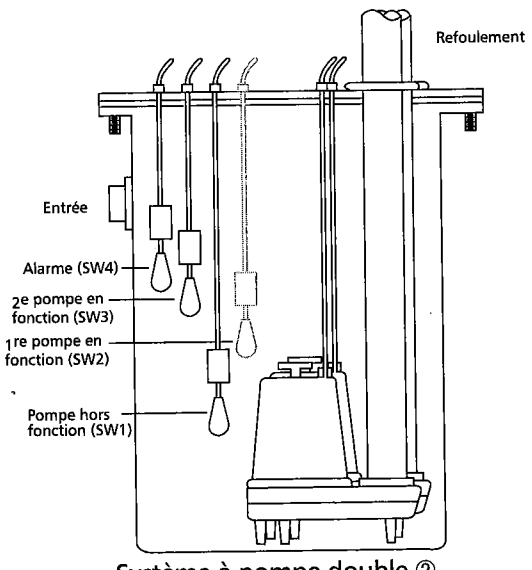
SW1	Inférieur	Pompe en fonction ou hors fonction
SW2	Supérieur	Alarme en fonction ou hors fonction

Un contacteur à flotteur sans alarme

SW1		Pompe en fonction ou hors fonction



Système à pompe simple ①



Système à pompe double ②

DÉSÉQUILIBRE DU COURANT TRIPHASÉ

Un circuit d'alimentation électrique entièrement triphasé est recommandé. Il peut être constitué de trois transformateurs distincts ou d'un transformateur triphasé. On peut aussi utiliser deux transformateurs montés en étoile ou en triangle « ouverts », mais il est possible qu'un tel montage crée un déséquilibre de courant se traduisant par des performances médiocres, le déclenchement intempestif du limiteur de surcharge et la défaillance prématurée du moteur.

Vérifier l'intensité du courant sur chacun des trois fils de moteur, puis calculer le déséquilibre du courant.

Si le déséquilibre est de 2 % ou moins, ne pas changer la connexion des fils.

S'il dépasse 2 %, on devrait vérifier l'intensité du courant sur chaque conducteur, dans les trois montages possibles ci-dessous. Afin de maintenir le sens de rotation du moteur, suivre l'ordre numérique indiqué dans chaque montage pour la connexion des fils de moteur.

Pour calculer le pourcentage de déséquilibre du courant :

A. Faire l'addition des trois intensités de courant de ligne mesurées.

B. Diviser le total par 3 pour obtenir l'intensité moyenne.

C. Prendre l'écart d'intensité le plus grand par rapport à la moyenne.

D. Soustraire cet écart de la moyenne.

E. Diviser la différence par la moyenne, puis multiplier le résultat par 100 pour obtenir le pourcentage de déséquilibre.

Le déséquilibre de courant ne devrait pas excéder 5 % en charge avec facteur de surcharge et 10 % en charge d'entrée nominale. Si l'on ne peut éliminer le déséquilibre en connectant les fils de moteur dans l'ordre numérique indiqué, on doit en trouver la cause et la rectifier. Si, dans les trois montages, l'écart d'intensité le plus grand par rapport à la moyenne est toujours sur le même conducteur, la cause du déséquilibre vient surtout de la source de courant.

On s'adressera alors à la société d'électricité pour rectifier le déséquilibre de courant.

	1er montage			2e montage			3e montage		
Bornes de démarreur	L1	L2	L3	L1	L2	L3	L1	L2	L3
	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T	⊥ T
Fils de moteur	R	B	W	W	R	B	B	W	R
	T3	T1	T2	T2	T3	T1	T1	T2	T3

Exemples :

T3-R = 51 A	T2-W = 50 A	T1-B = 50 A
T1-B = 46 A	T3-R = 48 A	T2-W = 49 A
T2-W = 53 A	T1-B = 52 A	T3-R = 51 A
Total = 150 A	Total = 150 A	Total = 150 A
÷ 3 = 50 A	÷ 3 = 50 A	÷ 3 = 50 A
– 46 A = 4 A	– 48 A = 2 A	– 49 A = 1 A
4 ÷ 50 = 0,08 ou 8 %	2 ÷ 50 = 0,04 ou 4 %	1 ÷ 50 = 0,02 ou 2 %

VALEURS DE RÉSISTANCE D'ISOLEMENT DU MOTEUR

Valeurs normalement mesurées en ohms et en mégohms entre chaque fil et le fil de terre

État du moteur et des fils	Valeurs en ohms	Valeurs en mégohms
Moteur neuf sans câble d'alimentation	20 000 000 (et plus)	20 (et plus)
Moteur usagé réutilisable en fosse	10 000 000 (et plus)	10 (et plus)
Moteur en fosse — valeurs mesurées : câble d'alimentation plus moteur		
Moteur neuf	2 000 000 (et plus)	2 (et plus)
Moteur en bon état	500 000 à 2 000 000	0,5 à 2
Isolation endommagée (la réparer)	Moins de 500 000	Moins de 0,5

La valeur de résistance d'isolement varie très peu d'un moteur à l'autre, peu importent la puissance, la tension d'alimentation et le nombre de phases du moteur.

Les valeurs de résistance d'isolement ci-dessus sont tirées de mesures prises avec un mégohmmètre et une tension de sortie de 500 V c.c. Les valeurs mesurées peuvent varier si l'on utilise un ohmmètre avec une tension moindre. Communiquer avec le personnel technique de l'usine en pareil cas.

Cette table a été publiée avec l'aimable autorisation de Franklin Electric.

On trouvera les données techniques sur des modèles particuliers dans le catalogue et à l'adresse du site Web inscrite au bas de la première page.

Les schémas de câblage des tableaux de commande sont fournis avec ces derniers. S'en servir conjointement avec les directives du présent manuel pour effectuer le câblage.

CONDITIONS DE SERVICE DE LA POMPE

Hauteur d'immersion minimale	
Service continu	Immersion totale
Service intermittent	6 po sous le dessus du compartiment moteur

Température maximale du liquide	
Service continu	40 °C (104 °F)
Service intermittent	60 °C (140 °F)

Raccordement fixe des contacteurs à flotteur Pumpmaster et Pumpmaster Plus

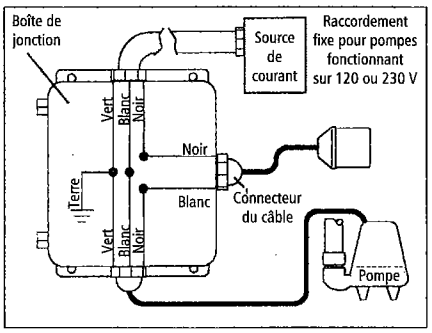


Fig. 1

Raccordement fixe pour contacteur à flotteur double

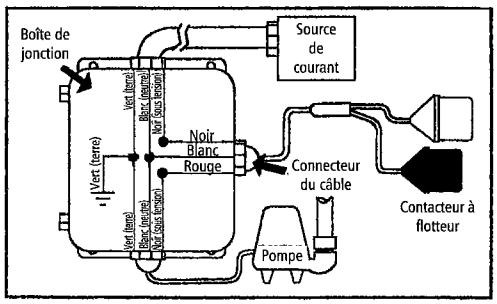


Fig. 2

Détermination de la plage de pompage

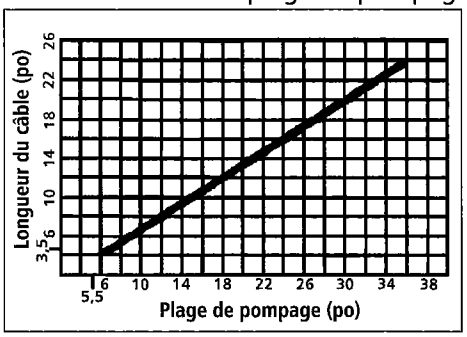


Fig. 3

Installation type à contacteur à flotteur à simple effet

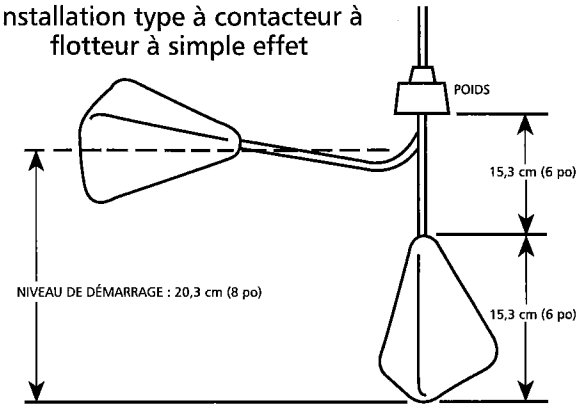


Fig. 4

Contacteur à flotteur à grand déplacement angulaire

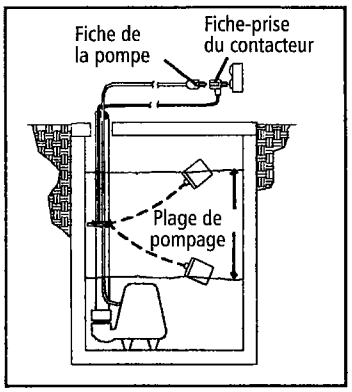


Fig. 5

Schéma de câblage triphasé

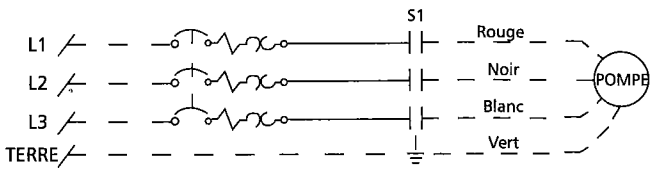
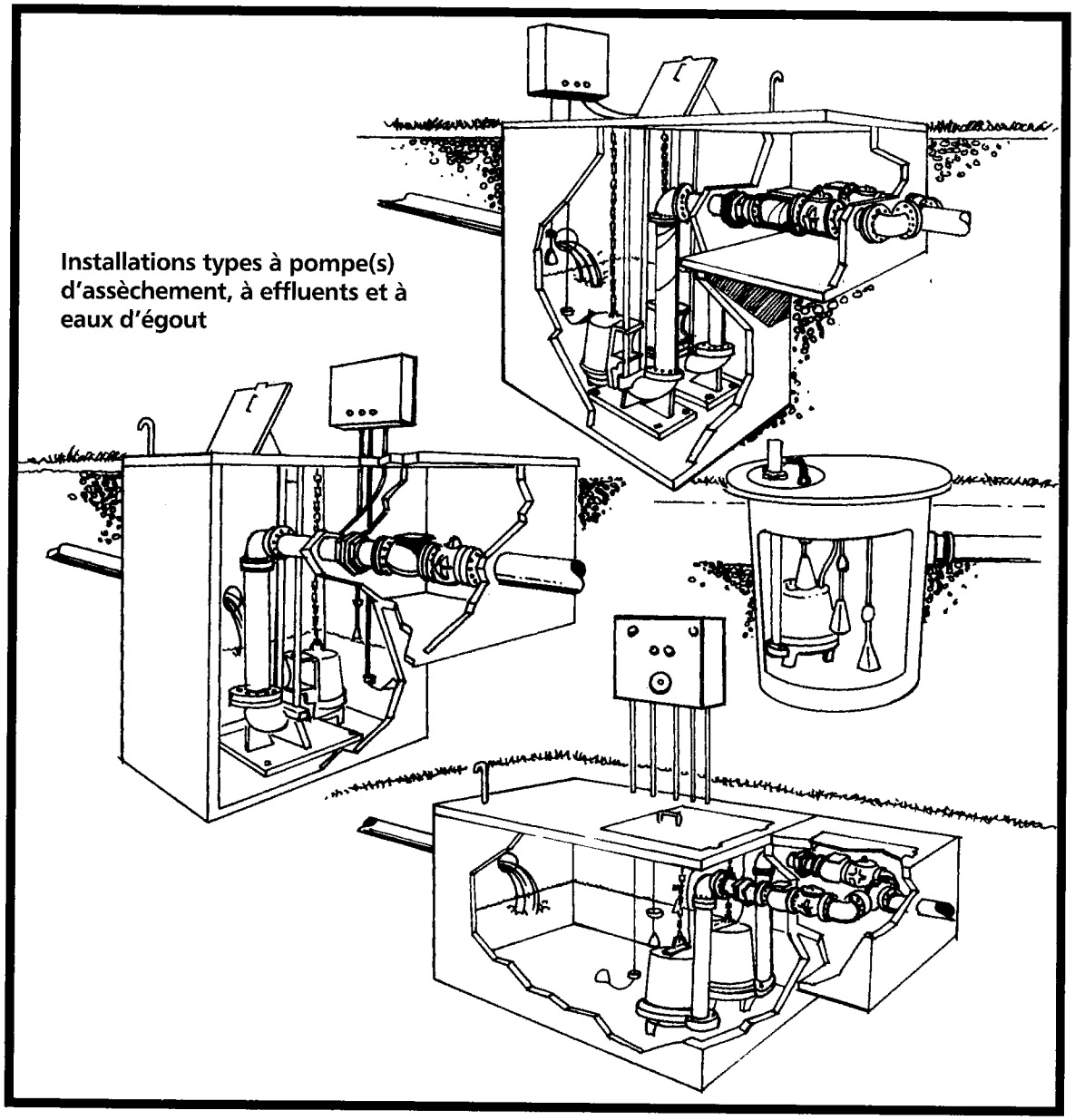


Fig. 6



Installations types à pompe(s) d'assèchement, à effluents et à eaux d'égout

⚠ AVERTISSEMENT
Tension dangereuse

OMETTRE DE VERROUILLER LA SOURCE DE COURANT EN POSITION OUVERTE AVANT D'EFFECTUER TOUT TRAVAIL D'ENTRETIEN SUR LA POMPE PEUT CAUSER UN CHOC ÉLECTRIQUE, DES BRÛLURES OU LA MORT.

ANOMALIES	CAUSES PROBABLES	CORRECTIFS RECOMMANDÉS
NON-FONCTIONNEMENT DU MOTEUR *NOTA* : si le disjoncteur ne cesse de s'« OUVRIR », NE PLUS le réarmer. S'adresser à un électricien.	Protecteur thermique du moteur déclenché	Laisser le moteur refroidir. Vérifier si la hauteur d'immersion est suffisante. Enlever les débris du corps de pompe et de la roue.
	Disjoncteur ouvert ou fusible sauté	En déterminer la cause et s'adresser à un électricien.
	Roue bloquée ou grippée	Mesurer le courant (A) consommé par le moteur. Si l'intensité est au moins deux fois plus élevée que celle qui figure sur la plaque signalétique de la pompe, la roue est grippée, ou bien les roulements ou l'arbre du moteur sont endommagés. Enlever les débris du corps de pompe et de la roue. Consulter le détaillant.
a) Mode manuel	Câble d'alimentation endommagé	
	Mauvaise connexion dans le tableau de commande	
b) Mode automatique	Fil neutre non connecté au tableau de commande	La valeur de résistance mesurée entre les fils d'alimentation et le fil de terre devrait être infinie. Si elle n'est pas appropriée, appeler un électricien.
	Mauvaise connexion dans le tableau de commande	Inspecter le câblage du tableau de commande. Appeler un électricien.
NOTA : vérifier si la pompe peut fonctionner en mode manuel d'abord. Si oui, la commande automatique ou le câblage sont défectueux. Dans la négative, voir les indications ci-dessus.	Contacteur à flotteur défectueux	Débrancher le contacteur à flotteur et en vérifier la continuité en l'actionnant. Le remplacer au besoin.
	Liquide trop bas pour actionner les commandes	Laisser le liquide monter de 76 à 101 mm (3 à 4 po) au-dessus du niveau de démarrage.
	Câbles de contacteur à flotteur enchevêtrés	Démêler les câbles de contacteur à flotteur et s'assurer que les contacteurs peuvent bouger librement.
NON-ARRÊT DE LA POMPE	Câbles de contacteur à flotteur enchevêtrés	Démêler les câbles de contacteur à flotteur et s'assurer que les contacteurs peuvent bouger librement.
	Poche d'air dans la pompe	Arrêter la pompe pendant environ une minute, puis la remettre en marche. Répéter l'opération jusqu'à ce que la poche d'air s'élimine. Si le problème persiste et que le tuyau de refoulement comporte un clapet de non-retour, on peut percer un trou-purgeur d'air de 4,8 mm (3/16 po) de diamètre dans le tuyau à environ 51 mm (2 po) en aval de l'orifice de refoulement de la pompe.
	Débit de l'influent égal à celui de la pompe	Il faut peut-être une pompe plus puissante.
DÉBIT DE REFOULEMENT FAIBLE OU NUL	Clapet de non-retour posé à l'envers, obstrué ou coincé en position fermée	Vérifier l'orientation de la flèche sur le clapet de non-retour et le fonctionnement de ce dernier.
	Hauteur de charge trop élevée du système	Consulter le détaillant.
	Entrée de pompe obstruée	Inspecter et dégager l'entrée au besoin.
	Connexions ou tension inappropriées	Vérifier le sens de rotation de la pompe, la tension et le câblage. Consulter un électricien.
	Poche d'air dans la pompe	Voir le correctif recommandé pertinent ci-dessus.
	Roue usée ou endommagée	Inspecter la roue et la remplacer au besoin.
	Contacteurs à flotteur défectueux ou mal placés	Inspecter, régler ou remplacer les contacteurs au besoin.
CYCLE DE FONCTIONNEMENT RÉPÉTÉ SANS ARRÊT	Clapet de non-retour défectueux	Inspecter, réparer ou remplacer le clapet au besoin.
	Installation de confinement des eaux d'égout trop petite	Consulter le détaillant.
	Contacteurs à flotteur défectueux ou mal placés	Inspecter, régler ou remplacer les contacteurs au besoin.
	Débit de l'influent supérieur à celui de la pompe	Consulter le détaillant.

GOULDS PUMPS

GARANTIE LIMITÉE DE GOULDS PUMPS

La présente garantie s'applique à chaque pompe de système d'alimentation en eau fabriquée par Goulds Pumps.
Toute pièce se révélant défectueuse sera remplacée sans frais pour le détaillant durant la période de garantie suivante expirant la première : douze (12) mois à compter de la date d'installation ou dix-huit (18) mois à partir de la date de fabrication.
Le détaillant qui, aux termes de cette garantie, désire effectuer une demande de règlement doit s'adresser au distributeur Goulds Pumps agréé chez lequel la pompe a été achetée et fournir tous les détails à l'appui de sa demande. Le distributeur est autorisé à régler toute demande par le biais du service à la clientèle de Goulds Pumps.

La garantie ne couvre pas :

(a) les frais de main-d'œuvre ni de transport ni les frais connexes encourus par le détaillant ;
(b) les frais de réinstallation de l'équipement réparé ;
(c) les frais de réinstallation de l'équipement de remplacement ;
(d) les dommages indirects de quelque nature que ce soit ;
(e) ni les pertes découlant de la panne.

Aux fins de la présente garantie, les termes ci-dessous sont définis comme suit :

(1) « Distributeur » signifie une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique servant d'intermédiaire entre Goulds Pumps et le détaillant pour les achats, les consignations ou les contrats de vente des pompes en question.
(2) « Détaillant » veut dire une personne, une société de personnes, une société de capitaux, une association ou autre entité juridique dont les activités commerciales sont la vente ou la location de pompes à des clients.
(3) « Client » signifie une entité qui achète ou loue les pompes en question chez un détaillant. Le « client » peut être une personne, une société de personnes, une société de capitaux, une société à responsabilité limitée, une association ou autre entité juridique se livrant à quelque activité que ce soit.

CETTE GARANTIE SE RAPPORTE AU DÉTAILLANT SEULEMENT.

Goulds Pumps et le logo à blocs siglés d'ITT sont des marques déposées et de commerce d'ITT Industries.

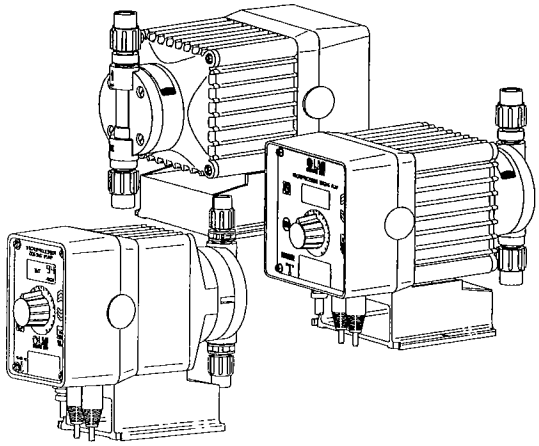
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Goulds Pumps

ITT Industries

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

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Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

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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).

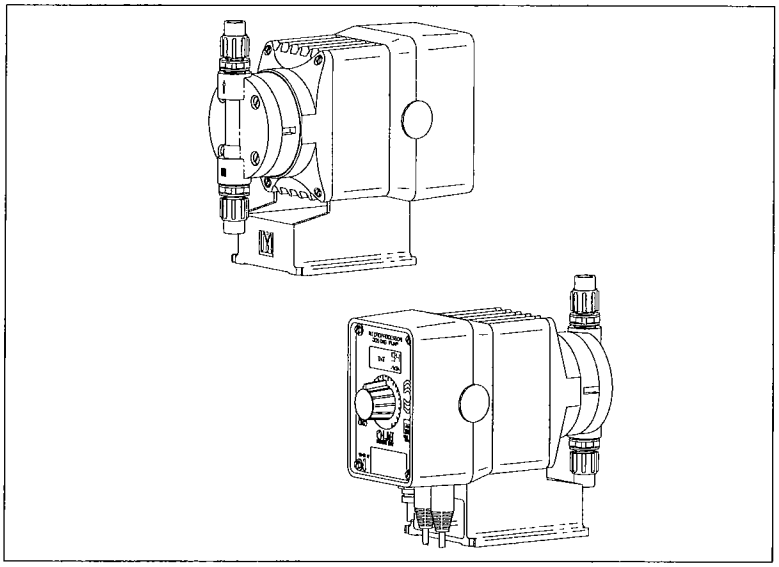


Figure 1: LMI Series A9 Electronic Metering Pump

2.0 Unpacking

You should find the following items in the box:

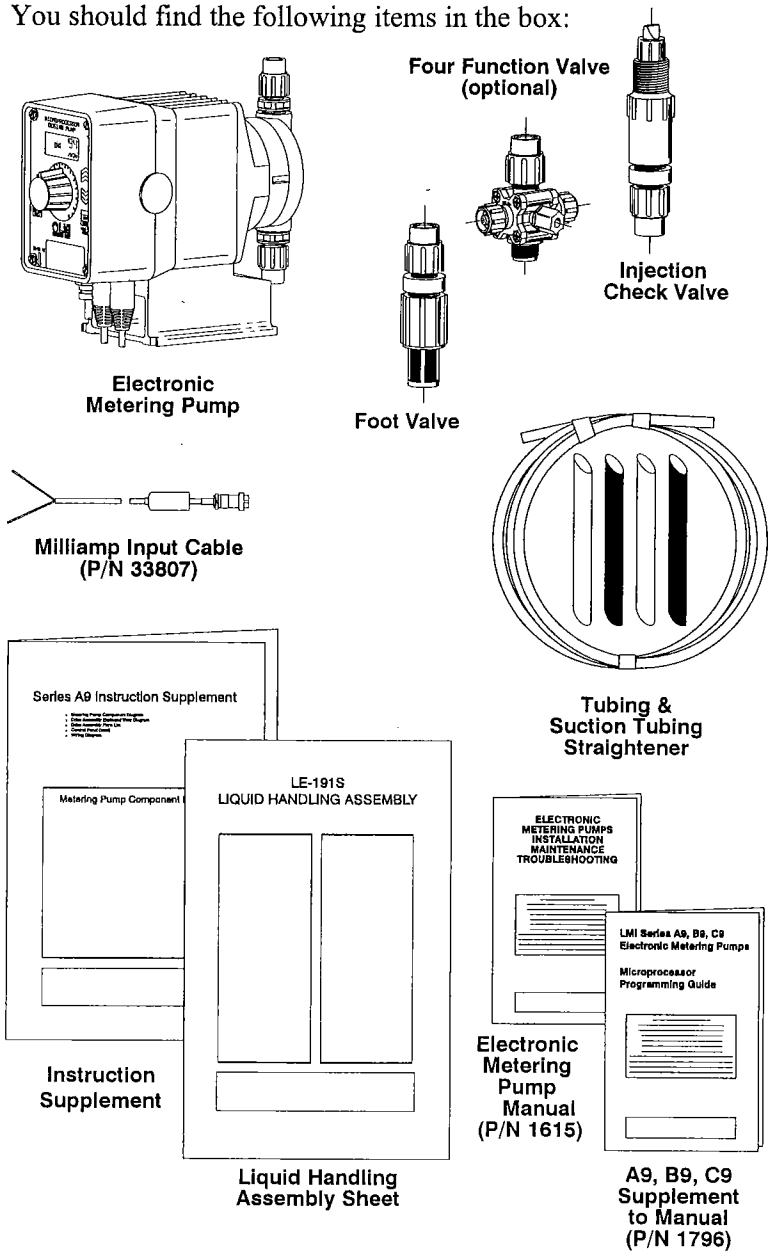


Figure 2: Unpacking Items

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.

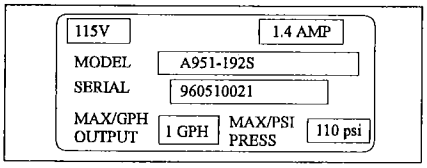


Figure 3a : Data Plate

Included on the data plate is the model number of the pump. Each number in the model number represents the following in Figure 3b.

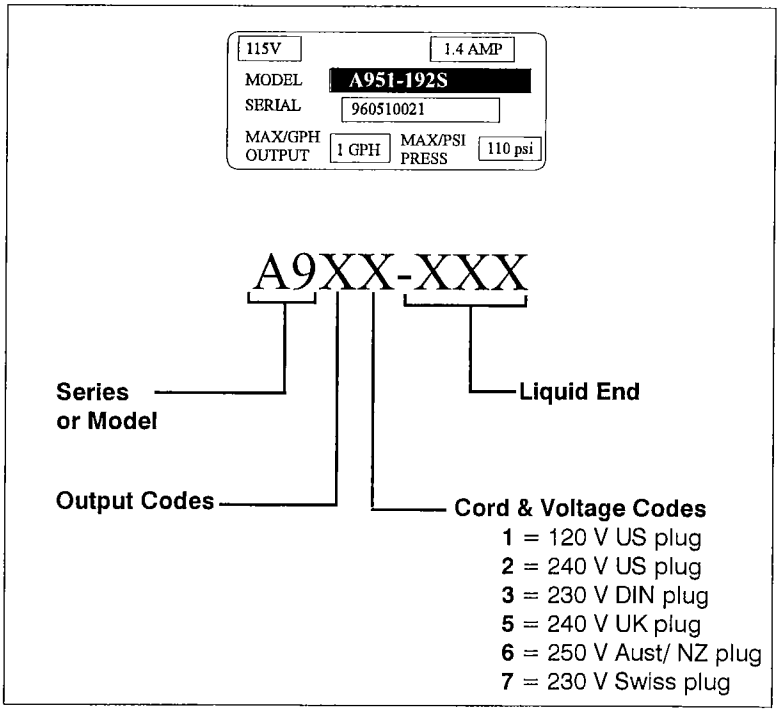


Figure 3b : Part Number Representation

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

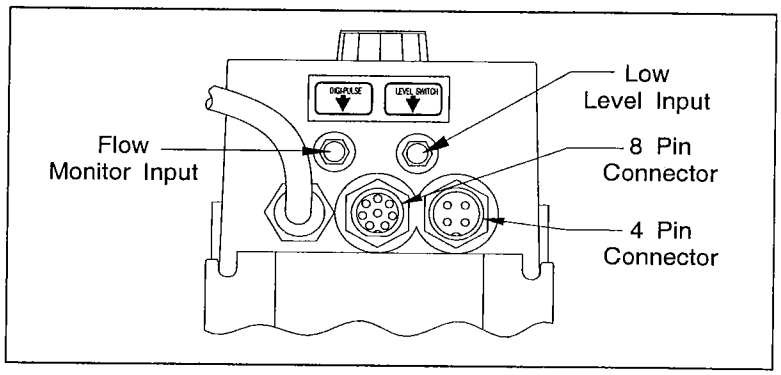


Figure 4: External Input and Output Connections



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.

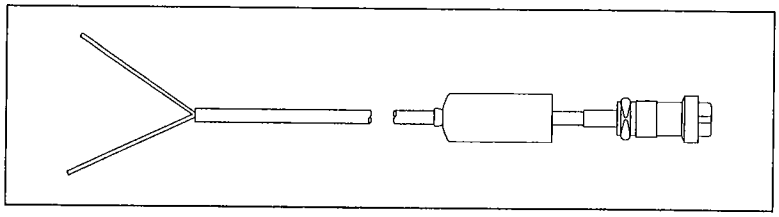


Figure 5: 2-Conductor Cable (P/N 33807)

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.

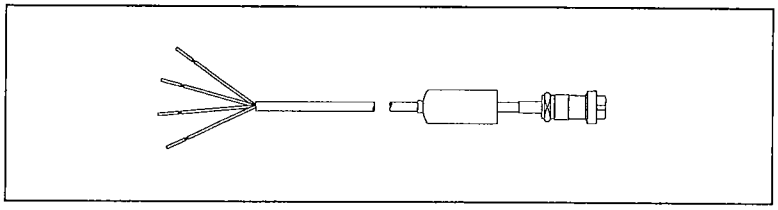


Figure 6: 4-Pin Cable (P/N 33796)

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.

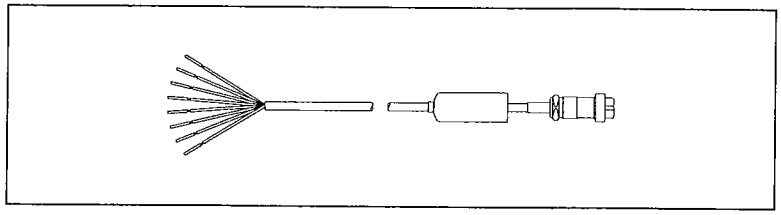


Figure 7: 8-Pin Cable (P/N 33738)

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).

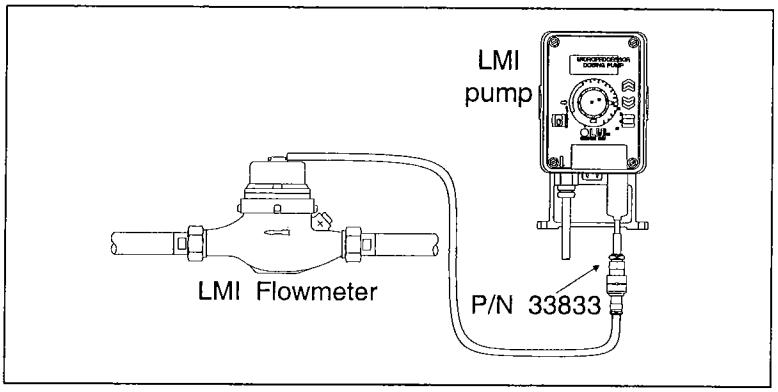


Figure 8: Optional "Hall Effect" Cable (P/N 33833)

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.

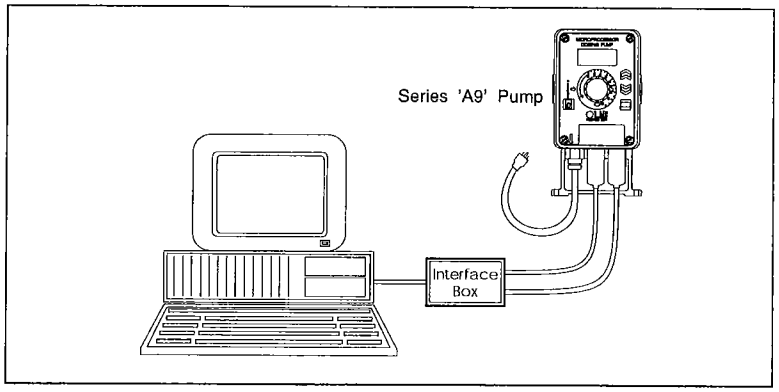


Figure 9: LiquiComm™ Computer Interface

7.0 Keypad/Display: Description and Function

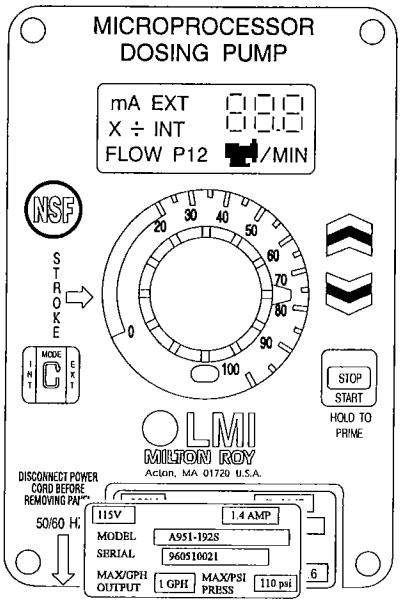


Figure 10: A9 Keypad

7.1 LCD Screen

The LCD screen is the window in which all values and menu choices are displayed (see Figure 11).

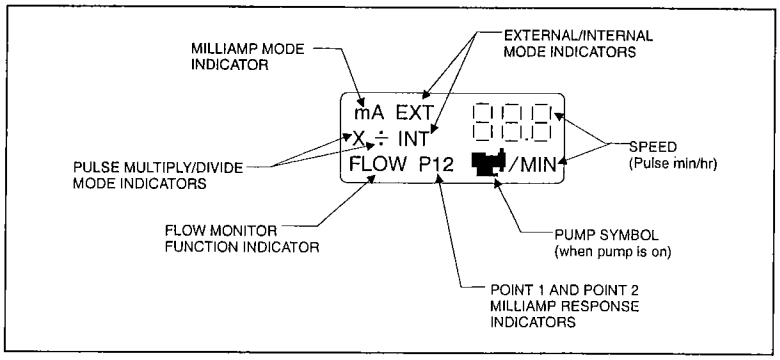


Figure 11: Liquid Crystal Display

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 [redacted] symbol appears on the display while the pump is running. Each time the pump strokes, the [redacted] 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 [redacted] (Up) and [redacted] (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 STOP START (Start/Stop) key to start or stop the pump. When the pump is OFF, the LCD screen will alternate between INT OFF and INT 100 /MIN every 16 seconds. When you start the pump, the symbol appears on the LCD INT 100 /MIN. Each time the pump strokes, the symbol disappears. Press the STOP START (Start/Stop) key again to stop the pump.

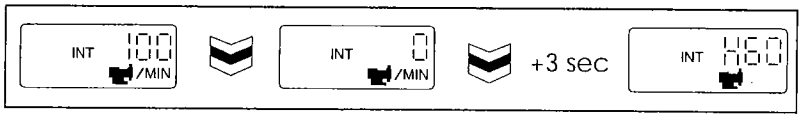


"INT" signifies that the pump is in the "Internal" (Manual) mode.

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 Pri /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 (Mode) key and ▲ (Up) key at the same time and hold for two (2) seconds. The current pressure setting [PS] 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* STOP/START (Start/Stop) and Prime. To activate this "LOC" mode, press the MODE (Mode) key and ▼ (Down) key at the same time and hold for two (2) seconds. The LCD will read [loc] for five (5) seconds and then return to the previous display. This display [loc] re-appears when any key except the STOP/START (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 [LOC] for five (5) seconds and then return to the previous display. This display [LOC] 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.

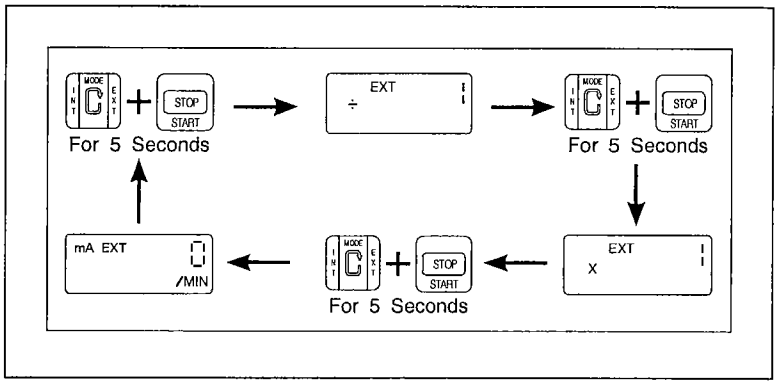
9.0 External Control Modes

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 ÷ EXT E3 /MIN. *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 × EXT 232. 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 × EXT E4 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.

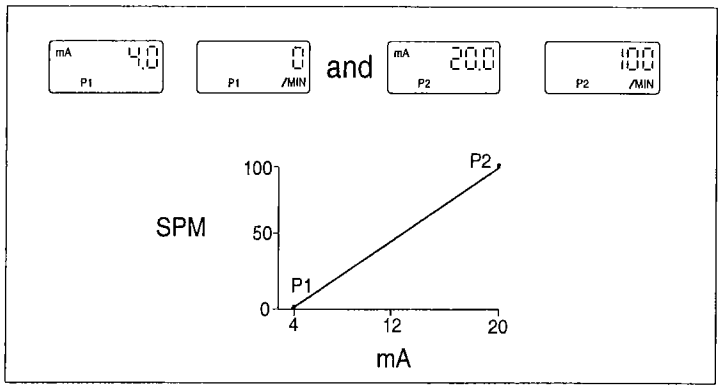


Figure 12

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.

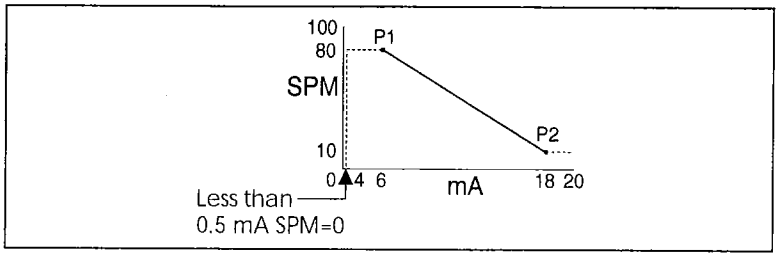


Figure 13

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 [Pro]. After five (5) seconds, the display will show the mA value for P1 [mA P1 4.0]. This value may be altered by using the (Up) key or (Down) key within five (5) seconds (i.e. [mA P1 6.0]). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed [P1 H50]. This value may be altered within five (5) seconds using the (Up) or (Down) key (i.e. [P1 H60]).

Five (5) seconds after the last key press, the mA value for P2 will be displayed [mA P2 20.0]. Edit as described above (i.e. [mA P2 18.0]). Likewise, five (5) seconds after the last keypress, the stroke rate for P2 is displayed and may be altered as above (i.e. [P2 H10]).

The above example would result in the inverse control profile shown in Figure 14.

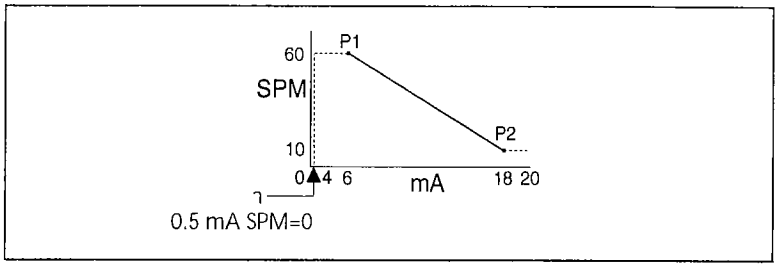


Figure 14



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 [EXT E5].



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 [C.2]. 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 [100].

10.2 Menu Items

10.2.1 Menu Item 1: Batch Accumulate Enable/Disable

Batch Accumulate may be enabled (1) [1] or disabled (0) [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) [2] 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).

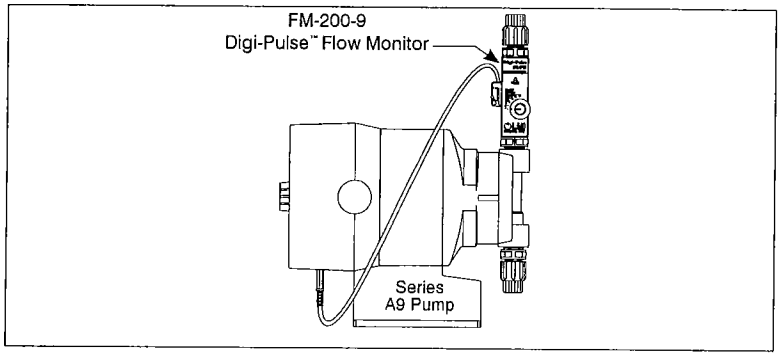
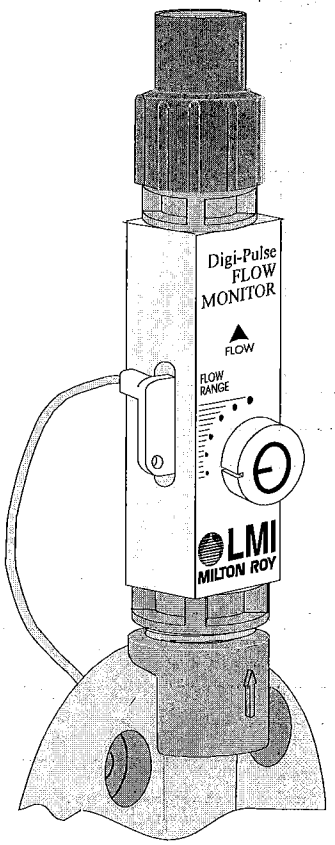


Figure 15

Information Sheet

Digi-Pulse™ Flow Monitor Series FM-200



- Corrosion resistant UHMW PE
- Senses pulsating metering pump flow
- Adjustable, in-line
- Flow range: ml/stroke 0.05 - 5.0 — Max. LMI Pump Output 7.9 GPH (30.0 l/h)
- Usable as Adjustable Flow Switch for non-pulsating flow
- Economical
- For LMI pumps with 3/8" check balls

Pulsating flow of your pump can be monitored and transmitted using the LMI Digi-Pulse™ Flow Monitor. Designed to electrically signal a low flow or no flow condition, you can be assured of your pumping performance; an advantage when working with pulsating or very low flows. A transmitter can be connected to a remote counting or recording device. The FM-200-9 Series transmitters are wired to be plugged directly into the receptacles of Series A9 pump housings. The Digi-Pulse™ Flow Monitor is adjustable to any desired pulsating flow rate within its range.

SPECIFICATIONS		
Flow Range	**ml/stroke**	**Max LMI pump output**
	0.05 - 5.0	7.9 GPH (30.0 l/h)
Max. Pulse (stroke) Rate	100 per minute	
Max. Pressure	150 psi (10 Bar) *For pressure over 150 psi, consult factory.*	
Transmitter	Reed Switch (No Flow = N.O. Switch Condition) Polarity Independent Minimum pulse width 15 msec	
Max. Load	100 mA AC or DC, 36V max.	
Cable Length	10 ft (3 m) ***(except FM-200-9)*** FM-200-9 : Cable Length 20 in (0.5 m)	
Body Material	UHMW PE (ultra high molecular weight polyethylene)	
Valve Fitting Material	Carbon Fiber Reinforced PVDF ***(where supplied)***	
Seals & O-Rings	Polypre®(PTFE copolymer)	

CONFIGURATIONS	
Model No.	**Connection**
FM- 200	Supplied **without** valve fitting (for use w/4FVs)
FM-200-9	Supplied **without** valve fitting (for use with 4FVs and Series A9 or B9 pumps.)
FM -201	Supplied w/ PVDF valve connection for 1/4" OD tubing
FM -202	Supplied w/ PVDF valve connection for 3/8" OD tubing
FM -203	Supplied w/ PVDF valve connection for 1/2" OD tubing (or 9 x 12 mm)
FM -204	Supplied w/ 1/4" NPT male PVDF valve housing
FM -205	Supplied w/ fitting and Metric Tubing Adapter Kit for: 3 x 6 mm PE Tubing 4 x 6 mm PE Tubing
FM -206	Supplied w/ fitting and Metric Tubing Adapter Kit for: 6 x 8 mm PE Tubing 6 x 12 mm PVC Tubing

LMI MILTON ROY

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

ISO9001

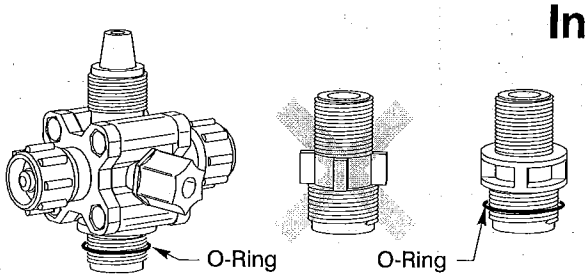
Replaces same of Rev. G 3/98
1708.H 7/99

Instruction **Sheet**

Digi-Pulse™ Flow Monitor Installation

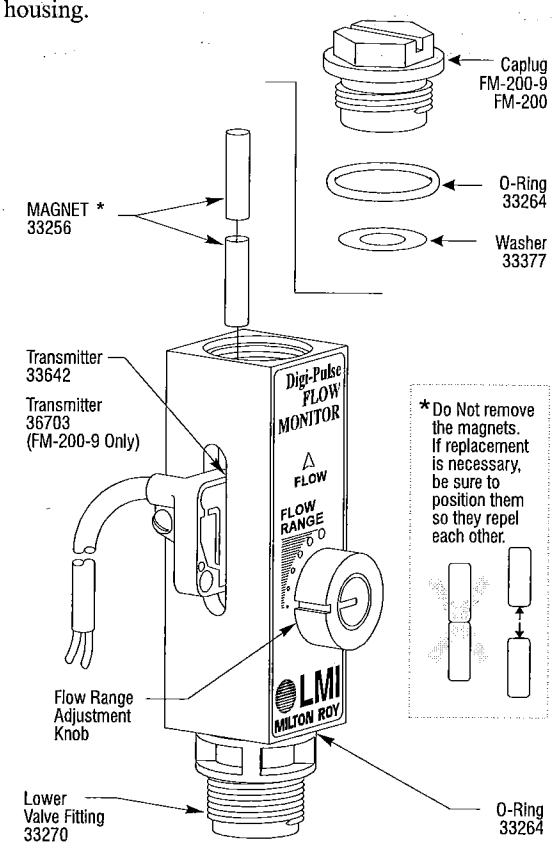
WARNING:

The valve fitting on the discharge portion of the Digi-Pulse™ Flow Monitor must be a flange type fitting to ensure a proper seal with the O-Ring. Using a winged type valve fitting will not create a seal and leakage of solution will occur.



1. With your pump turned off, screw the lower valve fitting of the Digi-Pulse™ Flow Monitor to the discharge side of the pump head.
2. **FM-200 and FM-200-9:** Remove the yellow Caplug from the top of the Digi-Pulse™. ***Be sure to save the O-Ring seal*** *and install it onto the mating end of the valve housing or 4FV you will be using.* Attach your 4FV or valve housing to the top of the Digi-Pulse™.

   All other models: Attach tubing to top of valve housing.
3. Connect the Digi-Pulse™ cable to your counter, computer, or other recording device (polarity is not critical). If cable extension is desired, consult factory. Plug the FM-200-9 cable directly into the receptacle in the Series A9 pump housing.



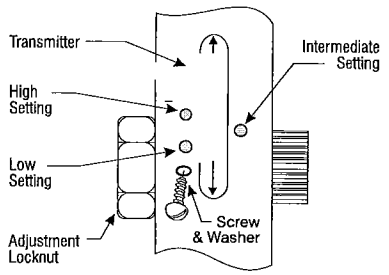
4. Loosen the locknut of the flow-range knob of the flow monitor and set the knob to the largest dot. Start the pump and adjust it (calibrate, if necessary) for proper output to satisfy your system requirements.
5. With the pump running, gradually turn the adjustment knob of the flow monitor counter-clockwise ↺ until the sensor just begins to trigger your electronic device.

   This will be the most sensitive setting of the Digi-Pulse™, given your pump setting and fluid properties. Every stroke of the pump will output enough volume of solution to cause the Digi-Pulse™ flow monitor to register a pulse. If the flow drops below the initial pump setting, the Digi-Pulse™ will no longer register strokes to your electronics, indicating some type of pump failure or low-level condition.
6. Tighten the adjustment locknut without altering the adjustment position.

Note:

After the initial pump and Digi-Pulse™ setup is complete, any adjustment of the stroke length of the pump (output per stroke) will require a readjustment of the Digi-Pulse™ Flow Monitor (repeat steps 4 - 6 above).

To change the flow range setting:
A set screw holds the transmitter body in a notch on the side of the flow monitor. Remove the screw and washer and slide or turn the transmitter 180° to an alternate position and tighten the screw and washer in the hole to secure the transmitter. The Digi-Pulse™ Flow Monitor comes factory set at the **"LOW"** setting which should accommodate most applications. However, the **"INTERMEDIATE"** or **"HIGH"** settings may be appropriate for a particular application if the sensor does not trigger in the **"LOW"** setting.



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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.

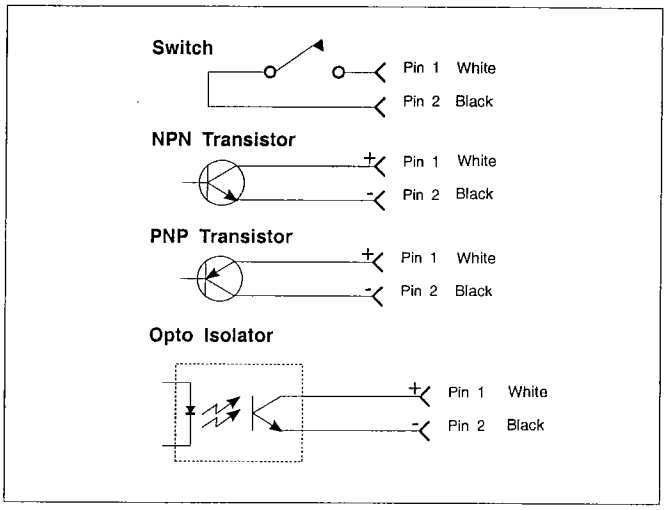
Appendix A: Input/Output Description

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)



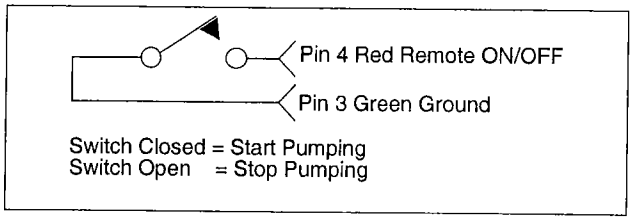


Switch or transistor must be capable of switching 2 mA at 15 VDC. When in the Divide mode, the switch must close then open to trigger.
Minimum time in low impedance state (i.e. switch closed) is 60 mSec by default.
Setup Menu Item 6 sets this value in multiples of 4 mSec.
Example: Default = 4 x $\boxed{15}$ *= 60 mSec*

Remote On/Off (Opto-isolated Input)

Switching this line to ground starts the pump. Releasing this line, stops the pump. The [STOP/START] (Start/Stop) key will always override the Remote Start/Stop.

Reference: 4-Pin Cable (P/N 33796)

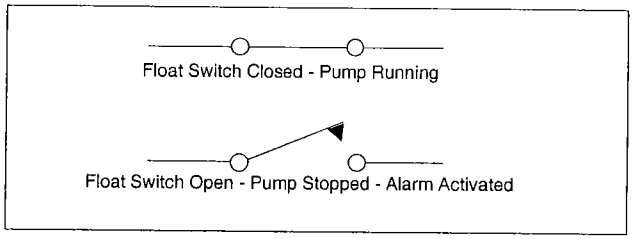




Switch must be capable of switching 2 mA at +15 VDC. Minimum time in low impedance state (i.e. Switch closed) is approximately one (1) second.

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

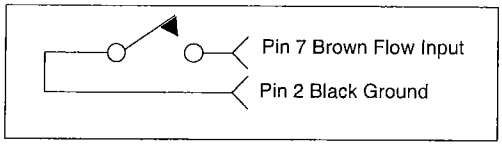
This is reverse polarity protected with a 22 Ohm impedance, a resolution or 0.1 mA and an accuracy of +/- 0.2 mA typically.

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.

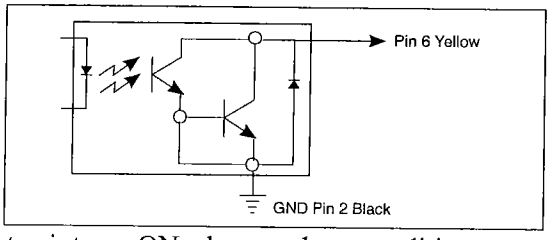
15V Output

The +15V Output (pin 1 Red) is regulated and capable of delivering 30 mA current.

Alarm Output

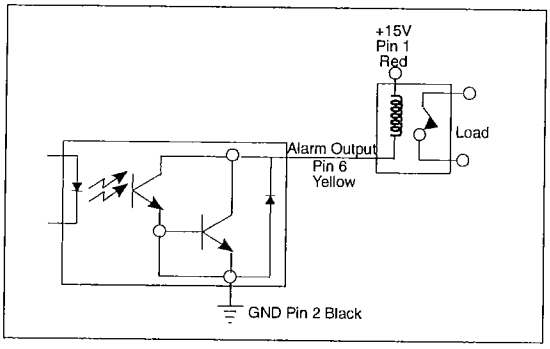
This is an opto-isolated open collector Darlington pair capable of switching 25 mA at +24 VDC to within 1V of ground typically.

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.

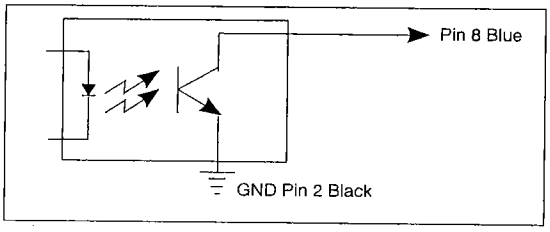
Application: Relay Switching



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.

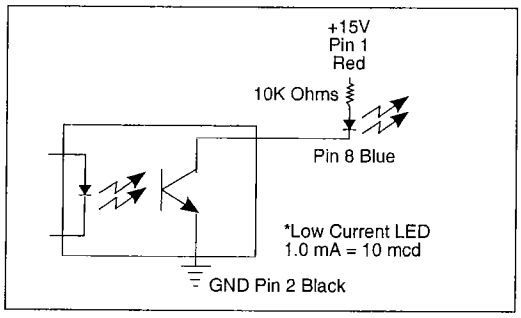
Reference: 8-Pin Cable (P/N 33738)



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.

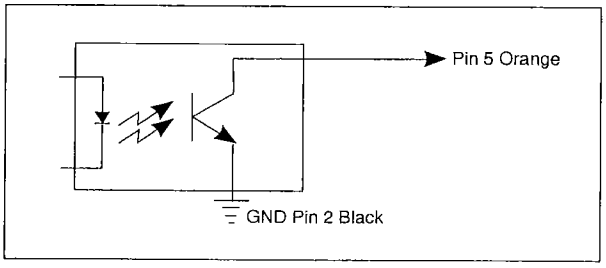
Application: Low Current LED Switching



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)

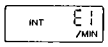
Reference: 8-Pin Cable (P/N 33738)



The output transistor turns ON at the start of a stroke and remains ON for approximately 100 mSec.

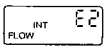
Appendix B: Summary of Error Messages

E1



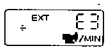
is caused by a Low-Level fault with a Low-Level Switch connected to the pump. The pump is stopped and the alarm outputs are activated. This operates in all Internal and External modes. The pump automatically restarts when the fault is cleared.

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



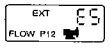
is displayed in the External mode if the stroke rate exceeds 100 SPM. The pump is NOT stopped and NO alarm outputs are activated with this fault. To stop E3 flashing, clear the fault condition, then stop and restart the pump.

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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http://www.lmlpumps.com

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Liquid Metronics, Inc.

STD: 1-0600-8X11A	INTL REF:	BAR = 1" AT PLOT SCALE

41074-210-1

MODEL NO.: EZ1 ASSEMBLY TO INCLUED THE FOLLOWING ITEMS:
CALIBRATION COLUMN, 250 ml, Y-STRAINER, BALL VALVES, ELECTRICAL ACCESSORIES

MODEL NO.: A951-392SU
LMI ELECTRONIC METERING PUMP, 0-1.0 GPH @ 50PSI, PVDF HEAD & FITTINGS, BALLS: CERAMIC, LIQUIDFRAM: FLUOROFILM, CHECK VALVE: PVDF/POLYPREL, 4FV: FOUR FUNCTION VALVE, TUBING: 16', 3/8" O.D. PE UV PROTECTION (BLACK), 4-20 mA, 120VAC PLUG, FOOT VALVE, AND INJECTION QUILL

MODEL NO.: FM-PRO-9
LMI FLOW SENSOR ADJUSTABLE: 0.05-5.0 ML/STROKE, 7.9 GPH MAX. PUMP OUTPUT, IN-LINE MOUNTING, MATERIAL: UHMW PE, SEALS & O-RINGS: TFE COPOLYMER, MAX. PRESSURE: 150 PSI, TRANSMITTER: REED SWITCH, MAX LOAD: 100 mA AC, CABLE LENGTH: 20 IN.

41074-210-2

MODEL NO.: EZ1 ASSEMBLY TO INCLUED THE FOLLOWING ITEMS:
CALIBRATION COLUMN, 250 ml, Y-STRAINER, BALL VALVES, ELECTRICAL ACCESSORIES

MODEL NO.: C931-318SU
LMI ELECTRONIC METERING PUMP, 0-8.0 GPH @ 60PSI, PVC HEAD & FITTINGS, BALLS: CERAMIC, LIQUIDFRAM: FLUOROFILM, CHECK VALVE: PVDF/POLYPREL, 4FV: FOUR FUNCTION VALVE, TUBING: 16', 1/2" O.D. PE UV PROTECTION (BLACK), 4-20 mA, 120VAC PLUG, FOOT VALVE, AND INJECTION QUILL

MODEL NO.: FM-301-9
LMI FLOW SENSOR ADJUSTABLE: 0.5-16.0 ML/STROKE, 25 GPH MAX. PUMP OUTPUT, IN-LINE MOUNTING, MATERIAL: UHMW PE, SEALS & O-RINGS: TFE COPOLYMER, MAX. PRESSURE: 150 PSI, TRANSMITTER: REED SWITCH, MAX LOAD: 100 mA AC, CABLE LENGTH: 20 IN.

41074-210-3

MODEL NO.: 10998
BRONZE CORPORATION STOP, 3/4"NPT - CPVC NOZZLE

USFILTER STRANCO
JAY PFOTENHAUER
595 INDUSTRIAL DR.
BRADLEY IL 60915
PH: 815.929.4164
FX: 815.932.5634

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DESIGNER	DATE
MFP	2/2/04
CHECKER	DATE
ENGINEER	DATE
MANAGER	DATE
FILE:	
SCALE: None	

TITLE METERING PUMP AND ACCESSORIES

CLIENT JET PROPULSION LAB

USFilter

Envirex Products
Waukesha, WI
800-524-6324

PROJECT	CODE	DRAWING	SHEET	REV
41074		41074-210	1 OF 1	A

Instruction **Manual**

Electronic Metering Pumps



Carefully read and understand all precautions before installing or servicing any metering



For file reference, please record the following data:

Model No: A951-392SM/C931-318SM

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

LMI
MILTON ROY

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
www.lmipumps.com

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1.0 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.

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.

This manual is for Series A, B, C, E, J5, and P pumps.

1.1 Spare Parts

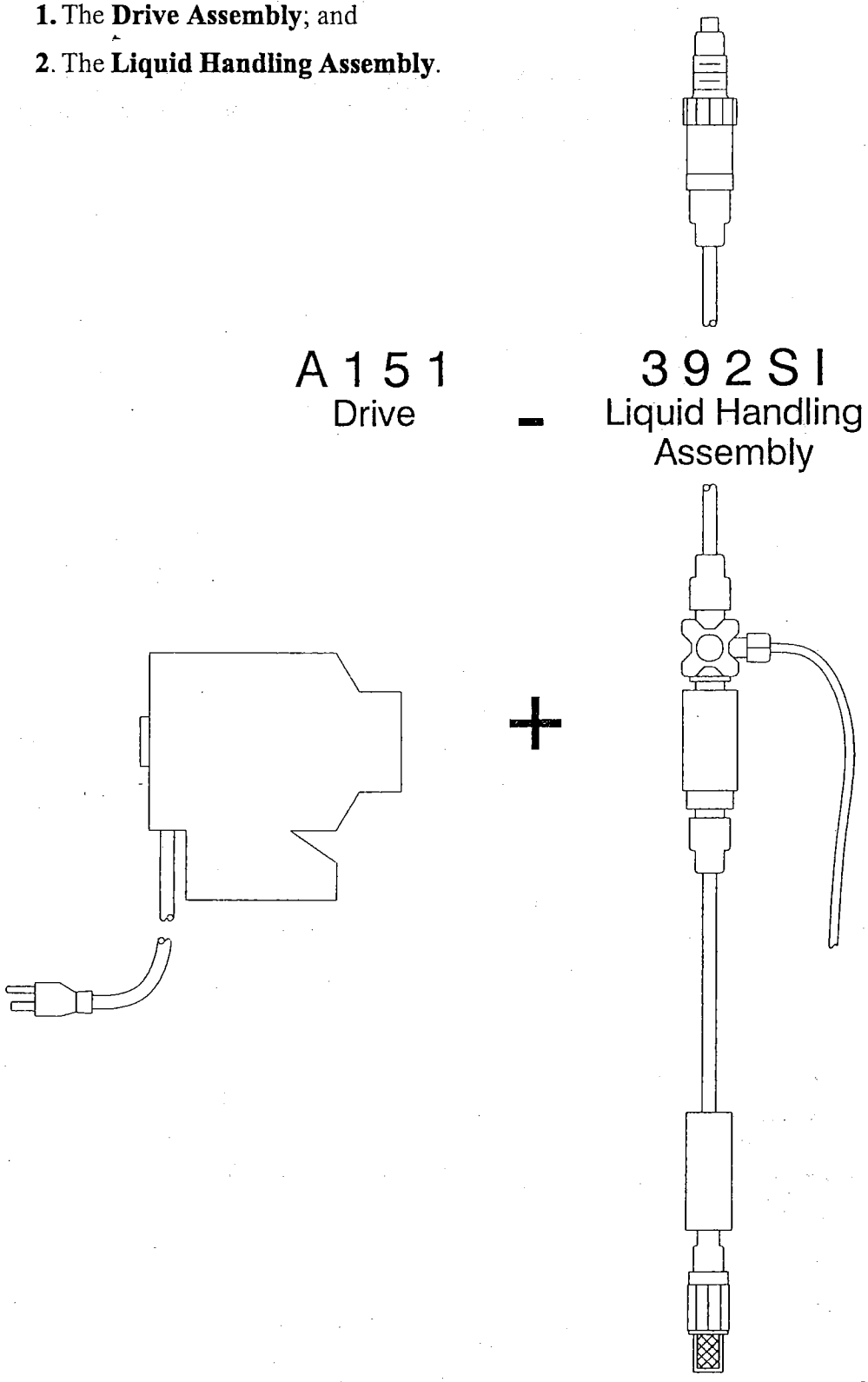
LMI recommends replacing the elastomeric components of the pump on an annual basis. RPM Pro Pacs™ and spare part kits are available from your local LMI Master Stocking Distributor.

Example:

Your pump consists of two main components:

1. The **Drive Assembly**; and

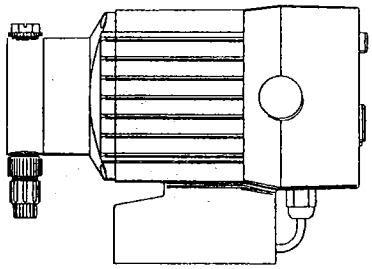
2. The **Liquid Handling Assembly**.



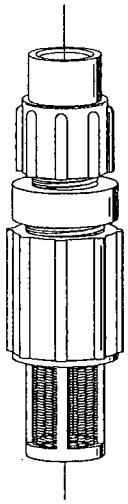
2.0 Unpacking Check List

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.

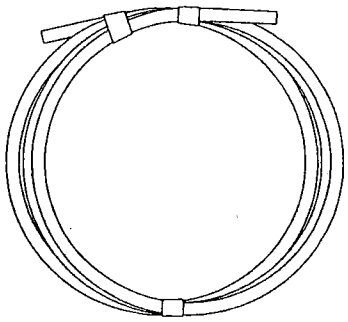
Please refer to the enclosed Instruction Supplement for an illustration and electrical diagram of your complete pump.



Metering Pump

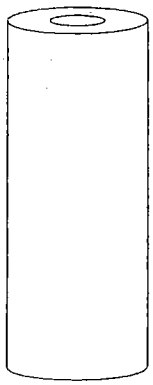


Foot Valve

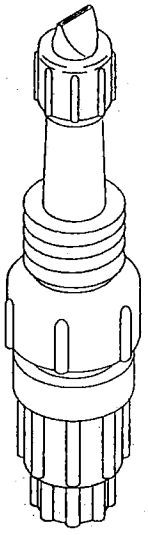


Tubing

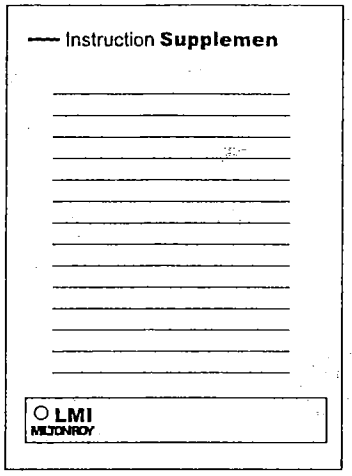
Depending on the model, your carton may contain 0, 1, 2 or 3 rolls of tubing. Your carton may contain a roll of clear vinyl tubing; this is for connection to the SUCTION SIDE OF THE PUMP HEAD ONLY.



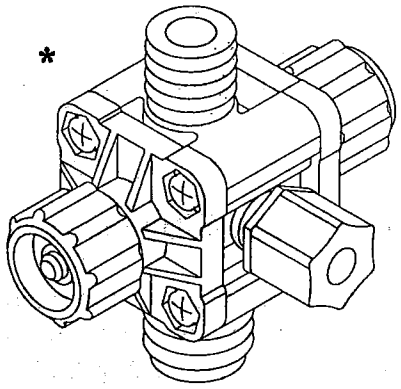
Ceramic Foot Valve Weight



Injection Check Valve



Instruction Supplement



MULTI-FUNCTION Valve and Tubing

* Your carton may or may not contain a 3-FV, 4-FV, or bleed 4-FV accessory.

7

3.0 Pre-Installation Instructions

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Precautions

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 MSDS 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.)

Solution Compatibility



Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. LMI pumps are tested by NSF for use on muriatic acid and sodium hypochlorite. 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 4.3, 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.



Fittings And Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting contacts the seal ring 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.

All LMI pumps have straight screw machine threads on the head and fittings and are sealed by the seal rings or O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve as well as stainless steel liquid end connections.**



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.



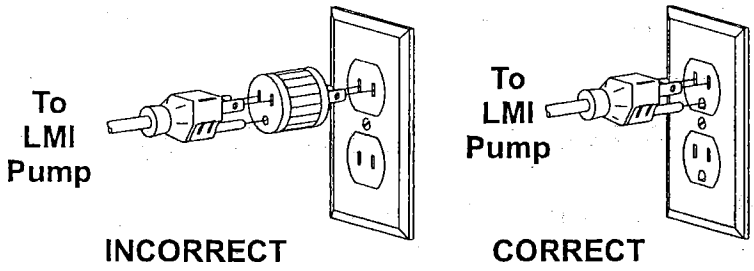
Back Pressure/Anti-Syphon Valve

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 overpumping or syphoning. Contact your LMI distributor for furthur information.

Electrical Connections



To reduce the risk of electrical shock, the metering pump must be plugged into a grounded outlet 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.



4.0 Installation

4.1 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 subjected to ambient temperatures above 122°F (50°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

4.2 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. For denser solutions, consult distributor.

Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

4.2.1 Flooded Suction

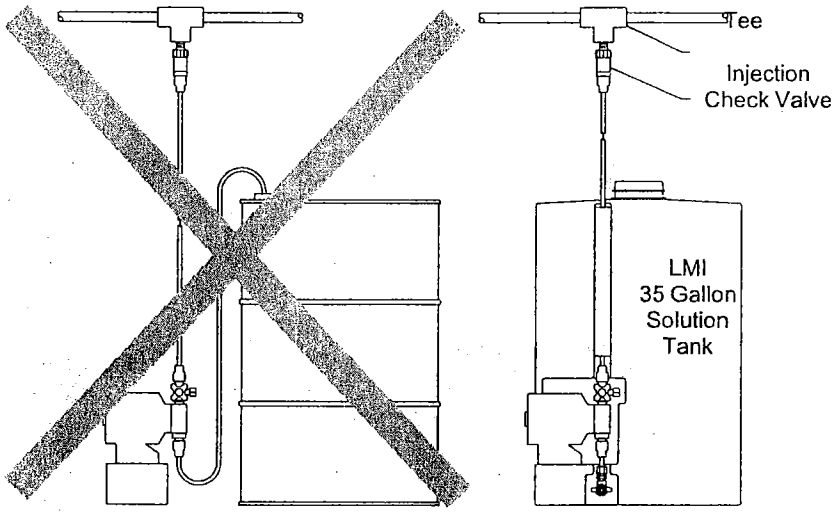
The pump is mounted at the base of the storage tank. This installation is the most trouble-free , and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced.



When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning.

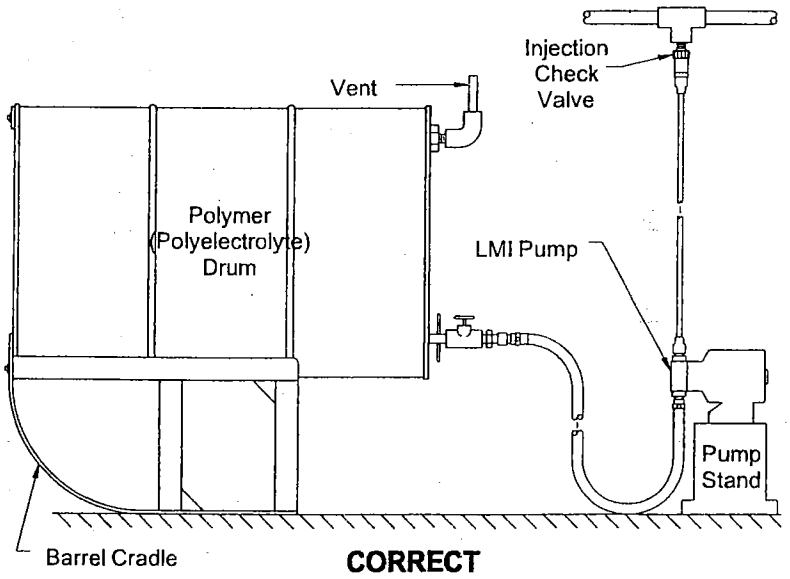


Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT **CORRECT**

Avoid this type of false flooded suction.

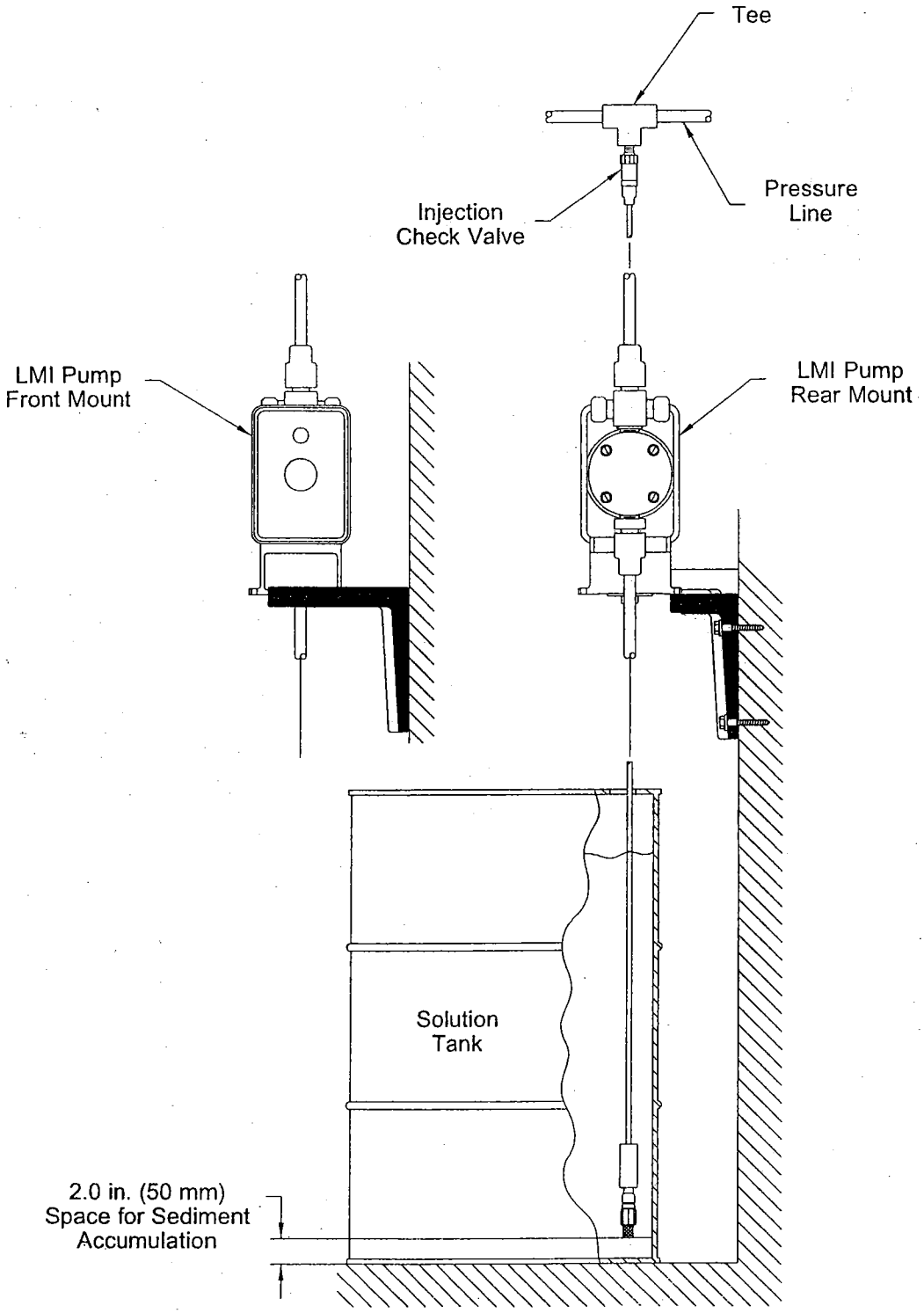


CORRECT

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4.2.2 Suction Lift - Wall Bracket Mount

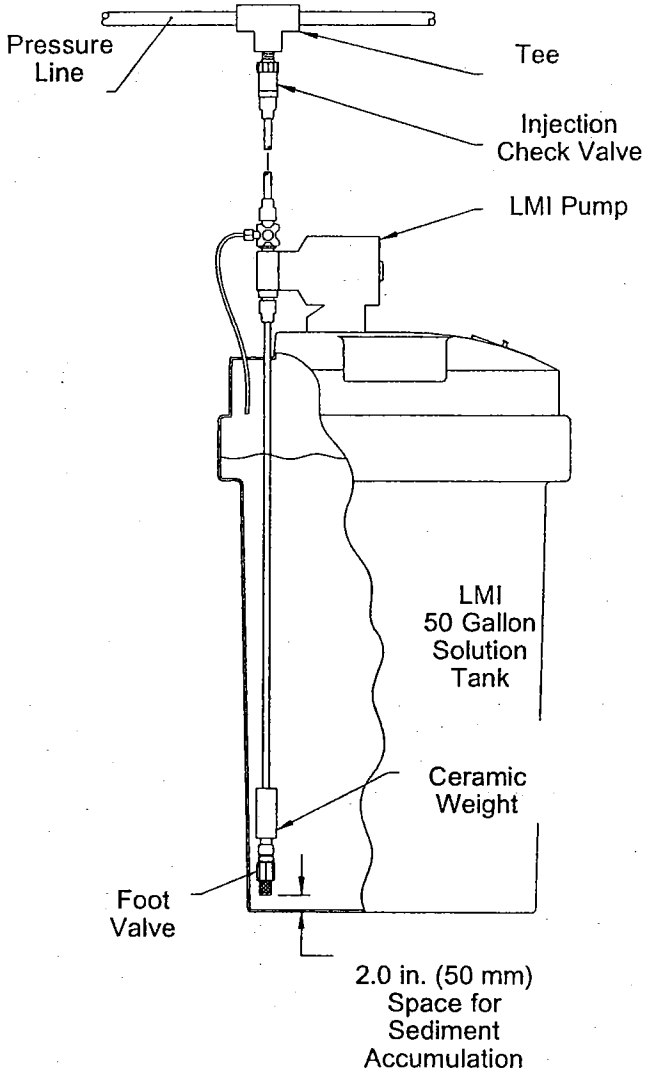
The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

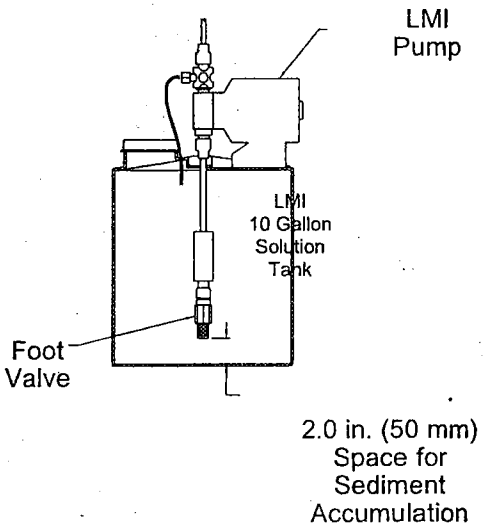


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4.2.3 Suction Lift - Tank Mount

The pump may be mounted on a molded tank provided there is a recess to keep the pump stationary. LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350) have molded recesses for pump mounting.

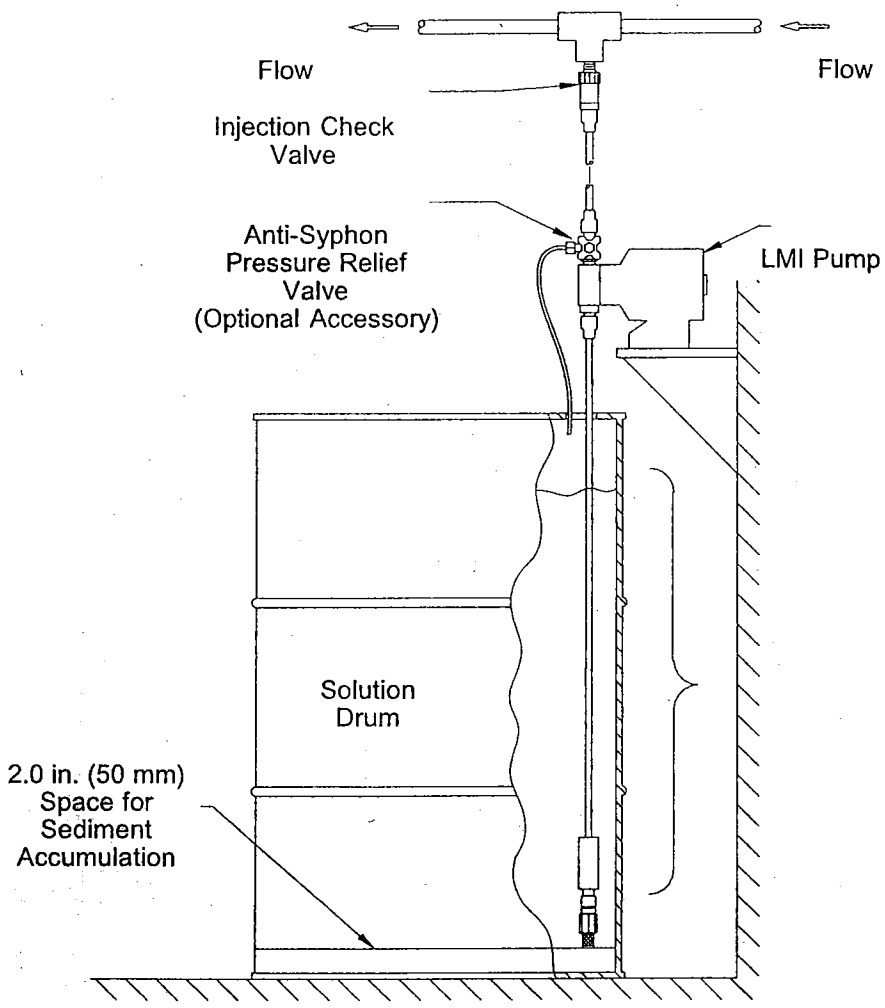




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4.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m). An LMI mounting kit (part number 10461) is available for securing the pump to a shelf.



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4.3 Tubing Connections

A. Use only LMI tubing.

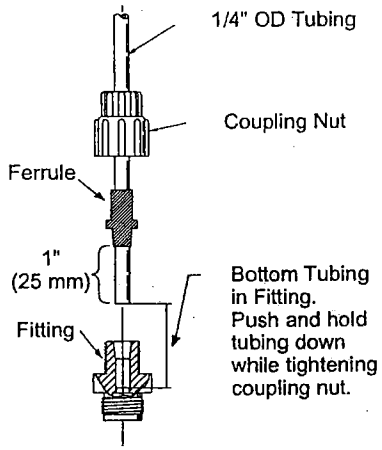
B. ***DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.*** The pressure created by the pump can rupture vinyl tubing.

C. Before installation, all tubing must be cut with a clean square end.

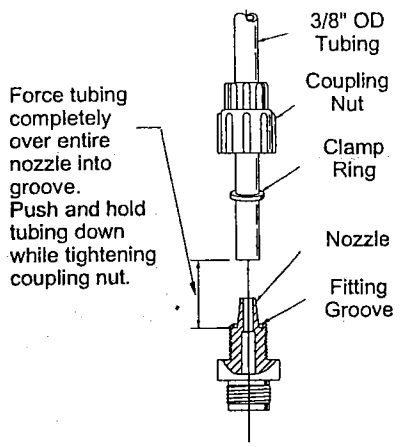
D. Valve and head connections from the factory are capped or plugged to retain pre-prime water. Remove and discard these caps or plugs before connecting tubing.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

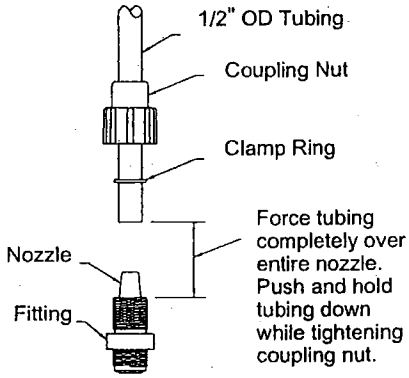
Tubing Connection
1/4" O.D. (.250") Tubing



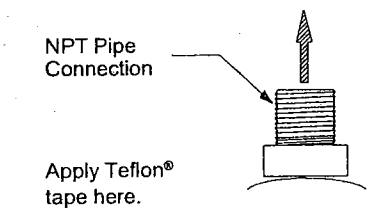
Tubing Connection
3/8" O.D. (.375") Tubing



Tubing Connection
1/2" O.D. (.5") Tubing



Pipe Thread Connection
1/4" or 1/2" NPT



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4.4 Multi-Function Valves

Your pump may be equipped with one of the following multi-function valves: 3-FV, 4-FV, Bleed 4-FV, or standard discharge valve. If your pump is not equipped with a multi-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor.

4.4.1 Three Function Valve (3-FV)

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. **Priming Aid**

   Opening the relief knob assists in priming the pump by venting the discharge line to the atmosphere.

4.4.2 Four Function Valve (4-FV)

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 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4.4.3 Bleed Four Function Valve (Bleed 4-FV)

1. **Line Depressurization**

   Opening the relief port provides line drain back to the supply tank.

2. **Anti-Syphon**

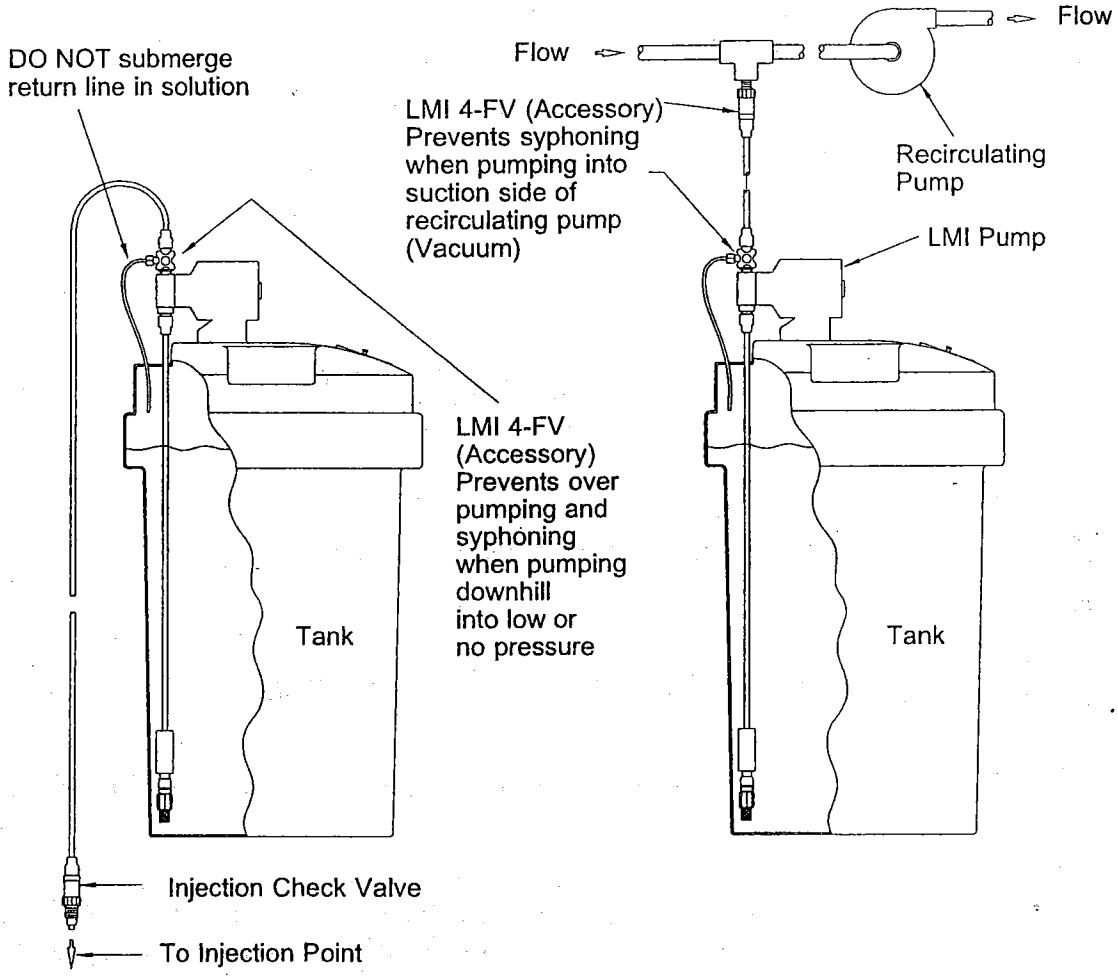
   Prevents syphoning when pumping solution downhill or into a vacuum.

3. **Back Pressure**

   Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4. **Bleed Function**

   Manually adjusted valve provides continuous bleed of entrapped vapors from Sodium Hypochlorite or Hydrogen Peroxide.



Typical 4-FV Installation

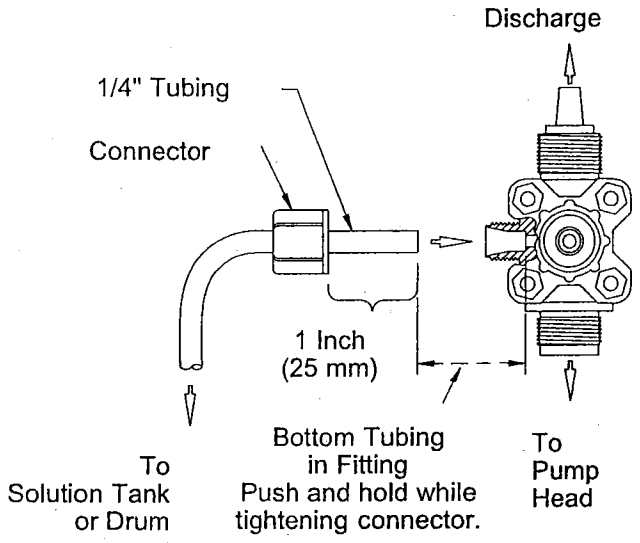
4.5 Multi-Function Valve Installation

To install the multi-function valve, remove the yellow screw cap on the top of the pump head and screw in the valve so that it contacts the seal ring. An additional 1/8 - 1/4 turn may be necessary to prevent leakage.

1/4" O.D. tubing connects to the side of the valve and acts as a return line to the solution tank. To ensure priming, this tubing must **NOT** be submerged in the solution.

CAUTION

This return line tubing must be secured to ensure pumped solution will safely return to supply tank.



Multi-Function Valve Tubing Connection

4.6 Foot Valve/Suction Tubing Installation

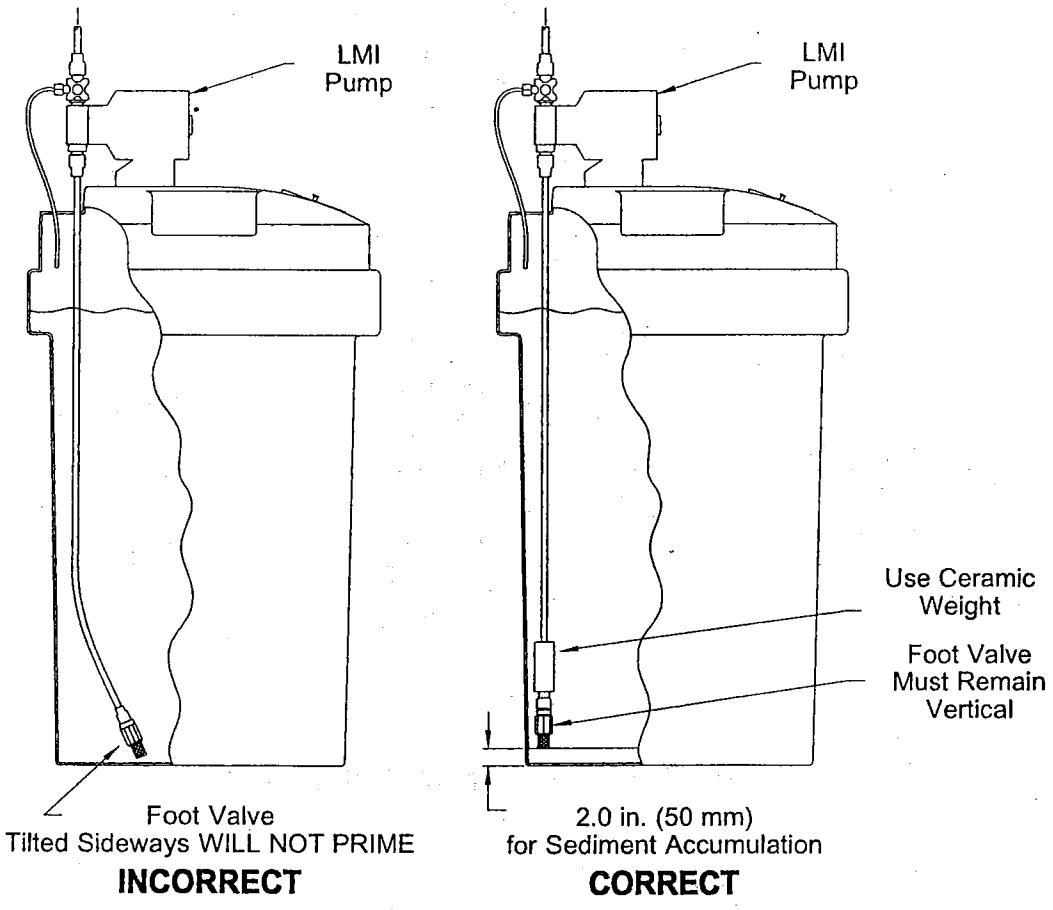
The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

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.

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 4.3).
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 4.3).



Proper Foot Valve Position

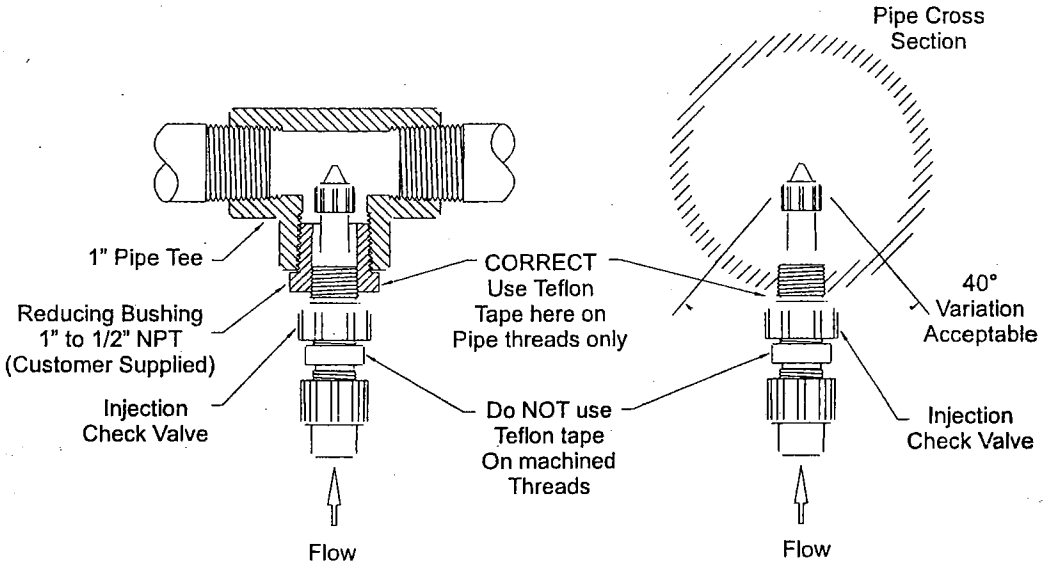
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4.7 Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Connect the Injection Check Valve to your "DISCHARGE" (outlet) line. Any size NPTF fitting or pipe tee with a reducing bushing to 1/2" NPTF will accept the injection check valve. Use Teflon® tape or pipe dope to seal the pipe threads ***only***.

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° are acceptable (see illustration below).

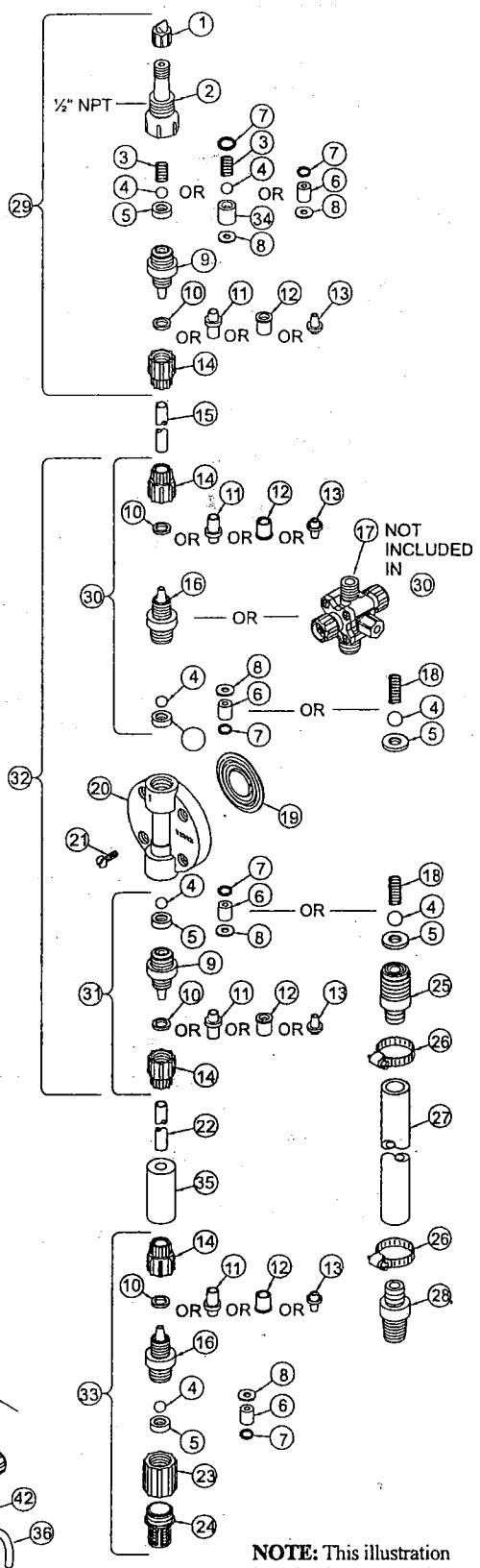
After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head valve or discharge fitting (top side), making sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 4.3).

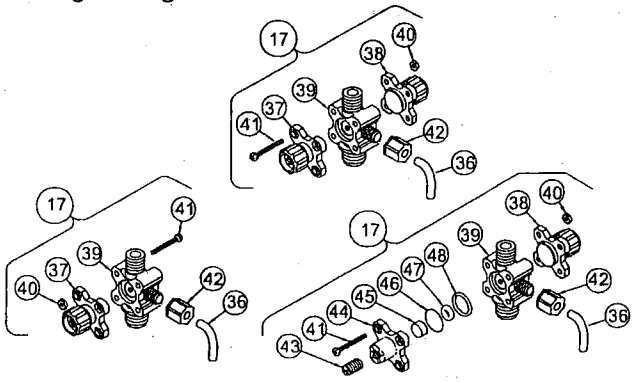


Typical Injection Check Valve Installations

5.0 Liquid End Parts List

1 Flapper valve
2 Injection check valve body
3 Injection check valve spring
4 Check valve ball
5 Seal ring
6 Cartridge valve
7 Cartridge valve o-ring
8 Cartridge valve washer
9 Valve seat
10 Clamp ring
11 Ferrule
12 Clamp sleeve
13 Tubing adapter
14 Coupling nut
15 Discharge tubing
16 Valve housing
17 Multi-function valve
18 High-viscosity spring
19 Liquifram
20 Pump head
21 Pump head screw
22 Suction tubing
23 Foot valve seat
24 Foot valve screen
25 High-viscosity valve seat
26 H.V. tubing clamp
27 H.V. suction tubing
28 H.V. Tubing x 1/2 NPT connector
29 Injection check valve assembly
30 Discharge valve assembly
31 Suction valve assembly
32 Pump head assembly
33 Foot valve assembly
34 Injection Seat PTFE
35 Ceramic Weight
36 Return Line
37 Cap ASM (Black Knob)
38 Cap ASM (Yellow Knob)
39 Multi-Function Valve Body
40 Nut Multi-Function Valve
41 Screw Multi-Function Valve
42 Return Line Coupling Nut
43 Adjustment Screw B/4-FV
44 Cap B/4-FV
45 Plug B/4-FV
46 Gasket B/4-FV
47 Small O-Ring B/4-FV
48 Large O-Ring B/4-FV





NOTE: This illustration is a visual representation of all LE components. Liquid ends will not include all parts shown.

6.0 Start-up and Adjustment



a.) The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.

b.) Pumps are shipped from the factory with water in the pump head to aid in priming.

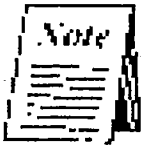
6.1 Output Adjustment Controls



Manual series pump controls are not equipped with pressure control.

1. Pressure Control Adjustment (if equipped): Pressure control provides the adjustment of the pump's pressure capability and power consumption, reducing heat, pipe shock and pulsation while increasing pump life. See Section 7.0 after priming for proper adjustment settings.
2. Speed Adjustment (Upper Knob) (if equipped): Speed control provides adjustment of the percent of maximum strokes per minute. Turning this knob clockwise increases stroke frequency (speed).
3. Stroke Adjustment (Lower Knob): Stroke control provides adjustment of the percent maximum of solution discharged during each pump actuation. Turning this knob clockwise ↺ increases solution displacement.

***A7 and P7 Only**: When operating the pump in external mode, the speed control knob should be turned fully counter-clockwise ↺.*



***A34 and A37 Only:** Pump comes equipped with a range selector switch which provides high or low speed adjustment. The high setting provides speed adjustments between 8 and 100 strokes per minute. The low setting provides accurate speed adjustments between 1 and 12.5 strokes per minute for applications requiring infrequent stroking.*

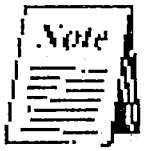
6.2 Start-Up/Priming for Pump Supplied with Multi-Function Valve



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 knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise.↺

3. 1/4 turn open the relief side (black knob) of the multi-function valve.

3A. (Bleed 4FV only) With screwdriver rotate bleed adjustment screw counter-clockwise ↺. 2 full turns. When solution begins to flow through translucent bleed return tubing, the pump is primed. Stop pump.

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 multi-function valve. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord.)
6. The pump is now primed.

6A. (Bleed 4FV only)

a. Start pump and let pump inject solution into the discharge line.

b. Close the bleed adjustment screw by rotating it clockwise ↺ with a screwdriver.

c. Now adjust the pump stroke length and/or speed (frequency) to a range approximately 25% higher than you would normally want for the process.

d. Slowly rotate bleed adjustment screw counter-clockwise ↺. until just a small amount of solution begins to trickle

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down inside the bleed return tubing. A small amount of solution pumped back to the tank with each stroke of the pump will allow gas and air to escape without air or gas locking in the pump head.

7. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the multi-function valve 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.

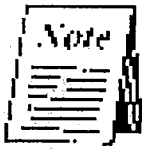
6.3 Start-Up/Priming without Multi-Function Valve



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 prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise ↻.

3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord).
5. The pump is now primed.

6. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the ball and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

6.4 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

6.5 Total Pump Output

Calculate the total output of the pump as follows:

PUMP OUTPUT = MAX PUMP OUTPUT **x** % SPEED **x** % STROKE

Example: A151-392SI

Use MAX Output (from dataplate on bottom center of pump control panel) = 24 GPD (24 gallons per day).

If the pump is set at 60% speed and 70% stroke length, the approximate pump output is:

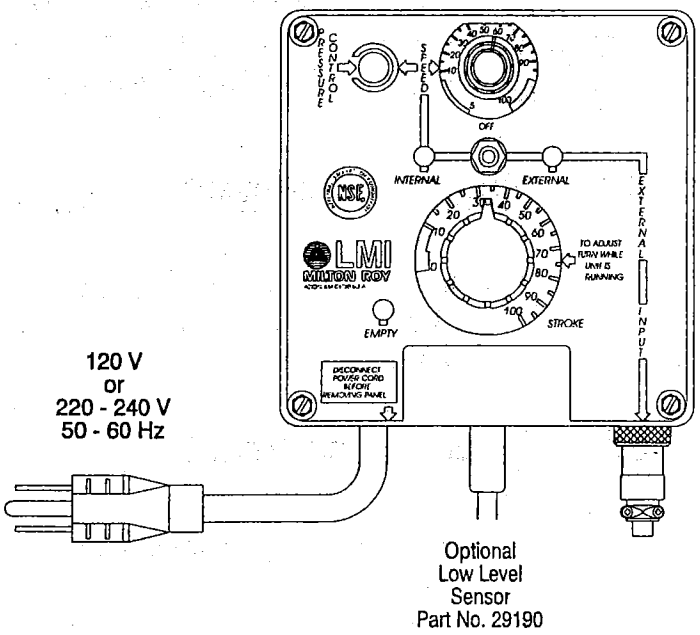
24.0 x 0.60 x 0.70 = 10.08 GPD (gallons per day). Divide by 24 (hours in one day) to calculate in gallons per hour.



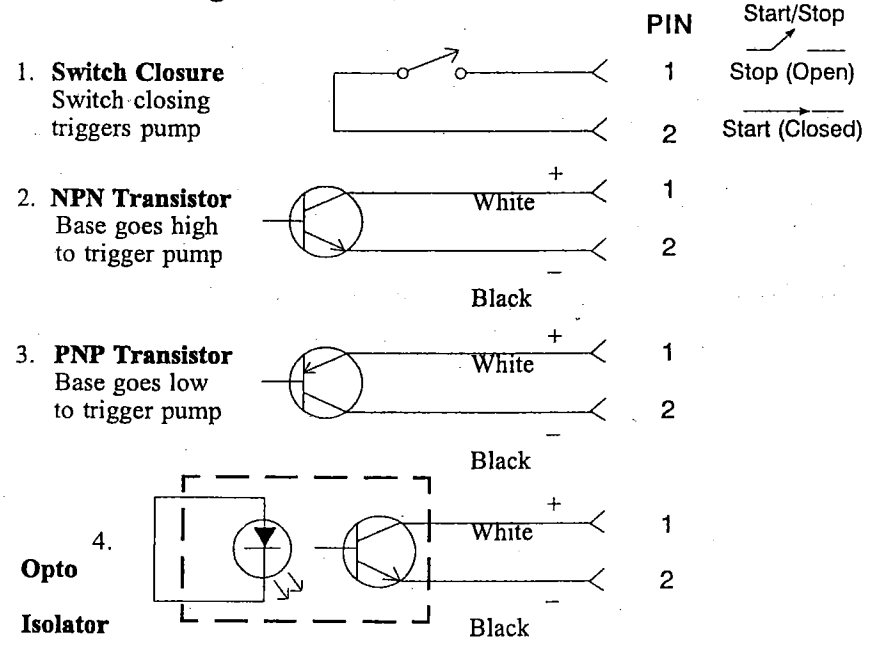
If pump is not equipped with speed adjustment, calculate by ***Max Pump Output x % Stroke*** *only.*

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7.0 Methods of Externally Triggering

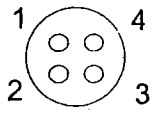


Method of Triggering LMI Pump Through 4-Pin Connector



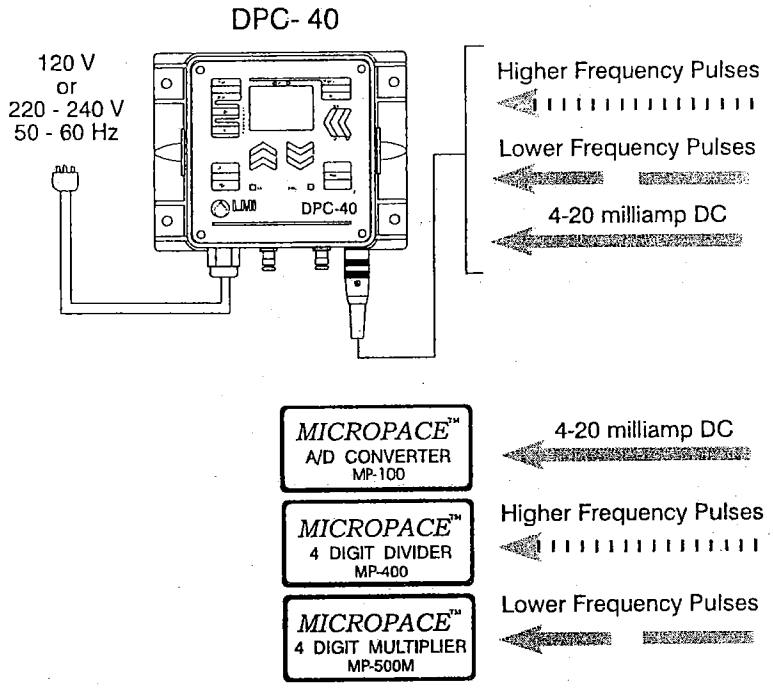


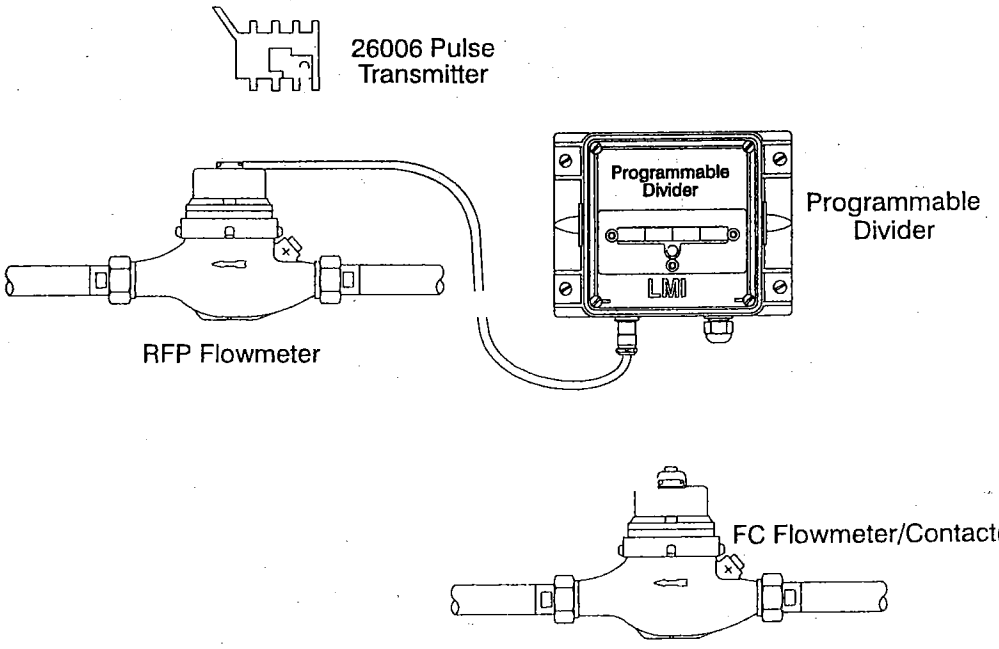
Switch or transistors must be capable of switching 15V DC at 2 milliamperes. Minimum time in low impedance state (ON) is 50 milliseconds. Minimum time in high impedance state (OFF) is 100 milliseconds.



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or Pacing A7, B7, C7 and P7 Pumps





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8.0 Calibration

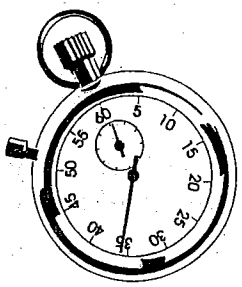
Once installation is complete and the approximate output has been determined, the pump should be calibrated to adjust speed and stroke for your actual desired output. (Calibration cylinders may be purchased from your local LMI distributor, ref. publication 1798.)

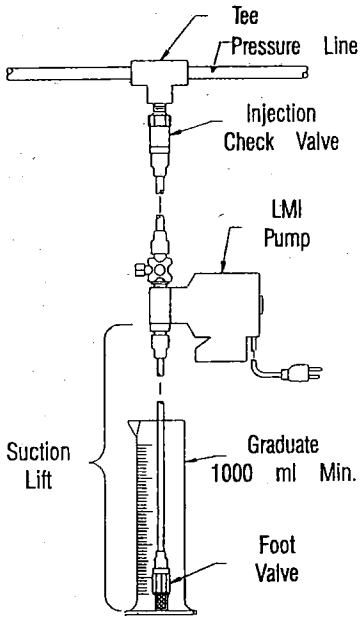
1. Be sure the pump is primed, and discharge tubing and Injection Check Valve are installed as they would be in normal service (i.e., including factors such as injection pressure, fluid viscosity, and suction lift).
2. Place the Foot Valve in a graduated container with a volume of 1000 ml or more.
3. Plug in and switch pump to Internal Mode. Pump until all the air is exhausted from the suction line and head.
4. Turn the pump off. Refill graduated container to a level starting point.



If pump is equipped with pressure control, see Section 8.1 before proceeding.

5. Using a stopwatch or timer, turn the pump on for a measured amount of time (50 pump strokes minimum). The longer the time period, the more confident you can be of the results. Be sure to count the number of strokes during the calibration period when making comparisons.
6. Turn the pump off. Note the time elapsed in relation to volume displaced in the graduate. Now, calculate the output in the time unit you choose (minutes, hours, days, etc.).
7. If the output is too low or too great, adjust speed and or stroke, estimating required correction and repeat steps 1-7.



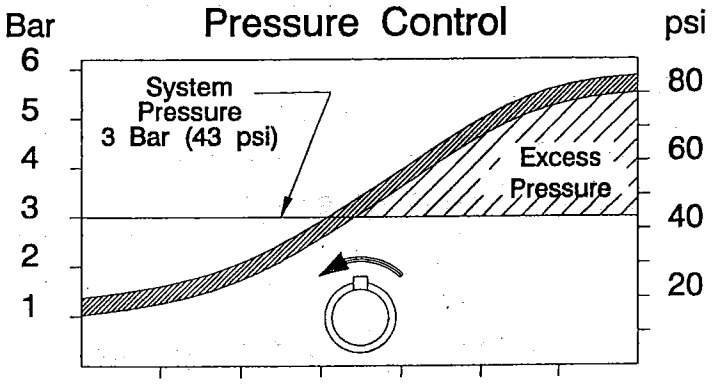


8.1 Pressure Control

Adjust Pressure Control: While unit is running, turn Pressure Control Potentiometer slowly counter-clockwise ↺ until unit just begins to stall. From this stall point, now turn Pressure Control Potentiometer clockwise ↻ halfway between the stall point and maximum setting. This is the optimum pressure control setting for your application.



Increase setting if back pressure is increased. Adjusting pressure control decreases pressure rating of pump.



Adjust pressure control to reduce heat, shock, and pulsations; and to prolong pump life.

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8.2 Calibration Procedure - On-Site Volumetric Calibration in External Mode

1. Since pump output is governed by an external device such as Flowmeter-Pulser, Liquitron™ Controller, or 4-20 mA DC signal from an instrument with an LMI Analog-to-Digital Converter, **only the output per stroke may be calibrated**.
2. With pump primed and discharge tubing connected to the injection point as it would be in normal service, place Foot Valve Assembly in a graduated container with a volume of 1000 ml or more.
3. Switch pump to **Internal** mode with Speed Knob set at 100 until air is exhausted from suction line and pump head.
4. **Adjust Pressure Control (if desired)** - See Section 8.1.
5. Switch pump **OFF** and note solution level in graduated container. Refill graduate to a starting point.
6. Switch pump **ON** and **count the number of strokes** for exactly one minute, then switch pump **OFF**.
7. Note volume pumped during the calibration period of one minute. Divide into this the number of strokes to determine the volume of solution pumped per stroke.

   Example: 500 ml in 100 strokes = 5.0 ml per stroke.

Multiply this by your expected stroke rate per minute, per hour or per day and compare with desired output requirements.

8. Adjust Stroke Length Knob (lower knob) to your best estimate of required correction and repeat calibration procedure.

9.0 Spare Parts Replacement Routine Maintenance

9.1 Depressurizing the Discharge Line (For Pumps Equipped with a 3-FV or a 4-FV only)



ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

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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.



Be sure your relief tubing is connected to your multi-function valve and runs back to your solution drum or tank.

2. 1/4 turn the black knob on the valve. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then 1/4 turn knob to normal position.

9.2 Liquifram™ (Diaphragm) Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS 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 or seal rings/valve balls, multi-function valve cap assemblies 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™ and the cartridge valves or seal rings/valve balls, the injection check valve spring should also be replaced (see next Section 9.3). A Spare Parts Kit (SP-#) or RPM Pro Pac™ kit containing these parts may be obtained from your local distributor.

Replacing the Liquifram™:

1. Carefully depressurize, drain, and disconnect the discharge line (see Section 8.1 in this manual). 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.

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If the liquid cannot be pumped due to Liquifram™ rupture using protective clothing, gloves and face shield, carefully disconnect the suction and discharge tubing. Remove the four screws to the head and immerse the head in water or other neutralizing solution.

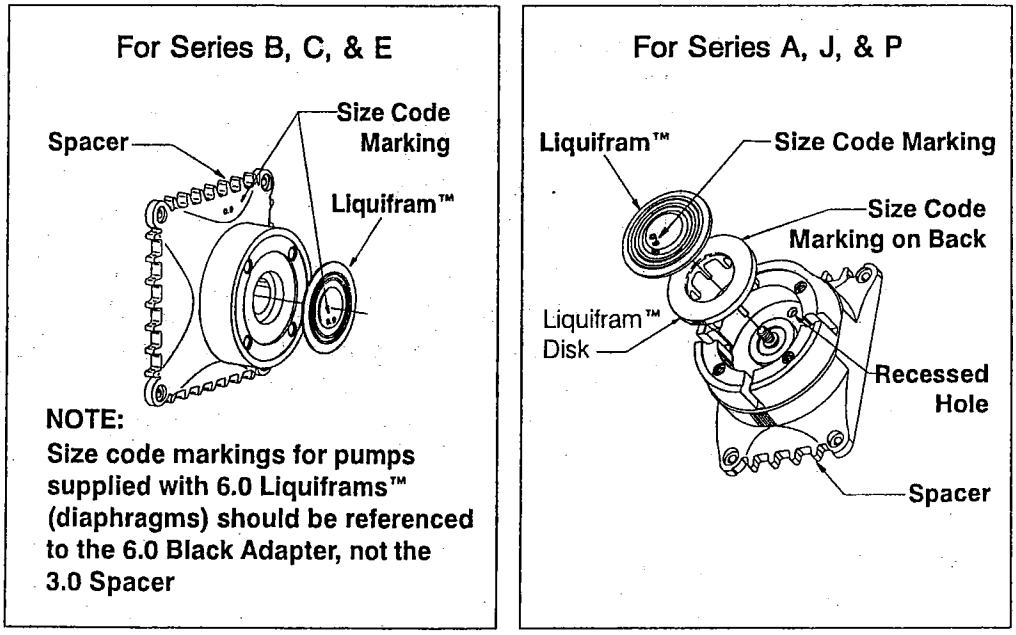
2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

See Section 10.0 for proper zero

3. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise ↺. Discard old Liquifram™. Remove the Liquifram™ disk if so equipped (located behind the Liquifram™) and check that the size code matches the size code on the replacement Liquifram™ (see illustration).

4. Reinstall the disk so the alignment pin on the disk (if present) seats in the recessed hole in the EPU.

CAUTION ***Be careful not to scratch the Teflon® face of the new Liquifram™.***



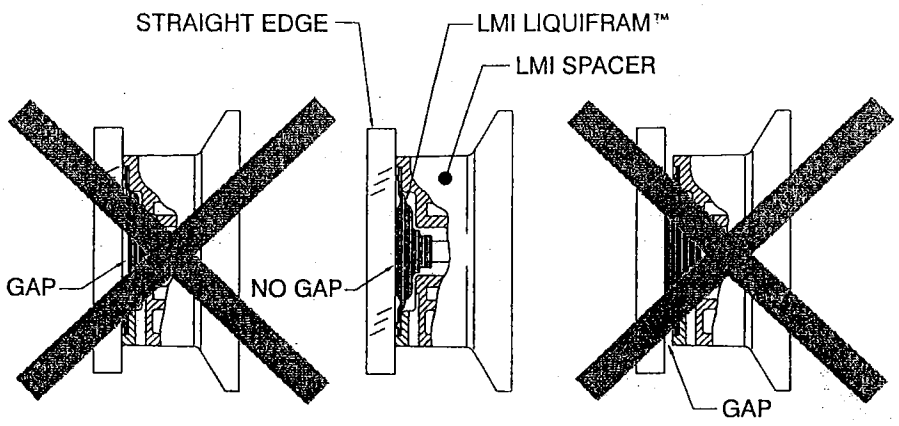
5. Start the pump and turn the stroke knob to the setting indicated on the following Stroke Setting Chart which matches the pump series number located on the pump dataplate. With the pump stroking (running), screw on the new Liquifram™ clockwise ↻ until the center begins to buckle inwards. Stop the pump.

Liquifram™ Stroke Setting Chart

Pump Series	Stroke Knob Setting
All A, B, J, P, Z Series C10, C11, C12, C70, C71, C72, C76, C90, C91, C92, E70, E71, E72	90%
All L Series	85%
C78	50%
C13, C14, C73, C74, C77, C93, C94, E73, E74	70%
All M Series	100% *

* Liquifram™ on M Series pumps only, must be bottomed completely (turned all the way in). ***Do Not Use Straight Edge.***

6. Grasp the outer edge of the Liquifram™ and adjust by screwing it in or out so that the center of the Liquifram™ is flush with the outside of the spacer edge (see illustration below).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram™ is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.

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9.3 Cartridge Valves, Seal Rings/Valve Balls and Injection Check Valve Spring Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

1. 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.
2. Carefully depressurize and disconnect the discharge line (see Section 9.1 in this manual). 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.

   Once the pump has been flushed, lift the Foot Valve out and continue to let air into the pump head until pump is purged of water or neutralizing solution.

   If the liquid cannot be pumped due to Liquifram™ rupture, with protective clothing, gloves and face shield, carefully disconnect the tubing and four screws to remove the head. 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.



***IMPORTANT**: Before disassembling the check valves, note the orientation of the valve.*

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve.

   If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.
4. Install new check valves in each location.

IMPORTANT: *Note correct orientation of each check valve.*

5. Install the new spring in the Injection Check Valve.



Depressurize and drain pipeline (or isolate I.C.V. point using valves) so that I.C.V. can safely be disassembled.

10.0 Checking Pump for Proper Zero Position (Stroke Knob)

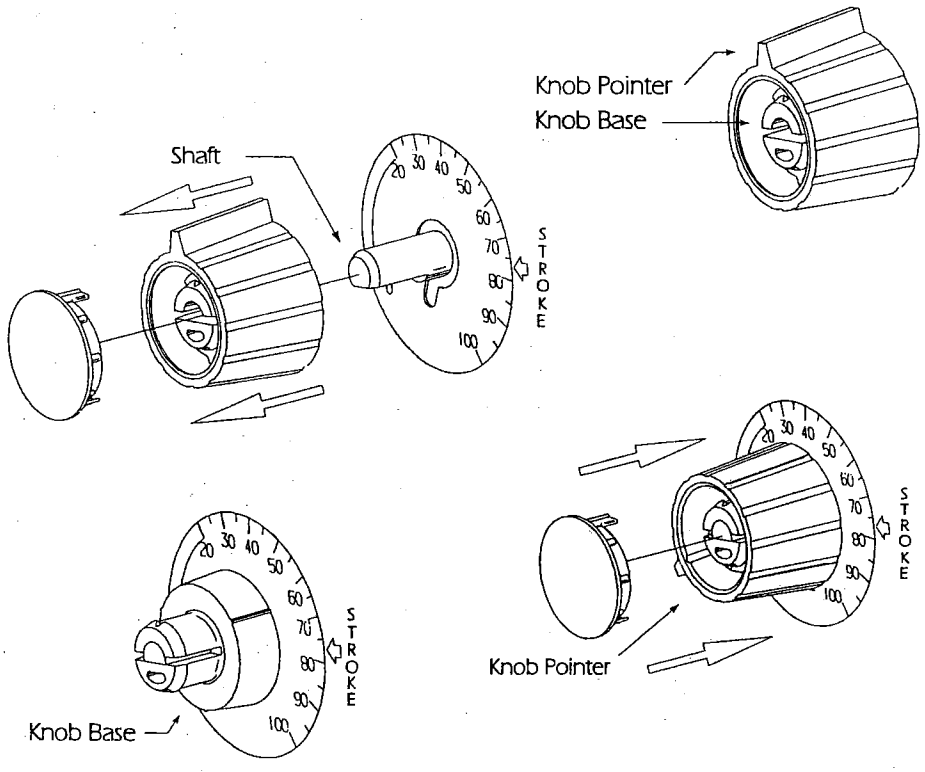
1. With pump running, turn stroke knob counter-clockwise ↺ toward zero or end of black or red band on dial.
2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).
3. If the pump continues to click at zero or stops clicking before zero is reached, the pump zero must be reset (see Section 10.1 or 10.2).

10.1 Type I - Push on Knob Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.
2. Pry off the yellow cap.
3. Place the knob on a flat surface.
4. Using needle-nose pliers, squeeze the inner section together while lifting the outer section up.
5. Push the inner section back onto the "D" shaped stroke shaft.
6. With the pump running, zero the pump by turning the inner section of the knob counter-clockwise ↺ until the pump stops clicking.

7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.
8. Push down on the outer section (a snap sound indicates parts are locked together).
9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



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10.2 Type II Collet Knob
Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove Yellow Cap.
2. Hold knob with soft jaw pliers.
3. Disconnect knob by loosening 5/16" (8 mm) collet nut. There is no need to remove nut.
4. Remove knob by pulling towards you.
5. With pump running, zero the pump using a screw driver to turn the stroke shaft counter-clockwise ↺ until the pump just stops clicking.
6. Pump is now zeroed.
7. Position knob at zero, or the end of the low range band, and tighten 5/16" (8 mm) collet nut.
8. Replace yellow cap.

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11.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE
Pump Will Not Prime	1. Pump not turned on or plugged in.
	2. Output dials not set properly.
	3. Foot Valve not in vertical position on bottom of tank.
	4. Pump suction lift too high.
	5. Suction tubing is curved or coiled in tank.
	6. Fittings are over tightened.
	7. Air trap in suction valve tubing.
	8. Too much pressure at discharge. (Pumps without multi-function valve.)
Pump Loses Prime	1. Solution container ran dry.
	2. Foot Valve is not in a vertical position on the bottom of the tank.
	3. Pump suction lift is too high.
	4. Suction tubing is curved or coiled in tank.
	5. Fittings are over tightened.
	6. Air trap in suction valve tubing.
	7. Air leak on suction side.

	SOLUTION
	1. Turn on pump/plug in pump.
	2. Always prime pump with speed at 80% and stroke at 100%.
	3. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	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. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 6.0). When pump is primed, reconnect discharge tubing.
	1. Refill container with solution and reprime (see Section 6.0).
	2. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	7. Check for pinholes, cracks. Replace if necessary.

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Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE
Leakage at tubing	1. Worn tubing ends.
	2. Loose or cracked fitting.
	3. Worn seal rings.
	4. Solution attacking Liquid Handling Assembly material.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.
	2. Worn Seal Rings.
	3. Ruptured Liquifram™.
	4. Incorrect stroke length.
	5. Tubing run on discharge may be too long.
	6. Clogged Foot Valve strainer.
Failure to Run	1. Pump not turned on or plugged in.
	2. EPU failure.
	3. Pulser failure.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).
	2. Little or no pressure at injection point.
	3. Excessive strokes per minute.

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	SOLUTION
	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Replace fitting if cracked. Carefully hand tighten fittings. *DO NOT USE PIPE WRENCH.* Once fitting comes into contact with seal ring, tighten an additional 1/8 or 1/4 turn.
	3. Replace balls and seal rings (see Section 8.3) Spare Parts (SP-#).
	4. Consult your local distributor for alternate materials.
	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn seal rings or cartridge valves may need replacement (see Section 9.3). Spare Parts (SP- #), or RPM Pro Pac™ kit.
	3. Replace Liquifram™ (see Section 9.2).
	4. Check zero on pump/Re-zero pump (see Section 10.0).
	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
	1. Turn on or plug in pump.
	2. Disassemble pump and measure the resistance of the EPU across the EPU wires. Resistance reading should be in accordance to the EPU Resistance Chart (see Section 12.0). Also, check EPU leads to ground. Consult supplier or factory.
	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 4.4).
	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 4.4).
	3. Replace pulser or resistor. Consult factory.

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12.0 EPU Resistance Chart

Pump Series	Voltage	Coil Resistance (Ohms) @ 20° C (68° F)*
A14, A15, A16, A34 A74, A75, A76 A94, A95, A96 J02, J03, J04, J05, J06 J13, J15, J16 PW4, PW5, PW6 P04, P05, P06 P08, P14, P15 P16, P18, P74 P75, P76, P78	115 VAC 230 VAC	76 - 87 307 - 353
(see Note 1) A17, A37, A77, A97, A18, A78 P02,P03 P12,P13	115 VAC 230 VAC	152 - 176 583 - 671
(see Note 2) A17, A37, A77, A97, A18, A78 P02, P03 P12, P13	115 VAC 230 VAC	76- 87 291- 335
J54D, J55D, J56D	12 VDC	1.1 - 1.3
D10, D11, D12, D13, D14 D70, D71, D72, D73, D74	115 VAC 230 VAC	25.7- 29.6 97 - 112
E70, E71, E72, E73, E74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
B11, B12, B13, B14 B71, B72, B73, B74	115 VAC 230 VAC	43 - 49 167 - 193
C10, C11, C12, C13, C14 C70, C71, C72, C73, C74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
C76, C77, C78	115 VAC 230 VAC	14.4 - 16.6 57.7 - 66.3

* Let pump cool down completely before checking resistance. EPU checked within 10 hours of operation can increase coil resistance reading as much as 20%.

NOTES:

1. Pumps with serial numbers LOWER than: **960113429**
2. Pumps with serial numbers HIGHER than: **960113429**

LMI MILTON ROY

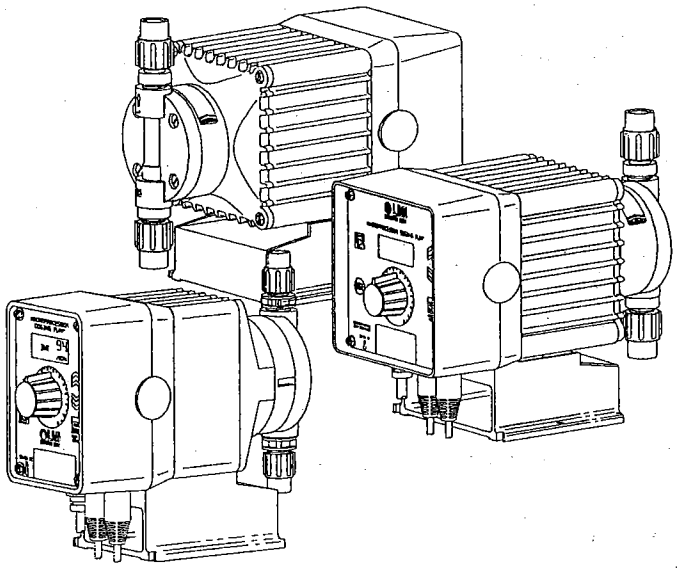
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Instruction Manual

Series A9, B9, and C9
Electronic Metering Pumps



For file reference, please record the following data:

Model No: A951-392SM / C931-318SM

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

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Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

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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).

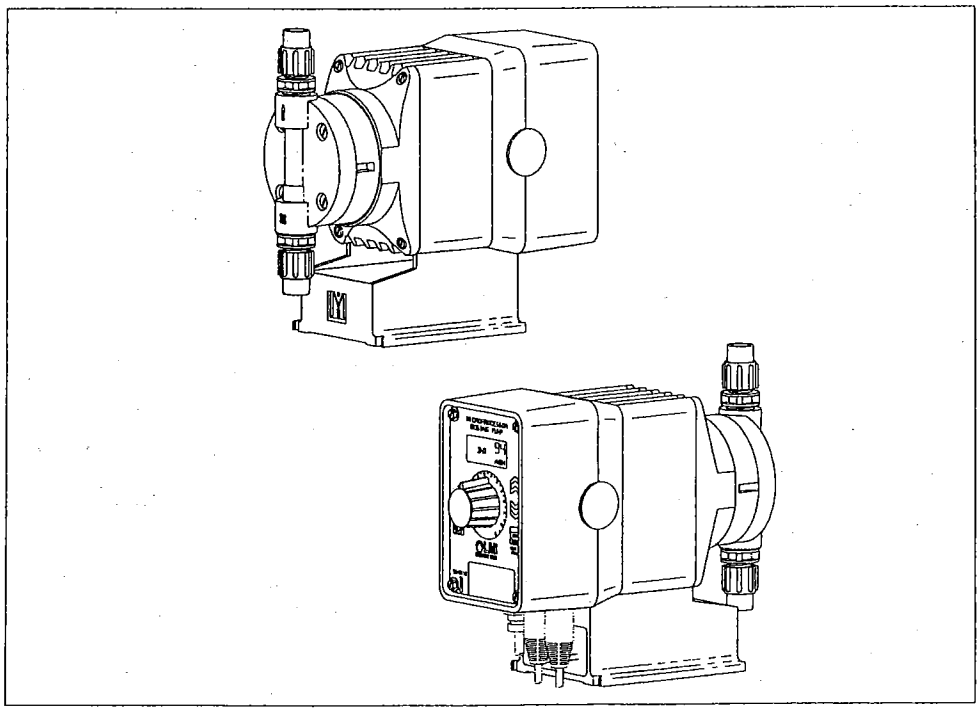


Figure 1: LMI Series A9 Electronic Metering Pump

2.0 Unpacking

You should find the following items in the box:

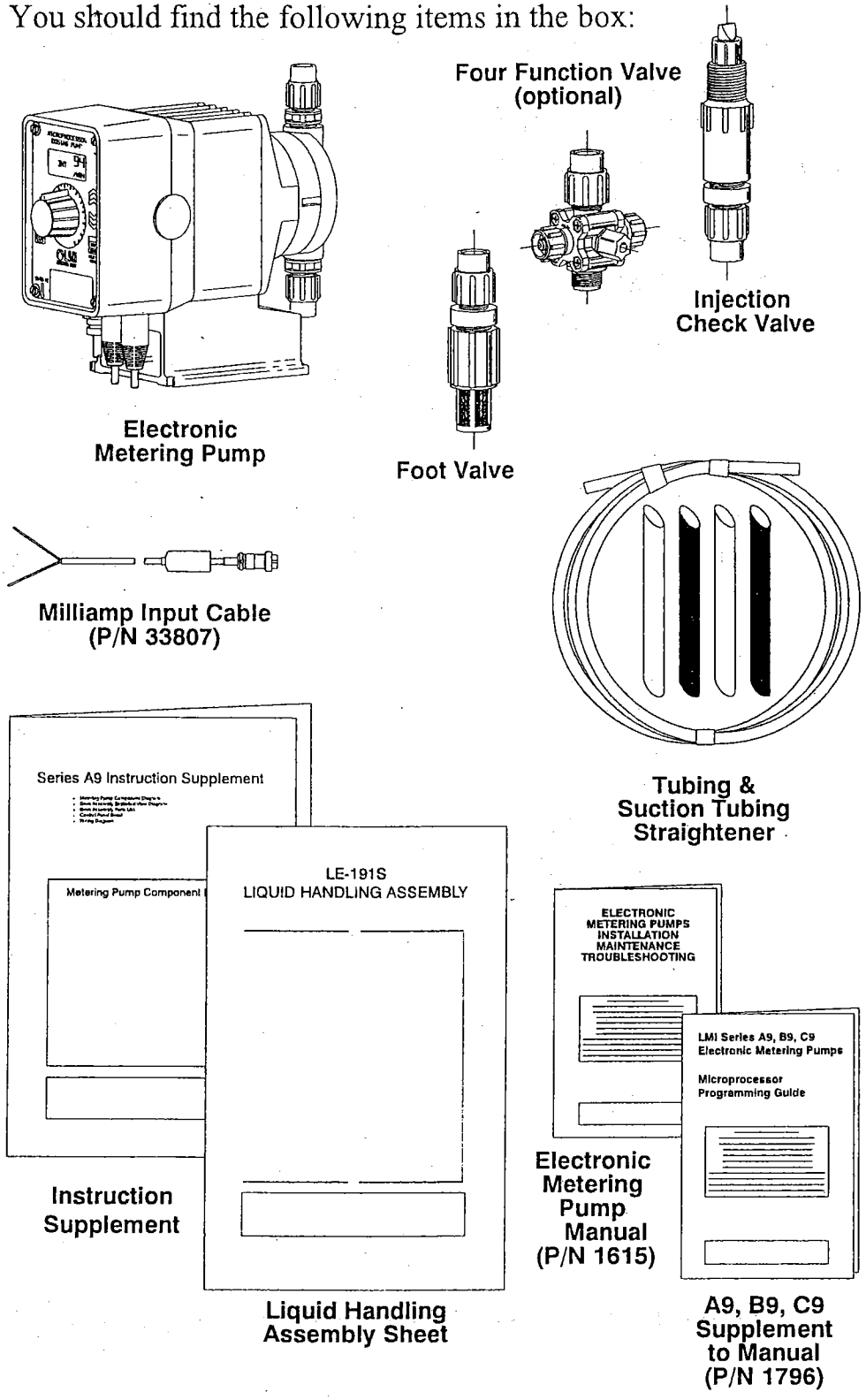


Figure 2: Unpacking Items

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.

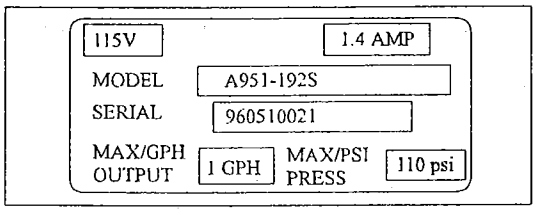


Figure 3a : Data Plate

Included on the data plate is the model number of the pump. Each number in the model number represents the following in Figure 3b.

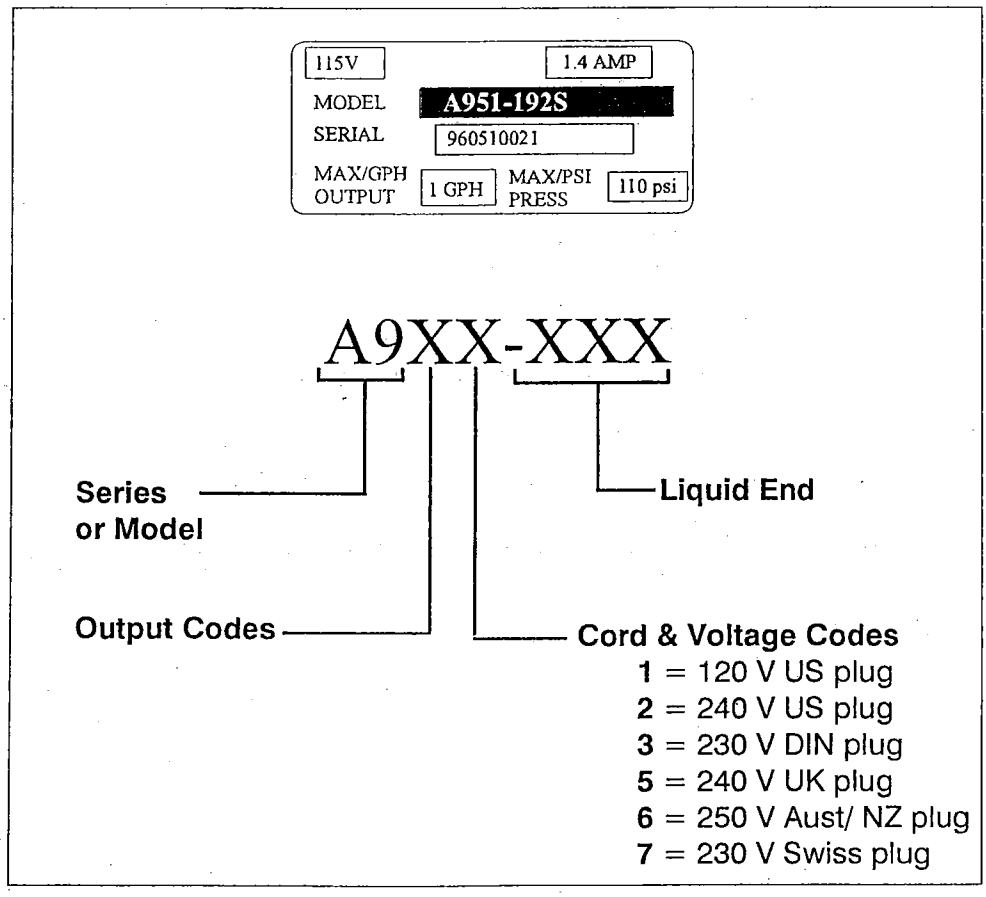


Figure 3b : Part Number Representation

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

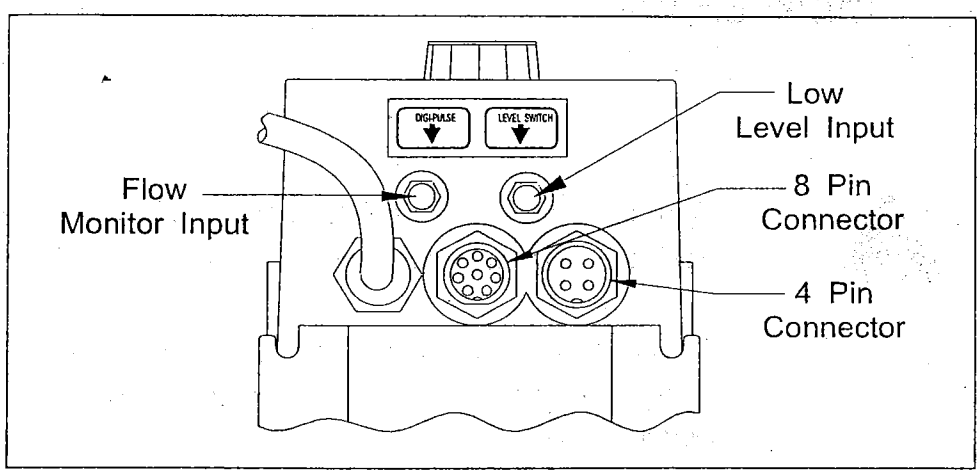


Figure 4: External Input and Output Connections



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.

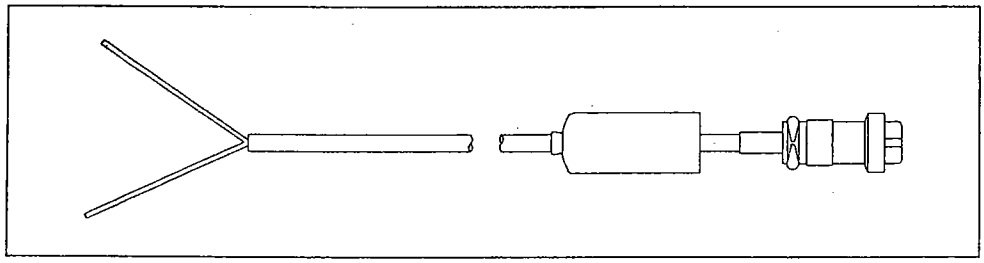


Figure 5: 2-Conductor Cable (P/N 33807)

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.

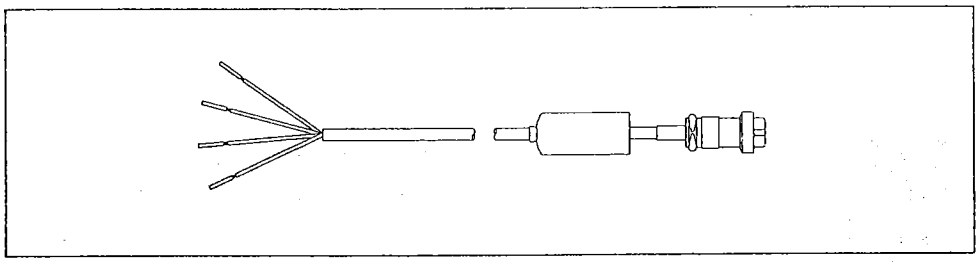


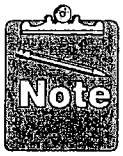
Figure 6: 4-Pin Cable (P/N 33796)

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.

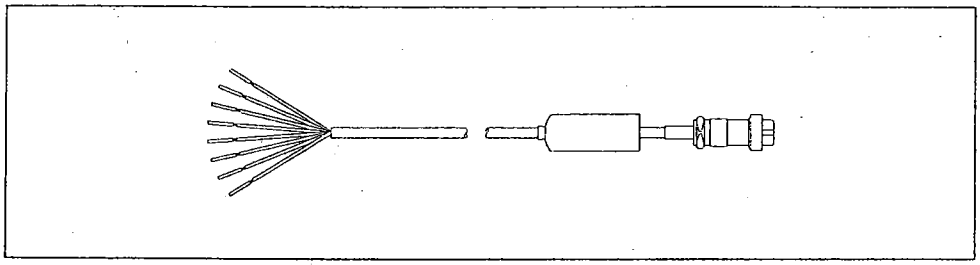


Figure 7: 8-Pin Cable (P/N 33738)

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).

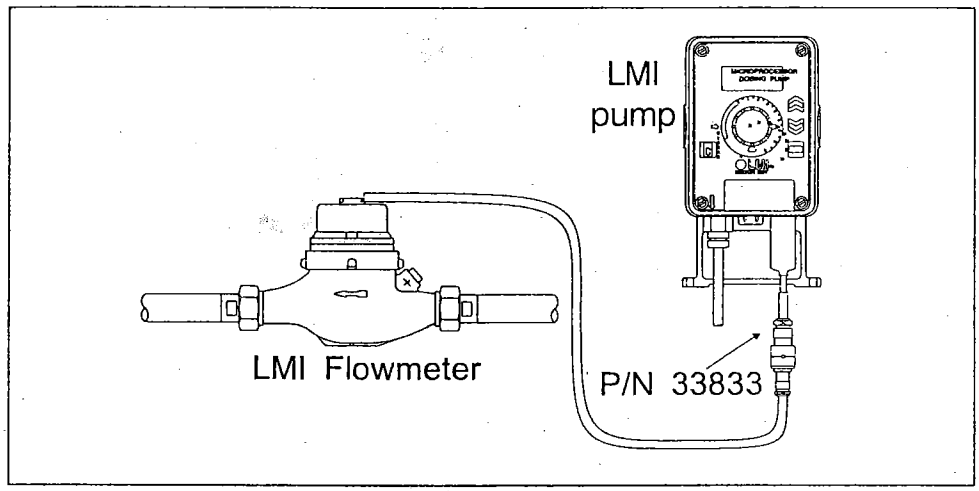


Figure 8: Optional "Hall Effect" Cable (P/N 33833)

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.

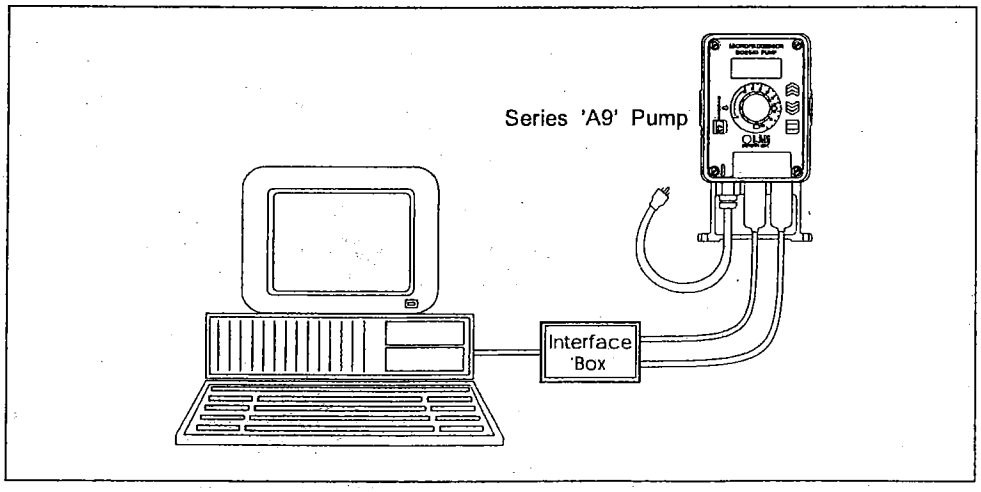


Figure 9: LiquiComm™ Computer Interface

7.0 Keypad/Display: Description and Function

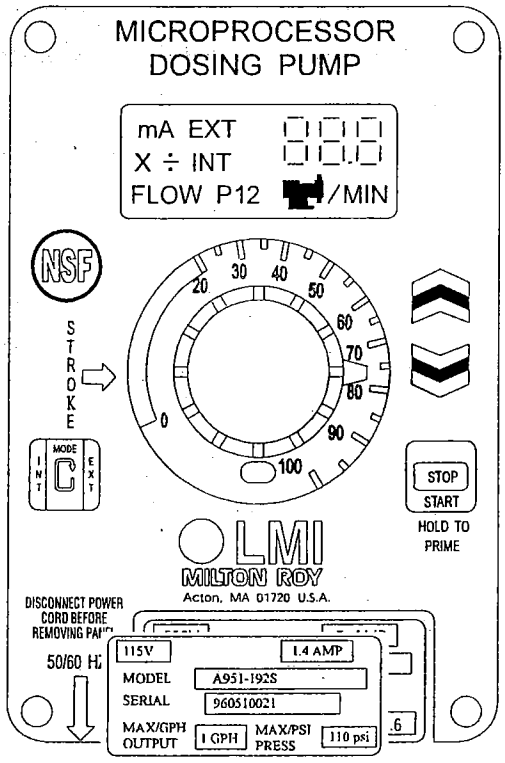


Figure 10: A9 Keypad

7.1 LCD Screen

The LCD screen is the window in which all values and menu choices are displayed (see Figure 11).

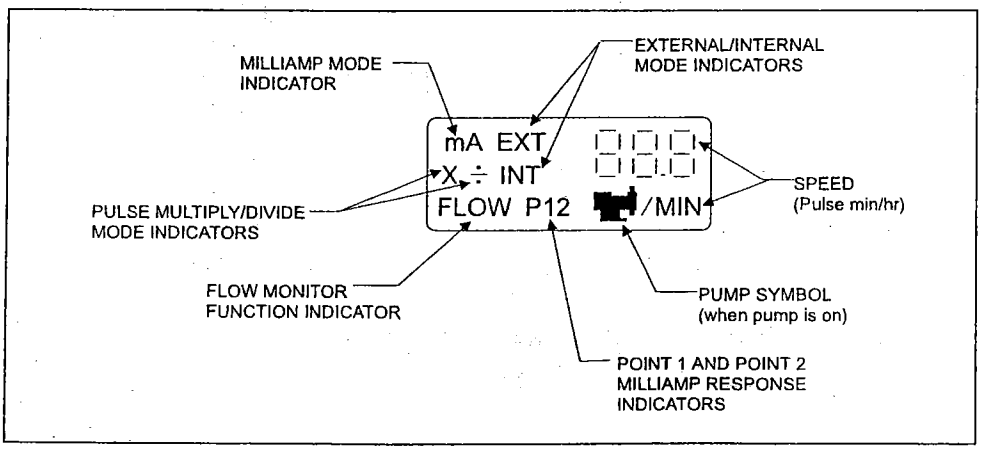


Figure 11: Liquid Crystal Display

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 [redacted] symbol appears on the display while the pump is running. Each time the pump strokes, the [redacted] 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 [redacted] (Up) and [redacted] (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.

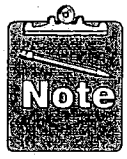
7.4 Mode Key 

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 STOP START (Start/Stop) key to start or stop the pump. When the pump is OFF, the LCD screen will alternate between INT OFF and INT 100 /MIN every 16 seconds. When you start the pump, the symbol appears on the LCD INT 100 /MIN. Each time the pump strokes, the symbol disappears. Press the STOP START (Start/Stop) key again to stop the pump.

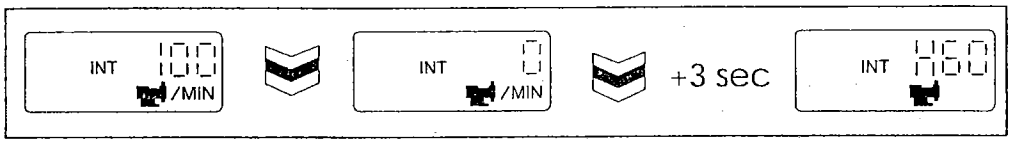


"INT" signifies that the pump is in the "Internal" (Manual) mode.

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 Pri /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 (Mode) key and (Up) key at the same time and hold for two (2) seconds. The current pressure setting [PS /MIN] 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

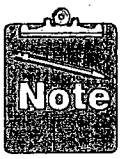
The pump has two (2) lock modes to prevent casual tampering. The small "LOC" de-activates all key functions *except* STOP START (Start/Stop) and Prime. To activate this "LOC" mode, press the MODE (Mode) key and (Down) key at the same time and hold for two (2) seconds. The LCD will read [LOC] for five (5) seconds and then return to the previous display. This display [LOC] re-appears when any key except the STOP START (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 [LOC] for five (5) seconds and then return to the previous display. This display [LOC] re-appears whenever any key is pressed.

To de-activate either lock mode, press the MODE (Mode) key and (Down) key at the same time, and hold for two (2) seconds. The LOC or LOC 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 INT E1 /MIN.



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.

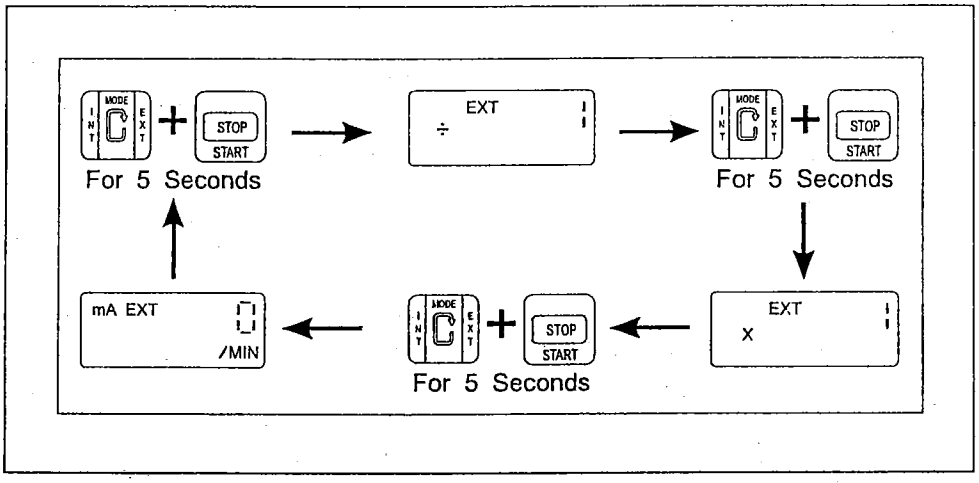
9.0 External Control Modes

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 (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) EXT ÷ 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.

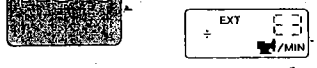
Summary of External Mode Select



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" [x EXT 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 [mA EXT 88 /MIN] and the mA value [mA 180] 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.

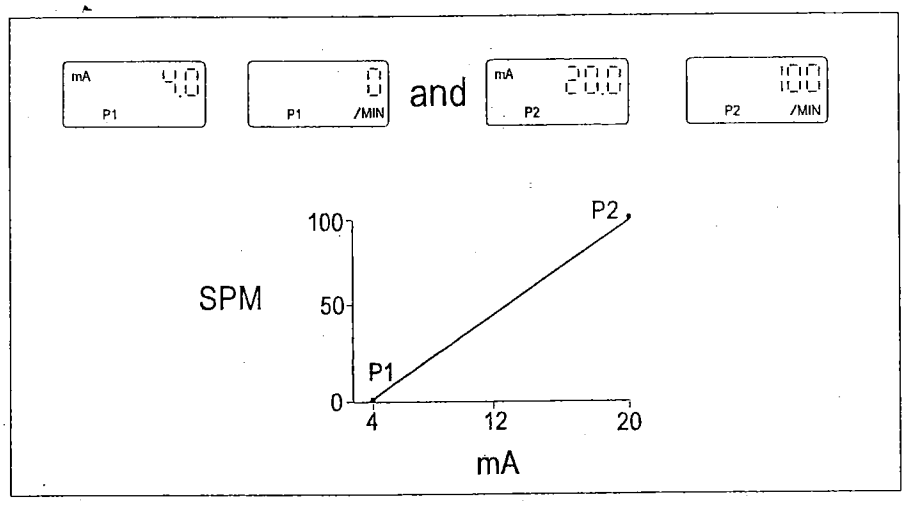


Figure 12

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 P1 4.0]. This value may be altered using the (Up) or (Down) key within five (5) seconds (i.e. [mA P1 6.0]). 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 P2 20.0]. Edit as described in the above paragraph (i.e. [mA P2 18.0]). 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.

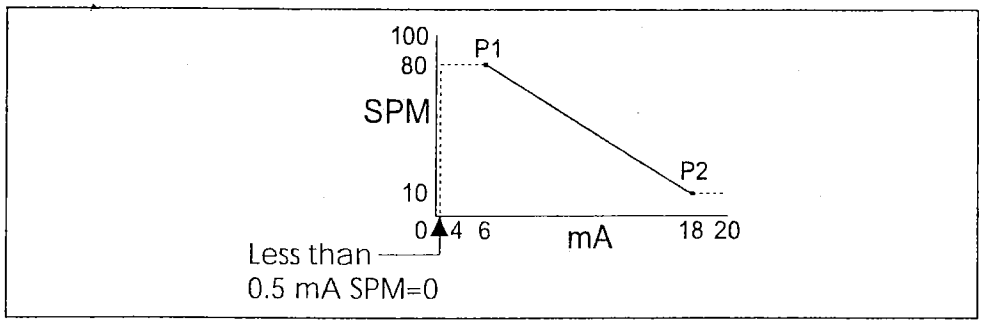


Figure 13

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 [Pro]. After five (5) seconds, the display will show the mA value for P1 [mA P1 4.0]. This value may be altered by using the (Up) key or (Down) key within five (5) seconds (i.e. [mA P1 6.0]). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed [P1 H50]. This value may be altered within five (5) seconds using the (Up) or (Down) key (i.e. [P1 H60]).

Five (5) seconds after the last key press, the mA value for P2 will be displayed [mA P2 20.0]. Edit as described above (i.e. [mA P2 18.0]). Likewise, five (5) seconds after the last keypress, the stroke rate for P2 is displayed and may be altered as above (i.e. [P2 H10]).

The above example would result in the inverse control profile shown in Figure 14.

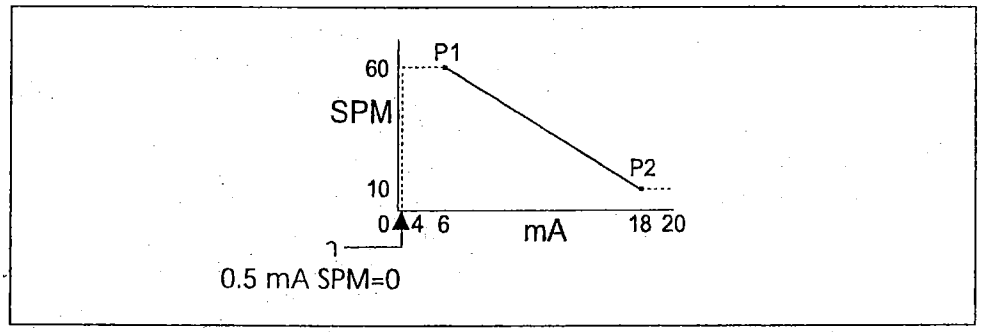


Figure 14



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 [EXT E5].



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 [C.2]. 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 [INT 100 /MIN].

10.2 Menu Items

10.2.1 Menu Item 1: Batch Accumulate Enable/Disable

Batch Accumulate may be enabled (1) [1 1] or disabled (0) [1 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) [2 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).

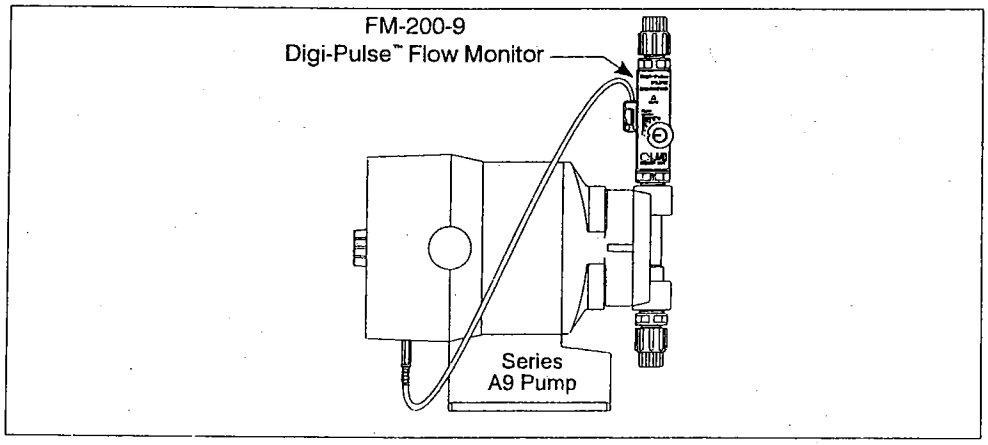


Figure 15

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.

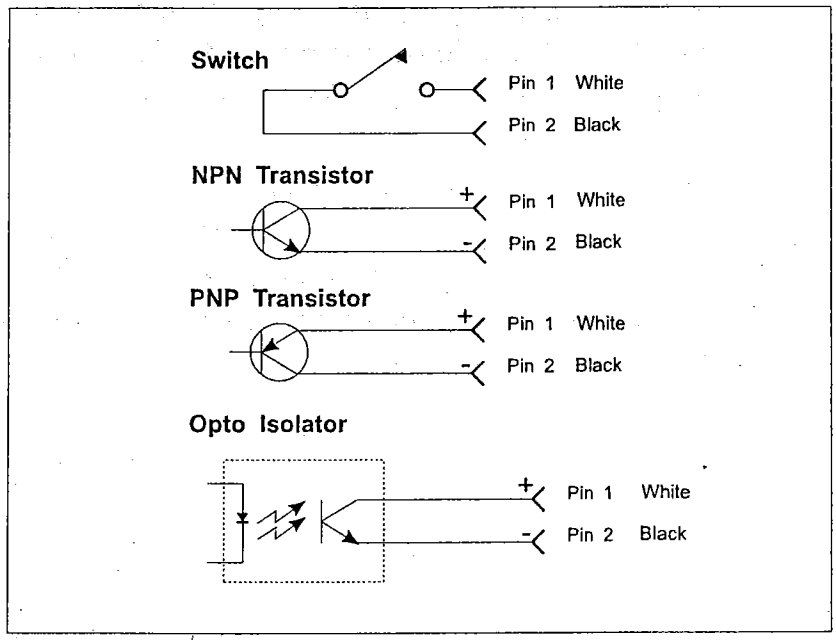
Appendix A: Input/Output Description

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)



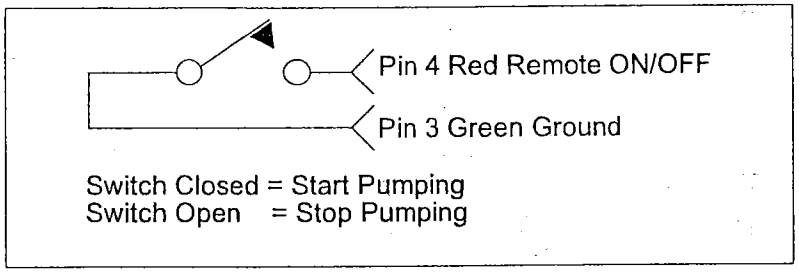


Switch or transistor must be capable of switching 2 mA at 15 VDC. When in the Divide mode, the switch must close then open to trigger.
Minimum time in low impedance state (i.e. switch closed) is 60 mSec by default.
Setup Menu Item 6 sets this value in multiples of 4 mSec.
Example: Default = 4 x [15] = 60 mSec

Remote On/Off (Opto-isolated Input)

Switching this line to ground starts the pump. Releasing this line, stops the pump. The [STOP/START] (Start/Stop) key will always override the Remote Start/Stop.

Reference: 4-Pin Cable (P/N 33796)

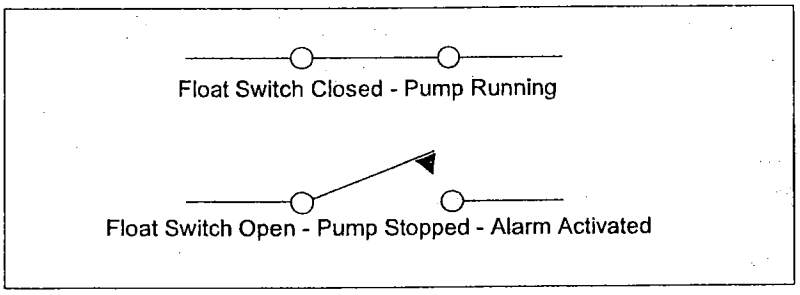




Switch must be capable of switching 2 mA at +15 VDC. Minimum time in low impedance state (i.e. Switch closed) is approximately one (1) second.

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

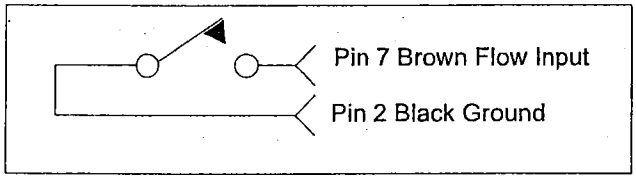
This is reverse polarity protected with a 22 Ohm impedance, a resolution or 0.1 mA and an accuracy of +/- 0.2 mA typically.

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.

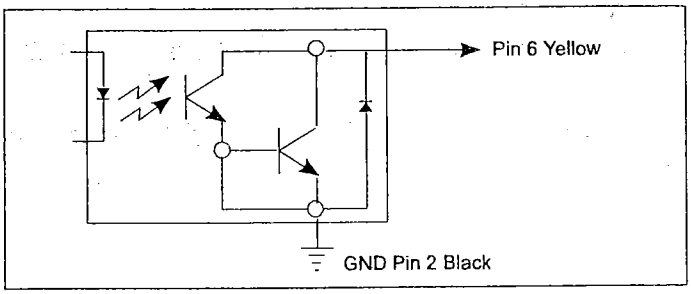
15V Output

The +15V Output (pin 1 Red) is regulated and capable of delivering 30 mA current.

Alarm Output

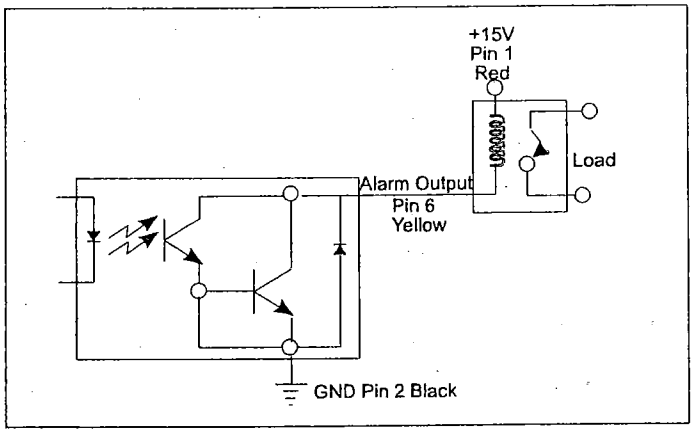
This is an opto-isolated open collector Darlington pair capable of switching 25 mA at +24 VDC to within 1V of ground typically.

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.

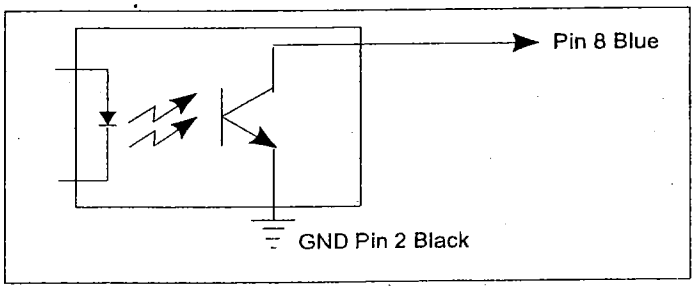
Application: Relay Switching



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.

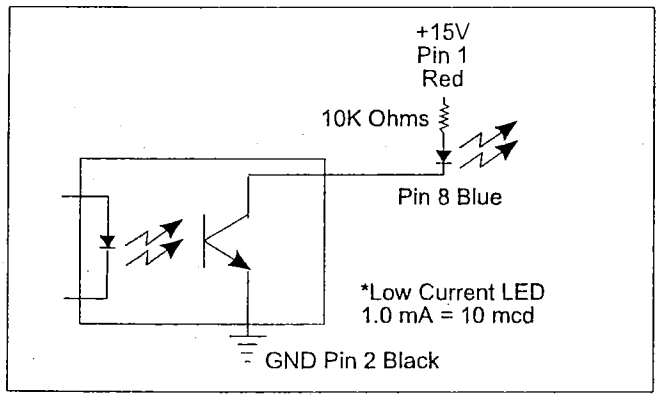
Reference: 8-Pin Cable (P/N 33738)



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.

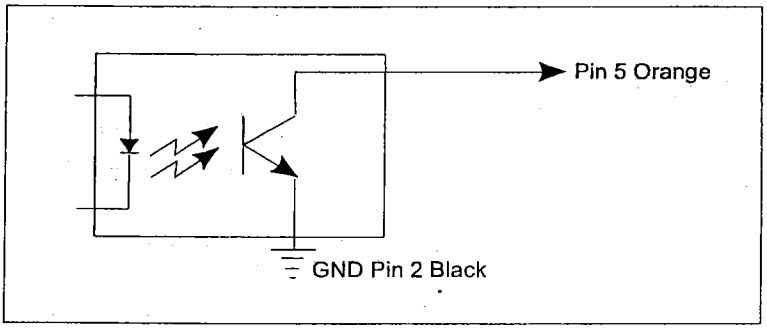
Application: Low Current LED Switching



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)

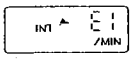
Reference: 8-Pin Cable (P/N 33738)



The output transistor turns ON at the start of a stroke and remains ON for approximately 100 mSec.

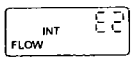
Appendix B: Summary of Error Messages

E1



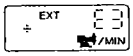
is caused by a Low-Level fault with a Low-Level Switch connected to the pump. The pump is stopped and the alarm outputs are activated. This operates in all Internal and External modes. The pump automatically restarts when the fault is cleared.

E2



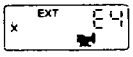
indicates that the pump has lost prime (or the flow had reduced) when an FM200-9 is connected and Flow Monitoring is enabled. Again, the pump is stopped and output alarms activated. Restart the pump when the fault is cleared.

E3



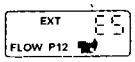
is displayed in the External mode if the stroke rate exceeds 100 SPM. The pump is NOT stopped and NO alarm outputs are activated with this fault. To stop E3 flashing, clear the fault condition, then stop and restart the pump.

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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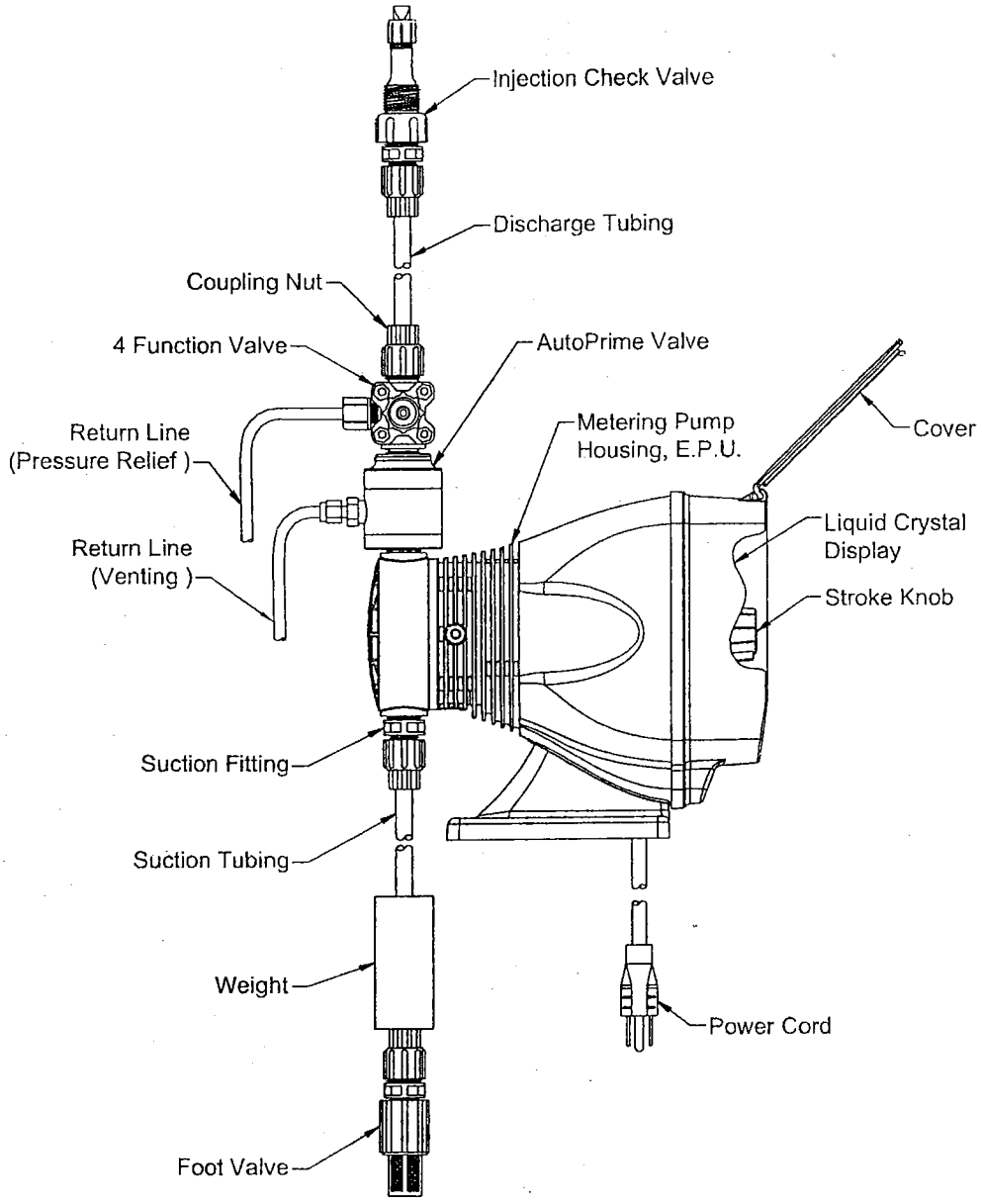
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Instruction **Supplement**

Series AA9
Electronic Metering Pump



Metering Pump Component Diagram

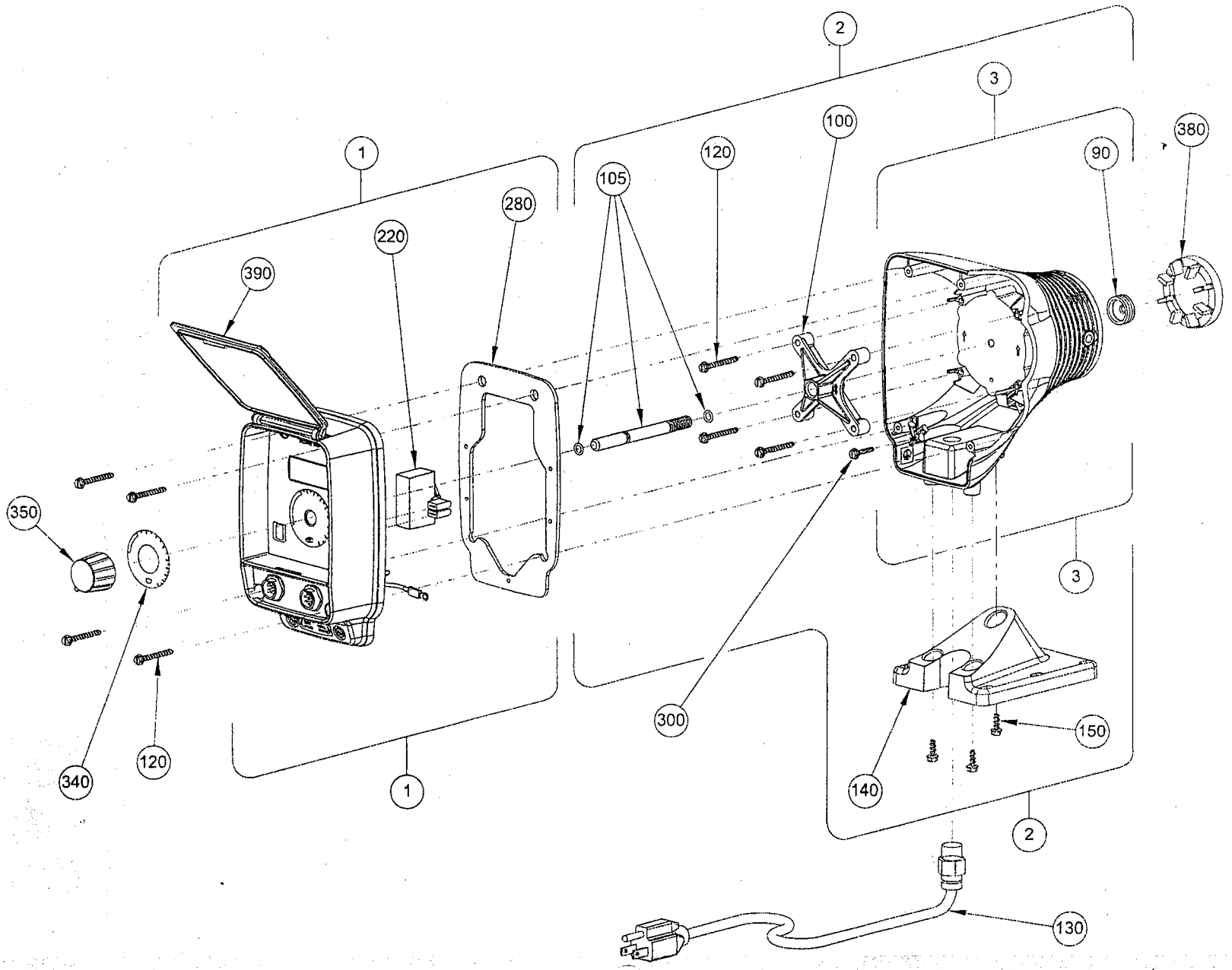
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Series AA9 Drive Assembly Exploded View Diagram

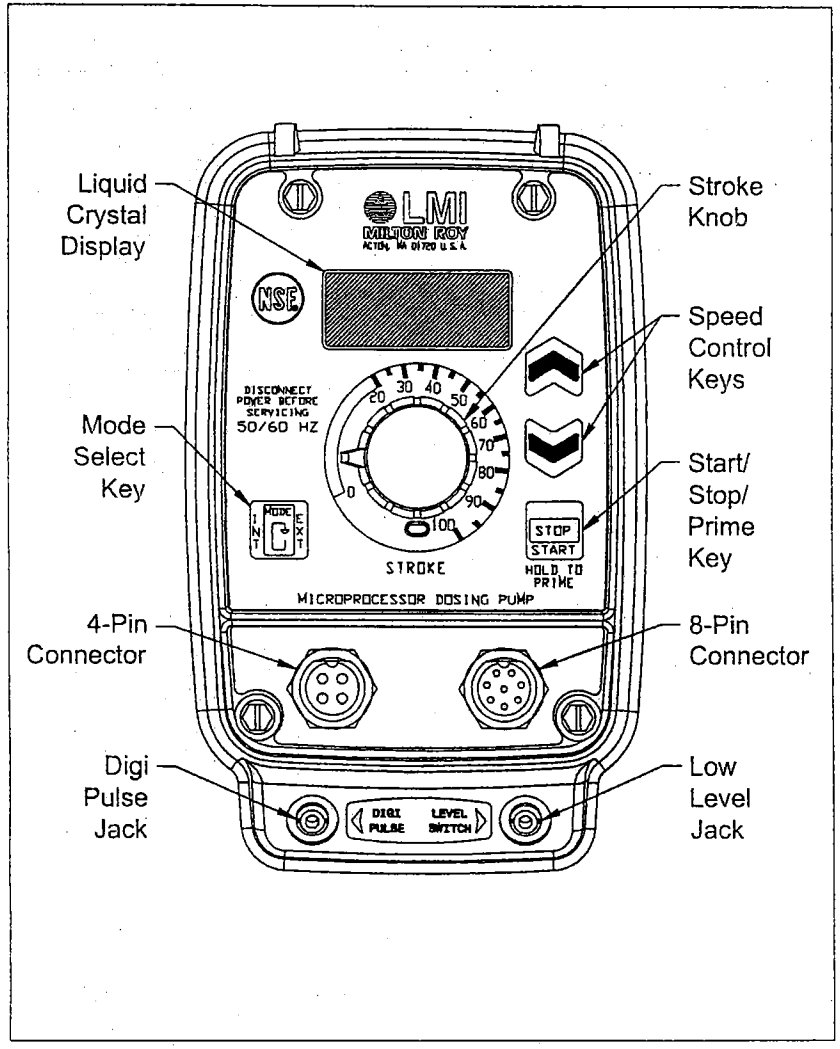


Series AA9 Drive Assembly Parts List

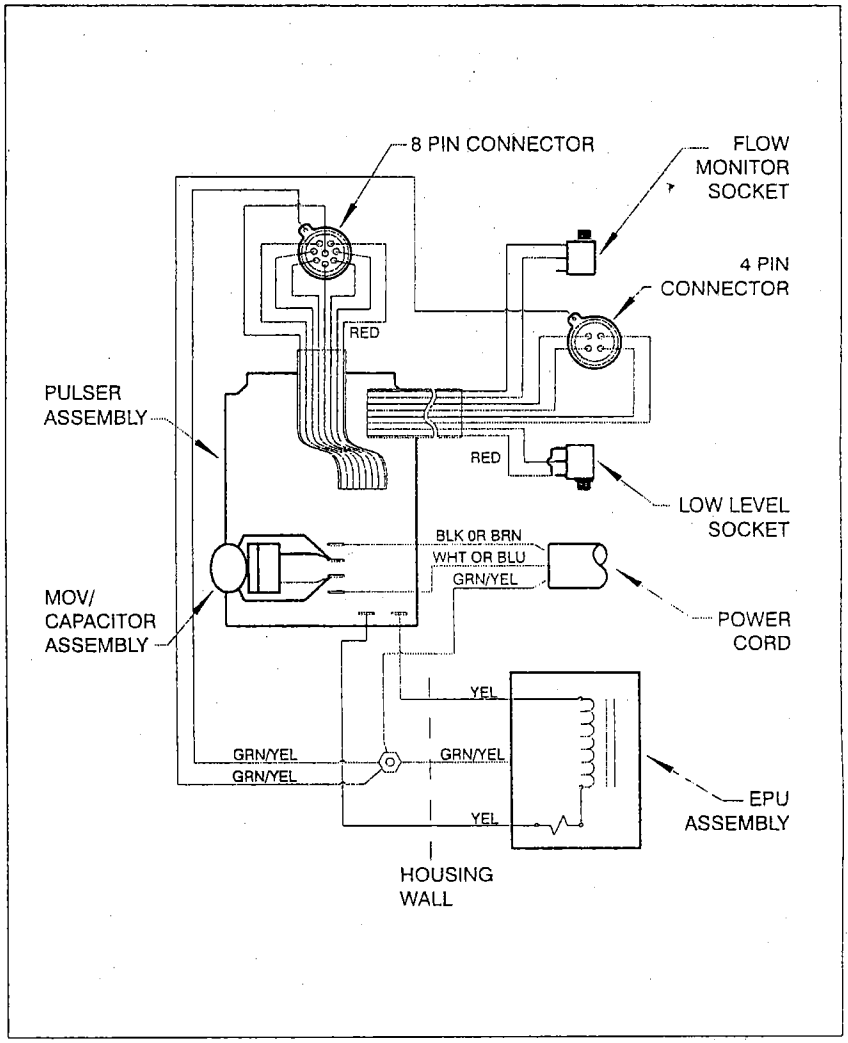
Key No.	Model Series	Part No.	Description	Qty.
1	AA941, AA951, AA961, AA971, AA981	48018	Control Panel Assembly, 115V	1
	AA942, AA952, AA962, AA972, AA982 AA943, AA953, AA963, AA973, AA983 AA945, AA955, AA965, AA975, AA985 AA946, AA956, AA966, AA976, AA986 AA947, AA957, AA967, AA977, AA987	48019	Control Panel Assembly, 230-250V	1
2	AA941, AA951	48034	EPU w/ Stroke Adjustment, 115V	1
	AA942, AA943, AA945, AA946, AA947 AA952, AA953, AA955, AA956, AA957	48035	EPU w/ Stroke Adjustment, 230-250V	1
	AA961	48036	EPU w/ Stroke Adjustment, 115V	1
	AA962, AA963, AA965, AA966, AA967	48037	EPU w/ Stroke Adjustment, 230-250V	1
	AA971, AA981	48038	EPU w/ Stroke Adjustment, 115V	1
	AA972, AA973, AA975, AA976, AA977 AA982, AA983, AA985, AA986, AA987	48039	EPU w/ Stroke Adjustment, 230-250V	1
3	AA941, AA951	48025	EPU, 115V	1
	AA942, AA943, AA945, AA946, AA947 AA952, AA953, AA955, AA956, AA957	48026	EPU, 230-250V	1
	AA961	48027	EPU, 115V	1
	AA962, AA963, AA965, AA966, AA967	48028	EPU, 230-250V	1
	AA971, AA981	48029	EPU, 115V	1
	AA972, AA973, AA975, AA976, AA977 AA982, AA983, AA985, AA986, AA987	48030	EPU, 230-250V	1
90	AA9	10973	Seal	1
100	AA9	38886	Stroke Adjustment Bracket	1
105	AA9	48012	Stroke Adjustment Shaft Assembly	1
120	AA9	41227	Screw	8

Key No.	Model Series	Part No.	Description	Qty.
130	AA941, AA951, AA961, AA971, AA981	29033CE	Power Cord Assembly, 115V	1
	AA742, AA752, AA762, AA772, AA782	29039CE	Power Cord Assembly, 230V US	1
	AA743, AA753, AA763, AA773, AA783	29042CE	Power Cord Assembly, 230V DIN	1
	AA745, AA755, AA765, AA775, AA785	29044CE	Power Cord Assembly, 240V UK	1
	AA746, AA756, AA766, AA776, AA786	29046CE	Power Cord Assembly, 250V AUST	1
	AA747, AA757, AA767, AA777, AA787	29048CE	Power Cord Assembly, 230V SWISS	1
140	AA9	37879	Foot	1
150	AA9	38199	Screw	3
210	AA9	10422	Retaining Ring	1
220	AA741, AA751, AA761, AA771, AA781	35254	MOV and Capacitor Assy, 115V	1
	AA942, AA952, AA962, AA972, AA982 AA943, AA953, AA963, AA973, AA983 AA945, AA955, AA965, AA975, AA985 AA946, AA956, AA966, AA976, AA986 AA947, AA957, AA967, AA977, AA987	35255	MOV and Capacitor Assy, 230-250V	1
280	AA9	38887	Gasket	1
300	AA9	41244	Screw	1
340	AA76	30374	Stroke Dial	1
	AA77	29269	Stroke Dial	1
	AA78	29268	Stroke Dial	1
350	AA9	31890	Stroke Knob Assembly	1
380	AA74, AA77	29445	Disk, 0.5	1
	AA75, AA78	29437	Disk, 0.9	1
	AA76	29442	Disk, 1.8	1
390	AA9	37974	Cover	1

Series AA9 Control Panel Detail



Series AA9 Wiring Diagram

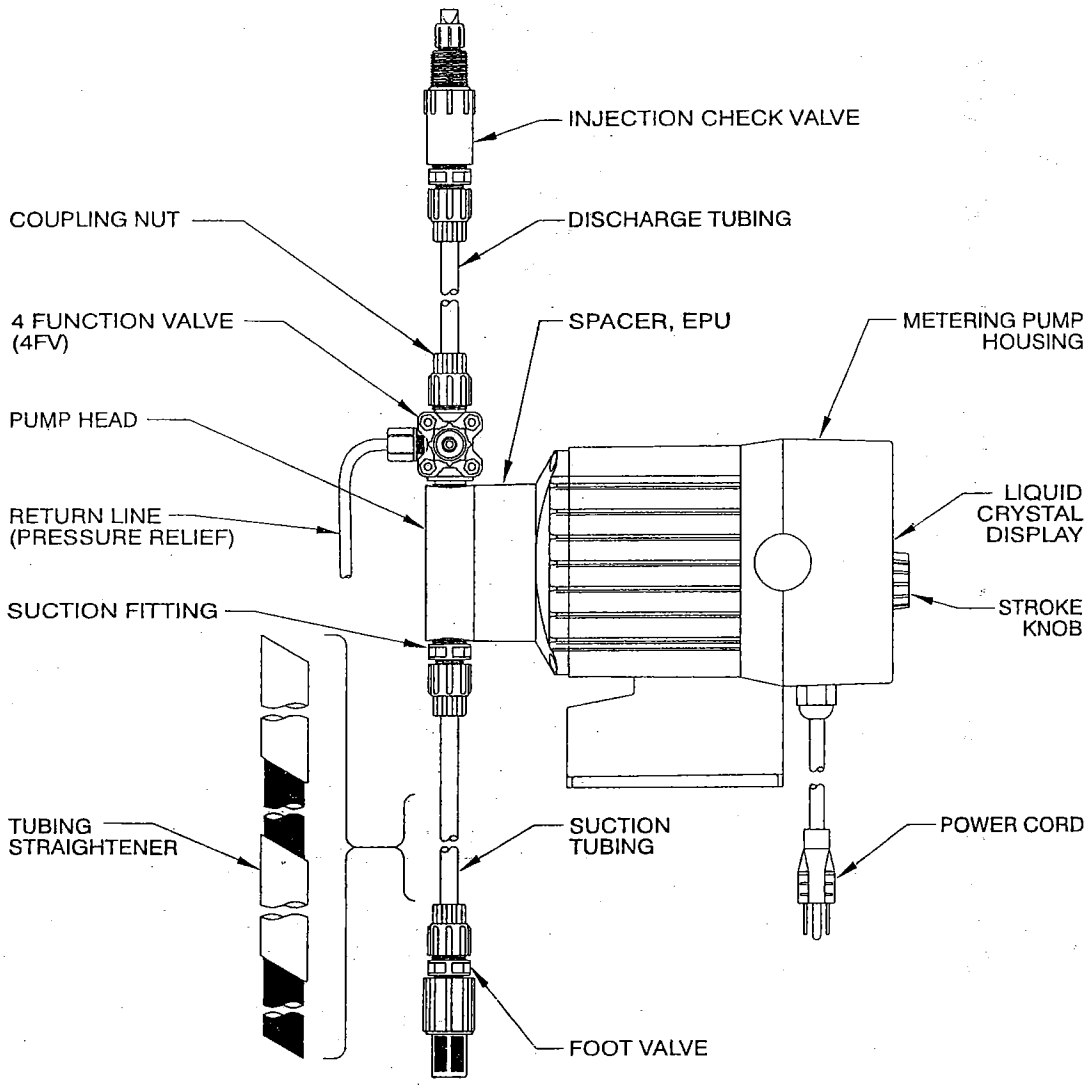


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Instruction **Supplement**

Series C9
Electronic Metering Pump



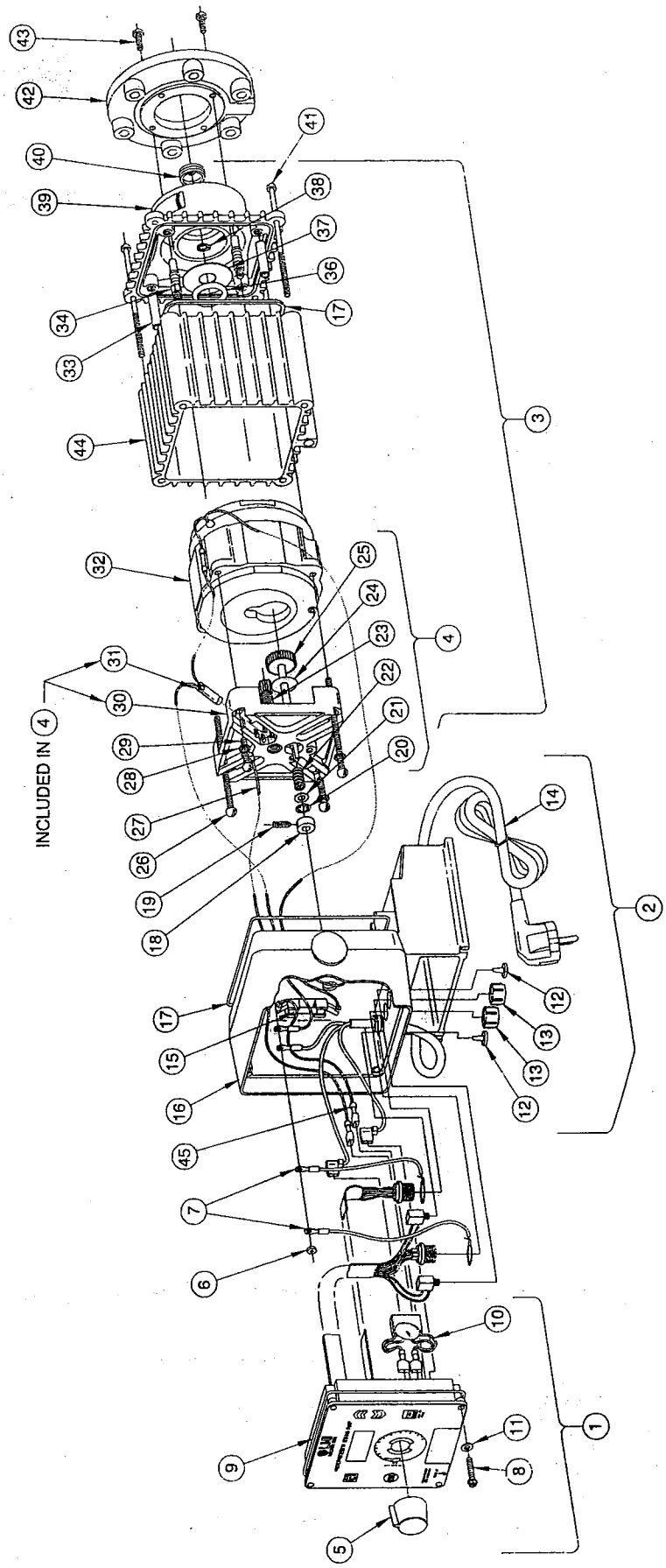
METERING PUMP COMPONENT DIAGRAM

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1795.C 2/98

SERIES C9 DRIVE ASSEMBLY EXPLODED VIEW DIAGRAM

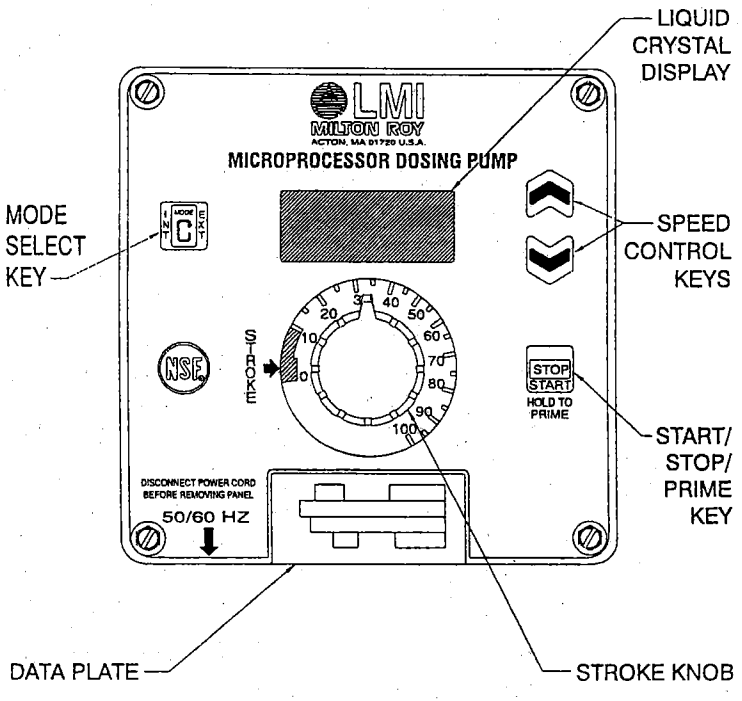


SERIES C9 DRIVE ASSEMBLY PARTS LIST

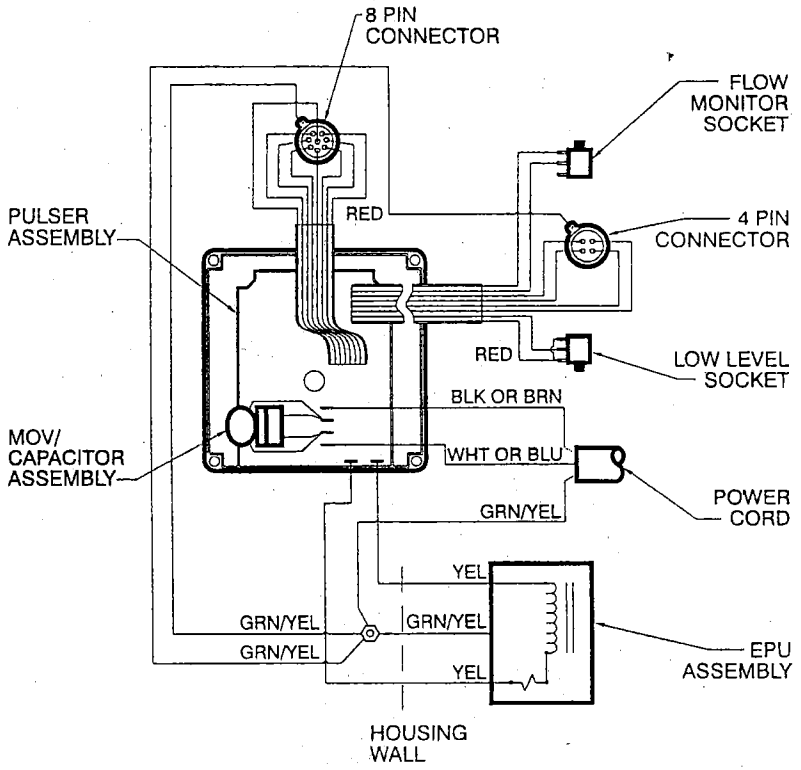
Key No	Model Series	Part No.	Description	Qty.
1	C901, C911	35960CE	Control Panel Assembly, 120V	1
	C902, C903, C905, C906, C907 C912, C913, C915, C916, C917	35961CE	Control Panel Assembly, 240V	1
	C921	35962CE	Control Panel Assembly, 120V	1
	C922, C923, C925, C926, C927	35963CE	Control Panel Assembly, 240V	1
	C931	35964CE	Control Panel Assembly, 120V	1
	C932, C933, C935, C936, C937	35965CE	Control Panel Assembly, 240V	1
	C941	35966CE	Control Panel Assembly, 120V	1
	C942, C943, C945, C946, C947	35967CE	Control Panel Assembly, 240V	1
2	C901, C911, C921, C931, C941	35949CE	Housing Assembly, 120V	1
	C902, C912, C922, C932, C942	35955CE	Housing Assembly, 230V	1
	C903, C913, C923, C933, C943	35950CE	Housing Assembly, 220-240V DIN	1
	C905, C915, C925, C935, C945	35951CE	Housing Assembly, 220-240V UK	1
	C906, C916, C926, C936, C946	35956CE	Housing Assembly, 220-240V AUST	1
	C907, C917, C927, C937, C947	35952CE	Housing Assembly, 220-240C SWISS	1
3	C901	32532CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C902, C903, C905, C906, C907	32533CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
	C911, C921	32534CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C912, C913, C915, C916, C917 C922, C923, C925, C926, C927	32535CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
	C931, C941	32536CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C932, C933, C935, C936, C937 C942, C943, C945, C946, C947	32537CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
4	C9	32251CE	Stroke Bracket Assembly	1
5	C9	31891	Knob, Stroke	1
6	C9	10191	Nut, 6-32	2
7	C9	35266	Wire Assembly	2
8	C9	30306	Screw, 10 x 1 PH S.S.	4
9	C9	10166	O-Ring	1
10	C9X1	35254	MOV/CAP Assembly, 120V	1
	C9X2, C9X3, C9X5, C9X6	35255	MOV/CAP Assembly, 220-240V	1
11	C9	33889	Washer	4
12	C9	30307	Plug	2
13	C9	25930	Cover	2
14	C9X1	37213CE	Power Cord, 120V	1
	C9X2	37214CE	Power Cord, 240V	1
	C9X3	36001CE	Power Cord, 220-240V DIN	1
	C9X5	37215CE	Power Cord, 220-240V UK	1
	C9X6	36002CE	Power Cord, 220-240V AUST	1
	C9X7	37216CE	Power Cord, 220-240V SWISS	1

Key No.	Model Series	Part No.	Description	Qty.
15	C901, C911, C921, C931, C941	25825	Fuse, 4A Rectifier	2
	C90, C91, C92, C93, C94 All models rated 220-240 Volts	25824	Fuse, 2A Rectifier	2
16	C9	35890	Housing	1
17	C9	35269	O-Ring	2
18	C9	25424	Collar	1
19	C9	25423	Set Screw	1
20	C9	10462	Retaining Ring	1
21	C9	32302	Washer	1
22	C9	32221	Spring	1
23	C9	32578	Pinion	1
24	C9	25121	Gasket	1
25	C9	31770	Shaft Assembly	1
26	C9	27552	Screw, 10-24 x 4.0	2
27	C9	35223	Ground Wire Assembly (GRN)	1
28	C9	10415	Washer	4
29	C9	27551	Screw, 10-24 x 1.25	4
30	C9	12064	Bracket (without mating parts)	1
31	C9	27501CE	Thermostat	1
32	C901, C911, C921, C931, C941	32158CE	EPU Assembly, 120V	1
	C90, C91, C92, C93, C94 All models rated 220-240 Volts	32159CE	EPU Assembly, 240V	1
33	C90, C91, C92, C93, C94	27187	Spacing Stud	2
34	C90, C91, C92	27641	Stud Assembly	4
	C93, C94	27641-1	Stud Assembly	4
36	C9	26983	O-Ring	1
37	C9	27586	Shim	1
38	C9	27253	Retaining Ring	1
39	C90	35393	Spacer, 0.9 SI	1
	C91, C92	35394	Spacer, 1.8 SI	1
	C93, C94	35395	Spacer, 3.0 SI	1
40	C9	10973	Seal	1
41	C9	25127	Screw, RH Slotted, S.S.	4
42	C94	25887	Spacer Adapter, 6.0 SI	1
43	C9	10598	Screw	4
44	C90, C91, C92, C93, C94	25068	Sleeve, EPU	1
45	C9	26344CE	Wire Assembly	2
Not Shown	C9	25849	Bushing, Unipulser	1

SERIES C9 CONTROL PANEL DETAIL



SERIES C9 WIRING DIAGRAM



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ACCUDRAW® Glass Cylinder Calibration Instructions

Note: ***Before starting the calibration procedure below, ensure that the pump is primed and void of any trapped air.***

Using the ml scale: (scale is based on <u>volume</u> pumped, over any given time)

1. Fill the calibration cylinder to the top mark with the liquid to be dispensed. This can be accomplished by manually filling the cylinder, or, if the the feed tank level is higher than the cylinder, by opening the isolation valve below the cylinder and back filling the cylinder.

Caution: Never leave unattended when back filling the cylinder.

2. With the calibration cylinder full of the liquid to be dispensed, start the metering pump and operate at 100% output until all air is removed from both suction lines and pump head.
3. Shut pump "OFF".
4. With calibration cylinder full, close isolation valve (#2) from supply tank, and open isolation valve (#1) below cylinder.
5. Start the pump.
6. Using a stop watch, measure the volume dispensed in 60 seconds.
7. Multiply the measured volume by 60 to find your <u>ml per hour</u> volume.
8. Adjust the pump volume control, higher or lower to meet with your desired output.
9. Repeat above steps 4 through 8 until your desired output is met.

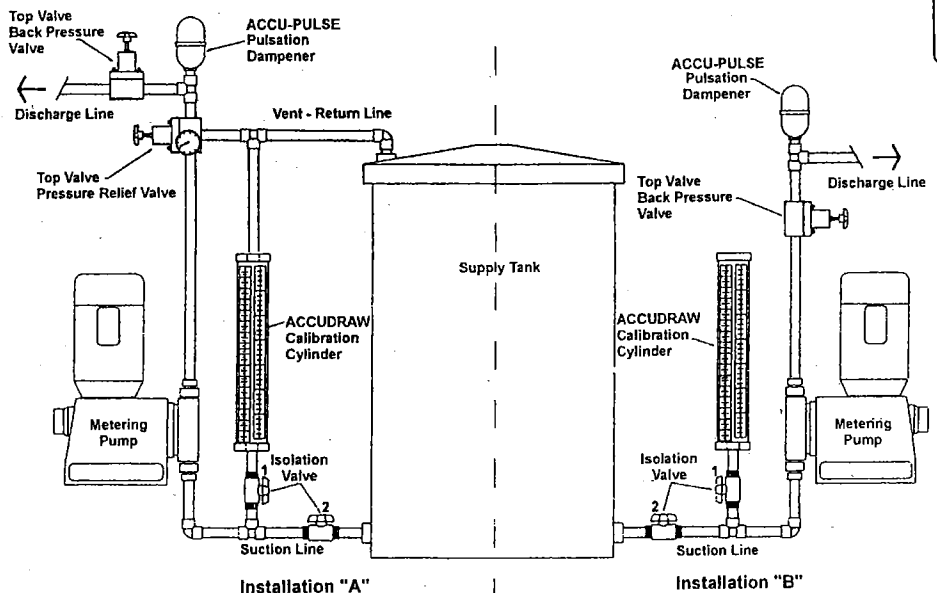
If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the volume by the same number used to divide the time by to determine ml per minute or hour.

e.g. 100 ml in 60 seconds equals
50 ml X 2 in 30 seconds or
25 ml X 4 in 15 seconds

Typical Installations ("A" and "B")

Conversion Factors
1 ml = 1 cc
1000 ml = 1 liter
ml/sec X 60 = ml/min
1 US gal/min X 0.063 = liters/sec
1 US gal = 3.786 liters

Caution:
<u>Do not</u> use as a pressure vessel



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HAYWARD INDUSTRIAL PRODUCTS
INSTALLATION OPERATION & MAINTENANCE
OF Y-STRAINER

PLEASE READ THE FOLLOWING INFORMATION PRIOR TO INSTALLING AND USING HAYWARD VALVES, STRAINERS, FILTERS, AND OTHER ASSOCIATED PRODUCTS. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS INJURY.

1. Hayward guarantees its products against defective material and workmanship only. Hayward assumes no responsibility for damage or injuries resulting from improper installation, misapplication, or abuse of any product.
2. Hayward assumes no responsibility for damage or injury resulting from chemical incompatibility between its products and the process fluids to which they are subjected. Compatibility charts provided in Hayward literature are based on ambient temperatures of 70F and are for reference only. Customer should always test to determine application suitability.
3. Consult Hayward literature to determine operating pressure and temperature limitations before installing any Hayward product. Note that the maximum recommended fluid velocity through any Hayward product is eight feet per second. Higher flow rates can result in possible damage due to the water hammer effect. Also note that maximum operating pressure is dependent upon material selection as well as operating temperature.
4. Hayward products are designed primarily for use with non-compressible liquids. They should NEVER be used or tested with compressible fluids such as compressed air or nitrogen.
5. Systems should always be depressurized and drained prior to installing or maintaining Hayward products.
6. Temperature effect on piping systems should always be considered when the systems are initially designed. Piping systems must be designed and supported to prevent excess mechanical loading on Hayward equipment due to system misalignment, weight, shock, vibration, and the effects of thermal expansion and contraction.
7. Because PVC and CPVC plastic products become brittle below 40F, Hayward recommends caution in their installation and use below this temperature.
8. Published operating torque requirements are based upon testing of new valves using clean water at 70F. Valve torque is affected by many factors including fluid chemistry, viscosity, flow rate, and temperature. These should be considered when sizing electric or pneumatic actuators.
9. Due to differential thermal expansion rates between metal and plastic, transmittal of pipe vibration, and pipe loading forces DIRECT INSTALLATION OF METAL PIPE INTO PLASTIC CONNECTIONS IS NOT RECOMMENDED. Wherever installation of plastic valves into metal piping systems is necessary, it is recommended that at least 10 pipe diameter in length of plastic pipe be installed upstream and downstream of the plastic valve to compensate for the factors mentioned above.

SOCKET CONNECTION:

Socket end connections are manufactured to ASTM D2467-94. Solvent cementing of socket end connections to pipe should be performed per ASTM specifications D2855-87. Cut pipe square. Chamfer and deburr pipe. Surfaces must be cleaned and free of dirt, moisture, oil and other foreign material. Apply primer to inside socket surface of the strainer. Never allow primer or cement to contact sealing surfaces or the screen, as leaking may result. Use a scrubbing motion. Repeat applications may be necessary to soften the surface of the socket. Next, liberally apply primer to the male end of the pipe to the length of the socket depth. Again apply to the socket, without delay apply cement to the pipe while the surface is still wet with primer. Next apply cement lightly, but uniformly to the inside of the socket. Apply a second coat of cement to the pipe, and assemble the strainer to the pipe, rotating the strainer 1/4 turn in one direction as it is slipped to full depth on to the pipe. The strainer should be held in position for approx. 30 seconds to allow the connection to "set". After assembly wipe off excess cement. Full set time is a minimum of 30 minutes at 60 to 100 F. Full cure time should be based on the chart below.

JOINT CURE SCHEDULE:

The cure schedules are suggested as guides. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual manufacturer's recommendations for their particular cement should be followed.

Temperature Range During Cure Period(B) °F(°C)	Test Pressures for Pipe Sizes 1/2 to 1-1/4 In.		Test Pressures for Pipe Sizes 1-1/2 to 3 In.		Test Pressures for Pipe Sizes 4 to 5 In.		Test Pressures for Pipe Sizes 6 to 8 In.	
	Up to 180 PSI (1240 kPa)	Above 180 to 370 PSI (1240 to 2550 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI 1240) to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2170 kPa)
60 to 100 (15 to 40)	1 h	6 h	2 h	12 h	6 h	18 h	8 h	24 h
40 to 60 (5 to 15)	2 h	12 h	4 h	24 h	12 h	36 h	16 h	48 h
20 to 40 (-7 to 5)	6 h	36 h	12 h	72 h	36 h A	4 days A	3 days A	9 days A
10 to 20) (-15 to 7)	8 h	48 h	16 h	96 h	72 h A	8 days A	4 days A	12 days A
Colder than 10 (-15)	Extreme care should be exercised on all joints made where pipe, fittings or cement is below 10°F.							

A: It is important to note that at temperatures colder than 20°F on sizes that exceed 3 in., test results indicate that many variables exist in the actual cure rate of the joint. The data expressed in these categories represent only estimated averages. In some cases, cure will be achieved in less time, but isolated test results indicate that even longer periods of cure may be required.

B: These cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT=in a dry fit the pipe bottoms snugly in the fitting socket without meeting interference).

THREADED CONNECTION:

Threaded end connections are manufactured to ASTM specifications D2464-88. F437-88 and ANSI B2.1. Wrap threads of pipe with Teflon tape of 3 to 3-1/2 mil thickness. The tape should be wrapped in a clockwise direction starting at the first or second full thread. Overlap each wrap by, 1/2 the width of the tape. The wrap should be applied with sufficient tension to allow the threads of a single wrapped area to show through without cutting the tape. The wrap should continue for the full effective length of the thread. Pipe sizes 2" and greater will not benefit with more than a second wrap, due to the greater thread depth. To provide a leak proof joint, the pipe should be threaded into the end connection "hand tight". Using a strap wrench only. (Never use a stillson type wrench) tighten the joint an additional 1/2 to 1-1/2 turns past hand tight. Tightening beyond this point may induce excessive stress that could cause failure.

FLANGED CONNECTION:

Flange bolts should be tight enough to slightly compress the gasket and make a good seal, without distorting or putting excessive stress on the flanges. Suitable washers should be used between the bolt head and flange and the nut and flange. Bolts should be tightened in alternating sequence.

RECOMMENDED FLANGE BOLT TORQUE. USE WELL LUBRICATED METAL BOLTS AND NUTS. USE SOFT RUBBER GASKETS.

FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.	FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.
1/2	1/2	10-15	2	5/8	15-25
3/4	1./2	10-15	2-1/2	5/8	20-25
1	1/2	10-15	3	5/8	20-25
1-1/4	1/2	10-15	4	5/8	20-25
1-1/2	1/2	10-15	6	3/4	30-40

INSTALLATION:

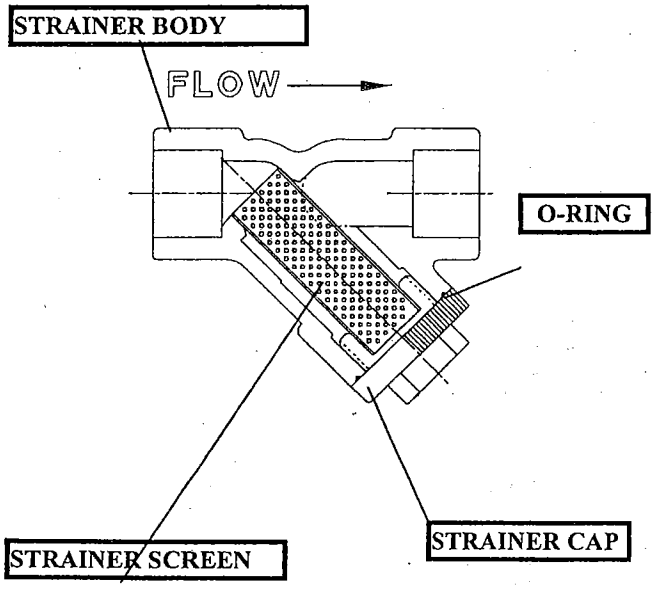
It is recommended that these strainers be installed no closer than 10 pipe diameters from a pump. At least 5 pipe diameters should be between these strainers and an elbow.

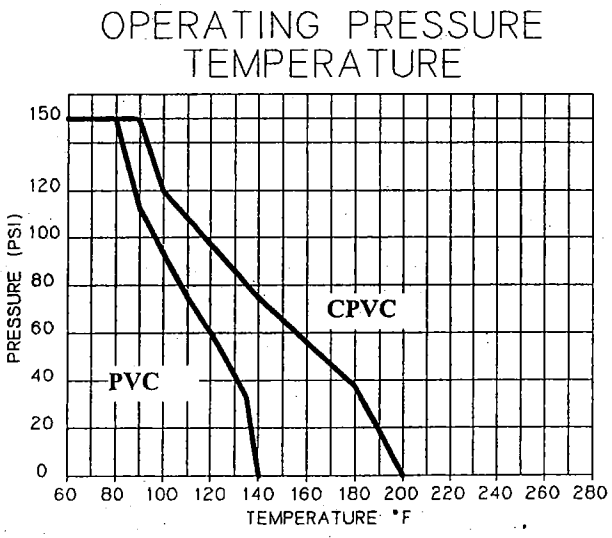
As in all plastic piping the maximum fluid velocity is 8 feet per second. This velocity minimizes the effects of valve closure and pump start up or shut down.

SCREEN CLEANING:

EXTREME CAUTION MUST BE TAKEN WHEN WORKING ON THIS STRAINER. THE PIPING SYSTEM MUST BE DEPRESSURIZED AND DRAINED. PROPER CARE MUST BE TAKEN. CONSULT M.S.D.S. (MATERIAL SAFETY DATA SHEETS) INFORMATION REGARDING YOUR SPECIFIC APPLICATION.

When the pressure drop across the strainer is in excess of 5 PSI the screen requires cleaning. To clean the screen remove the screen cap nut from the strainer by turning counter clockwise. The collected debris should be removed with the screen. Clean the screen. **DO NOT POUND OR DEFORM THE SCREEN.** Insert the screen back into the strainer with the flange, if one is on the screen into the body first. Install the o-ring in the body groove. Use a non-petroleum base lubricant to lubricate the o-ring and thread , and re-assemble the cap to the strainer.





YSIS REV B
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ECR 819R

Griffco Valve Inc.

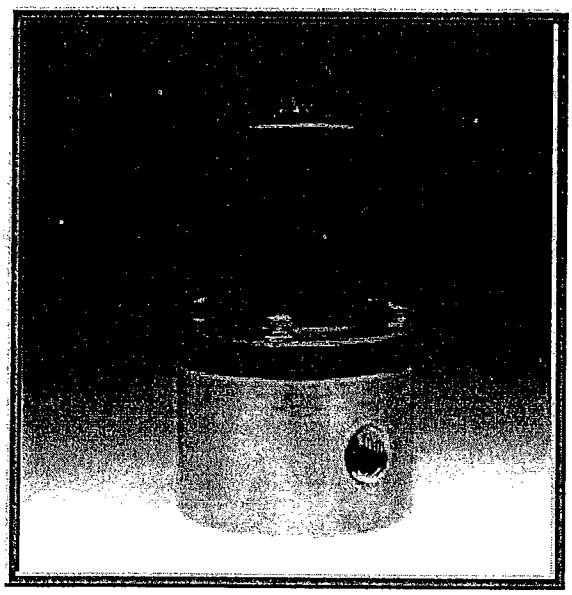
3 North Main Street
Middleport, NY 14105
Phone: 1 800-474-3326
FAX: 1 716-735-3166

Instruction Manual

Back Pressure Valves
Pressure Relief Valves

Call 1 - 800 - GRIFFCO

INS 1002-94



INTRODUCTION

GRIFFCO diaphragm back pressure valves are used to enhance the performance of chemical feed pumps and systems by providing a constant discharge head pressure. These valves also function as an antisyphon valve. The diaphragm is held against the seat by the internal spring. Back pressure is adjustable from 0 - 150 psi via the tamper resistant adjustment screw. When the inlet pressure exceeds the preset pressure the diaphragm lifts off the seat and the chemical flows to the injection point. After each discharge stroke of the pump, as the pressure drops, the diaphragm reseats itself.

GRIFFCO diaphragm pressure relief valves are designed to protect chemical feed pumps and systems from overpressure caused by defective equipment or blockages in the chemical line.
The 3 port design allows chemical to flow through the valve via an internal chamber. When the pressure in the chemical line exceeds the preset pressure of the valve the diaphragm lifts off the seat and the chemical then flows out the bottom port back to the chemical tank. Relief pressure is adjustable form 0 - 150 psi via the tamper resistant screw in the top of the valve.

INSTALLATION

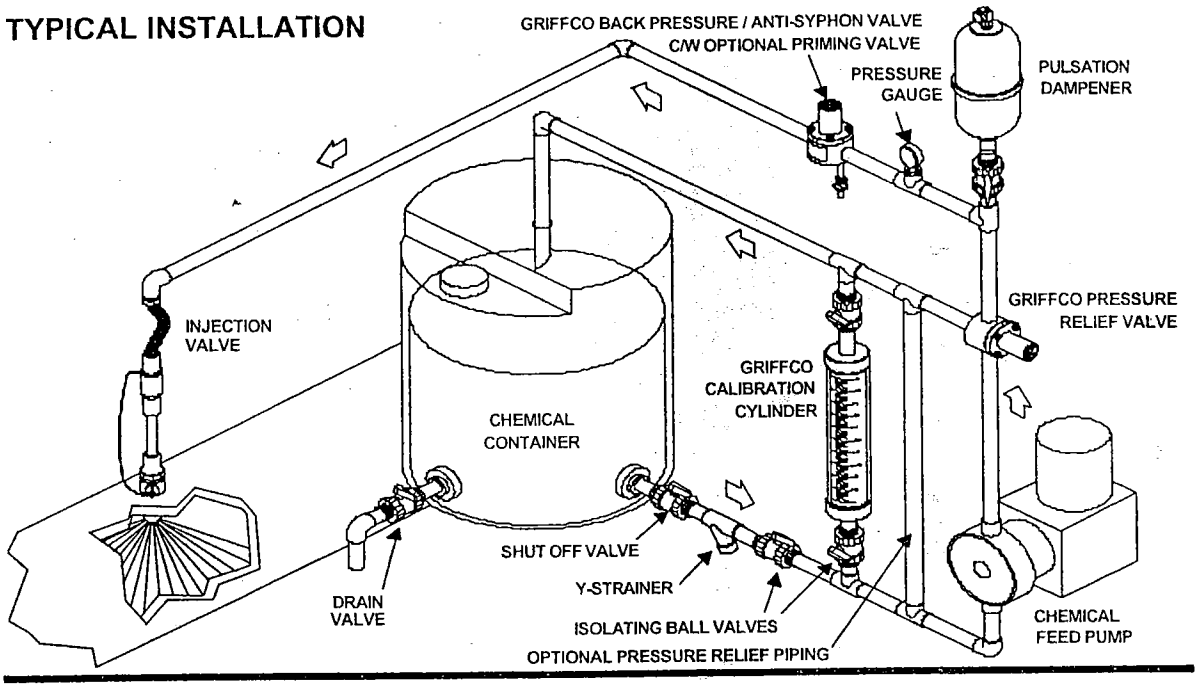
Back Pressure Valve:
Generally, the back pressure valve can be installed anywhere in the discharge line, provided there is some downstream pressure at the dosage point. If there is no downstream pressure the back pressure valve should be installed at the dosage point to prevent siphoning and drainage of the chemical line. All **GRIFFCO** valves are factory set at 50 psi, unless otherwise specified. Field adjustment is possible with the adjustment screw, (appx. 8 psi/revolution).

Back pressure valve performance will be enhanced with the installation of a pulsation dampener to smooth out the discharge / suction cycles of the pump. Thus, the diaphragm is free to float inside the valve chamber, minimising the wear on the stress points of the diaphragm. For many low pressure applications dampeners without diaphragms are acceptable. These pulsation dampeners should be sized at 12 - 15 times the dosage volume of the pump head. For some applications diaphragm type dampeners are required. Generally speaking 5 to 10% dampening is sufficient. Consult with your pump manufacturer to get his recommendations.

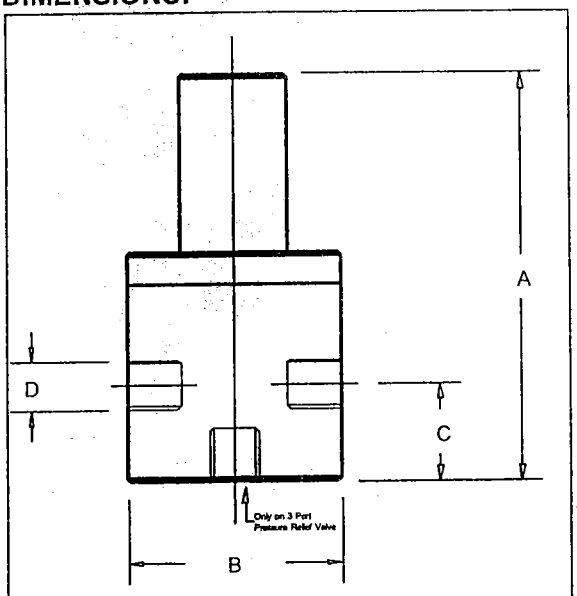
Pressure Relief Valve:
Installation should be made as close to the chemical pump discharge valve as possible, without any equipment, especially shut-off valves, between the valve and the pump. Direction of flow must be across the valve, however the side of entry is not important. All **GRIFFCO** valves are factory set at 50psi, however field adjustment is possible with the adjustment screw.

The optimum installation for the relief valve is to vent the relief port back to the chemical tank, or directly to a containment area. However if this is not possible, the relief port can be piped back into the suction side of the pump. This will apply the suction head to the relief port. To compensate, divide the NPSH by 4 and add this pressure to the relief valve setting.

TYPICAL INSTALLATION



DIMENSIONS:



D	1/4"	1/2"	3/4"	1"	1 1/2"	2"
A	3.500	5.500	5.500	6.250	9.000	9.000
B	2.375	3.500	3.500	3.500	5.500	5.500
C	0.750	1.125	1.125	1.375	2.250	2.250

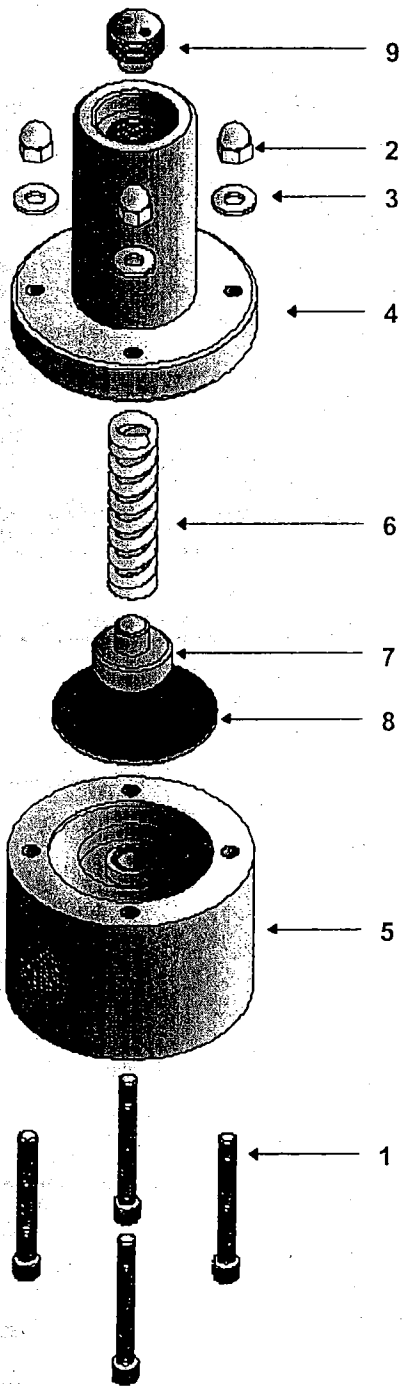
MAINTENANCE:

The pressure relief and back pressure valves were designed with minimizing the amount of maintenance required to keep the valves in operation. However, periodic replacement of the diaphragm is required. To facilitate inspection and replacement, the valve layout is such that removal of the diaphragm can be done without taking the valve out of the chemical line.

Caution: Ensure the system is not under pressure and that the chemical lines are flushed with water before disassembly.

Unscrew the pressure adjuster to remove the pressure from the diaphragm. Remove the 4 cap nuts and lift off the valve top.
After the diaphragm has been inspected and replaced if necessary check the adjustment spring. Make sure there is no rust or corrosion. Replaced the spring and the spring bumper into the valve top and slide the top back over the four bolts.

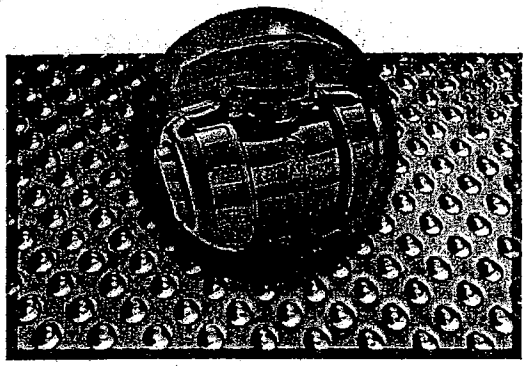
Snug down the four cap nuts. Screw in the tension adjuster to approximately the same position as it was prior to disassembly. If an exact pressure setting is required or a different pressure be desired a pressure gauge should be used to verify the setting. Pressure can be increased by turning the set screw clockwise.


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ITEM	DESCRIPTION	PART #
1	1/4 - 20 X 2 3/4" Bolt - 1/2 - 1" Plastic Valves	PV-00101
	5/16 - 18 X 1 1/2" Bolt - 1 1/2" - 2" Metal Valves	PV-00102
	5/16 - 18 X 5" Bolt - 1 1/2" - 2" Plastic Valves	PV-00105
	10/32 X 3/4" Bolt - 1/4" Metal Valves	PV-00106
	10/32 X 1 3/4 Bolt - 1/4" Plastic Valves	PV-00106
	1/4 - 20 X 1 1/4" Bolt - 1/2 - 1" Metal Valves	PV-00108
2	10/32 Cap hex nut	PV-00201
	1/4 - 20 Cap hex nut	PV-00202
	5/16 - 18 Cap hex nut	PV-00203
3	10/32 Flat washer	PV-00301
	1/4 Flat washer	PV-00302
	5/16 Flat washer	PV-00303
4	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Grey	PV-004011
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Orange	PV-004012
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Yellow	PV-004013
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Green	PV-004014
	1/4" – 3/8" & 1/2" T-Series Valve Top, Threaded – PVC, Grey	PV-004015
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Orange	PV-004016
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Yellow	PV-004017
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Green	PV-004018
	1/2" – External Adjustment Valve Top – PVC (Tiberian)	PV-004019
	1/4" – 3/8" & T-Series Alloy Valve Top – Coated Steel	PV-00402
	1/4" – 3/8" & T-Series Alloy Valve Top – 316 SS	PV-00403
	1/2" - 1" Valve Top – PVC. Grey	PV-004051
	1/2" - 1" Valve Top – PVC, Orange	PV-004052
	1/2" - 1" Valve Top – PVC, Yellow	PV-004053
	1/2" - 1" Valve Top – PVC, Green	PV-004054
	1/2" - 1" Valve Top – CPVC	PV-004055
	1/2" - 1" Valve Top - Steel	PV-00406
	1/2" - 1" Valve Top - 316 SS	PV-00407
	1 1/2" - 2" Valve Top; 5 ½" Valves, PVC	PV-00408
	1 1/2" - 2" Valve Top; 5 ½" Valves. Coated Steel	PV-00409
	1 1/2" - 2" Valve Top; 5 ½" Valves. 316 SS	PV-00410
	1 1/2" Valve Top; 4 ½" Valves, PVC	PV-00411
	1 1/2" Valve Top; 4 ½" Valves. Coated Steel	PV-00412
	1 1/2" Valve Top; 4 ½" Valves. 316 SS	PV-00413
	2" Valve Top; 5" Valves, PVC	PV-00414
	2" Valve Top; 5" Valves. Coated Steel	PV-00415
	2" Valve Top; 5" Valves. 316 SS	PV-00416
6	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 0 – 150 psi	PV-00601
	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 0 – 50 psi	PV-006011
	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 50 – 350 psi	PV-006012
	Pressure Spring - 1/2" - 1" Valve; 0 – 150 psi	PV-00602
	Pressure Spring - 1/2" - 1" Valve; 0 – 50 psi	PV-006021
	Pressure Spring - 1/2" - 1" Valve; 50 – 350 psi	PV-006122
	Pressure Spring - 1/2" - 1" Valve; 0 – 100 psi, 316 SS	PV-006123
	Pressure Spring - 1 1/2" - 2" Valve	PV-00603
7	Support Disc - 1/4" – 3/8" & T-Series Valve, PP	PV-00701
	Support Disc - 1/4" – 3/8" & T-Series Valve, 316 SS	PV-00702
	Support Disc - 1/2 - 1" Valve, PP	PV-00705
	Support Disc - 1/2 - 1" Valve, 316 SS	PV-00706
	Support Disc - 11/2" - 2" Valve, PP	PV-00708
	Support Disc - 11/2" - 2" Valve, 316 SS	PV-00709
8	Diaphragm - 1/4" – 3/8" & T-Series Valve - PTFE / EPDM	PV-00800
	Diaphragm - 1/4" – 3/8" & T-Series Valve - Viton	PV-00802
	Diaphragm - 1/4" – 3/8" & T-Series Valve - PTFE / Viton (High Temp)	PV-00803
	Diaphragm - 1/2" - 1" Valve - PTFE / EPDM	PV-00810
	Diaphragm - 1/2" - 1" Valve – Viton	PV-00812
	Diaphragm - 1/2" - 1" Valve - PTFE / Viton (High Temperature)	PV-00813
	Diaphragm - 1 1/2" - 2" Valve - PTFE / EPDM	PV-00820
	Diaphragm - 1 1/2" - 2" Valve - Viton	PV-00821
9	Adjustment Screw - 1/4" - 1" Valve PVC	PV-00900
	Adjustment Screw - 1/4" - 1" Valve PVC, Slotted	PV-00902
	Adjustment Screw - 1/4" - 1" Valve Coated Steel	PV-00901
	Adjustment Screw - 1/4" - 1" Valve Coated Steel, Slotted	PV-00903
	Adjustment Screw - 1 1/2" - 2" Valve PVC	PV-00920
	Adjustment Screw - 1 1/2" - 2" Valve Coated Steel	PV-00921

ITEM	DESCRIPTION	BPV	PRV
5	1/4" Valve Body PVC	BPV-00501	PRV-00501
	1/4" T-Series Valve Body PVC,	BPV-005011	PRV-005011
	1/4" Valve Body PP	BPV-00502	PRV-00502
	1/4" T-Series Valve Body PP	BPV-005021	PRV-005021
	1/4" Valve Body PTFE	BPV-00503	PRV-00503
	1/4" T-Series Valve Body PTFE	BPV-005031	PRV-005031
	1/4" Valve Body PVDF	BPV-00504	PRV-00504
	1/4" T-Series Valve Body PVDF	BPV-005041	PRV-005041
	1/4" Valve Body 316 SS	BPV-00505	PRV-00505
	1/4" Valve Body Alloy 20	BPV-00506	PRV-00506
	1/4" Valve Body Hast C	BPV-00507	PRV-00507
	1/4" Valve Body CPVC	BPV-00508	PRV-00508
	1/4" T-Series Valve Body CPVC	BPV-005081	PRV-005081
	3/8" Valve Body PVC	BPV-00561	PRV-00561
	3/8" T-Series Valve Body PVC,	BPV-005611	PRV-005611
	3/8" Valve Body PP	BPV-00562	PRV-00562
	3/8" T-Series Valve Body PP	BPV-005621	PRV-005621
	1/4" Valve Body PTFE	BPV-00563	PRV-00563
	3/8" T-Series Valve Body PTFE	BPV-005631	PRV-005631
	3/8" Valve Body PVDF	BPV-00564	PRV-00564
	3/8" T-Series Valve Body PVDF	BPV-005641	PRV-005641
	3/8" Valve Body 316 SS	BPV-00565	PRV-00565
	3/8" Valve Body Alloy 20	BPV-00566	PRV-00566
	3/8" Valve Body Hast C	BPV-00567	PRV-00567
	3/8" Valve Body CPVC	BPV-00568	PRV-00568
	3/8" T-Series Valve Body CPVC	BPV-005681	PRV-005681
	1/2" Valve Body PVC	BPV-00511	PRV-00511
	1/2" T-Series Valve Body PVC	BPV-005111	PRV-005111
	1/2" Valve Body PP	BPV-00512	PRV-00512
	1/2" T-Series Valve Body PP	BPV-005121	PRV-005121
	1/2" Valve Body PTFE	BPV-00513	PRV-00513
	1/2" T-Series Valve Body PTFE	BPV-005131	PRV-005131
	1/2" Valve Body PVDF	BPV-00514	PRV-00514
	1/2" T-Series Valve Body PVDF	BPV-005141	PRV-005141
	1/2" Valve Body 316 SS	BPV-00515	PRV-00515
	1/2" T-Series Valve Body 316 SS	BPV-005151	PRV-005151
	1/2" Valve Body Alloy 20	BPV-00516	PRV-00516
	1/2" T-Series Valve Body Alloy 20	BPV-005161	PRV-005161
	1/2" Valve Body Hast C	BPV-00517	PRV-00517
	1/2" T-Series Valve Body Hast C	BPV-005171	PRV-005171
	1/2" Valve Body CPVC	BPV-00518	PRV-00518
	1/2" T-Series Valve Body CPVC	BPV-005181	PRV-005181
	3/4" Valve Body PVC	BPV-00521	PRV-00521
	3/4" Valve Body PP	BPV-00522	PRV-00522
	3/4" Valve Body PTFE	BPV-00523	PRV-00523
	3/4" Valve Body PVDF	BPV-00524	PRV-00524
	3/4" Valve Body 316 SS	BPV-00525	PRV-00525
	3/4" Valve Body Alloy 20	BPV-00526	PRV-00526
	3/4" Valve Body Hast C	BPV-00527	PRV-00527
	3/4" Valve Body CPVC	BPV-00528	PRV-00528
	1" Valve Body PVC	BPV-00531	PRV-00531
	1" Valve Body PP	BPV-00532	PRV-00532
	1" Valve Body PTFE	BPV-00533	PRV-00533
	1" Valve Body PVDF	BPV-00534	PRV-00534
	1" Valve Body 316 SS	BPV-00535	PRV-00535
	1" Valve Body Alloy 20	BPV-00536	PRV-00536
	1" Valve Body Hast C	BPV-00537	PRV-00537
	1" Valve Body CPVC	BPV-00538	PRV-00538
	1 1/2" Valve Body PVC	BPV-00541	PRV-00541
	1 1/2" Valve Body PP	BPV-00542	PRV-00542
	1 1/2" Valve Body PTFE	BPV-00543	PRV-00543
	1 1/2" Valve Body PVDF	BPV-00544	PRV-00544
	1 1/2" Valve Body 316 SS	BPV-00545	PRV-00545
	1 1/2" Valve Body Alloy 20	BPV-00546	PRV-00546
	1 1/2" Valve Body Hast C	BPV-00547	PRV-00547
	1 1/2" Valve Body CPVC	BPV-00548	PRV-00548
	2" Valve Body PVC	BPV-00551	PRV-00551
	2" Valve Body PP	BPV-00552	PRV-00552
	2" Valve Body PTFE	BPV-00553	PRV-00553
	2" Valve Body PVDF	BPV-00554	PRV-00554
	2" Valve Body 316 SS	BPV-00555	PRV-00555
	2" Valve Body Alloy 20	BPV-00556	PRV-00556
	2" Valve Body Hast C	BPV-00557	PRV-00557
	2" Valve Body CPVC	BPV-00558	PRV-00558

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Type 21 Ball Valve

Specifications

Sizes:	1/2" – 6"
Models:	PVC & CPVC: Socket, Threaded and Flanged (ANSI) PP & PVDF: IPS and Metric (DIN) Socket, Threaded, Butt and Flanged (ANSI)
Bodies:	PVC, CPVC, PP and PVDF
Seats:	PTFE backed with EPDM or Viton®†
Seals:	EPDM or Viton®† or AFLAS®‡

† Trademarks of E. I. du Pont de Nemours and Company
‡ Trademark of Asahi Glass Co., Ltd.

Standard Features (Sizes 1/2" – 6")

- Pressure rated up to 230 psi (PVC, CPVC, PVDF)
- Double O-ring seals on stem for an added protection.
- Full bore, sizes 1/2" - 2"
- Full vacuum rated, all sizes
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve
- Integrally molded ISO mounting pad for both manual and actuated operations
- Integrally molded base pad to mount valves securely or panel mounting
- PTFE seats with elastomeric backing cushions ensure bubble-tight shut-off and a low fixed torque, while at the same time compensating for wear
- True Union design for easier installation or repairs without expanding the pipe system
- Built-in spanner wrench on the handle for valve disassembly and assembly
- Two sets of end connectors (socket and threaded) included with all PVC and CPVC valves in sizes 1/2"- 2"
- CPVC threaded end connectors on sizes 1/2" - 1" come with stainless steel reinforcing rings

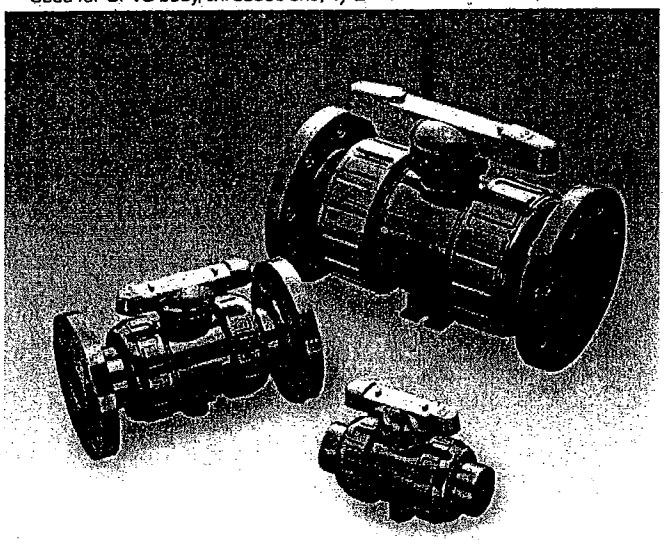
Options

- Pneumatic and electric actuators & accessories
- Stem extensions
- 2" square operating nut or "T" nut
- Locking and/or spring return handles
- Limit switches

Parts List (Sizes 1/2" – 2")

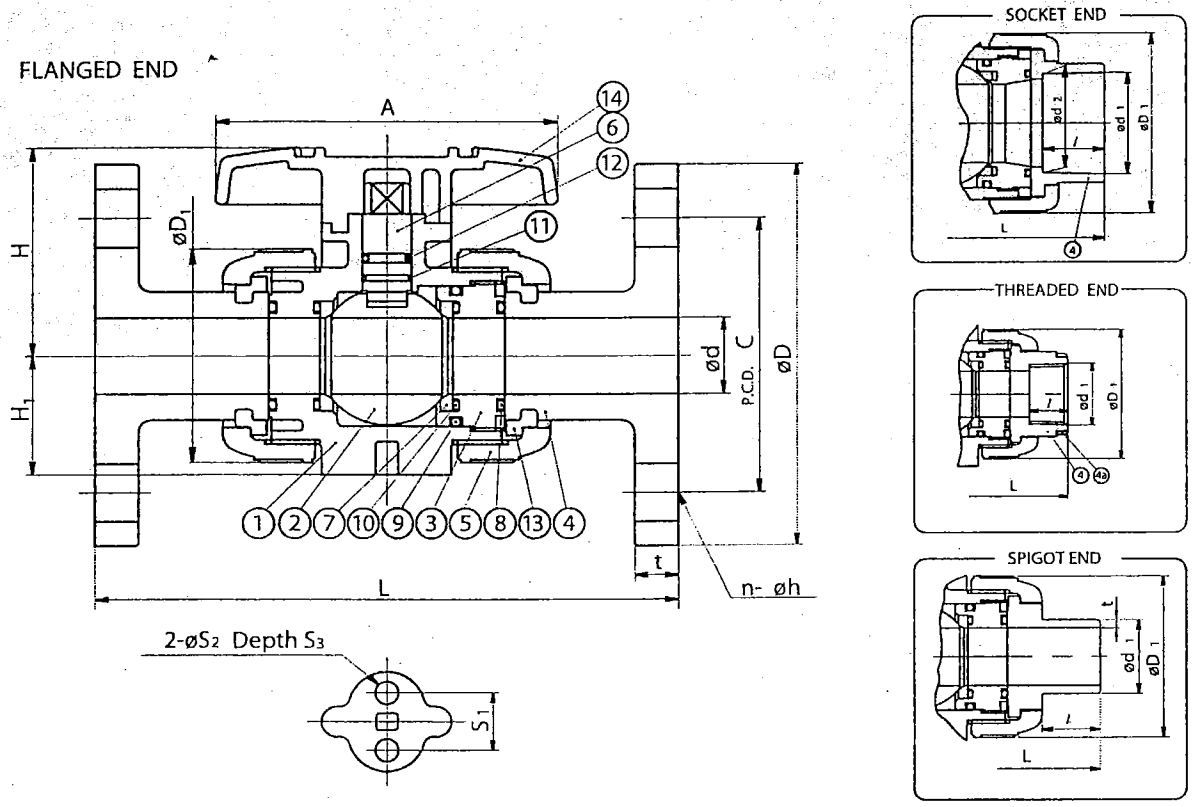
PARTS			
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Carrier	1	PVC, CPVC, PP, PVDF
4	End Connector	2	PVC, CPVC, PP, PVDF
5	Union Nut	2	PVC, CPVC, PP, PVDF
6	Stem	1	PVC, CPVC, PP, PVDF
7	Seat	2	PTFE
8	O-Ring (A)	2	EPDM, Viton,® Others
9	O-Ring (B)	1	EPDM, Viton,® Others
10	O-Ring (C)	2	EPDM, Viton,® Others
11	O-Ring (D)	1	EPDM, Viton,® Others
12	O-Ring (E)	1	EPDM, Viton,® Others
13	Stop Ring*	2	PVDF
14	Handle	1	ABS
4a	Ring**	2	304 Stainless Steel

* Used for flanged end
** Used for CPVC body, threaded end, 1/2"-1"



ASAHI/AMERICA
Rev. A 01-02

Type 21 Ball Valves



Dimensions (Sizes 1/2" – 2")

NOMINAL SIZE			FLANGED						SOCKET										
			ANSI CLASS 150						PVC, CPVC				PP, PVDF (DIN)				PP, PVDF (IPS)		
									ANSI SCH 80				DIN 16962						
INCHES	mm	d	D	C	n	h	L	t	d1	d2	l	L	d1	d2	l	L	d1	l	L
1/2	15	0.59	3.50	2.38	4	0.62	5.63	0.47	0.848	0.836	0.875	4.45	0.768	0.760	0.57	3.90	0.83	0.87	4.45
3/4	20	0.79	3.88	2.75	4	0.62	6.77	0.55	1.058	1.046	1.000	5.08	0.965	0.957	0.63	4.49	1.03	1.00	5.08
1	25	0.98	4.25	3.12	4	0.62	7.36	0.55	1.325	1.310	1.125	5.75	1.240	1.232	0.71	4.84	1.30	1.13	5.75
1 1/4	32	1.26	4.62	3.50	4	0.62	7.48	0.63	1.670	1.655	1.250	6.46	1.553	1.543	0.81	5.47	1.65	1.25	6.46
1 1/2	40	1.57	5.00	3.88	4	0.62	8.35	0.63	1.912	1.894	1.375	7.24	1.947	1.937	0.93	5.83	1.89	1.37	7.24
2	50	2.01	6.00	4.75	4	0.75	9.21	0.63	2.387	2.369	1.500	8.23	2.461	2.445	1.08	6.93	2.36	1.50	8.23

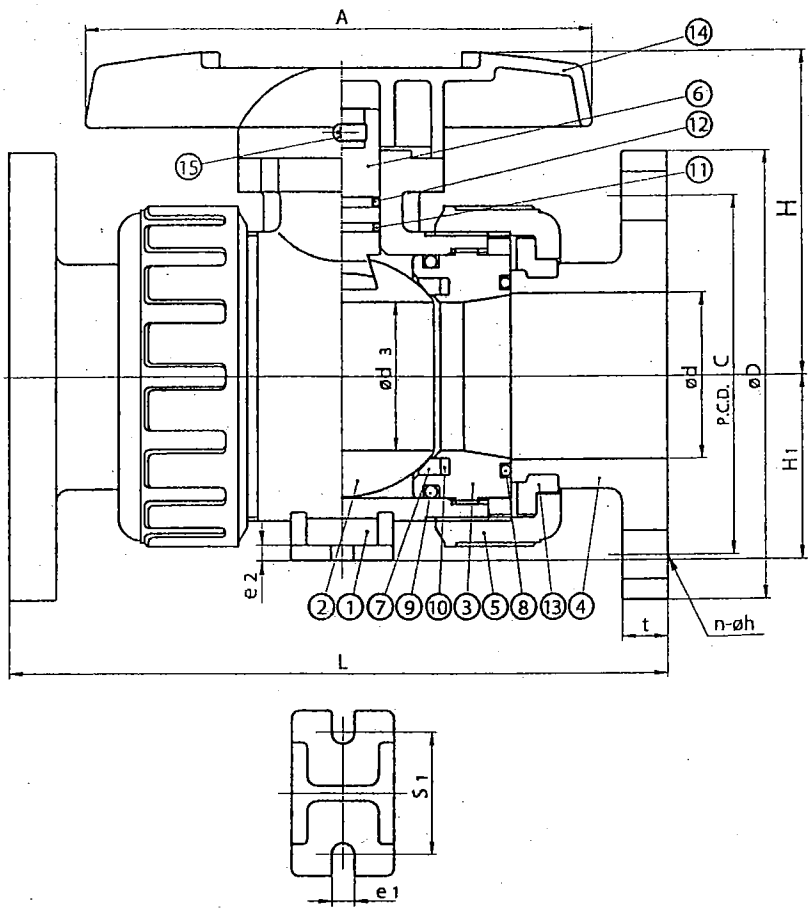
NOMINAL SIZE		THREADED							SPIGOT (BUTT END)							
									PP,PVDF							
									DIN 3442		PP	PVDF				
INCHES	mm	d1	l	L	D1	H	H1	A	d1	l	t	t	L	S1	S2	S3
1/2	15	1/2-14 NPT	0.59	4.02	1.89	2.03	1.14	3.62	0.787	0.728	0.098	0.075	4.882	0.75	0.29	0.43
3/4	20	3/4-14 NPT	0.67	4.72	2.36	2.34	1.38	3.94	0.984	0.866	0.106	0.075	5.670	0.75	0.29	0.43
1	25	1-11 1/2 NPT	0.79	5.16	2.76	2.68	1.54	4.33	1.260	0.886	0.118	0.094	6.063	0.75	0.29	0.43
1 1/4	32	1 1/4-11 1/2 NPT	0.87	5.91	3.23	3.17	1.85	4.76	1.575	1.024	0.146	0.094	6.850	1.18	0.35	0.59
1 1/2	40	1 1/2-11 1/2 NPT	0.98	6.42	3.94	3.50	2.17	5.16	1.969	1.260	0.181	0.118	7.638	1.18	0.35	0.59
2	50	2-11 1/2 NPT	1.10	7.76	4.96	4.04	2.60	6.26	2.480	1.417	0.228	0.118	8.819	1.18	0.35	0.59

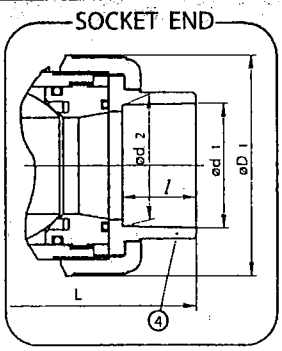
Type 21 Ball Valves

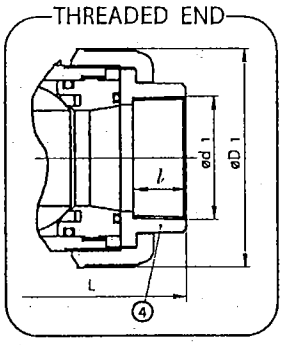
FLANGED END

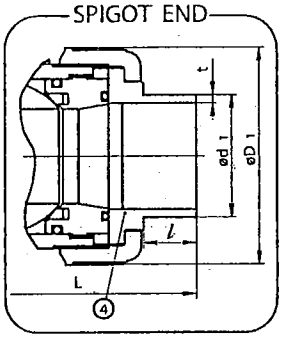
PARTS (DIFFERENT NUMBERS FROM 1/2" – 2")			
NO.	DESCRIPTION	PCS.	MATERIAL
10	Cushion	2	EPDM, Viton,®Others
15	Screw	1	304 Stainless Steel

NOTE: Quantity on Nos. 3 and 9 (see p. 6) is 2.









Dimensions (Sizes 2 1/2" – 4") FOR 6" SIZE CONSULT FACTORY

NOMINAL SIZE			FLANGED						SOCKET										
			ANSI CLASS 150						PVC, CPVC				PP, PVDF (DIN)				PP, PVDF (IPS)		
									ANSI SCH 80				DIN 16962						
INCHES	mm	d	D	C	n	h	L	t	d1	d2	l	L	d1	d2	l	L	d1	l	L
21/2	65	2.56	7	5.5	4	0.75	10.2	0.71	2.889	2.868	1.75	9.45	2.923	2.911	1.22	8.15	2.88	1.752	9.45
3	80	3.07	7.5	6	4	0.75	11.97	0.71	3.516	3.492	1.875	11.1	3.512	3.498	1.4	9.88	3.48	1.874	11.1
4	100	3.94	9	7.5	8	0.75	14.65	0.71	4.518	4.491	2	13.9	4.293	4.278	1.63	12.2	4.48	2.252	14.37

NOMINAL SIZE		THREADED								SPIGOT (BUTT END)							
										PP,PVDF							
										DIN 3442		PP	PVDF				
INCHES	mm	d1	l	L	d3	D1	H	H1	A	d1	l	t	t	L	e1	e2	S1
21/2	65	2 1/2 - 8NPT	1.26	8.46	2.28	5.24	4.96	2.83	7.87	2.953	1.496	0.272	0.142	9.72	0.35	0.24	1.89
3	80	3 - 8NPT	1.38	10.39	2.70	5.98	5.51	3.35	9.45	3.543	1.496	0.323	0.169	11.61	0.43	0.28	2.17
4	100	4 - 8NPT	1.77	14.17	3.54	8.27	7.01	4.33	11.81	4.331	1.752	0.394	0.209	12.72	0.43	0.31	2.56

Type 21 Ball Valves

Pressure vs. Temperature (PSI, WATER, NON-SHOCK)

NOMINAL SIZE		PVC				CPVC						PP				PVDF				
		30° F	71° F	106° F	121° F	30° F	71° F	106° F	121° F	141° F	176° F	-5° F	86° F	121° F	141° F	-5° F	71° F	106° F	141° F	176° F
INCHES	mm	70° F	105° F	120° F	140° F	70° F	105° F	120° F	140° F	175° F	195° F	85° F	120° F	140° F	175° F	70° F	105° F	140° F	175° F	210° F
1/2-2	15-50	230	170	150	30	230	170	150	120	75	55	150	110	90	55	230	185	150	115	85
2 1/2	65	230	170	150	NA	230	170	150	120	75	55	150	95	70	40	230	185	150	115	85
3	80	230	170	150	NA	230	170	150	85	55	40	150	95	70	40	230	185	150	100	70
4-6	100-150	150	150	150	NA	150	150	150	85	55	40	150	95	70	40	150	150	150	100	70

Sample Specification

All TYPE 21 Ball Valves, sizes 1/2" to 4", shall be of true union design with two-way blocking capability. All O-rings shall be EPDM or Viton® with PTFE seats. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double O-rings and be of blowout-proof design. The valve handle shall double as carrier removal and/or tightening tool. ISO mounting pad shall be integrally molded to valve body for actuation. PVC conforming to ASTM D1784 Cell Classification 12454-A, CPVC conforming to ASTM D1784 Cell Classification 23567-A, PP Conforming to ASTM D4101 Cell Classification PP0210B67272 and PVDF conforming to ASTM D3222 Cell Classification Type II. The ball valves, except PP, shall have a pressure rating of 230 psi for sizes"1/2" to 3" and 150 psi for 4" (150 psi for PP, all sizes) at 70 ° F. Type 21 Ball Valves must carry a two-year guarantee, as manufactured by Asahi/America, Inc.

Cv Values

NOMINAL SIZE		Cv
INCHES	mm	
1/2	15	14
3/4	20	29
1	25	47
1 1/4	32	72
1 1/2	40	155
2	50	190
2 1/2	65	365
3	80	410
4	100	680

Weight (POUNDS)

NOMINAL SIZE		SOCKET THREADED	FLANGED
INCHES	mm		
1/2	15	0.44	1.10
3/4	20	0.66	1.54
1	25	1.10	2.70
1 1/4	32	1.54	3.30
1 1/2	40	2.64	4.40
2	50	4.40	8.15
2 1/2	65	6.17	8.80
3	80	9.70	13.00
4	100	24.00	26.67

Caution

- Never remove valve from pipeline under pressure.
- Always wear protective gloves and goggles.
- Watch out for trapped fluid in valve. It is safe to close valve before removing it from the pipeline.

Caution

- Do not use ball valves where media has suspended particles. Use the following valves: *Butterfly Valves* – PVDF disc is most abrasion resistant and make sure of chemical compatibility. *Diaphragm Valves* – Elastomeric diaphragm is designed for handling suspended particles.
- Volatile fluids such as sodium hypochlorite (NaClO) and hydrogen peroxide (H_2O_2) could be trapped and gasified within the valve. We can provide you with a Type 21 ball valve with a *vented ball* to relieve pressure build-up inside the valve.

Troubleshooting

What if the fluid still flows when valve is closed?

1. Carrier is not properly tightened. Tighten it.
2. PTFE seat is damaged or worn. Replace seat.
3. Foreign material is caught between ball and PTFE seat. Remove material and clean.
4. Ball is damaged or worn. Change ball.

What if fluid leaks outside of valve?

1. Union nut not properly tightened. Retighten.
2. Carrier is not properly tightened. Thread it in firmly.
3. Carrier or face O-ring is damaged, worn, or missing. Replace O-ring.

What if handle does not rotate smoothly?

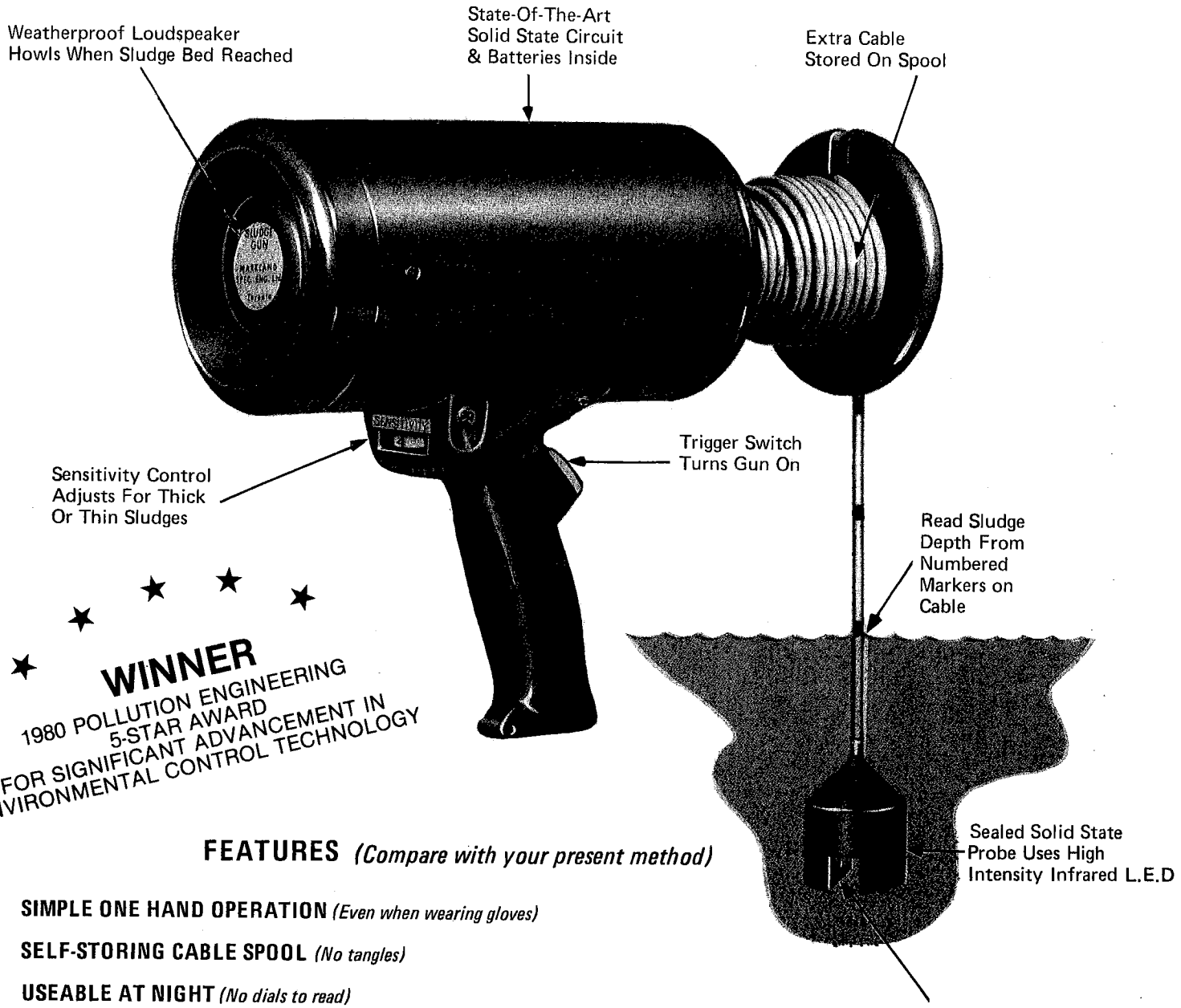
1. Foreign material has formed on the ball or seat. Clean both.
2. Internal part(s) chemically attacked or swollen. Refer to Asahi/America Chemical Resistance Chart for compatibility. Replace part(s) as required.
3. Carrier over-tightened. Retighten properly.

What if handle rotates too freely?

1. Stem is damaged. Replace stem.
2. Handle is not engaged with stem. Disassemble and reengage. Inspect.
3. Engaging part of stem and/or ball is damaged. Change stem and/or ball.

PORTABLE SLUDGE LEVEL DETECTOR

MARKLAND MODEL 10 SLUDGE GUN



★ ★ ★ ★ ★

WINNER

1980 POLLUTION ENGINEERING
5-STAR AWARD
FOR SIGNIFICANT ADVANCEMENT IN
ENVIRONMENTAL CONTROL TECHNOLOGY

FEATURES *(Compare with your present method)*

- **SIMPLE ONE HAND OPERATION** *(Even when wearing gloves)*
- **SELF-STORING CABLE SPOOL** *(No tangles)*
- **USEABLE AT NIGHT** *(No dials to read)*
- **WEATHERPROOF CASE** *(Useable in the rain)*
- **SPRING LOADED TRIGGER TURNS GUN OFF** *(Can't leave on & drain battery)*
- **NO LIGHT BULBS TO CHANGE** *(100% solid state)*
- **OVER ONE YEAR BATTERY LIFE** *(Normal service)*
- **THUMB-ADJUSTABLE SENSITIVITY CONTROL** *(Easy to set)*
- **USES STANDARD PENCELL BATTERIES** *(Readily available)*
- **SINGLE PLUG-IN STYLE PRINTED CIRCUIT BOARD** *(Easily replaced if ever necessary)*

EVEN THE MOST INEXPERIENCED OPERATOR CAN USE THE SLUDGE GUN

HOW IT WORKS

When the trigger is depressed, high intensity bursts of focused infrared light are transmitted by a solid state LED (Light Emitting Diode) across a probe gap which contains either liquid or sludge. The highly penetrating infrared beam is received by a sensitive phototransistor on the other side of the gap. This pulsing is repeated many times per second by the electronic control circuit. If the gap contains air or clear liquid, nothing happens. However, when suspended solids are encountered in the gap, some beam energy is absorbed, and the rear facing loudspeaker on the butt of the gun starts to howl. As the percent solids content increases, both the pitch and volume of the sound increase which gives the operator a clear indication of where the thickest sludge is located. By holding the trigger and listening to the note while slowly moving the probe up and down, the operator can observe the depth markers on the cable and establish the location of both the sludge blanket and the overlying unsettled layer.

EASY TO USE

Markland's popular Sludge Gun® makes even an inexperienced operator an expert at sludge level detection. A trigger turns on the gun, and a thumb adjustable sensitivity control compensates for thin or thick sludges. There can be no mistaking the loud howl of the speaker as the probe enters the sludge bed. Variable pitch sound (higher pitch for higher % solids) permits locating both the upper and lower limits of the settling zone above the sludge bed. After use, the cable is wound on the self-storing spool at the front of the gun. The one hand, one piece, Sludge Gun® detector is easy for an operator to carry from tank to tank. Use it in the rain or snow, day or night. This rugged tool is a valuable addition to any plant.

FIXED INSTALLATION

Markland Series 600 Sludge Depth Meters can automate desludging or function as intelligent sensors for your computer or PLC. Ask for complete details.

SPECIFICATIONS

• Weight	2 Kilo (4½ Lbs.)
• Batteries	Six Alkaline Pencells
• Battery Life	One Year (Normal Service)
• Materials	Probe — PVC & Epoxy Cable — Vinyl Jacketed Gun — PVC & Aluminum
• Operating Temperature	Minus 20°C (0°F) to 50°C (120°F)
• Loudspeaker	3 Watts, Weatherproof Type
• Printed Circuit Board	Epoxy Glass, Moisture Sealed, Plug-In Style
• Sensitivity Control	Trip point can be adjusted from barely cloudy water, right up to the thickest sludge
• Cable Length	10 Metres (33 Feet)
• Cable Markers	Self Adhesive Vinyl (Numbers 1 to 30) (Shipped loose for customer installation at either foot or metre readings)

MODEL 10HS - Special high sensitivity version can be used to detect Air/Liquid or Air/Powder interface in addition to Liquid/Sludge interface.

MANUFACTURED BY

MARKLAND SPECIALTY ENGINEERING LTD.

48 Shaft Road, Rexdale (Toronto), Ontario, Canada M9W 4M2
Telephone: (416) 244-4980 **Fax: (416) 244-2287**
web site: www.sludgecontrols.com **E-mail: markland@sludgecontrols.com**

TELEPHONE: (416) 244-4980 FAX: (416) 244-2287

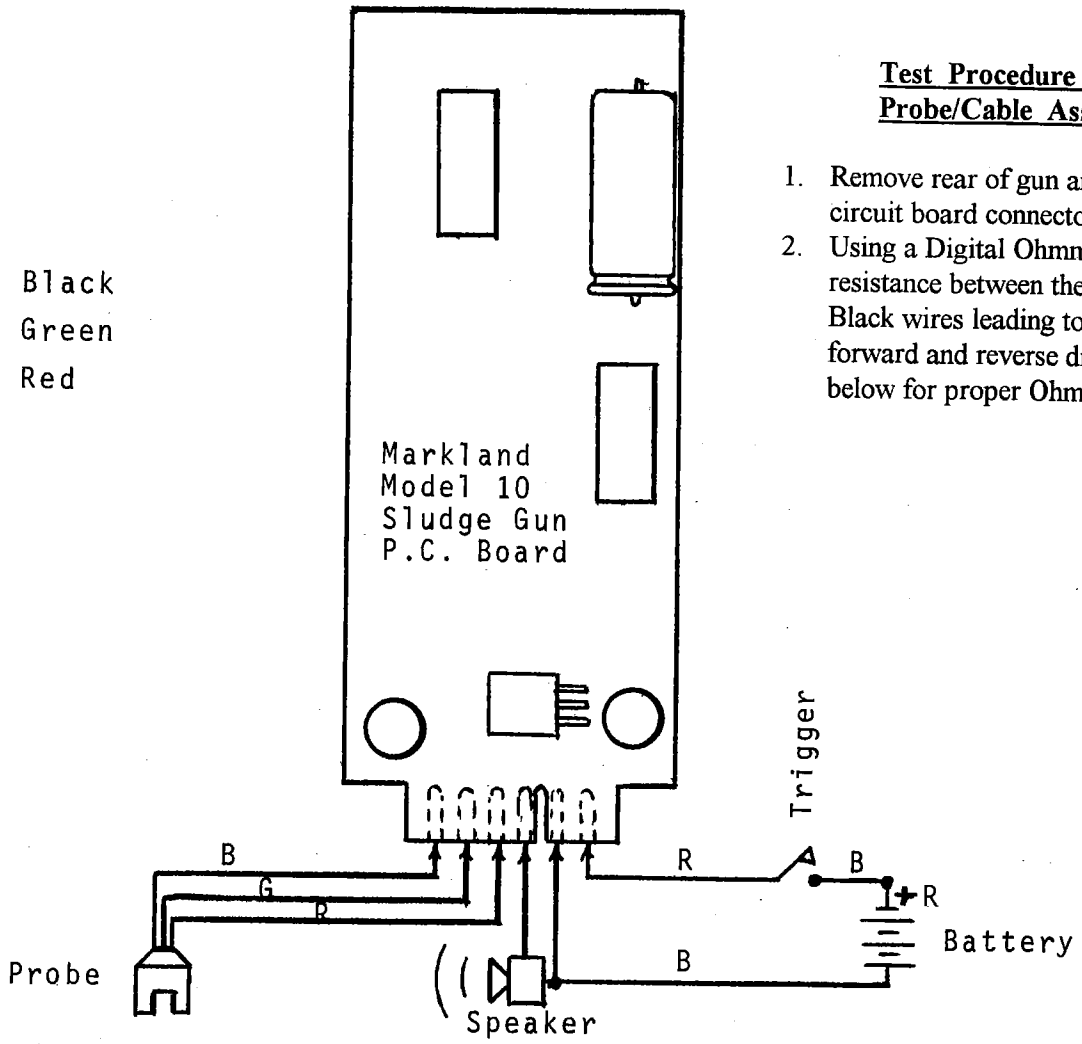
MARKLAND SPECIALTY ENGINEERING LTD.

48 SHAFT ROAD, REXDALE (TORONTO), ONTARIO, CANADA M9W 4M2
web site: www.sludgecontrols.com E-mail: markland@sludgecontrols.com

MODEL 10 SLUDGE GUN®

WIRING CONNECTIONS

B = Black
G = Green
R = Red



Test Procedure to Check Probe/Cable Assembly

1. Remove rear of gun and unplug the circuit board connector.
2. Using a Digital Ohmmeter, measure the resistance between the Red, Green, and Black wires leading to the Probe, in both forward and reverse directions. See below for proper Ohmmeter reading.

PROPER OHMETER READING

WIRES	DIRECTION	READING (OHMS)
Black to Red	Forward	Infinity (or very high)
Red to Black	Reverse	>20 Megohms (probe covered from light) 1K-30K on 1K Scale (probe 'sees' ambient light)
Green to Red	Forward	Infinity (or very high)
Red to Green	Reverse	1K (on 1K scale)

NOTE: Actual readings will vary depending on type of Meter used. Infinity readings in both directions indicate a broken cable.

MARKLAND MODEL 10

SLUDGE GUN® TROUBLE SHOOTING GUIDE

Symptom	Problem	Remedy
No Sound	-Loose connection or broken wire.	Check wires and circuit board connector and battery connector.
	-Batteries dead	Replace with Eveready E91 Alkaline (or equal).
	-Trigger switch defective. Check if power (7 VDC or more) is getting through to circuit board connector (right hand Red lead) when trigger depressed.	Replace Switch.
	-Probe in air and 'sees' ambient light from sun or lamps.	Normal. Probe should be shaded from light if testing in air.
Sound all the time when trigger depressed	-Broken Cable. Do Digital ohmeter test outlined overleaf.	Find break and repair, or replace Probe/Cable assembly.
	-Probe defective. Do Digital ohmeter test outlined overleaf.	Replace Probe/Cable assembly.
	-Short circuit (wires touching). Check all wires and connectors.	Remove short circuit.
	-P.C. board defective.	Replace
Weak Sound (Probe in Sludge)	-Batteries Weak	Replace
	-Speaker Defective	Replace
Weak Sound (Probe in Air)	-Batteries Weak	Replace
	-Dirty Probe	Wash
Weak Sound (Probe in clear liquid)	-Batteries Weak	If can't tune out sound with SENSITIVITY Control, replace batteries.
	-Dirty Probe	Wash
	-This is normal in Model 10HS which is designed to detect clear liquids.	

MARKLAND SPECIALTY ENGINEERING LTD.
OPERATING INSTRUCTIONS MODEL 10 SLUDGE GUN®

Cable Markers

Make sure the cable is *clean and dry*. String a 50 ft. tape measure beside the cable, with the zero end of the tape at the Probe. Carefully peel off the numbers and place the "1" at the 1ft. mark, "2" at the 2ft. mark, etc... Metric or any other units can also be used. Placing a strip of black vinyl electrical tape midway between the number markers permits more precision in reading the depth.

Sensitivity Adjustment

This thumb adjustable control is at the back of the handle. Rotate the control knob so that with the trigger depressed, there is no sound with the Probe in air or when it is in the liquid at the top of the tank, and the high pitch note sounds when the probe is down in the sludge. This setting is not critical. The sensitivity control is mainly needed for extremely thick or thin slurries, or for boosting the power as the batteries get weak.

Unwinding/Rewinding Cable

Point the Gun downward and rotate the whole Gun in a circular motion and the cable will come off the front of the spool like a fishing line coming off a reel. Unwind only as much as needed, then pass it through the pinch-groove at the front of the Gun. To get the cable backup, guide the cable with one hand, and again rotate the whole Gun with the other hand so the cable comes back onto the spool. ***Do not twist the cable!***

Finding The Sludge Blanket

Lower the Probe while squeezing the trigger. If the Sensitivity control is set right (see Sensitivity Adjustment) no sound will be heard. As the Probe nears the sludge bed a low pitch sound will come from the speaker. This will increase in volume and rise in pitch as the solids concentration increases. Keep the trigger depressed and lower the Probe to the bottom of the tank (the cable will go slack when on the bottom). Read the cable marker opposite the handrail (for example - 25ft.). The speaker will still be howling with the trigger depressed and the Probe in the sludge. *Slowly* raise the cable until the note starts to become lower pitched, and again read the marker opposite the handrail (for example - 20 ft.). Continue *slowly* raising the Probe until the sound stops and read the cable marker (for example - 18 ft.). In this example, you would have 5ft. of dense sludge, covered by 2 ft. of a partially settled sludge 'cloud'. Remember to move *slowly*, or you will stir up a large 'cloud' and confuse the reading.

Battery Replacement

Batteries will last about one year in normal service. With the Probe in air, if a low pitched ticking is heard as soon as the trigger is depressed, and this can not be removed by turning the sensitivity control, this indicates that either the Probe is dirty and needs washing, or the batteries are weak and will soon need to be replaced. Ignore the short beep that is heard when the Gun is first switched on. This is normal. Battery life is shorter when the Gun is used at low temperatures. To change batteries, remove two screws and take off rear speaker, pull down on spring loaded plunger and slide out the Battery Pack. Replace with AA size Pencell Alkaline batteries, and be careful to install in the direction shown on the Battery Holder.

Cold Weather Operation

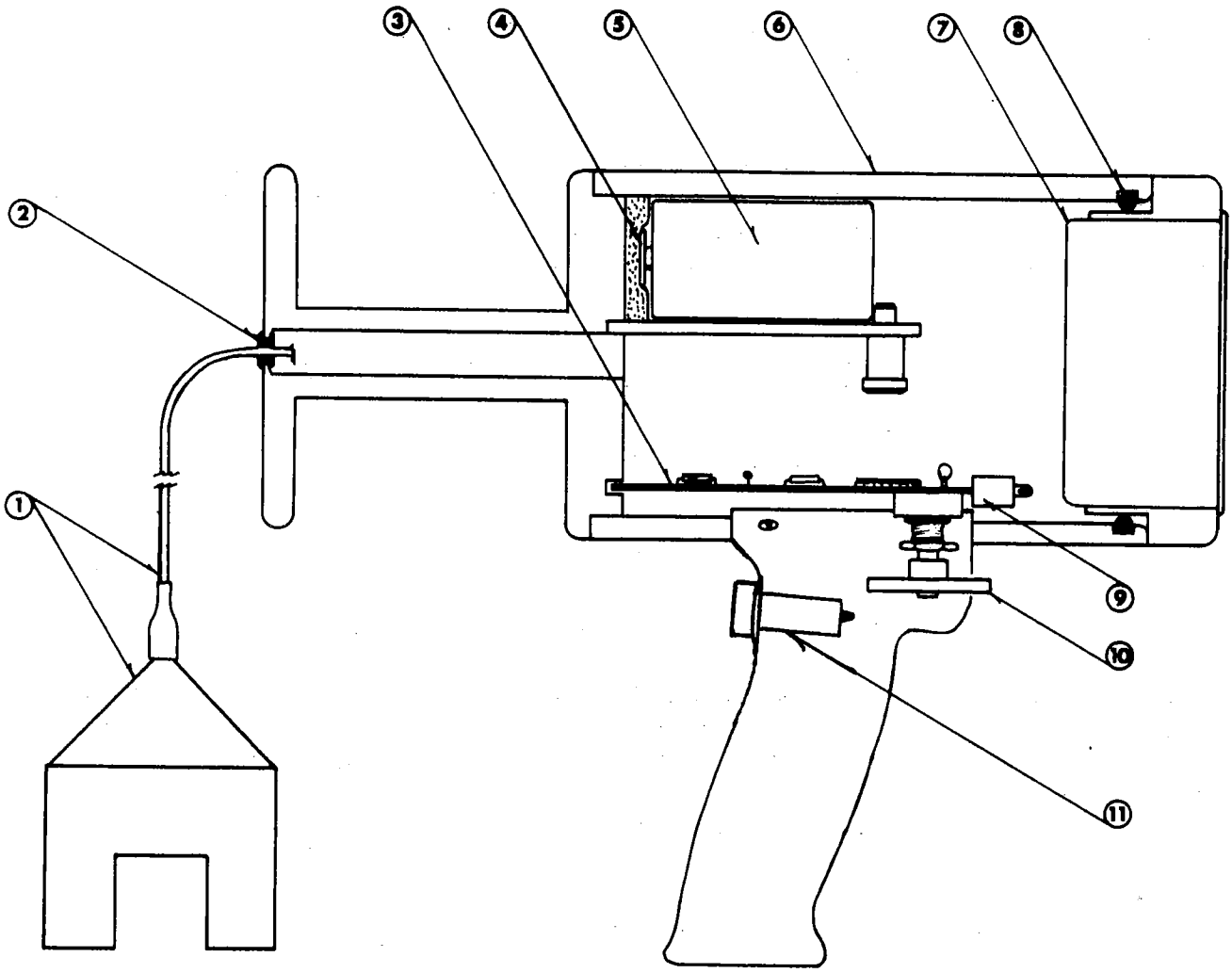
Battery output is greatly reduced at low temperatures. It is suggested that the Gun be fitted with new batteries if it is going to be used at temperatures near or below freezing. The Gun should be stored indoors when not in use.

Probe

The solid-state Probe is sealed and requires no maintenance other than washing. The cable is sealed at the Probe and can't be disconnected. If defective, the entire Probe/Cable assembly must be replaced. Care should be taken not to tangle the Probe in Rakes or Scrapers, which should be stopped before lowering the Probe into the tank. Do not drop the Probe onto the concrete tank bottom, lower it slowly. Quickly dropping the Probe stirs up the sludge bed making readings difficult, and could cause Probe damage.

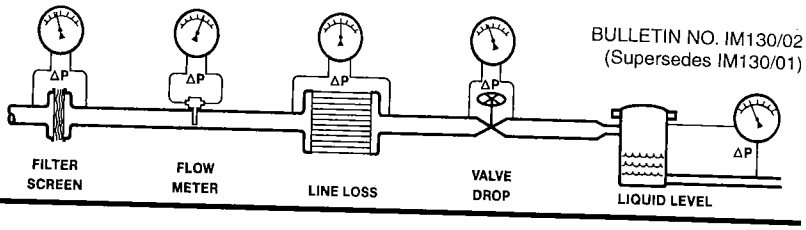
PARTS LIST

Markland Model 10 Sludge Gun®



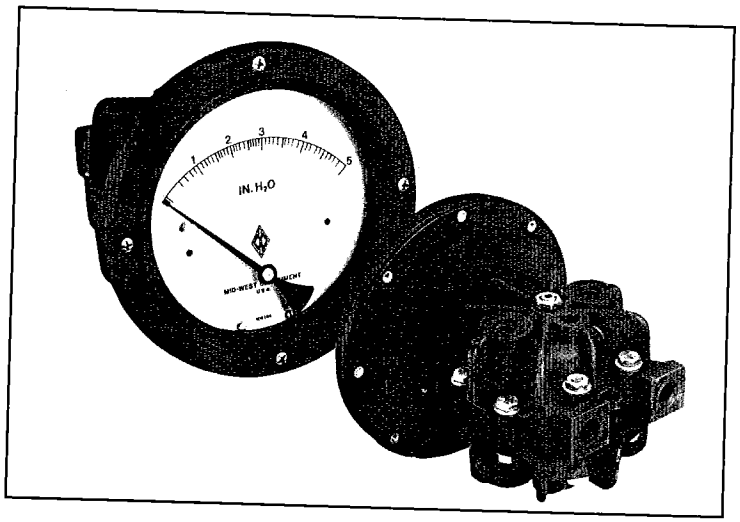
PART NO.	NAME
1/10	Sealed Probe and Cable Assembly
2/10	Grommet
3/10	P.C. Board Assembly
4/10	Battery Connector
5/10	Battery Holder (Buy Batteries Locally)
6/10	Body Assembly, complete
7/10	Loudspeaker/End Ring Assembly
8/10	"O"-Ring
9/10	P.C. Board Connector
10/10	Sensitivity Adjust Knob
11/10	Switch

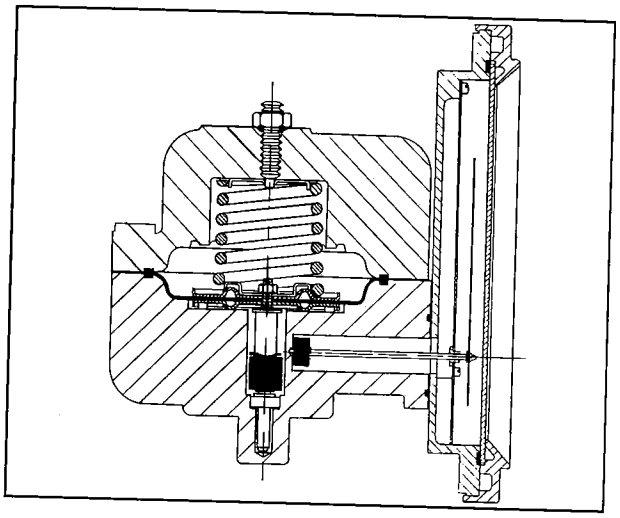
Mid-West®
Instrument



BULLETIN NO. IM130/02
(Supersedes IM130/01)

Model 130
Installation and Operating Instructions





INSPECTION

Before installation check nameplate on each instrument against the receiving paperwork and the intended application for correct part number, materials, working pressure, dial range, etc. If equipped with switches, check electrical rating, type of enclosure, etc. Inspect for shipping damage. If damaged, report it immediately.

NOTE - Before attempting repairs contact your local Mid-West Representative or our factory. Failure to do so will void any warranty.

PRODUCT DESCRIPTION

The Model 130 is a differential pressure instrument available as a switch, gauge, or both. See "Part Numbering System", (Fig. 2).

A flexible elastomer diaphragm and calibrated range spring are moved by differential pressure. A magnet, coupled with the diaphragm, transmits motion through the wall of the pressure housing to a follower magnet attached to an indicating pointer. The rotation of the follower magnet causes the pointer to track movement of internal magnet and indicate differential on the dial scale.

When equipped with switches for Aluminum, Brass or 316SS bodies only, a contact is made or broken by the magnetic field of the internal magnet.

The diaphragm is totally supported upon reaching full travel in either direction, providing full over-range protection to rated working pressure.

INSTALLATION

Model 130 is calibrated and tested prior to shipment and is ready for immediate installation. Use of the following installation procedures should eliminate potential damage and provide optimum trouble-free operation.

NOTE - It is highly recommended that a three valve manifold be installed in the instrumentation loop to minimize possible damage during pressurization.

1. CONNECTIONS

Model 130 P is provided with 1/4" compression tube fittings, one low and one high, on the top and bottom of gauge body.

Model 130 A, B, H, S, is provided with **dual** 1/4" FNPT connections top and bottom as standard. One pair of high and low pressure ports is for process connections. The other pair is plugged or used as drain/bleed connections.

Ports are identified for high and low pressure. Be sure to plumb to proper connections on system. Improper connection will not damage instrument but it will not function properly.

Flexible tubing is recommended to minimize effect of any vibration that may exist.

When attaching connections to the 130 P, care must be taken to prevent over-tightening which may result in stripping threads and/or cracking ports. In order to prevent this, use a suitable wrench to hold the factory supplied fitting in place while tightening, sometimes called "double wrenching".

2. INSTRUMENT LOCATION

On liquid service, the instrument should be mounted **below** the process connections to facilitate self-bleeding. On gas service, it should be located **above** the process connections to promote self-draining. If the process contains particulates, a "pigtail" loop or drop leg (manometer "U-tube" configuration) in the tubing will minimize the possibility of it migrating into the instrument.

NOTE - On liquid applications, unequal liquid heads on high or low side will result in an inaccurate differential pressure indication.

3. PANEL MOUNTING

The Model 130 is designed for mounting through the **front** of the instrument panel and is provided with a panel mount kit, consisting of (4) panel mounting studs/nuts.

Make cutouts as indicated in (Fig. 1). Insert (4) panel mounting studs, finger tight, into metal inserts located in the rear of the bezel.

Insert gauge through the panel, aligning panel mounting studs with holes in the panel. Install #8-32 nuts onto studs and tighten securely.

4. PIPE MOUNTING

If specified, your Model 130 will have a pipe mount kit installed. This provides for mounting on a 2" vertical or horizontal pipe. See (Fig. 1).

5. ELECTRICAL - See Mid-West Bulletin IMELEC130/latest

TROUBLE SHOOTING

1. Gauge does not indicate differential.

A. Check for proper hook up, high to "hi" and low to "lo".

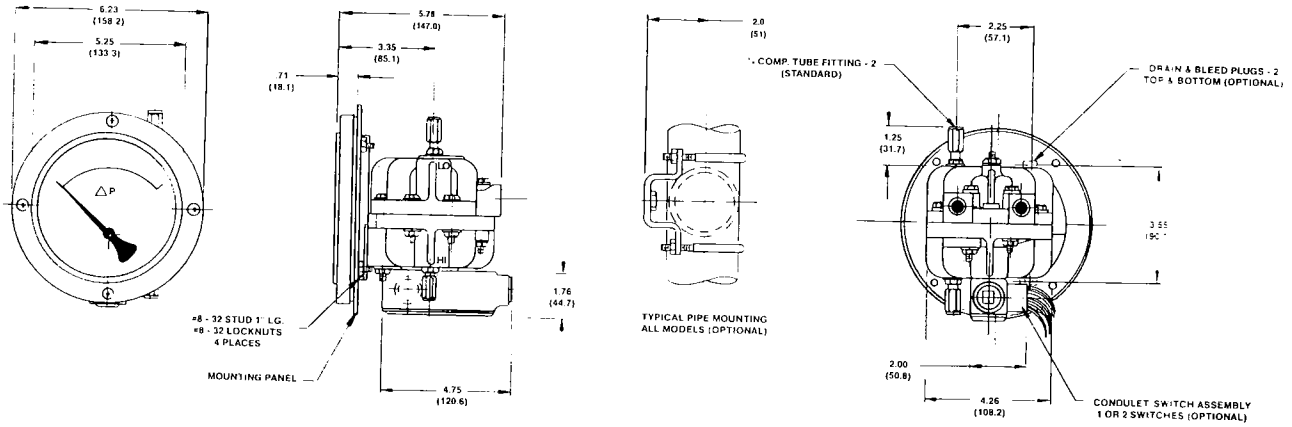
B. Make certain block valves are open and, if using a 3-valve manifold, that the equalizer (balance) valve is closed.

C. If A & B check out, loosen high pressure line to determine if there is pressure to instrument.

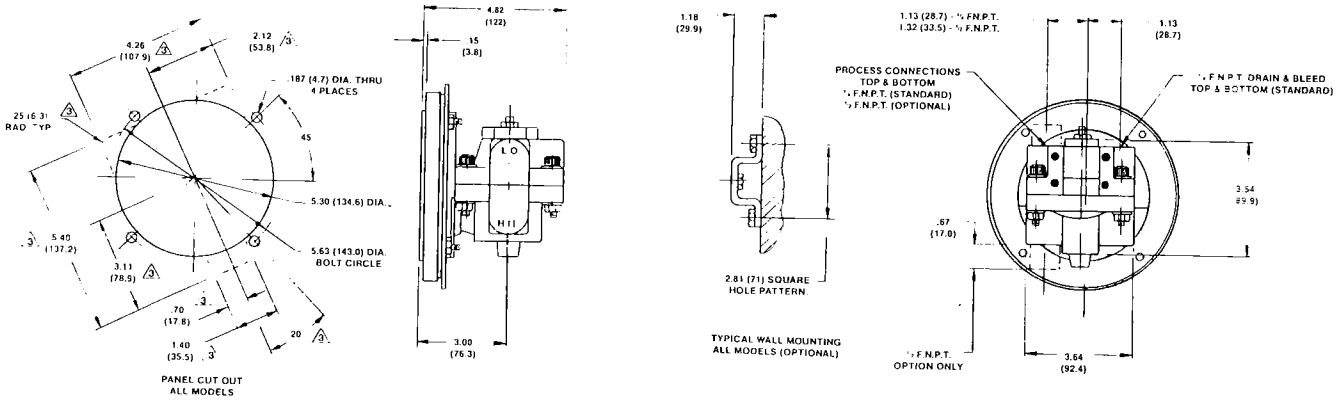
D. If there is pressure to instrument, check to determine that there is differential across the unit being monitored. If so, contact factory for assistance and/or an "RGA" (return goods authorization) number to return instrument for repair or replacement.

MOUNTING INFORMATION & DIMENSIONAL DATA
(FIG. 1)

MODEL 130 - P



MODEL 130 A - 130 B - 130 H - 130 S



NOTES: 1. Drawings show standard gauge nominal dimensions. (not to scale)

2. Dimensions shown in parentheses are in millimeters.

3. Add to panel cut out for condulet/switch assembly option.

PART NUMBERING SYSTEM 1 3 0 - □ □ - □ □ - □ □ □ □ - □ □ □

① **BASIC MODEL NUMBER**

② **MATERIAL**
- A. Aluminum
- B. Brass
- H. Hastelloy C
- P. Glass-Reinforced Engineering Plastic Body
- S. 316 S.S.
- Z. Special (Uncoded Options)

③ **DIAL SIZE**
- C. 4-1/2" Round Dial Engrd. Plastic Housing Assy. **(STANDARD)**
- E. 3-1/2" Round Dial Anod. Aluminum Housing Assy.
- G. 4-1/2" Round Dial Anod. Aluminum Housing Assy.
- T. Non-Indicating Differential Pressure Switch Only (Select Appropriate Electrical Options)
- Z. Special (Uncoded Options)

④ **SEALS & DIAPHRAGM MATERIAL**
- 0. Buna N **(STANDARD)**
- 1. *Viton®
- 2. Silicone
- 5. Ethylene Propylene (0-5" H_2O thru 0-100" H_2O max)
- 9. Special (Uncoded Options)

*Viton® is a Registered Trademark of DuPont Dow Elastomers.

⑤ **CONNECTIONS**
- 0. 1/4" C.S. Comp. Tube Ftgs. (2) Model P or 1/4" FNPT (4) for Models A, B & S **(STANDARD)**
- 1. 1/4" 316 S.S. Comp. Tube Ftgs. (2)
- 2. 1/4" FNPT Brass Adapters (2) (Model P Only)
- 3. 1/4" FNPT 316 S.S. Adapters (2) (Model P Only)
- 4. 1/2" FNPT 316 S.S. Adapters (2) (All Models, Except P)
- 9. Special (Uncoded Options)

NOTE: The use of diaphragm seals is not recommended for the model 130 series gauges. Attempts to install such seals will void the warranty.

NOTE: Not all options available in combination with other options.

⑥ **OPTIONS (Up to four options)**
- O. None **(STANDARD)**
- B. Drain & Bleed Plugs, 316 Stainless Steel (2) (Model 130 P only)
- D. Drain & Bleed, for Model 130 P in Nema 4X Enclosure
- E. Drain & Bleed, for all other Model 130's in Nema 4X Enclosure
- F. Pipe Mounting Kit
- H. Hastelloy C Internal Wetted Metal Parts and Fittings
- M. Maximum Indicator Follower Pointer
- T. Oxygen Cleaning
- U. S.S. Tag Mounted w/S.S. Wire
- V. S.S.Tag Mounted w/S.S.Screws
- W. Wall Mounting Kit
- Z. Special (Uncoded Options)

⑦ **ELECTRICAL CONFIGURATIONS (SWITCH ADJUSTABLE RANGE 10-90%)**

(NOTE: Switch option not available for 130-PC Models)

(NOTE: All options CE marked, except N & P)
- O. None **(STANDARD)**
- H. (1) Reed Switch with Condulet Enclosure
- I. (2) Reed Switches with Condulet Enclosure
- J. (1) Reed Switch with Condulet Enclosure and Plug-In Connector (DIN 43650-PG 11)
- K. (2) Reed Switches with Condulet Enclosure and Plug-In Connector (DIN 43650-PG11)
- L. (1) Switch in NEMA-4X Plastic Enclosure
- M. (2) Switches in NEMA-4X Plastic Enclosure
- N. One (1) Switch in Explosion Proof Enclosure with Glass Window Cover and C.S.A. Listing (1)
- P. Two (2) Switches in Explosion Proof Enclosure with Glass Window Cover and C.S.A. Listing (1)
- Z. Special (Uncoded Options)

(1) Complete Assembly Rated Class I, Division I, Groups C & D; Class II, Division I, Groups E, F & G.

⑧ **ELECTRICAL SPECIFICATIONS (For Resistive Loads)**
- A. SPDT, 3 Watts, 0.25 Amp, 125 VAC/VDC (Switch adjustable range 10-90°₀)
- Z. Special (Uncoded Options)

– (Up to three options) ⑧ ⑦

(FIG. 2)

Manufacturer reserves the right to change specifications without prior notice.

Temperature limitations: -40°F(-40°C) to +200°F (+93°C). **Proof pressure:** two times rated working pressure.

NOTE: These limits are based on the entire instrument being saturated to these temperatures. Systems (process) temperatures may exceed these limitations with proper installation. Contact our customer service representative for details.

STANDARDS: All Model 130 Series differential pressure gauges either conform to and/or are designed to the requirements of the following standards:

ASME B1.20.1
ASME B40.1
CSA-C22.2 No. 14.25 and 30
EN-61010-1

NACE MR0175
NEMA Std. No. 250
SAE J514
UL Std. No. 50,508 and 1203

Mid-West®
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REPRESENTED BY:

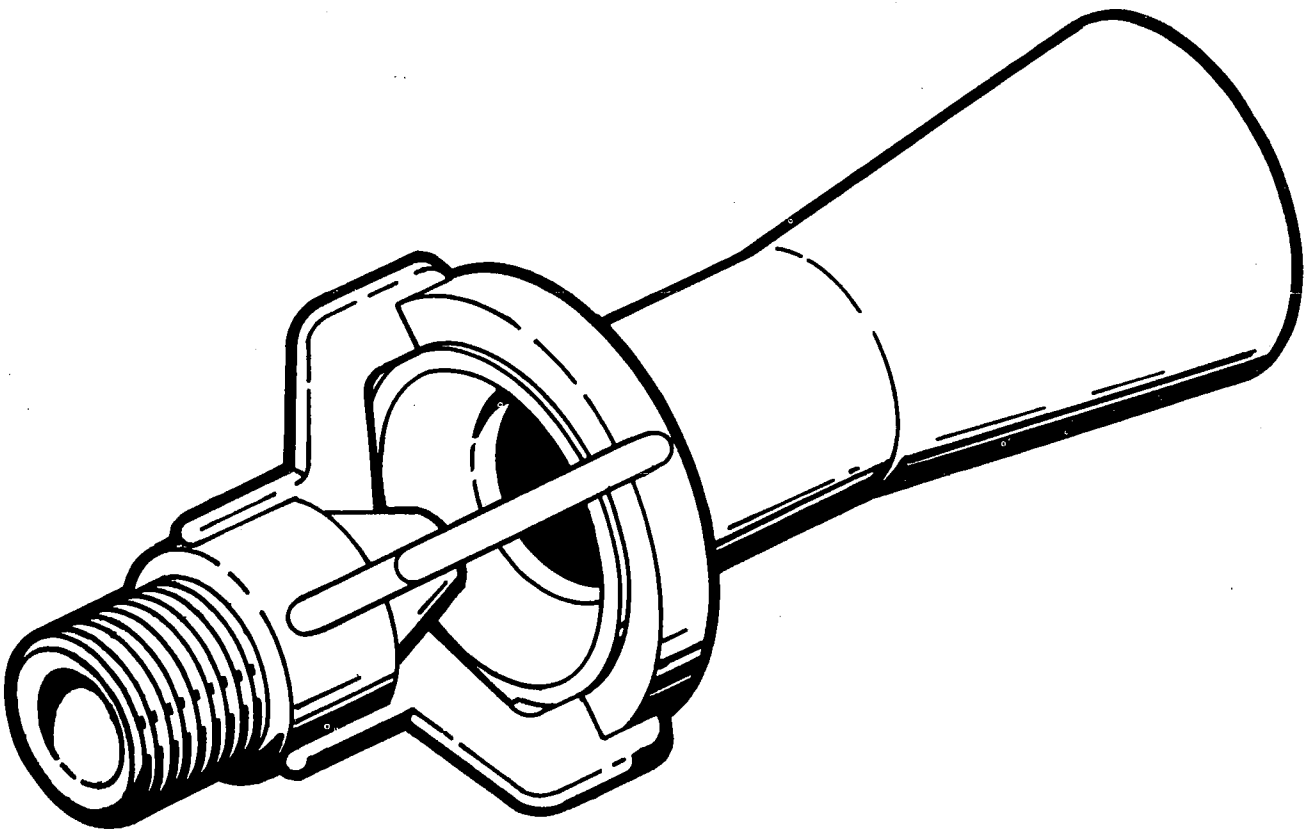
Printed in U.S.A.

PENBERTHY ®

Section 1000
Instal. Instr. 1963
Issued 6/91
Replaces NEW

Mixer

Model TME



Installation / Operation / Maintenance Instructions

PENBERTHY

INSTALLATION/OPERATION/MAINTENANCE FOR TANK MIXING EDUCTOR (TME)

This manual has been prepared as an aid and guide for personnel involved in installation or maintenance. All instructions must be read and understood thoroughly before attempting *any* installation, operation or maintenance. Failure to follow any instruction could possibly result in a malfunction of the TME with resulting property damage or physical injury to personnel.

Caution: Penberthy does not have any control over the manner in which its TME is handled, installed or used, and Penberthy cannot and does not warrant or guarantee that a TME is suitable or compatible with the user's specific application.

WARNING: Safety glasses should be worn when in the area of a TME Installation.

I. INTRODUCTION:

A. Features and Specifications:

Penberthy's TME's are designed for in-tank mixing of liquids using a liquid as the motive fluid.

Mixing is accomplished first within the TME as the motive liquid entrains the tank contents into the suction openings, and thoroughly mixes within the unit before being discharged. The discharge flow, or plume, provides further mixing and agitation within the tank. The motive liquid can be drawn from the tank, or it can be a second liquid drawn from another source.

B. Design Ratings

SIZE	MATERIAL	MAXIMUM ALLOWABLE WORKING PRESSURE
3/4"	25% Glass-Filled Polypropylene	100 psi at 0 to 220 F
1 - 1/2"	25% Glass-Filled Polypropylene	100 psi at 0 to 220 F

C. Application Data

1. Mixing

Minimum inlet pressure - 10 PSIG
Maximum inlet pressure - 100 PSIG

Most efficient operation takes place when inlet pressure is within the range of 20 to 70 PSIG. Four gallons of tank contents can be mixed for every gallon of operating fluid. For inlet pressures outside this range, tank contents mixed will be reduced.

Note: For specific application data within the above ranges, the user should consult the Penberthy product proposal for the specific model and TME size, or should request Penberthy to supply the applicable technical data bulletin.

WARNING: Under no circumstances should these design ratings or application data be exceeded. Exceeding design ratings or application data may cause property damage or physical injury to personnel.

II. INSPECTION AND PERFORMANCE CONFIRMATION:

A. Receiving Inspection

Upon receipt of TME, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request damage inspection.

B. User's Rating Inspection

The user should confirm:

1. That the TME size (molded on side of body) conforms to the description on the user's purchase order.
2. That the operating conditions described in the purchase order agree with the actual conditions at the installation site.
3. That the actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above.
4. That the materials of construction of the TME are compatible with both the contained fluid and surrounding atmosphere in the specific application.

Caution: If the size model or performance data or the TME as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for direction on what to do.

III. INSTALLATION:

Installation should only be undertaken by qualified, experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual.

The user should refer to Penberthy's dimension sheets or product proposal to obtain dimensional information for the specific size and model TME.

Check the TME cut-away view in Figure 1 for the location of the threaded inlet port.

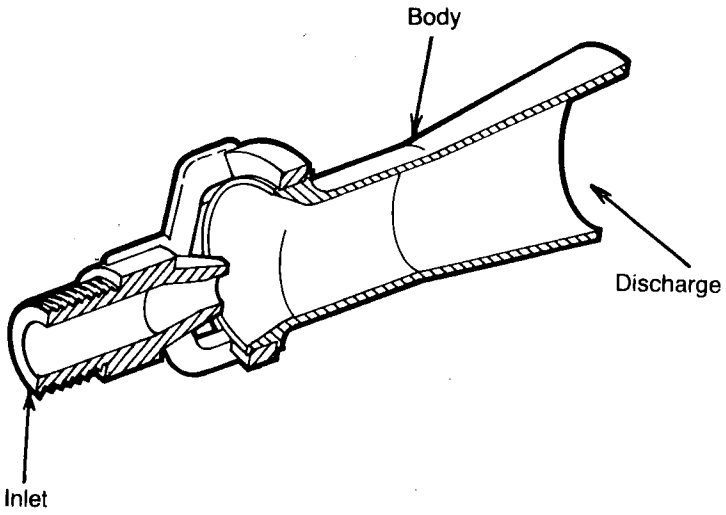


Figure 1

A. Mounting

A TME can be mounted in any position. The supply line and manifold piping to multiple TME's must be sized to supply uniform pressure to each TME.

It is important that the TME be positioned within the tank to insure the free flow of liquid to be mixed into and out of the unit(s). The greatest agitation occurs within the discharge plume; therefore, the discharge end should be aimed towards the most remote part of the tank. On the other hand, the intake end of the unit must be just far enough from the tank corner or wall to allow the free flow of liquid into the suction openings.

Tank shape and size influence the placement and number of TME's required to maintain even agitation. With a spherical tank, a single TME mounted as shown in the Figure 2 illustration makes the best use of the mixing characteristics of the TME. With no corners to impede liquid flow, the liquid circulates evenly.

In a cylindrical, square, or rectangular tank, the angular intersection of surfaces can interrupt liquid flow patterns and cause liquid stagnation in these areas. A single TME mounted as shown in Figure 3 will minimize this. Whenever the ratio of length to diameter of the tank is greater than 2:1 (such as tank trucks or railroad cars), it is recommended that multiple TME's be used.

In tanks where a critical velocity must be maintained on the tank bottom, a slight downward angle of the TME's can be helpful (See Figure 4).

B. Effect of Related Piping Precautions

1. For Mixing

   a. Operating liquid supply line pressure loss must be taken into account when applying TME's.
   b. Supply line must be clean and should be provided with a strainer to prevent foreign materials from clogging mixer.
   c. TME's must be fully submerged to prevent liquid from splashing and drawing atmospheric air, and to promote maximum mixing.
   d. Clearance should be provided for removal of the TME.
   e. Provisions should be made for a pressure gauge connection at or near the TME inlet. It may become necessary to install a pressure gauge if operating difficulties are encountered.
   f. Inlet piping must be secured to the tank wall near the TME to keep strain off piping when in operation.
   g. Supply line and manifold piping must be sized to supply adequate pressure equally to each TME when multiple TME's are used.

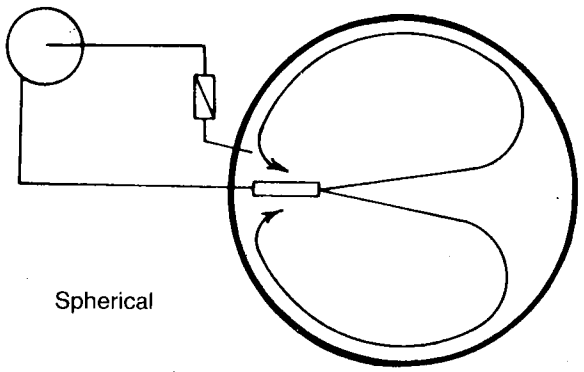


Figure 2

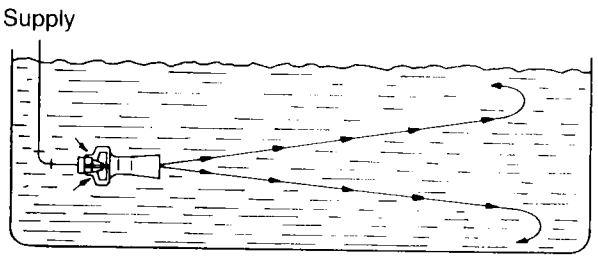


Figure 3

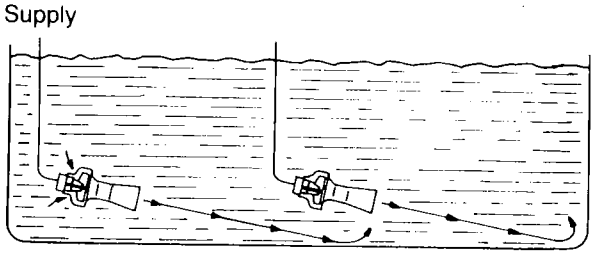


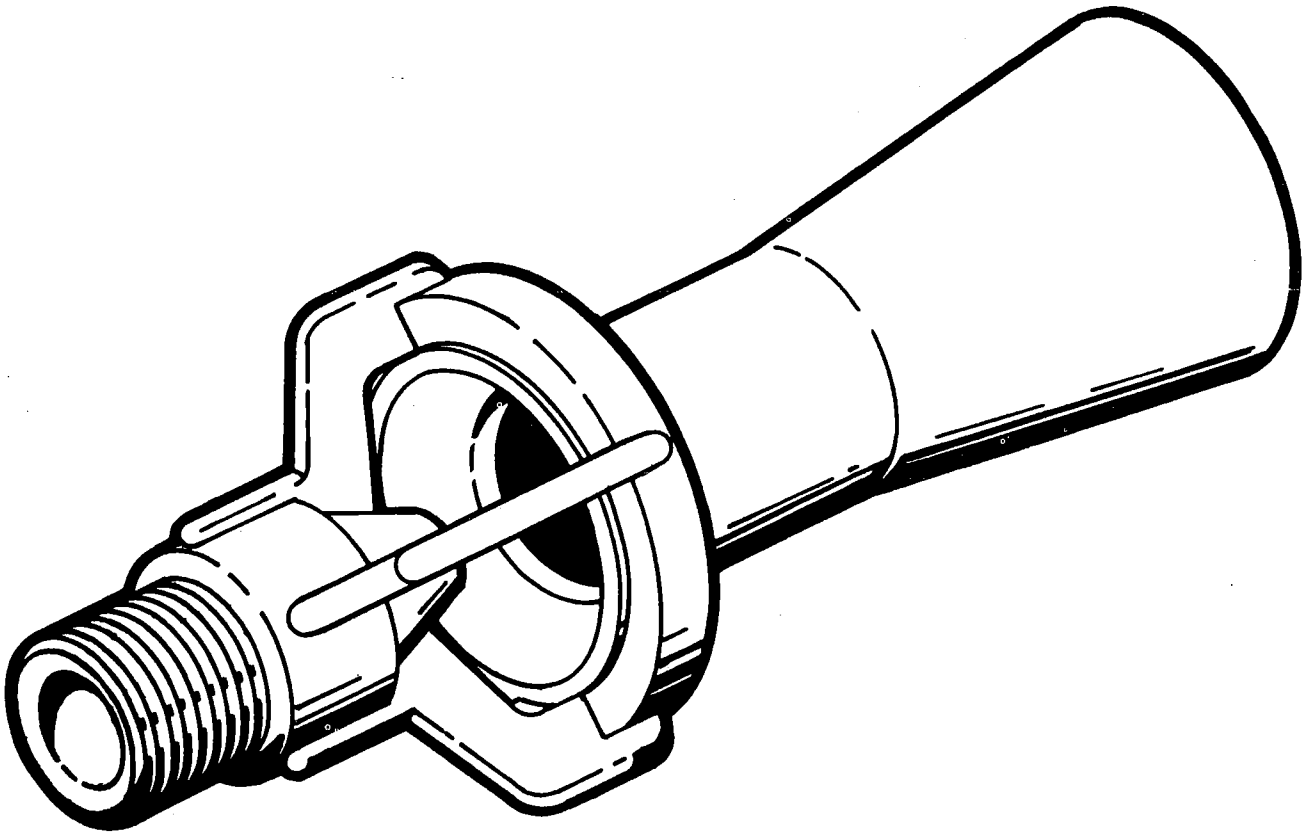
Figure 4

Section 1000
Instal. Instr. 1963
Issued 6/91
Replaces NEW

PENBERTHY ®

Mixer

Model TME



Installation / Operation / Maintenance Instructions

STD: 1-0600-8X11A	INTL REF:	BAR = 1" AT PLOT SCALE

41074-208-1

SSI EQUIPMENT CHECK VALVE MODEL 150WTSSSSVSSR

8" 316 STAINLESS STEEL DUAL DISC CHECK VALVE ASTM A351 GRADE WCB
END STYLE: WAFER ANSI CLASS 125/150
TRIM: 316 SS DISC, SHAFT AND SPRINGS
SEAT MATERIAL: VITON

DORNER COMPANY
8585 W. BRADLEY RD
MILWAUKEE, WI 53224
PH: 414-355-8685
FAX: 414-355-3556

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ENGINEER	DATE
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FILE:	
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TITLE CHECK VALVE

CLIENT JET PROPULSION LAB, NASA

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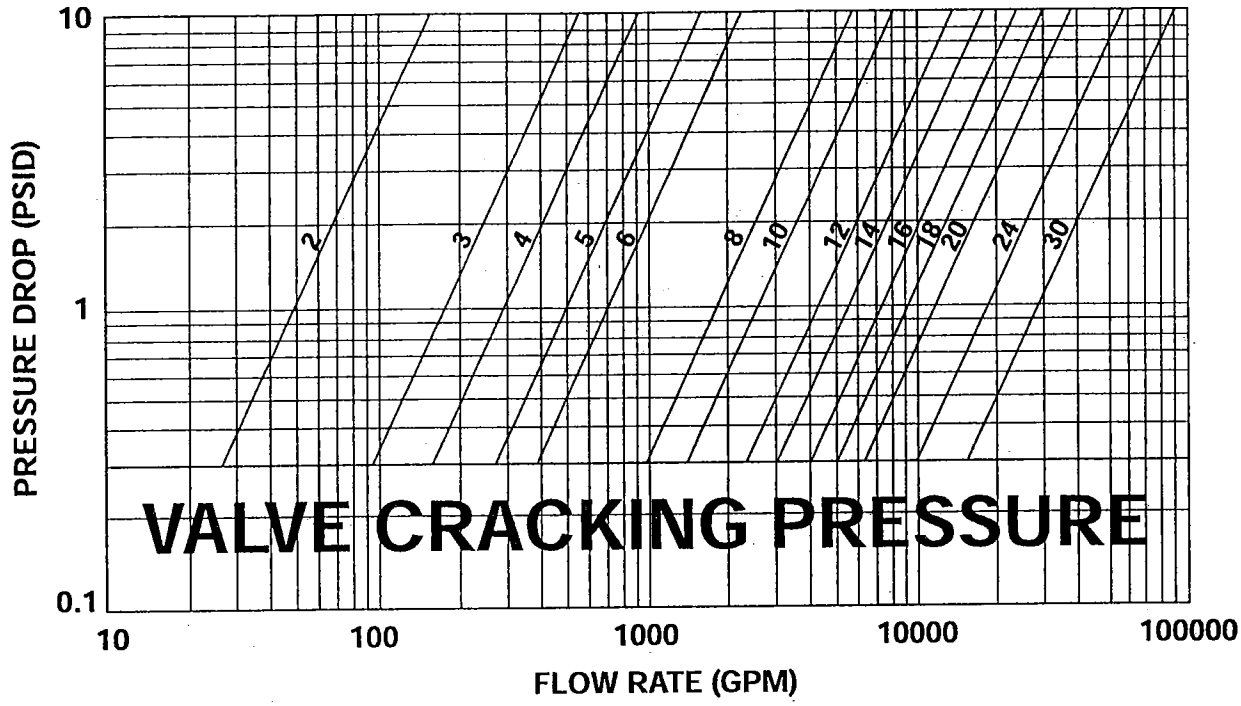
Envirex Products
Waukesha, WI
800-524-6324

PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-208	1 OF 1	0

DUAL DISC CHECK VALVES PRESSURE DROP - LIQUIDS

Sizes 2" - 30"

FIGURE 1



(1) Pressure drop curves are based on water flow.
(2) Valve cracking pressure is equal to or less then 0.3 psid.
(3) Valve cracking pressure increases to between 0.75 and 1.25 psid when installed vertically with flow upwards.

DUAL DISK CHECK VALVES CV VALUES

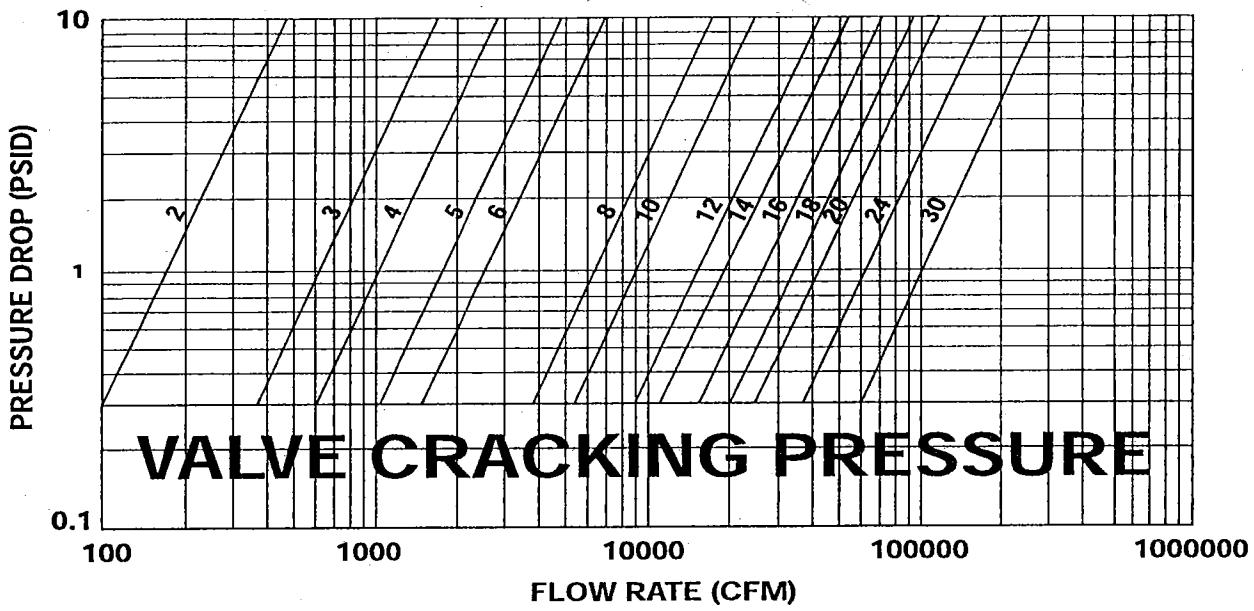
(US-GPM @ 1 PSID)

Valve Size	CV
2"	48
3"	171
4"	291
5"	494
6"	705
8"	1795
10"	2563
12"	4295
14"	5463
16"	7355
18"	9537
20"	12004
24"	17804
30"	28660

DUAL DISC CHECK VALVES PRESSURE DROP - AIR

@ 60°F, 1 ATM, Sizes 2" - 30"

FIGURE 2



(1) Pressure drop curves are based on air flow at 60 0F and 1 ATM pressure.
(2) Valve cracking pressure is equal to or less then 0.3 psid.
(3) Valve cracking pressure increases to between 0.75 and 1.25 psid when installed vertically with flow upwards.

METHOD OF CALCULATING FLOW

LIQUID FLOW

$$C_v = Q\sqrt{\frac{G}{\Delta P}} \qquad Q = C_v\sqrt{\frac{\Delta P}{G}} \qquad \Delta P = G\left(\frac{Q}{C_v}\right)^2$$

GAS FLOW

$$C_v = \frac{Q}{963}\sqrt{\frac{6T}{\Delta P\,(P_1 + P_2)}} \qquad Q = 963C_v\sqrt{\frac{\Delta P\,(P_1 + P_2)}{GT}}$$

SATURATED VAPOR

$$C_v = \frac{W}{K}\sqrt{\frac{1}{\Delta P\,(P_1 + P_2)}} \qquad W = C_vK\sqrt{\Delta P\,(P_1 + P_2)}$$

SUPERHEATED VAPOR

$$C_v = \frac{W(1+0.0007T_{SH})}{K}\sqrt{\frac{1}{\Delta P\,(P_1 + P_2)}} \qquad C_v = \frac{C_vK}{(1+0.0007T_{SH})}\sqrt{\Delta P\,(P_1 + P_2)}$$

C_V = Valve Coefficient
ΔP = (P1 - P2) Pressure Drop
P1 = Inlet Pressure (PSIA)
P2 = Outlet Pressure (PSIA)
G = Specific Gravity
Water = 1.0 at 60°F and 1 ATM
Air = 1.0 at 60°F and 1 ATM

Q = Flow
Liquid = USGPM
Gas = SCFH
T = Absolute Temperature (°F+460)
T_{SH} = Superheat (°F) Total Temperature Minus Saturation Temperature
W = Lbs. Per Hour (LBH)
K = Constant For Vapors

DUAL DISK CHECK VALVES
PRESSURE/TEMPERATURE RATINGS
(In accordance with ASME B16.1, B16.5, B16.34)

Cast Iron A126-B			
Class	**125**	**125**	**125**
NPS	**1-12**	**14-24**	**30-48**
Temp °F	**Maximum Non-Shock Working Pressure, psig**		
-20 to 150	200	150	150
200	190	135	115
225	180	130	100
250	175	125	85
275	170	120	65
300	165	110	50
325	155	105	–
353 (1)	150	100	–
375	145	–	–
406 (2)	140	–	–
425	130	–	–
450	125	–	–

(1) 353 °F (max) to reflect the temperature of saturated steam at 125 psig.

(2) 406 °F (max) to reflect the temperature of saturated steam at 250 psig.

Cast Carbon Steel A216-WCB					
Class	**150**	**300**	**600**	**900**	**1500**
Shell Test, Psig	**450**	**1125**	**2225**	**3330**	**5575**
Temp °F	**Maximum Non-Shock Working Pressure, psig**				
-20 to 100	285	740	1480	2220	3705
200	260	675	1350	2025	3375
300	230	655	1315	1970	3280
400	200	635	1270	1900	3170
500	170	600	1200	1795	2995
600	140	550	1095	1640	2735
650	125	535	1075	1610	2685
700	110	535	1065	1600	2665
750	95	505	1010	1510	2520
800	80	410	825	1235	2060
850 (1)	65	270	535	805	1340

(1) Permissible but not recommended for prolonged usage above 800°F.

(2) Flanged end ratings terminate at 1000°F.

Cast Stainless Steel A351-CF8M					
Class	**150**	**300**	**600**	**900**	**1500**
Shell Test, Psig	**425**	**1100**	**2175**	**3240**	**5400**
Temp °F	**Maximum Non-Shock Working Pressure, psig**				
-20 to 100	275	720	1440	2160	3600
200	240	620	1240	1860	3095
300	215	560	1120	1680	2795
400	195	515	1030	1540	2570
500	170	480	955	1435	2390
600	140	450	905	1355	2255
650	125	445	890	1330	2220
700	110	430	865	1295	2160
750	95	425	845	1270	2110
800	80	415	830	1245	2075
850	65	405	810	1215	2030
900 (1)	50	395	790	1180	1970
950	35	385	775	1160	1930
1000 (2)	20	365	725	1090	1820

(1) Contact factory for use at higher temperatures.

(2) Flanged end ratings terminate at 1000°F.

MATERIAL SELECTION GUIDE - DUAL DISC CHECK VALVES

A - Recommended, B - May be Acceptable. Testing Recommended, N - Not Recommended

CORROSIVE MEDIA	BODY / DISC MATERIALS			SEAT MATERIALS		
	AB	CS	316	EPDM	BUNA-N	VITON
Acetaldehyde	A	B	A	A	N	N
Acetone	A	A	A	B	N	N
Acetylene	N	A	A	A		A
Air	A	A	A	A	A	A
Aluminum Acetate	A	A	A	A	B	N
Aluminum Nitrate	N	N	A	A	A	A
Amino Acids	N		A	N	N	A
Ammonia Gas		A	A	B	70	N
Ammonium Bicarbonate		B	A	A	N	N
Ammonium Phosphate		N	A	A	A	A
Arsenic Acid	N	N	A	A	A	A
Beer-Breweries	N	N	A	A	A	A
Beet Sugar Liquors	A	N	A	A	A	A
Benzene	A	A	A	N	N	70
Brine	B	N	A	A	A	A
Bromine - Anhydrous	N	N	N	N	N	A
Bromine - Wet	N	N	N	N	N	A
Butane	A	A	A	N	A	A
Butanoic Acid			A			
Butyl Alcohol	A	A	A	B	A	A
Butylene (Gas)	A	A	A	N	N	A
Calcium Chlorate	N	A	A	A	A	A
Calcium Hydroxide	B	B	A	A	A	A
Carbonated Water	N	B	A	A	A	A
Carbon Monoxide	A	A	A	A	A	B
Carbonic Acid	N	B	A	A	A	A
Caster Oil	A	A	A	B	A	A
Chlorine (Wet or Dry)	N	70	N	N	N	A
Cider	B	N	A	A	B	A
Citric Acid	B	N	A	A	A	A
Citrus Juices	B	N	A	A	A	A
Corn Oil	A	A	A	N	A	A
Diacetone Alcohol	A	A	A	A	N	N
Dibutyl Phthalate		A	A	B	N	N
Dichloroethane			A	N	N	A
Diesel Fuel	A	A	A	N	A	A
Diethylamine	N	A	A	N	B	A
Diphenyl Oxide	B	A	A	N	N	A
Dowtherm	A	A	A	N	N	A
Ethanol	A	A	A	A	A	N
Ether	A	A	A	N	N	N
Ethyl Acetate	B	A	A	B	N	N
Ethyl Chloride	B	200	A	A	A	A
Ethylene Glycol	A	A	A	A	A	A
Ethylene Oxide	N	A	A	N	N	N
Fatty Acids	N	N	A	N	A	A
Ferrous Chloride	N	N	N	A	A	A
Fish Oils	B	B	A		A	
Gas-Natural	A	A	A	N	A	A
Gasoline - Ethyl	A	A	A	N	N	A
Gasoline - Regular	A	A	A	N	A	A
Glucose	A	A	A	A	A	A
Glycerine	A	A	A	A	A	A
Helium Gas	A	A	A	A	A	A
Hydraulic Fluid (Pydraul)	A	A	A	N	N	A
Hydrocarbons (Aromatic)	N	A	A	N	N	A
Hydrogen Peroxide	N	N	A	A	N	A
Hydrogen Sulfide	N	B	A	A	70	N
Iodine	N	N	N	N	N	A
Isopropyl Acete			B	B	N	N
Kerosene	A	A	A	N	A	A

CORROSIVE MEDIA	BODY / DISC MATERIALS			SEAT MATERIALS		
	AB	CS	316	EPDM	BUNA-N	VITON
Lactic Acid	N		A	70	70	A
Lime	A		A	A	B	A
Liquefied Petroleum Gas	A	A	A	N	A	A
Mercuric Chloride	B	N	B	A	A	A
Mercury	N	A	A	A	A	A
Methane	A	A	A	N	A	A
Methyl Alcohol	A	A	A	A	B	N
Methyl Acetate		B	A	B	N	N
Methyl Chloride	A	A	A	N	N	A
Naphtha	A	A	A	N	N	A
Natural Gas	A	A	A	N	A	A
Nitrogen - Gas	A	A	A	A	A	A
Nitrous Oxide	B	B	A		B	
Oil - Crude (sweet)	A	A	A	N	A	A
Oil - Crude (sour)	A	A	A	N	B	A
Oil - Vegetable	B	N	A	B	A	A
Oleic Acid		B	A	N	N	B
Olive Oil	B	B	A	B	A	A
Oxalic Acid			A	A	B	A
Oxygen - Gas	A	A	A	A	B	A
Palm Oil		N	A		A	A
Paint - Thinner/Remover	A	A	A	N	N	A
Phenol	B	B	A	B	N	A
Plating Solutions	N	A	N	A	N	A
Potassium Acetate		N	A	A	B	N
Potassium Bisulfate			A			
Potassium Chlorate		N	A	A	B	A
Potassium Cyanide	A	A	A	A	A	A
Potassium Sulfide	N	A	A	B	N	A
Potassium Sulfate	A	A	A	A	A	A
Propylene Glycol		N	A	A	A	A
Propylene Oxide	N		A	A	B	
Pyridene	B	A	A	B	N	N
Shellac	B	A	A	A	A	
Silver Nitrate	N	N	A	A	N	A
Sodium Bicarbonate	A	A	A	A	A	A
Sodium Carbonate	N	B	A	A	A	A
Sodium Chlorate	N		A	A	B	A
Sodium Chloride	N	B	B	A	A	A
Sodium Nitrite	B	A	A	A	A	
Sodium Sulfate	A	B	A	A	A	A
Sodium Sulfide	B	A	A	A	A	A
Sodium Thiosulfate		B	A	A	B	A
Soybean Oil	B	B	A	N	A	A
Steam and Hot Water	A	B	A	A	N	
Sulfur	N	B	A	A	N	N
Sulfuric Acid	N	N	B	N	N	A
Sulfurous Acid	N	N	B	N	N	A
Tartaric Acid		B	A	B	A	A
Tetrachloroethane	B	75	A	N	N	A
Turpentine	A	A	A	N	A	A
Varnish	A	A	A	N	N	A
Vinegar	N	N	A	A	B	A
Water, Carbonated	N	B	A	A	A	A
Water, Chilled	A	B	A	A	A	A
Water, Distilled	N	B	A	A	A	A
Water, Salt, Sea	A	N	A	A	A	B
Wine	B	N	A	A	A	A
Zinc Bromide	N		A		A	
Zinc Cyanide	N	N	A		A	
Zinc Sulfate	N	N	A	A	A	A

(1) If # appears, material is recommended for use up to indicated temperature (°F). (2) AB = Aluminum Bronze, CS = Carbon Steel, 316 = 316 Stainless Steel.
(3) If uncertain, please contact factory concerning valve compatibility.

No representation, warranty or guarantee of compatibility, expressed or implied, is made by this Selection Guide due to the complexity and almost infinite variations of mixtures, concentrations, temperatures and flow conditions possible in actual service. As a result, the end user must assume all responsibility for ultimate determination of value compatibility.

INSTALLATION AND MAINTENANCE INSTRUCTIONS
DUAL DISC CHECK VALVES

VALVE LOCATION AND ORIENTATION IN PIPING

Check valves should be installed if possible a minimum of 6 pipe diameters from other line elements, i.e. elbows, pumps, valves, etc.

Horizontal Lines

- Valves installed in horizontal lines must be bolted in place with the hinge post in the vertical position, i.e. in such a manner that the hinge pin retainers are at the top and bottom of the installed valve, perpendicular to the flow.

Vertical Lines

- In the upward position, no special attention needs to be given to the hinge post position. The only exception being when mounted directly downstream of an elbow. In this case the hinge post should be mounted perpendicular to the outermost portion of the elbow. Consult factory for vertical down flow applications.

PRECAUTIONS

- Do not install Series WT check valves directly against another valve whereby the check valve discharges downstream directly into the valve.
- Do not install the valve whereby it directly discharges downstream into a tee or elbow fitting.
- Series WT check valves should not be used in severe pulsating services such as reciprocating compressor discharges.
- It is recommended that the check valves be installed a minimum of three pipe diameters downstream of a pump or compressor.

MAINTENANCE

Spence Series WT check valves are permanently lubricated and normally require no routine maintenance.

RECONDITIONING

IMPORTANT! PRIOR TO DISASSEMBLY, VALVE MUST FIRST BE ISOLATED FROM SYSTEM PRESSURE AND FLOW.

Disc & Shaft Removal

CAUTION! BEFORE ATTEMPTING THE FOLLOWING SHAFT EXTRACTION, BE SURE TO PRESS A HAND OVER THE DISC SPRING. FAILURE TO DO THIS MAY RESULT IN PERSONAL INJURY DUE TO THE SPRING "LAUNCHING" ITSELF UNEXPECTEDLY ONCE THE SHAFT IS PULLED FREE OF IT.

- After observing the above precaution, remove the valve from the pipeline and lay flat with open, body cavity side facing up. Remove pipe plugs from top and bottom of body with a wrench. Insert a punch and lightly tap the top of the shaft until it is accessible on the other side of the body. Pull shaft through body to remove. The internals of the valve are now ready to be cleaned and inspected.

REASSEMBLY

Use new replacement parts, as required and a liberal amount of general-purpose grease (such as Mystic JT-6) on seals and machined mating surfaces. Reinsert the disc into the body cavity with the shaft holes inline with top and bottom shaft port. Slide the shaft into the body through the shaft opening on one side of the valve. Continue sliding the shaft through the disc, spring and remaining shaft port the opposite side of the body. Install pipe plugs into the body using a good industrial grade thread sealant compound.

How To Order Dual Disk Check Valves

Class	Body Type	Valve Type	Body Material	Disc Material	Seat Material	Spring Material	End Detail	Size, In.	Specials/ Other
150	**WC**	**T**	**S**	**SS**	**M**	**N**	**R**	**P**	**-1**
1	2	3	4	5	6	7	8	9	-10

6"150WTSSSMNRP-1 is a 6" 150 lb. wafer twin door check valve with a carbon steel body, 316 SS discs, Inconel X-750 springs, metal seat and Nace compliance.

Class - Box 1
See Below

Body Type - Box 2
WC = Wafer
LC = Lug

Valve Type - Box 3
T = Dual Disk Check Valve

Body Material - Box 4
I = A126-B Cast Iron
S = A216-WCB Carbon Steel
SS = A351-CF8M Stainless Steel

Disc Material - Box 5
B = Aluminum Bronze
SS = Type 316 Stainless Steel

Seat Material - Box 6
M = Metal to metal
B = Buna-N
E = EPDM
V = Viton

Spring Material - Box 7
S = 17 - 7 PH
SS = Type 316 SS
X = Inconel X-750
N = Nace (X-750)

End Detail - Box 8
F = Flat face (No Serrations)
R = Raised face (Serrated Finish)
RTJ = Ring Joint

Size - Box 9

H	= 2"	S	= 12"
J	= 2-1/2"	T	= 14"
K	= 3"	U	= 16"
M	= 4"	V	= 18"
N	= 5"	W	= 20"
P	= 6"	X	= 22"
Q	= 8"	Y	= 24"
R	= 10"		

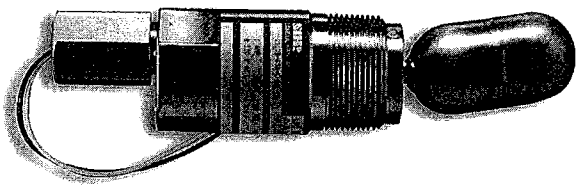
Specials/Other - Box 10
1 = NACE MR01-75 Compliance
2 = Grooved Seat Design
3 = Special External Coating
4 = Special Internal Coating
5 = Special N.D.E.
6 = Body Bearing
7 = Retainerless Option
8 = Other Special

Dual Disk Check Valve Current Program

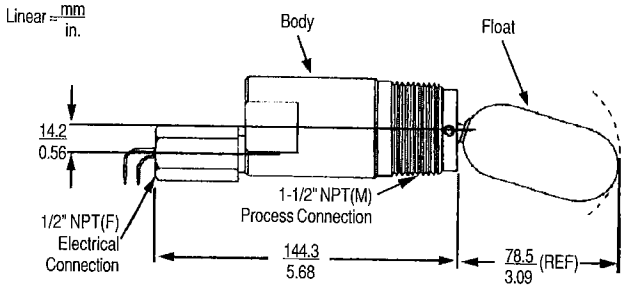
1 - Size	2 - Class	3 - Body Type	4 - Valve Type	5 - Valve Material	6 - Disc Material	6 - Seat Material	8 - Spring Material	9 - End Detail
2" - 30"	125	W	T	I	B, SS	B	S, SS	F
2" - 12"	150	W	T	S, SS	SS	B, V, M	S, SS	R
2" - 12"	300	W	T	S, SS	SS	B, V, M	S, SS	R
2" - 3"	600	W	T	S, SS	SS	B, V, M	S, SS	R

Note:
Spence is continuously adding more dual disc check valves to our manufacturing/stocking program. Please consult factory if check valve required not shown.

Type 1510 Side-Mount
Electric Level Switch



General Instructions



General

The SOR Type 1510 Electric Level Switch mounts into the side of a vessel.

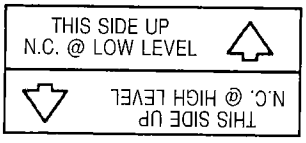
Electric switching action is provided by the float moving a magnet into the field of a hermetically sealed reed switch capsule.

The unit may be mounted for either high or low liquid level alarm by rotating the switch body to the proper position. The body wrench flats provide for ease of rotation and proper positioning. See decal on housing.

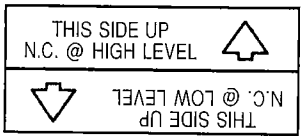
Design and specifications are subject to change without notice.

Before Installation of the Level Switch

1. Inspect the unit for any shipment damage.
2. Check for mechanical clearance of the float. Float must move freely without binding throughout its stroke.
3. Use an acceptable thread compound when installing unit to ensure a leak-free fit and avoid thread galling.
4. To achieve required function, install unit according to the nameplate instructions shown here.



Nameplate Position for Low Level Alarm



Nameplate Position for High Level Alarm

NOTE: NC - indicates circuit is closed

Installation

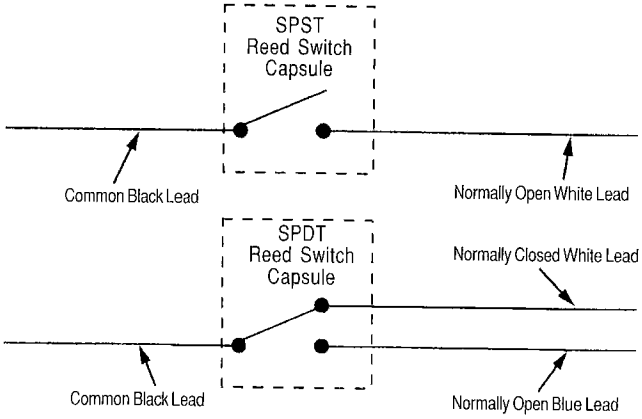
The unit may be mounted in any of the following installation arrangements.

a. 1-1/2" NPT half coupling (No full coupling).
b. 2" NPT full coupling. (Use in conjunction with 2 x 1-1/2" NPT bushing as required.)
c. 2" NPT pipe tee. (Use in conjunction with 2 x 1-1/2" NPT bushing as required.)
d. Optional flanged mounting.
e. Optional chamber mounting.

Electrical Connection

Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

Electrical connection is free wire leads with a 1/2" NPT(F) conduit connection. Use two wrenches — one to hold hex conduit connection, the other to tighten conduit fitting. Switching element is a hermetically sealed reed switch.

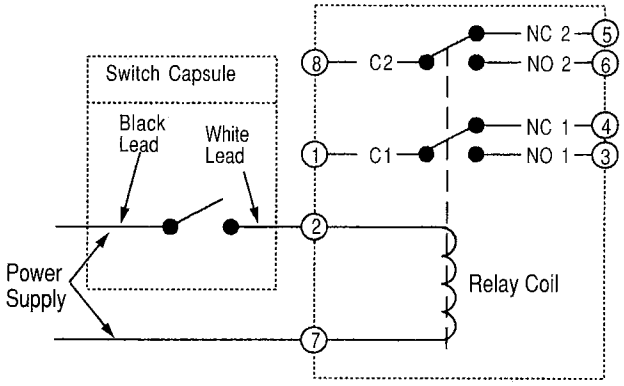


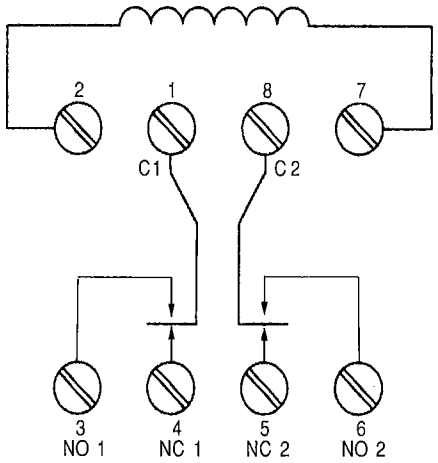
Wiring schematic for DPDT relay option shown on reverse.

CAUTION: Do not exceed 1 amp @ 110 VAC or 3 amps @ 28 VDC (resistive). High current input to switch will cause permanent damage to contacts.

Wiring for DPDT Relay

For Type 1510 Level Switches equipped with DPDT relays, a wiring schematic and pin position schematic is shown below. When the 1510 is actuated, the coil will energize and "make" both NO1 and NO2 while it will "break" NC1 and NC2. This provides a DPDT circuit.





Troubleshooting

Symptom	Probable Cause
1. Float in actuated position but no output signal.	a. No power supply. b. Switch damaged. (Replace.)
2. Float in de-actuated position but still receiving an output signal.	a. Switch damaged. (Replace.)
3. Control will not function when installed but operates when removed from process connection.	a. Inadequate float travel. Float travel restricted by mounting nozzle. See Mounting Requirements.
4. Liquid in vessel at the actuation level but unit does not respond.	a. Leaky or collapsed float. (Replace.) b. Liquid specific gravity too low. c. Float stem bound up or dirty. (Clean.)

Replacement Parts

Part Number	Description
3130-091	SPST Hermetically Sealed Reed Switch Capsule
3130-242	SPDT Hermetically Sealed Reed Switch Capsule
3130-106	SPST Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-243	SPDT Hermetically Sealed Reed Switch Capsule for CSA Certified units
3130-052	316SS Float Assembly

All information and specifications in this bulletin are current at the time of printing. Changes in product design and specifications may occur without notice. Contact the SOR representative in your area or the factory for the current revision of this bulletin.

14685 West 105th Street, Lenexa, Kansas 66215 913-888-2630 Fax 913-888-0767 www.sorinc.com

PB100-0.4 Custom PolyBlend (SP60102019) & PB200-2 Custom PolyBlend (SP60102020)

USFilter Stranco Project #212363

Jet Propulsion Lab

USFilter

Operation and Maintenance Manual

Submitted To:
USFilter / Envirex
1901 S Prairie Ave
Waukesha, WI 53189
Attn: Mark Pamperin
Phone: 262-521-8263

Manufacturer / Supplier Parts & Service:
USFilter Stranco Products
595 Industrial Drive
Bradley, IL 60915
Phone: 800-882-6466
Fax: 815-932-0674
Justin James, Project Supervisor

Prepared Date:
5/17/04 das

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PolyBlend PB200-2 (Custom SP60102020)

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Skid Interface Panel, DWG # 13497-01 103

PolyBlend Warranty

USFilter

STRANCO PRODUCTS
P.O.BOX 389
BRADLEY, IL 60915

TELEPHONE 815-932-8154
800-882-6466
FACSIMILE 815-939-9845

PolyBlend
Model #PB100-0.4 (SP60102019)
INSTALLATION, OPERATION, AND MAINTENANCE INFORMATION

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READ THIS MANUAL BEFORE YOU INSTALL, OPERATE, OR SERVICE THIS UNIT.

OVERVIEW

SAFETY PRECAUTIONS

- ☐ Ensure that the control panel is grounded to avoid possible electrical shock or damage to equipment.
- ☐ Before servicing, turn off all power and assure power "lockout" to avoid possible electric shock.
- ☐ Disconnect external power to the control panel before removing or replacing fuses.

SPECIFICATIONS

Pump	Diaphragm
Inlet	1/2" FPT, Water Supply
	5/8" Hose Barb, Polymer Supply
Outlet	1/2" FPT, Solution Discharge
Water Capacity	100 GPH Primary
Polymer Capacity	0.4 GPH
Pressure Rating	100 PSI
Electrical Supply	120/1/60, 6 Amps
Dimensions	23" H x 10" W x 16" D
Weight	51 lbs.
Motor(s)	(1) 1/6 HP, 120VAC, 3.6 AMPS

INSTALLATION

LOCATION

Select a location that provides:

- Electrical Supply
- Potable Water (Clean)
- Proximity to the Point of Use
- Easy Handling and Storage of Polymer
- Access to Unit
- Protection Against Severe Weather

UNPACKING

Examine package contents for damage. Report any to freight forwarder. Check plastic bag(s) for contents against individual packing list(s).

NOTE: Disregard any moisture; this unit was wet tested.

CONNECTIONS

- Use Teflon tape on threads. Use joint compound (pipe dope) in small amounts, if necessary.
- Do not over-tighten fittings.
- Insure that supply water pressure is **less than 100 psi.**
- Install water isolation valve with unions.
- Insure that neat polymer feed line has a **flooded suction.**

NOTE: To enhance performance, reduce the number of piping turns and elevation changes.

STORAGE

Store in atmosphere controlled environment. Protect from extreme temperature (above 110°F, 52°C, below 32°, 0°C) and wide ambient temperature fluctuations.

Protect from direct weather exposure, i.e., sun, rain, high wind, etc.

OPERATION

GENERAL

This PolyBlend unit will perform the following functions: meter polymer dosage, regulate mixing water, provide uniform dilution and activation, operate on-line continuously, and feed solution to the point of use.

Neat polymer from the metering pump and dilution water controlled by the solenoid valve enter the mixing chamber. Dilution and activation occur, yielding prepared solution ready for use.

Neat polymer dosage rate is adjusted at pump face or at electronic controller (REM-1D, SCR, etc.). Primary dilution (and post dilution) water are controlled by individual flow control valves.

START-UP

Step 1: Switch pump to external mode at pump face.
Step 2: Prime polymer pump, using priming kit provided with unit.
Step 3: Place unit power switch in Off position.
Step 4: Energize power circuit that feeds unit. Solenoid opens. Allow mixing chamber to fill with water by opening primary dilution water control valve.

NOTE: Do not turn mixer motor on until chamber is filled with water, running dry will damage mechanical seal.

Step 5: Place unit power switch in On position. Mixing chamber motor starts.
Step 6: Access REM-1D controller to turn pump On/Off and for polymer output adjustment. Output can also be adjusted at pump face by varying the stroke length.

NOTE: For optimum pump performance, keep stroke frequency as high as possible. This is done by decreasing the stroke length setting. More stroke repetition with a shorter length is better than fewer strokes with a long stroke length. If stroke length is too short, pump prime may be affected.

Step 7: Adjust water flow at mixing chamber by turning control valve. (The other control valve should be turned for post-dilution adjustment, if applicable.)

NOTE: Do not run polymer pump unless water flow is established. Polymer alone can plug discharge plumbing.

WATER PRESSURE

This unit is equipped with a differential pressure switch. It has been factory set. See Appendix for details.

SOLUTION OUTPUT

Unit output is determined by setting pump stroke length and stroke frequency together with setting dilution water flow. Establish desired solution volume and solution concentration, then proceed.

EXAMPLE: 100 GPH (380 LPH) of .5% polymer solution desired. A 2 GPH (7.6 LPH) diaphragm pump is used.

— Determine neat polymer requirement.

(100 GPH) x (.005) = 0.5 GPH neat polymer
(380 LPH)) x (.005) = 1.9 LPH neat polymer

— Determine pump usage.

(0.5 GPH) ÷ (2 GPH) = 25% pump capacity
(1.9 LPH) ÷ (7.6 LPH) = 25% pump capacity

— Set Controls

A 2 GPH (7.6 LPH) pump @ 100% stroke length and 25 strokes per minute will deliver 0.5 GPH (1.9 LPH). However, 2 GPH (7.6 LPH) pump @ 50% stroke length and 50 strokes per minute will also deliver 0.5 GPH (1.9 LPH) with a more homogeneous mix.

NOTE: Do not exceed polymer concentrations of 1% in the PolyBlend.

MAINTENANCE

SHUTDOWNS

If out of service more than one week, flush mixing chamber.

- Turn pump off.
- Place unit power switch in On position to establish water flow for five minutes.

If out of service for more than two weeks, flush pump and mixing chamber.

- Connect pump suction to a container of mineral oil (not water).
- Place unit power switch in On position to establish water flow.
- Turn pump on and run for three minutes.
- Turn pump off.
- Continue water flow for five additional minutes.
- Drain water from chamber and piping to prevent freezing.

MAINTENANCE

1. Clean ancillary water and/or polymer strainers weekly.

2. Flush system monthly following one week procedure.
3. Refer to the appendix for specific information on drawings, part identification, and components.

RECOMMENDED SPARE PARTS

QTY.	PART #	DESCRIPTION
1	K2341002	Kit includes parts below:
1	SP-155HV	Pump Liquid End
1	7802910	Chamber Mechanical Seal
1	1450318	Belt, Chamber
1	1414001	Bearing, Chamber Base
1	1410002	Bearing, Chamber Top
1	28391-1	Pump Head

PUMP REPLACEMENT

QTY.	PART #	DESCRIPTION
1	AA771-155PBX	Pump

SPECIAL TOOLS

No special tools needed for operation, maintenance, and repair of components.

LUBRICATION

No lubrication is required.

PREDICTED LIFE SPAN

There is no predicted life span of wear parts as each application and operation varies.

OPERATING PROCEDURES

For normal operation, once settings are adjusted based on operation parameters, the system can simply be turned ON or OFF. Special operating instructions for Seasonal operation do not apply.

EMERGENCY OPERATING INSTRUCTIONS

Emergency operating instructions do not apply to USFilter-Stranco equipment. In case of an emergency, TURN OFF POWER TO STOP RUNNING.

DISASSEMBLY, REPAIR, & REASSEMBLY

This equipment is an open-frame design. It allows for easy removal of all components. There are no special procedures for removal of parts. If assistance is required, contact USFilter Stranco Technical Service at 800-882-6466.

PB100
TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER FLOW	• Closed valve on water supply	• Make sure valve is open
	• Blocked solenoid valve	• Disassemble and clean valve
	• Closed or clogged discharge line	• Remove any blockages or open any closed valves
	• Rate control valve closed	• Make sure valve is open
PUMP WON'T PUMP CHEMICAL	• Pump is in off position	• Make sure pump is turned on
	• No water flow	• Make sure all water valves (supply and discharge) are open
	• Blocked pump discharge line	• Take discharge line apart, check for blockage and clean if necessary
	• Back pressure is too high	• Reduce back pressure on unit
	• Differential pressure is too high	• Adjust pressure switch
CLOGGED INJECTION CHECK VALVE	• Debris or clumps in polymer	• Check polymer supply for contamination
	• Valve is stuck open allowing water into polymer line	• Remove valve from chamber and clean it
PUMP WON'T STOP	• Water flow is still established	• Shut off water valve or power to the unit
	• Pump is in internal mode	• Switch pump to external mode

Location of Differential Pressure Switch

The high pressure port connects to the inlet manifold between the solenoid valve and the rotameter/rate-adjusting valve. The low pressure port connects to the discharge side of the rotameter.

Function of Differential Pressure Switch

The differential pressure switch ensures sufficient water flow is present before the polymer pump is energized. This integral, automatic safety feature eliminates the problem of overfeeding neat polymer to an application without proper dilution.

In operation, the rate valve is adjusted to produce the desired flow through the system. This causes a pressure drop to occur across the valve which is applied to the differential pressure switch.

If supply pressure decreases enough to affect flow rate or if back pressure between the PolyBlend and the point of solution application increases enough to affect flow rate, the differential pressure across the rotameter and valve decreases. This causes power to be interrupted to the polymer pump and prevents damage to the mixing system caused by extremely high viscosity developing in the mixing chamber.

NOTICE: If system pressure or flow are not adequate, investigate the ***cause* of lack of flow.** (For example, inadequately sized piping can produce inadequate flow.) To avoid undesirable water dilution conditions and damage to equipment, **do not** bypass or adjust the differential pressure switch for a lower pressure/flow setting.

Question: *Why doesn't the polymer pump turn off when I turn the water off using the rotameter?*

The differential pressure switch senses flow on either side of a pressure drop. Because the rotameter is the sensing point, the rotameter closing is the only cause of loss of flow that the differential pressure switch cannot see.

Test the differential switch by turning off the source water or the discharge flow. (See step 5 on the next page.)

Adjusting the Differential Pressure Switch

Adjust the PolyBlend differential pressure switch only if pressure and flow to the system **are adequate**.

The adjustment logic is the **opposite** of what you might expect. The PolyBlend differential pressure switches have a red light (on the left side) that lights up whenever source water flow is too low and the polymer pump is disabled. The pump stops pumping when the flow is too low. Low flow may be from lack of incoming water or from too much back pressure on the outgoing side.

	Adjustment		**System Reaction**
1.	Turn the PolyBlend rotameter until water flow is at **maximum** on the flow gauge.		
2.	Screw in the *differential pressure knob* until the red alarm light goes on.		Polymer pump is disabled.
3.	Back off the differential pressure knob until the red alarm light goes off.		The pump starts again.
4.	4a. If you want very close control of flow, leave the knob at this setting. *At this setting, any loss of flow (as observed by the rotameter) results in the pump being disabled.*	4b. If you want to make the system "more forgiving" prior to shutdown, continue to turn the knob another 1-2 turns. *The further you turn the knob, the more flow can be lost before the pump is disabled.*	Step 4 determines how "forgiving" the system is before it shuts down due to inadequate flow.
5.	To test sensitivity and operation, turn off the water at the source *or* the solution at the discharge. The float in the flow meter will fall more for the control knob setting described in step 4b than for 4a (above).		As the source or discharge is turned off, the float in the flow meter falls and the pump is disabled.
6.	Set the rotameter for the desired flow.		Retest (as in step 5).

DIGITAL DISPLAY PUMP CONTROLLER



General Description

The REM-1D Digital Display Controller serves as either a pump remote control station or a proportional pump controller (4-20 mA input) or both. The REM-1D can be used to vary the output of any Liquid Metronics (LMI) Series A7, B7, or C7 metering pump when those pumps are placed in the external mode. This is truly a "plug-'n-play" accessory. A simple connection of 4-conductor cable from the control unit to the external input jack of the LMI pump is all that is required for start-up. Power is supplied by a 15 VDC source from the LMI pump through the 4-conductor cable.

The controller output, in the form of contact closures of 80 ms duration, triggers the LMI pump. In the internal mode, output is 0-100 strokes-per-hour (sph) or 0-100 strokes-per-minute (spm). A touch of the pressure-sensitive membrane keys varies the output, which is displayed in large, easy-to-read LCD digital format. In the external mode, output is from 0-100 sph or 0-100 spm directly proportional to the 4-20 mA analog input signal. Ten feet of 3-conductor cable and connectors are supplied as standard for the 4-20 mA application. Zero and span adjustments may be done through the outside keys of the controller.

In the "OFF" position, the 15 VDC power source will be present, but the controller output will be zero. The display will read OFF. The rugged, polycarbonate NEMA 4X enclosure is easily wall-mounted near the associated pump, or can be remotely located,

Benefits

- Provides remote control option
- Improves dosage control
- Enhances treatment program efficiencies
- Makes changing dosage easy
- Allows operator to link dosage to process variables
- Expands range of precise pump control
- Designed for industrial applications

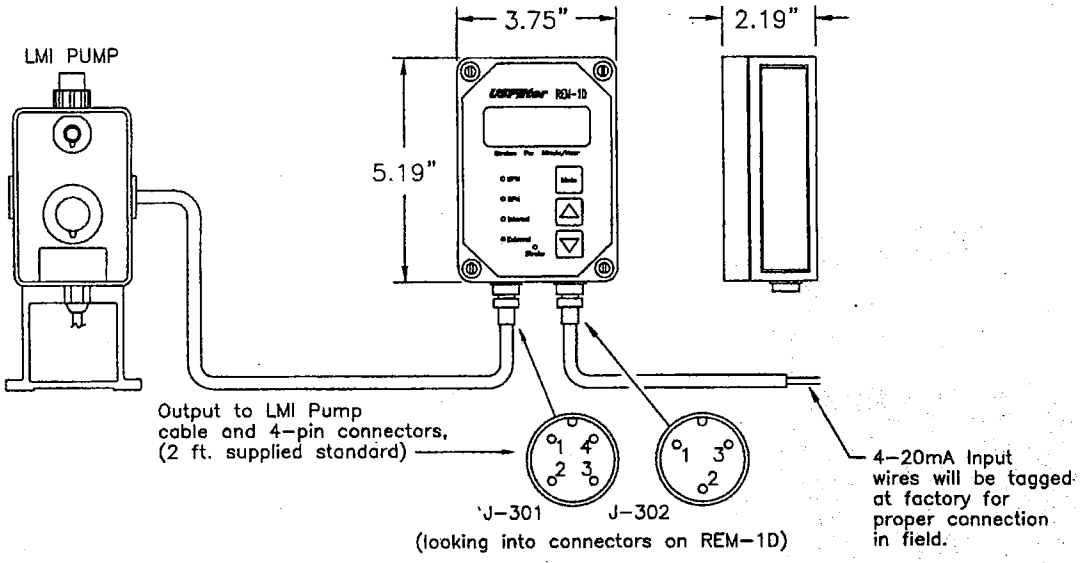
Features

- Solid-state microprocessor core
- Push-button control
- Large, easy-to-read display
- Remote control
- Proportional control (4-20 mA input) strokes-per-minute, strokes-per-hour
- Internal or external control
- NEMA 4X enclosure

USFilter

REM–1D

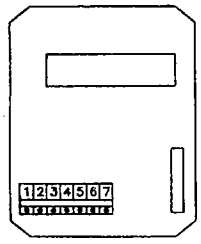
Revised 3–01



STRANCO PART NOS.

RM1974183	CABLE
2723001	3 PIN CONNECTOR
25643	4 PIN CONNECTOR

NOTE: J–301 PIN NUMBERS CORRESPOND TO IDENTICAL PIN NUMBERS ON LMI PUMP REMOTE SIGNAL INPUT CONNECTORS.



CONNECTIONS INSIDE REM–1D	J–301, J–302 CONNECTORS	CABLE CONNECTIONS		
T #2 WHITE →	J–301, Pin #1	RED	Future Use	4–Pin Connector J–301
T #4 BLACK →	J–301, Pin #3	WHITE	Power – (Common)	
T #3 GREEN →	J–301, Pin #2	GREEN	Pump Trigger (+15VDC)	
T #1 RED →	J–301, Pin #4	BLACK	Power + (+15VDC)	
T #6 BLACK →	J–302, Pin #2	BLACK	Signal Common	3–Pin Connector J–302 External Control 4–20mADC 220Ω Input Impedance
T #7 GREEN →	J–302, Pin #1	WHITE	Future Use	
T #5 RED →	J–302, Pin #3	RED	4–20 mA Signal	

ZERO AND SPAN ADJUSTMENTS

Press MODE Key to enter external mode.

1. To Set Display/Output Ranges:
   - A. Press MODE key to enter external mode.
   - B. Press all 3 keys simultaneously and release. SPM and SPH LEDs will light up.
   - C. Use UP/DOWN ARROW keys to set maximum display range.
   - D. Press MODE key to accept and then INTERNAL and EXTERNAL LEDs will light up.
   - E. Use UP/DOWN ARROW keys to set minimum display range.
   - F. Press MODE key to accept and return to normal operation.
2. To Calibrate 4mA Point:
   - A. Input 4mA into REM–1D.
   - B. Press and hold DOWN ARROW key.
   - C. Press MODE key (while still pressing DOWN ARROW key).
3. To Calibrate 20mA Point:
   - A. Input 20mA into REM–1D.
   - B. Press and hold UP ARROW key.
   - C. Press MODE key (while still pressing UP ARROW key).

* NOTE: GASKET KIT P/N K7809901 AVAILABLE FOR PANEL MOUNTING.

USFilter
Stranco Products
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http://www.stranco.com
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Lit No. IH-0702

VIVENDI
Environnement company

DIAPHRAGM PUMP INFORMATION

WARNING: ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing and maintenance or replacement on your pump. See MSDS Sheet from polymer supplier foe additional precautions.

OUTPUT ADJUSTMENT CONTROLS

In most external controlled pumps the uppermost knob serves as speed control. Graduations for the Speed Knob appear directly on the face of the control panel. The largest knob below is Stroke Control.

1. Speed adjustment: Speed control provides adjustment of the percent of maximum strokes per minute. Turning this clockwise increase stroke frequency. **Note AA7 Series Only:** When operating pump in the external mode, the speed control knob should be fully turned counter clockwise. A click indicates pump is in external mode.
2. Stroke Adjustment; Stroke control provides adjustment of percent of maximum Liquifram (diaphragm) travel. Turning this knob counterclockwise increases percent output per stroke. Only adjust while pump is running.

PRIMING THE PUMP

Hold tip of syringe firmly in fitting with one hand while using the other hand to pull back on plunger. Repeat until a small amount of polymer is drawn into the syringe. The pump is now primed.

PUMP CALIBRATION

Perform calibration if your system application requires it. Normally calibration is NOT required.

You will need:
- A watch
- A calculator
- Calibrated cylinder (with at least 1000 ml capacity.
- Length of hose or tubing (same I.D. as pump ports)

1. Maintain all usual connections to the PolyBlend unit except disconnect the polymer suction line at pump input. The flow meter and pump setting should be those used for normal service.

2. Connect hose or tubing to the pump input. Place the free end of the tubing in the graduated cylinder.

3. Fill the cylinder with polymer to its measured capacity (for example, 1000 ml etc.).

4. Turn on the metering pump. Allow the pump to run until all air has been exhausted from the tubing and pump and polymer is injected into the mixing chamber.

5. Stop the pump.

6. Refill the cylinder to the measured capacity.

7. Start the pump again, and start timing as the pump runs. For best results, let the pump run long enough to pump at least half of the polymer out of the graduated cylinder. (in general, the longer the calibration period, the greater the accuracy of the measurement).

8. Stop the pump. Record the time and level of the polymer remaining in the cylinder. Fill in the following equation to find the volume of polymer pumped per one unit of time (a minute, an hour, or a day).

$$\frac{\text{Starting ml - Remaining ml}}{\text{Calibration period}} = \text{ml/Time}$$

9. Compare the actual volume pumped to the desired volume, and adjust pump controls.

10. Check volume again to confirm the new settings.

PRESSURE CONTROL
(B and C series only)

A capped potentiometer is located on the face plate of the diaphragm pump. This potentiometer is for pressure control or power to the pump solenoid. Since the PolyBlend unit is equipped with a 20 PSI backpressure/check valve, the potentiometer should be set for full power or full clockwise.
NOTE: This is preset at the factory. In a case where obvious over-pumping is present, this potentiometer may be adjusted counter-clockwise.

Liquifram (Diaphragm) Replacement

When replacing the Liquifram, valve balls, seal rings and the injection check valve spring should also be replaced.

1. Carefully depressurize, drain and disconnect the pump discharge and suction lines. Place the suction tubing into a container of mineral oil. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the suction tubing out of the mineral oil and continue to pump air into the pump head until the pump head is purged.

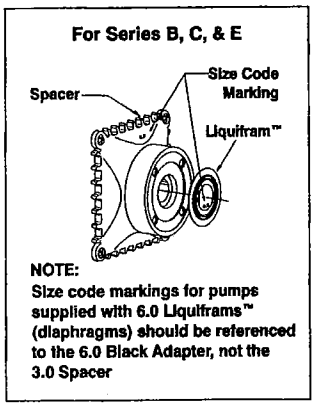
2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

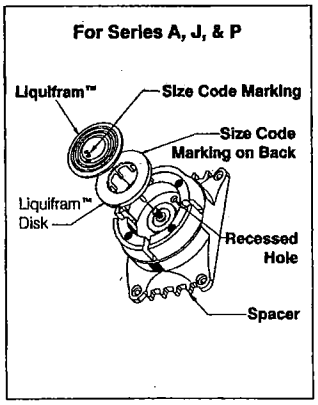
NOTE: See section on proper zeroing.

3. With the unit off, unscrew the Liquifram by carefully grasping the outer edge of the Liquifram and turning it counter clockwise. Discard old Liquifram disk if so equipped (locate behind the Liquifram) and check that the size code matches the size code on the replacement Liquifram (see illustration).

4. Reinstall the disk so alignment pin on the disk (if present) seats in the recessed hole in the EPU.

WARNING: Take care not to scratch the Teflon face of the new Liquifram.



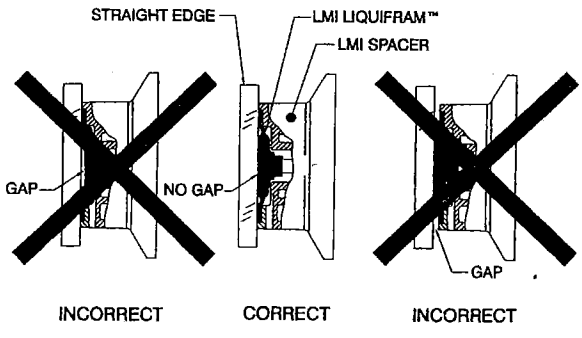


5. Start the pump and turn the stroke knob to the setting indicated on the Stroke Setting Chart which matches the pump model number located on the pump dataplate. With the pump stoking (running), screw on the new Liquifram clockwise until the center begins to buckle inward. Stop the pump.

Liquifram Stroke Setting Chart

Pump Series	Stroke Knob Settings
A11 AA, B72, C72,	90%
C77	70%

6. Grasp the outer edge of the Liquifram and adjust by screwing it in or out so that the center of the Liquifram is flush with the outside of the spacer edge (see illustration).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a crisscross pattern. After one week of operation, recheck the screws and tighten if necessary.

Seal Ring, Ball and Injection Check Valve Spring Replacement

1. Carefully depressurize, drain and disconnect the discharge and suction lines. Place the suction tubing into a container of mineral oil. Turn the pump on to flush the head assembly. After flushing, lift the suction tubing out of the mineral oil and continue to pump air into the pump head until the pump head is purged. If the liquid cannot be pumped due to Liquifram rupture, with protective gloves, carefully disconnect the tubing and four screws to remove the head. Immerse the head in mineral oil or other neutralizing solution.

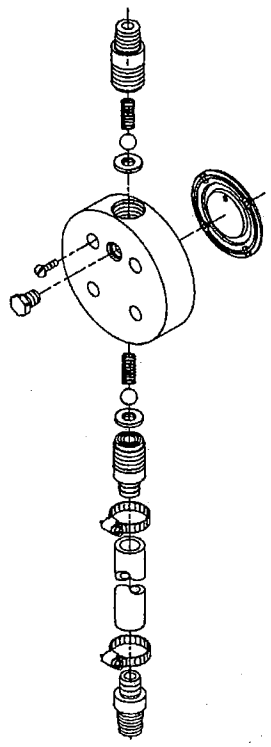
IMPORTANT: Before disassembling valves, note the orientation of seal ring and ball. (See illustration).

2. Carefully disconnect one tubing connection and fitting at a time and remove the worn seal ring and ball. Carefully loosen sealing by prying side to side using a small screw driver through the center hole of the seal ring.

3. Install new seal ring and ball in each location.
IMPORTANT: Note correct orientation.

4. Install the new spring valve in the Injection Check Valve.

Seal Ring, Ball and Injection Check Valve Spring Replacement



Order of Installation

Check Pump for Proper Zeroing (Stroke Knob)

1. With pump running, turn stroke knob counter clockwise toward zero or end of black or red band.

2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).

3. If the pump continues to click at zero or stops clicking before zero is reached, the pump must be reset.

Type I – Push on Knob
Rezeroing and Stroke Knob Disassembly and Assembly

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.

2. Pry off the yellow cap.

3. Place the knob on a flat surface.

4. Using needle nose pliers, squeeze the inner section up together while lifting the outer section up.

5. Push the inner section back onto the "D" shaped stroke shaft.

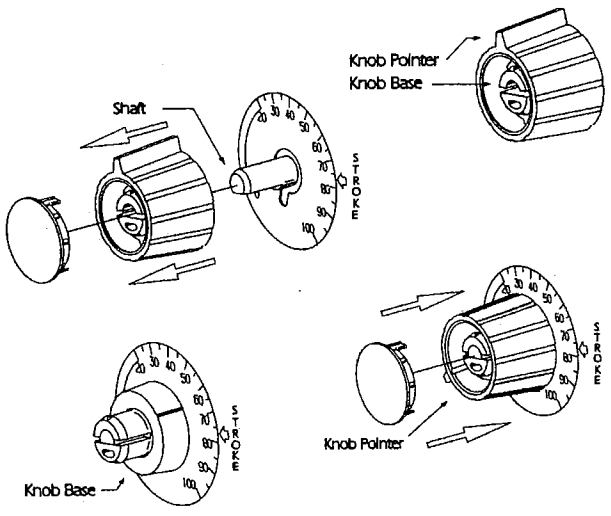
6. With the pump running, zero the pump by turning the inner section of the knob counter clockwise until the pump stops clicking.

7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.

8. Push down on the outer section (a snap sound indicates parts are locked together).

9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



Type III Collet Knob
Rezeroing and Stroke Knob Disassembly and Assembly

1. Remove yellow cap.

2. Hold knob with soft jaw pliers.

3. Disconnect knob by loosening 5/16" (8mm) collet nut. There is no need to remove nut.

4. Remove knob by pulling towards you.

5. With pump running, zero the pump using a screwdriver to turn the stroke shaft counter-clockwise until the pump just stops clicking.

6. Pump is now zeroed.

7. Position knob at zero, or the end of the low range band, and tighten 5/16" (8mm) collet nut.

8. Replace yellow cap.

BODINE® ELECTRIC COMPANY

MOTOR/GEARMOTOR SAFETY, INSTALLATION, USE, AND MAINTENANCE INFORMATION

Bodine Electric Co., 2500 W. Bradley Pl., Chicago, IL 60618 U.S.A.

Form P/N 074 00045 Printed in U.S.A. (OH)

Congratulations . . . and thanks on your selection of a Bodine Motor/Gearmotor. With your new drive unit you will find yourself enjoying the same high performance and relatively trouble free operation that have been characteristic of Bodine products since 1905. We call it ADE (After Delivery Economies).

The Bodine Electric Company prides itself on the quality of design and manufacture of its products. Great care is taken in an attempt to provide products free of defective design, workmanship, or materials. It will be considered a favor to have cases of unsatisfactory service from Bodine products brought to our attention.

SAFETY

"The use of electric motors and generators, like that of all other utilization of concentrated power, is potentially hazardous. The degree of hazard can be greatly reduced by proper design, selection, installation, and use, but hazards cannot be completely eliminated. The reduction of hazard is the joint responsibility of the user, the manufacturer of the driven or driving equipment, and the manufacturer of the motor or generator."■

Bodine products are designed and manufactured to comply to applicable safety standards and in particular to those issued by ANSI (American National Standards Institute), NEMA (National Electrical Manufacturers Association), U.L. (Underwriters Laboratories, Inc.), and CSA (Canadian Standards Association).

Most Bodine products are "third party approved" with respect to construction. Motors and gearmotors having component recognition by U.L. Inc. have a "C" or "ℛ" symbol in the left-most unlabeled space on the bottom row of their nameplates. Those that are CSA certified have a "Ⓒ" mark in the same location. If you need specific information regarding the "third party approval" of Bodine products, contact your Bodine representative, or the home office.

However, since even well-built apparatus can be installed or operated in a hazardous manner, it is important that safety considerations be observed by the user. With respect to the load and environment, the user must properly *select, install,* and *use* the apparatus—for guidance on all three aspects see safety standards publication No. ANSI/NEMA MG-2.■

■Standards Publication No. ANSI/NEMA MG-2. "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators."

Available from:
National Electrical Manufacturers Assoc.
2101 L Street N.W.
Washington, D.C. 20037, U.S.A.

SELECTION

Before proceeding with the installation, the user should review the application to confirm that the proper drive has been selected. This should be done after reading this notice and all applicable safety standards. If in doubt, contact your Bodine Representative or the Home Office if there is no Representative in your area. Any selection or application suggestions made by Bodine are only to assist the customer—and in all cases, determination of fitness for purpose or use is solely the customer's responsibility.

Unless otherwise agreed to by Bodine, all nameplate ratings are based on the following *normal operating conditions:*

1. Duty—8 hours per day; 5 days per week if nameplated continuous duty (CONT), without frequent reversals or starts and stops. Products intended for intermittent duty show a time rating on the nameplate based on keeping the winding temperature within the maximum allowable temperature of the insulation system when the motor is started with windings within 5°C of the ambient temperature.
2. Ambient temperature 0 to 40°C (104°F).
3. Load—Uniform and free from shock or high inertia.
4. Voltage—Within 10% of nameplate rating.
5. Frequency—Within 5% of nameplate rating.
6. Combined variation of voltage and frequency—Within a total of 10% providing frequency variation does not exceed 5%.

Consult Bodine if variations from the above conditions are contempated.

INSTALLATION

It is the responsibility of the equipment manufacturer or individual installing the apparatus to take diligent care in installing it. The National Electrical Code (NEC), sound local electrical and safety codes, and when applicable, the Occupational Safety and Health Act (OSHA) should be followed when installing the apparatus to reduce hazards to persons and property.

Inspection

Examine for damage from shipment before connecting. Any claim(s) for shipping damage should be made to the freight carrier. Do not attempt to turn the output shaft of a gearmotor with an externally applied torque arm.

Mounting

Any screws, or similar devices, that penetrate the motor frame either for mounting the Bodine product or mounting something to the product should be limited in length so as not to come in contact with, or in close proximity to, intended features that conduct electricity. Spacings as high as .158" may be required based on voltages and circuitry involved. Consult factory if necessary.

Preferred mounting positions for Bodine products are illustrated in selection literature. Gearmotor mountings other than those shown are not recommended on some *gearmotors* due to (a) the possibility of gearhead lubricant leakage into the motor portion and (b) possible leakage from gearhead breather and oil level holes. Also, for parallel-shaft gearmotors, the proper lubricant quantity provided for horizontal mounting is not sufficient for vertical mounting. By making the proper adjustments (normally done at the factory), mountings other than the preferred positions of gearmotors are possible.

Connection

Follow nameplate for voltage, frequency, and phase of power supply. See accompanying wiring diagram as to connections for rotation (and capacitor, resistor, relay, protector, if required). *When connecting, make sure that your motor/gearmotor is securely and adequately grounded—failure to ground properly may cause serious injury to personnel.* (If wiring diagram shipped with drive unit becomes lost or missing, contact Bodine, providing serial number (NO) and (TYPE) information shown on the nameplate of the unit).

Wiring

For wire sizes and electrical connections refer to the National Electric Code (NEC)—Article 430—"Motors, Motor Circuits, and Controllers" and/or applicable local area codes. If extension cords are used, they should be kept short for minimum voltage drop. Long or inadequately sized cords can cause motor failure, particularly with hard starting loads when current draw tends to be at its highest.

USE

Additional Safety Considerations

The chance of electric shocks, fires, or explosions can be reduced by giving proper consideration to the use of grounding, thermal and over current protection, type of enclosure, and good maintenance procedures.

The following information *supplements* the foregoing safety considerations: This information is not purported to be all-inclusive and the aforementioned references should be consulted.

1. Do not insert objects into the ventilation openings of products.
2. Sparking of starting switches in AC motors so equipped, and of brushes in commutator type motors, can be expected during normal operation. In addition, open-type enclosures may eject flame in the event of an insulation failure. Therefore, avoid, protect from, or prevent the presence of flammable or combustible materials in the area of motors/gearmotors.
3. Bodine totally enclosed products are not explosion proof or dust ignition proof nor does Bodine offer such products for hazardous locations (flammable/explosive gas, vapor, dust). When dealing with hazardous locations, an *approved* explosion proof or dust ignition proof product is the recommended approach. Exceptions are allowed by the National Electrical Code: The NEC and the NEMA safety standard should be studied thoroughly before exercising this option.
4. Open, ventilated motors are suitable for clean, dry locations where cooling air is not restricted. Enclosed motors/gearmotors are suitable for dirty, damp locations. For outdoor use, wash downs, etc., enclosed motors must be protected by a cover while still allowing adequate air flow.
5. Moisture will increase the electrical shock hazard of electrical insulation. Therefore, consideration should be given to the avoidance of (or protection from) liquids in the area of motors. Use of totally enclosed motors/gearmotors will reduce the hazard if all openings are sealed.
6. Products equipped with thermal protectors are labeled "THERMALLY PROTECTED." If severe over-loading, jamming, or other abnormal operating conditions occur, such heat sensitive protectors operate to open the electric power supply circuit. Motors/gearmotors with "automatic" thermal protectors MUST NOT be used where automatic restarting of the drive unit could be hazardous in that clothing or parts of the human body could be in electrical or physical contact with a machine that *starts unexpectedly* when the thermal protector cools down. MANUAL RESET protectors or suitable electric supply disconnect devices/procedures should be used where such hazards could be created.

7. The windings of DC stepper motors, or their switching transistors, must be disconnected from the DC power source to avoid unexpected motion. If not, extraneous signals could turn on the power transistors and generate motion.
8. Some oil-type capacitors contain a non-PCB impregnate which is *flammable*. Such capacitors are identified by means of a Warning Label and, in addition, are stamped "NON-PCB." The user has to provide at least .57 in. (14.5mm) clearance beyond the terminal blades for case expansion to allow an internal safety switch to *permanently* open and electrically disconnect the capacitor. The internal pressure sensitive switch is designed to prevent the expulsion of the flammable dielectric medium if excessive temperatures are generated by electrical operation. Do not discard such capacitors into open fire as excessive external heat could cause them to explode.
9. Motors/gearmotors which employ capacitors, can develop more than nameplate voltage across the capacitor and/or capacitor winding (depending on design). Also, overdrive voltages may be many times greater than a stepper motor's continuous voltage rating. Suitable precautions should be taken when applying such motors.
10. Abnormal conditions such as cut-out switch failure, or a partial winding failure can very occasionally cause some AC motors/gearmotors to start in a direction reverse from normal. Also, use a capacitance or resistance value other than that recommended for Hy-Sync™ motors may result in unpredictable reverse operation. Susceptability to unplanned reversing under such conditions is greatest when the motor's actual load is light relative to it's rated load. One-way clutches or similar devices are advisable if unexpected reverse rotation is unsafe in the application.
11. Do not rely upon self-locking gears or permanent magnet, stepper, Hy-Sync™, or energized motors to hold a load in place if movement could result in personal injury. Mechanical looking devices should be used in such applications.
12. For motors driven by electronic controls, do not use a function of the control for safety interlock purposes. An independent switch or relay should be used. On stepper motors, the device should be between the control and the motor.

Before Starting

1. Before attempting to start, check all connections and fuses.
2. Proper consideration should be given to rotating members: Before starting, be sure keys, pulleys, etc. are securely fastened. *Proper guards should be provided to prevent hazards to personnel while rotating.*
3. Other mechanical considerations include proper mounting and alignment of products and safe loads on shafting and gearing.

Starting

1. The motor/gearmotor should be test-started in an unloaded state (because of possible reaction torque, the drive should be securely mounted when starting—even when unloaded).
2. If the drive unit does not start promptly and run smoothly, disconnect at once.
3. If unable to correct the problem, contact your purchase source, or a Bodine Authorized Service Center, describing the trouble in detail. Include the serial number, type, and other nameplate data. Do not dismantle the product—unless authorized by Bodine, removing screws voids the warranty.

MAINTENANCE

IMPORTANT—*Before* servicing or working on equipment, disconnect power source (this applies especially to equipment using automatic restart devices instead of manual restart devices and when examining or replacing brushes on brush-type motors/gearmotors).

Clean regularly to prevent dirt and dust from interfering with ventilation or clogging moving parts.

Brush Type Motors/Gearmotors—The wear rate of brushes is dependent upon many parameters (armature speed, amperage duty cycle, humidity, etc.). For optimum performance, brush-type motors and gearmotors need periodic user-maintenance. The maintenance interval is best determined by the user. Inspect brushes regularly for wear (replace in same axial position). Replace brushes when their length is less than ¼ inch (7mm). Periodically remove carbon dust from commutator and inside the motor—this can be accomplished by occasionally wiping them with a clean, dry, non-linting cloth. Do not use lubricants or solvents on the commutator. If necessary, use No. 0000 or finer sandpaper only to dress the commutator. Do not use solvents on a non-metallic endshield if the product is so equipped.

Products Employing Capacitors—Before servicing motors/gearmotors employing capacitors, always discharge the capacitor by placing a conductor across its terminals before touching the terminals with any part of your body.

LUBRICATION INSTRUCTIONS

Motor Ball Bearings (not gearhead bearings)—are grease lubricated and do not normally require re-lubrication or replacement for a period of approximately five years if run under normal operating conditions (defined above). More adverse conditions generally require more frequent servicing. Do not over-grease ball bearings as shortened life can result.

Motor Sleeve Bearings (not gearhead sleeve bearings)—sleeve bearing motors are identified by the presence of oil holes or oilers on the motor endshields. Motor sleeve bearings should be re-lubricated every six months or 1000 operational hours (whichever comes first) when used under normal operating conditions as defined above. For motors under (4) inches in diameter, re-lubricate with 5-6 drops of SAE No. 10 non-detergent oil (Bodine #LO-30). For larger diameter motors, re-lubricate with 5-6 drops of SAE #20 non-detergent oil (Bodine #LO-17). More severe conditions will require more frequent servicing. Do not over-lubricate.

Gearhead Lubrication—Gearmotors consists of a motor portion and a gearhead portion. The previous sections dealt with motor bearings—the following text concerns gearhead (gear and gear-shaft bearing) lubrication.

A. *Oil Lubricated Gearmotors* (identified by the presence of an oil level sight gauge or plug marked "Oil Level"). Oil lubricated gearheads are shipped with a red plastic plug in their vent holes. *Remove red plastic plug from oil fill vent hole before starting.* (Gearbox must be vented to prevent internal pressure build-up as the unit heats up.) When operating under normal operating conditions, check oil level every 4 to 5 months or 600 operating hours—whichever occurs first.

   1. *Type "-10" Gearheads:* These gearmotors are identified by the "10" appearing after a hyphen in the TYPE box on the nameplate. For example; N□□-1□0□ (where the identifying designators are illustrated and a '□' indicates the location of any other number or letter). Refill "-10" gearheads to the indicated oil level with a good quality rust and oxidation inhibited oil conforming to AGMA#5 (SAE#50 non-detergent) with a viscosity range of 918-1122 SUS @ 100°F, viscosity index of 90 minimum, and pour point of 0°F (minus 17.8°C) max., or Bodine lubricant #LO-38. Do not over-fill.

   2. *Oil Lubricated Gearmotors other than Type "-10":* These gearmotors can be identified as follows: examine the nomenclature in the "TYPE" box on the nameplate; if any of the combinations of numbers and letters defined below appear after a hyphen, the gearmotor is oil lubricated. (The identifying designators are illustrated and a "□" symbol indicates the position of any other number or letter).

      -3□RHL -5□RL -3□RJ
      -5F -5N -5H

      Examples: NCI-34RHL (-3□RHL)
      32D5BEPM-5F (-5F)

      Refill these gearmotors to oil level indicated on the respective product with a good quality worm gear oil conforming to AGMA #5 EP compounded (SAE #90) oil, or Bodine lubricant #LO-23. Do not over-fill.

   3. *Note:* For test and run-in of gearmotors that are applied to equipment for resale, remove red plastic vent hole plug from oil fill vent hole. If gearmotor may be tipped during shipment, replace plastic plug and include instructions to remove the plug before operating the gearmotor.

B. *Grease Lubricated Gearmotors:* Grease lubricated gearmotors can be identified as follows: examine the nomenclature in the "TYPE" box on the nameplate; If any of the combinations of numbers and letters defined below appear *after a hyphen,* the gearmotor is grease lubricated. (The locations of the identifying designators are illustrated and a '□' symbol indicates the position of any other number or letter).

   -2□A□ -2□R□ -1□R -1□RH* -3□R*
   -1□RG -3□RH -5□R* -W□ -E□ -F□

   Examples: NSI-12R (-1□R)
   42R5BFCI-E3 (-E□)

   The above gearmotors are supplied with sufficient grease to last for the "design life" of the gearmotors. Some right-angle gearheads may have oilers on their output shaft hubs. The oilers should be relubricated every three months with 5-6 drops of SAE #20 non-detergent oil (Bodine #LO-17).

C. *General*—The above recommended lubricants may be purchased in one pint containers from the Bodine Electric Company, 2500 West Bradley Place, Chicago, Illinois 60618, U.S.A., or a Bodine Authorized Service Center. Gearmotors should be re-lubricated only with recommended lubricants for maximum life of gears, bearings, and seals.

BODINE LIMITED WARRANTY

The Bodine Electric Company warrants all products manufactured by it to be free of defects in workmanship and materials when used under Normal Operating Conditions and when applied in accordance with nameplate specifications. This warranty shall be in effect for a period of twelve months from date of purchase or eighteen months from date of manufacture, whichever comes first.

The Bodine Electric Company will repair or replace at its option, any of its products which has been found to be defective and is within the warranty period, provided that the product is shipped freight prepaid, with previous authorization, to Bodine's plant in Chicago, Illinois 60618 U.S.A., or to the nearest Bodine Authorized Service Center. At its option, all return shipments are F.O.B. Bodine's plant or Authorized Service Center. Bodine is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to or from Bodine.

This warranty is in lieu of any other expressed or implied warranty—including (but not limited to) any implied warranties of merchantability and/or fitness for a particular use or purpose.

Bodine's liability under this warranty shall be solely limited to repair or replacement of the Bodine product within the warranty period and Bodine shall not be liable, under any circumstances, for any consequential, incidental or indirect damages or expenses associated with the warranted products.

Commutators and/or brush wear and its associated effects are a normal occurrence and are not covered by this warranty unless otherwise agreed to by Bodine in writing.

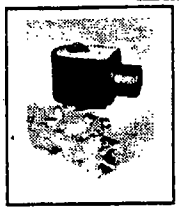
Any Bodine product which is damaged due to misuse, abuse, negligence or has been modified or dismantled without the knowledge or written consent of Bodine, is not covered by this warranty.

Motor/Gearmotor Serial No._____ Purchase Date_____ Installed By_____

SKINNER VALVE
Parker Hannifin Corporation
95 Edgewood Avenue
New Britain, CT 06051
Telephone (860) 827-2300

IOM7218

Parker
Climate & Industrial Controls





INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS
2-WAY N.C. AND N.O. PILOT OPERATED VALVES
3/8", 1/2", 3/4" and 1" NPT
1-1/4", 1-1/2" and 2" NPT
WATER VALVE TYPES: 7321B

CE

DESCRIPTION

The 7321B valves are 2-way, pilot operated diaphragm valves requiring a minimum operating pressure differential to insure valve operation. Valves are available in normally closed (N.C.) and normally open versions of brass construction. Valves may be ordered with either NEMA 2, 4, 4X integrated coils for ordinary locations or NEMA 4, 4X, 7, and 9 for hazardous locations: Divisions I and II; Class I, Groups A, B, C, and D; Class II, Groups E, F, and G. Additional solenoid coils and enclosures are offered as described in our catalog.

PRINCIPLES OF OPERATION

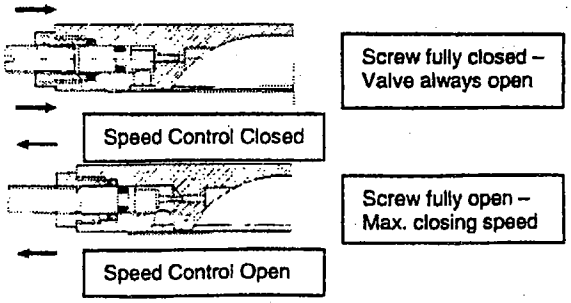
Normally Closed type: 7321B

De-energized: A flow arrow on the body indicates flow direction. Ports are not marked. Pressure is connected to the inlet port. The fluid enters the valve below the diaphragm assembly, flows through the diaphragm bleed hole and fills the cavity above the diaphragm. The diaphragm is pressed against the main orifice by the force of the plunger spring and the fluid pressure sealing the main orifice. The plunger seals the diaphragm pilot orifice and there is no flow through the valve.

Energized: Low differential pressure operation: With very low differential pressure, energizing the coil creates a magnetic force sufficient to lift the plunger off the pilot orifice and vents the pressure above the diaphragm. The venting creates a pressure imbalance across the diaphragm, which causes the diaphragm to open the valve main orifice allowing flow through the valve. The valve will remain open as long as the coil is energized.

Metering Valves (Closing Speed):

Metering described is optional – these descriptions and operating instructions apply only to valves that have been equipped with the appropriate metering.



Valves with the metering screw feature located in the cover function the same as the above valves except during de-energizing the closing of the diaphragm assembly is slowed by adjustment of a speed control metering stem.

Manual Overrides Valves:

Manual overrides described are optional – these descriptions and operating instructions apply only to valves that have been equipped with the appropriate manual override.

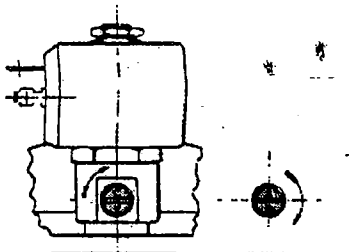


Fig. 1 Fig. 2

The unit is shipped with a manual override feature. The manual control is used to operate the valve without connecting the coil. The slotted control screw has two positions:
Closed: To function, turn the slotted screw component located in the cover below the sleeve tube so the letter "C" is in the upper position of the screw head (Fig. 1).
Open: To function, turn the slotted screw head so the letter "A" is in the upper position of the screw head (Fig. 2).

Normally Open type: 7322B

De-energized: A flow arrow on the body indicates flow direction. Ports are not marked. Pressure is connected to the inlet port. The fluid enters the valve below the diaphragm assembly lifting the diaphragm open allowing flow through the valve. The valve will remain open as long as the coil is de-energized.

Energized: The plunger moves, closing the pilot orifice, which causes the pressure to build up above the diaphragm. The increased pressure and the diaphragm spring cause the diaphragm to close the main orifice,

stopping flow through the valve. The valve will remain closed as long as the coil is energized.

NOTE: When the valve is removed from the box, the diaphragm will be closed. Line pressure will open the valve.

CAUTION: A minimum operating pressure differential is required for proper valve operation. Consult nameplate rating.

FLUID CODES

Listed below are the codes utilized by Underwriters Laboratories (UL) and the Canadian Standards Association (CSA) for various common fluids. The codes for those fluids that are approved or certified by the agencies for use with each valve are printed on the outside of the individual packaging.

CODE	FLUID
S	- Steam
W	- Water or other aqueous nonflammable liquids

For the maximum fluid temperatures, as well as valve ambient limitations, check the valve part number on the nameplate and refer to the catalog.

INSTALLATION INSTRUCTIONS

Mounting position and pressure limits: Valves can be mounted directly on piping and are designed to operate in any position. However, for optimum life and performance the valves should be mounted vertically upright so as to minimize wear and reduce the possibility of foreign matter accumulating inside the sleeve area possibly resulting in valve failure

Line pressure must conform to nameplate rating.

Piping: Remove protective closures from the ports. Connect line pressure to the upstream port. An arrow on the body indicates direction of flow. Use of Teflon tape, thread compound or sealants are permissible, but should be applied sparingly to male pipe threads only.

CAUTION: *Do not allow foreign particles, Teflon tape, or thread compound to enter valve. Only the wrench flats provided on the body ports should be used in applying the torque. Tightening torque should not exceed the following values for each port size:*
3/8" NPT – 250 in-lbs. 1/2" NPT - 350 in-lbs.
3/4" NPT – 450 in-lbs. 1" NPT - 600 in-lbs.
1-1/4" NPT – 700 in-lbs. 1-1/2" NPT – 750 in-lbs.
2" NPT – 950 in-lbs.
***Do not use sleeve or enclosure as a lever when applying torque. Connect outlet line to opposite port.** Only use wrench flats provided on the body when applying torque.*

Media filtration: For protection of the valve, install a suitable strainer or filter in the inlet side as close to the valve as possible. Recommended strainer of 100 microns or better. Dirt or foreign material in the media may cause excessive leakage, wear, or in exceptional cases, malfunction. Clean periodically depending on service conditions.

Lubrication: Lubrication is not required although air line lubrication will substantially increase valve life.
CAUTION: *Valve types with an "E" in the 10th position of part number have parts made from ethylene propyene rubber and must not be exposed to petroleum based lubricants or other hydrocarbons.*

ELECTRICAL CONNECTION: Electrical supply must conform to nameplate rating. Connect coil leads or terminals to the electrical circuit using standard electrical practices in compliance with local authorities and the National Electrical Code.

Do not power coil until it has been fitted and the retaining washer and screw have been installed to prevent possible coil damage from overheating.

WARNING: *Valves to be installed in **Hazardous Locations** must be outfitted with Hazardous Location coils only. Verify nameplate data and coil part number before installing the valve.*

WARNING: *Turn off electrical power before connecting the valve to the power source.*

If the coil assembly is located in an inconvenient orientation, it may be reoriented to facilitate installation. Loosen coil assembly nut, rotate coil assembly to desired position, and then retighten the nut with an input torque of 43-53 in-lbs.

DIN Coil and Various Cable Option Terminations: Loosen cable screw and remove plastic housing from DIN coil. Do not remove the gasket from the DIN spades on the coil. Separate the plastic block from the housing with a small screwdriver to expose the electrical terminations. Feed the lead wires through the DIN connector housing and attach them to the appropriate screw terminal. Snap the plastic block back into place. Replace the plastic housing onto the DIN spades and tighten the screws. To secure the housing and coil together. Apply 20 to 30 in-lbs. torque to the mounting screw.

DIN Coil and Terminal Box Assembly (Coil / Option Codes D1DB, D2DB, D3DB): Loosen cover screws and swing cover 90° toward the conduit hub in order to access the interior space. Separate the plastic block containing the screw terminals from the metal enclosure using a small Flathead screwdriver. Feed the lead wires through the conduit hub and attach them to the appropriate screw terminal. For electrical connection within the terminal box, use field wire that is rated for 90° C or greater. Snap the plastic block back into place inside the metal enclosure. Replace the cover and hand-tighten the cover screws. Place the gasket over the DIN spades on the coil and press the terminal box and coil together. Secure the terminal box to the coil using the mounting screw provided. Apply 20 to 30 in-lbs. torque to the mounting screw.

Screw Terminal Coil and Terminal Box Assembly (Coil / Option Codes S1TB, S2TB, S3TB): Loosen cover screws and swing cover 90° toward the conduit hub in order to access the interior space. Feed the lead wires through the conduit hub and attach them to the

appropriate screw terminal. For electrical connection within the terminal box, use field wire that is rated for 90° C or greater. Replace the cover and hand-tighten the cover screws. Press the terminal box and coil together. Secure the terminal box to the coil using the mounting screw provided. Apply 20 to 30 in-lbs. torque to the mounting screw.

CAUTION: *When the DIN or Screw Terminal coils are used with the Terminal Box Assembly, be sure to apply a wrench to the wrench flats on the conduit hub when installing electrical conduit.*

Coil/enclosure temperature: Standard valves are supplied with coils designed for continuous duty service. Normal free space must be provided for proper ventilation. When the coil is energized continuously for long periods of time, the coil assembly will become hot. The coil is designed to operate permanently under these conditions. Any excessive heating will be indicated by smoking and/or odor of burning coil insulation.

For the maximum valve ambient conditions, as well as the fluid temperatures, check the valve part number on the nameplate and refer to the catalog to determine the maximum temperatures.

MAINTENANCE

Note: Depending on service conditions, fluid being used, filtration, and lubrication, it may be required to periodically clean and/or replace worn components. See Disassembly Instructions.

CAUTION: *Do not expose plastic or elastomeric materials to any type of commercial cleaning fluid. Parts should be cleaned with a mild soap and water solution.*

DISASSEMBLY INSTRUCTIONS

WARNING: *Depressurize system and turn off electrical power to the valve before attempting repair.*

The valve body need not be removed from the line.

To remove the coil assembly:

For both ordinary and hazardous location constructions, unscrew the nut on the top of the coil assembly. The wave washer and coil assembly can now be removed.

To disassemble the pressure vessel:

CAUTION: *Do not use a pipe wrench directly on the sleeve tube.*

Use a 7/8" (22mm) wrench or an adjustable wrench to remove the sleeve tube. The plunger, return spring and flange seal may be removed.

Unscrew the four (4) or (6) cover screws. The diaphragm assembly, return spring, and O-ring can now be removed. On metering valves, the speed control feature can also be removed at this time. If the cover cannot be easily lifted off the body, laterally tap the cover or gently pry the cover from the body. Care must be taken not to damage the diaphragm, cover or body.

Replacement Parts: When ordering replacement parts kits, specify valve number and voltage from nameplate. Parts kits are available for each valve. Parts included in each kit are marked with an **asterisk** (*). See section drawing and component tabulation.

REASSEMBLY INSTRUCTIONS

WARNING: *Valves equipped with **Hazardous Location** coils must use Hazardous Location replacement coils only. Verify nameplate data and coil part number before installing the replacement coil.*

To reassemble the pressure vessel:

Refer to exploded view drawings. Assemble the O-ring into the body groove. For valves with the metering feature, replace the O-rings and reassemble the speed control device at this time. Install the diaphragm assembly into the body. Making sure the diaphragm tab is located over the outlet port of the body. Line up the diaphragm bolt holes with the appropriate bolt and flow holes in the body. Install the screws and tighten screw with a torque of 70-80 in-lbs for the 3/8" and 1/2" sizes and 125-150 in-lbs for the larger port size valves. Avoid damaging the main orifice when placing the diaphragm assembly in the valve.

Install the manual override (where applicable) into the cover prior to sleeve assembly. Insert the manual override into the valve cover. Rotate the override until the large flat surface of the override is facing out of the cover. This orientation is required for proper sleeve assembly.

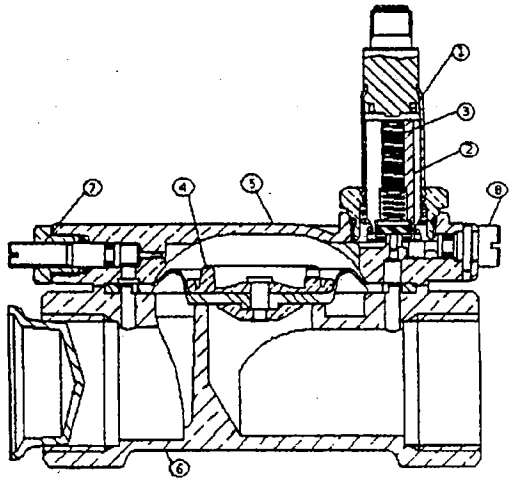
If the sleeve was removed from the cover, install the plunger and spring into the sleeve. Tighten the sleeve assembly with an input torque of 230-250 in-lbs.

With the coil assembly repositioned on the sleeve, slide the wave washer over the sleeve and tighten coil assembly nut with an input torque of 43-53 in-lbs.

After re-assembly, it is advisable to thoroughly check for leakage and for correct operation of the valve.

Refer to the Installation Instructions for remaining installation procedures.

TROUBLE SHOOTING	
PROBLEM	**PROCEDURE**
Valve fails to operate.	1. Check electrical supply with voltmeter. Voltage must agree with nameplate rating. 2. Check coil with ohmmeter for shorted or open coil. 3. Make sure that pressure complied with nameplate rating.
Valve is sluggish or inoperative - electrical supply and pressure check out.	1. Disassemble valve as per the Disassembly Instructions. Clean out any extraneous matter. The plunger must be free to move without binding. 2. Check the diaphragm for tears and for clogged or obstructed bleed hole or pilot orifice. Torn diaphragm must be replaced. 3. Check all springs, if broken, replace.
External leakage at sleeve flange to cover joint.	1. Check that sleeve is torqued to 260-270 in-lbs. 2. Check flange seal for damage. Replace if defective.
External leakage at flange joint between body and cover.	1. Check that cover screws are torqued with an input torque per reassembly instructions. If leakage persists, replacement of diaphragm assembly or flange O-ring may be required and/or bodies or covers with damaged sealing surfaces may have to be replaced.
External leakage at metering speed control device.	1. Check O-rings for damage. Replace if necessary.
Internal Leakage	1. Disassemble valve as per the Disassembly Instructions. Remove extraneous matter. Clean parts in a mild soap and water solution. 2. Examine diaphragm sealing surface for dirt. Remove all foreign particles. Examine orifice for nicks. Damaged parts must be repaired or replaced. 3. Check plunger return spring. Replace if broken.



Normally Closed Valve (typical)

Part	Description
1	Sleeve Assembly
2	Plunger Assembly
3	Plunger Spring
4	Diaphragm Assembly
5	Cover
6	Body
7	Metering Stem (optional)
8	Manual Override Stem (optional)

* Parts included in repair kit. Contact Parker Skinner Valve for repair kit number based on selected valve.

DECLARATION

Parker's Skinner Valve Division certifies its valve appliance products comply with the essential requirements of the applicable European Community Directives. We hereby confirm that the appliance has been manufactured in compliance with the applicable standards and is intended for installation in a machine or application where commissioning is prohibited until evidence has been provided that the machine or application is also in compliance with EC directives.

The data supplied in the Skinner valve catalogs and general Installation, Operating & Maintenance Instructions are to be consulted and pertinent accident prevention regulations followed during product installation and use. Any unauthorized work performed on the product by the purchaser or by third parties can impair its function and relieves Parker Hannifin of all warranty claims and liability for any misuse and resulting damage.

A separate Declaration of Conformity or Manufacturer's declaration is available upon request. Please provide valve identification numbers and order serial numbers of products concerned.

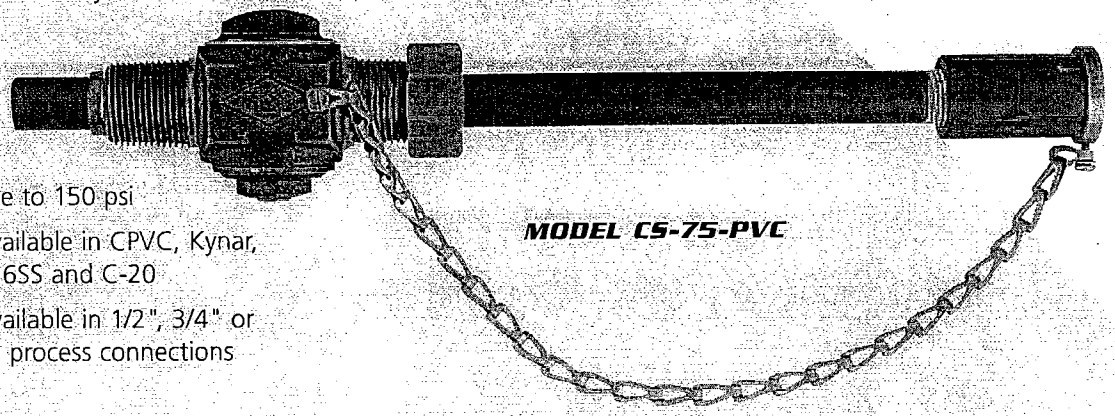
Corporation Stops and Injection Quills

Corporation Stops

Neptune CHEMICAL PUMP CO., INC.

Corporation Stops with injection quills are used for injecting chemicals pumped by metering pumps into tanks, mains, cooling towers and process systems. Quill extends into the center of the stream providing more uniform dispersion of injection chemical.

Corporation Stop can be mounted to a "hot tap" which is installed without draining the system. Corporation Stop allows injection quill to be inserted or removed without having to drain or shut down the system.

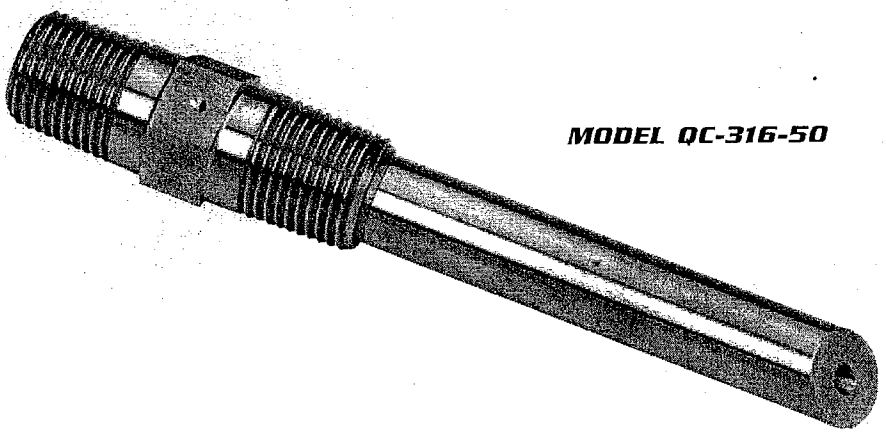


MODEL CS-75-PVC

- Use to 150 psi
- Available in CPVC, Kynar, 316SS and C-20
- Available in 1/2", 3/4" or 1" process connections

High Pressure Injection Quills

High Pressure Injection Quills are used to inject chemicals pumped by metering pumps into the turbulent flow zone of high pressure water or steam lines.



MODEL QC-316-50

- Use to 3,000 psi
- Built-in check valve
- Available in PVC, Kynar, 316SS and C-20

Corporation Stops with Quills

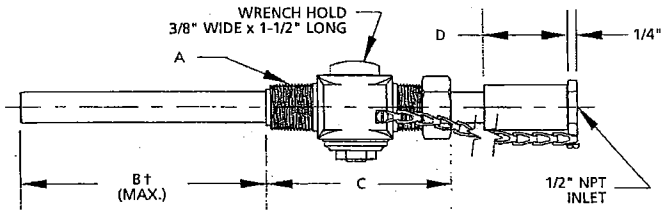
MODEL	MATERIAL OF CONSTR.	PRESS. PSI	MAXIMUM TEMP.	SIZE (INCHES)	DIMENSIONS (INCHES)		
				A	B	C	D
CS-50-PVC	CPVC	125 psi	100°F (37°C)	1/2 NPT	9	4	2
CS-75-PVC	CPVC	125 psi	100°F (37°C)	3/4 NPT	8-1/2	4-5/8	2
CS75PVC-SP	CPVC	125 psi	100°F (37°C)	3/4 AWWA	8-1/2	4-5/8	2
CS-100-PVC	CPVC	125 psi	100°F (37°C)	1 NPT	8-3/8	5-1/4	1-5/8
CS100PVCSP	CPVC	125 psi	100°F (37°C)	1 AWWA	8-3/8	5-1/4	1-5/8
CS-50-KY	Kynar	150 psi	200°F (93°C)	1/2 NPT	9	4	2-3/8
CS-75-KY	Kynar	150 psi	200°F (93°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-KY	Kynar	150 psi	200°F (93°C)	1 NPT	7-5/8	5-1/4	2
CS-50-316	316SS	150 psi	250°F (121°C)	1/2 NPT	9	4	2-3/8
CS-75-316	316SS	150 psi	250°F (121°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-316	316SS	150 psi	250°F (121°C)	1 NPT	7-5/8	5-1/4	2-3/8
CS-50-C20	C-20-Cb3	150 psi	250°F (121°C)	1/2 NPT	9	4	2-3/8
CS-75-C20	C-20-Cb3	150 psi	250°F (121°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-C20	C-20-Cb3	150 psi	250°F (121°C)	1 NPT	7-5/8	5-1/4	2-3/8

Features

- Protection chain prevents withdrawal before Corporation Stop is closed
- Operating pressures to 150 psi
- Quill available in Corrosion-resistant CPVC, Kynar, 316 stainless steel and Carpenter 20-Cb3
- Corporation Stop (brass only) available with 1/2", 3/4" or 1" process connections
- Quill connection 1/2" female all models

Recommendation

- Install a check valve and isolation valve at the inlet of the quill for ease of maintenance.



†Special lengths are available up to 24".

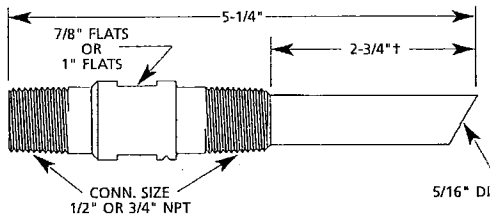
High Pressure Injection Quills with Built-in Check Valves

Features

- Built-in Spring Loaded Check on all models
- High pressure to 3,000 psi
- Available in PVC, Kynar, 316 stainless steel and Carpenter 20-Cb3

MODEL	MATERIAL OF BODY	MATERIAL OF CHECK	MATERIAL OF SPRING	PRESS. (MAX.)	MAXIMUM TEMP.	CONN. SIZE NPT
QC-PVC-50	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	1/2"
QC-PVC-75	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	3/4"
QC-316-50	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-316-75	316SS	316SS	HAST C	3000 psi	750°F (400°C)	3/4"
QC-316-HPSE*	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-C20-50	C-20	C-20	HAST C	3000 psi	750°F (400°C)	1/2"
QC-KY-50	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	1/2"
QC-KY-75	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	3/4"

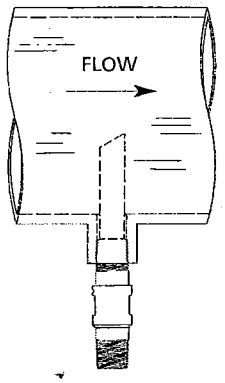
*Has slotted end.



†Special lengths are available up to 24".

Recommendations

- For lines smaller than 4" diameter, trim quill so chemical is released near center of line. Use as is for lines over 4" diameter.
- Install with "Telltale" V-notch facing upstream so flow strikes angled face at end of quill for most rapid dispersal of injected chemical.
- For maintenance ease, installation of an isolation valve, rated above line operating pressure, immediately behind the quill is recommended.



SOLD BY:

Neptune
CHEMICAL PUMP CO., INC.

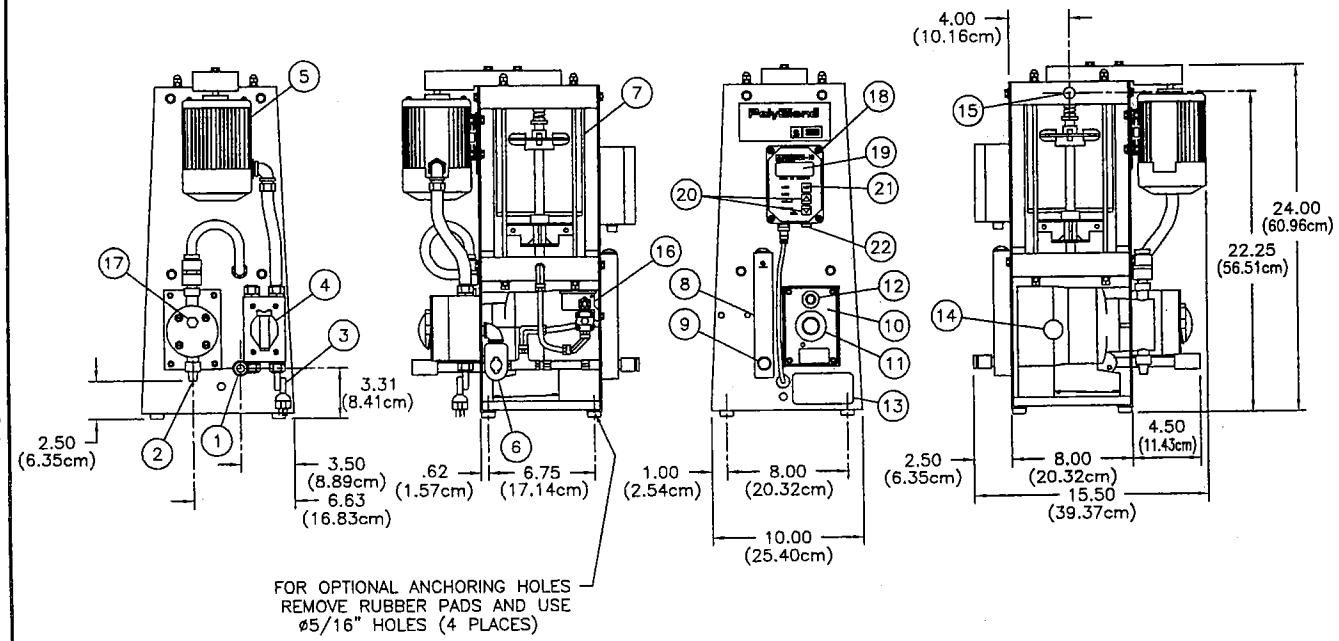
P.O. Box 247 • Lansdale, PA 19446-0247
Tel: 215-699-8700 • Fax: 215-699-0370
Toll-Free Tel: 1-888-3NEPTUNE (1-888-363-7886)
Toll-Free Fax: 1-800-255-4017
Web Site: http://www.neptune1.com
E-mail: pump@neptune1.com

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DRAWING NUMBER:
PB100

NOTICE – U.S. Filter/Stranco CLAIMS PROPRIETARY RIGHTS IN THE MATERIAL DISCLOSED ON THIS DRAWING. IT IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY AND MAY NOT BE REPRODUCED OR USED TO MANUFACTURE ANYTHING HEREON WITHOUT DIRECT WRITTEN CONSENT FROM U.S. Filter/Stranco TO THE USER.

PB UNIT	PUMP OUTPUT	ROTAMETER RANGE
PB16–0.4	0–0.42GPH	1–16GPH
PB16–1	0–1GPH	1–16GPH
PB16–2	0–2GPH	1–16GPH
PB50–0.4	0–0.42GPH	4–50GPH
PB50–1	0–1GPH	4–50GPH
PB50–2	0–2GPH	4–50GPH
PB100–0.4	0–0.42GPH	10–100GPH
PB100–0.6	0–0.6GPH	10–100GPH
PB100–1	0–1GPH	10–100GPH
PB100–2	0–2GPH	10–100GPH
PB100–1A	0–3.8LPH	38–375LPH
PB100–0.4K	0–1.6LPH	38–375LPH
PB100–1K	0–3.8LPH	38–375LPH
PB100–2K	0–7.6LPH	38–375LPH



KEY	DESCRIPTION
1	WATER INLET, 1/2" (F)NPT
2	POLYMER INLET, 5/8" O.D. BARB
3	POWER CORD
4	MIXER MOTOR SWITCH w/THERMAL OVERLOAD
5	MIXER MOTOR
6	SOLENOID VALVE, (WATER)
7	MIXING CHAMBER
8	ROTAMETER
9	RATE VALVE
10	DIAPHRAGM PUMP
11	STROKE LENGTH KNOB

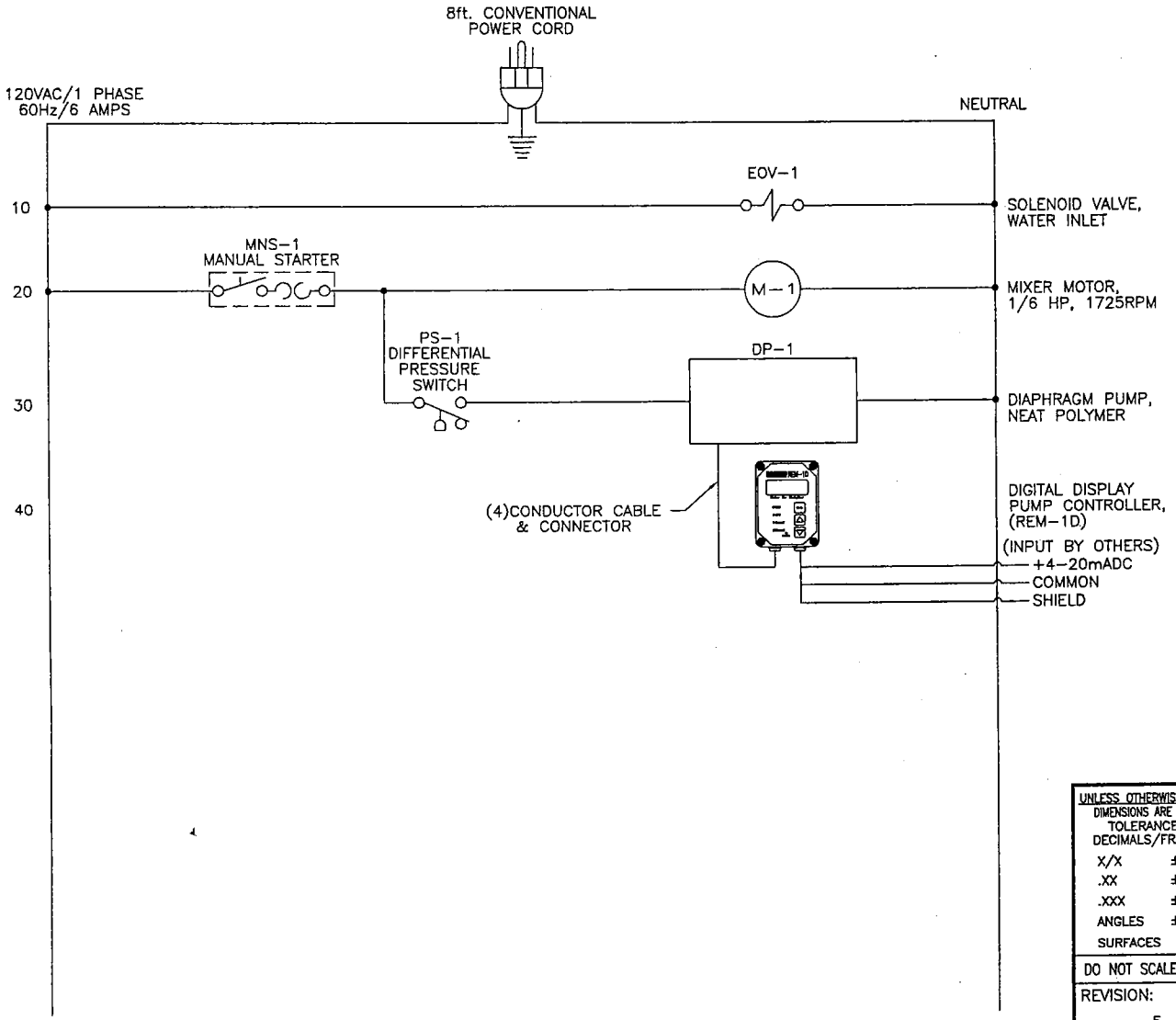
12	STROKE RATE/EXTERNAL SELECTOR SWITCH
13	SERIAL PLATE
14	EXTERNAL INPUT SIGNAL CONNECTOR
15	SOLUTION OUTLET, 1/2" (F)NPT
16	DIFFERENTIAL PRESSURE SWITCH
17	PRIMING PORT, (POLYMER)
18	DIGITAL DISPLAY PUMP CONTROLLER, (REM–1D)
19	LCD DISPLAY
20	INPUT KEYS
21	MODE SELECTOR KEY
22	4–20mADC INPUT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS/FRACTIONS X/X ±1/32 .XX ±0.01 .XXX ±0.003 ANGLES ±0°–0.5" SURFACES 125√	DRAWN BY: BRIAN DISMANG	DATE: 01–05–94	USFilter STRANCO PRODUCTS BRADLEY, IL
	CHECKED BY: GG (ON FILE)	11–15–00	DRAWING TITLE: GENERAL ARRANGEMENT PB100 (STANDARD UNIT)
	APPROVED BY: JRC (ON FILE)	11–15–00	
DO NOT SCALE DRAWING	WEIGHT: N/A		SCALE: 1/8 = 1 / SHEET 1 OF 1
REVISION: 5	REVISED BY: JOHN COULTER	DATE: 11–15–00	PART NUMBER: / DRAWING NUMBER: PB100

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DRAWING NUMBER:
SES–0003

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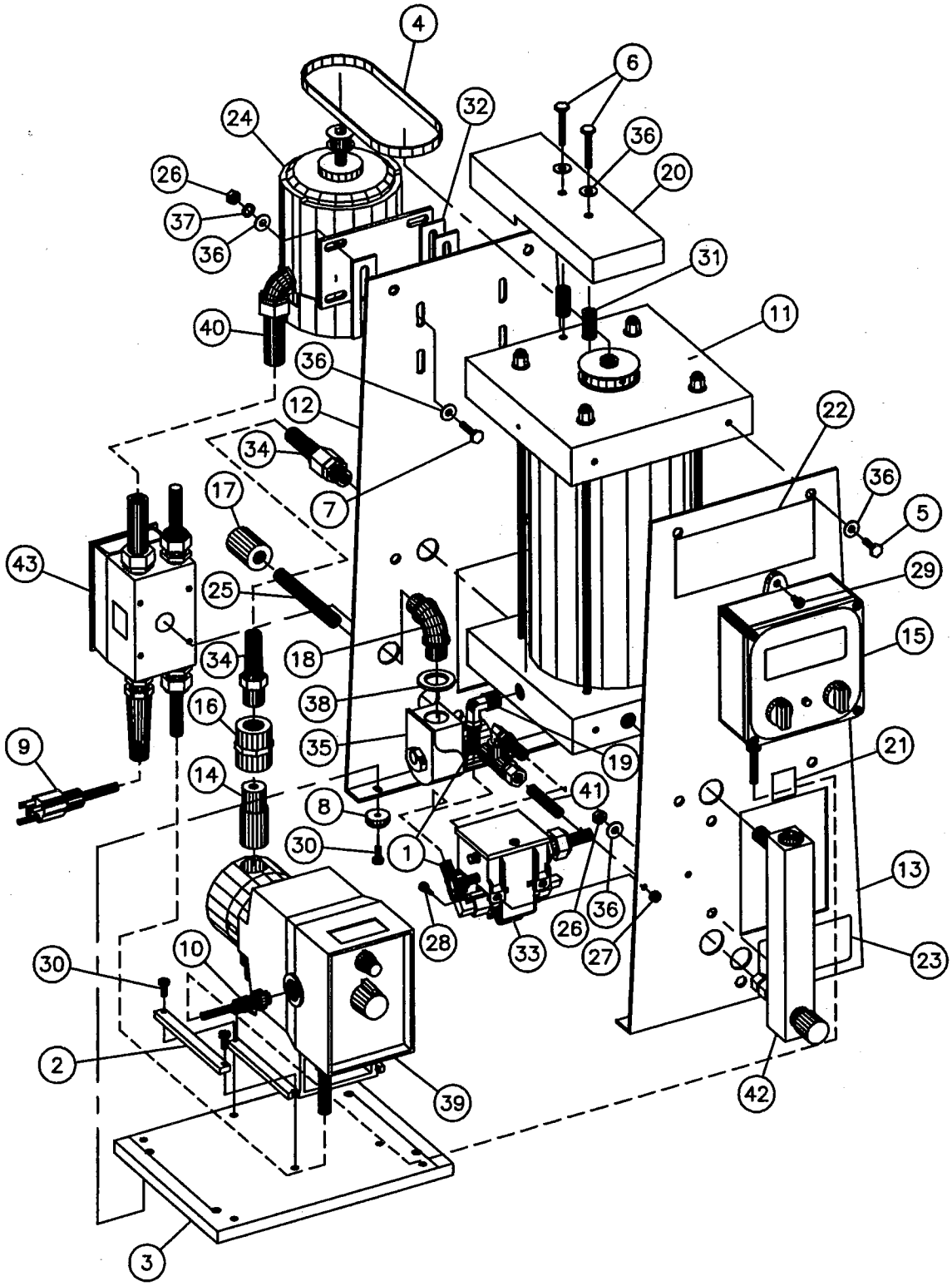


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS/FRACTIONS X/X ±1/16 .XX ±0.03 .XXX ±0.010 ANGLES ±1.0°–0" SURFACES 250	DRAWN BY: BRIAN DISMANG	DATE: 02–23–89	USFilter STRANCO PRODUCTS BRADLEY, IL
	CHECKED BY: GG (ON FILE)	12–14–98	DRAWING TITLE: ELECTRICAL LADDER LOGIC SERIES PBLO & PB100/200 DIAPHRAGM
	APPROVED BY: JC (ON FILE)	12–14–98	
DO NOT SCALE DRAWING	WEIGHT: N/A		SCALE: N/A / SHEET 1 OF 1
REVISION: 5	REVISED BY: JOHN COULTER	DATE: 12–14–98	PART NUMBER: N/A / DRAWING NUMBER: SES–0003

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OVERALL

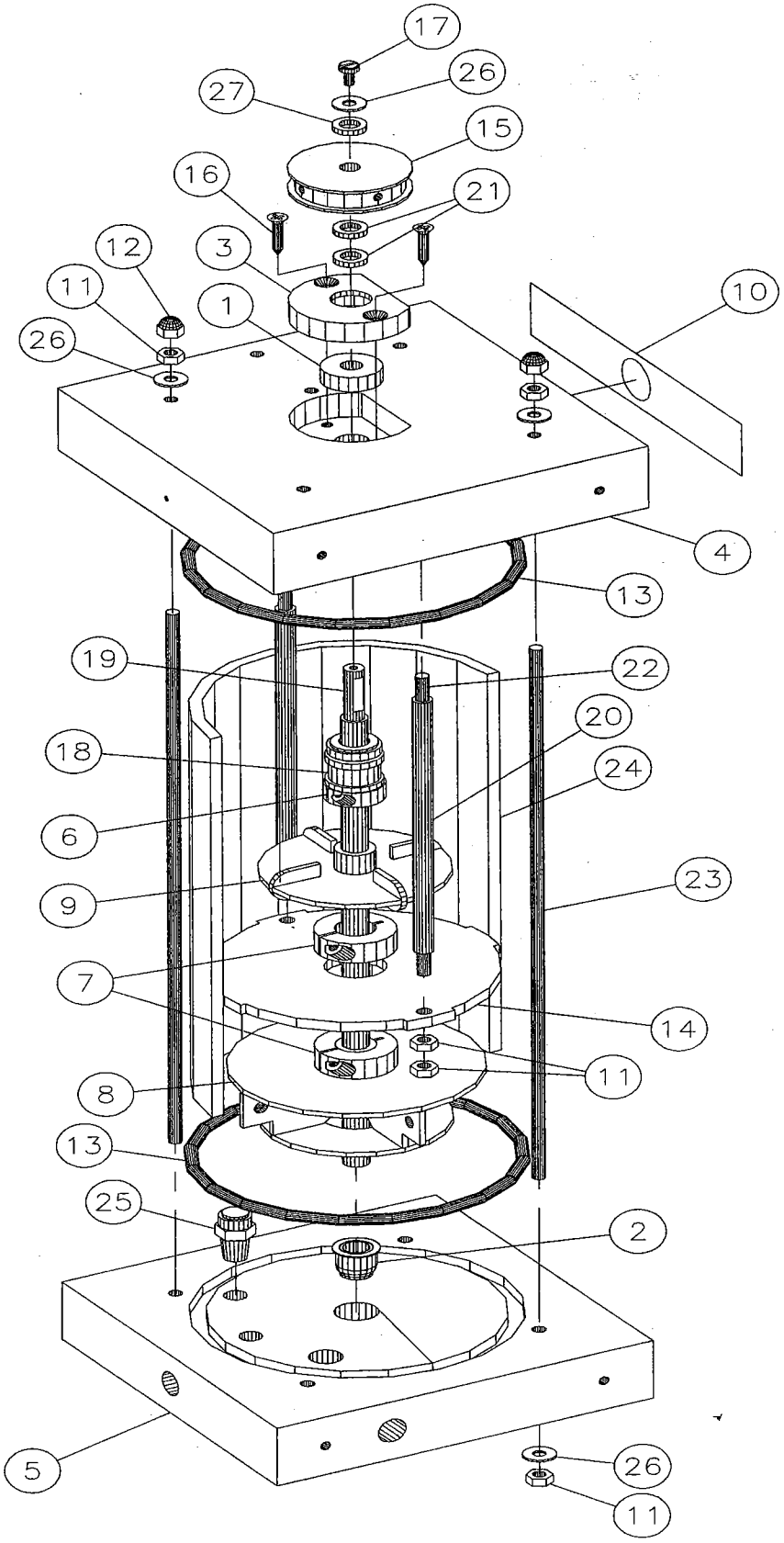
ITEM	P/N	DESCRIPTION	QTY	UM
1	10342	TUBING, 3/8" OD X 1/4" ID, POLYETHYLENE	1.00	FT
2	10746	BRACKET, PUMP	2.00	EA
3	1364001	BASE SUB-ASSY. PB100-0	1.00	EA
4	1450318	BELT	1.00	EA
5	1600312	BOLT, HH, 1/4-20 X 3/4 SS	8.00	EA
6	1600324	BOLT, HH, 1/4-20 X 1-1/2 SS (CAP SCREW)	2.00	EA
7	1600366	BOLT, HH, 1/4-20 X 1 SS	4.00	EA
8	1890001	BUMPER, RUBBER	4.00	EA
9	1983001	CABLE, ASSY, 110V, 8FT, GROUNDED, MALE PLG,16/3	1.00	EA
10	1984005	CABLE ASSY.	1.00	EA
11	*******	CHAMBER ASSY, MIXING SML FRM (SEE SECTION)	1.00	EA
12	2383001	CHASSIS, BACK	1.00	EA
13	2383002	CHASSIS, FRONT	1.00	EA
14	26033	VALVE	1.00	EA
15	2846006	CONTROLLER, REM-1D	1.00	EA
16	2930004	CPLG, PVC, SCH 80 1/2 FPT	1.00	EA
17	2930420	CPLG, RED, SS 1/2 X 1/4 FT X T	1.00	EA
18	3579864	ELBOW, CONDUIT	1.00	EA
19	3581604	ELBOW, 90, BRASS 3/8 OD X 3/8 MPT	1.00	EA
20	4681310	BELT GUARD	1.00	EA
21	5551209	LABEL, WATER FLOW	2.00	EA
22	5551210	LABEL, POLYBLEND	1.00	EA
23	5554000	LABEL, SERIAL PLATE	1.00	EA
24	5902001	MOTOR	1.00	EA
25	5963028	NIPPLE, SS 1/4 X 4"	1.00	EA
26	6020031	NUT, 1/4-20, HEX SS	6.00	EA
27	6020962	NUT, 8-32, HEX	2.00	EA
28	7771558	SCREW, MACH, SS PAN HD, PHIL, 8-32 X 1/2	2.00	EA
29	7772506	SCREW, MACH, 304SS PAN HD, SLTD, 10-32 X 3/8	2.00	EA
30	7772508	SCREW, MACH, 10-32 X 1/2, SLTD PS, SS	8.00	EA
31	8140001	SPACER	2.00	EA
32	8141001	SPACER, MOTOR SHIM	3.00	EA
33	8724903	SWITCH, DIFF. PRESSURE	1.00	EA
34	9414002	TUBE BRAIDED SS, 1/2" MPT X 3/8" MPT X 14" LG*	1.00	EA
35	9571301	VALVE SOLENOID	1.00	EA
36	9740300	WASHER, SS, FLAT 1/4"	9.00	EA
37	9740330	WASHER, SS, INT TOOTH, 1/4"	4.00	EA
38	9748300	WASHER, SS, FLAT 1/8"	1.00	EA
39	AA771-155PBX	PUMP (SEE SECTION)	1.00	EA
40	RM2702060	CONDUIT, SEALTITE 3/8"	1.00	FT
41	RM9414061	TUBE, RIGID 304 SS 3/8"OD X 1/4"ID	1.00	FT
42	*******	FLOWMETER (SEE SECTION)	1.00	EA
43	1672002	BOX JUNCTION SUB-ASSY.	1.00	EA


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MIXING CHAMBER SP2340003

ITEM	PART NO.	DESCRIPTION	QTY.
1	1410002	BEARING	1
2	1414001	BEARING, THRUST	1
3	1419001	BEARING, FLANGE CARRIER	1
4	SP2124008	CAP, TOP, MIXING CHAMBER	1
5	SP2124009	CAP, BOTTOM, MIXING CHAMBER	1
6	2650001	COLLAR, 1/2" I.D.	1
7	2650002	COLLAR, 3/4" I.D.	2
8	5173304	IMPELLER	1
9	5173305	IMPELLER, SECONDARY	1
10	5551002	LABEL - DISCHARGE	1
11	6020031	NUT, HEX HD., 1/4"-20	12
12	6023031	NUT, ACORN, 1/4"-20, S.S.	4
13	6091801	O-RING	2
14	6676002	PLATE, BAFFLE	1
15	7071201	PULLEY	1
16	7772216	SCREW, 10-32 X 1"	2
17	7772506	SCREW, 10-32 X 3/8"	1
18	7802910	SEAL, MECHANICAL	1
19	7854303	SHAFT, IMPELLER	1
20*	8140005	SPACER ROD	2
21	8143011	SPACER	2
22	8603002	STUD	2
23	8603004	ROD	4
24	9412606	TUBE, ACRYLIC	1
25	9572304	VALVE, INJ. CHECK	1
26	9740300	WASHER, FLAT, 1/4"	9
27	8143010	SPACER	1

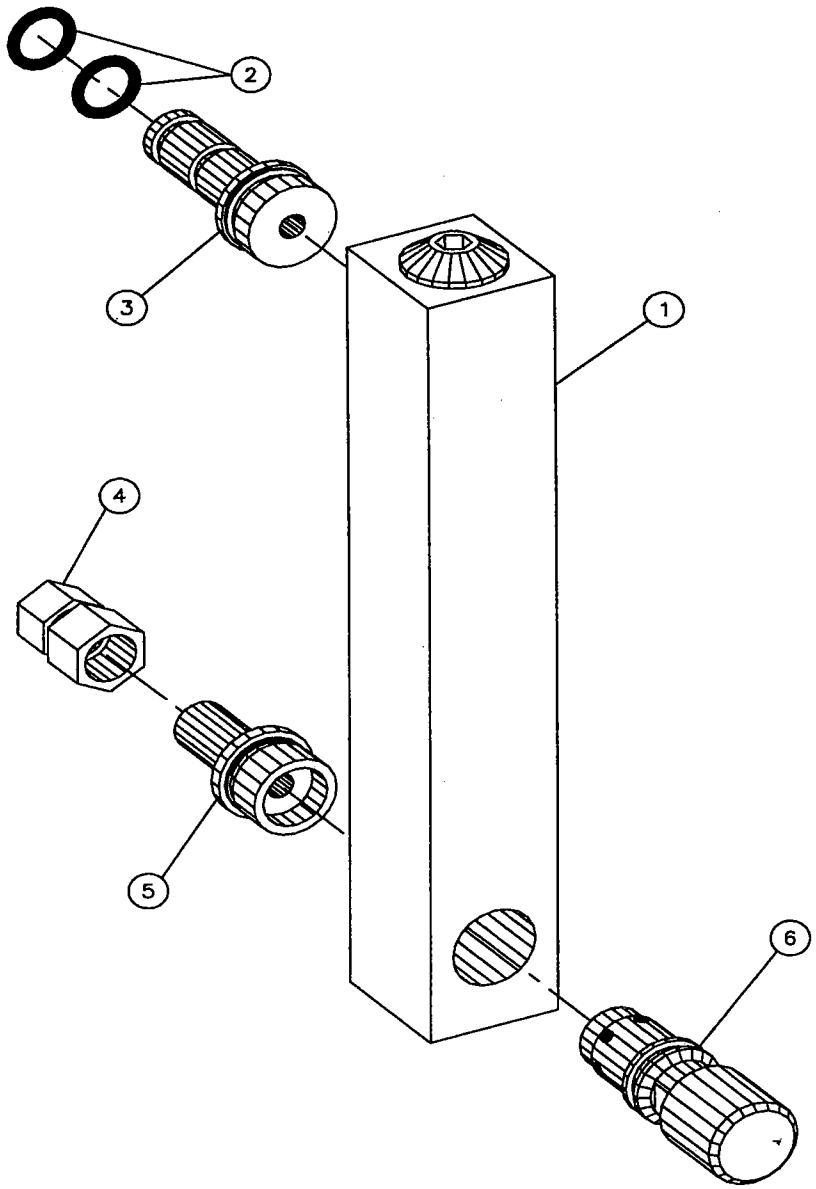
*Factory personnel identify item #20 as part RM6600021, which must be cut to a length of 6-3/4 inches. For replacements, request P/N 8140005 to receive spacer rods, which are pre-cut to the appropriate length.


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FLOWMETER

ITEM	PART NO.	DESCRIPTION	QTY.	UM
1	4291102	FLOWMETER, KING, 100GPH	1	EA
2	6091301	O-RING, BUNA N	2	EA
3	1040093	ADAPTER, SPUD	1	EA
4	2735634	CONNECTOR, TUBE, 1/4" FPT X 3/8" OD COMP.	1	EA
5	1048401	ADAPTER, FLOWMETER	1	EA
6	9579301	VALVE, KING	1	EA

Flowmeter Assembly - P/N 4301102



USFilter

STRANCO PRODUCTS
P.O.BOX 389
BRADLEY, IL 60915

TELEPHONE 815-932-8154
800-882-6466
FACSIMILE 815-939-9845

PolyBlend
Model #PB200-2 (SP60102020)
INSTALLATION, OPERATION, AND MAINTENANCE INFORMATION

CONTENTS

Overview
Installation
Operation
Maintenance
Warranty
Appendixes
Drawings

READ THIS MANUAL BEFORE YOU INSTALL, OPERATE, OR SERVICE THIS UNIT.

OVERVIEW

SAFETY PRECAUTIONS

- ☐ Ensure that the control panel is grounded to avoid possible electrical shock or damage to equipment.
- ☐ Before servicing, turn off all power and assure power "lockout" to avoid possible electric shock.
- ☐ Disconnect external power to the control panel before removing or replacing fuses.

SPECIFICATIONS

Pump	Diaphragm
Inlet	1/2" FPT, Water Supply
	5/8" Hose Barb, Polymer Supply
Outlet	3/4" FPT, Solution Discharge
Water Capacity	100 GPH Primary
	100 GPH Post Dilution
Polymer Capacity	2.0 GPH
Pressure Rating	100 PSI
Electrical Supply	120/1/60, 6 Amps
Dimensions	27" H x 12" W x 16" D
Weight	65 lbs.
Motor(s)	(1) 1/6 HP, 120VAC, 3.6 AMPS

INSTALLATION

LOCATION

Select a location that provides:

- Electrical Supply
- Potable Water (Clean)
- Proximity to the Point of Use
- Easy Handling and Storage of Polymer
- Access to Unit
- Protection Against Severe Weather

UNPACKING

Examine package contents for damage. Report any to freight forwarder. Check plastic bag(s) for contents against individual packing list(s).

NOTE: Disregard any moisture; this unit was wet tested.

CONNECTIONS

- Use Teflon tape on threads. Use joint compound (pipe dope) in small amounts, if necessary.
- Do not over-tighten fittings.
- Insure that supply water pressure is **less than 100 psi.**
- Install water isolation valve with unions.
- Insure that neat polymer feed line has a **flooded suction.**

NOTE: To enhance performance, reduce the number of piping turns and elevation changes.

STORAGE

Store in atmosphere controlled environment. Protect from extreme temperature (above 110°F, 52°C, below 32°, 0°C) and wide ambient temperature fluctuations.

Protect from direct weather exposure, i.e., sun, rain, high wind, etc.

OPERATION

GENERAL

This PolyBlend unit will perform the following functions: meter polymer dosage, regulate mixing water, provide uniform dilution and activation, operate on-line continuously, and feed solution to the point of use.

Neat polymer from the metering pump and dilution water controlled by the solenoid valve enter the mixing chamber. Dilution and activation occur, yielding prepared solution ready for use.

Neat polymer dosage rate is adjusted at pump face or at electronic controller (REM-1D, SCR, etc.). Primary dilution (and post dilution) water are controlled by individual flow control valves.

START-UP

Step 1: Switch pump to external mode at pump face.
Step 2: Prime polymer pump, using priming kit provided with unit.
Step 3: Place unit power switch in Off position.
Step 4: Energize power circuit that feeds unit. Solenoid opens. Allow mixing chamber to fill with water by opening primary dilution water control valve.

NOTE: Do not turn mixer motor on until chamber is filled with water, running dry will damage mechanical seal.

Step 5: Place unit power switch in On position. Mixing chamber motor starts.
Step 6: Access REM-1D controller to turn pump On/Off and for polymer output adjustment. Output can also be adjusted at pump face by varying the stroke length.

NOTE: For optimum pump performance, keep stroke frequency as high as possible. This is done by decreasing the stroke length setting. More stroke repetition with a shorter length is better than fewer strokes with a long stroke length. If stroke length is too short, pump prime may be affected.

Step 7: Adjust water flow at mixing chamber by turning control valve. (The other control valve should be turned for post-dilution adjustment, if applicable.)

NOTE: Do not run polymer pump unless water flow is established. Polymer alone can plug discharge plumbing.

WATER PRESSURE

This unit is equipped with a differential pressure switch. It has been factory set. See Appendix for details.

SOLUTION OUTPUT

Unit output is determined by setting pump stroke length and stroke frequency together with setting dilution water flow. Establish desired solution volume and solution concentration, then proceed.

EXAMPLE: 100 GPH (380 LPH) of .5% polymer solution desired. A 2 GPH (7.6 LPH) diaphragm pump is used.

— Determine neat polymer requirement.

(100 GPH) x (.005) = 0.5 GPH neat polymer
(380 LPH)) x (.005) = 1.9 LPH neat polymer

— Determine pump usage.

(0.5 GPH) ÷ (2 GPH) = 25% pump capacity
(1.9 LPH) ÷ (7.6 LPH) = 25% pump capacity

— Set Controls

A 2 GPH (7.6 LPH) pump @ 100% stroke length and 25 strokes per minute will deliver 0.5 GPH (1.9 LPH). However, 2 GPH (7.6 LPH) pump @ 50% stroke length and 50 strokes per minute will also deliver 0.5 GPH (1.9 LPH) with a more homogeneous mix.

NOTE: Do not exceed polymer concentrations of 1% in the PolyBlend.

MAINTENANCE

SHUTDOWNS

If out of service more than one week, flush mixing chamber.

- Turn pump off.
- Place unit power switch in On position to establish water flow for five minutes.

If out of service for more than two weeks, flush pump and mixing chamber.

- Connect pump suction to a container of mineral oil (not water).
- Place unit power switch in On position to establish water flow.
- Turn pump on and run for three minutes.
- Turn pump off.
- Continue water flow for five additional minutes.
- Drain water from chamber and piping to prevent freezing.

MAINTENANCE

1. Clean ancillary water and/or polymer strainers weekly.
2. Flush system monthly following one week procedure.
3. Refer to the appendix for specific information on drawings, part identification, and components.

RECOMMENDED SPARE PARTS

QTY.	PART #	DESCRIPTION
1	K2341003	Kit includes parts below:
1	SP-75HV	Pump Liquid End
1	7802910	Chamber Mechanical Seal
1	1450318	Belt, Chamber
1	1414001	Bearing, Chamber Base
1	1410002	Bearing, Chamber Top
1	26040-1	Pump Head

PUMP REPLACEMENT

QTY.	PART #	DESCRIPTION
1	AA761-75PBX	Pump

SPECIAL TOOLS

No special tools needed for operation, maintenance, and repair of components.

LUBRICATION

No lubrication is required.

PREDICTED LIFE SPAN

There is no predicted life span of wear parts as each application and operation varies.

OPERATING PROCEDURES

For normal operation, once settings are adjusted based on operation parameters, the system can simply be turned ON or OFF. Special operating instructions for Seasonal operation do not apply.

EMERGENCY OPERATING INSTRUCTIONS

Emergency operating instructions do not apply to USFilter-Stranco equipment. In case of an emergency, TURN OFF POWER TO STOP RUNNING.

DISASSEMBLY, REPAIR, & REASSEMBLY

This equipment is an open-frame design. It allows for easy removal of all components. There are no special procedures for removal of parts. If assistance is required, contact USFilter Stranco Technical Service at 800-882-6466.

PB200
TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER FLOW	• Closed valve on water supply	• Make sure valve is open
	• Blocked solenoid valve	• Disassemble and clean valve
	• Closed or clogged discharge line	• Remove any blockages or open any closed valves
	• Rate control valve closed	• Make sure valve is open
PUMP WON'T PUMP CHEMICAL	• Pump is in off position	• Make sure pump is turned on
	• No water flow	• Make sure all water valves (supply and discharge) are open
	• Blocked pump discharge line	• Take discharge line apart, check for blockage and clean if necessary
	• Back pressure is too high	• Reduce back pressure on unit
	• Differential pressure is too high	• Adjust pressure switch
CLOGGED INJECTION CHECK VALVE	• Debris or clumps in polymer	• Check polymer supply for contamination
	• Valve is stuck open allowing water into polymer line	• Remove valve from chamber and clean it
PUMP WON'T STOP	• Water flow is still established	• Shut off water valve or power to the unit
	• Pump is in internal mode	• Switch pump to external mode

Location of Differential Pressure Switch

The high pressure port connects to the inlet manifold between the solenoid valve and the rotameter/rate-adjusting valve. The low pressure port connects to the discharge side of the rotameter.

Function of Differential Pressure Switch

The differential pressure switch ensures sufficient water flow is present before the polymer pump is energized. This integral, automatic safety feature eliminates the problem of overfeeding neat polymer to an application without proper dilution.

In operation, the rate valve is adjusted to produce the desired flow through the system. This causes a pressure drop to occur across the valve which is applied to the differential pressure switch.

If supply pressure decreases enough to affect flow rate or if back pressure between the PolyBlend and the point of solution application increases enough to affect flow rate, the differential pressure across the rotameter and valve decreases. This causes power to be interrupted to the polymer pump and prevents damage to the mixing system caused by extremely high viscosity developing in the mixing chamber.

NOTICE: If system pressure or flow are not adequate, investigate the ***cause* of lack of flow.** (For example, inadequately sized piping can produce inadequate flow.) To avoid undesirable water dilution conditions and damage to equipment, **do not** bypass or adjust the differential pressure switch for a lower pressure/flow setting.

Question: *Why doesn't the polymer pump turn off when I turn the water off using the rotameter?*

The differential pressure switch senses flow on either side of a pressure drop. Because the rotameter is the sensing point, the rotameter closing is the only cause of loss of flow that the differential pressure switch cannot see.

Test the differential switch by turning off the source water or the discharge flow. (See step 5 on the next page.)

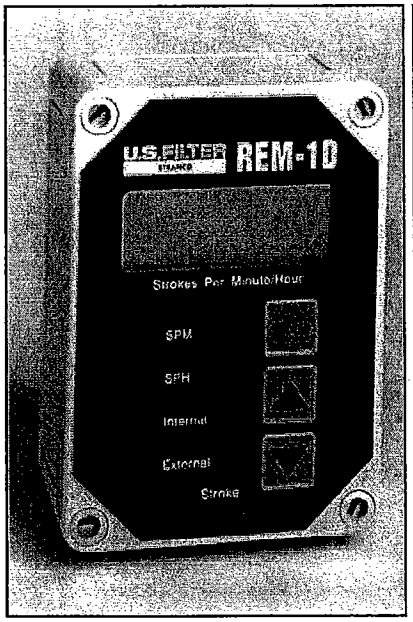
Adjusting the Differential Pressure Switch

Adjust the PolyBlend differential pressure switch only if pressure and flow to the system **are adequate**.

The adjustment logic is the **opposite** of what you might expect. The PolyBlend differential pressure switches have a red light (on the left side) that lights up whenever source water flow is too low and the polymer pump is disabled. The pump stops pumping when the flow is too low. Low flow may be from lack of incoming water or from too much back pressure on the outgoing side.

	Adjustment		**System Reaction**
1.	Turn the PolyBlend rotameter until water flow is at **maximum** on the flow gauge.		
2.	Screw in the *differential pressure knob* until the red alarm light goes on.		Polymer pump is disabled.
3.	Back off the differential pressure knob until the red alarm light goes off.		The pump starts again.
4.	4a. If you want very close control of flow, leave the knob at this setting. *At this setting, any loss of flow (as observed by the rotameter) results in the pump being disabled.*	4b. If you want to make the system "more forgiving" prior to shutdown, continue to turn the knob another 1-2 turns. *The further you turn the knob, the more flow can be lost before the pump is disabled.*	Step 4 determines how "forgiving" the system is before it shuts down due to inadequate flow.
5.	To test sensitivity and operation, turn off the water at the source *or* the solution at the discharge. The float in the flow meter will fall more for the control knob setting described in step 4b than for 4a (above).		As the source or discharge is turned off, the float in the flow meter falls and the pump is disabled.
6.	Set the rotameter for the desired flow.		Retest (as in step 5).

DIGITAL DISPLAY PUMP CONTROLLER



General Description

The REM-1D Digital Display Controller serves as either a pump remote control station or a proportional pump controller (4-20 mA input) or both. The REM-1D can be used to vary the output of any Liquid Metronics (LMI) Series A7, B7, or C7 metering pump when those pumps are placed in the external mode. This is truly a "plug-'n-play" accessory. A simple connection of 4-conductor cable from the control unit to the external input jack of the LMI pump is all that is required for start-up. Power is supplied by a 15 VDC source from the LMI pump through the 4-conductor cable.

The controller output, in the form of contact closures of 80 ms duration, triggers the LMI pump. In the internal mode, output is 0-100 strokes-per-hour (sph) or 0-100 strokes-per-minute (spm). A touch of the pressure-sensitive membrane keys varies the output, which is displayed in large, easy-to-read LCD digital format. In the external mode, output is from 0-100 sph or 0-100 spm directly proportional to the 4-20 mA analog input signal. Ten feet of 3-conductor cable and connectors are supplied as standard for the 4-20 mA application. Zero and span adjustments may be done through the outside keys of the controller.

In the "OFF" position, the 15 VDC power source will be present, but the controller output will be zero. The display will read OFF. The rugged, polycarbonate NEMA 4X enclosure is easily wall-mounted near the associated pump, or can be remotely located.

CUSTOMIZING YOUR
CHEMICAL FEED SYSTEM

Benefits

- Provides remote control option
- Improves dosage control
- Enhances treatment program efficiencies
- Makes changing dosage easy
- Allows operator to link dosage to process variables
- Expands range of precise pump control
- Designed for industrial applications

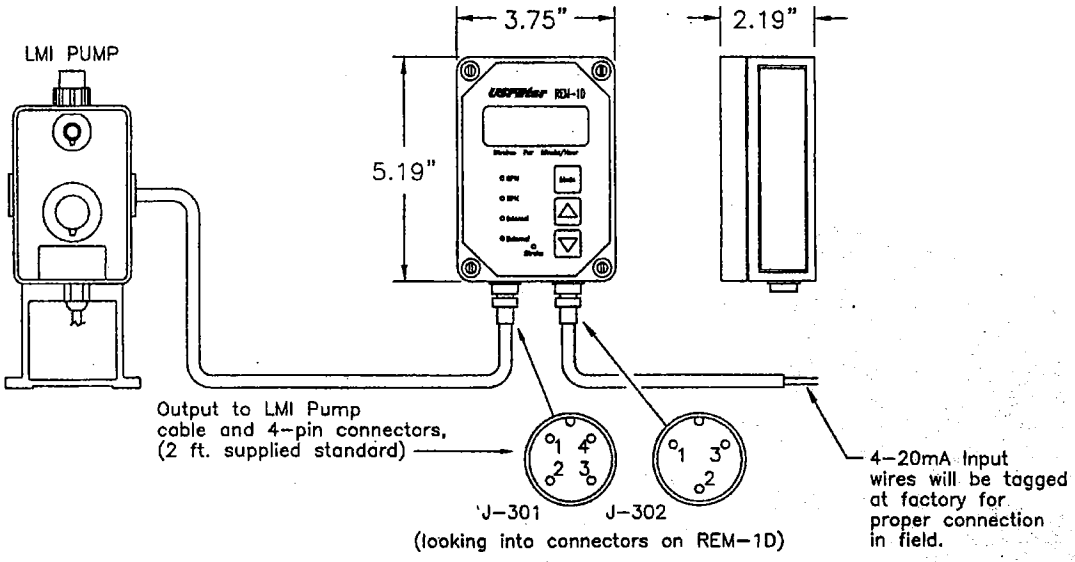
Features

- Solid-state microprocessor core
- Push-button control
- Large, easy-to-read display
- Remote control
- Proportional control (4-20 mA input) strokes-per-minute, strokes-per-hour
- Internal or external control
- NEMA 4X enclosure

USFilter

REM–1D

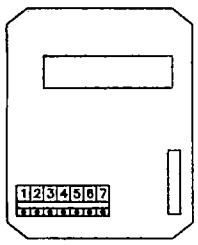
Revised 3–01



STRANCO PART NOS.

RM1974183	CABLE
2723001	3 PIN CONNECTOR
25643	4 PIN CONNECTOR

NOTE: J–301 PIN NUMBERS CORRESPOND TO IDENTICAL PIN NUMBERS ON LMI PUMP REMOTE SIGNAL INPUT CONNECTORS.



CONNECTIONS INSIDE REM–1D		J–301, J–302 CONNECTORS	CABLE CONNECTIONS		
T #2	WHITE	J–301, Pin #1	RED	Future Use	4–Pin Connector J–301
T #4	BLACK	J–301, Pin #3	WHITE	Power – (Common)	
T #3	GREEN	J–301, Pin #2	GREEN	Pump Trigger (+15VDC)	
T #1	RED	J–301, Pin #4	BLACK	Power + (+15VDC)	
T #6	BLACK	J–302, Pin #2	BLACK	Signal Common	3–Pin Connector J–302 External Control 4–20mADC 220Ω Input Impedance
T #7	GREEN	J–302, Pin #1	WHITE	Future Use	
T #5	RED	J–302, Pin #3	RED	4–20 mA Signal	

ZERO AND SPAN ADJUSTMENTS

Press MODE Key to enter external mode.

1. To Set Display/Output Ranges:
   - A. Press MODE key to enter external mode.
   - B. Press all 3 keys simultaneously and release. SPM and SPH LEDs will light up.
   - C. Use UP/DOWN ARROW keys to set maximum display range.
   - D. Press MODE key to accept and then INTERNAL and EXTERNAL LEDs will light up.
   - E. Use UP/DOWN ARROW keys to set minimum display range.
   - F. Press MODE key to accept and return to normal operation.
2. To Calibrate 4mA Point:
   - A. Input 4mA into REM–1D.
   - B. Press and hold DOWN ARROW key.
   - C. Press MODE key (while still pressing DOWN ARROW key).
3. To Calibrate 20mA Point:
   - A. Input 20mA into REM–1D.
   - B. Press and hold UP ARROW key.
   - C. Press MODE key (while still pressing UP ARROW key).

* NOTE: GASKET KIT P/N K7809901 AVAILABLE FOR PANEL MOUNTING.

USFilter
Stranco Products
P.O. Box 389
Bradley, IL 60915 U.S.A.
800.882.6466 *phone*
815.932.8154 *phone*
815.939.9845 *fax*
http://www.stranco.com

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Lit No. IH-0702

VIVENDI Environnement company

DIAPHRAGM PUMP INFORMATION

WARNING: ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing and maintenance or replacement on your pump. See MSDS Sheet from polymer supplier foe additional precautions.

OUTPUT ADJUSTMENT CONTROLS

In most external controlled pumps the uppermost knob serves as speed control. Graduations for the Speed Knob appear directly on the face of the control panel. The largest knob below is Stroke Control.

1. Speed adjustment: Speed control provides adjustment of the percent of maximum strokes per minute. Turning this clockwise increase stroke frequency. **Note AA7 Series Only:** When operating pump in the external mode, the speed control knob should be fully turned counter clockwise. A click indicates pump is in external mode.
2. Stroke Adjustment; Stroke control provides adjustment of percent of maximum Liquifram (diaphragm) travel. Turning this knob counterclockwise increases percent output per stroke. Only adjust while pump is running.

PRIMING THE PUMP

Hold tip of syringe firmly in fitting with one hand while using the other hand to pull back on plunger. Repeat until a small amount of polymer is drawn into the syringe. The pump is now primed.

PUMP CALIBRATION

Perform calibration if your system application requires it. Normally calibration is NOT required.

You will need:
- A watch
- A calculator
- Calibrated cylinder (with at least 1000 ml capacity.
- Length of hose or tubing (same I.D. as pump ports)

1. Maintain all usual connections to the PolyBlend unit except disconnect the polymer suction line at pump input. The flow meter and pump setting should be those used for normal service.

2. Connect hose or tubing to the pump input. Place the free end of the tubing in the graduated cylinder.

3. Fill the cylinder with polymer to its measured capacity (for example, 1000 ml etc.).

4. Turn on the metering pump. Allow the pump to run until all air has been exhausted from the tubing and pump and polymer is injected into the mixing chamber.

5. Stop the pump.

6. Refill the cylinder to the measured capacity.

7. Start the pump again, and start timing as the pump runs. For best results, let the pump run long enough to pump at least half of the polymer out of the graduated cylinder. (in general, the longer the calibration period, the greater the accuracy of the measurement).

8. Stop the pump. Record the time and level of the polymer remaining in the cylinder. Fill in the following equation to find the volume of polymer pumped per one unit of time (a minute, an hour, or a day).

$$\frac{\text{Starting ml - Remaining ml}}{\text{Calibration period}} = \text{ml/Time}$$

9. Compare the actual volume pumped to the desired volume, and adjust pump controls.

10. Check volume again to confirm the new settings.

PRESSURE CONTROL
(B and C series only)

A capped potentiometer is located on the face plate of the diaphragm pump. This potentiometer is for pressure control or power to the pump solenoid. Since the PolyBlend unit is equipped with a 20 PSI backpressure/check valve, the potentiometer should be set for full power or full clockwise.
NOTE: This is preset at the factory. In a case where obvious over-pumping is present, this potentiometer may be adjusted counter-clockwise.

Liquifram (Diaphragm) Replacement

When replacing the Liquifram, valve balls, seal rings and the injection check valve spring should also be replaced.

1. Carefully depressurize, drain and disconnect the pump discharge and suction lines. Place the suction tubing into a container of mineral oil. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the suction tubing out of the mineral oil and continue to pump air into the pump head until the pump head is purged.

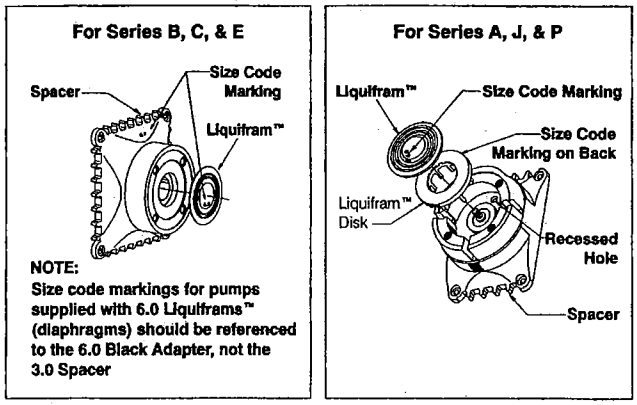
2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

NOTE: See section on proper zeroing.

3. With the unit off, unscrew the Liquifram by carefully grasping the outer edge of the Liquifram and turning it counter clockwise. Discard old Liquifram disk if so equipped (locate behind the Liquifram) and check that the size code matches the size code on the replacement Liquifram (see illustration).

4. Reinstall the disk so alignment pin on the disk (if present) seats in the recessed hole in the EPU.

WARNING: Take care not to scratch the Teflon face of the new Liquifram.

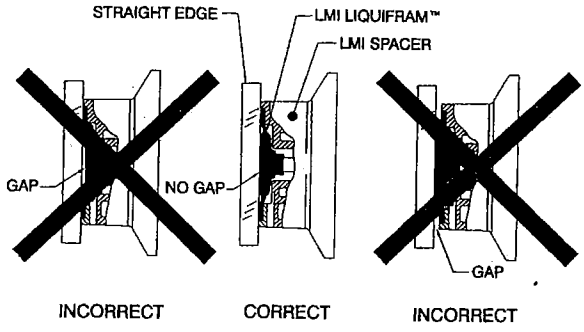


5. Start the pump and turn the stroke knob to the setting indicated on the Stroke Setting Chart which matches the pump model number located on the pump dataplate. With the pump stoking (running), screw on the new Liquifram clockwise until the center begins to buckle inward. Stop the pump.

Liquifram Stroke Setting Chart

Pump Series	Stroke Knob Settings
A11 AA, B72, C72, C77	90% 70%

6. Grasp the outer edge of the Liquifram and adjust by screwing it in or out so that the center of the Liquifram is flush with the outside of the spacer edge (see illustration).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a crisscross pattern. After one week of operation, recheck the screws and tighten if necessary.

Seal Ring, Ball and Injection Check Valve Spring Replacement

1. Carefully depressurize, drain and disconnect the discharge and suction lines. Place the suction tubing into a container of mineral oil. Turn the pump on to flush the head assembly. After flushing, lift the suction tubing out of the mineral oil and continue to pump air into the pump head until the pump head is purged. If the liquid cannot be pumped due to Liquifram rupture, with protective gloves, carefully disconnect the tubing and four screws to remove the head. Immerse the head in mineral oil or other neutralizing solution.

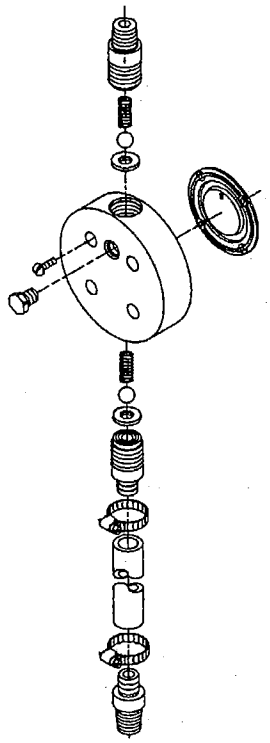
IMPORTANT: Before disassembling valves, note the orientation of seal ring and ball. (See illustration).

2. Carefully disconnect one tubing connection and fitting at a time and remove the worn seal ring and ball. Carefully loosen sealing by prying side to side using a small screw driver through the center hole of the seal ring.

3. Install new seal ring and ball in each location.
IMPORTANT: Note correct orientation.

4. Install the new spring valve in the Injection Check Valve.

Seal Ring, Ball and Injection Check Valve Spring Replacement



Order of Installation

Check Pump for Proper Zeroing (Stroke Knob)

1. With pump running, turn stroke knob counter clockwise toward zero or end of black or red band.

2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).

3. If the pump continues to click at zero or stops clicking before zero is reached, the pump must be reset.

Type I – Push on Knob
Rezeroing and Stroke Knob Disassembly and Assembly

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.

2. Pry off the yellow cap.

3. Place the knob on a flat surface.

4. Using needle nose pliers, squeeze the inner section up together while lifting the outer section up.

5. Push the inner section back onto the "D" shaped stroke shaft.

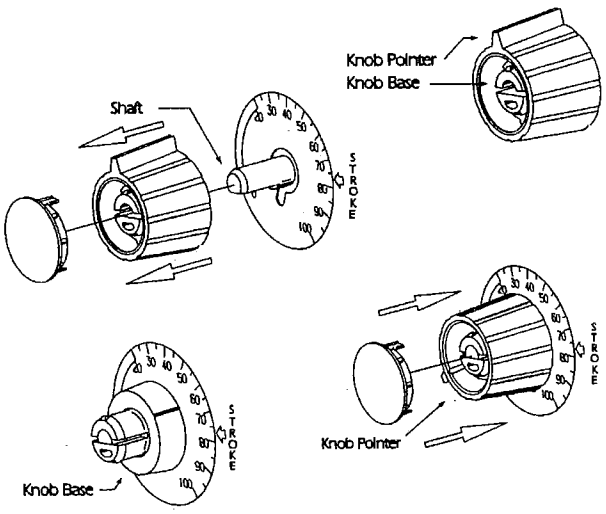
6. With the pump running, zero the pump by turning the inner section of the knob counter clockwise until the pump stops clicking.

7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.

8. Push down on the outer section (a snap sound indicates parts are locked together).

9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



Type III Collet Knob
Rezeroing and Stroke Knob Disassembly and Assembly

1. Remove yellow cap.

2. Hold knob with soft jaw pliers.

3. Disconnect knob by loosening 5/16" (8mm) collet nut. There is no need to remove nut.

4. Remove knob by pulling towards you.

5. With pump running, zero the pump using a screwdriver to turn the stroke shaft counter-clockwise until the pump just stops clicking.

6. Pump is now zeroed.

7. Position knob at zero, or the end of the low range band, and tighten 5/16" (8mm) collet nut.

8. Replace yellow cap.

BODINE® ELECTRIC COMPANY

MOTOR/GEARMOTOR SAFETY, INSTALLATION, USE, AND MAINTENANCE INFORMATION

Bodine Electric Co., 2500 W. Bradley Pl., Chicago, IL 60618 U.S.A.

Form P/N 074 00045 Printed in U.S.A. (OH)

Congratulations . . . and thanks on your selection of a Bodine Motor/Gearmotor. With your new drive unit you will find yourself enjoying the same high performance and relatively trouble free operation that have been characteristic of Bodine products since 1905. We call it ADE (After Delivery Economies).

The Bodine Electric Company prides itself on the quality of design and manufacture of its products. Great care is taken in an attempt to provide products free of defective design, workmanship, or materials. It will be considered a favor to have cases of unsatisfactory service from Bodine products brought to our attention.

SAFETY

"The use of electric motors and generators, like that of all other utilization of concentrated power, is potentially hazardous. The degree of hazard can be greatly reduced by proper design, selection, installation, and use, but hazards cannot be completely eliminated. The reduction of hazard is the joint responsibility of the user, the manufacturer of the driven or driving equipment, and the manufacturer of the motor or generator."■

Bodine products are designed and manufactured to comply to applicable safety standards and in particular to those issued by ANSI (American National Standards Institute), NEMA (National Electrical Manufacturers Association), U.L. (Underwriters Laboratories, Inc.), and CSA (Canadian Standards Association).

Most Bodine products are "third party approved" with respect to construction. Motors and gearmotors having component recognition by U.L. Inc. have a "C" or "ℛ" symbol in the left-most unlabeled space on the bottom row of their nameplates. Those that are CSA certified have a "Ⓢ" mark in the same location. If you need specific information regarding the "third party approval" of Bodine products, contact your Bodine representative, or the home office.

However, since even well-built apparatus can be installed or operated in a hazardous manner, it is important that safety considerations be observed by the user. With respect to the load and environment, the user must properly *select, install,* and *use* the apparatus—for guidance on all three aspects see safety standards publication No. ANSI/NEMA MG-2.■

■Standards Publication No. ANSI/NEMA MG-2. "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators."

Available from:
National Electrical Manufacturers Assoc.
2101 L Street N.W.
Washington, D.C. 20037, U.S.A.

SELECTION

Before proceeding with the installation, the user should review the application to confirm that the proper drive has been selected. This should be done after reading this notice and all applicable safety standards. If in doubt, contact your Bodine Representative or the Home Office if there is no Representative in your area. Any selection or application suggestions made by Bodine are only to assist the customer—and in all cases, determination of fitness for purpose or use is solely the customer's responsibility.

Unless otherwise agreed to by Bodine, all nameplate ratings are based on the following *normal operating conditions:*

1. Duty—8 hours per day; 5 days per week if nameplated continuous duty (CONT), without frequent reversals or starts and stops. Products intended for intermittent duty show a time rating on the nameplate based on keeping the winding temperature within the maximum allowable temperature of the insulation system when the motor is started with windings within 5°C of the ambient temperature.
2. Ambient temperature 0 to 40°C (104°F).
3. Load—Uniform and free from shock or high inertia.
4. Voltage—Within 10% of nameplate rating.
5. Frequency—Within 5% of nameplate rating.
6. Combined variation of voltage and frequency—Within a total of 10% providing frequency variation does not exceed 5%.

Consult Bodine if variations from the above conditions are contempated.

INSTALLATION

It is the responsibility of the equipment manufacturer or individual installing the apparatus to take diligent care in installing it. The National Electrical Code (NEC), sound local electrical and safety codes, and when applicable, the Occupational Safety and Health Act (OSHA) should be followed when installing the apparatus to reduce hazards to persons and property.

Inspection

Examine for damage from shipment before connecting. Any claim(s) for shipping damage should be made to the freight carrier. Do not attempt to turn the output shaft of a gearmotor with an externally applied torque arm.

Mounting

Any screws, or similar devices, that penetrate the motor frame either for mounting the Bodine product or mounting something to the product should be limited in length so as not to come in contact with, or in close proximity to, intended features that conduct electricity. Spacings as high as .158" may be required based on voltages and circuitry involved. Consult factory if necessary.

Preferred mounting positions for Bodine products are illustrated in selection literature. Gearmotor mountings other than those shown are not recommended on some *gearmotors* due to (a) the possibility of gearhead lubricant leakage into the motor portion and (b) possible leakage from gearhead breather and oil level holes. Also, for parallel-shaft gearmotors, the proper lubricant quantity provided for horizontal mounting is not sufficient for vertical mounting. By making the proper adjustments (normally done at the factory), mountings other than the preferred positions of gearmotors are possible.

Connection

Follow nameplate for voltage, frequency, and phase of power supply. See accompanying wiring diagram as to connections for rotation (and capacitor, resistor, relay, protector, if required). *When connecting, make sure that your motor/gearmotor is securely and adequately grounded—failure to ground properly may cause serious injury to personnel.* (If wiring diagram shipped with drive unit becomes lost or missing, contact Bodine, providing serial number (NO) and (TYPE) information shown on the nameplate of the unit).

Wiring

For wire sizes and electrical connections refer to the National Electric Code (NEC)—Article 430—"Motors, Motor Circuits, and Controllers" and/or applicable local area codes. If extension cords are used, they should be kept short for minimum voltage drop. Long or inadequately sized cords can cause motor failure, particularly with hard starting loads when current draw tends to be at its highest.

USE

Additional Safety Considerations

The chance of electric shocks, fires, or explosions can be reduced by giving proper consideration to the use of grounding, thermal and over current protection, type of enclosure, and good maintenance procedures.

The following information *supplements* the foregoing safety considerations: This information is not purported to be all-inclusive and the aforementioned references should be consulted.

1. Do not insert objects into the ventilation openings of products.
2. Sparking of starting switches in AC motors so equipped, and of brushes in commutator type motors, can be expected during normal operation. In addition, open-type enclosures may eject flame in the event of an insulation failure. Therefore, avoid, protect from, or prevent the presence of flammable or combustible materials in the area of motors/gearmotors.
3. Bodine totally enclosed products are not explosion proof or dust ignition proof nor does Bodine offer such products for hazardous locations (flammable/explosive gas, vapor, dust). When dealing with hazardous locations, an *approved* explosion proof or dust ignition proof product is the recommended approach. Exceptions are allowed by the National Electrical Code: The NEC and the NEMA safety standard should be studied thoroughly before exercising this option.
4. Open, ventilated motors are suitable for clean, dry locations where cooling air is not restricted. Enclosed motors/gearmotors are suitable for dirty, damp locations. For outdoor use, wash downs, etc., enclosed motors must be protected by a cover while still allowing adequate air flow.
5. Moisture will increase the electrical shock hazard of electrical insulation. Therefore, consideration should be given to the avoidance of (or protection from) liquids in the area of motors. Use of totally enclosed motors/gearmotors will reduce the hazard if all openings are sealed.
6. Products equipped with thermal protectors are labeled "THERMALLY PROTECTED." If severe over-loading, jamming, or other abnormal operating conditions occur, such heat sensitive protectors operate to open the electric power supply circuit. Motors/gearmotors with "automatic" thermal protectors MUST NOT be used where automatic restarting of the drive unit could be hazardous in that clothing or parts of the human body could be in electrical or physical contact with a machine that *starts unexpectedly* when the thermal protector cools down. MANUAL RESET protectors or suitable electric supply disconnect devices/procedures should be used where such hazards could be created.

7. The windings of DC stepper motors, or their switching transistors, must be disconnected from the DC power source to avoid unexpected motion. If not, extraneous signals could turn on the power transistors and generate motion.
8. Some oil-type capacitors contain a non-PCB impregnate which is *flammable*. Such capacitors are identified by means of a Warning Label and, in addition, are stamped "NON-PCB." The user has to provide at least .57 in. (14.5mm) clearance beyond the terminal blades for case expansion to allow an internal safety switch to *permanently* open and electrically disconnect the capacitor. The internal pressure sensitive switch is designed to prevent the expulsion of the flammable dielectric medium if excessive temperatures are generated by electrical operation. Do not discard such capacitors into open fire as excessive external heat could cause them to explode.
9. Motors/gearmotors which employ capacitors, can develop more than nameplate voltage across the capacitor and/or capacitor winding (depending on design). Also, overdrive voltages may be many times greater than a stepper motor's continuous voltage rating. Suitable precautions should be taken when applying such motors.
10. Abnormal conditions such as cut-out switch failure, or a partial winding failure can very occasionally cause some AC motors/gearmotors to start in a direction reverse from normal. Also, use a capacitance or resistance value other than that recommended for Hy-Sync™ motors may result in unpredictable reverse operation. Susceptability to unplanned reversing under such conditions is greatest when the motor's actual load is light relative to it's rated load. One-way clutches or similar devices are advisable if unexpected reverse rotation is unsafe in the application.
11. Do not rely upon self-locking gears or permanent magnet, stepper, Hy-Sync™, or energized motors to hold a load in place if movement could result in personal injury. Mechanical looking devices should be used in such applications.
12. For motors driven by electronic controls, do not use a function of the control for safety interlock purposes. An independent switch or relay should be used. On stepper motors, the device should be between the control and the motor.

Before Starting

1. Before attempting to start, check all connections and fuses.
2. Proper consideration should be given to rotating members: Before starting, be sure keys, pulleys, etc. are securely fastened. *Proper guards should be provided to prevent hazards to personnel while rotating.*
3. Other mechanical considerations include proper mounting and alignment of products and safe loads on shafting and gearing.

Starting

1. The motor/gearmotor should be test-started in an unloaded state (because of possible reaction torque, the drive should be securely mounted when starting—even when unloaded).
2. If the drive unit does not start promptly and run smoothly, disconnect at once.
3. If unable to correct the problem, contact your purchase source, or a Bodine Authorized Service Center, describing the trouble in detail. Include the serial number, type, and other nameplate data. Do not dismantle the product—unless authorized by Bodine, removing screws voids the warranty.

MAINTENANCE

IMPORTANT—*Before* servicing or working on equipment, disconnect power source (this applies especially to equipment using automatic restart devices instead of manual restart devices and when examining or replacing brushes on brush-type motors/gearmotors).

Clean regularly to prevent dirt and dust from interfering with ventilation or clogging moving parts.

Brush Type Motors/Gearmotors—The wear rate of brushes is dependent upon many parameters (armature speed, amperage duty cycle, humidity, etc.). For optimum performance, brush-type motors and gearmotors need periodic user-maintenance. The maintenance interval is best determined by the user. Inspect brushes regularly for wear (replace in same axial position). Replace brushes when their length is less than ¼ inch (7mm). Periodically remove carbon dust from commutator and inside the motor—this can be accomplished by occasionally wiping them with a clean, dry, non-linting cloth. Do not use lubricants or solvents on the commutator. If necessary, use No. 0000 or finer sandpaper only to dress the commutator. Do not use solvents on a non-metallic endshield if the product is so equipped.

Products Employing Capacitors—Before servicing motors/gearmotors employing capacitors, always discharge the capacitor by placing a conductor across its terminals before touching the terminals with any part of your body.

LUBRICATION INSTRUCTIONS

Motor Ball Bearings (not gearhead bearings)—are grease lubricated and do not normally require re-lubrication or replacement for a period of approximately five years if run under normal operating conditions (defined above). More adverse conditions generally require more frequent servicing. Do not over-grease ball bearings as shortened life can result.

Motor Sleeve Bearings (not gearhead sleeve bearings)—sleeve bearing motors are identified by the presence of oil holes or oilers on the motor endshields. Motor sleeve bearings should be re-lubricated every six months or 1000 operational hours (whichever comes first) when used under normal operating conditions as defined above. For motors under (4) inches in diameter, re-lubricate with 5-6 drops of SAE No. 10 non-detergent oil (Bodine #LO-30). For larger diameter motors, re-lubricate with 5-6 drops of SAE #20 non-detergent oil (Bodine #LO-17). More severe conditions will require more frequent servicing. Do not over-lubricate.

Gearhead Lubrication—Gearmotors consists of a motor portion and a gearhead portion. The previous sections dealt with motor bearings—the following text concerns gearhead (gear and gear-shaft bearing) lubrication.

A. *Oil Lubricated Gearmotors* (identified by the presence of an oil level sight gauge or plug marked "Oil Level"). Oil lubricated gearheads are shipped with a red plastic plug in their vent holes. *Remove red plastic plug from oil fill vent hole before starting.* (Gearbox must be vented to prevent internal pressure build-up as the unit heats up.) When operating under normal operating conditions, check oil level every 4 to 5 months or 600 operating hours—whichever occurs first.

1. *Type "-10" Gearheads:* These gearmotors are identified by the "10" appearing after a hyphen in the TYPE box on the nameplate. For example; N□□-1□D□ (where the identifying designators are illustrated and a "□" indicates the location of any other number or letter). Refill "-10" gearheads to the indicated oil level with a good quality rust and oxidation inhibited oil conforming to AGMA#5 (SAE#50 non-detergent) with a viscosity range of 918-1122 SUS @ 100°F, viscosity index of 90 minimum, and pour point of 0°F (minus 17.8°C) max., or Bodine lubricant #LO-38. Do not over-fill.

2. *Oil Lubricated Gearmotors other than Type "-10":* These gearmotors can be identified as follows: examine the nomenclature in the "TYPE" box on the nameplate; if any of the combinations of numbers and letters defined below appear after a hyphen, the gearmotor is oil lubricated. (The identifying designators are illustrated and a "□" symbol indicates the position of any other number or letter).

-3□RHL -5□RL -3□RJ
-5F -5N -5H

Examples: NCI-34RHL (-3□RHL)
32D5BEPM-5F (-5F)

Refill these gearmotors to oil level indicated on the respective product with a good quality worm gear oil conforming to AGMA #5 EP compounded (SAE #90) oil, or Bodine lubricant #LO-23. Do not over-fill.

3. *Note:* For test and run-in of gearmotors that are applied to equipment for resale, remove red plastic vent hole plug from oil fill vent hole. If gearmotor may be tipped during shipment, replace plastic plug and include instructions to remove the plug before operating the gearmotor.

B. *Grease Lubricated Gearmotors:* Grease lubricated gearmotors can be identified as follows: examine the nomenclature in the "TYPE" box on the nameplate; if any of the combinations of numbers and letters defined below appear *after a hyphen*, the gearmotor is grease lubricated. (The locations of the identifying designators are illustrated and a "□" symbol indicates the position of any other number or letter).

-2□A□ -2□T□ -1□R -1□RH* -3□R*
-1□RG -3□RH -5□R* -W□ -E□ -F□

Examples: NSI-12R (-1□R)
42R5BFCI-E3 (-E□)

The above gearmotors are supplied with sufficient grease to last for the "design life" of the gearmotors. Some right-angle gearheads may have oilers on their output shaft hubs. The oilers should be relubricated every three months with 5-6 drops of SAE #20 non-detergent oil (Bodine #LO-17).

C. *General*—The above recommended lubricants may be purchased in one pint containers from the Bodine Electric Company, 2500 West Bradley Place, Chicago, Illinois 60618, U.S.A., or a Bodine Authorized Service Center. Gearmotors should be re-lubricated only with recommended lubricants for maximum life of gears, bearings, and seals.

BODINE LIMITED WARRANTY

The Bodine Electric Company warrants all products manufactured by it to be free of defects in workmanship and materials when used under Normal Operating Conditions and when applied in accordance with nameplate specifications. This warranty shall be in effect for a period of twelve months from date of purchase or eighteen months from date of manufacture, whichever comes first.

The Bodine Electric Company will repair or replace at its option, any of its products which has been found to be defective and is within the warranty period, provided that the product is shipped freight prepaid, with previous authorization, to Bodine's plant in Chicago, Illinois 60618 U.S.A., or to the nearest Bodine Authorized Service Center. At its option, all return shipments are F.O.B. Bodine's plant or Authorized Service Center. Bodine is not responsible for removal, installation, or any other incidental expenses incurred in shipping the product to or from Bodine.

This warranty is in lieu of any other expressed or implied warranty—including (but not limited to) any implied warranties of merchantability and/or fitness for a particular use or purpose.

Bodine's liability under this warranty shall be solely limited to repair or replacement of the Bodine product within the warranty period and Bodine shall not be liable, under any circumstances, for any consequential, incidental or indirect damages or expenses associated with the warranted products.

Commutators and/or brush wear and its associated effects are a normal occurrence and are not covered by this warranty unless otherwise agreed to by Bodine in writing.

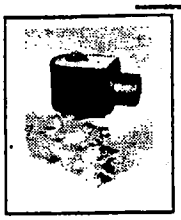
Any Bodine product which is damaged due to misuse, abuse, negligence or has been modified or dismantled without the knowledge or written consent of Bodine, is not covered by this warranty.

Motor/Gearmotor Serial No._____ Purchase Date._____ Installed By_____

SKINNER VALVE
Parker Hannifin Corporation
95 Edgewood Avenue
New Britain, CT 06051
Telephone (860) 827-2300

IOM7218

Parker Climate & Industrial Controls





INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS
2-WAY N.C. AND N.O. PILOT OPERATED VALVES
3/8", 1/2", 3/4" and 1" NPT
1-1/4", 1-1/2" and 2" NPT
WATER VALVE TYPES: 7321B

CE

DESCRIPTION

The 7321B valves are 2-way, pilot operated diaphragm valves requiring a minimum operating pressure differential to insure valve operation. Valves are available in normally closed (N.C.) and normally open versions of brass construction. Valves may be ordered with either NEMA 2, 4, 4X integrated coils for ordinary locations or NEMA 4, 4X, 7, and 9 for hazardous locations: Divisions I and II; Class I, Groups A, B, C, and D; Class II, Groups E, F, and G. Additional solenoid coils and enclosures are offered as described in our catalog.

PRINCIPLES OF OPERATION

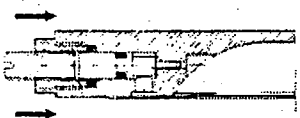
Normally Closed type: 7321B

De-energized: A flow arrow on the body indicates flow direction. Ports are not marked. Pressure is connected to the inlet port. The fluid enters the valve below the diaphragm assembly, flows through the diaphragm bleed hole and fills the cavity above the diaphragm. The diaphragm is pressed against the main orifice by the force of the plunger spring and the fluid pressure sealing the main orifice. The plunger seals the diaphragm pilot orifice and there is no flow through the valve.

Energized: Low differential pressure operation: With very low differential pressure, energizing the coil creates a magnetic force sufficient to lift the plunger off the pilot orifice and vents the pressure above the diaphragm. The venting creates a pressure imbalance across the diaphragm, which causes the diaphragm to open the valve main orifice allowing flow through the valve. The valve will remain open as long as the coil is energized.

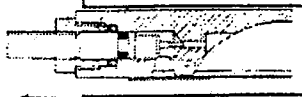
Metering Valves (Closing Speed):

Metering described is optional – these descriptions and operating instructions apply only to valves that have been equipped with the appropriate metering.



Screw fully closed – Valve always open

Speed Control Closed



Screw fully open – Max. closing speed

Speed Control Open

Valves with the metering screw feature located in the cover function the same as the above valves except during de-energizing the closing of the diaphragm assembly is slowed by adjustment of a speed control metering stem.

Manual Overrides Valves:

Manual overrides described are optional – these descriptions and operating instructions apply only to valves that have been equipped with the appropriate manual override.

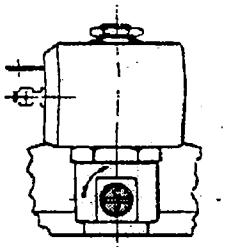


Fig. 1



Fig. 2

The unit is shipped with a manual override feature. The manual control is used to operate the valve without connecting the coil. The slotted control screw has two positions:
Closed: To function, turn the slotted screw component located in the cover below the sleeve tube so the letter "C" is in the upper position of the screw head (Fig. 1).
Open: To function, turn the slotted screw head so the letter "A" is in the upper position of the screw head (Fig. 2).

Normally Open type: 7322B

De-energized: A flow arrow on the body indicates flow direction. Ports are not marked. Pressure is connected to the inlet port. The fluid enters the valve below the diaphragm assembly lifting the diaphragm open allowing flow through the valve. The valve will remain open as long as the coil is de-energized.

Energized: The plunger moves, closing the pilot orifice, which causes the pressure to build up above the diaphragm. The increased pressure and the diaphragm spring cause the diaphragm to close the main orifice,

stopping flow through the valve. The valve will remain closed as long as the coil is energized.

NOTE: When the valve is removed from the box, the diaphragm will be closed. Line pressure will open the valve.

CAUTION: A minimum operating pressure differential is required for proper valve operation. Consult nameplate rating.

FLUID CODES

Listed below are the codes utilized by Underwriters Laboratories (UL) and the Canadian Standards Association (CSA) for various common fluids. The codes for those fluids that are approved or certified by the agencies for use with each valve are printed on the outside of the individual packaging.

CODE	FLUID
S	- Steam
W	- Water or other aqueous nonflammable liquids

For the maximum fluid temperatures, as well as valve ambient limitations, check the valve part number on the nameplate and refer to the catalog.

INSTALLATION INSTRUCTIONS

Mounting position and pressure limits: Valves can be mounted directly on piping and are designed to operate in any position. However, for optimum life and performance the valves should be mounted vertically upright so as to minimize wear and reduce the possibility of foreign matter accumulating inside the sleeve area possibly resulting in valve failure

Line pressure must conform to nameplate rating.

Piping: Remove protective closures from the ports. Connect line pressure to the upstream port. An arrow on the body indicates direction of flow. Use of Teflon tape, thread compound or sealants are permissible, but should be applied sparingly to male pipe threads only.

CAUTION: *Do not allow foreign particles, Teflon tape, or thread compound to enter valve. Only the wrench flats provided on the body ports should be used in applying the torque. Tightening torque should not exceed the following values for each port size:*

3/8" NPT – 250 in-lbs. 1/2" NPT - 350 in-lbs.
3/4" NPT – 450 in-lbs. 1" NPT - 600 in-lbs.
1-1/4" NPT – 700 in-lbs. 1-1/2" NPT – 750 in-lbs.
2" NPT – 950 in-lbs.

Do not use sleeve or enclosure as a lever when applying torque. Connect outlet line to opposite port. *Only use wrench flats provided on the body when applying torque.*

Media filtration: For protection of the valve, install a suitable strainer or filter in the inlet side as close to the valve as possible. Recommended strainer of 100 microns or better. Dirt or foreign material in the media may cause excessive leakage, wear, or in exceptional cases, malfunction. Clean periodically depending on service conditions.

Lubrication: Lubrication is not required although air line lubrication will substantially increase valve life.
CAUTION: *Valve types with an "E" in the 10th position of part number have parts made from ethylene propylene rubber and must not be exposed to petroleum based lubricants or other hydrocarbons.*

ELECTRICAL CONNECTION: Electrical supply must conform to nameplate rating. Connect coil leads or terminals to the electrical circuit using standard electrical practices in compliance with local authorities and the National Electrical Code.

Do not power coil until it has been fitted and the retaining washer and screw have been installed to prevent possible coil damage from overheating.

WARNING: *Valves to be installed in **Hazardous Locations** must be outfitted with Hazardous Location coils only. Verify nameplate data and coil part number before installing the valve.*

WARNING: *Turn off electrical power before connecting the valve to the power source.*

If the coil assembly is located in an inconvenient orientation, it may be reoriented to facilitate installation. Loosen coil assembly nut, rotate coil assembly to desired position, and then retighten the nut with an input torque of 43-53 in-lbs.

DIN Coil and Various Cable Option Terminations: Loosen cable screw and remove plastic housing from DIN coil. Do not remove the gasket from the DIN spades on the coil. Separate the plastic block from the housing with a small screwdriver to expose the electrical terminations. Feed the lead wires through the DIN connector housing and attach them to the appropriate screw terminal. Snap the plastic block back into place. Replace the plastic housing onto the DIN spades and tighten the screws. To secure the housing and coil together. Apply 20 to 30 in-lbs. torque to the mounting screw.

DIN Coil and Terminal Box Assembly (Coil / Option Codes D1DB, D2DB, D3DB): Loosen cover screws and swing cover 90° toward the conduit hub in order to access the interior space. Separate the plastic block containing the screw terminals from the metal enclosure using a small Flathead screwdriver. Feed the lead wires through the conduit hub and attach them to the appropriate screw terminal. For electrical connection within the terminal box, use field wire that is rated for 90° C or greater. Snap the plastic block back into place inside the metal enclosure. Replace the cover and hand-tighten the cover screws. Place the gasket over the DIN spades on the coil and press the terminal box and coil together. Secure the terminal box to the coil using the mounting screw provided. Apply 20 to 30 in-lbs. torque to the mounting screw.

Screw Terminal Coil and Terminal Box Assembly (Coil / Option Codes S1TB, S2TB, S3TB): Loosen cover screws and swing cover 90° toward the conduit hub in order to access the interior space. Feed the lead wires through the conduit hub and attach them to the

appropriate screw terminal. For electrical connection within the terminal box, use field wire that is rated for 90° C or greater. Replace the cover and hand-tighten the cover screws. Press the terminal box and coil together. Secure the terminal box to the coil using the mounting screw provided. Apply 20 to 30 in-lbs. torque to the mounting screw.

CAUTION: *When the DIN or Screw Terminal coils are used with the Terminal Box Assembly, be sure to apply a wrench to the wrench flats on the conduit hub when installing electrical conduit.*

Coil/enclosure temperature: Standard valves are supplied with coils designed for continuous duty service. Normal free space must be provided for proper ventilation. When the coil is energized continuously for long periods of time, the coil assembly will become hot. The coil is designed to operate permanently under these conditions. Any excessive heating will be indicated by smoking and/or odor of burning coil insulation.

For the maximum valve ambient conditions, as well as the fluid temperatures, check the valve part number on the nameplate and refer to the catalog to determine the maximum temperatures.

MAINTENANCE

Note: Depending on service conditions, fluid being used, filtration, and lubrication, it may be required to periodically clean and/or replace worn components. See Disassembly Instructions.

CAUTION: *Do not expose plastic or elastomeric materials to any type of commercial cleaning fluid. Parts should be cleaned with a mild soap and water solution.*

DISASSEMBLY INSTRUCTIONS

WARNING: *Depressurize system and turn off electrical power to the valve before attempting repair.*

The valve body need not be removed from the line.

To remove the coil assembly:

For both ordinary and hazardous location constructions, unscrew the nut on the top of the coil assembly. The wave washer and coil assembly can now be removed.

To disassemble the pressure vessel:

CAUTION: *Do not use a pipe wrench directly on the sleeve tube.*

Use a 7/8" (22mm) wrench or an adjustable wrench to remove the sleeve tube. The plunger, return spring and flange seal may be removed.

Unscrew the four (4) or (6) cover screws. The diaphragm assembly, return spring, and O-ring can now be removed. On metering valves, the speed control feature can also be removed at this time. If the cover cannot be easily lifted off the body, laterally tap the cover or gently pry the cover from the body. Care must be taken not to damage the diaphragm, cover or body.

Replacement Parts: When ordering replacement parts kits, specify valve number and voltage from nameplate. Parts kits are available for each valve. Parts included in each kit are marked with an **asterisk (*)**. See section drawing and component tabulation.

REASSEMBLY INSTRUCTIONS

WARNING: *Valves equipped with **Hazardous Location** coils must use Hazardous Location replacement coils only. Verify nameplate data and coil part number before installing the replacement coil.*

To reassemble the pressure vessel:

Refer to exploded view drawings. Assemble the O-ring into the body groove. For valves with the metering feature, replace the O-rings and reassemble the speed control device at this time. Install the diaphragm assembly into the body. Making sure the diaphragm tab is located over the outlet port of the body. Line up the diaphragm bolt holes with the appropriate bolt and flow holes in the body. Install the screws and tighten screw with a torque of 70-80 in-lbs for the 3/8" and 1/2" sizes and 125-150 in-lbs for the larger port size valves. Avoid damaging the main orifice when placing the diaphragm assembly in the valve.

Install the manual override (where applicable) into the cover prior to sleeve assembly. Insert the manual override into the valve cover. Rotate the override until the large flat surface of the override is facing out of the cover. This orientation is required for proper sleeve assembly.

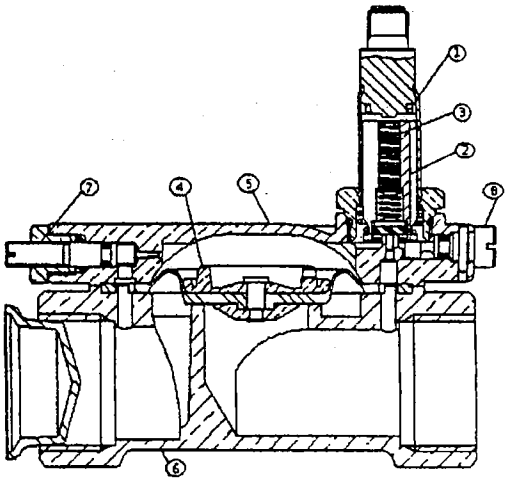
If the sleeve was removed from the cover, install the plunger and spring into the sleeve. Tighten the sleeve assembly with an input torque of 230-250 in-lbs.

With the coil assembly repositioned on the sleeve, slide the wave washer over the sleeve and tighten coil assembly nut with an input torque of 43-53 in-lbs.

After re-assembly, it is advisable to thoroughly check for leakage and for correct operation of the valve.

Refer to the Installation Instructions for remaining installation procedures.

TROUBLE SHOOTING	
PROBLEM	**PROCEDURE**
Valve fails to operate.	1. Check electrical supply with voltmeter. Voltage must agree with nameplate rating. 2. Check coil with ohmmeter for shorted or open coil. 3. Make sure that pressure complied with nameplate rating.
Valve is sluggish or inoperative - electrical supply and pressure check out.	1. Disassemble valve as per the Disassembly Instructions. Clean out any extraneous matter. The plunger must be free to move without binding. 2. Check the diaphragm for tears and for clogged or obstructed bleed hole or pilot orifice. Torn diaphragm must be replaced. 3. Check all springs, if broken, replace.
External leakage at sleeve flange to cover joint.	1. Check that sleeve is torqued to 260-270 in-lbs. 2. Check flange seal for damage. Replace if defective.
External leakage at flange joint between body and cover.	1. Check that cover screws are torqued with an input torque per reassembly instructions. If leakage persists, replacement of diaphragm assembly or flange O-ring may be required and/or bodies or covers with damaged sealing surfaces may have to be replaced.
External leakage at metering speed control device.	1. Check O-rings for damage. Replace if necessary.
Internal Leakage	1. Disassemble valve as per the Disassembly Instructions. Remove extraneous matter. Clean parts in a mild soap and water solution. 2. Examine diaphragm sealing surface for dirt. Remove all foreign particles. Examine orifice for nicks. Damaged parts must be repaired or replaced. 3. Check plunger return spring. Replace if broken.



Normally Closed Valve (typical)

Part	Description
1	Sleeve Assembly
2	Plunger Assembly
3	Plunger Spring
4	Diaphragm Assembly
5	Cover
6	Body
7	Metering Stem (optional)
8	Manual Override Stem (optional)

* Parts included in repair kit. Contact Parker Skinner Valve for repair kit number based on selected valve.

DECLARATION

Parker's Skinner Valve Division certifies its valve appliance products comply with the essential requirements of the applicable European Community Directives. We hereby confirm that the appliance has been manufactured in compliance with the applicable standards and is intended for installation in a machine or application where commissioning is prohibited until evidence has been provided that the machine or application is also in compliance with EC directives.

The data supplied in the Skinner valve catalogs and general Installation, Operating & Maintenance Instructions are to be consulted and pertinent accident prevention regulations followed during product installation and use. Any unauthorized work performed on the product by the purchaser or by third parties can impair its function and relieves Parker Hannifin of all warranty claims and liability for any misuse and resulting damage.

A separate Declaration of Conformity or Manufacturer's declaration is available upon request. Please provide valve identification numbers and order serial numbers of products concerned.

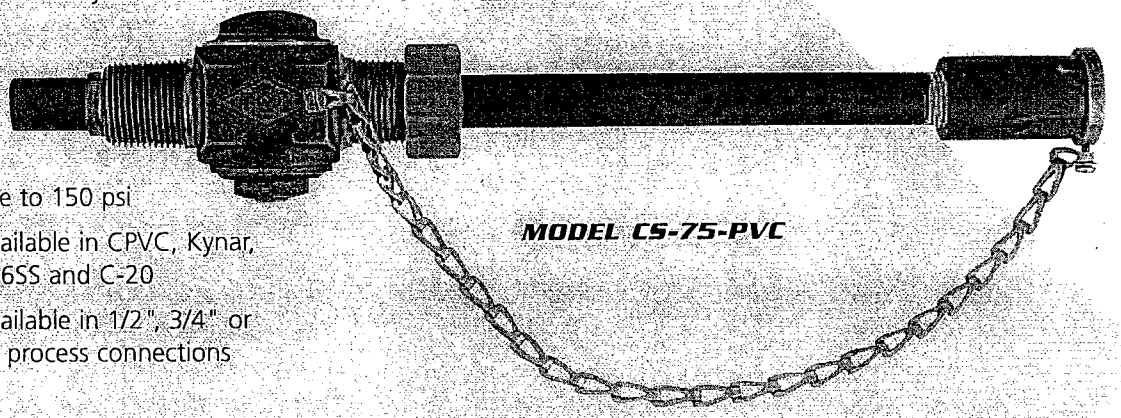
Corporation Stops and Injection Quills

Corporation Stops

Neptune
CHEMICAL PUMP CO., INC.

Corporation Stops with injection quills are used for injecting chemicals pumped by metering pumps into tanks, mains, cooling towers and process systems. Quill extends into the center of the stream providing more uniform dispersion of injection chemical.

Corporation Stop can be mounted to a "hot tap" which is installed without draining the system. Corporation Stop allows injection quill to be inserted or removed without having to drain or shut down the system.

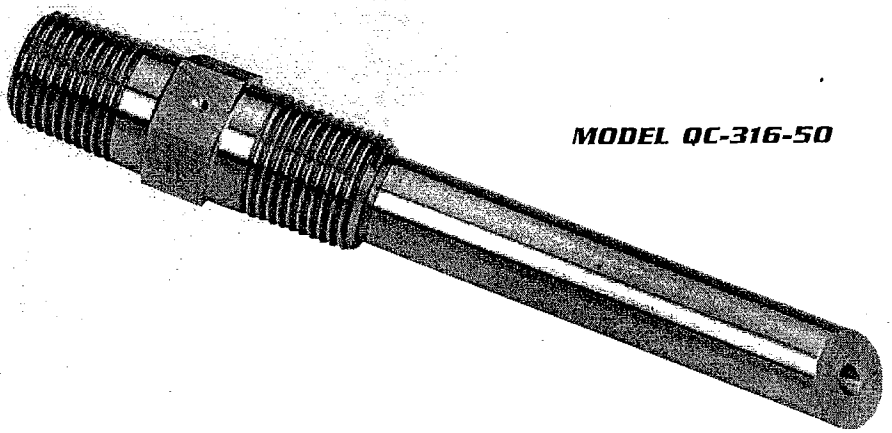


MODEL CS-75-PVC

- Use to 150 psi
- Available in CPVC, Kynar, 316SS and C-20
- Available in 1/2", 3/4" or 1" process connections

High Pressure Injection Quills

High Pressure Injection Quills are used to inject chemicals pumped by metering pumps into the turbulent flow zone of high pressure water or steam lines.



MODEL QC-316-50

- Use to 3,000 psi
- Built-in check valve
- Available in PVC, Kynar, 316SS and C-20

Corporation Stops with Quills

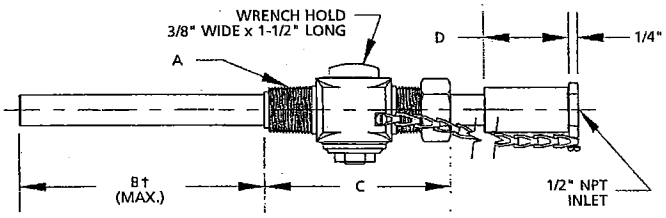
MODEL	MATERIAL OF CONSTR.	PRESS. PSI	MAXIMUM TEMP.	SIZE (INCHES)	DIMENSIONS (INCHES)		
				A	B	C	D
CS-50-PVC	CPVC	125 psi	100°F (37°C)	1/2 NPT	9	4	2
CS-75-PVC	CPVC	125 psi	100°F (37°C)	3/4 NPT	8-1/2	4-5/8	2
CS75PVC-SP	CPVC	125 psi	100°F (37°C)	3/4 AWWA	8-1/2	4-5/8	2
CS-100-PVC	CPVC	125 psi	100°F (37°C)	1 NPT	8-3/8	5-1/4	1-5/8
CS100PVCSP	CPVC	125 psi	100°F (37°C)	1 AWWA	8-3/8	5-1/4	1-5/8
CS-50-KY	Kynar	150 psi	200°F (93°C)	1/2 NPT	9	4	2-3/8
CS-75-KY	Kynar	150 psi	200°F (93°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-KY	Kynar	150 psi	200°F (93°C)	1 NPT	7-5/8	5-1/4	2
CS-50-316	316SS	150 psi	250°F (121°C)	1/2 NPT	9	4	2-3/8
CS-75-316	316SS	150 psi	250°F (121°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-316	316SS	150 psi	250°F (121°C)	1 NPT	7-5/8	5-1/4	2-3/8
CS-50-C20	C-20-Cb3	150 psi	250°F (121°C)	1/2 NPT	9	4	2-3/8
CS-75-C20	C-20-Cb3	150 psi	250°F (121°C)	3/4 NPT	8-1/2	4-5/8	2-3/8
CS-100-C20	C-20-Cb3	150 psi	250°F (121°C)	1 NPT	7-5/8	5-1/4	2-3/8

Features

- Protection chain prevents withdrawal before Corporation Stop is closed
- Operating pressures to 150 psi
- Quill available in Corrosion-resistant CPVC, Kynar, 316 stainless steel and Carpenter 20-Cb3
- Corporation Stop (brass only) available with 1/2", 3/4" or 1" process connections
- Quill connection 1/2" female all models

Recommendation

- Install a check valve and isolation valve at the inlet of the quill for ease of maintenance.



†Special lengths are available up to 24".

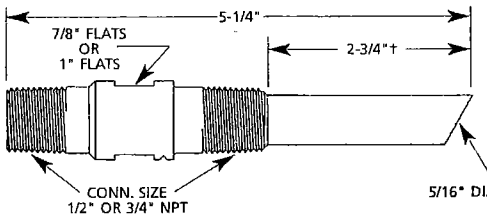
High Pressure Injection Quills with Built-in Check Valves

Features

- Built-in Spring Loaded Check on all models
- High pressure to 3,000 psi
- Available in PVC, Kynar, 316 stainless steel and Carpenter 20-Cb3

MODEL	MATERIAL OF BODY	MATERIAL OF CHECK	MATERIAL OF SPRING	PRESS. (MAX.)	MAXIMUM TEMP.	CONN. SIZE NPT
QC-PVC-50	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	1/2"
QC-PVC-75	PVC	Ceramic	HAST C	150 psi	100°F (37°C)	3/4"
QC-316-50	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-316-75	316SS	316SS	HAST C	3000 psi	750°F (400°C)	3/4"
QC-316-HPSE*	316SS	316SS	HAST C	3000 psi	750°F (400°C)	1/2"
QC-C20-50	C-20	C-20	HAST C	3000 psi	750°F (400°C)	1/2"
QC-KY-50	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	1/2"
QC-KY-75	Kynar	Ceramic	HAST C	150 psi	200°F (93°C)	3/4"

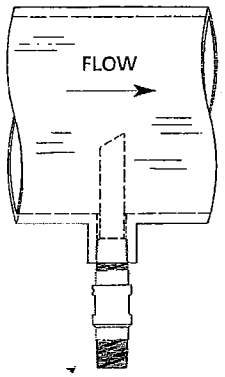
*Has slotted end.



†Special lengths are available up to 24".

Recommendations

- For lines smaller than 4" diameter, trim quill so chemical is released near center of line. Use as is for lines over 4" diameter.
- Install with "Telltale" V-notch facing upstream so flow strikes angled face at end of quill for most rapid dispersal of injected chemical.
- For maintenance ease, installation of an isolation valve, rated above line operating pressure, immediately behind the quill is recommended.



SOLD BY:

Neptune
CHEMICAL PUMP CO., INC.

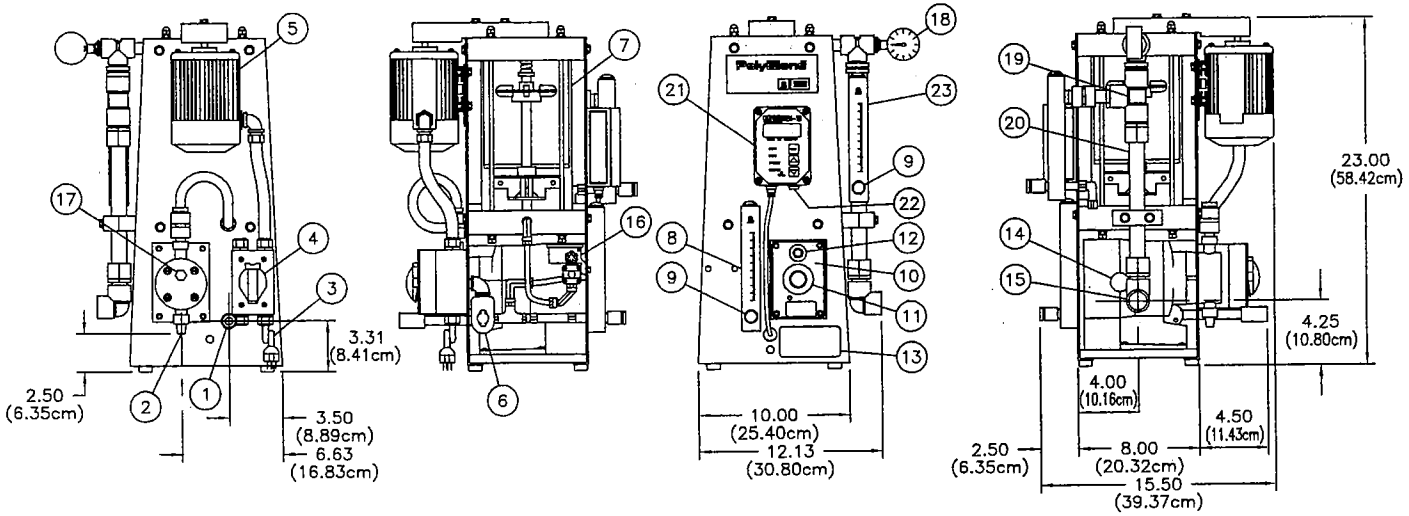
P.O. Box 247 • Lansdale, PA 19446-0247
Tel: 215-699-8700 • Fax: 215-699-0370
Toll-Free Tel: 1-888-3NEPTUNE (1-888-363-7886)
Toll-Free Fax: 1-800-255-4017
Web Site: http://www.neptune1.com
E-mail: pump@neptune1.com

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DRAWING NUMBER:
PB200

NOTICE – U.S. Filter/Stranco CLAIMS PROPRIETARY RIGHTS IN THE MATERIAL DISCLOSED ON THIS DRAWING. IT IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY AND MAY NOT BE REPRODUCED OR USED TO MANUFACTURE ANYTHING HEREON WITHOUT DIRECT WRITTEN CONSENT FROM U.S. Filter/Stranco TO THE USER.

PB UNIT	PUMP OUTPUT	PRIMARY ROTAMETER RANGE	SECONDARY ROTAMETER RANGE
PB200–0.4	0–.42GPH	10–100GPH	10–100GPH
PB200–1	0–1GPH	10–100GPH	10–100GPH
→ PB200–2	0–2GPH	10–100GPH	10–100GPH
PB200–2.5	0–2.5GPH	10–100GPH	10–100GPH
PB200–0.4K	0–1.5LPH	38–375LPH	38–375LPH
PB200–1K	0–3.8LPH	38–375LPH	38–375LPH
PB200–2K	0–7.6LPH	38–375LPH	38–375LPH
PB200–1A	0–3.8LPH	38–375LPH	38–375LPH
PB200–2A	0–7.6LPH	38–375LPH	38–375LPH



KEY	DESCRIPTION
1	WATER INLET, 1/2" (F)NPT
2	POLYMER INLET, 5/8" O.D. BARB
3	POWER CORD
4	MIXER MOTOR SWITCH w/THERMAL OVERLOAD
5	MIXER MOTOR
6	SOLENOID VALVE, (WATER)
7	MIXING CHAMBER
8	PRIMARY ROTAMETER
9	RATE VALVE
10	DIAPHRAGM PUMP
11	STROKE LENGTH KNOB
12	STROKE RATE/EXTERNAL SELECTOR SWITCH
13	SERIAL PLATE

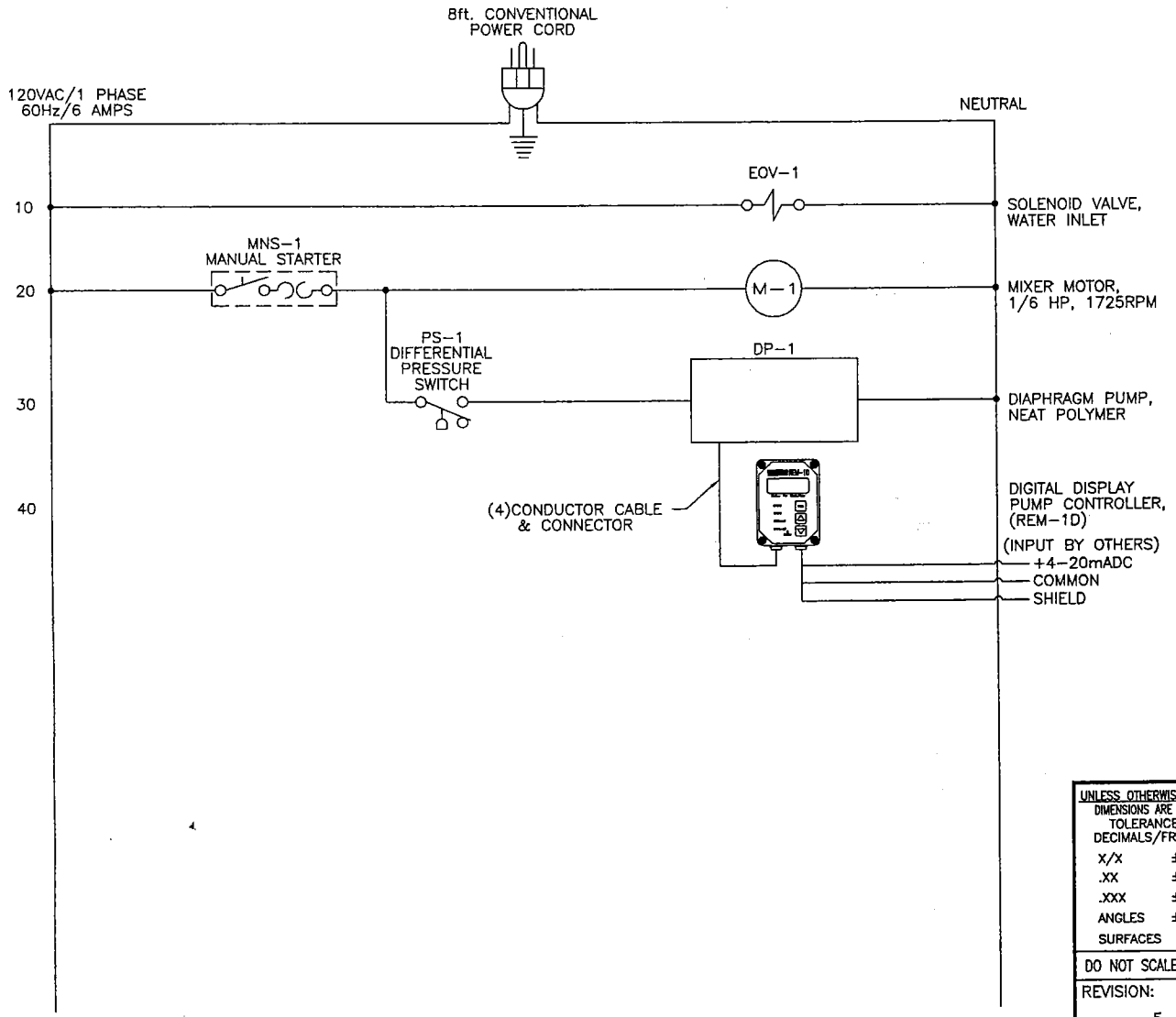
14	EXTERNAL INPUT SIGNAL CONNECTOR
15	SOLUTION OUTLET, 3/4" (F)NPT
16	DIFFERENTIAL PRESSURE SWITCH
17	PRIMING PORT, (POLYMER)
18	PRESSURE GAUGE
19	CONFLUENCE ASSEMBLY
20	STATIC MIXER
21	DIGITAL DISPLAY PUMP CONTROLLER, (REM–1D)
22	4–20mADC INPUT
23	SECONDARY ROTAMETER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS/FRACTIONS X/X ±1/32 .XX ±0.01 .XXX ±0.003 ANGLES ±0°–0.5° SURFACES 125	DRAWN BY: BRIAN DISMANG	DATE: 01-04-94	USFilter STRANCO PRODUCTS BRADLEY, IL
	CHECKED BY: JRC (ON FILE)	06-09-98	DRAWING TITLE: GENERAL ARRANGEMENT PB200 (STANDARD UNIT)
	APPROVED BY: ALN (ON FILE)	06-10-98	
DO NOT SCALE DRAWING	WEIGHT: N/A		SCALE: 1/8 = 1 / SHEET 1 OF 1
REVISION: 2	REVISED BY: GEORGE GIDDINGS	DATE: 10-28-97	PART NUMBER: N/A / DRAWING NUMBER: PB200

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DRAWING NUMBER:
SES–0003

NOTICE – U.S. Filter/Stranco CLAIMS PROPRIETARY RIGHTS IN THE MATERIAL DISCLOSED ON THIS DRAWING. IT IS ISSUED IN CONFIDENCE FOR ENGINEERING INFORMATION ONLY AND MAY NOT BE REPRODUCED OR USED TO MANUFACTURE ANYTHING HEREON WITHOUT DIRECT WRITTEN CONSENT FROM U.S. Filter/Stranco TO THE USER.

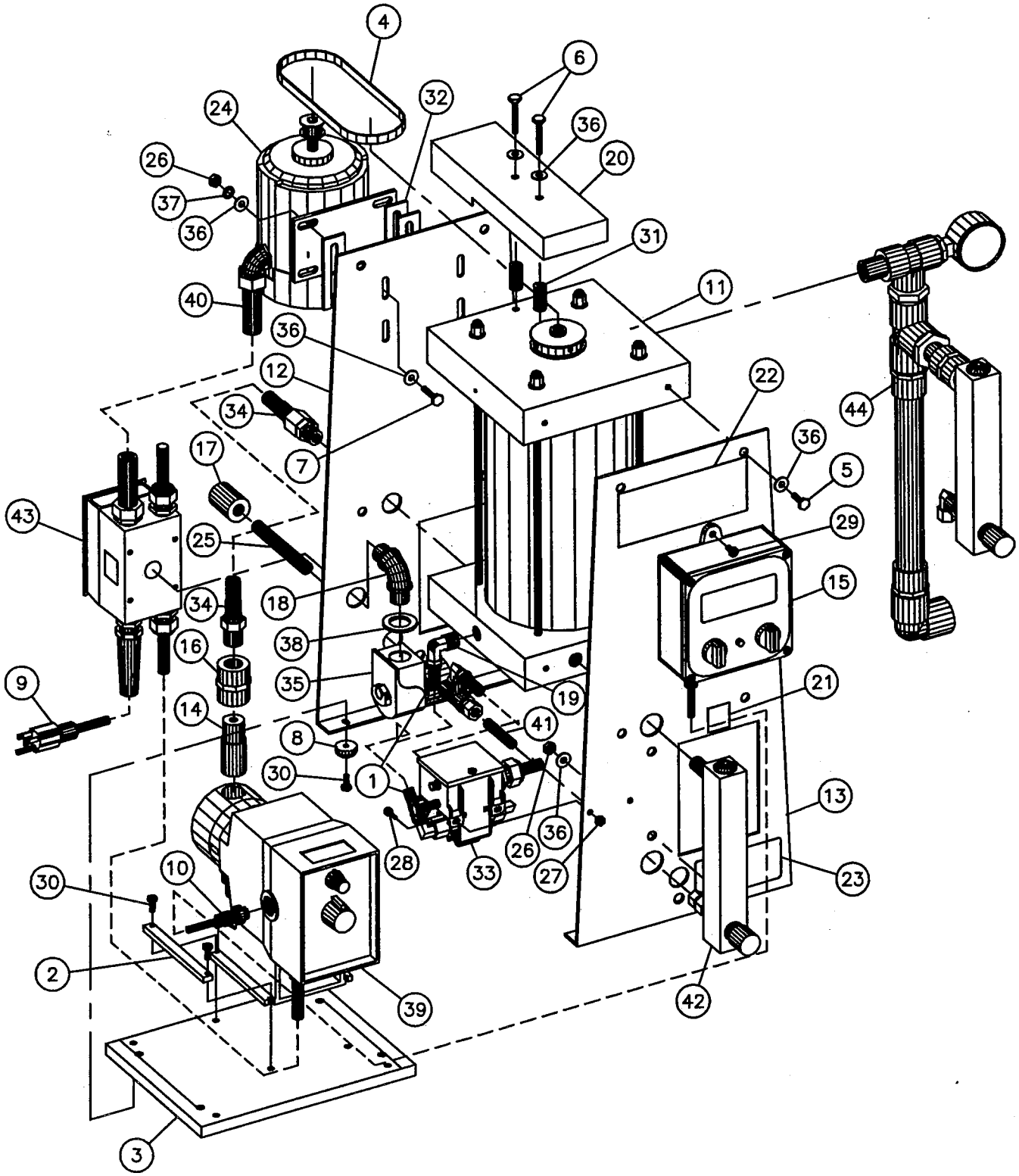


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS/FRACTIONS X/X ±1/16 .XX ±0.03 .XXX ±0.010 ANGLES ±1.0°–0" SURFACES 250	DRAWN BY: BRIAN DISMANG	DATE: 02–23–89	USFilter STRANCO PRODUCTS BRADLEY, IL
	CHECKED BY: GG (ON FILE)	12–14–98	DRAWING TITLE: ELECTRICAL LADDER LOGIC SERIES PBLO & PB100/200 DIAPHRAGM
	APPROVED BY: JC (ON FILE)	12–14–98	
DO NOT SCALE DRAWING	WEIGHT: N/A		SCALE: N/A / SHEET 1 OF 1
REVISION: 5	REVISED BY: JOHN COULTER	DATE: 12–14–98	PART NUMBER: N/A / DRAWING NUMBER: SES–0003

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OVERALL

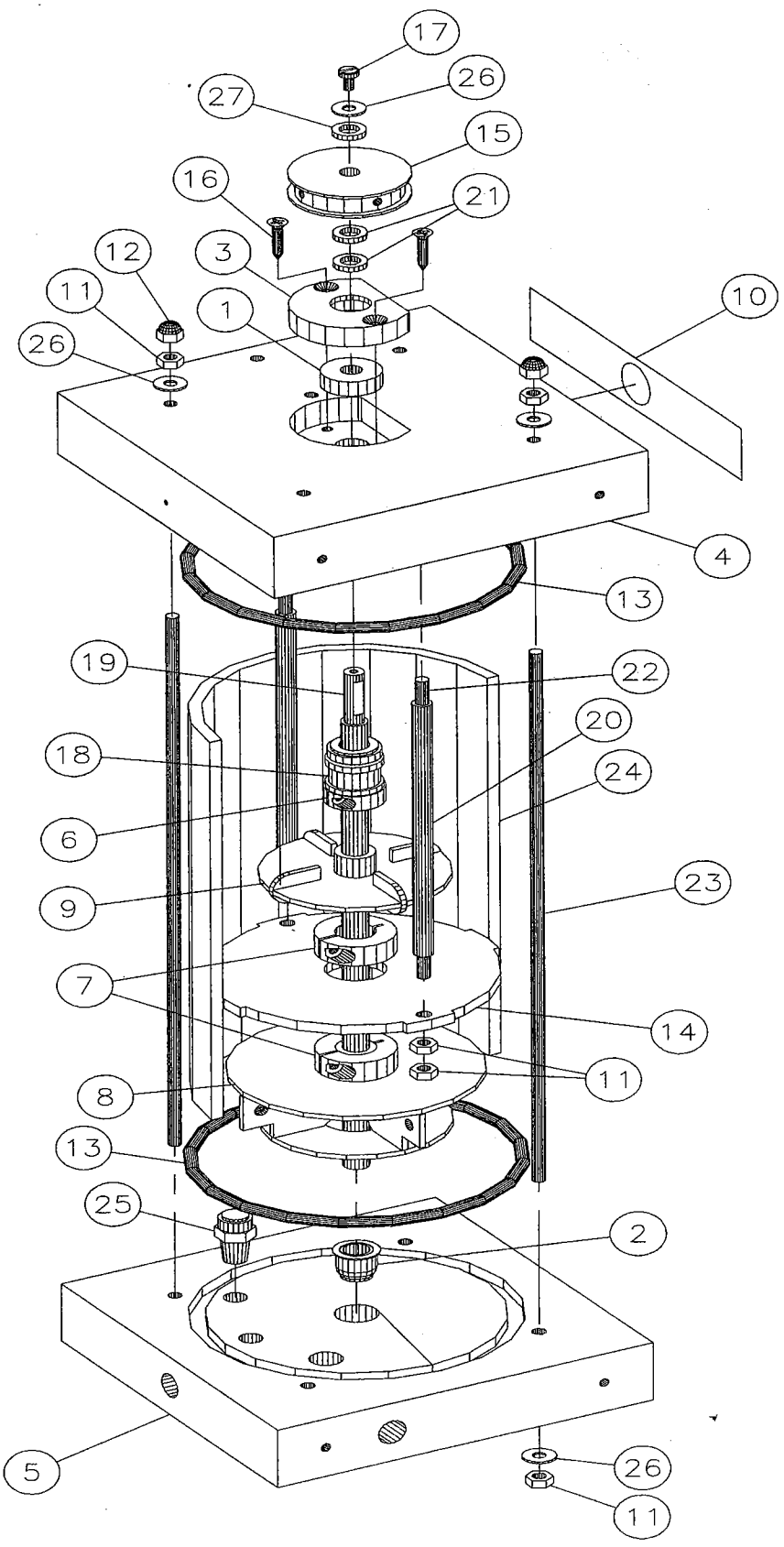
ITEM	P/N	DESCRIPTION	QTY	UM
1	10342	TUBING, 3/8" OD X 1/4" ID, POLYETHYLENE	1.00	FT
2	10746	BRACKET, PUMP	2.00	EA
3	1364001	BASE SUB-ASSY. PB100-0	1.00	EA
4	1450318	BELT	1.00	EA
5	1600312	BOLT, HH, 1/4-20 X 3/4 SS	8.00	EA
6	1600324	BOLT, HH, 1/4-20 X 1-1/2 SS (CAP SCREW)	2.00	EA
7	1600366	BOLT, HH, 1/4-20 X 1 SS	4.00	EA
8	1890001	BUMPER, RUBBER	4.00	EA
9	1983001	CABLE ASSY, 110V, 8FT GROUNDED, MALE PLG, 16/3	1.00	EA
10	1984005	CABLE ASSY.	1.00	EA
11	*******	CHAMBER ASSY., MIXING (SEE SECTION)	1.00	EA
12	2383001	CHASSIS, BACK	1.00	EA
13	2383002	CHASSIS, FRONT	1.00	EA
14	26033	VALVE	1.00	EA
15	2896006	CONTROLLER, REM-1D	1.00	EA
16	2930004	CPLG, PVC, SCH 80 1/2"FPT	1.00	EA
17	2930420	CPLG, RED, SS 1/2 X 1/4 FT X T	1.00	EA
18	3579864	ELBOW, CONDUIT	1.00	EA
19	3581604	ELBOW, 90, BRASS 3/8 OD X 3/8 MPT	1.00	EA
20	4681310	BELT GUARD	1.00	EA
21	5551209	LABEL, WATER FLOW	2.00	EA
22	5551210	LABEL, POLYBLEND	1.00	EA
23	5554000	LABEL, SERIAL PLATE	1.00	EA
24	5902001	MOTOR	1.00	EA
25	5963028	NIPPLE, SS 1/4" X 4"	1.00	EA
26	6020031	NUT, 1/4-20, HEX SS	6.00	EA
27	6020962	NUT, 8-32, HEX	2.00	EA
28	7771558	SCREW, MACH, SS PAN HD, PHIL, 8-32 X 1/2	2.00	EA
29	7772506	SCREW, MACH, 304SS, PAN HD, SLTD, 10-32 X 3/8	2.00	EA
30	7772508	SCREW, MACH, 10-32 X 1/2, SLTD PH, SS	8.00	EA
31	8140001	SPACER	2.00	EA
32	8141001	SPACER, MOTOR SHIM	3.00	EA
33	8724903	SWITCH, DIFF. PRESSURE	1.00	EA
34	9414002	TUBE BRAIDED SS, 1/2" MPT X 3/8" MPT X 14" LG*	1.00	EA
35	9571301	VALVE SOLENOID	1.00	EA
36	9740300	WASHER, SS, FLAT 1/4"	9.00	EA
37	9740330	WASHER, SS, INT TOOTH, 1/4"	4.00	EA
38	9748300	WASHER, SS, FLAT 1/8"	1.00	EA
39	AA761-75PBX	PUMP	1.00	EA
40	RM2702060	CONDUIT, SEALTITE 3/8"	1.00	FT
41	RM9414061	TUBE, RIGID 304 SS 3/8"OD X 1/4"ID	1.00	FT
42	*******	FLOWMETER (SEE SECTION)	1.00	EA
43	1672002	BOX JUNCTION SUB-ASSY.	1.00	EA
44	*******	STATIC MIXER ASSY., (SEE SECTION)	1.00	EA


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MIXING CHAMBER SP2340003

ITEM	PART NO.	DESCRIPTION	QTY.
1	1410002	BEARING	1
2	1414001	BEARING, THRUST	1
3	1419001	BEARING, FLANGE CARRIER	1
4	SP2124008	CAP, TOP, MIXING CHAMBER	1
5	SP2124009	CAP, BOTTOM, MIXING CHAMBER	1
6	2650001	COLLAR, 1/2" I.D.	1
7	2650002	COLLAR, 3/4" I.D.	2
8	5173304	IMPELLER	1
9	5173305	IMPELLER, SECONDARY	1
10	5551002	LABEL - DISCHARGE	1
11	6020031	NUT, HEX HD., 1/4"-20	12
12	6023031	NUT, ACORN, 1/4"-20, S.S.	4
13	6091801	O-RING	2
14	6676002	PLATE, BAFFLE	1
15	7071201	PULLEY	1
16	7772216	SCREW, 10-32 X 1"	2
17	7772506	SCREW, 10-32 X 3/8"	1
18	7802910	SEAL, MECHANICAL	1
19	7854303	SHAFT, IMPELLER	1
20*	8140005	SPACER ROD	2
21	8143011	SPACER	2
22	8603002	STUD	2
23	8603004	ROD	4
24	9412606	TUBE, ACRYLIC	1
25	9572304	VALVE, INJ. CHECK	1
26	9740300	WASHER, FLAT, 1/4"	9
27	8143010	SPACER	1

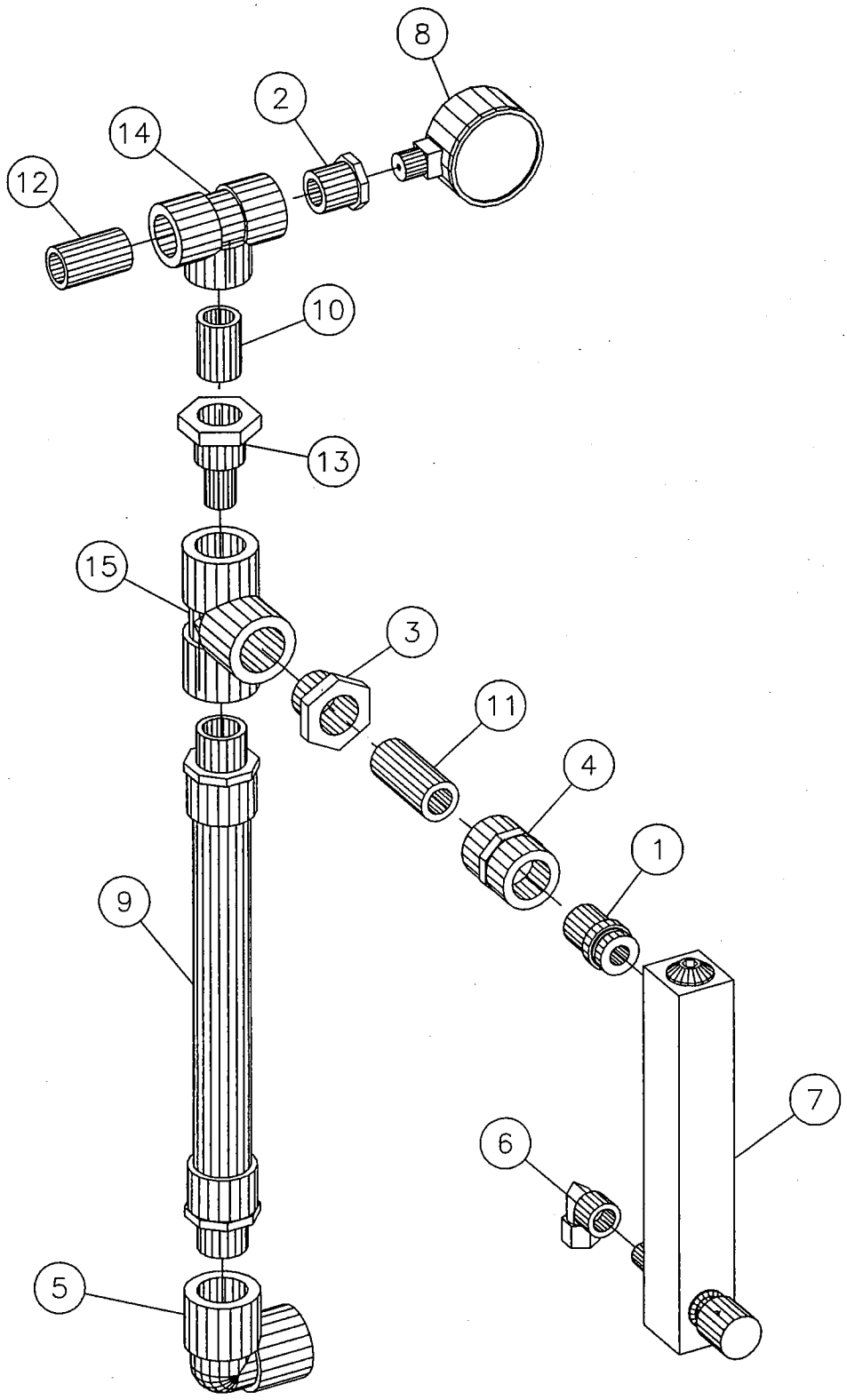
*Factory personnel identify item #20 as part RM6600021, which must be cut to a length of 6-3/4 inches. For replacements, request P/N 8140005 to receive spacer rods, which are pre-cut to the appropriate length.


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POST DILUTION, STATIC MIXER ASSEMBLY - P/N SP5860016

ITEM	PART NO.	DESCRIPTION	QTY.
1	1040692	ADAPTER, FLOWMETER	1
2	1930305	BUSH, PVC, 1/2" X 1/4", TXT	1
3	1930310	BUSH, PVC, TXT, 3/4" X 1/2"	1
4	SP2930906	COUPLING, PVC, 1/2", FPT	1
5	3570105	ELBOW, 90 PVC, TXT 3/4"	1
6	3585634	ELBOW, COMP, 90, NP, 3/8" OD X 1/4" FPT	1
7	4291102	FLOWMETER, KING, 100GPH	1
8	4480010	GAUGE, PRESSURE, 0-160PSI	1
9	5850002	MIXER, STATIC	1
10	5961062	NIPPLE, PVC, 1/2 X CLOSE	1
11	5961064	NIPPLE, PVC, 1/2" X 2"	1
12	5963063	NIPPLE, SS, 1/2" X 1-1/2" 304SS	1
13	SP5961046	NIPPLE, CPVC, SCH 8, 3/8" x 3"	1
14	8850104	TEE, PVC, 1/2" FPT	1
15	SP8850304	TEE, PVC, 3/4" FPT	1

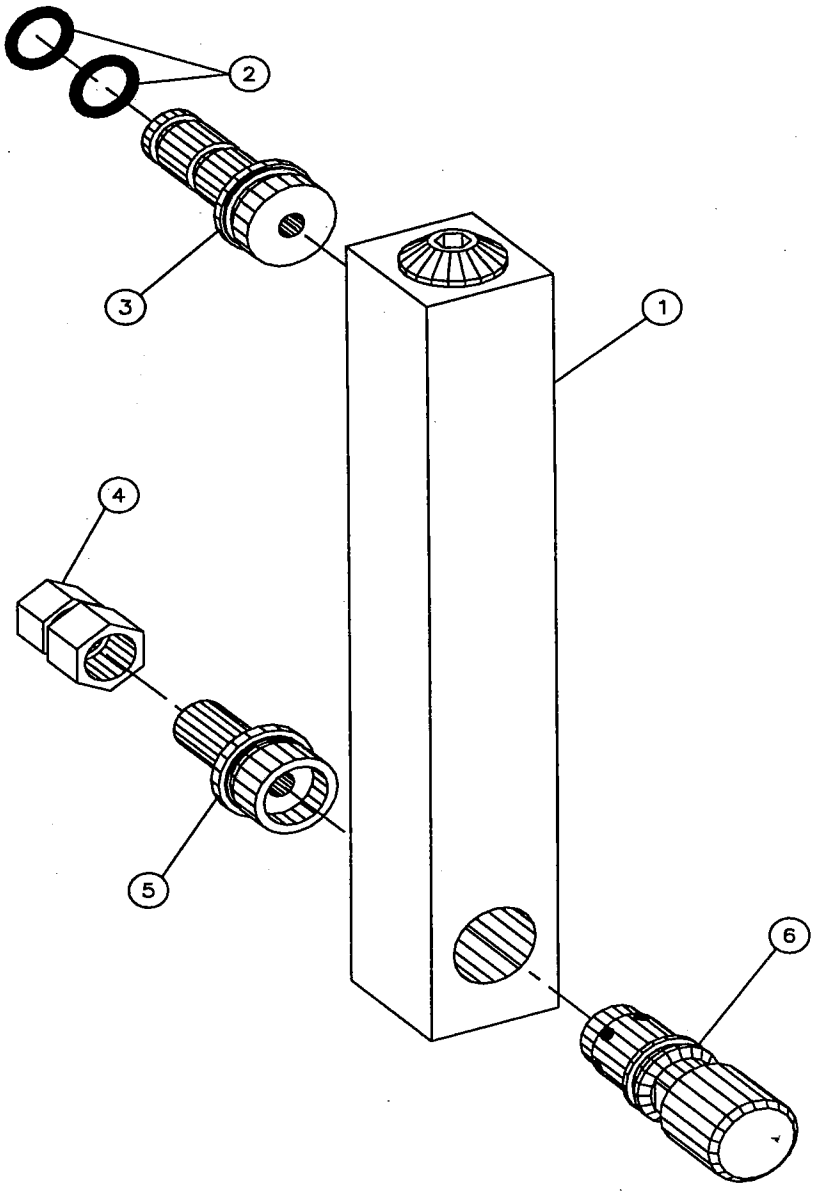
Post Dilution, Static Mixer Assembly - P/N AP5860016



FLOWMETER

ITEM	PART NO.	DESCRIPTION	QTY.	UM
1	4291102	FLOWMETER, KING, 100GPH	1	EA
2	6091301	O-RING, BUNA N	2	EA
3	1040093	ADAPTER, SPUD	1	EA
4	2735634	CONNECTOR, TUBE, 1/4" FPT X 3/8" OD COMP.	1	EA
5	1048401	ADAPTER, FLOWMETER	1	EA
6	9579301	VALVE, KING	1	EA

Flowmeter Assembly - P/N 4301102



USFILTER STRANCO PRODUCTS
(USFILTER STRANCO)
P.O.BOX 389
BRADLEY, IL 60915

TELEPHONE: 815-932-8154
800-882-6466
FACSIMILE: 815-932-0674

PolyBlend® Warranty

USFilter Stranco warrants equipment of its manufacture and bearing its trademark to be free of defects in workmanship and materials. If the customer gives USFilter Stranco prompt written notice of a breach of this warranty within the Warranty Period (as defined below), USFilter Stranco shall, at its sole option and as the customer's exclusive remedy, either repair or replace at no charge, or refund the purchase price paid with respect to, any part or product of its manufacture that is returned to the factory freight prepaid and found to be in breach of this warranty. If USFilter Stranco determines that any claimed breach is not, in fact, covered by this warranty, the customer shall pay USFilter Stranco's then customary charges for any repair or replacement. The foregoing warranty is conditioned upon the customer's (i) operating and maintaining the equipment in accordance with all applicable product instructions, (ii) not making any unauthorized repairs or alterations, and (iii) not being in default of any payment obligation to USFilter Stranco. This warranty does not cover damage caused by chemical action or abrasive material (including, without limitation, particulates in the makeup water), damage caused by handling or during transportation, or damage arising from misuse, installation or any other cause beyond USFilter Stranco's control. Standard units not in outdoor configurations are not warranted in outdoor applications.

Warranty Period – The warranty begins with the date of shipment and extends for a period of twelve (12) months. However, if start-up of the product by an authorized USFilter Stranco technician occurs within twelve (12) months after the date of shipment, and if a USFilter Stranco start-up report form is filed with USFilter Stranco within 30 days of start-up, the warranty period begins with the date of start-up. If a non-potable water source is used as primary or secondary dilution water to the PolyBlend unit, the warranty period shall not exceed ninety (90) days from the date of shipment.

PolyBlend HydroForce® Warranty

The PolyBlend HydroForce® mixing assembly is covered for the life of the product by the limited warranty set forth herein, provided that the limited lifetime warranty extends only to the original user of the product.

30-Day Guarantee -- Each product of USFilter Stranco's manufacture is covered by a 30-day 100% buy-back guarantee of customer satisfaction. If customer is dissatisfied with the product's performance for any reason, the product can be returned to USFilter Stranco for a full refund of the sale price. In order to take advantage of the 30-day guarantee the product must have received only normal use and care and the customer must request the refund prior to the expiration of thirty (30) calendar days from the date of shipment.

No representative has authority to change or modify the foregoing warranties in any respect. However, representatives are free to offer service contracts and preventive maintenance agreements on their own, acting independently of USFilter Stranco. **THE WARRANTIES SET FORTH ABOVE ARE USFILTER STRANCO'S SOLE AND EXCLUSIVE WARRANTIES. USFILTER STRANCO MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, AND ALL SUCH EXPRESS OR IMPLIED WARRANTIES ARE HEREBY DISCLAIMED.**

LIMITATION OF LIABILITY:
NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, USFILTER STRANCO SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND USFILTER STRANCO'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

Whether in or out of warranty, a Return Materials Authorization number (RMA) is required and can be obtained by calling our customer service department telephone at 800.882.6466. Have the make, model, and serial number of the item being returned. Reference the RMA number on the outside of the shipping container.

Instruction **Manual**

Electronic Metering Pumps



Carefully read and understand all precautions before installing or servicing any metering



For file reference, please record the following data:

Model No: AA971-353SU / C931-313SI

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

LMI
MILTON ROY

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
www.lmipumps.com

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1615.N 6/01

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1.0 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.

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.

This manual is for Series A, B, C, E, J5, and P pumps.

1.1 Spare Parts

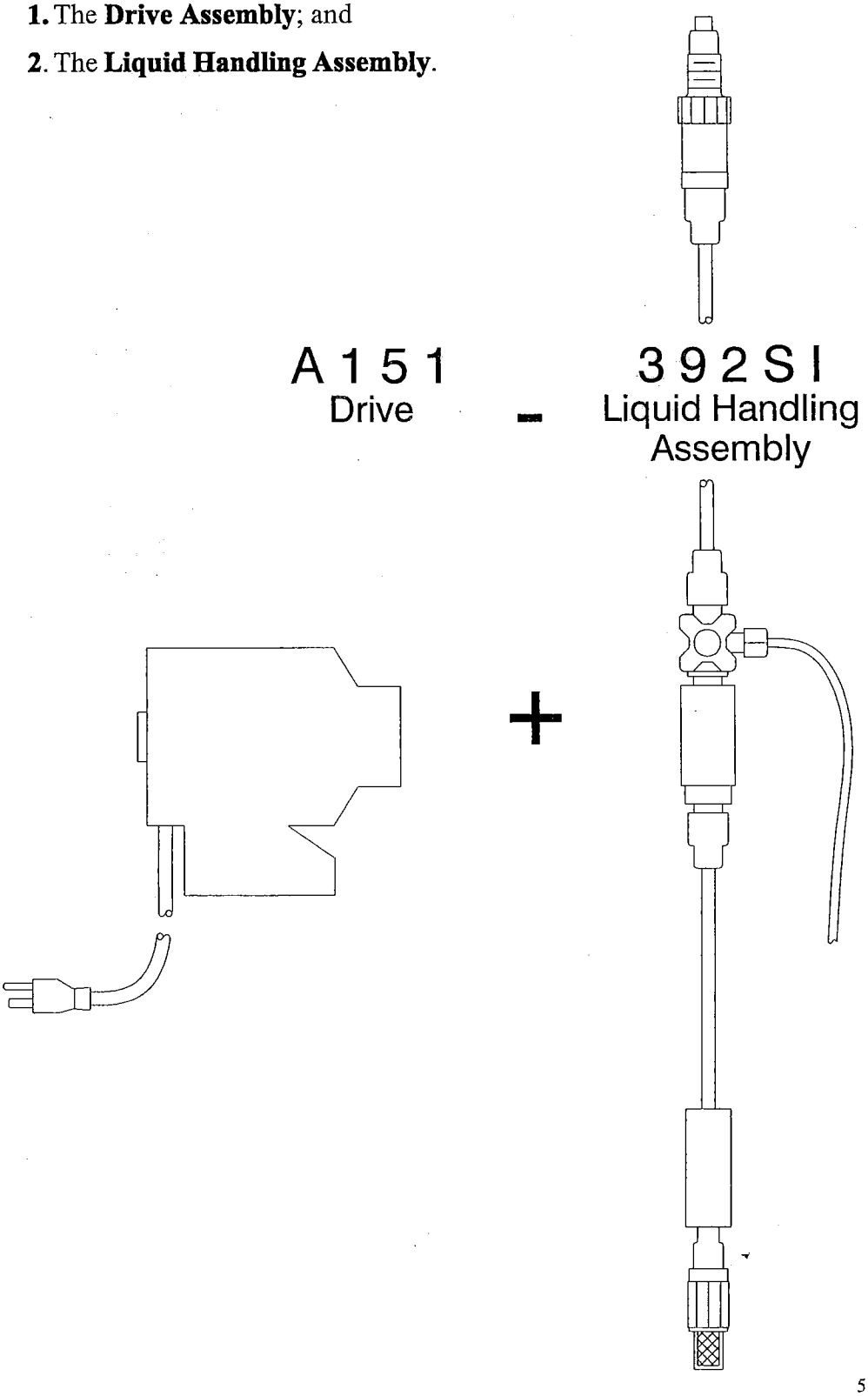
LMI recommends replacing the elastomeric components of the pump on an annual basis. RPM Pro Pacs™ and spare part kits are available from your local LMI Master Stocking Distributor.

Example:

Your pump consists of two main components:

1. The **Drive Assembly**; and

2. The **Liquid Handling Assembly**.

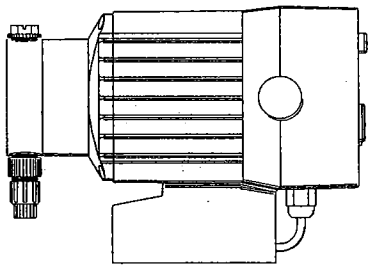


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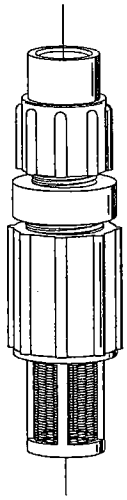
2.0 Unpacking Check List

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.

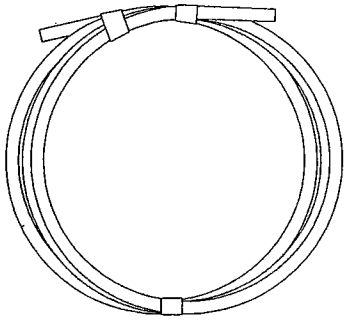
Please refer to the enclosed Instruction Supplement for an illustration and electrical diagram of your complete pump.



Metering Pump

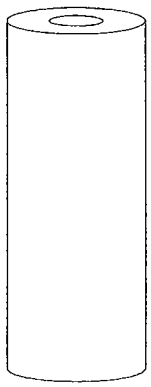


Foot Valve

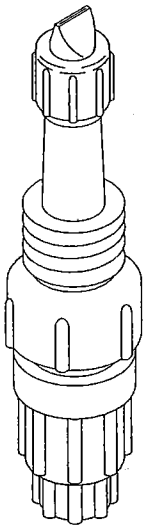


Tubing

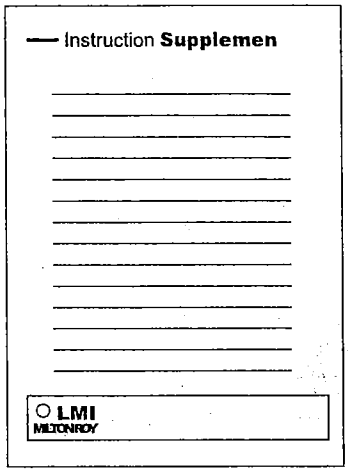
Depending on the model, your carton may contain 0, 1, 2 or 3 rolls of tubing. Your carton may contain a roll of clear vinyl tubing; this is for connection to the SUCTION SIDE OF THE PUMP HEAD ONLY.



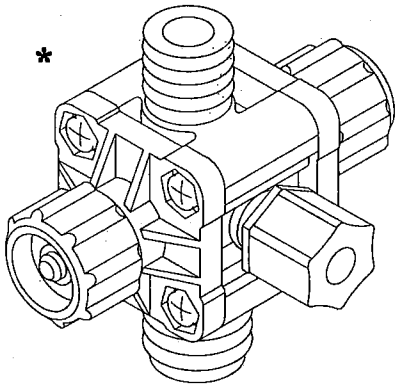
Ceramic Foot Valve Weight



Injection Check Valve



Instruction Supplement



MULTI-FUNCTION Valve and Tubing

* Your carton may or may not contain a 3-FV, 4-FV, or bleed 4-FV accessory.

3.0 Pre-Installation Instructions

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Precautions

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 MSDS 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.)

Solution Compatibility



Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. LMI pumps are tested by NSF for use on muriatic acid and sodium hypochlorite. 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 4.3, 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.



Fittings And Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting contacts the seal ring 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.

All LMI pumps have straight screw machine threads on the head and fittings and are sealed by the seal rings or O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve as well as stainless steel liquid end connections.**



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.



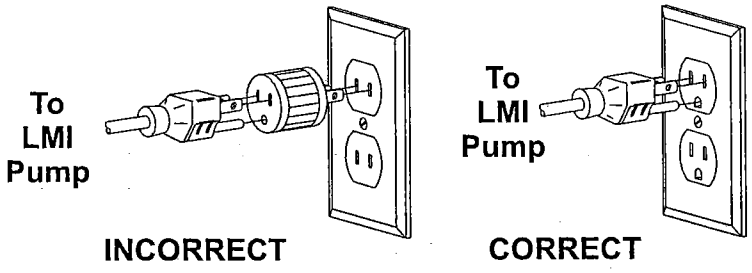
Back Pressure/Anti-Syphon Valve

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 overpumping or syphoning. Contact your LMI distributor for furthur information.

Electrical Connections



To reduce the risk of electrical shock, the metering pump must be plugged into a grounded outlet 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.



4.0 Installation

4.1 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 subjected to ambient temperatures above 122°F (50°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

4.2 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. For denser solutions, consult distributor.

Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

4.2.1 Flooded Suction

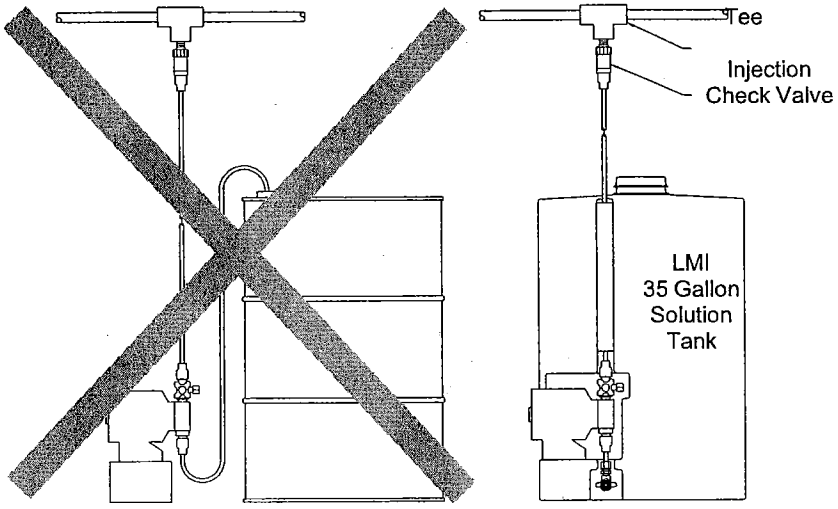
The pump is mounted at the base of the storage tank. This installation is the most trouble-free , and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced.

CAUTION

When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning.

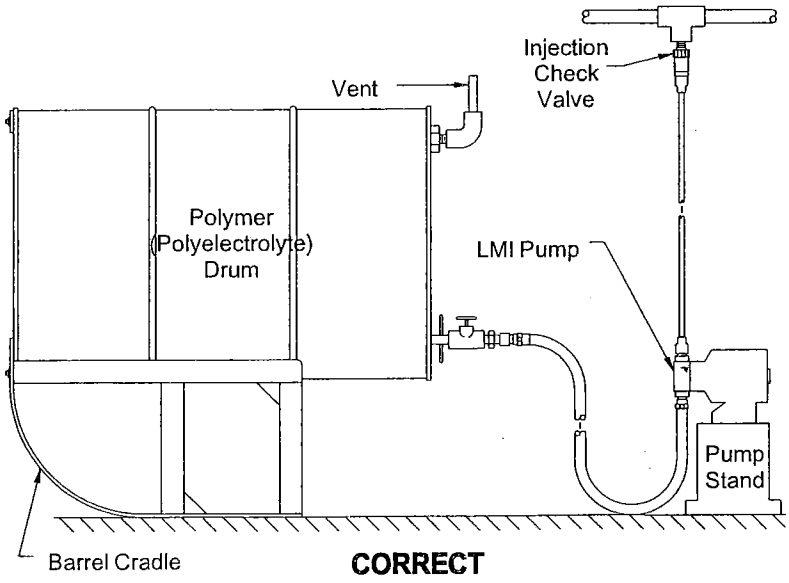
Note

Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT **CORRECT**

Avoid this type of false flooded suction.

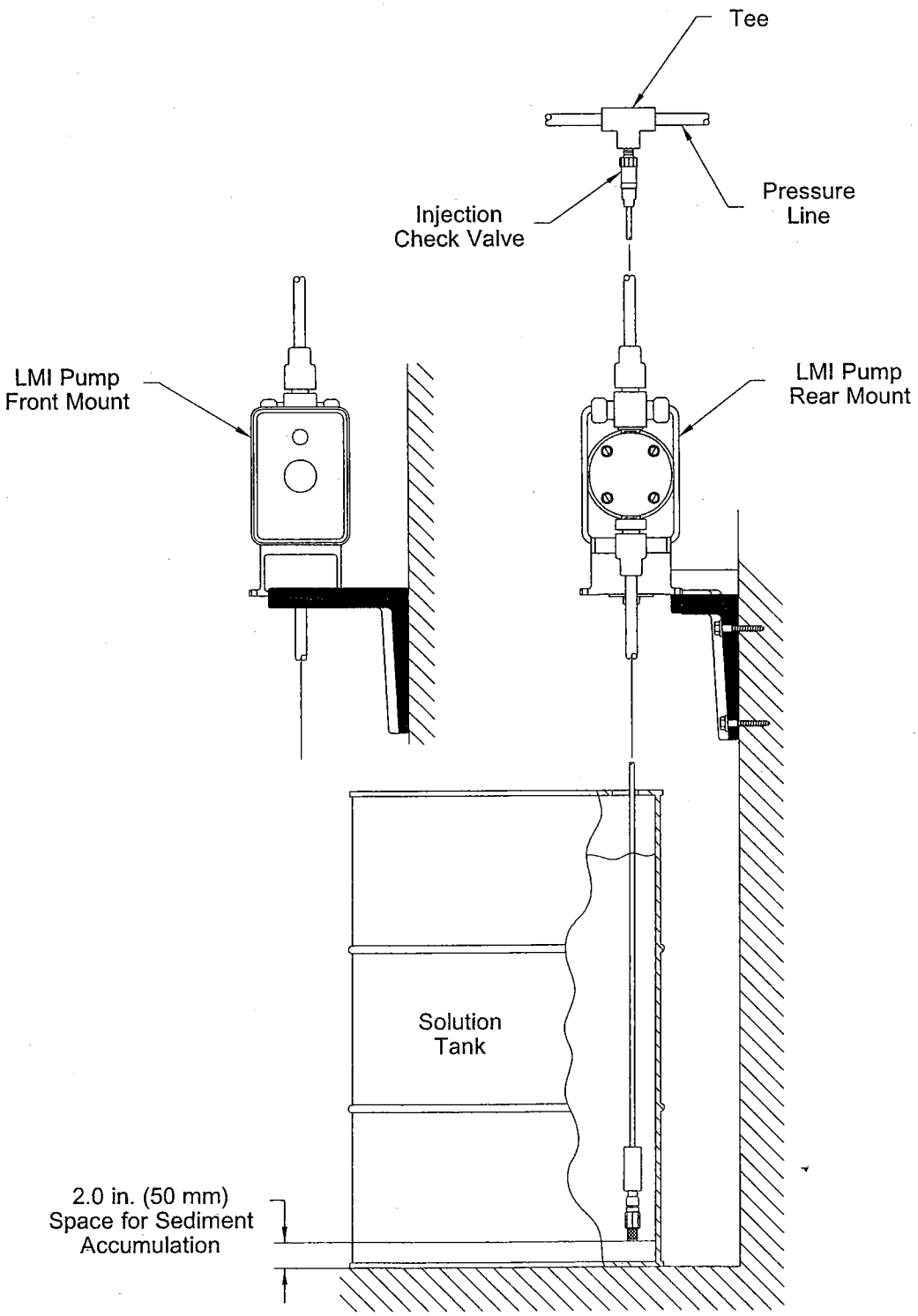


CORRECT

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4.2.2 Suction Lift - Wall Bracket Mount

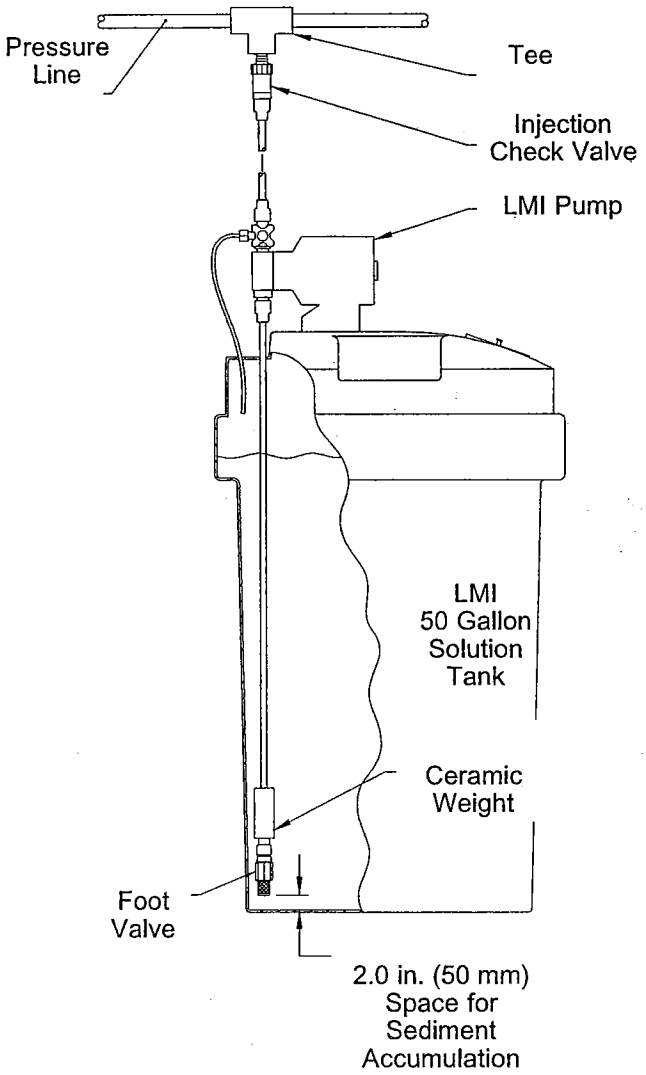
The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

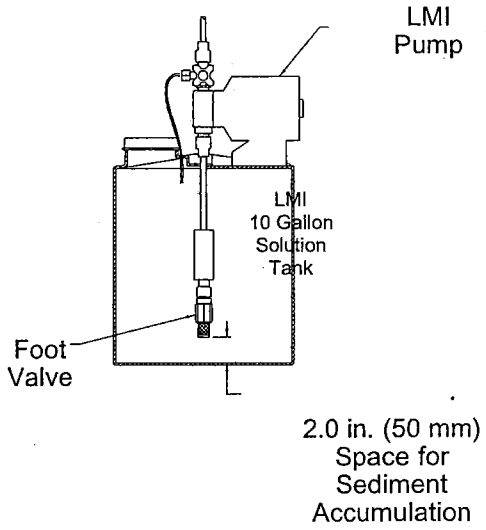


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4.2.3 Suction Lift - Tank Mount

The pump may be mounted on a molded tank provided there is a recess to keep the pump stationary. LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350) have molded recesses for pump mounting.

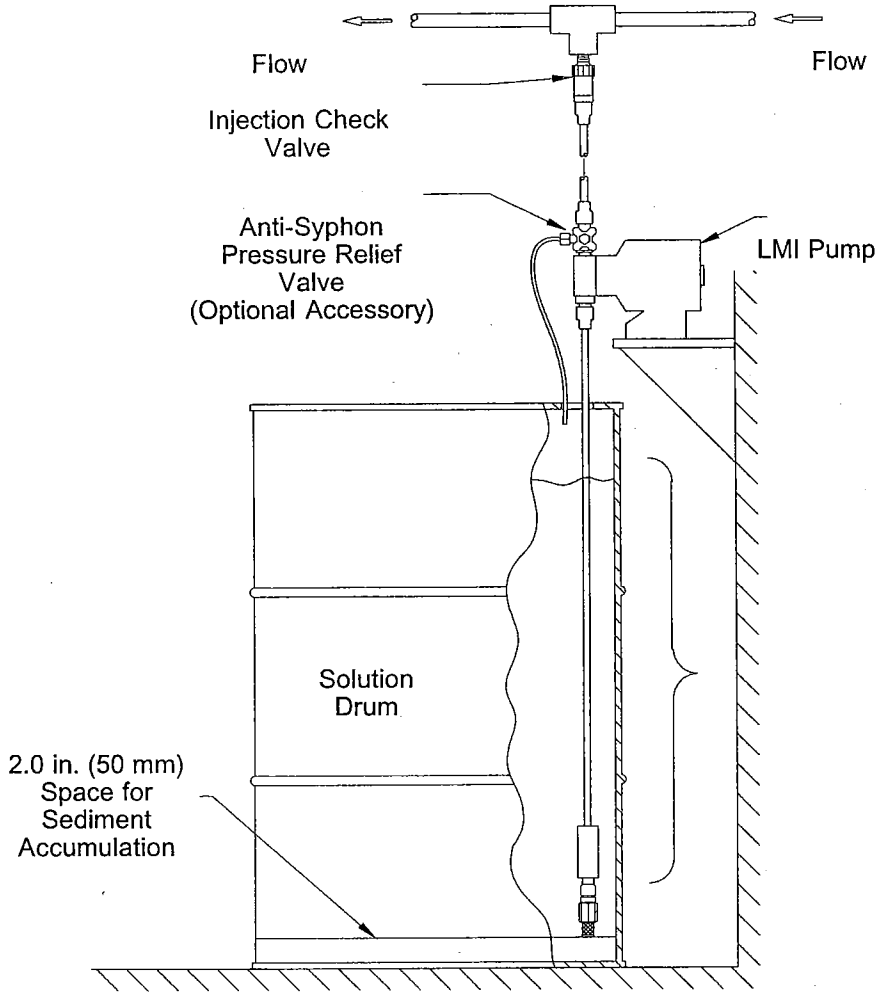




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4.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m). An LMI mounting kit (part number 10461) is available for securing the pump to a shelf.



4.3 Tubing Connections

A. Use only LMI tubing.

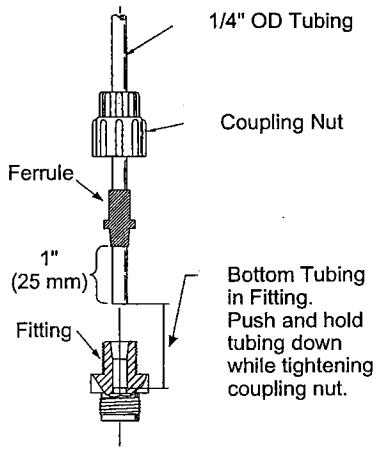
B. ***DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.*** The pressure created by the pump can rupture vinyl tubing.

C. Before installation, all tubing must be cut with a clean square end.

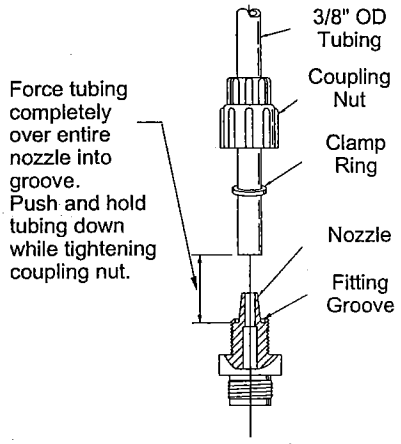
D. Valve and head connections from the factory are capped or plugged to retain pre-prime water. Remove and discard these caps or plugs before connecting tubing.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

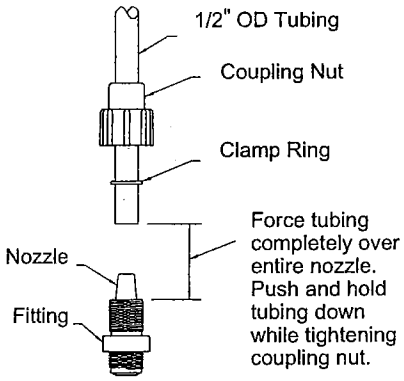
Tubing Connection
1/4" O.D. (.250") Tubing



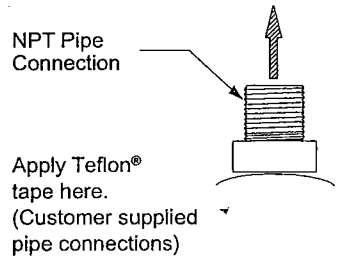
Tubing Connection
3/8" O.D. (.375") Tubing



Tubing Connection
1/2" O.D. (.5") Tubing



Pipe Thread Connection
1/4" or 1/2" NPT



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4.4 Multi-Function Valves

Your pump may be equipped with one of the following multi-function valves: 3-FV, 4-FV, Bleed 4-FV, or standard discharge valve. If your pump is not equipped with a multi-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor.

4.4.1 Three Function Valve (3-FV)

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. **Priming Aid**

   Opening the relief knob assists in priming the pump by venting the discharge line to the atmosphere.

4.4.2 Four Function Valve (4-FV)

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 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4.4.3 Bleed Four Function Valve (Bleed 4-FV)

1. Line Depressurization

Opening the relief port provides line drain back to the supply tank.

2. Anti-Syphon

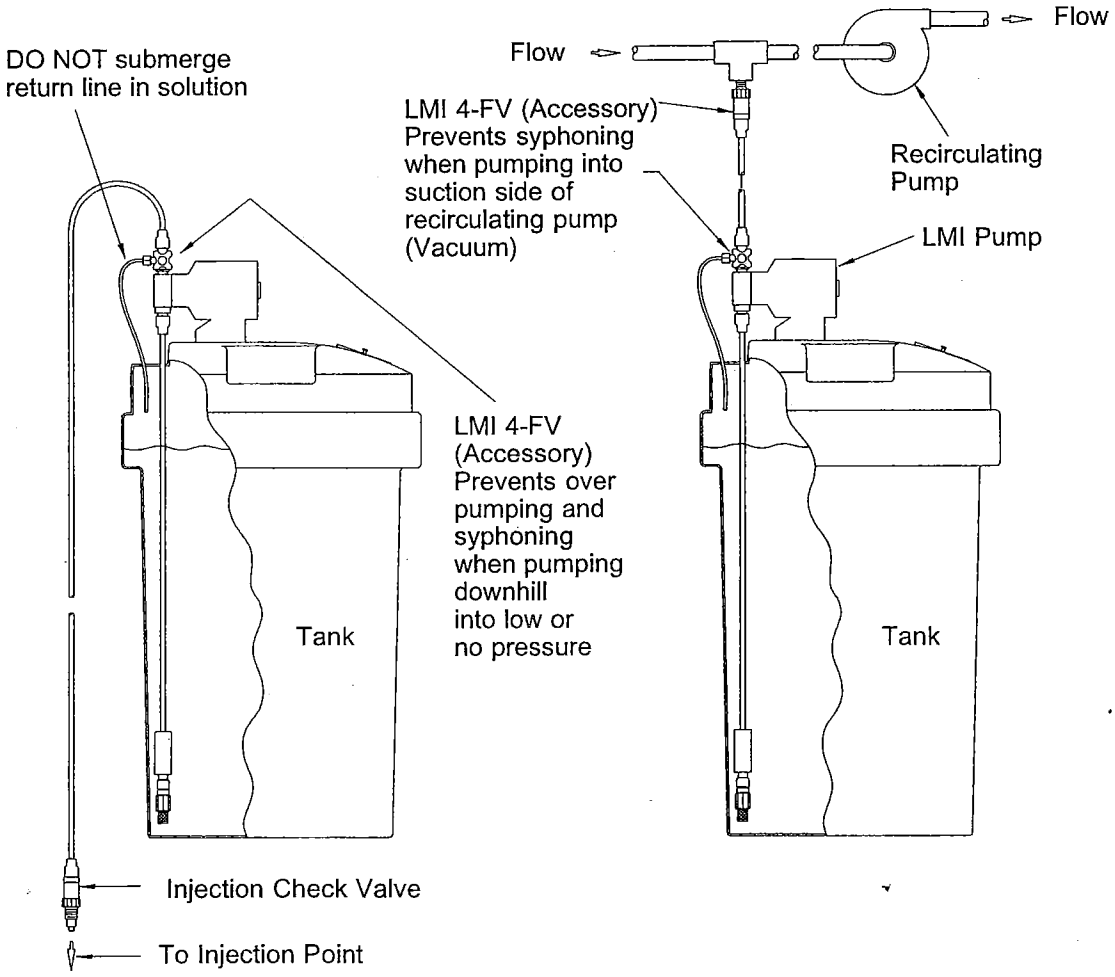
Prevents syphoning when pumping solution downhill or into a vacuum.

3. Back Pressure

Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

4. Bleed Function

Manually adjusted valve provides continuous bleed of entrapped vapors from Sodium Hypochlorite or Hydrogen Peroxide.



Typical 4-FV Installation

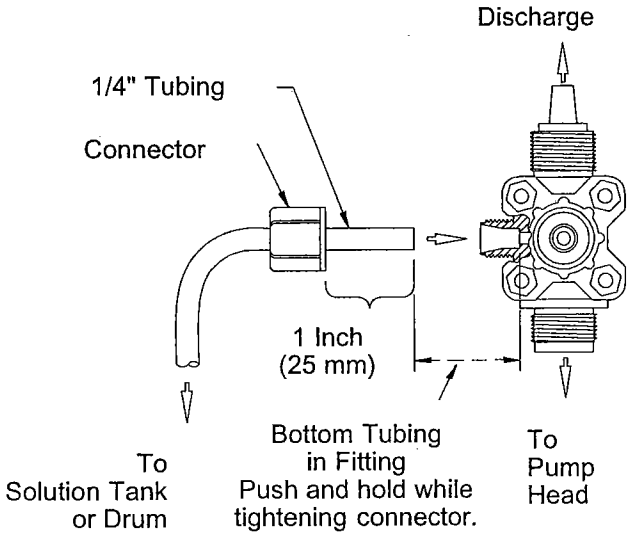
4.5 Multi-Function Valve Installation

To install the multi-function valve, remove the yellow screw cap on the top of the pump head and screw in the valve so that it contacts the seal ring. An additional 1/8 - 1/4 turn may be necessary to prevent leakage.

1/4" O.D. tubing connects to the side of the valve and acts as a return line to the solution tank. To ensure priming, this tubing must **NOT** be submerged in the solution.

CAUTION

This return line tubing must be secured to ensure pumped solution will safely return to supply tank.



Multi-Function Valve Tubing Connection

4.6 Foot Valve/Suction Tubing Installation

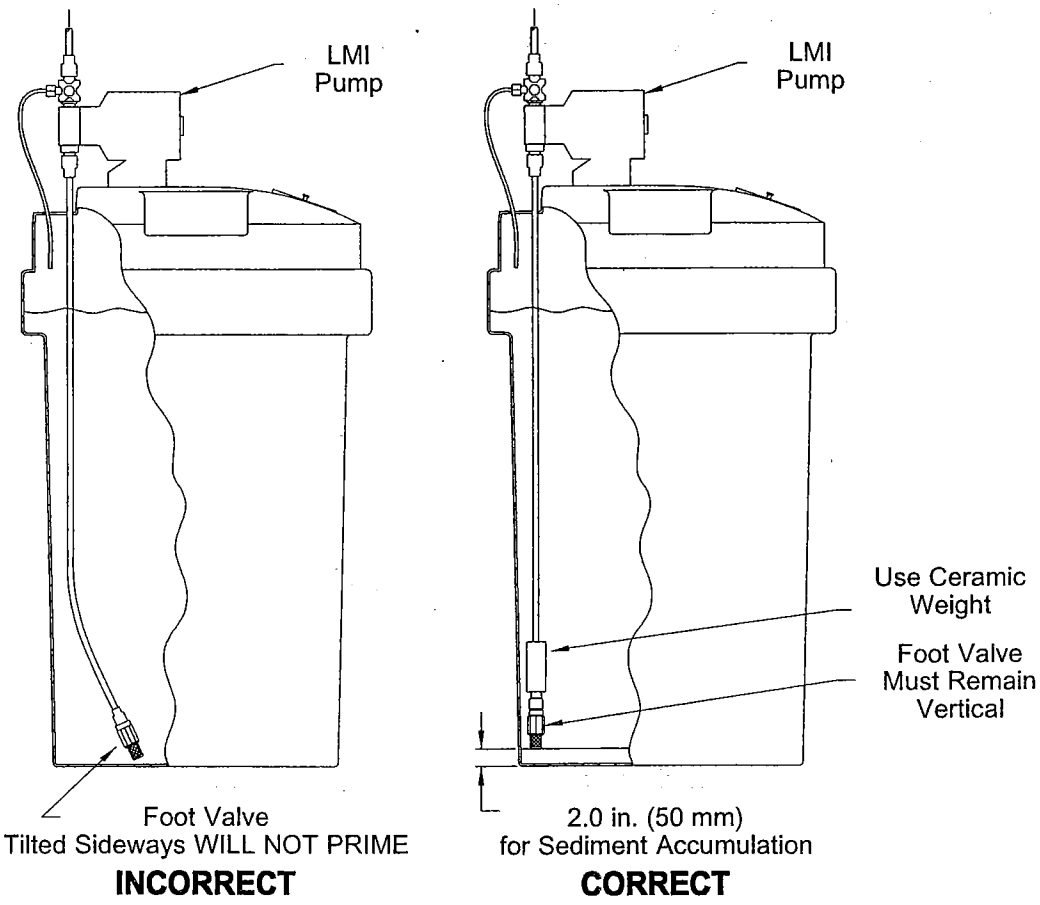
The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

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.

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 4.3).
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 4.3).



Proper Foot Valve Position

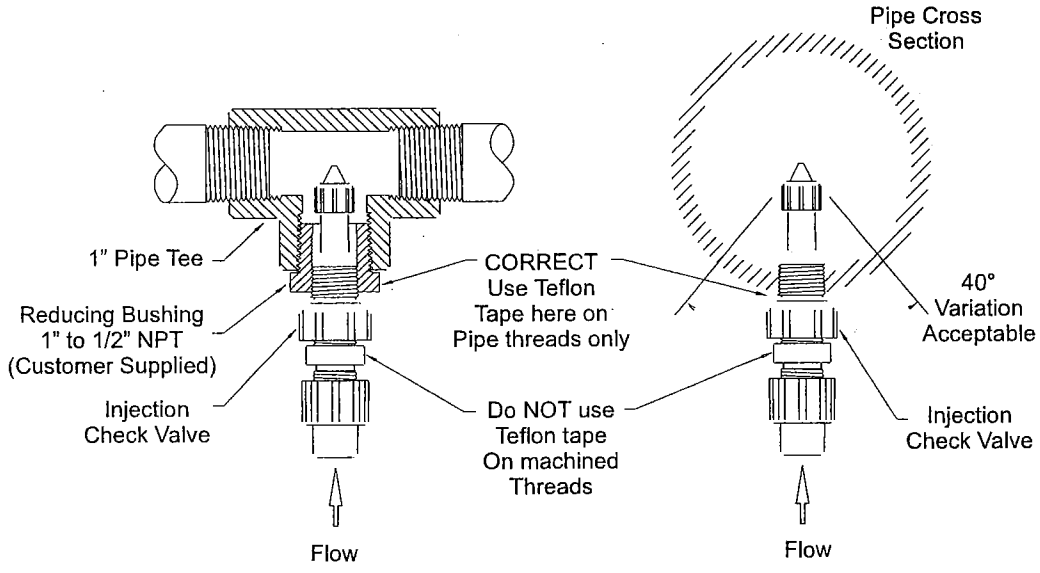
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4.7 Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Connect the Injection Check Valve to your "DISCHARGE" (outlet) line. Any size NPTF fitting or pipe tee with a reducing bushing to 1/2" NPTF will accept the injection check valve. Use Teflon® tape or pipe dope to seal the pipe threads ***only***.

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° are acceptable (see illustration below).

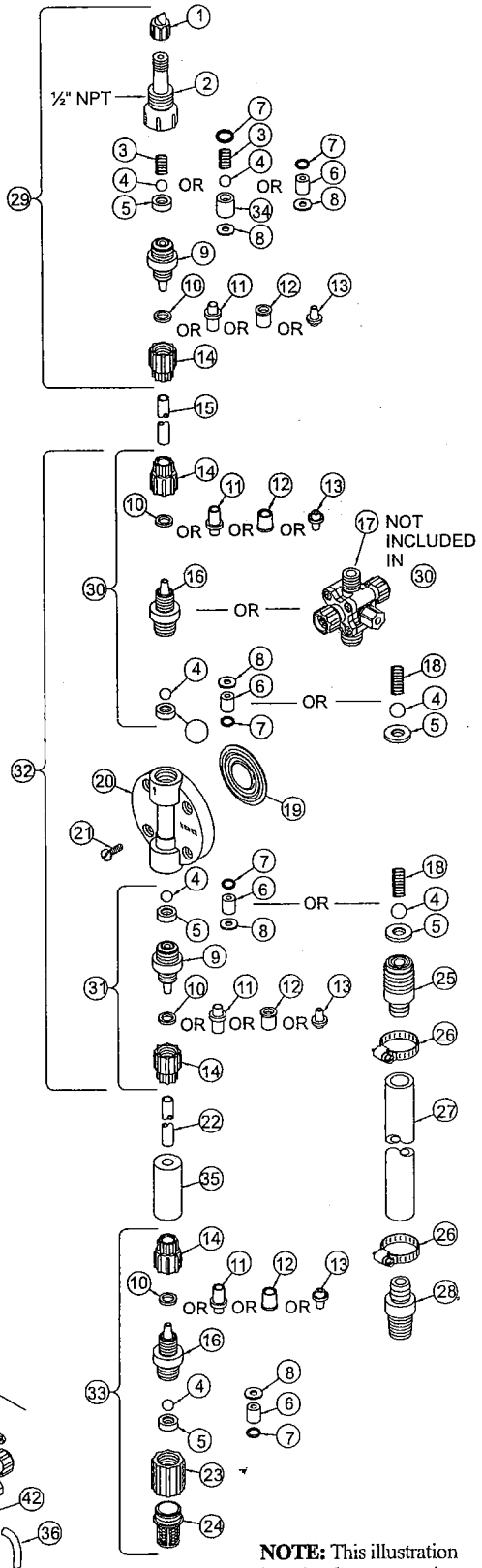
After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head valve or discharge fitting (top side), making sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 4.3).

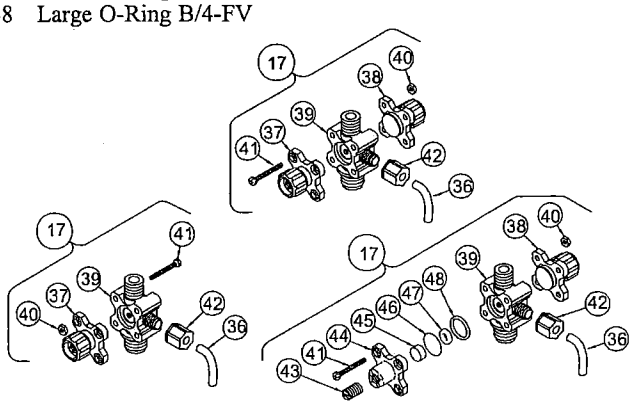


Typical Injection Check Valve Installations

5.0 Liquid End Parts List

1 Flapper valve
2 Injection check valve body
3 Injection check valve spring
4 Check valve ball
5 Seal ring
6 Cartridge valve
7 Cartridge valve o-ring
8 Cartridge valve washer
9 Valve seat
10 Clamp ring
11 Ferrule
12 Clamp sleeve
13 Tubing adapter
14 Coupling nut
15 Discharge tubing
16 Valve housing
17 Multi-function valve
18 High-viscosity spring
19 Liquifram
20 Pump head
21 Pump head screw
22 Suction tubing
23 Foot valve seat
24 Foot valve screen
25 High-viscosity valve seat
26 H.V. tubing clamp
27 H.V. suction tubing
28 H.V. Tubing x 1/2 NPT connector
29 Injection check valve assembly
30 Discharge valve assembly
31 Suction valve assembly
32 Pump head assembly
33 Foot valve assembly
34 Injection Seat PTFE
35 Ceramic Weight
36 Return Line
37 Cap ASM (Black Knob)
38 Cap ASM (Yellow Knob)
39 Multi-Function Valve Body
40 Nut Multi-Function Valve
41 Screw Multi-Function Valve
42 Return Line Coupling Nut
43 Adjustment Screw B/4-FV
44 Cap B/4-FV
45 Plug B/4-FV
46 Gasket B/4-FV
47 Small O-Ring B/4-FV
48 Large O-Ring B/4-FV





NOTE: This illustration is a visual representation of all LE components. Liquid ends will not include all parts shown.

6.0 Start-up and Adjustment



a.) The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.

b.) Pumps are shipped from the factory with water in the pump head to aid in priming.

6.1 Output Adjustment Controls



Manual series pump controls are not equipped with pressure control.

1. Pressure Control Adjustment (if equipped): Pressure control provides the adjustment of the pump's pressure capability and power consumption, reducing heat, pipe shock and pulsation while increasing pump life. See Section 7.0 after priming for proper adjustment settings.
2. Speed Adjustment (Upper Knob) (if equipped): Speed control provides adjustment of the percent of maximum strokes per minute. Turning this knob clockwise increases stroke frequency (speed).
3. Stroke Adjustment (Lower Knob): Stroke control provides adjustment of the percent maximum of solution discharged during each pump actuation. Turning this knob clockwise ↻ increases solution displacement.

***A7 and P7 Only**: When operating the pump in external mode, the speed control knob should be turned fully counter-clockwise ↺.*



***A34 and A37 Only:** Pump comes equipped with a range selector switch which provides high or low speed adjustment. The high setting provides speed adjustments between 8 and 100 strokes per minute. The low setting provides accurate speed adjustments between 1 and 12.5 strokes per minute for applications requiring infrequent stroking.*

6.2 Start-Up/Priming for Pump Supplied with Multi-Function Valve



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 knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise.↶

3. 1/4 turn open the relief side (black knob) of the multi-function valve.

3A. (Bleed 4FV only) With screwdriver rotate bleed adjustment screw counter-clockwise ↶. 2 full turns. When solution begins to flow through translucent bleed return tubing, the pump is primed. Stop pump.

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 multi-function valve. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord.)
6. The pump is now primed.

6A. (Bleed 4FV only)

a. Start pump and let pump inject solution into the discharge line.

b. Close the bleed adjustment screw by rotating it clockwise ↶ with a screwdriver.

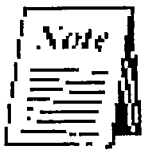
c. Now adjust the pump stroke length and/or speed (frequency) to a range approximately 25% higher than you would normally want for the process.

d. Slowly rotate bleed adjustment screw counter-clockwise ↶. until just a small amount of solution begins to trickle

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down inside the bleed return tubing. A small amount of solution pumped back to the tank with each stroke of the pump will allow gas and air to escape without air or gas locking in the pump head.

7. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the multi-function valve 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.

6.3 Start-Up/Priming without Multi-Function Valve



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 prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.



If the pump is equipped with pressure control, turn fully clockwise ↻.

3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord).
5. The pump is now primed.

6. Proceed to output adjustment, Section 6.4.



If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the ball and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

6.4 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

6.5 Total Pump Output

Calculate the total output of the pump as follows:

PUMP OUTPUT = MAX PUMP OUTPUT x % SPEED x % STROKE

Example: A151-392SI

Use MAX Output (from dataplate on bottom center of pump control panel) = 24 GPD (24 gallons per day).

If the pump is set at 60% speed and 70% stroke length, the approximate pump output is:

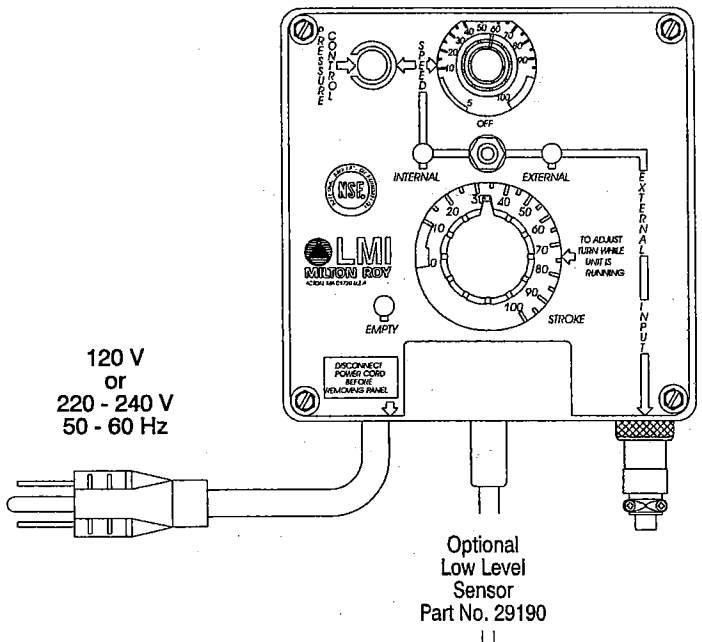
24.0 x 0.60 x 0.70 = 10.08 GPD (gallons per day). Divide by 24 (hours in one day) to calculate in gallons per hour.



If pump is not equipped with speed adjustment, calculate by ***Max Pump Output x % Stroke*** *only.*

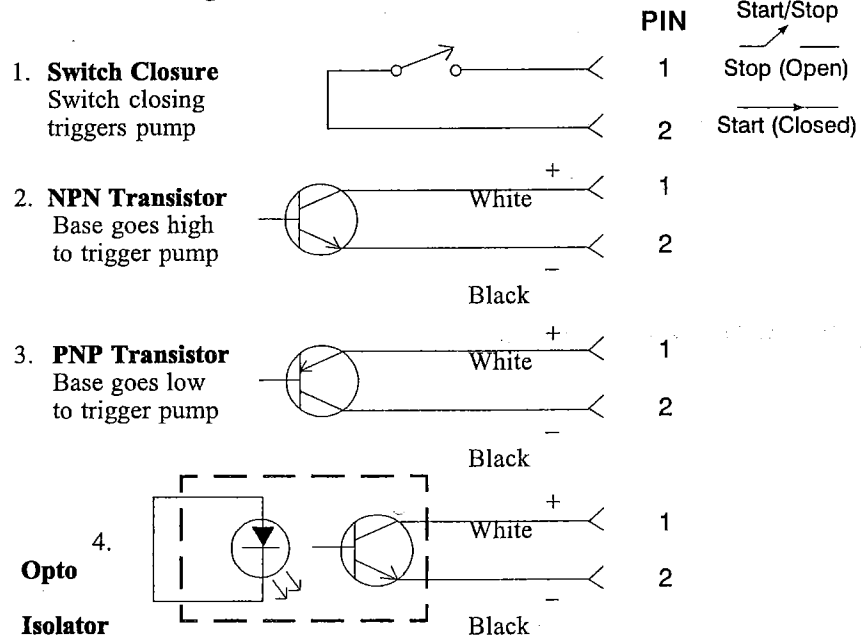
25

7.0 Methods of Externally Triggering

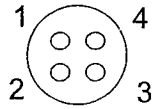


Optional
Low Level
Sensor
Part No. 29190

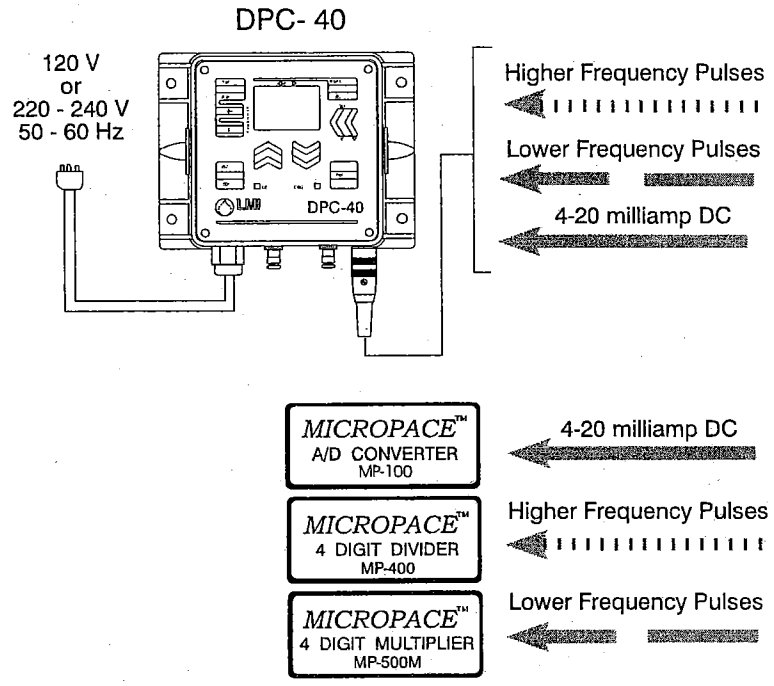
Method of Triggering LMI Pump Through 4-Pin Connector

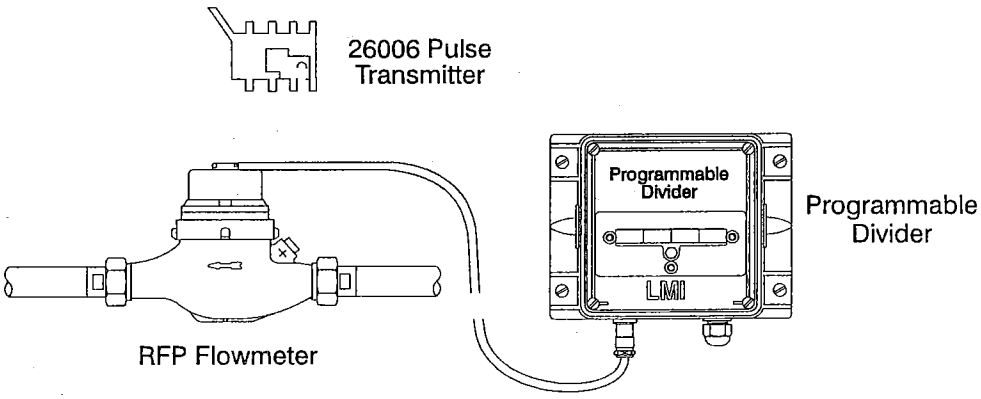


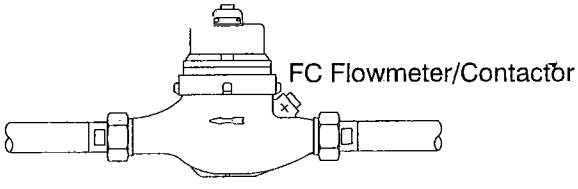
Switch or transistors must be capable of switching 15V DC at 2 milliamperes. Minimum time in low impedance state (ON) is 50 milliseconds. Minimum time in high impedance state (OFF) is 100 milliseconds.



or Pacing A7, B7, C7 and P7 Pumps







8.0 Calibration

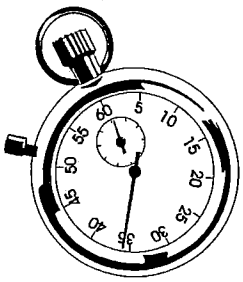
Once installation is complete and the approximate output has been determined, the pump should be calibrated to adjust speed and stroke for your actual desired output. (Calibration cylinders may be purchased from your local LMI distributor, ref. publication 1798.)

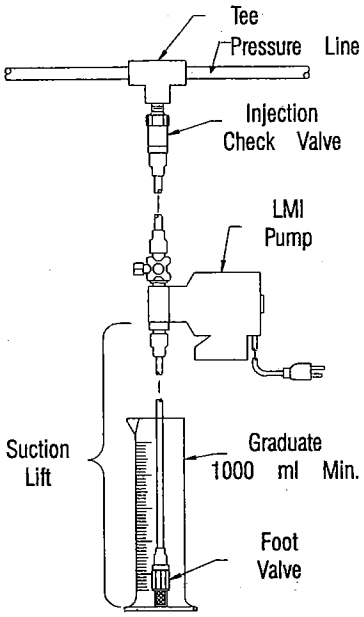
1. Be sure the pump is primed, and discharge tubing and Injection Check Valve are installed as they would be in normal service (i.e., including factors such as injection pressure, fluid viscosity, and suction lift).
2. Place the Foot Valve in a graduated container with a volume of 1000 ml or more.
3. Plug in and switch pump to Internal Mode. Pump until all the air is exhausted from the suction line and head.
4. Turn the pump off. Refill graduated container to a level starting point.



If pump is equipped with pressure control, see Section 8.1 before proceeding.

5. Using a stopwatch or timer, turn the pump on for a measured amount of time (50 pump strokes minimum). The longer the time period, the more confident you can be of the results. Be sure to count the number of strokes during the calibration period when making comparisons.
6. Turn the pump off. Note the time elapsed in relation to volume displaced in the graduate. Now, calculate the output in the time unit you choose (minutes, hours, days, etc.).
7. If the output is too low or too great, adjust speed and or stroke, estimating required correction and repeat steps 1-7.



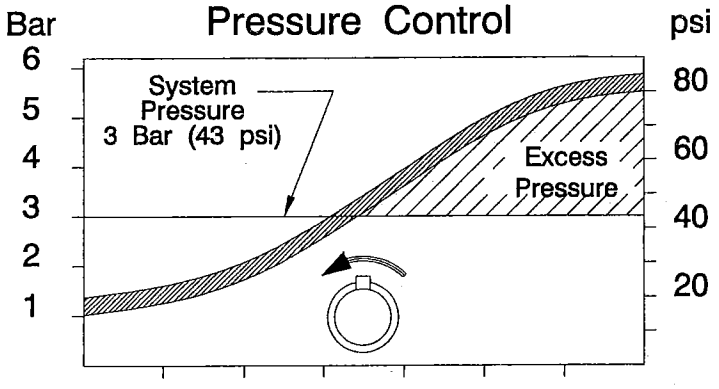


8.1 Pressure Control

Adjust Pressure Control: While unit is running, turn Pressure Control Potentiometer slowly counter-clockwise ↺ until unit just begins to stall. From this stall point, now turn Pressure Control Potentiometer clockwise ↻ halfway between the stall point and maximum setting. This is the optimum pressure control setting for your application.



Increase setting if back pressure is increased. Adjusting pressure control decreases pressure rating of pump.



Adjust pressure control to reduce heat, shock, and pulsations; and to prolong pump life.

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8.2 Calibration Procedure - On-Site Volumetric Calibration in External Mode

1. Since pump output is governed by an external device such as Flowmeter-Pulser, Liquitron™ Controller, or 4-20 mA DC signal from an instrument with an LMI Analog-to-Digital Converter, **only the output per stroke may be calibrated**.
2. With pump primed and discharge tubing connected to the injection point as it would be in normal service, place Foot Valve Assembly in a graduated container with a volume of 1000 ml or more.
3. Switch pump to **Internal** mode with Speed Knob set at 100 until air is exhausted from suction line and pump head.
4. **Adjust Pressure Control (if desired)** - See Section 8.1.
5. Switch pump **OFF** and note solution level in graduated container. Refill graduate to a starting point.
6. Switch pump **ON** and **count the number of strokes** for exactly one minute, then switch pump **OFF**.
7. Note volume pumped during the calibration period of one minute. Divide into this the number of strokes to determine the volume of solution pumped per stroke.

   Example: 500 ml in 100 strokes = 5.0 ml per stroke.

Multiply this by your expected stroke rate per minute, per hour or per day and compare with desired output requirements.

8. Adjust Stroke Length Knob (lower knob) to your best estimate of required correction and repeat calibration procedure.

9.0 Spare Parts Replacement Routine Maintenance

9.1 Depressurizing the Discharge Line (For Pumps Equipped with a 3-FV or a 4-FV only)



ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.



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.



Be sure your relief tubing is connected to your multi-function valve and runs back to your solution drum or tank.

2. 1/4 turn the black knob on the valve. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then 1/4 turn knob to normal position.

9.2 Liquifram™ (Diaphragm) Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS 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 or seal rings/valve balls, multi-function valve cap assemblies 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™ and the cartridge valves or seal rings/valve balls, the injection check valve spring should also be replaced (see next Section 9.3). A Spare Parts Kit (SP-#) or RPM Pro Pac™ kit containing these parts may be obtained from your local distributor.

Replacing the Liquifram™:

1. Carefully depressurize, drain, and disconnect the discharge line (see Section 8.1 in this manual). 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.

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If the liquid cannot be pumped due to Liquifram™ rupture using protective clothing, gloves and face shield, carefully disconnect the suction and discharge tubing. Remove the four screws to the head and immerse the head in water or other neutralizing solution.

2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

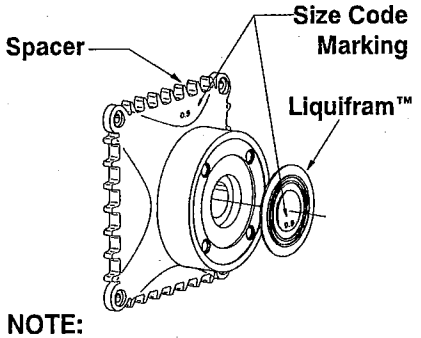
See Section 10.0 for proper zero

3. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise ↺. Discard old Liquifram™. Remove the Liquifram™ disk if so equipped (located behind the Liquifram™) and check that the size code matches the size code on the replacement Liquifram™ (see illustration).

4. Reinstall the disk so the alignment pin on the disk (if present) seats in the recessed hole in the EPU.

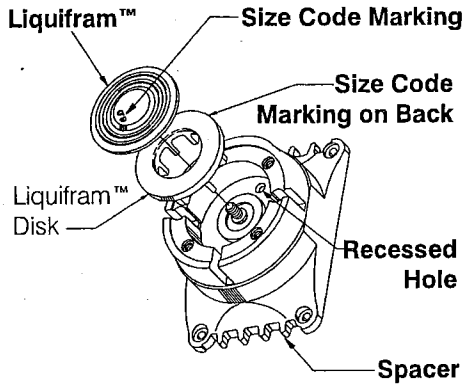
CAUTION ***Be careful not to scratch the Teflon® face of the new Liquifram™.***

For Series B, C, & E



NOTE:
Size code markings for pumps supplied with 6.0 Liquiframs™ (diaphragms) should be referenced to the 6.0 Black Adapter, not the 3.0 Spacer

For Series A, J, & P



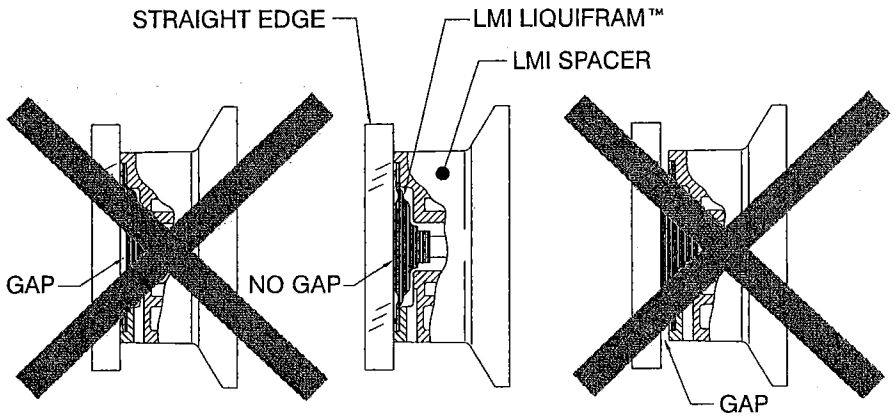
5. Start the pump and turn the stroke knob to the setting indicated on the following Stroke Setting Chart which matches the pump series number located on the pump dataplate. With the pump stroking (running), screw on the new Liquifram™ clockwise ↻ until the center begins to buckle inwards. Stop the pump.

Liquifram™ Stroke Setting Chart

Pump Series	Stroke Knob Setting
All A, B, J, P, Z Series C10, C11, C12, C70, C71, C72, C76, C90, C91, C92, E70, E71, E72	90%
All L Series	85%
C78	50%
C13, C14, C73, C74, C77, C93, C94, E73, E74	70%
All M Series	100% *

* Liquifram™ on M Series pumps only, must be bottomed completely (turned all the way in). ***Do Not Use Straight Edge.***

6. Grasp the outer edge of the Liquifram™ and adjust by screwing it in or out so that the center of the Liquifram™ is flush with the outside of the spacer edge (see illustration below).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram™ is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.

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9.3 Cartridge Valves, Seal Rings/Valve Balls and Injection Check Valve Spring Replacement



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

1. 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.
2. Carefully depressurize and disconnect the discharge line (see Section 9.1 in this manual). 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.

   Once the pump has been flushed, lift the Foot Valve out and continue to let air into the pump head until pump is purged of water or neutralizing solution.

   If the liquid cannot be pumped due to Liquifram™ rupture, with protective clothing, gloves and face shield, carefully disconnect the tubing and four screws to remove the head. 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.



***IMPORTANT**: Before disassembling the check valves, note the orientation of the valve.*

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve.

   If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.
4. Install new check valves in each location.

IMPORTANT: *Note correct orientation of each check valve.*

5. Install the new spring in the Injection Check Valve.



Depressurize and drain pipeline (or isolate I.C.V. point using valves) so that I.C.V. can safely be disassembled.

10.0 Checking Pump for Proper Zero Position (Stroke Knob)

1. With pump running, turn stroke knob counter-clockwise ↺ toward zero or end of black or red band on dial.
2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).
3. If the pump continues to click at zero or stops clicking before zero is reached, the pump zero must be reset (see Section 10.1 or 10.2).

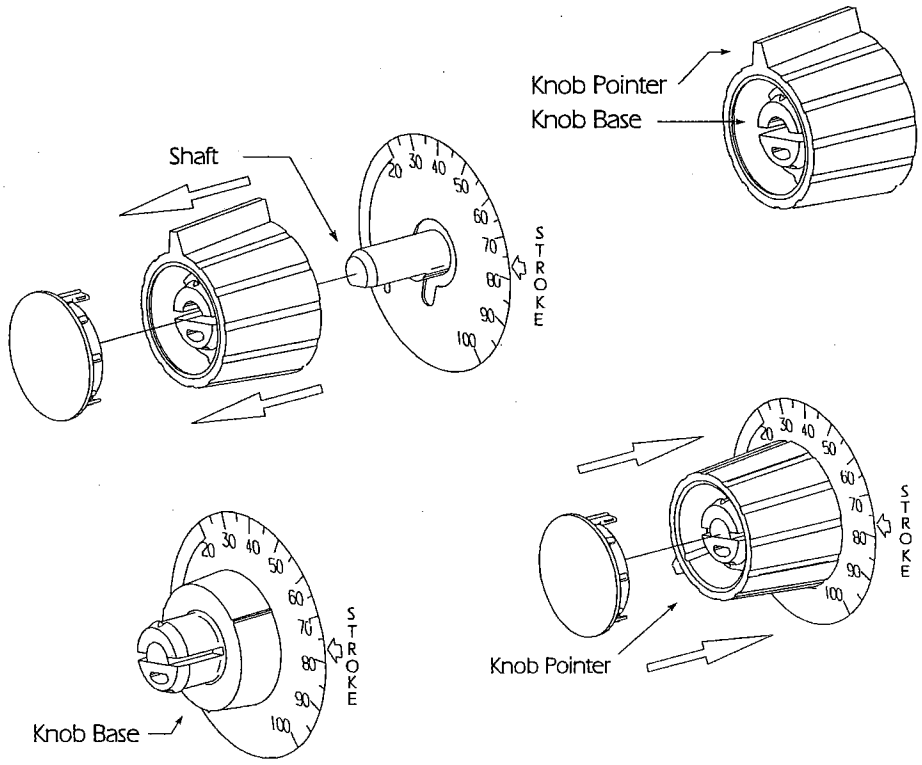
10.1 Type I - Push on Knob Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.
2. Pry off the yellow cap.
3. Place the knob on a flat surface.
4. Using needle-nose pliers, squeeze the inner section together while lifting the outer section up.
5. Push the inner section back onto the "D" shaped stroke shaft.
6. With the pump running, zero the pump by turning the inner section of the knob counter-clockwise ↺ until the pump stops clicking.

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7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.
8. Push down on the outer section (a snap sound indicates parts are locked together).
9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



10.2 Type II Collet Knob
Re-Zeroing and Stroke Knob Disassembly and Assembly

1. Remove Yellow Cap.
2. Hold knob with soft jaw pliers.
3. Disconnect knob by loosening 5/16" (8 mm) collet nut. There is no need to remove nut.
4. Remove knob by pulling towards you.
5. With pump running, zero the pump using a screw driver to turn the stroke shaft counter-clockwise ↺ until the pump just stops clicking.
6. Pump is now zeroed.
7. Position knob at zero, or the end of the low range band, and tighten 5/16" (8 mm) collet nut.
8. Replace yellow cap.

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11.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE
Pump Will Not Prime	1. Pump not turned on or plugged in.
	2. Output dials not set properly.
	3. Foot Valve not in vertical position on bottom of tank.
	4. Pump suction lift too high.
	5. Suction tubing is curved or coiled in tank.
	6. Fittings are over tightened.
	7. Air trap in suction valve tubing.
	8. Too much pressure at discharge. (Pumps without multi-function valve.)
Pump Loses Prime	1. Solution container ran dry.
	2. Foot Valve is not in a vertical position on the bottom of the tank.
	3. Pump suction lift is too high.
	4. Suction tubing is curved or coiled in tank.
	5. Fittings are over tightened.
	6. Air trap in suction valve tubing.
	7. Air leak on suction side.

	SOLUTION
	1. Turn on pump/plug in pump.
	2. Always prime pump with speed at 80% and stroke at 100%.
	3. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	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. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 6.0). When pump is primed, reconnect discharge tubing.
	1. Refill container with solution and reprime (see Section 6.0).
	2. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	7. Check for pinholes, cracks. Replace if necessary.

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Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE
Leakage at tubing	1. Worn tubing ends.
	2. Loose or cracked fitting.
	3. Worn seal rings.
	4. Solution attacking Liquid Handling Assembly material.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.
	2. Worn Seal Rings.
	3. Ruptured Liquifram™.
	4. Incorrect stroke length.
	5. Tubing run on discharge may be too long.
	6. Clogged Foot Valve strainer.
Failure to Run	1. Pump not turned on or plugged in.
	2. EPU failure.
	3. Pulser failure.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).
	2. Little or no pressure at injection point.
	3. Excessive strokes per minute.

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	SOLUTION
	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Replace fitting if cracked. Carefully hand tighten fittings. *DO NOT USE PIPE WRENCH.* Once fitting comes into contact with seal ring, tighten an additional 1/8 or 1/4 turn.
	3. Replace balls and seal rings (see Section 8.3) Spare Parts (SP-#).
	4. Consult your local distributor for alternate materials.
	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn seal rings or cartridge valves may need replacement (see Section 9.3). Spare Parts (SP- #), or RPM Pro Pac™ kit.
	3. Replace Liquifram™ (see Section 9.2).
	4. Check zero on pump/Re-zero pump (see Section 10.0).
	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
	1. Turn on or plug in pump.
	2. Disassemble pump and measure the resistance of the EPU across the EPU wires. Resistance reading should be in accordance to the EPU Resistance Chart (see Section 12.0). Also, check EPU leads to ground. Consult supplier or factory.
	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 4.4).
	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 4.4).
	3. Replace pulser or resistor. Consult factory.

12.0 EPU Resistance Chart

Pump Series	Voltage	Coil Resistance (Ohms) @ 20° C (68° F)*
A14, A15, A16, A34 A74, A75, A76 A94, A95, A96 J02, J03, J04, J05, J06 J13, J15, J16 PW4, PW5, PW6 P04, P05, P06 P08, P14, P15 P16, P18, P74 P75, P76, P78	115 VAC 230 VAC	76 - 87 307 - 353
(see Note 1) A17, A37, A77, A97, A18, A78 P02,P03 P12,P13	115 VAC 230 VAC	152 - 176 583 - 671
(see Note 2) A17, A37, A77, A97, A18, A78 P02, P03 P12, P13	115 VAC 230 VAC	76- 87 291- 335
J54D, J55D, J56D	12 VDC	1.1 - 1.3
D10, D11, D12, D13, D14 D70, D71, D72, D73, D74	115 VAC 230 VAC	25.7- 29.6 97 - 112
E70, E71, E72, E73, E74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
B11, B12, B13, B14 B71, B72, B73, B74	115 VAC 230 VAC	43 - 49 167 - 193
C10, C11, C12, C13, C14 C70, C71, C72, C73, C74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
C76, C77, C78	115 VAC 230 VAC	14.4 - 16.6 57.7 - 66.3

* Let pump cool down completely before checking resistance. EPU checked within 10 hours of operation can increase coil resistance reading as much as 20%.

NOTES:

1. Pumps with serial numbers LOWER than: **960113429**
2. Pumps with serial numbers HIGHER than: **960113429**

LMI MILTON ROY

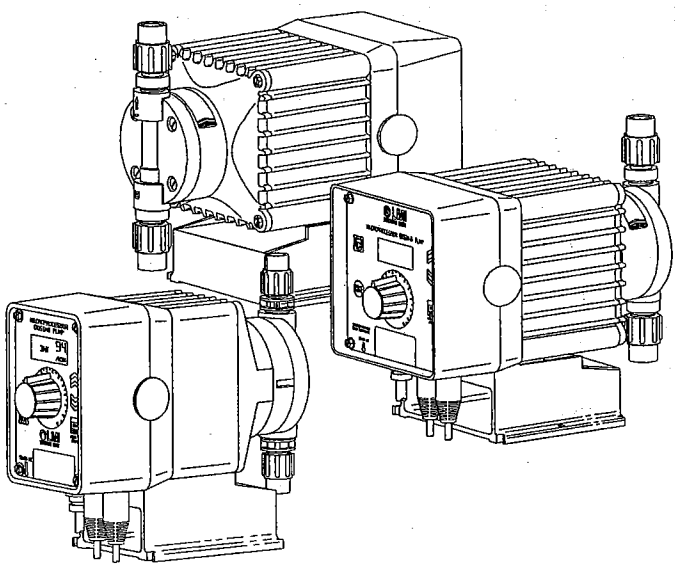
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Instruction Manual

Series A9, B9, and C9
Electronic Metering Pumps



For file reference, please record the following data:

Model No: AA971-353SU / C931-312SI

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

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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).

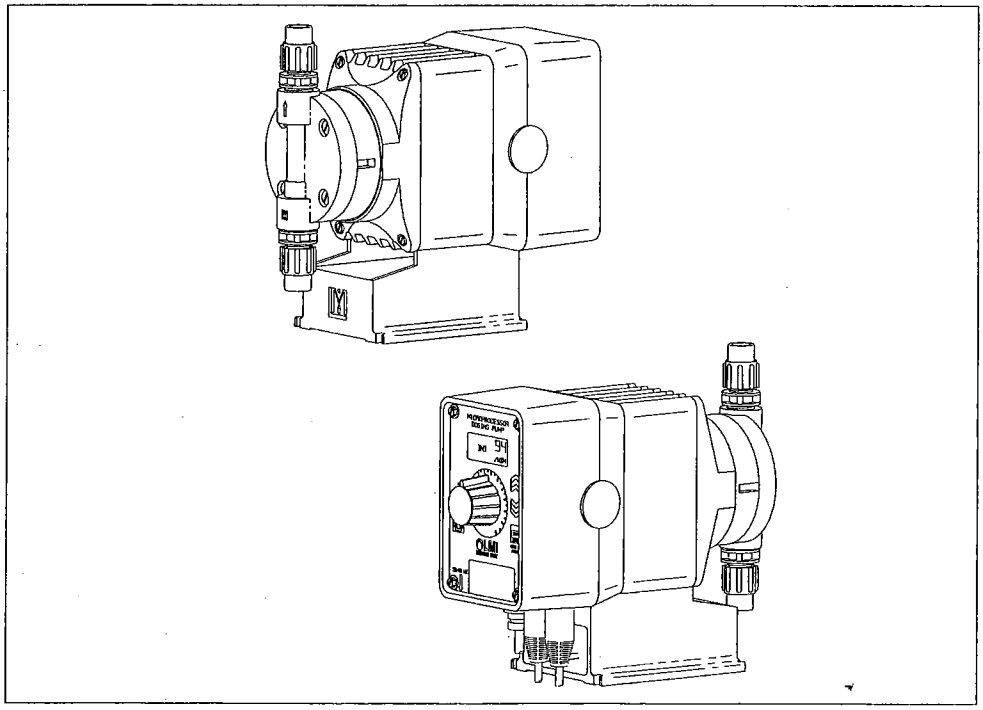


Figure 1: LMI Series A9 Electronic Metering Pump

2.0 Unpacking

You should find the following items in the box:

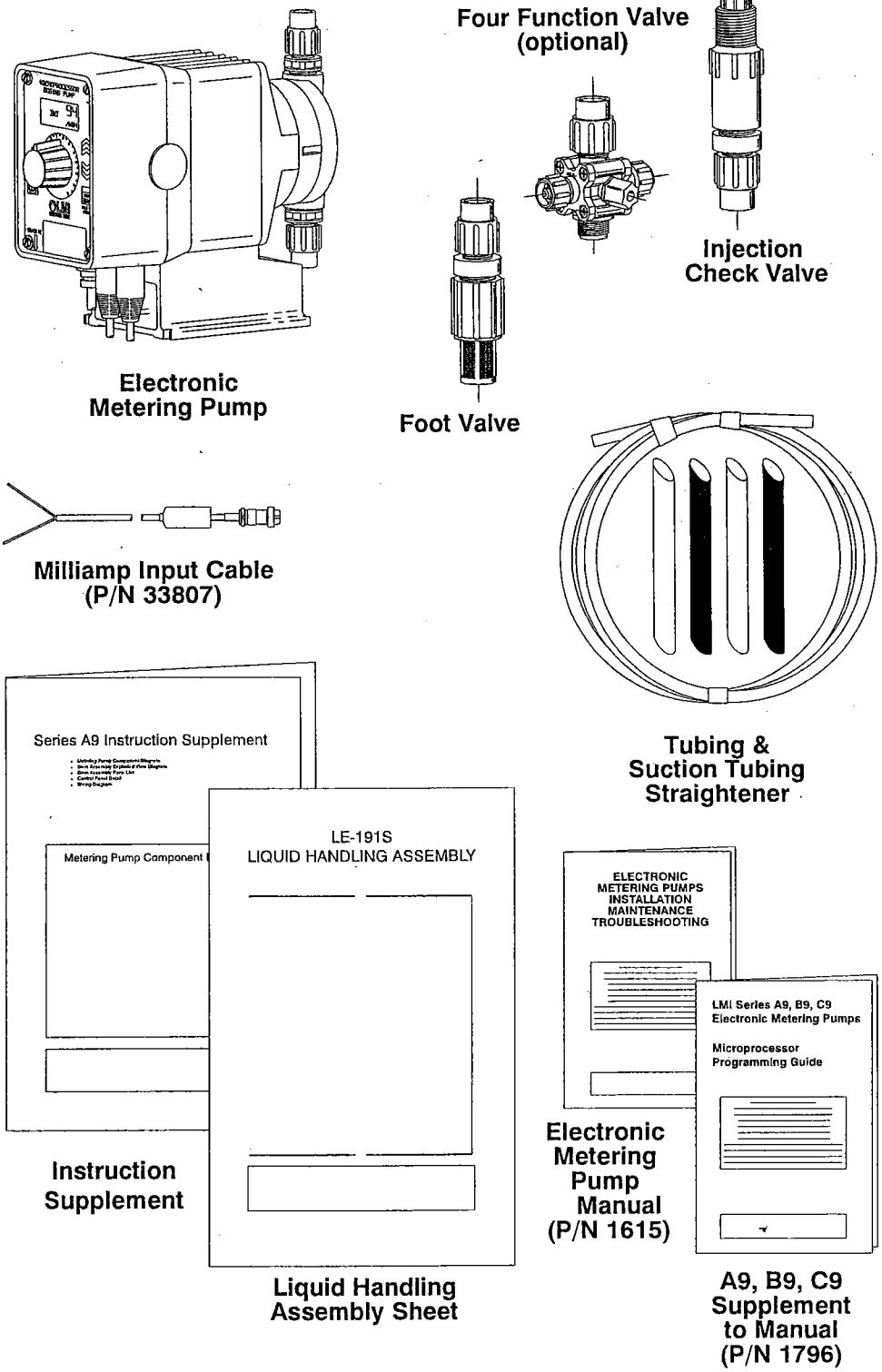


Figure 2: Unpacking Items

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.

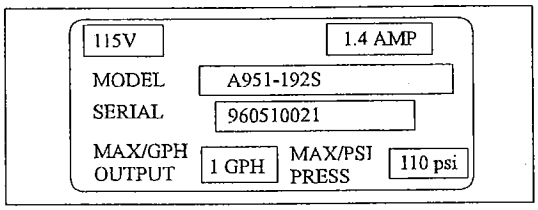


Figure 3a : Data Plate

Included on the data plate is the model number of the pump. Each number in the model number represents the following in Figure 3b.

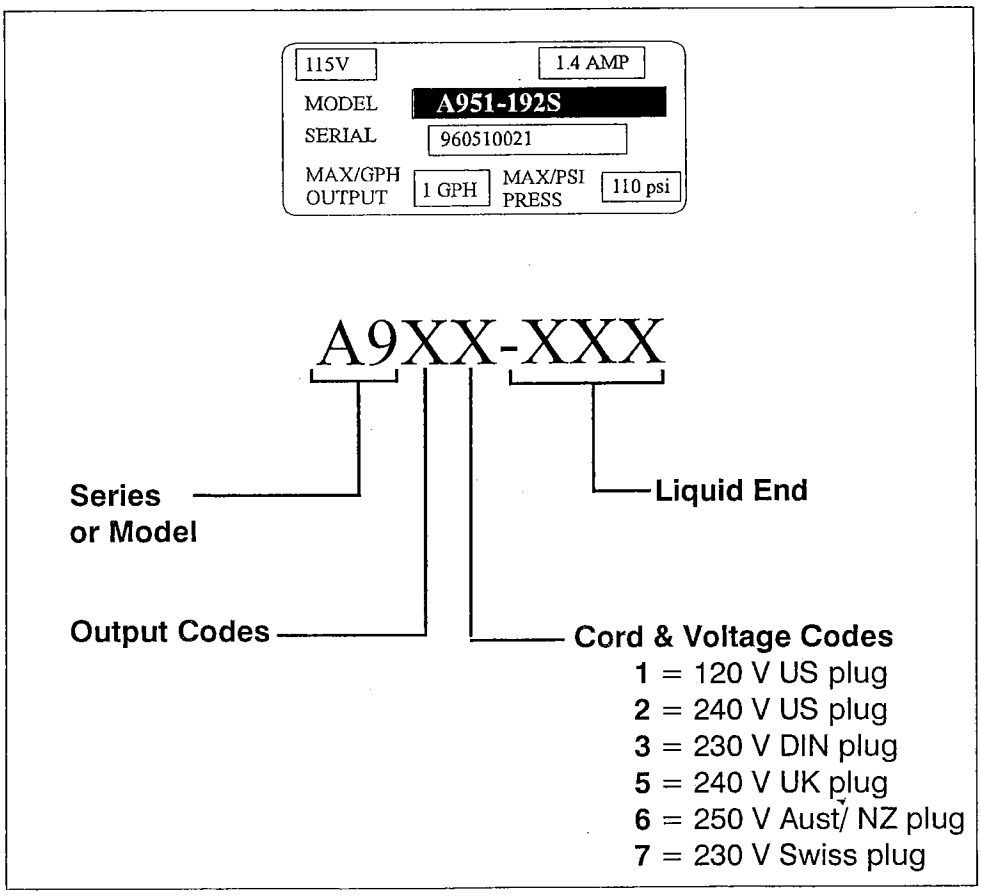


Figure 3b : Part Number Representation

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

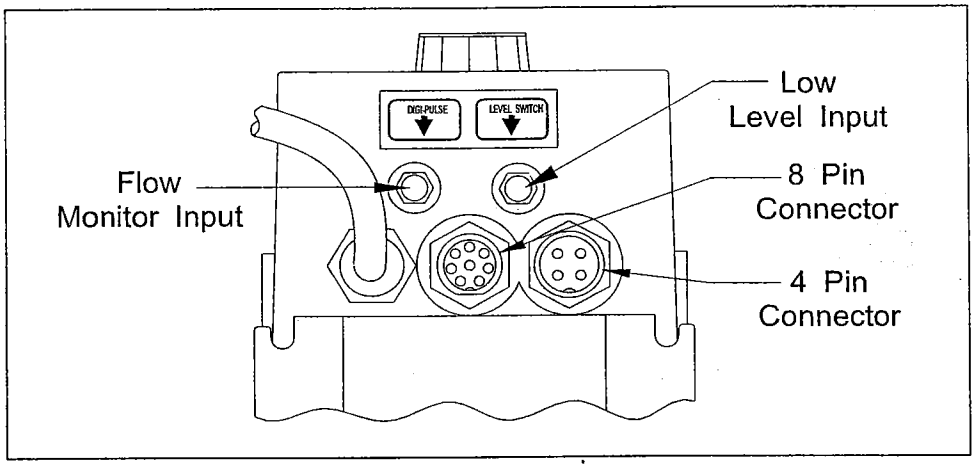


Figure 4: External Input and Output Connections



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.

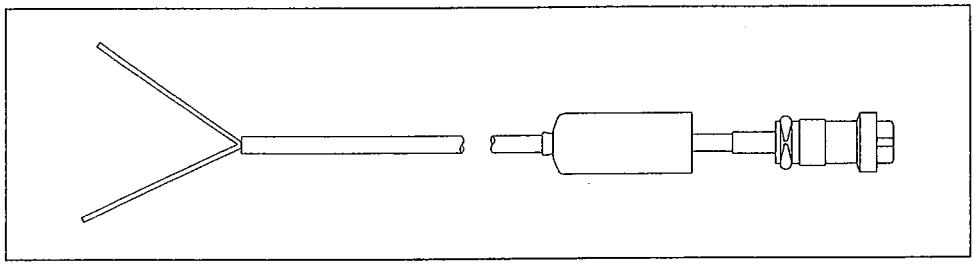


Figure 5: 2-Conductor Cable (P/N 33807)

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.

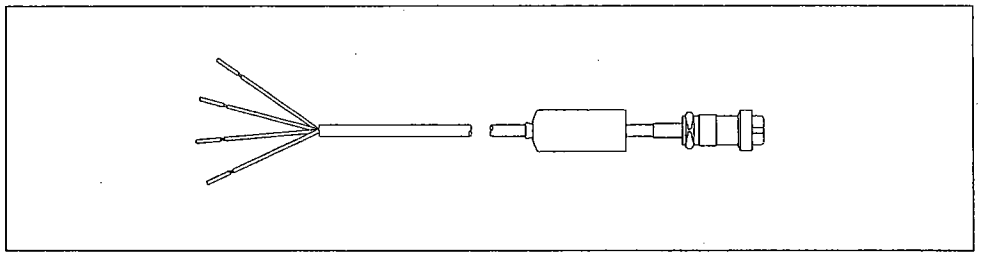


Figure 6: 4-Pin Cable (P/N 33796)

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.

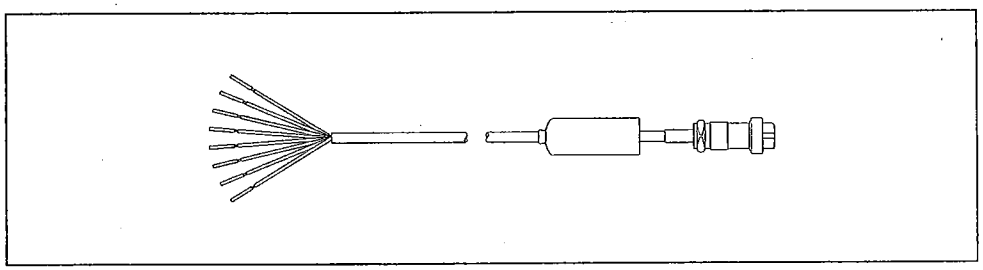


Figure 7: 8-Pin Cable (P/N 33738)

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).

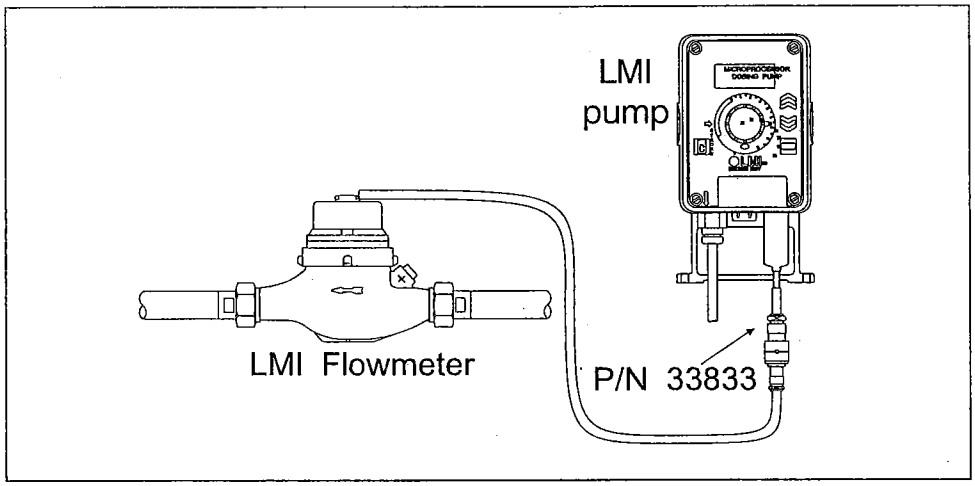


Figure 8: Optional "Hall Effect" Cable (P/N 33833)

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.

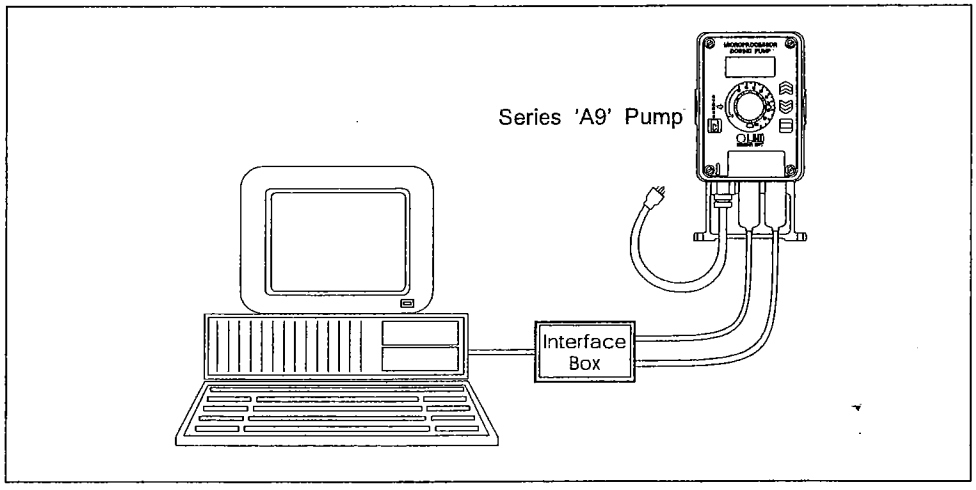


Figure 9: LiquiComm™ Computer Interface

7.0 Keypad/Display: Description and Function

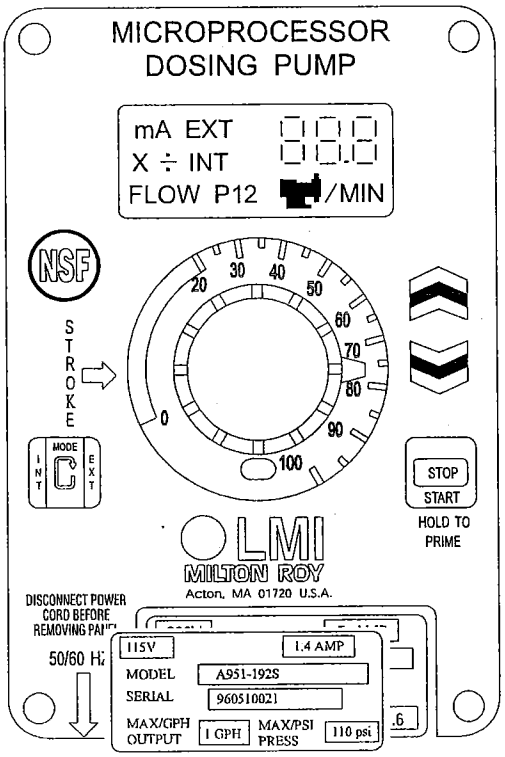


Figure 10: A9 Keypad

7.1 LCD Screen

The LCD screen is the window in which all values and menu choices are displayed (see Figure 11).

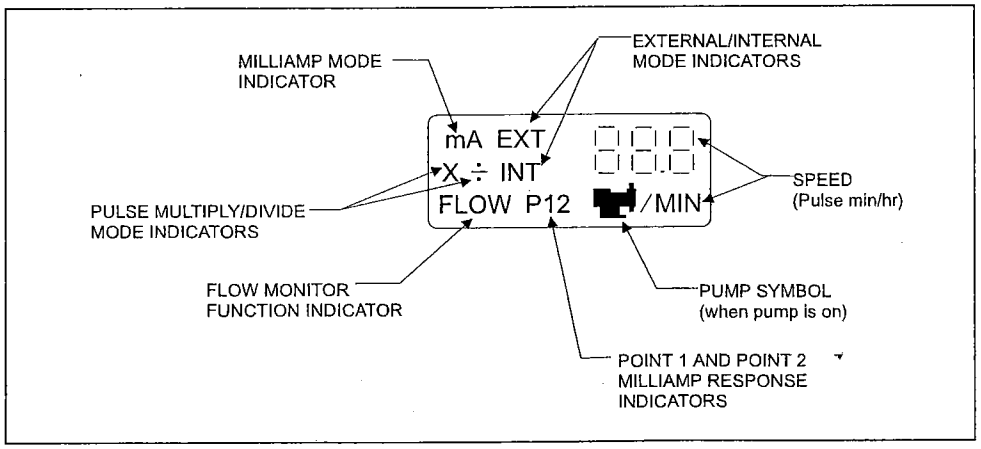


Figure 11: Liquid Crystal Display

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 [redacted] symbol appears on the display while the pump is running. Each time the pump strokes, the [redacted] 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.

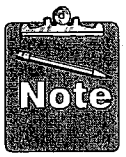
7.4 Mode Key 

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 STOP/START (Start/Stop) key to start or stop the pump. When the pump is OFF, the LCD screen will alternate between INT OFF and INT 100 /MIN every 16 seconds. When you start the pump, the symbol appears on the LCD INT 100 /MIN. Each time the pump strokes, the symbol disappears. Press the STOP/START (Start/Stop) key again to stop the pump.

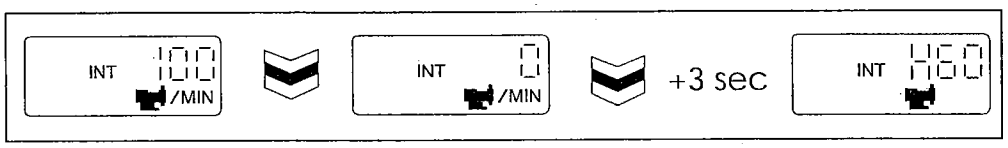


"INT" signifies that the pump is in the "Internal" (Manual) mode.

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 (Mode) key and ▲ (Up) key at the same time and hold for two (2) seconds. The current pressure setting [PS /MIN] 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* STOP/START (Start/Stop) and Prime. To activate this "LOC" mode, press the MODE (Mode) key and ▼ (Down) key at the same time and hold for two (2) seconds. The LCD will read [LOC] for five (5) seconds and then return to the previous display. This display [LOC] re-appears when any key except the STOP/START (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 [LOC] for five (5) seconds and then return to the previous display. This display [LOC] 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.

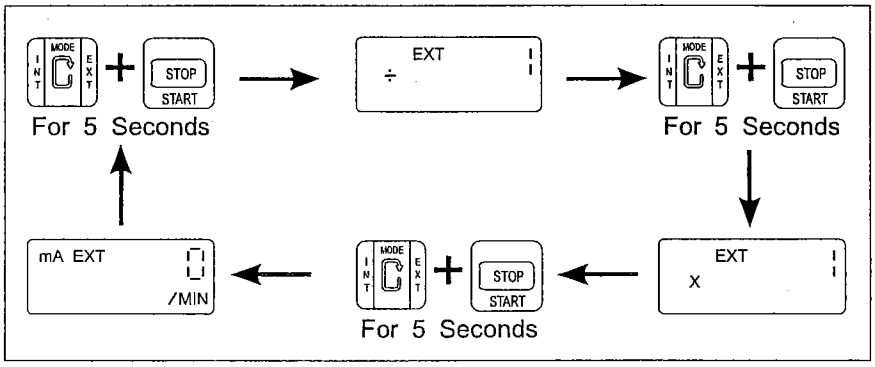
9.0 External Control Modes

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

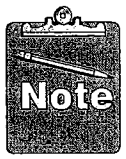
Any of three external modes may be selected when the pump is stopped by pressing and holding the MODE (Mode) key and STOP START (Start/Stop) key for five (5) seconds, then releasing. As noted above, the default is Pulse Divide. Pressing and releasing these keys brings you to the Pulse Multiply mode EXT x. 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 mA EXT 0 /MIN. In this mode the LCD screen alternates between SPM and the mA value.

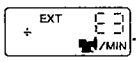
Summary of External Mode Select



9.1 Programming the Pulse Divide Value

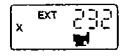
The divide value is altered by using the (Up) and (Down) keys. To do this, the pump must be in the External Divide mode and be OFF. The valid range for the divide value runs from 1 to 999. With the pump running in the Divide mode, the speed in SPM is calculated based on the rate of incoming pulses and the divide value, and displayed on the LCD screen EXT ÷ 29 /MIN.



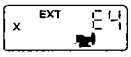
If the calculated speed is less than one (1) SPM, the LCD screen will display 0 SPM. If the calculated speed is GREATER THAN 100 SPM, the E3 error code will be displayed periodically until the fault condition is corrected 

. 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" [x EXT 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 [mA EXT 88 /MIN] and the mA value [mA 180] 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.

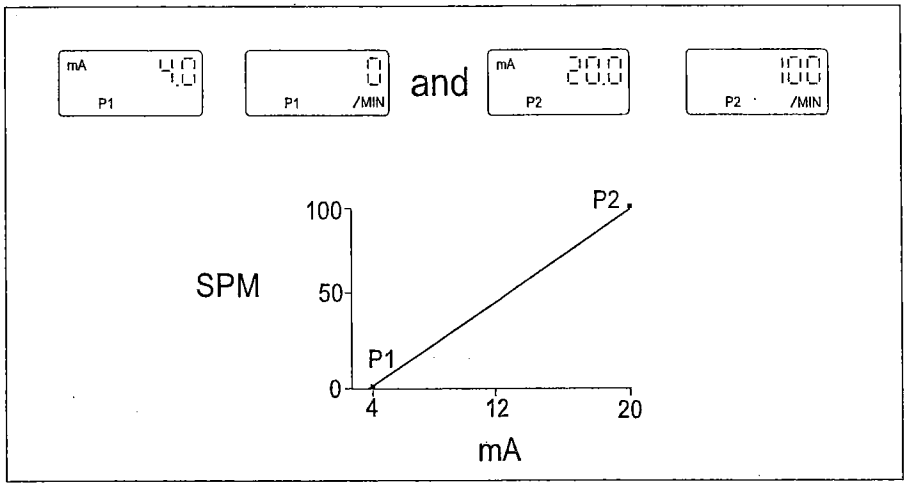


Figure 12

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 P1 4.0]. This value may be altered using the (Up) or (Down) key within five (5) seconds (i.e. [mA P1 6.0]). 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 P2 20.0]. Edit as described in the above paragraph (i.e. [mA P2 18.0]). 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.

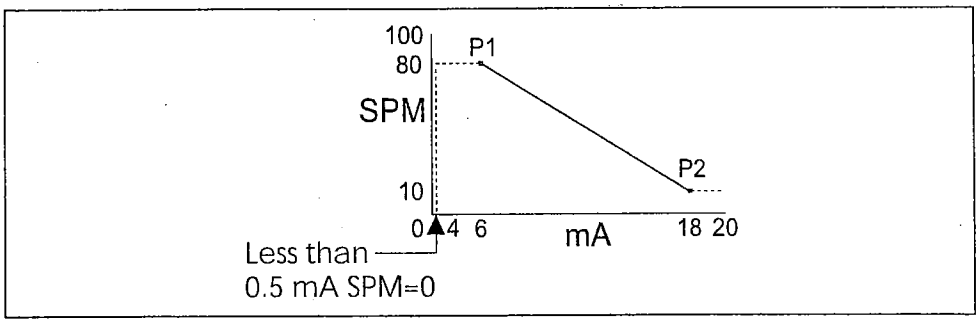


Figure 13

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 [Pro]. After five (5) seconds, the display will show the mA value for P1 [mA P1 4.0]. This value may be altered by using the (Up) key or (Down) key within five (5) seconds (i.e. [mA P1 6.0]). Five (5) seconds following the last key press, the stroke rate for P1 will be displayed [P1 H50]. This value may be altered within five (5) seconds using the (Up) or (Down) key (i.e. [P1 H60]).

Five (5) seconds after the last key press, the mA value for P2 will be displayed [mA P2 20.0]. Edit as described above (i.e. [mA P2 18.0]). Likewise, five (5) seconds after the last keypress, the stroke rate for P2 is displayed and may be altered as above (i.e. [P2 H10]).

The above example would result in the inverse control profile shown in Figure 14.

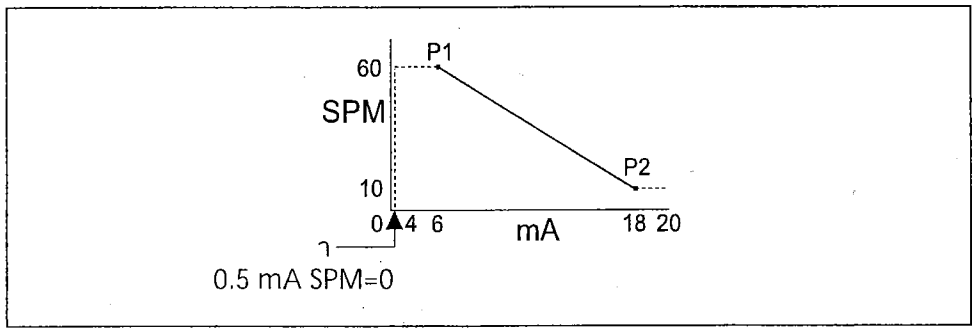
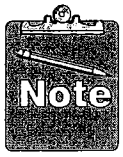


Figure 14



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 [EXT E5].



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 [C.2]. 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 [INT 100 /MIN].

10.2 Menu Items

10.2.1 Menu Item 1: Batch Accumulate Enable/Disable

Batch Accumulate may be enabled (1) [1] or disabled (0) [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) [2 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).

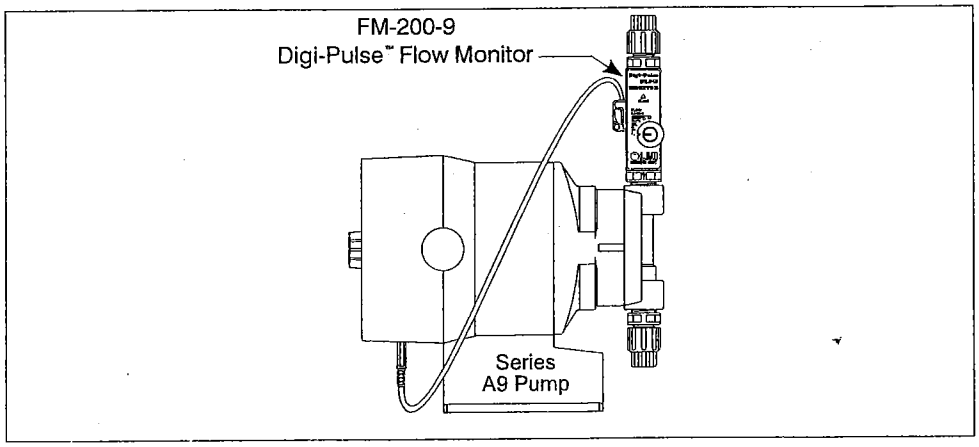


Figure 15

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.

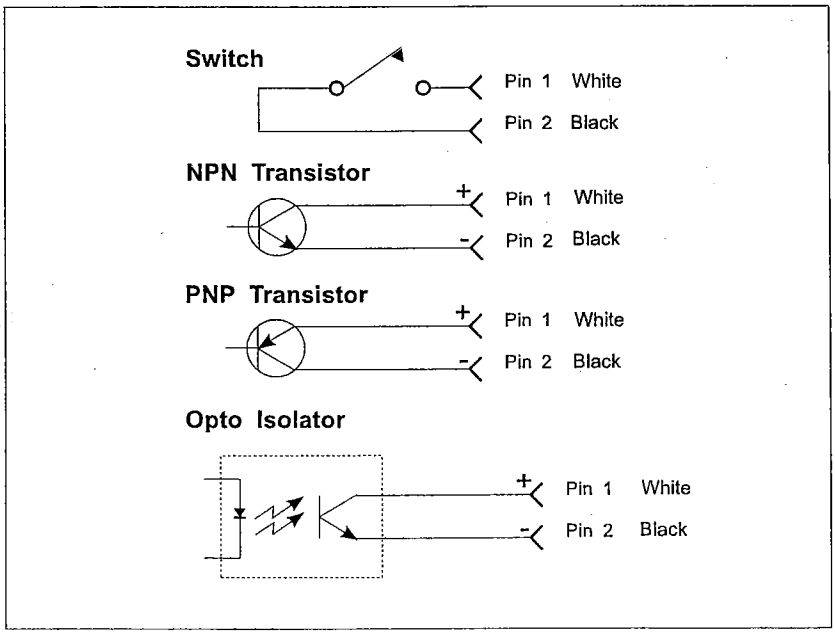
Appendix A: Input/Output Description

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)



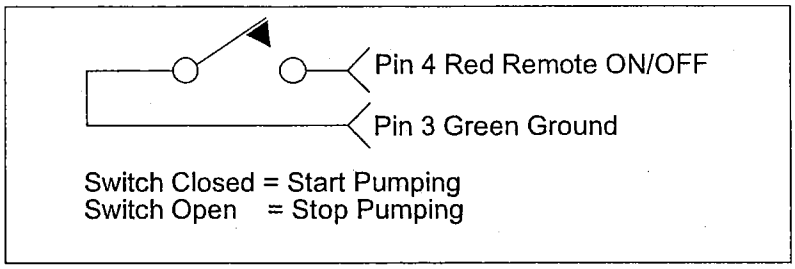


Switch or transistor must be capable of switching 2 mA at 15 VDC. When in the Divide mode, the switch must close then open to trigger.
Minimum time in low impedance state (i.e. switch closed) is 60 mSec by default.
Setup Menu Item 6 sets this value in multiples of 4 mSec.
Example: Default = 4 x [15] = 60 mSec

Remote On/Off (Opto-isolated Input)

Switching this line to ground starts the pump. Releasing this line, stops the pump. The [STOP/START] (Start/Stop) key will always override the Remote Start/Stop.

Reference: 4-Pin Cable (P/N 33796)

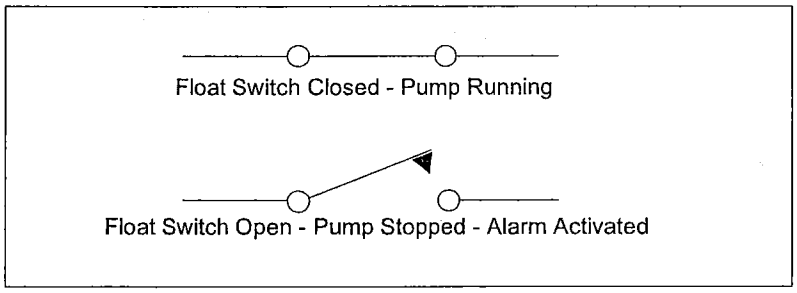




Switch must be capable of switching 2 mA at +15 VDC. Minimum time in low impedance state (i.e. Switch closed) is approximately one (1) second.

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

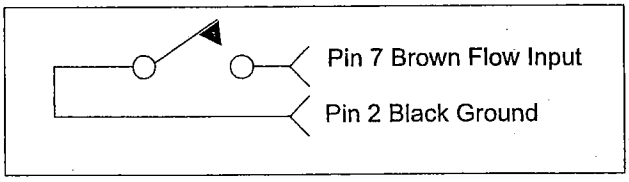
This is reverse polarity protected with a 22 Ohm impedance, a resolution or 0.1 mA and an accuracy of +/- 0.2 mA typically.

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.

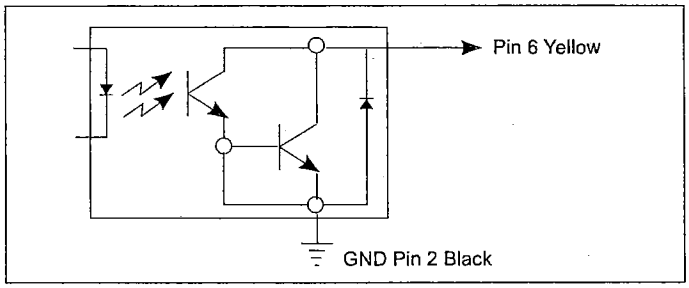
15V Output

The +15V Output (pin 1 Red) is regulated and capable of delivering 30 mA current.

Alarm Output

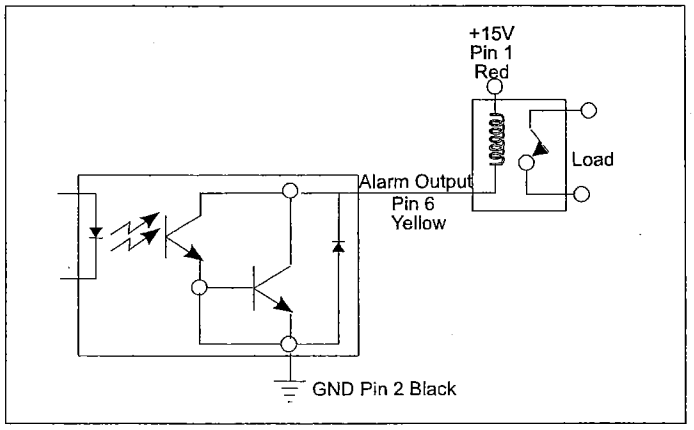
This is an opto-isolated open collector Darlington pair capable of switching 25 mA at +24 VDC to within 1V of ground typically.

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.

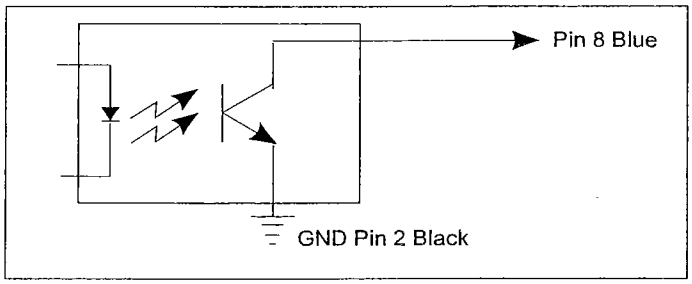
Application: Relay Switching



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.

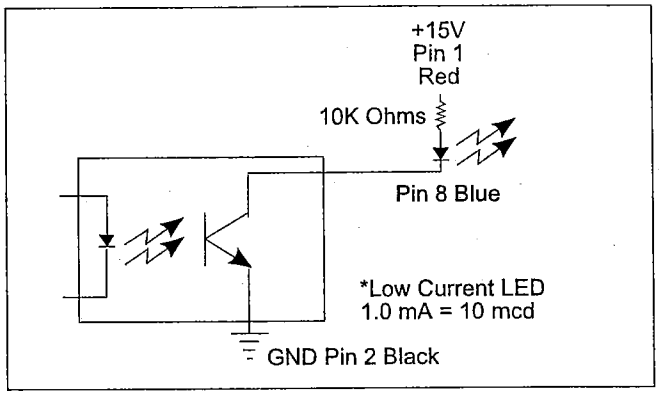
Reference: 8-Pin Cable (P/N 33738)



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.

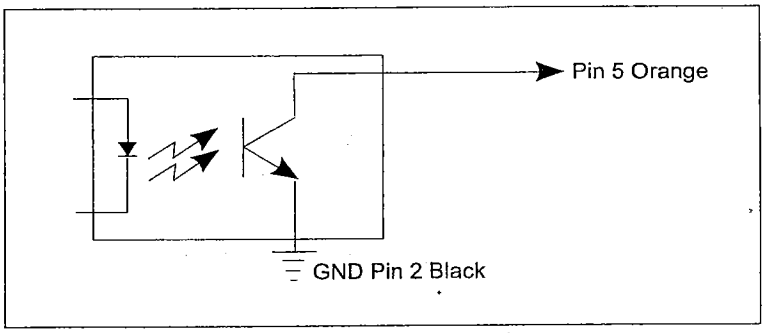
Application: Low Current LED Switching



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)

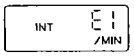
Reference: 8-Pin Cable (P/N 33738)



The output transistor turns ON at the start of a stroke and remains ON for approximately 100 mSec.

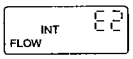
Appendix B: Summary of Error Messages

E1



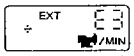
is caused by a Low-Level fault with a Low-Level Switch connected to the pump. The pump is stopped and the alarm outputs are activated. This operates in all Internal and External modes. The pump automatically restarts when the fault is cleared.

E2



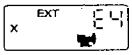
indicates that the pump has lost prime (or the flow had reduced) when an FM200-9 is connected and Flow Monitoring is enabled. Again, the pump is stopped and output alarms activated. Restart the pump when the fault is cleared.

E3



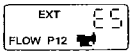
is displayed in the External mode if the stroke rate exceeds 100 SPM. The pump is NOT stopped and NO alarm outputs are activated with this fault. To stop E3 flashing, clear the fault condition, then stop and restart the pump.

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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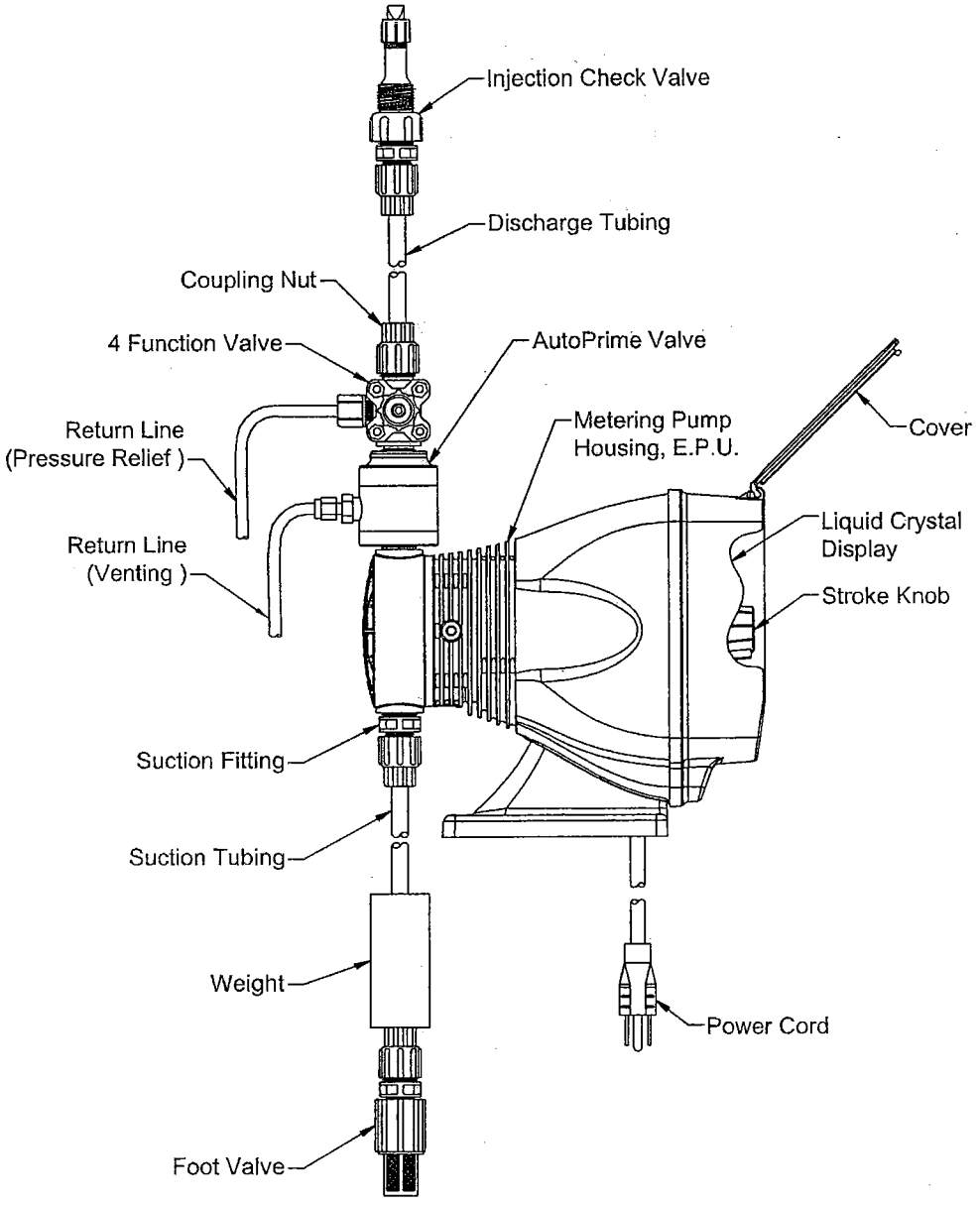
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Instruction **Supplement**

Series AA9
Electronic Metering Pump



Metering Pump Component Diagram

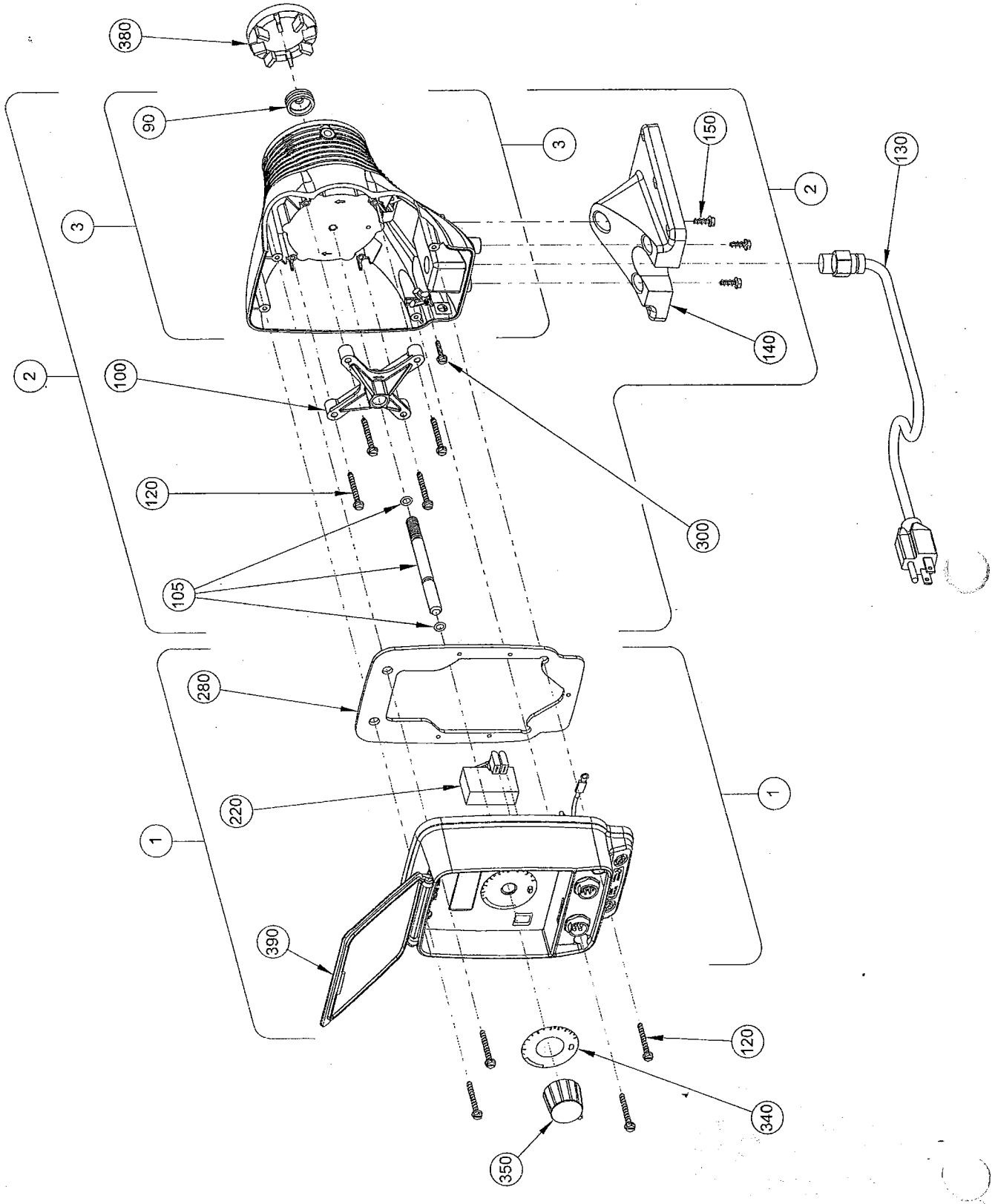
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Series AA9 Drive Assembly Exploded View Diagram

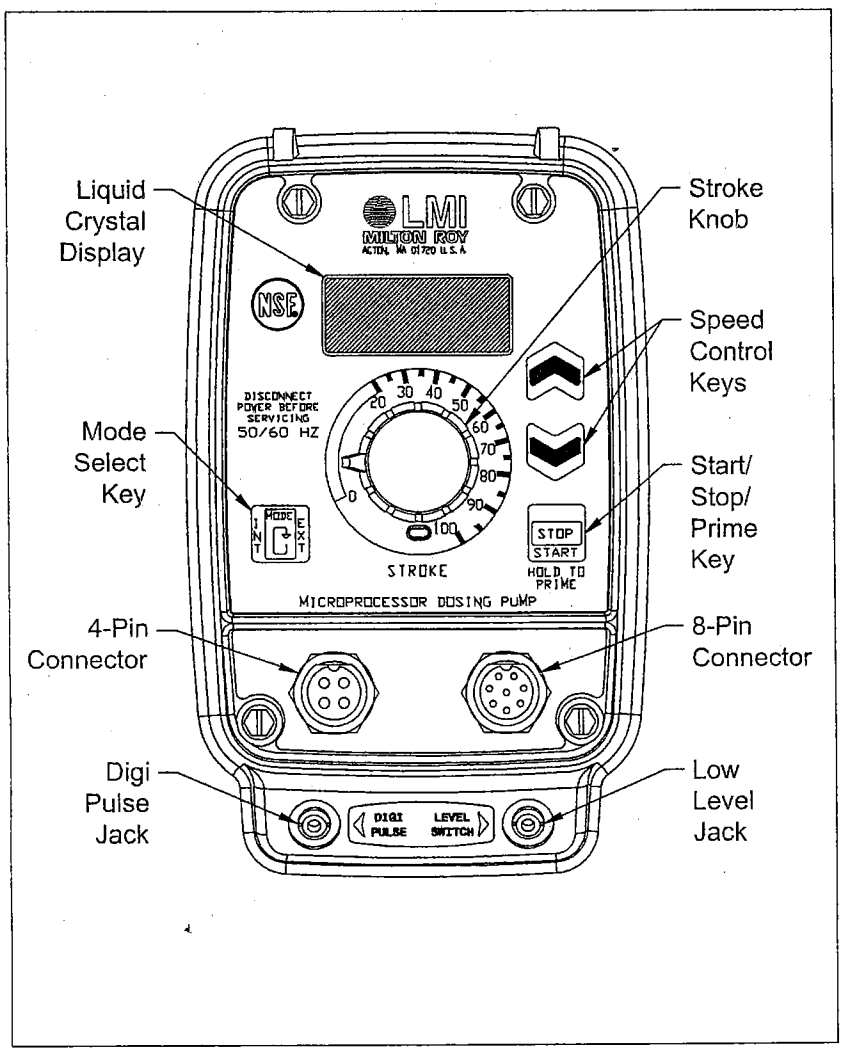


Series AA9 Drive Assembly Parts List

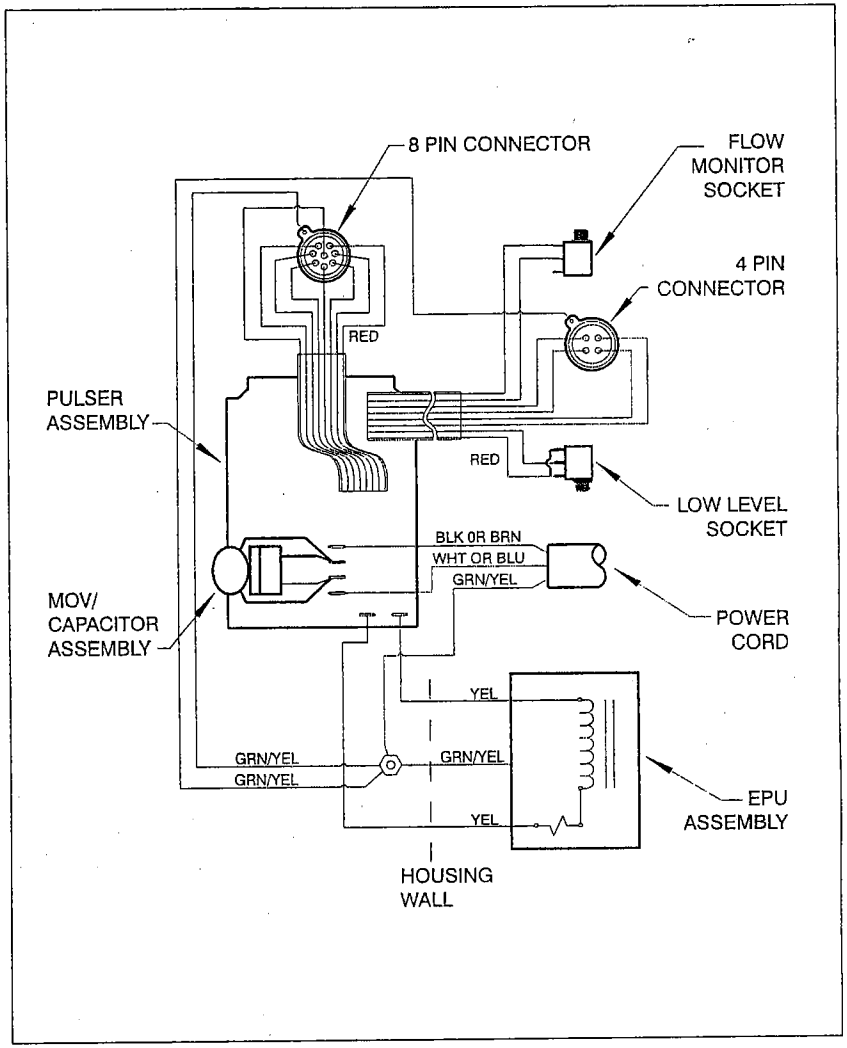
Key No.	Model Series	Part No.	Description	Qty.
1	AA941, AA951, AA961, AA971, AA981	48018	Control Panel Assembly, 115V	1
	AA942, AA952, AA962, AA972, AA982 AA943, AA953, AA963, AA973, AA983 AA945, AA955, AA965, AA975, AA985 AA946, AA956, AA966, AA976, AA986 AA947, AA957, AA967, AA977, AA987	48019	Control Panel Assembly, 230-250V	1
2	AA941, AA951	48034	EPU w/ Stroke Adjustment, 115V	1
	AA942, AA943, AA945, AA946, AA947 AA952, AA953, AA955, AA956, AA957	48035	EPU w/ Stroke Adjustment, 230-250V	1
	AA961	48036	EPU w/ Stroke Adjustment, 115V	1
	AA962, AA963, AA965, AA966, AA967	48037	EPU w/ Stroke Adjustment, 230-250V	1
	AA971, AA981	48038	EPU w/ Stroke Adjustment, 115V	1
	AA972, AA973, AA975, AA976, AA977 AA982, AA983, AA985, AA986, AA987	48039	EPU w/ Stroke Adjustment, 230-250V	1
3	AA941, AA951	48025	EPU, 115V	1
	AA942, AA943, AA945, AA946, AA947 AA952, AA953, AA955, AA956, AA957	48026	EPU, 230-250V	1
	AA961	48027	EPU, 115V	1
	AA962, AA963, AA965, AA966, AA967	48028	EPU, 230-250V	1
	AA971, AA981	48029	EPU, 115V	1
	AA972, AA973, AA975, AA976, AA977 AA982, AA983, AA985, AA986, AA987	48030	EPU, 230-250V	1
90	AA9	10973	Seal	1
100	AA9	38886	Stroke Adjustment Bracket	1
105	AA9	48012	Stroke Adjustment Shaft Assembly	1
120	AA9	41227	Screw	8

Key No.	Model Series	Part No.	Description	Qty.
130	AA941, AA951, AA961, AA971, AA981	29033CE	Power Cord Assembly, 115V	1
	AA742, AA752, AA762, AA772, AA782	29039CE	Power Cord Assembly, 230V US	1
	AA743, AA753, AA763, AA773, AA783	29042CE	Power Cord Assembly, 230V DIN	1
	AA745, AA755, AA765, AA775, AA785	29044CE	Power Cord Assembly, 240V UK	1
	AA746, AA756, AA766, AA776, AA786	29046CE	Power Cord Assembly, 250V AUST	1
	AA747, AA757, AA767, AA777, AA787	29048CE	Power Cord Assembly, 230V SWISS	1
140	AA9	37879	Foot	1
150	AA9	38199	Screw	3
210	AA9	10422	Retaining Ring	1
220	AA741, AA751, AA761, AA771, AA781	35254	MOV and Capacitor Assy, 115V	1
	AA942, AA952, AA962, AA972, AA982 AA943, AA953, AA963, AA973, AA983 AA945, AA955, AA965, AA975, AA985 AA946, AA956, AA966, AA976, AA986 AA947, AA957, AA967, AA977, AA987	35255	MOV and Capacitor Assy, 230-250V	1
280	AA9	38887	Gasket	1
300	AA9	41244	Screw	1
340	AA76	30374	Stroke Dial	1
	AA77	29269	Stroke Dial	1
	AA78	29268	Stroke Dial	1
350	AA9	31890	Stroke Knob Assembly	1
380	AA74, AA77	29445	Disk, 0.5	1
	AA75, AA78	29437	Disk, 0.9	1
	AA76	29442	Disk, 1.8	1
390	AA9	37974	Cover	1

Series AA9 Control Panel Detail



Series AA9 Wiring Diagram

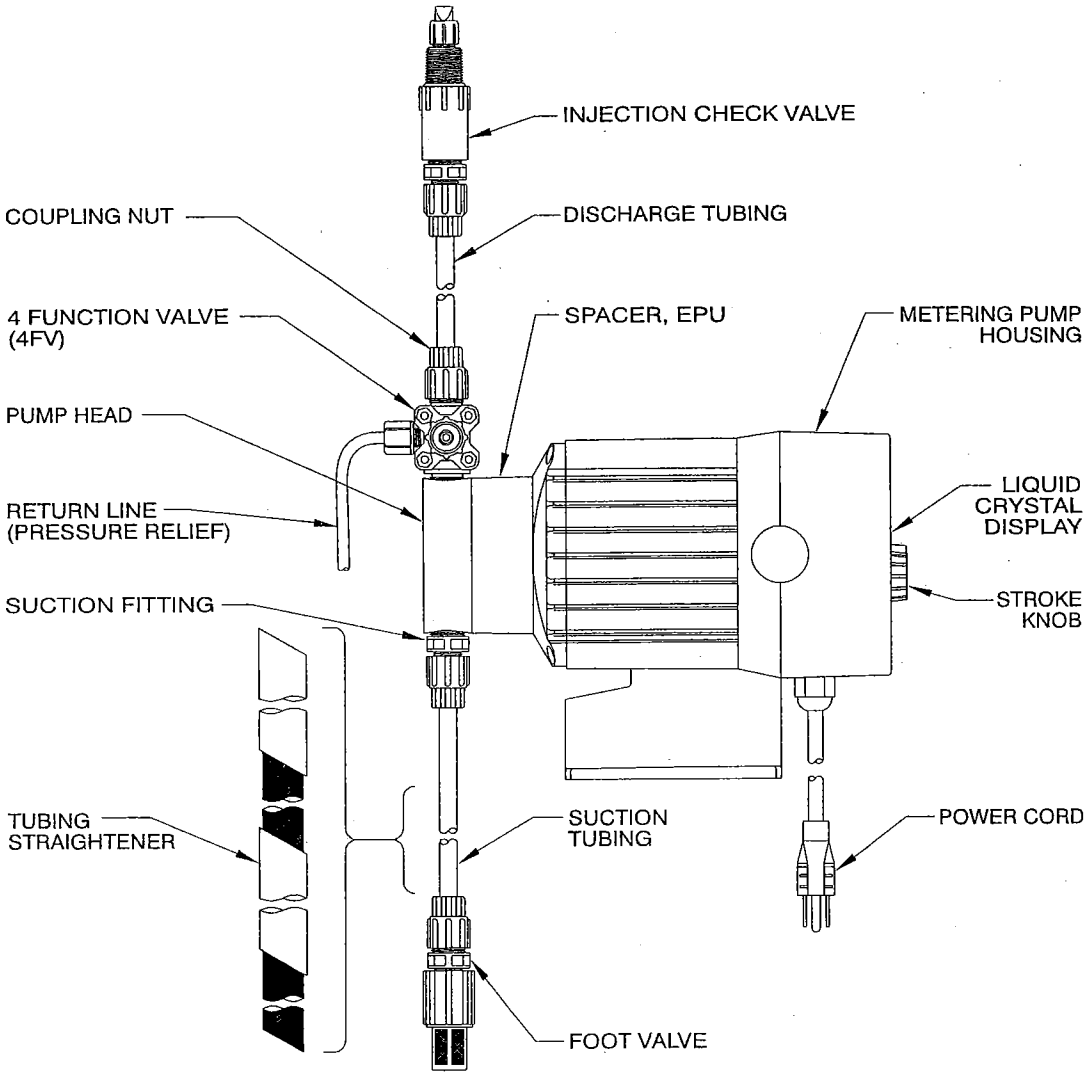


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Instruction **Supplement**

Series C9
Electronic Metering Pump



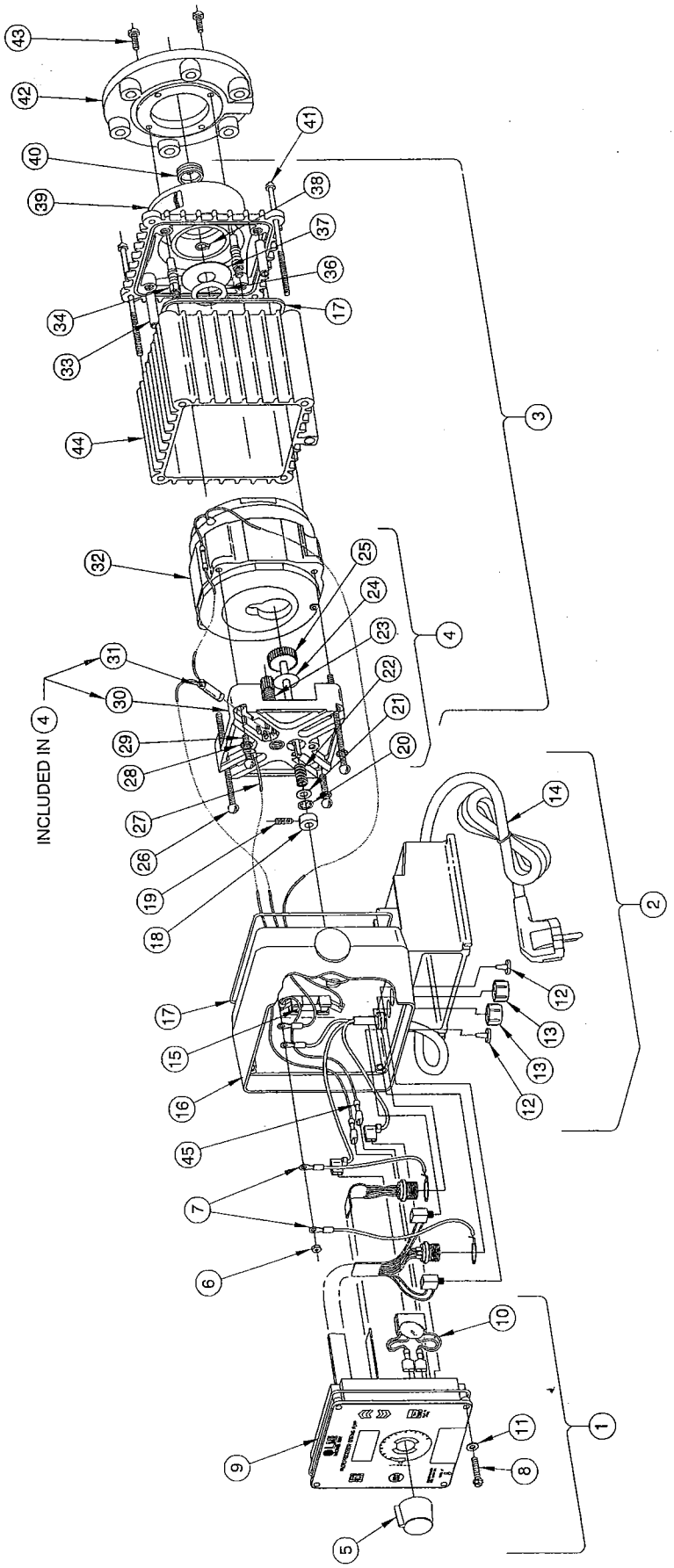
METERING PUMP COMPONENT DIAGRAM

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1795.C 2/98

SERIES C9 DRIVE ASSEMBLY EXPLODED VIEW DIAGRAM

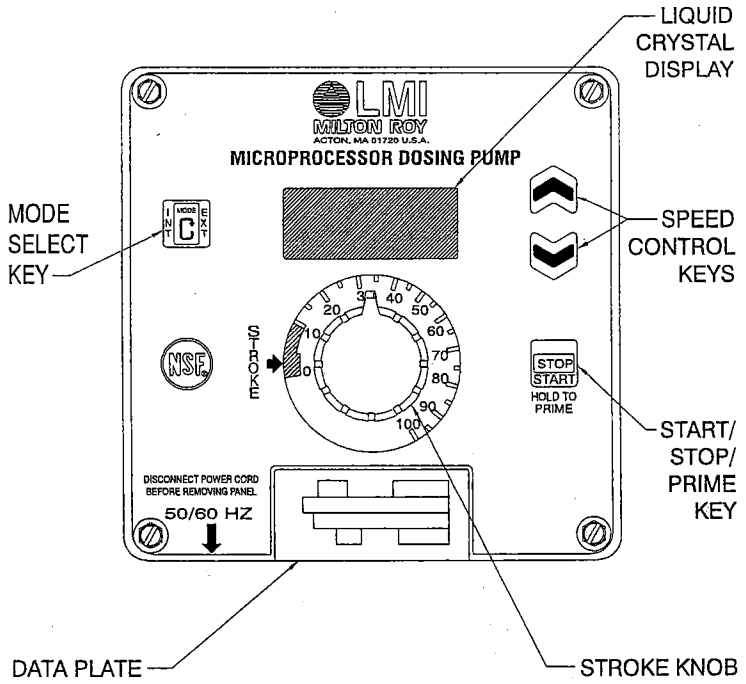


SERIES C9 DRIVE ASSEMBLY PARTS LIST

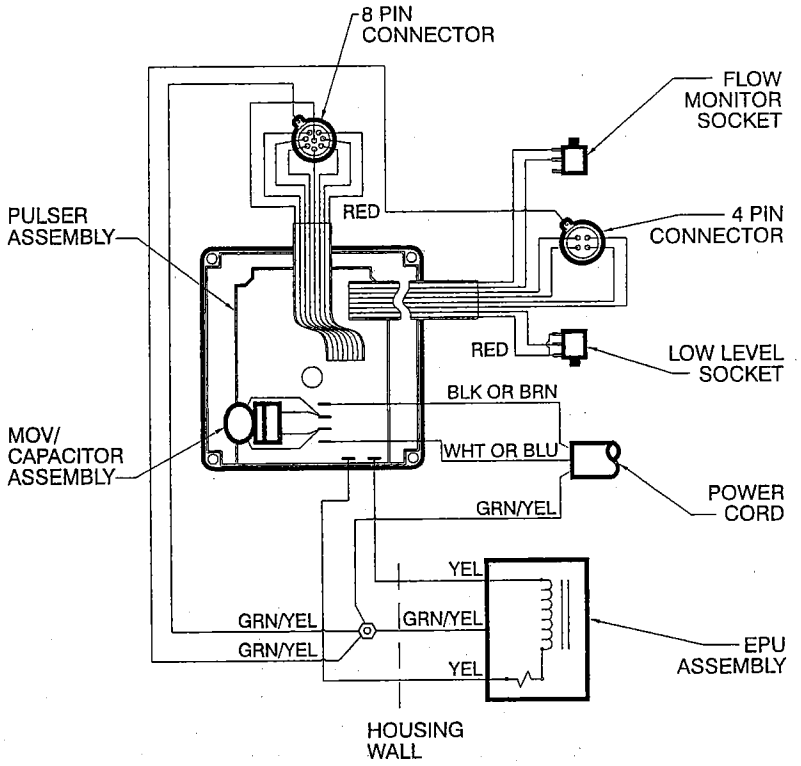
Key No	Model Series	Part No.	Description	Qty.
1	C901, C911	35960CE	Control Panel Assembly, 120V	1
	C902, C903, C905, C906, C907 C912, C913, C915, C916, C917	35961CE	Control Panel Assembly, 240V	1
	C921	35962CE	Control Panel Assembly, 120V	1
	C922, C923, C925, C926, C927	35963CE	Control Panel Assembly, 240V	1
	C931	35964CE	Control Panel Assembly, 120V	1
	C932, C933, C935, C936, C937	35965CE	Control Panel Assembly, 240V	1
	C941	35966CE	Control Panel Assembly, 120V	1
	C942, C943, C945, C946, C947	35967CE	Control Panel Assembly, 240V	1
2	C901, C911, C921, C931, C941	35949CE	Housing Assembly, 120V	1
	C902, C912, C922, C932, C942	35955CE	Housing Assembly, 230V	1
	C903, C913, C923, C933, C943	35950CE	Housing Assembly, 220-240V DIN	1
	C905, C915, C925, C935, C945	35951CE	Housing Assembly, 220-240V UK	1
	C906, C916, C926, C936, C946	35956CE	Housing Assembly, 220-240V AUST	1
	C907, C917, C927, C937, C947	35952CE	Housing Assembly, 220-240C SWISS	1
3	C901	32532CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C902, C903, C905, C906, C907	32533CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
	C911, C921	32534CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C912, C913, C915, C916, C917 C922, C923, C925, C926, C927	32535CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
	C931, C941	32536CE	EPU & Spacer Asm, w/Stroke Adj, 120V	1
	C932, C933, C935, C936, C937 C942, C943, C945, C946, C947	32537CE	EPU & Spacer Asm, w/Stroke Adj, 240V	1
4	C9	32251CE	Stroke Bracket Assembly	1
5	C9	31891	Knob, Stroke	1
6	C9	10191	Nut, 6-32	2
7	C9	35266	Wire Assembly	2
8	C9	30306	Screw, 10 x 1 PH S.S.	4
9	C9	10166	O-Ring	1
10	C9X1	35254	MOV/CAP Assembly, 120V	1
	C9X2, C9X3, C9X5, C9X6	35255	MOV/CAP Assembly, 220-240V	1
11	C9	33889	Washer	4
12	C9	30307	Plug	2
13	C9	25930	Cover	2
14	C9X1	37213CE	Power Cord, 120V	1
	C9X2	37214CE	Power Cord, 240V	1
	C9X3	36001CE	Power Cord, 220-240V DIN	1
	C9X5	37215CE	Power Cord, 220-240V UK	1
	C9X6	36002CE	Power Cord, 220-240V AUST	1
	C9X7	37216CE	Power Cord, 220-240V SWISS	1

Key No.	Model Series	Part No.	Description	Qty.
15	C901, C911, C921, C931, C941	25825	Fuse, 4A Rectifier	2
	C90, C91, C92, C93, C94 All models rated 220-240 Volts	25824	Fuse, 2A Rectifier	2
16	C9	35890	Housing	1
17	C9	35269	O-Ring	2
18	C9	25424	Collar	1
19	C9	25423	Set Screw	1
20	C9	10462	Retaining Ring	1
21	C9	32302	Washer	1
22	C9	32221	Spring	1
23	C9	32578	Pinion	1
24	C9	25121	Gasket	1
25	C9	31770	Shaft Assembly	1
26	C9	27552	Screw, 10-24 x 4.0	2
27	C9	35223	Ground Wire Assembly (GRN)	1
28	C9	10415	Washer	4
29	C9	27551	Screw, 10-24 x 1.25	4
30	C9	12064	Bracket (without mating parts)	1
31	C9	27501CE	Thermostat	1
32	C901, C911, C921, C931, C941	32158CE	EPU Assembly, 120V	1
	C90, C91, C92, C93, C94 All models rated 220-240 Volts	32159CE	EPU Assembly, 240V	1
33	C90, C91, C92, C93, C94	27187	Spacing Stud	2
34	C90, C91, C92	27641	Stud Assembly	4
	C93, C94	27641-1	Stud Assembly	4
36	C9	26983	O-Ring	1
37	C9	27586	Shim	1
38	C9	27253	Retaining Ring	1
39	C90	35393	Spacer, 0.9 SI	1
	C91, C92	35394	Spacer, 1.8 SI	1
	C93, C94	35395	Spacer, 3.0 SI	1
40	C9	10973	Seal	1
41	C9	25127	Screw, RH Slotted, S.S.	4
42	C94	25887	Spacer Adapter, 6.0 SI	1
43	C9	10598	Screw	4
44	C90, C91, C92, C93, C94	25068	Sleeve, EPU	1
45	C9	26344CE	Wire Assembly	2
Not Shown	C9	25849	Bushing, Unipulser	1

SERIES C9 CONTROL PANEL DETAIL



SERIES C9 WIRING DIAGRAM



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ACCUDRAW® Glass Cylinder Calibration Instructions

Note: ***Before starting the calibration procedure below, ensure that the pump is primed and void of any trapped air.***

Using the ml scale: (scale is based on **volume** pumped, over any given time)

1. Fill the calibration cylinder to the top mark with the liquid to be dispensed. This can be accomplished by manually filling the cylinder, or, if the the feed tank level is higher than the cylinder, by opening the isolation valve below the cylinder and back filling the cylinder.

Caution: Never leave unattended when back filling the cylinder.

2. With the calibration cylinder full of the liquid to be dispensed, start the metering pump and operate at 100% output until all air is removed from both suction lines and pump head.
3. Shut pump "OFF".
4. With calibration cylinder full, close isolation valve (#2) from supply tank, and open isolation valve (#1) below cylinder.
5. Start the pump.
6. Using a stop watch, measure the volume dispensed in 60 seconds.
7. Multiply the measured volume by 60 to find your **ml per hour** volume.
8. Adjust the pump volume control, higher or lower to meet with your desired output.
9. Repeat above steps 4 through 8 until your desired output is met.

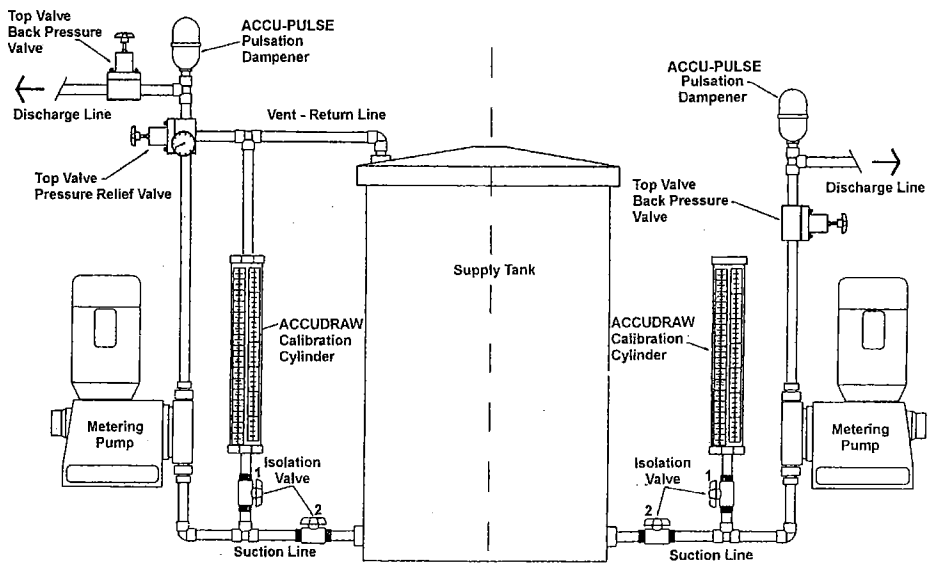
If you wish to shorten the time of dispensing for calibration by one half (1/2) or one quarter (1/4), you must multiply the volume by the same number used to divide the time by to determine ml per minute or hour.

e.g. 100 ml in 60 seconds equals
50 ml X 2 in 30 seconds or
25 ml X 4 in 15 seconds

Typical Installations ("A" and "B")

Conversion Factors
1 ml = 1 cc
1000 ml = 1 liter
ml/sec X 60 = ml/min
1 US gal/min X 0.063 = liters/sec
1 US gal = 3.786 liters

Caution:
Do not use as a pressure vessel



PRIMARY FLUID SYSTEMS INC.

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HAYWARD INDUSTRIAL PRODUCTS
INSTALLATION OPERATION & MAINTENANCE
OF Y-STRAINER

PLEASE READ THE FOLLOWING INFORMATION PRIOR TO INSTALLING AND USING HAYWARD VALVES, STRAINERS, FILTERS, AND OTHER ASSOCIATED PRODUCTS. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS INJURY.

1. Hayward guarantees its products against defective material and workmanship only. Hayward assumes no responsibility for damage or injuries resulting from improper installation, misapplication, or abuse of any product.
2. Hayward assumes no responsibility for damage or injury resulting from chemical incompatibility between its products and the process fluids to which they are subjected. Compatibility charts provided in Hayward literature are based on ambient temperatures of 70F and are for reference only. Customer should always test to determine application suitability.
3. Consult Hayward literature to determine operating pressure and temperature limitations before installing any Hayward product. Note that the maximum recommended fluid velocity through any Hayward product is eight feet per second. Higher flow rates can result in possible damage due to the water hammer effect. Also note that maximum operating pressure is dependent upon material selection as well as operating temperature.
4. Hayward products are designed primarily for use with non-compressible liquids. They should NEVER be used or tested with compressible fluids such as compressed air or nitrogen.
5. Systems should always be depressurized and drained prior to installing or maintaining Hayward products.
6. Temperature effect on piping systems should always be considered when the systems are initially designed. Piping systems must be designed and supported to prevent excess mechanical loading on Hayward equipment due to system misalignment, weight, shock, vibration, and the effects of thermal expansion and contraction.
7. Because PVC and CPVC plastic products become brittle below 40F, Hayward recommends caution in their installation and use below this temperature.
8. Published operating torque requirements are based upon testing of new valves using clean water at 70F. Valve torque is affected by many factors including fluid chemistry, viscosity, flow rate, and temperature. These should be considered when sizing electric or pneumatic actuators.
9. Due to differential thermal expansion rates between metal and plastic, transmittal of pipe vibration, and pipe loading forces DIRECT INSTALLATION OF METAL PIPE INTO PLASTIC CONNECTIONS IS NOT RECOMMENDED. Wherever installation of plastic valves into metal piping systems is necessary, it is recommended that at least 10 pipe diameter in length of plastic pipe be installed upstream and downstream of the plastic valve to compensate for the factors mentioned above.

SOCKET CONNECTION:

Socket end connections are manufactured to ASTM D2467-94. Solvent cementing of socket end connections to pipe should be performed per ASTM specifications D2855-87. Cut pipe square. Chamfer and deburr pipe. Surfaces must be cleaned and free of dirt, moisture, oil and other foreign material. Apply primer to inside socket surface of the strainer. Never allow primer or cement to contact sealing surfaces or the screen, as leaking may result. Use a scrubbing motion. Repeat applications may be necessary to soften the surface of the socket. Next, liberally apply primer to the male end of the pipe to the length of the socket depth. Again apply to the socket, without delay apply cement to the pipe while the surface is still wet with primer. Next apply cement lightly, but uniformly to the inside of the socket. Apply a second coat of cement to the pipe, and assemble the strainer to the pipe, rotating the strainer 1/4 turn in one direction as it is slipped to full depth on to the pipe. The strainer should be held in position for approx. 30 seconds to allow the connection to "set". After assembly wipe off excess cement. Full set time is a minimum of 30 minutes at 60 to 100 F. Full cure time should be based on the chart below.

JOINT CURE SCHEDULE:

The cure schedules are suggested as guides. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual manufacturer's recommendations for their particular cement should be followed.

Temperature Range During Cure Period(B) °F(°C)	Test Pressures for Pipe Sizes 1/2 to 1-1/4 In. Up to 180 PSI (1240 kPa)	Test Pressures for Pipe Sizes 1/2 to 1-1/4 In. Above 180 to 370 PSI (1240 to 2550 kPa)	Test Pressures for Pipe Sizes 1-1/2 to 3 In. Up to 180 PSI (1240 kPa)	Test Pressures for Pipe Sizes 1-1/2 to 3 In. Above 180 to 315 PSI 1240) to 2170 kPa)	Test Pressures for Pipe Sizes 4 to 5 In. Up to 180 PSI (1240 kPa)	Test Pressures for Pipe Sizes 4 to 5 In. Above 180 to 315 PSI (1240 to 2170 kPa)	Test Pressures for Pipe Sizes 6 to 8 In. Up to 180 PSI (1240 kPa)	Test Pressures for Pipe Sizes 6 to 8 In. Above 180 to 315 PSI (1240 to 2170 kPa)
60 to 100 (15 to 40)	1 h	6 h	2 h	12 h	6 h	18 h	8 h	24 h
40 to 60 (5 to 15)	2 h	12 h	4 h	24 h	12 h	36 h	16 h	48 h
20 to 40 (-7 to 5)	6 h	36 h	12 h	72 h	36 h A	4 days A	3 days A	9 days A
10 to 20) (-15 to 7)	8 h	48 h	16 h	96 h	72 h A	8 days A	4 days A	12 days A
Colder than 10 (-15)	Extreme care should be exercised on all joints made where pipe, fittings or cement is below 10°F.							

A: It is important to note that at temperatures colder than 20°F on sizes that exceed 3 in., test results indicate that many variables exist in the actual cure rate of the joint. The data expressed in these categories represent only estimated averages. In some cases, cure will be achieved in less time, but isolated test results indicate that even longer periods of cure may be required.

B: These cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT=in a dry fit the pipe bottoms snugly in the fitting socket without meeting interference).

THREADED CONNECTION:

Threaded end connections are manufactured to ASTM specifications D2464-88. F437-88 and ANSI B2.1. Wrap threads of pipe with Teflon tape of 3 to 3-1/2 mil thickness. The tape should be wrapped in a clockwise direction starting at the first or second full thread. Overlap each wrap by, 1/2 the width of the tape. The wrap should be applied with sufficient tension to allow the threads of a single wrapped area to show through without cutting the tape. The wrap should continue for the full effective length of the thread. Pipe sizes 2" and greater will not benefit with more than a second wrap, due to the greater thread depth. To provide a leak proof joint, the pipe should be threaded into the end connection "hand tight". Using a strap wrench only. (Never use a stillson type wrench) tighten the joint an additional 1/2 to 1-1/2 turns past hand tight. Tightening beyond this point may induce excessive stress that could cause failure.

FLANGED CONNECTION:

Flange bolts should be tight enough to slightly compress the gasket and make a good seal, without distorting or putting excessive stress on the flanges. Suitable washers should be used between the bolt head and flange and the nut and flange. Bolts should be tightened in alternating sequence.

RECOMMENDED FLANGE BOLT TORQUE. USE WELL LUBRICATED METAL BOLTS AND NUTS. USE SOFT RUBBER GASKETS.

FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.	FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.
1/2	1/2	10-15	2	5/8	15-25
3/4	1./2	10-15	2-1/2	5/8	20-25
1	1/2	10-15	3	5/8	20-25
1-1/4	1/2	10-15	4	5/8	20-25
1-1/2	1/2	10-15	6	3/4	30-40

INSTALLATION:

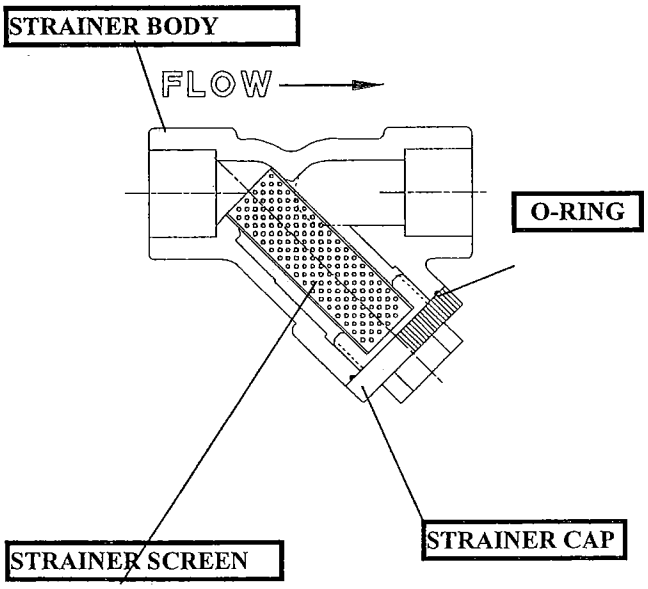
It is recommended that these strainers be installed no closer than 10 pipe diameters from a pump. At least 5 pipe diameters should be between these strainers and an elbow.

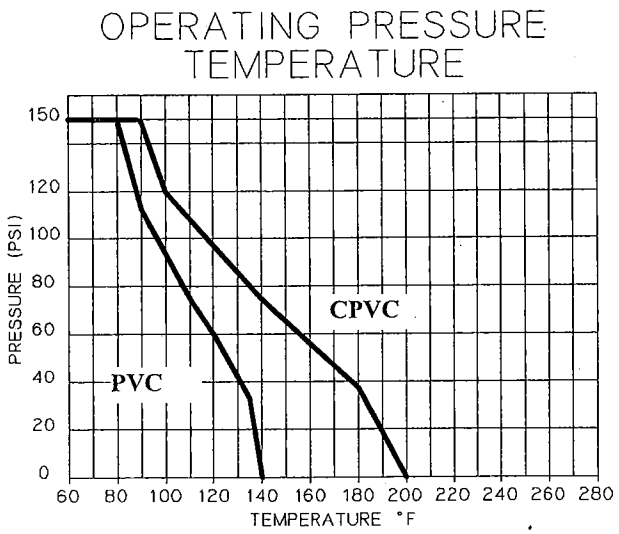
As in all plastic piping the maximum fluid velocity is 8 feet per second. This velocity minimizes the effects of valve closure and pump start up or shut down.

SCREEN CLEANING:

EXTREME CAUTION MUST BE TAKEN WHEN WORKING ON THIS STRAINER. THE PIPING SYSTEM MUST BE DEPRESSURIZED AND DRAINED. PROPER CARE MUST BE TAKEN. CONSULT M.S.D.S. (MATERIAL SAFETY DATA SHEETS) INFORMATION REGARDING YOUR SPECIFIC APPLICATION.

When the pressure drop across the strainer is in excess of 5 PSI the screen requires cleaning. To clean the screen remove the screen cap nut from the strainer by turning counter clockwise. The collected debris should be removed with the screen. Clean the screen. **DO NOT POUND OR DEFORM THE SCREEN.** Insert the screen back into the strainer with the flange, if one is on the screen into the body first. Install the o-ring in the body groove. Use a non-petroleum base lubricant to lubricate the o-ring and thread , and re-assemble the cap to the strainer.





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Griffco Valve Inc.

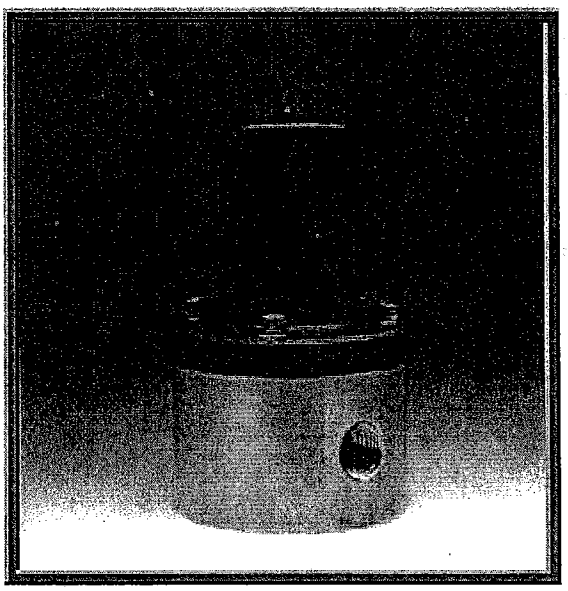
3 North Main Street
Middleport, NY 14105
Phone: 1 800-474-3326
FAX: 1 716-735-3166

Instruction Manual

Back Pressure Valves
Pressure Relief Valves

Call 1 - 800 - GRIFFCO

INS 1002-94



INTRODUCTION

GRIFFCO diaphragm back pressure valves are used to enhance the performance of chemical feed pumps and systems by providing a constant discharge head pressure. These valves also function as an antisyphon valve. The diaphragm is held against the seat by the internal spring. Back pressure is adjustable from 0 - 150 psi via the tamper resistant adjustment screw. When the inlet pressure exceeds the preset pressure the diaphragm lifts off the seat and the chemical flows to the injection point. After each discharge stroke of the pump, as the pressure drops, the diaphragm reseats itself.

GRIFFCO diaphragm pressure relief valves are designed to protect chemical feed pumps and systems from overpressure caused by defective equipment or blockages in the chemical line.
The 3 port design allows chemical to flow through the valve via an internal chamber. When the pressure in the chemical line exceeds the preset pressure of the valve the diaphragm lifts off the seat and the chemical then flows out the bottom port back to the chemical tank. Relief pressure is adjustable form 0 - 150 psi via the tamper resistant screw in the top of the valve.

INSTALLATION

Back Pressure Valve:

Generally, the back pressure valve can be installed anywhere in the discharge line, provided there is some downstream pressure at the dosage point. If there is no downstream pressure the back pressure valve should be installed at the dosage point to prevent siphoning and drainage of the chemical line. All **GRIFFCO** valves are factory set at 50 psi, unless otherwise specified. Field adjustment is possible with the adjustment screw, (appx. 8 psi/revolution).

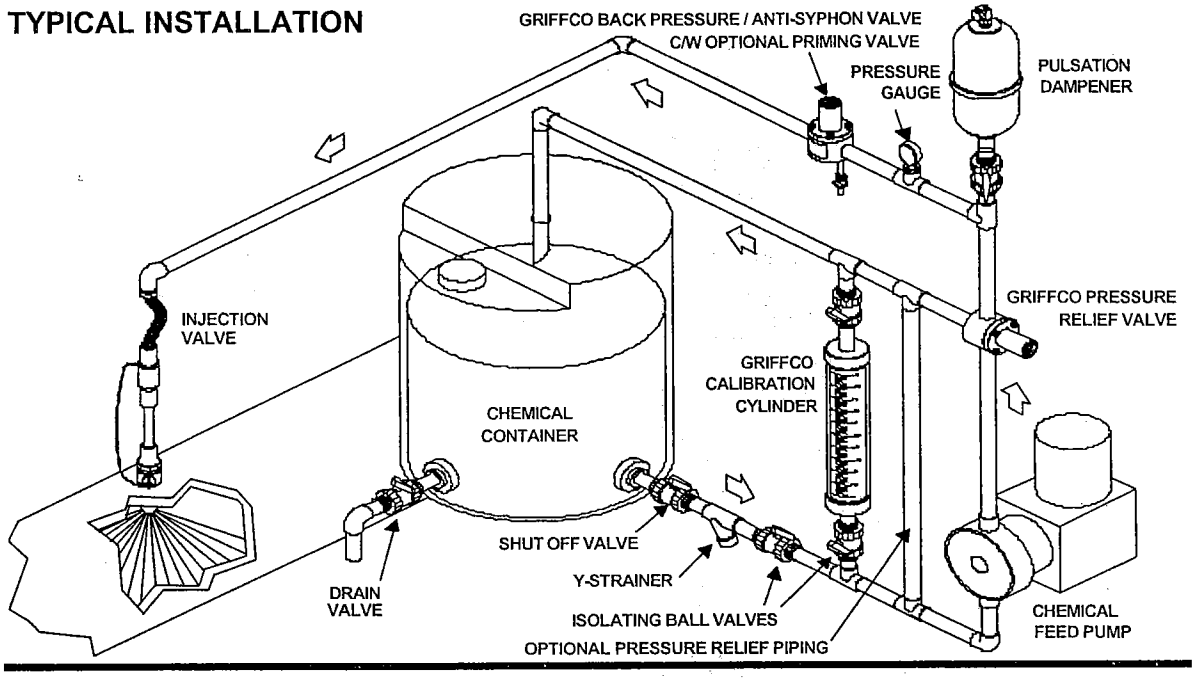
Back pressure valve performance will be enhanced with the installation of a pulsation dampener to smooth out the discharge / suction cycles of the pump. Thus, the diaphragm is free to float inside the valve chamber, minimising the wear on the stress points of the diaphragm. For many low pressure applications dampeners without diaphragms are acceptable. These pulsation dampeners should be sized at 12 - 15 times the dosage volume of the pump head. For some applications diaphragm type dampeners are required. Generally speaking 5 to 10% dampening is sufficient. Consult with your pump manufacturer to get his recommendations.

Pressure Relief Valve:

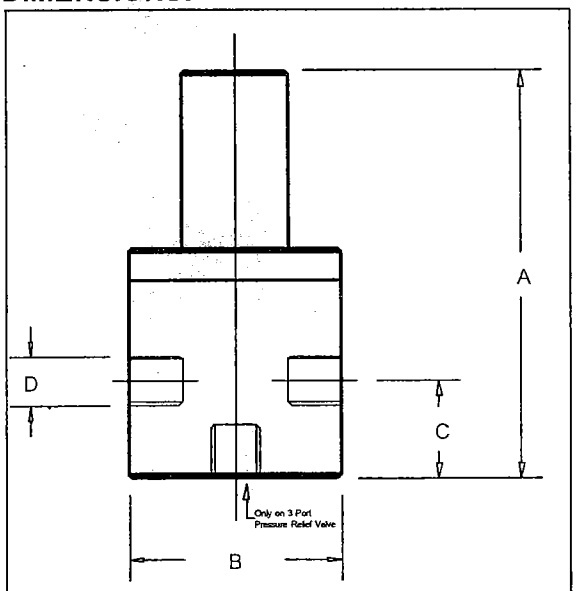
Installation should be made as close to the chemical pump discharge valve as possible, without any equipment, especially shut-off valves, between the valve and the pump. Direction of flow must be across the valve, however the side of entry is not important. All **GRIFFCO** valves are factory set at 50psi, however field adjustment is possible with the adjustment screw.

The optimum installation for the relief valve is to vent the relief port back to the chemical tank, or directly to a containment area. However if this is not possible, the relief port can be piped back into the suction side of the pump. This will apply the suction head to the relief port. To compensate, divide the NPSH by 4 and add this pressure to the relief valve setting.

TYPICAL INSTALLATION



DIMENSIONS:



D	1/4"	1/2"	3/4"	1"	1 1/2"	2"
A	3.500	5.500	5.500	6.250	9.000	9.000
B	2.375	3.500	3.500	3.500	5.500	5.500
C	0.750	1.125	1.125	1.375	2.250	2.250

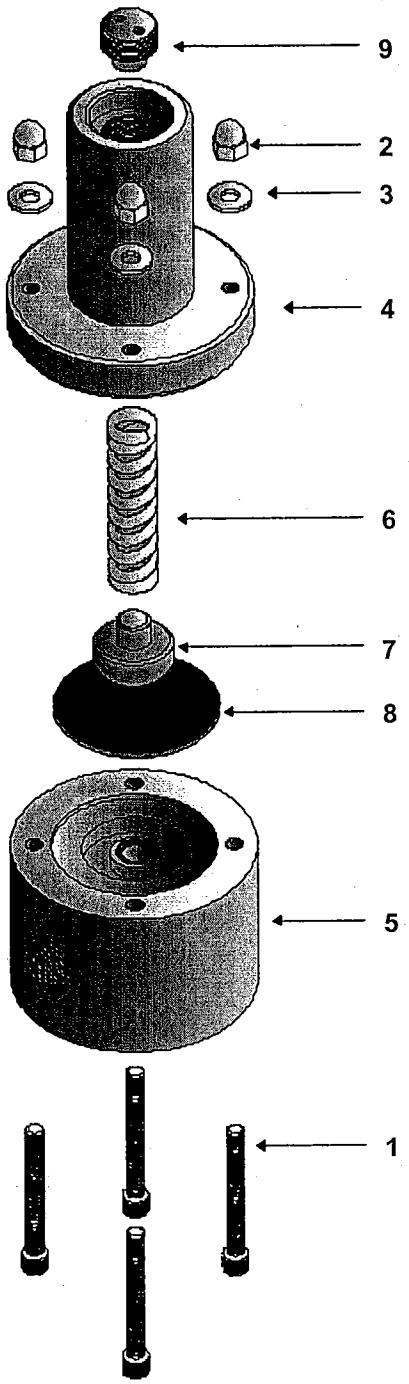
MAINTENANCE:

The pressure relief and back pressure valves were designed with minimizing the amount of maintenance required to keep the valves in operation. However, periodic replacement of the diaphragm is required. To facilitate inspection and replacement, the valve layout is such that removal of the diaphragm can be done without taking the valve out of the chemical line.

Caution: Ensure the system is not under pressure and that the chemical lines are flushed with water before disassembly.

Unscrew the pressure adjuster to remove the pressure from the diaphragm. Remove the 4 cap nuts and lift off the valve top.
After the diaphragm has been inspected and replaced if necessary check the adjustment spring. Make sure there is no rust or corrosion. Replaced the spring and the spring bumper into the valve top and slide the top back over the four bolts.

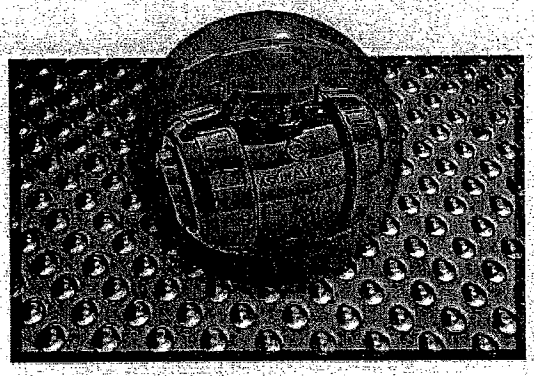
Snug down the four cap nuts. Screw in the tension adjuster to approximately the same position as it was prior to disassembly. If an exact pressure setting is required or a different pressure be desired a pressure gauge should be used to verify the setting. Pressure can be increased by turning the set screw clockwise.


9
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1

ITEM	DESCRIPTION	PART #
1	1/4 - 20 X 2 3/4" Bolt - 1/2 - 1" Plastic Valves	PV-00101
	5/16 - 18 X 1 1/2" Bolt - 1 1/2" - 2" Metal Valves	PV-00102
	5/16 - 18 X 5" Bolt - 1 1/2" - 2" Plastic Valves	PV-00105
	10/32 X 3/4" Bolt - 1/4" Metal Valves	PV-00106
	10/32 X 1 3/4 Bolt - 1/4" Plastic Valves	PV-00106
	1/4 - 20 X 1 1/4" Bolt - 1/2 - 1" Metal Valves	PV-00108
2	10/32 Cap hex nut	PV-00201
	1/4 - 20 Cap hex nut	PV-00202
	5/16 - 18 Cap hex nut	PV-00203
3	10/32 Flat washer	PV-00301
	1/4 Flat washer	PV-00302
	5/16 Flat washer	PV-00303
4	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Grey	PV-004011
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Orange	PV-004012
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Yellow	PV-004013
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Green	PV-004014
	1/4" – 3/8" & 1/2" T-Series Valve Top, Threaded – PVC, Grey	PV-004015
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Orange	PV-004016
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Yellow	PV-004017
	1/4" – 3/8" & T-Series Alloy Valve Top, Bolted – PVC, Green	PV-004018
	1/2" – External Adjustment Valve Top – PVC (Tiberian)	PV-004019
	1/4" – 3/8" & T-Series Alloy Valve Top – Coated Steel	PV-00402
	1/4" – 3/8" & T-Series Alloy Valve Top – 316 SS	PV-00403
	1/2" - 1" Valve Top – PVC. Grey	PV-004051
	1/2" - 1" Valve Top – PVC, Orange	PV-004052
	1/2" - 1" Valve Top – PVC, Yellow	PV-004053
	1/2" - 1" Valve Top – PVC, Green	PV-004054
	1/2" - 1" Valve Top – CPVC	PV-004055
	1/2" - 1" Valve Top - Steel	PV-00406
	1/2" - 1" Valve Top - 316 SS	PV-00407
	1 1/2" - 2" Valve Top; 5 ½" Valves, PVC	PV-00408
	1 1/2" - 2" Valve Top; 5 ½" Valves. Coated Steel	PV-00409
	1 1/2" - 2" Valve Top; 5 ½" Valves. 316 SS	PV-00410
	1 1/2" Valve Top; 4 ½" Valves, PVC.	PV-00411
	1 1/2" Valve Top; 4 ½" Valves. Coated Steel	PV-00412
	1 1/2" Valve Top; 4 ½" Valves. 316 SS	PV-00413
	2" Valve Top; 5" Valves, PVC	PV-00414
	2" Valve Top; 5" Valves. Coated Steel	PV-00415
	2" Valve Top; 5" Valves. 316 SS	PV-00416
6	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 0 – 150 psi	PV-00601
	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 0 – 50 psi	PV-006011
	Pressure Spring - 1/4" – 3/8" & T-Series Valve; 50 – 350 psi	PV-006012
	Pressure Spring - 1/2" - 1" Valve; 0 – 150 psi	PV-00602
	Pressure Spring - 1/2" - 1" Valve; 0 – 50 psi	PV-006021
	Pressure Spring - 1/2" - 1" Valve; 50 – 350 psi	PV-006122
	Pressure Spring - 1/2" - 1" Valve; 0 – 100 psi, 316 SS	PV-006123
	Pressure Spring - 1 1/2" - 2" Valve	PV-00603
7	Support Disc - 1/4" – 3/8" & T-Series Valve, PP	PV-00701
	Support Disc - 1/4" – 3/8" & T-Series Valve, 316 SS	PV-00702
	Support Disc - 1/2 - 1" Valve, PP	PV-00705
	Support Disc - 1/2 - 1" Valve, 316 SS	PV-00706
	Support Disc - 11/2" - 2" Valve, PP	PV-00708
	Support Disc - 11/2" - 2" Valve, 316 SS	PV-00709
8	Diaphragm - 1/4" – 3/8" & T-Series Valve - PTFE / EPDM	PV-00800
	Diaphragm - 1/4" – 3/8" & T-Series Valve - Viton	PV-00802
	Diaphragm - 1/4" – 3/8" & T-Series Valve - PTFE / Viton (High Temp)	PV-00803
	Diaphragm - 1/2" - 1" Valve - PTFE / EPDM	PV-00810
	Diaphragm - 1/2" - 1" Valve – Viton	PV-00812
	Diaphragm - 1/2" - 1" Valve - PTFE / Viton (High Temperature)	PV-00813
	Diaphragm - 1 1/2" - 2" Valve - PTFE / EPDM	PV-00820
	Diaphragm - 1 1/2" - 2" Valve - Viton	PV-00821
9	Adjustment Screw - 1/4" - 1" Valve PVC	PV-00900
	Adjustment Screw - 1/4" - 1" Valve PVC, Slotted	PV-00902
	Adjustment Screw - 1/4" - 1" Valve Coated Steel	PV-00901
	Adjustment Screw - 1/4" - 1" Valve Coated Steel, Slotted	PV-00903
	Adjustment Screw - 1 1/2" - 2" Valve PVC	PV-00920
	Adjustment Screw - 1 1/2" - 2" Valve Coated Steel	PV-00921

ITEM	DESCRIPTION	BPV	PRV
5	1/4" Valve Body PVC	BPV-00501	PRV-00501
	1/4" T-Series Valve Body PVC,	BPV-005011	PRV-005011
	1/4" Valve Body PP	BPV-00502	PRV-00502
	1/4" T-Series Valve Body PP	BPV-005021	PRV-005021
	1/4" Valve Body PTFE	BPV-00503	PRV-00503
	1/4" T-Series Valve Body PTFE	BPV-005031	PRV-005031
	1/4" Valve Body PVDF	BPV-00504	PRV-00504
	1/4" T-Series Valve Body PVDF	BPV-005041	PRV-005041
	1/4" Valve Body 316 SS	BPV-00505	PRV-00505
	1/4" Valve Body Alloy 20	BPV-00506	PRV-00506
	1/4" Valve Body Hast C	BPV-00507	PRV-00507
	1/4" Valve Body CPVC	BPV-00508	PRV-00508
	1/4" T-Series Valve Body CPVC	BPV-005081	PRV-005081
	3/8" Valve Body PVC	BPV-00561	PRV-00561
	3/8" T-Series Valve Body PVC,	BPV-005611	PRV-005611
	3/8" Valve Body PP	BPV-00562	PRV-00562
	3/8" T-Series Valve Body PP	BPV-005621	PRV-005621
	1/4" Valve Body PTFE	BPV-00563	PRV-00563
	3/8" T-Series Valve Body PTFE	BPV-005631	PRV-005631
	3/8" Valve Body PVDF	BPV-00564	PRV-00564
	3/8" T-Series Valve Body PVDF	BPV-005641	PRV-005641
	3/8" Valve Body 316 SS	BPV-00565	PRV-00565
	3/8" Valve Body Alloy 20	BPV-00566	PRV-00566
	3/8" Valve Body Hast C	BPV-00567	PRV-00567
	3/8" Valve Body CPVC	BPV-00568	PRV-00568
	3/8" T-Series Valve Body CPVC	BPV-005681	PRV-005681
	1/2" Valve Body PVC	BPV-00511	PRV-00511
	1/2" T-Series Valve Body PVC	BPV-005111	PRV-005111
	1/2" Valve Body PP	BPV-00512	PRV-00512
	1/2" T-Series Valve Body PP	BPV-005121	PRV-005121
	1/2" Valve Body PTFE	BPV-00513	PRV-00513
	1/2" T-Series Valve Body PTFE	BPV-005131	PRV-005131
	1/2" Valve Body PVDF	BPV-00514	PRV-00514
	1/2" T-Series Valve Body PVDF	BPV-005141	PRV-005141
	1/2" Valve Body 316 SS	BPV-00515	PRV-00515
	1/2" T-Series Valve Body 316 SS	BPV-005151	PRV-005151
	1/2" Valve Body Alloy 20	BPV-00516	PRV-00516
	1/2" T-Series Valve Body Alloy 20	BPV-005161	PRV-005161
	1/2" Valve Body Hast C	BPV-00517	PRV-00517
	1/2" T-Series Valve Body Hast C	BPV-005171	PRV-005171
	1/2" Valve Body CPVC	BPV-00518	PRV-00518
	1/2" T-Series Valve Body CPVC	BPV-005181	PRV-005181
	3/4" Valve Body PVC	BPV-00521	PRV-00521
	3/4" Valve Body PP	BPV-00522	PRV-00522
	3/4" Valve Body PTFE	BPV-00523	PRV-00523
	3/4" Valve Body PVDF	BPV-00524	PRV-00524
	3/4" Valve Body 316 SS	BPV-00525	PRV-00525
	3/4" Valve Body Alloy 20	BPV-00526	PRV-00526
	3/4" Valve Body Hast C	BPV-00527	PRV-00527
	3/4" Valve Body CPVC	BPV-00528	PRV-00528
	1" Valve Body PVC	BPV-00531	PRV-00531
	1" Valve Body PP	BPV-00532	PRV-00532
	1" Valve Body PTFE	BPV-00533	PRV-00533
	1" Valve Body PVDF	BPV-00534	PRV-00534
	1" Valve Body 316 SS	BPV-00535	PRV-00535
	1" Valve Body Alloy 20	BPV-00536	PRV-00536
	1" Valve Body Hast C	BPV-00537	PRV-00537
	1" Valve Body CPVC	BPV-00538	PRV-00538
	1 1/2" Valve Body PVC	BPV-00541	PRV-00541
	1 1/2" Valve Body PP	BPV-00542	PRV-00542
	1 1/2" Valve Body PTFE	BPV-00543	PRV-00543
	1 1/2" Valve Body PVDF	BPV-00544	PRV-00544
	1 1/2" Valve Body 316 SS	BPV-00545	PRV-00545
	1 1/2" Valve Body Alloy 20	BPV-00546	PRV-00546
	1 1/2" Valve Body Hast C	BPV-00547	PRV-00547
	1 1/2" Valve Body CPVC	BPV-00548	PRV-00548
	2" Valve Body PVC	BPV-00551	PRV-00551
	2" Valve Body PP	BPV-00552	PRV-00552
	2" Valve Body PTFE	BPV-00553	PRV-00553
	2" Valve Body PVDF	BPV-00554	PRV-00554
	2" Valve Body 316 SS	BPV-00555	PRV-00555
	2" Valve Body Alloy 20	BPV-00556	PRV-00556
	2" Valve Body Hast C	BPV-00557	PRV-00557
	2" Valve Body CPVC	BPV-00558	PRV-00558

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Type 21 Ball Valve

Specifications

Sizes:	1/2" - 6"
Models:	PVC & CPVC: Socket, Threaded and Flanged (ANSI) PP & PVDF: IPS and Metric (DIN) Socket, Threaded, Butt and Flanged (ANSI)
Bodies:	PVC, CPVC, PP and PVDF
Seats:	PTFE backed with EPDM or Viton®†
Seals:	EPDM or Viton®† or AFLAS®‡

† Trademarks of E. I. du Pont de Nemours and Company
‡ Trademark of Asahi Glass Co., Ltd.

Standard Features (Sizes 1/2" – 6")

- Pressure rated up to 230 psi (PVC, CPVC, PVDF)
- Double O-ring seals on stem for an added protection.
- Full bore, sizes 1/2" – 2"
- Full vacuum rated, all sizes
- Blocks in two directions, upstream and downstream, leaving full pressure on the opposite end of the valve
- Integrally molded ISO mounting pad for both manual and actuated operations
- Integrally molded base pad to mount valves securely or panel mounting
- PTFE seats with elastomeric backing cushions ensure bubble-tight shut-off and a low fixed torque, while at the same time compensating for wear
- True Union design for easier installation or repairs without expanding the pipe system
- Built-in spanner wrench on the handle for valve disassembly and assembly
- Two sets of end connectors (socket and threaded) included with all PVC and CPVC valves in sizes 1/2"– 2"
- CPVC threaded end connectors on sizes 1/2" – 1" come with stainless steel reinforcing rings

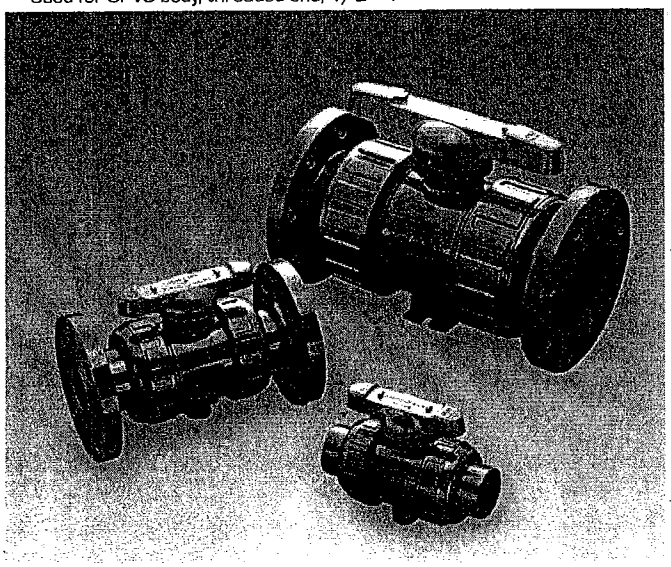
Options

- Pneumatic and electric actuators & accessories
- Stem extensions
- 2" square operating nut or "T" nut
- Locking and/or spring return handles
- Limit switches

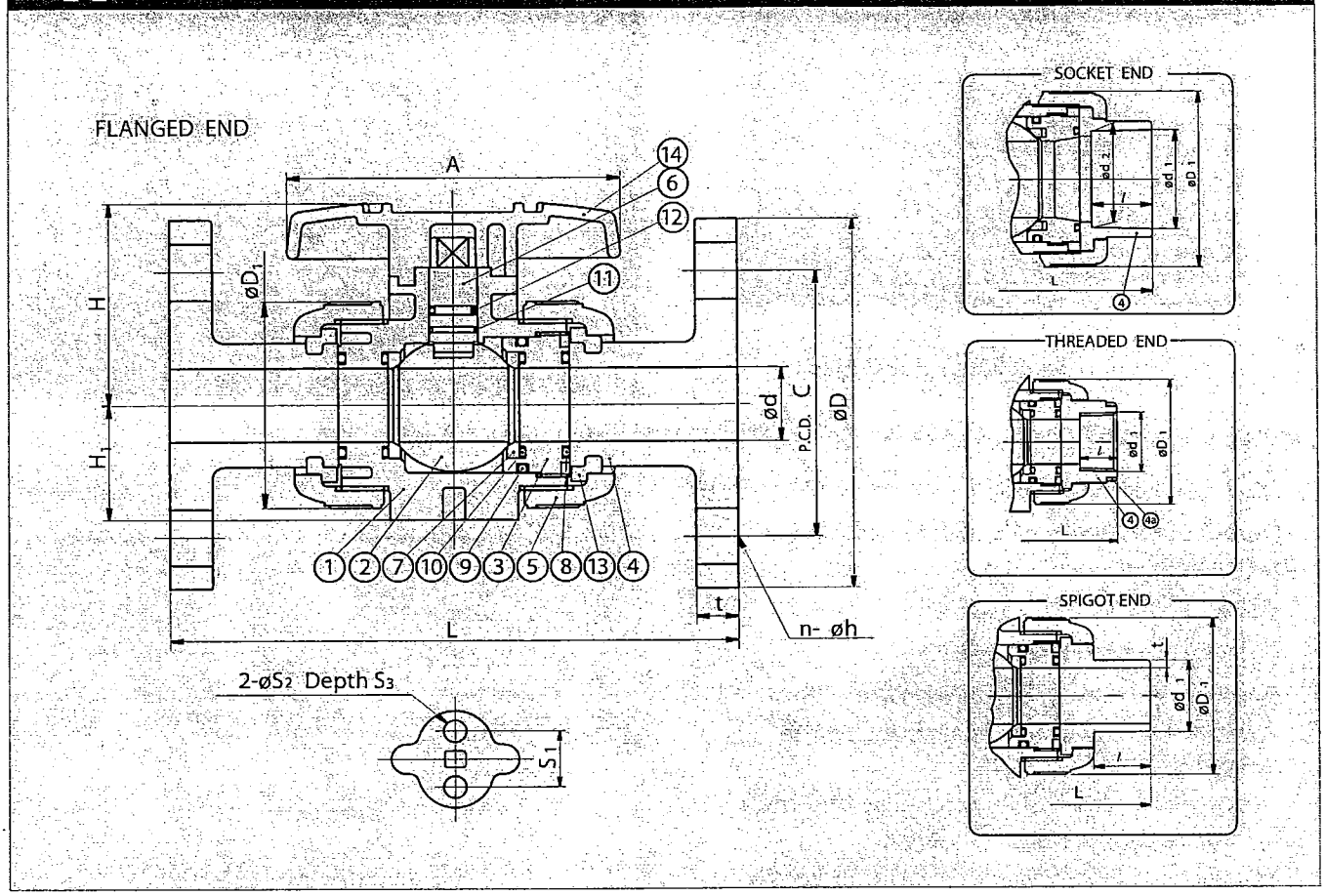
Parts List (Sizes 1/2" – 2")

PARTS			
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	Carrier	1	PVC, CPVC, PP, PVDF
4	End Connector	2	PVC, CPVC, PP, PVDF
5	Union Nut	2	PVC, CPVC, PP, PVDF
6	Stem	1	PVC, CPVC, PP, PVDF
7	Seat	2	PTFE
8	O-Ring (A)	2	EPDM, Viton,® Others
9	O-Ring (B)	1	EPDM, Viton,® Others
10	O-Ring (C)	2	EPDM, Viton,® Others
11	O-Ring (D)	1	EPDM, Viton,® Others
12	O-Ring (E)	1	EPDM, Viton,® Others
13	Stop Ring*	2	PVDF
14	Handle	1	ABS
4a	Ring**	2	304 Stainless Steel

* Used for flanged end
** Used for CPVC body, threaded end, 1/2"-1"



Type 21 Ball Valves



Dimensions (Sizes 1/2" – 2")

NOMINAL SIZE			FLANGED						SOCKET										
			ANSI CLASS 150						PVC, CPVC				PP, PVDF (DIN)				PP, PVDF (IPS)		
									ANSI SCH 80				DIN 16962						
INCHES	mm	d	D	C	n	h	L	t	d1	d2	l	L	d1	d2	l	L	d1	l	L
1/2	15	0.59	3.50	2.38	4	0.62	5.63	0.47	0.848	0.836	0.875	4.45	0.768	0.760	0.57	3.90	0.83	0.87	4.45
3/4	20	0.79	3.88	2.75	4	0.62	6.77	0.55	1.058	1.046	1.000	5.08	0.965	0.957	0.63	4.49	1.03	1.00	5.08
1	25	0.98	4.25	3.12	4	0.62	7.36	0.55	1.325	1.310	1.125	5.75	1.240	1.232	0.71	4.84	1.30	1.13	5.75
1 1/4	32	1.26	4.62	3.50	4	0.62	7.48	0.63	1.670	1.655	1.250	6.46	1.553	1.543	0.81	5.47	1.65	1.25	6.46
1 1/2	40	1.57	5.00	3.88	4	0.62	8.35	0.63	1.912	1.894	1.375	7.24	1.947	1.937	0.93	5.83	1.89	1.37	7.24
2	50	2.01	6.00	4.75	4	0.75	9.21	0.63	2.387	2.369	1.500	8.23	2.461	2.445	1.08	6.93	2.36	1.50	8.23

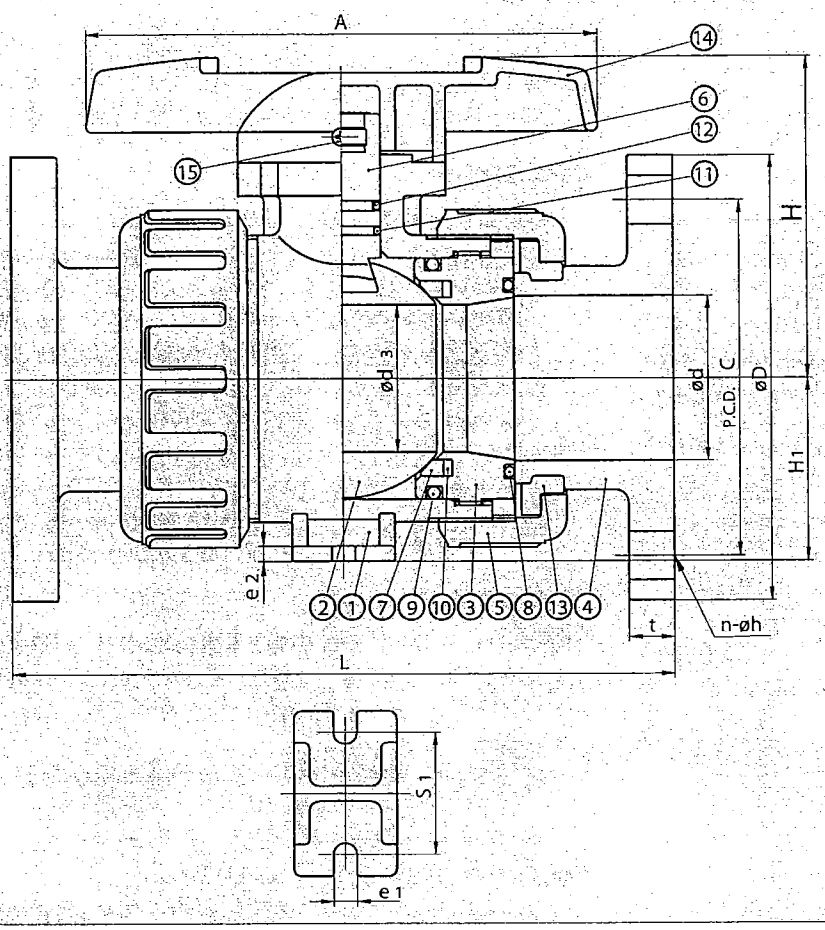
NOMINAL SIZE		THREADED							SPIGOT (BUTT END)							
									PP,PVDF							
									DIN 3442		PP	PVDF				
INCHES	mm	d1	l	L	D1	H	H1	A	d1	l	t	t	L	S1	S2	S3
1/2	15	1/2-14 NPT	0.59	4.02	1.89	2.03	1.14	3.62	0.787	0.728	0.098	0.075	4.882	0.75	0.29	0.43
3/4	20	3/4-14 NPT	0.67	4.72	2.36	2.34	1.38	3.94	0.984	0.866	0.106	0.075	5.670	0.75	0.29	0.43
1	25	1-11 1/2 NPT	0.79	5.16	2.76	2.68	1.54	4.33	1.260	0.886	0.118	0.094	6.063	0.75	0.29	0.43
1 1/4	32	1 1/4-11 1/2 NPT	0.87	5.91	3.23	3.17	1.85	4.76	1.575	1.024	0.146	0.094	6.850	1.18	0.35	0.59
1 1/2	40	1 1/2-11 1/2 NPT	0.98	6.42	3.94	3.50	2.17	5.16	1.969	1.260	0.181	0.118	7.638	1.18	0.35	0.59
2	50	2-11 1/2 NPT	1.10	7.76	4.96	4.04	2.60	6.26	2.480	1.417	0.228	0.118	8.819	1.18	0.35	0.59

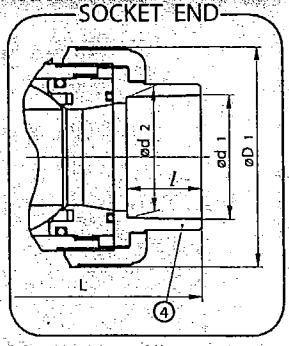
Type 21 Ball Valves

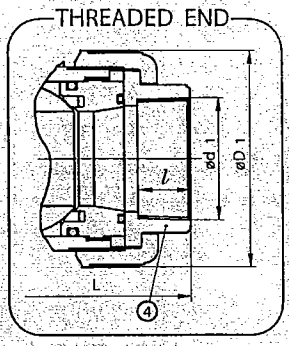
FLANGED END

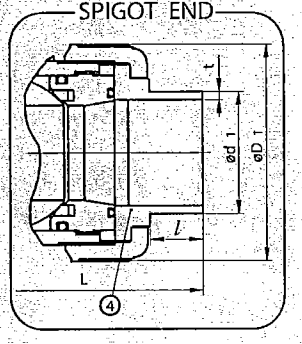
PARTS (DIFFERENT NUMBERS FROM 1/2" – 2")			
NO.	DESCRIPTION	PCS.	MATERIAL
10	Cushion	2	EPDM, Viton,®Others
15	Screw	1	304 Stainless Steel

NOTE: Quantity on Nos. 3 and 9 (see p. 6) is 2.









Dimensions (Sizes 2 1/2" – 4") FOR 6" SIZE CONSULT FACTORY

NOMINAL SIZE			FLANGED						SOCKET										
			ANSI CLASS 150						PVC, CPVC				PP, PVDF (DIN)				PP, PVDF (IPS)		
									ANSI SCH 80				DIN 16962						
INCHES	mm	d	D	C	n	h	L	t	d1	d2	l	L	d1	d2	l	L	d1	l	L
21/2	65	2.56	7	5.5	4	0.75	10.2	0.71	2.889	2.868	1.75	9.45	2.923	2.911	1.22	8.15	2.88	1.752	9.45
3	80	3.07	7.5	6	4	0.75	11.97	0.71	3.516	3.492	1.875	11.1	3.512	3.498	1.4	9.88	3.48	1.874	11.1
4	100	3.94	9	7.5	8	0.75	14.65	0.71	4.518	4.491	2	13.9	4.293	4.278	1.63	12.2	4.48	2.252	14.37

NOMINAL SIZE		THREADED								SPIGOT (BUTT END)							
										PP,PVDF							
										DIN 3442		PP	PVDF				
INCHES	mm	d1	l	L	d3	D1	H	H1	A	d1	l	t	t	L	e1	e2	S1
21/2	65	2 1/2 - 8NPT	1.26	8.46	2.28	5.24	4.96	2.83	7.87	2.953	1.496	0.272	0.142	9.72	0.35	0.24	1.89
3	80	3 - 8NPT	1.38	10.39	2.70	5.98	5.51	3.35	9.45	3.543	1.496	0.323	0.169	11.61	0.43	0.28	2.17
4	100	4 - 8NPT	1.77	14.17	3.54	8.27	7.01	4.33	11.81	4.331	1.752	0.394	0.209	12.72	0.43	0.31	2.56

Type 21 Ball Valves

Pressure vs. Temperature (PSI, WATER, NON-SHOCK)

NOMINAL SIZE		PVC				CPVC						PP				PVDF				
		30° F	71° F	106° F	121° F	30° F	71° F	106° F	121° F	141° F	176° F	-5° F	86° F	121° F	141° F	-5° F	71° F	106° F	141° F	176° F
INCHES	mm	70° F	105° F	120° F	140° F	70° F	105° F	120° F	140° F	175° F	195° F	85° F	120° F	140° F	175° F	70° F	105° F	140° F	175° F	210° F
1/2-2	15-50	230	170	150	30	230	170	150	120	75	55	150	110	90	55	230	185	150	115	85
2 1/2	65	230	170	150	NA	230	170	150	120	75	55	150	95	70	40	230	185	150	115	85
3	80	230	170	150	NA	230	170	150	85	55	40	150	95	70	40	230	185	150	100	70
4-6	100-150	150	150	150	NA	150	150	150	85	55	40	150	95	70	40	150	150	150	100	70

Sample Specification

All TYPE 21 Ball Valves, sizes 1/2" to 4", shall be of true union design with two-way blocking capability. All O-rings shall be EPDM or Viton® with PTFE seats. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double O-rings and be of blowout-proof design. The valve handle shall double as carrier removal and/or tightening tool. ISO mounting pad shall be integrally molded to valve body for actuation. PVC conforming to ASTM D1784 Cell Classification 12454-A, CPVC conforming to ASTM D1784 Cell Classification 23567-A, PP Conforming to ASTM D4101 Cell Classification PP0210B67272 and PVDF conforming to ASTM D3222 Cell Classification Type II. The ball valves, except PP, shall have a pressure rating of 230 psi for sizes"1/2" to 3" and 150 psi for 4" (150 psi for PP, all sizes) at 70 ° F. Type 21 Ball Valves must carry a two-year guarantee, as manufactured by Asahi/America, Inc.

Cv Values

NOMINAL SIZE		Cv
INCHES	mm	
1/2	15	14
3/4	20	29
1	25	47
1 1/4	32	72
1 1/2	40	155
2	50	190
2 1/2	65	365
3	80	410
4	100	680

Weight (POUNDS)

NOMINAL SIZE		SOCKET THREADED	FLANGED
INCHES	mm		
1/2	15	0.44	1.10
3/4	20	0.66	1.54
1	25	1.10	2.70
1 1/4	32	1.54	3.30
1 1/2	40	2.64	4.40
2	50	4.40	8.15
2 1/2	65	6.17	8.80
3	80	9.70	13.00
4	100	24.00	26.67

Caution

- Never remove valve from pipeline under pressure.
- Always wear protective gloves and goggles.
- Watch out for trapped fluid in valve. It is safe to close valve before removing it from the pipeline.

Caution

- Do not use ball valves where media has suspended particles. Use the following valves: *Butterfly Valves* – PVDF disc is most abrasion resistant and make sure of chemical compatibility. *Diaphragm Valves* – Elastomeric diaphragm is designed for handling suspended particles.
- Volatile fluids such as sodium hypochlorite (NaClO) and hydrogen peroxide (H_2O_2) could be trapped and gasified within the valve. We can provide you with a Type 21 ball valve with a *vented ball* to relieve pressure build-up inside the valve.

Troubleshooting

What if the fluid still flows when valve is closed?

1. Carrier is not properly tightened. Tighten it.
2. PTFE seat is damaged or worn. Replace seat.
3. Foreign material is caught between ball and PTFE seat. Remove material and clean.
4. Ball is damaged or worn. Change ball.

What if fluid leaks outside of valve?

1. Union nut not properly tightened. Retighten.
2. Carrier is not properly tightened. Thread it in firmly.
3. Carrier or face O-ring is damaged, worn, or missing. Replace O-ring.

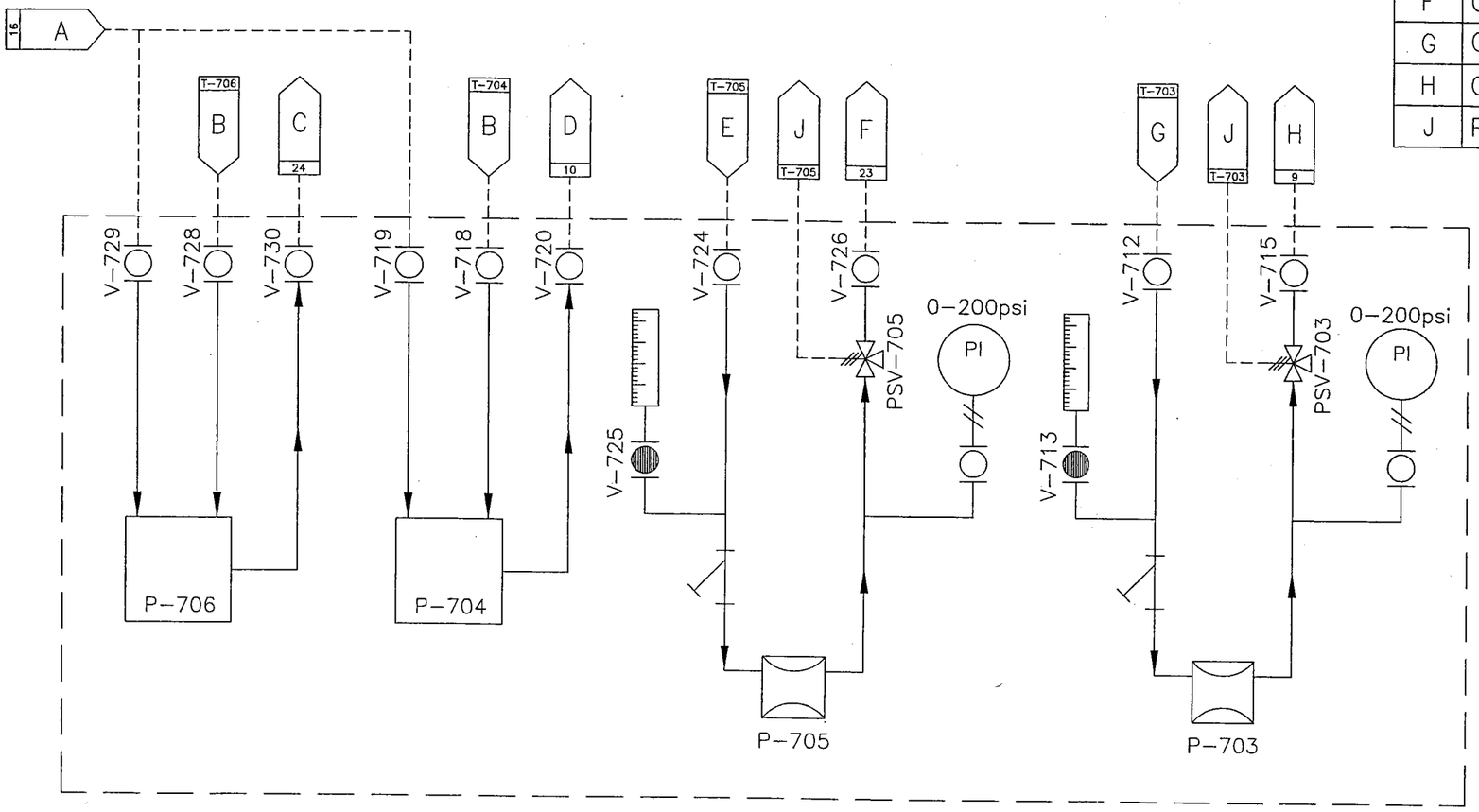
What if handle does not rotate smoothly?

1. Foreign material has formed on the ball or seat. Clean both.
2. Internal part(s) chemically attacked or swollen. Refer to Asahi/America Chemical Resistance Chart for compatibility. Replace part(s) as required.
3. Carrier over-tightened. Retighten properly.

What if handle rotates too freely?

1. Stem is damaged. Replace stem.
2. Handle is not engaged with stem. Disassemble and reengage. Inspect.
3. Engaging part of stem and/or ball is damaged. Change stem and/or ball.

A	SERVICE WATER INLET, 1/2" (F)NPT,
B	POLYMER INLET, 1/2" (F)NPT,
C	POLYMER OUTLET, CLARIFIER, 3/4"(F)NPT
D	POLYMER OUTLET, FILTER, 3/4"(F)NPT
E	CHEMICAL INLET, CLARIFIER COAGULANT FEED, 1/2"(F)NPT
F	CHEMICAL OUTLET, CLARIFIER COAGULANT FEED, 1/2"(F)NPT
G	CHEMICAL INLET, FILTER COAGULANT FEED, 1/2"(F)NPT
H	CHEMICAL OUTLET, FILTER COAGULANT FEED, 1/2"(F)NPT
J	PRESSURE RELIEF DRAIN, TO BE ROUTED BY OTHERS



LEGEND	DESCRIPTION
	METERING PUMP
	BALL VALVE
	CALIBRATION CYLINDER
	Y-STRAINER
	NORMALLY CLOSED BALL VALVE
	PRESSURE RELIEF VALVE
PI	PRESSURE INDICATOR w/GUARD

NOTES:

1. POWER REQUIREMENTS:
   120VAC/1-PHASE/60Hz

2. WETTED MATERIALS OF CONSTRUCTION:
   PVC, CPVC, VITON, TEFLON, GLASS

3. SEE SOV-4681 FOR GENERAL ARRANGEMENT DRAWING

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	CHANGED VALVE TAGS TO MEET CUSTOMER SPEC	05/04/04	DA		JJ	N/A
A	ADDED VALVE TAGS AND UPDATED FLOW DESCRIPTIONS	04/29/04	DA		JJ	N/A

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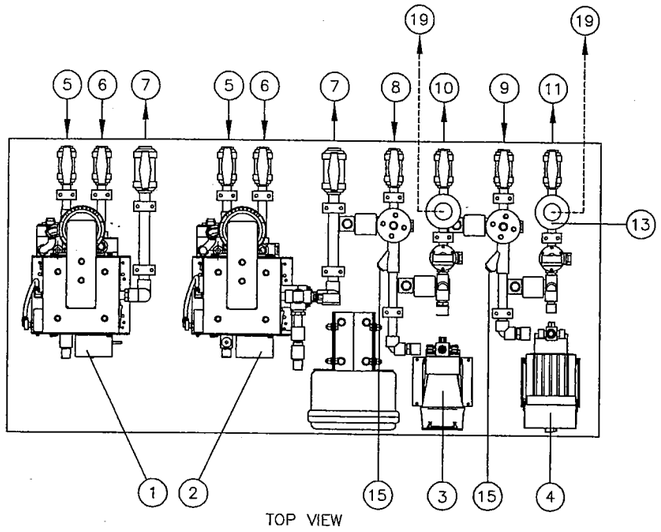
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ENGINEER		DATE
MANAGER	JJ	DATE 04/28/04
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SCALE: N/A		

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2 PUMP / 2 POLYBLEND UNITS SKID
FERRIC CHLORIDE / ALUMINUM SULFATE

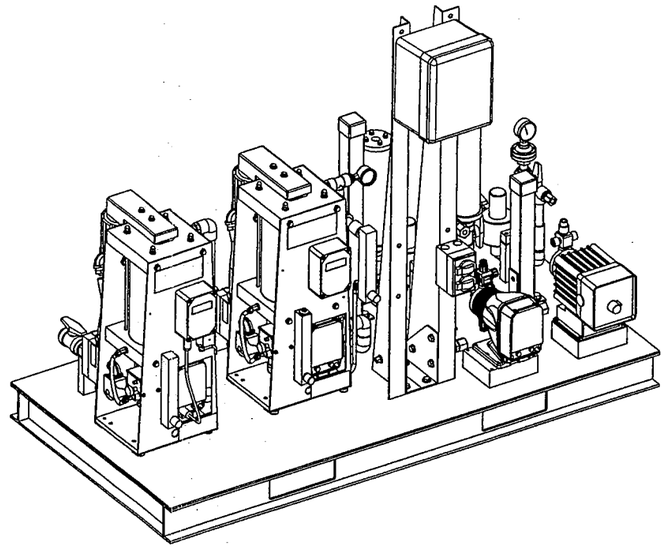
CLIENT: US FILTER ENVIREX
JET PROPULSION LAB

USFilter
USFILTER/STRANCO PRODUCTS
BRADLEY, IL USA
815-932-8154 FAX 815-932-0674

PROJECT	CODE	DRAWING	SHEET	REV
212363	SP10701744	SPID-0718	1 OF 1	B



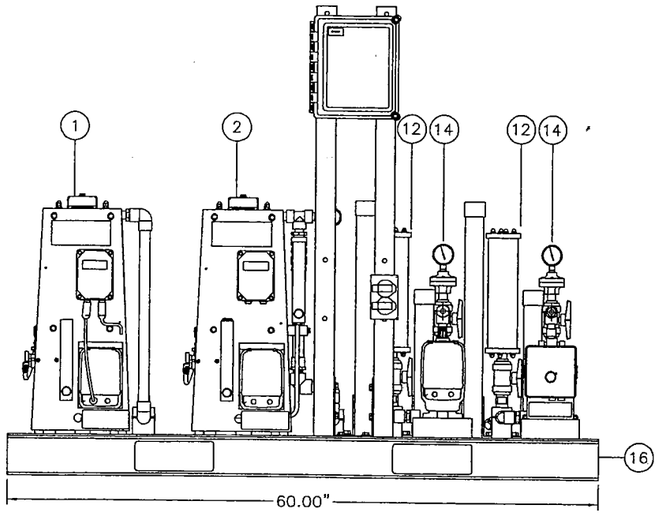
TOP VIEW



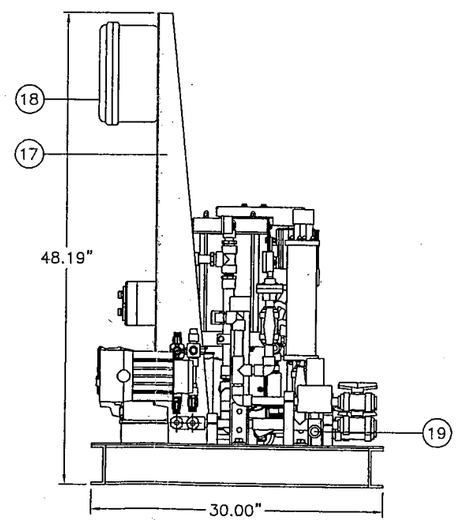
KEY	QTY	DESCRIPTION
1	1	POLYBLEND UNIT PB100-0.4, TAG #P-706
2	1	POLYBLEND UNIT PB200-2, TAG #P-704
3	1	PUMP, AA971-353SU, LMI, TAG #P-705
4	1	PUMP, C931-313SU, LMI, TAG #P-703
5	2	SERVICE WATER INLET, 1/2" (F)NPT, CPVC, VITON
6	2	POLYMER INLET, 1/2(F)NPT, CPVC, VITON
7	2	SOLUTION OUTLET, 3/4"(F)NPT, CPVC, VITON
8	2	CHEMICAL INLET, FILTER COAGULANT FEED
9	2	CHEMICAL INLET, CLARIFIER COAGULANT FEED
10	2	CHEMICAL OUTLET, CLARIFIER COAGULANT FEED
11	2	CHEMICAL OUTLET, FILTER COAGULANT
12	2	CALIBRATION CYLINDER, CPVC, EPDM, GLASS, 250mL
13	2	PRESSURE RELIEF VALVE, 1/2" CPVC,
14	2	PRESSURE INDICATOR, 1/2" PVDF/PTFE, 0-200psi
15	2	Y-STRAINER, 1/2" CPVC, EPDM
16	1	60"x30" SKID, MILD STEEL, EPOXY COATED "USF BLUE"
17	2	PANEL UPRIGHTS, SUPPORT LEGS
18	1	CONTROL PANEL, P/N SP13497
19	2	PRESSURE RELEIF DRAIN, TO BE ROUTED BY OTHERS

NOTES:

1. THE DESIGN INTENT OF THIS EQUIPMENT IS FOR: ALUMINUM SULFATE, FERRIC CHLORIDE
2. WETTED MATERIAL OF CONSTRUCTION: PVC, CPVC, VITON, TEFLON, GLASS
4. POWER REQUIREMENTS: 120VAC/1-PH/60Hz
5. FOR FLOW SCHEMATIC SEE SPID-0718
6. CALIBRATION CYLINDER, BLEEDS, DRAINS TO BE VENTED TO SAFE AREA BY OTHERS
7. SUPPORTS MAY BE REQUIRED THAT ARE NOT SHOWN OR REMOVED AS NECESSARY. FABRICATION PROCESS DETAILS WILL BE VERIFIED BY USFILTER STRANCO ENGINEERING PRIOR TO SHIPMENT, AND DRAWINGS UPDATED 'AS-BUILT'
8. FLEX TUBING NOT SHOWN FOR CLARITY.



FRONT VIEW



SIDE VIEW

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
B	CHANGED VALVE TYPES ADDED WEATHER PROOF RECEPTACLE	05/10/04	DA	JJ		N/A
A	ADDED CONTROL PANEL & UPRIGHTS ADDED PRESSURE RELIEF DRAIN LINE	04/30/04	DA			N/A

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	DATE
DESIGNER: DA	04/23/04
CHECKER: BDJ	04/27/04
ENGINEER:	DATE
MANAGER: JJ	4/28
FILE: SOV-4681.dwg	
SCALE: 1/8 : 1	

TITLE: GENERAL ARRANGEMENT DRAWING
2 PUMP / 2 POLYBLEND UNITS SKID
FERRIC CHLORIDE / ALUMINUM SULFATE

CLIENT: US FILTER ENVIREX
JET PROPULSION LAB

USFilter
USFILTER/STRANCO PRODUCTS
BRADLEY, IL USA
815-932-8154 FAX 815-932-0674

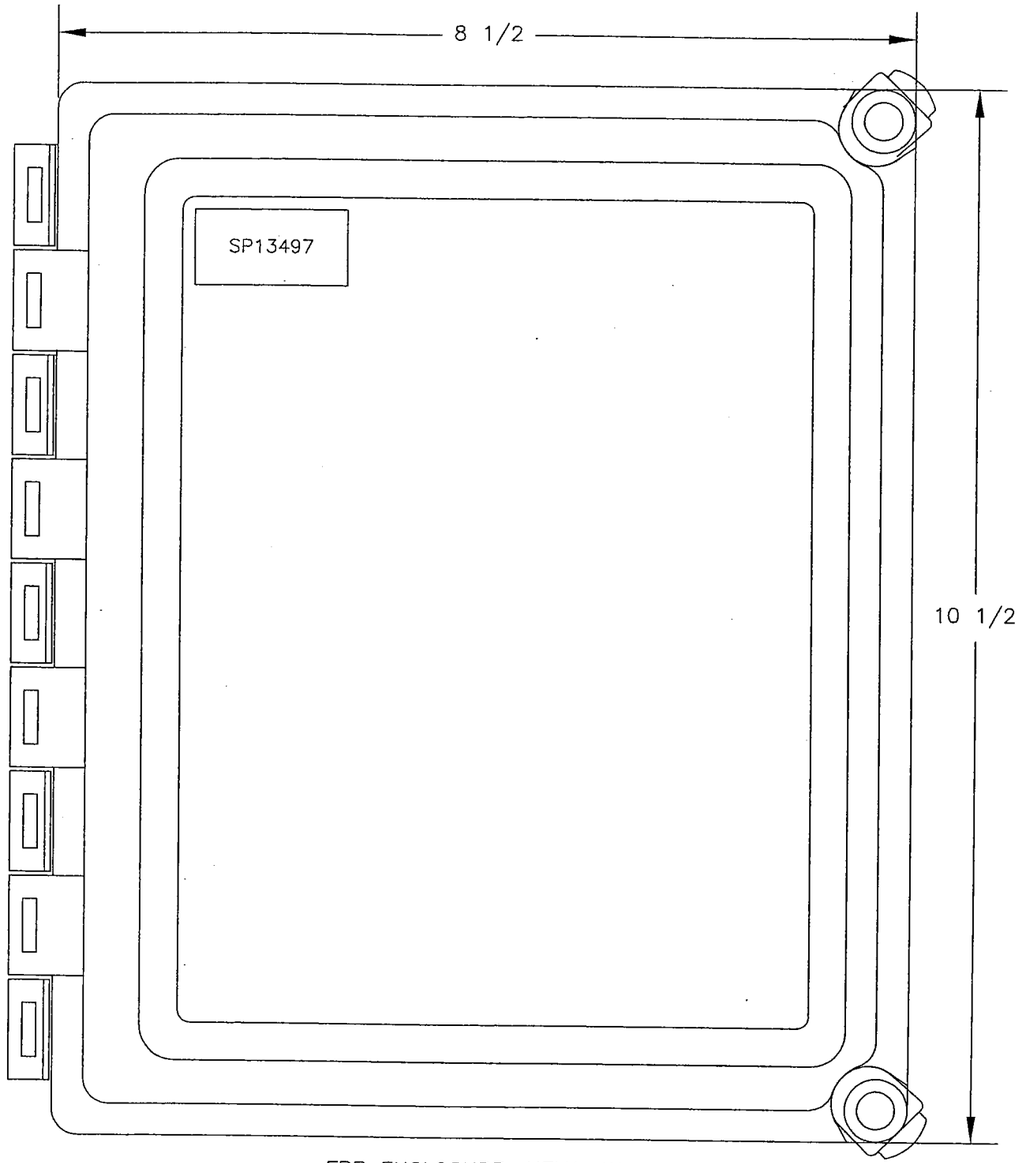
PROJECT	CODE	DRAWING	SHEET	REV
212363	SP10701744	TSOV-4681	1 OF 1	B

STD: 2-0200-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE

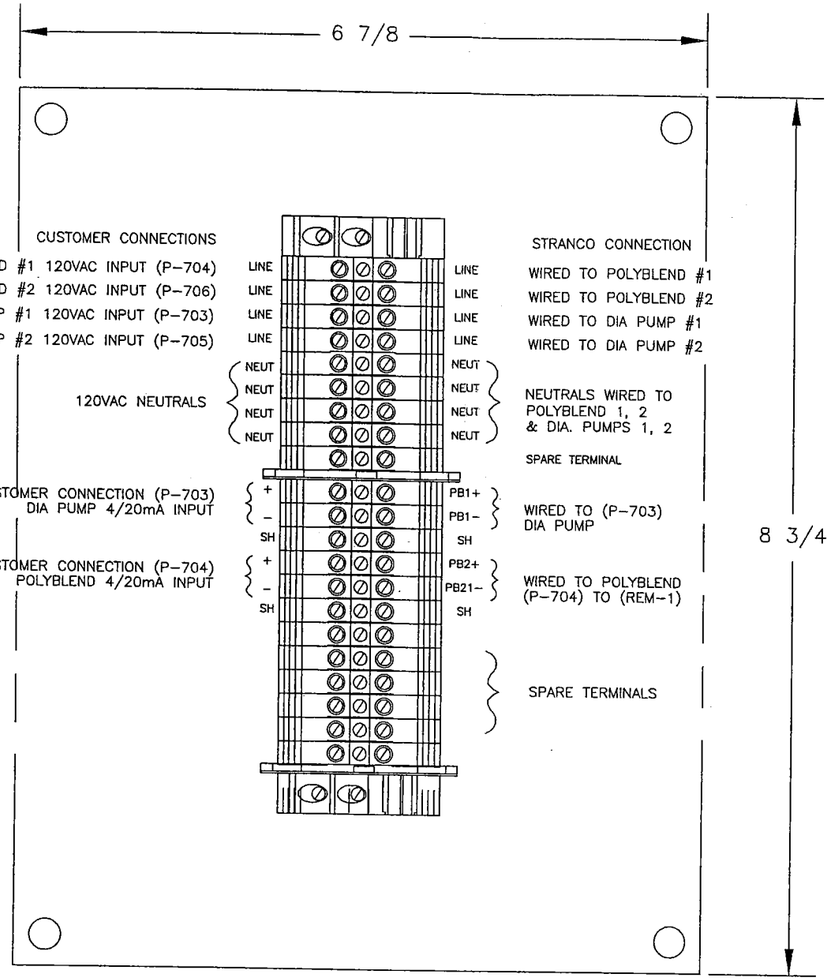
BAR = 1" AT PLOT SCALE

INTL REF:

STD: 2-0600-11X17B



FRP ENCLOSURE, NEMA 4X



BACK PANEL

NOTES:

1. [XX] = SYSTEM INTERCONNECTION TERMINALS.

   ⟨XXX⟩ = CUSTOMER CONNECTION TERMINALS.
2. DASHED LINES BETWEEN TERMINALS REPRESENT WIRING TO COMPONENTS NOT MOUNTED IN CONTROL PANEL.
3. ALL 4/20 mA SIGNAL WIRES ARE TO BE SHIELDED CABLE
4. TIN ALL WIRE ENDS.

[1] QTY. PART NO. SP5550251
3/4" X 1-1/2", 0.145" TEXT

SP13497

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN

COMPANY CONFIDENTIAL
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DESIGNER	RRW	DATE 04/28/04
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	13497-01.dwg	
SCALE:	FULL	

TITLE: JUNCTION BOX
SKID INTERFACE PANEL
INTERCONNECT AND LAYOUT

CLIENT

USFilter
USFILTER/STRANCO PRODUCTS
BRADLEY, IL USA
815-932-8154 FAX 815-932-0674

PROJECT	CODE	DRAWING	SHEET	REV
	SP13497	13497-01	1 OF 1	-

41074-201-1

SULZER PUMP.

APT31-6 8x6-11. CASING ASTM A890 3A DUPLEX SS. 1300GPM@38TDH. DYNAMIC SEAL SHAFT 2324 DUPLEX SS. 11.02" TRIM IMPELLER. 20HP TEFC 230/460V 60HZ 3PH 1200RPM 286T FRAME. 3 POINT BASE PLATE GALVENIZED CARBON STEEL .

NAME PLATE:
P-301A
P-301B

41074-201-2

SULZER PUMP.

APT21-3 6x3-8. CASING ASTM A890 3A DUPLEX SS. 350GPM@34TDH. DYNAMIC SEAL SHAFT 2324 DUPLEX SS. 7.09" TRIM IMPELLER. 7.5HP TEFC 230/460V 60HZ 3PH 1800RPM 213T FRAME. 3 POINT BASE PLATE GALVENIZED CARBON STEEL .

NAME PLATE:
P-401

SULZER PROCESS PUMPS US INC
789 S. LARKIN AVE
ROCKDALE, IL 60436
PHONE: 815-725-7890
FAX: 815-741-3504

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DESIGNER	DATE
FD	2/17/04
CHECKER	DATE
ENGINEER	DATE
FD	2/17/04
MANAGER	DATE
KJM	
FILE:	
SCALE:	

TITLE PUMP

CLIENT JET PROPULSION LAB, NASA

USFilter

Envirex Products
Waukesha, WI
800-524-6324

PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-201	1 OF 1	0

SULZER

Sulzer Process Pumps (US) Inc.

TECHNICAL DOCUMENTS

CUSTOMER: US Filter's Envirex Products

PURCHASE ORDER #: 313341

Sulzer Order No. 23773

PUMP MODEL	SERIAL #
APT31-6	100014503
APT31-6	100014504
APT21-3	100014505

SULZER

Sulzer Process Pumps (US) Inc.

Table of Contents:

Section	Model & Serial #	Contents
1	**APT31-6 100014503**	Specification Data, Bill of Material, Characteristic Curve, Dimensional Drawing, Shaft Seal Sectional Drawing
2	**APT31-6 100014504**	Specification Data, Bill of Material, Characteristic Curve, Dimensional Drawing, Shaft Seal Sectional Drawing
3	**APT21-3 100014505**	Specification Data, Bill of Material, Characteristic Curve, Dimensional Drawing, Shaft Seal Sectional Drawing
4		Installation, Operation, Safety, and Maintenance Instructions
5		Bill of Material Reference Drawings
6		Motor Information
7		Coupling Instructions

SULZER

Sulzer Process Pumps US
Easley Pump Factory

PRODUCT SPECIFICATION

Description	APT 31-6
Serial Number	100014503
Time of delivery/EXW	04/09/2004
Date printed	04/21/2004 Page 1

Customer
US FILTER'S ENVIREX PRODUCTS
PO Box 1604
WAUKESHA WI 53187-1604
USA
Cust. Order 313341
Cust. PO line
Country code US

US FILTER'S ENVIREX PRODUCTS
PO Box 1604
WAUKESHA WI 53187-1604
USA

Equipment P-301A
Id

GENERAL

Pump type: **APT**
Version: **11**
Classification: **B**
Units: **US**
Delivery: **Easley**

Painting method: **Epoxy**
Color shade: **NCS 1700**
Coupling and Guard: **Included in the delivery**
Base plate: **Included in the delivery**
Drive motor: **Included in the delivery**

PROCESS DATA

Process: **All Other Water Applications**
Pumped liquid: **WATER**
Specific gravity: **1.02**

Temperature: **70 °F**
Capacity Q: **1,300.0 gpm**
Head H: **38.0 Feet**

PUMP PERFORMANCE

Characteristic curve: **K15660, C 1160 rpm 31-6**
Pump power P: **16.2 HP**
Dynamic seal power: **0.2 HP**
Efficiency: **83 %**

Pump rotational speed: **1160 rpm**
Variable speed: **No**
NPSH required: **6.2 Feet**

PUMP

Manufacturer: **Easley**
Pump Size: **31-6**
Flange drilling: **ASME B16.5 CLASS 150**
Impeller no.: **283912, C 31-150 31-6**
Impeller Type: **Closed**
Impeller diameter: **280 mm**
Impeller max.diameter: **286 mm**
Impeller balance holes: **Yes**
Casing material: **A890 3A**
Gasket Material: **PTFE/Glass**
O-ring Material: **EPDM**
Shaft seal fitting: **DS01 Dynamic seal SS**

Dynamic seal type: **Single stage Large Expeller**
Dynamic seal material: **A890 3A**
Draining of pump conn. 040: **Yes**
Seal box draining conn. 049: **No**
Discharge pipe conn. 027: **Yes**
Press. measuring conn.036: **Yes**
Temper. measuring conn. 048: **No**
Bearing Unit Lubrication: **Oil lubrication**
Bearing unit model: **04, 52 / 33 / NSs / Met**
Constant level oiler 638: **Yes**
Sign: **CE marking, US-patents**

ASSEMBLY

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 10
Reference no. 23773/000010
Telephone
Telefax

SULZER

Sulzer Process Pumps US Easley Pump Factory **PRODUCT SPECIFICATION**	Description APT 31-6 Serial Number 100014503 Time of delivery/EXW 04/09/2004 Date printed 04/21/2004 Page 2
Customer US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Cust. Order 313341 Cust. PO line Country code US	US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Equipment P-301A Id

Dim.drawing, Assembly of Pump: **P20027, BASEPLATE N? 31-6** Coupling type: **Rex-Omega ES**
Base plate type: **Pump Motor Steel Zinc** Coupling guard material: **S+Z EN10025**
Motor NEMA code: **286T**

MOTOR

Motor Supplier: **Easley** Power: **20.00 HP**
Motor manufacturer: **RELIANCE** Frequency: **60 Hz**
Motor NEMA code: **286T** Voltage: **230/460**
Motor type: **XEX** Enclosure: **TEFC**
Rotational speed: **1,200 rpm**

CUSTOMER INSTRUCTIONS

End user language: **English** Doc. for Component Lang / Qty: **EN03**

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 10 Reference no. 23773/000010 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014503 04/09/2004 04/21/2004 Page 3

Customer Instructions

001.1		1	Dimensional drawing	P20027EN
001.2		1	Dimensional drawing	P10173EN
002		1	Characteristic curve	K15660EN
010.1		1	ASSEMBLY SECTDWG	N10484EN_20000301
011		1	PUMP SECTDWG	N10487EN_20000301
012		1	SHAFT SEAL SECTDWG	N14829EN_20000301
013		1	BEARING UNIT SECTDWG	N10490EN_20010910
058.1		1	DECLARATION OF QUALITY	N14737EN_20000330
059.1		1	PAINTING CERTIFICATE	N14948EN_20020110
060		1	EC DECLARATION OF CONFORMITY	N14960EN_20000330
062.1		1	INFORMATION FOR USE	N14800EN_20000301
063.1		1	SAFETY INSTRUCTIONS	N11168EN_950220
063.2		1	SAFETY INSTRUCTIONS	N14801EN_20030903
064.1		1	HOISTINGS AND TRANSPORTATIONS	N14802EN_20000301
065.1		1	COMMISSIONING	N14803EN_20000301
067.1		1	INSTALLATION	N14804EN_20030130
068.1		1	OPERATION	N14805EN_20010910
069.1		1	PREVENTIVE MAINTENANCE	N14806EN_20030130
070.1		1	CORRECTIVE MAINTENANCE	N14807EN_20031215
071.1		1	SPARE PARTS RECOMMENDATION	N14808EN_20010510

Connections

000.1		1	SPECIFICATION AND PART LIST Serial number	
027	CON027	1	DISCHARGE PIPE CONN. 3/8-18NPT	
036.1	CON036	1	PRESSURE MEASURING 3/8-18NPT	
036.2	CON036	1	PRESSURE MEASURING 3/8-18NPT	
040	CON040	1	DRAINING OF PUMP 3/8-18NPT	
042	CON042	1	OIL FILLING 1/2-14NPT	
043	CON043	1	DRAINING OF LUBRICAT 1/2-14NPT	
044	CON044	2	CONSTANT LEVEL OILER 1/4-18NPT	

Parts

102	1422180141	1	VOLUTE CASING S APT31- 6 Flange drilling: **ASME B16.5 CLASS 150** Draining of pump conn. 040: **Yes** Discharge pipe conn. 027: **Yes** Press. measuring conn.036: **Yes** Temper. measuring conn. 048: **No**	(41) A890 3A

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 10 Reference no. 23773/000010 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014503 04/09/2004 04/21/2004 Page 4

161.2	2839730141	1	CASING COVER APT31	(41) A890 3A
183	2837740152	1	SUPPORT FOOT AP	(52) A48 CL 30 B
210	2837930133	1	SHAFT APT3	(33) SS2324
230	2839120141	1	IMPELLER S 286 B41 Z6 APP31-150,APT31- 6.	(41) A890 3A
			Impeller diameter: **280 mm**	
			Impeller max.diameter: **286 mm**	
320.1	G433000311	1	ANTIFRICTION BEARING NUP311 ECJ	
320.2	G325007312	2	ANTIFRICTION BEARING 7312 BECBM	
330	1420070152	1	BEARING HOUSING O APT3	(52) A48 CL 30 B
339	384696T304	1	BEARING UNIT APT3 O	
344	1420280152	1	ADAPTER APT31	(52) A48 CL 30 B
360	2880820152	1	BEARING COVER APT3	(52) A48 CL 30 B
400.1	E805310884	1	GASKET 310(-3/-4)/295(-1/-2)X0,5	(84) PTFE/Glass
400.3	3822780484	1	GASKET 0,5X290/245	(84) PTFE/Glass
412.3	E113016194	1	O-RING 16,1X1,6 SMS1586	(94) PTFE
412.4	E11B039294	1	O-RING 39,2X3 SMS1586	(94) PTFE
412.5	E11B124591	1	O-RING 124,5X3 SMS1586	(91) NBR
412.6	E11B039294	1	O-RING 39,2X3 SMS1586	(94) PTFE
412.7	E11B049592	1	O-RING 49,5X3 SMS1586	(92) EPDM
412.8	E11B099592	1	O-RING 99,5X3 SMS1586	(92) EPDM
423	4845290171	1	LABYRINTH RING AP3	(71) GC-CuPb5Sn5Zn5
SFS2209				
423.2	3844840171	1	LABYRINTH RING AP3	(71) GC-CuPb5Sn5Zn5
SFS2209				
435	3822790384	1	STATIC SEAL AP3	(84) PTFE/Glass
451	1423480141	1	STUFFING BOX HOUSING APT31	(41) A890 3A
			Seal box draining conn. 049: **No**	
			Temper. measuring conn. 048: **No**	
471.2	7070210142	1	COVER PLATE FOR SEAL AP3	(42) A743 CF-8M
475	9110080133	1	THRUST RING APT3	(33) SS2324
502	4843110141	1	CASING WEAR RING 220/240X20	(41) A890 3A
507	EL12055064	2	DEFLECTOR 9RB 55	(64) SS 2343/NBR
554.1	B31001051K	3	WASHER ISO 7089-10-A140	(1K) S+Z EN10025
554.2	B36001051K	4	WASHER 10,5 DIN7349	(1K) S+Z EN10025
554.8	B31001051K	4	WASHER ISO 7089-10-A140	(1K) S+Z EN10025
556.1	707007011K	2	RISER BLOCK NEMA 284T, 284TS, 286T, 286T	(1K) S+Z EN10025
604	2839910141	1	EXPELLER AP31	(41) A890 3A
638	GH78503000	1	CONSTANT LEVEL OILER VABL 7973+00677	
			Glass Bottle	
642	GH3330506D	2	SIGHT GLASS SM-12 ISO 228/1-G 1/2	(6D) Al (aluminium)
672	GH55305000	1	VENTING DEVICE EV 1028-14-00 R 1/2	
685	2840320111	1	GUARD END D250/D95,S4	(11) S235JRG2 EN10025
686	288064011K	1	GUARD JACKET D250 L330	(1K) S+Z EN10025

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 10
Reference no. 23773/000010
Telephone
Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014503 04/09/2004 04/21/2004 Page 5

686.3	384476011K	1	GUARD JACKET D250 L130	(1K) S+Z EN10025
800	J351502004	1	MOTOR 20HP/1200RPM 286T TEFC-XEX 230/	
			20HP/1200RPM 286T TEFC-XEX 230/460V	
			MODEL #P28G3320	
840	H1A5604148	1	COUPLING ES10-R SHSB-1.625/1.875	
			Keyways Ansi B17.1 sq.key	
890	607225011K	1	BASEPLATE SLT 4, J, 286T, 324T	(1K) S+Z EN10025
901.1	A132073839	12	HEXAGONAL SCREW 5/8-11UNCX1 1/2 ANSI B18	(39) A4-80 ISO3506
901.10	A13205381E	4	HEXAGONAL SCREW 3/8-16 UNC X 1 1/2" ANSI	(1E) 8.8 ZnK ISO898
901.2	A132065139	2	HEXAGONAL SCREW 1/2-13 UNC X 2" ANSI B18	(39) A4-80 ISO3506
901.3	A13207381E	4	HEXAGONAL SCREW 5/8-11UNCX1 1/2 ANSI B18	(1E) 8.8 ZnK ISO898
901.4	A13205381E	4	HEXAGONAL SCREW 3/8-16 UNC X 1 1/2" ANSI	(1E) 8.8 ZnK ISO898
901.5	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.6	A13205321E	3	HEXAGONAL SCREW 3/8-16UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.7	A13208441E	4	HEXAGONAL SCREW 3/4-10UNCX1 3/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.8	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.9	A13205451E	4	HEXAGONAL SCREW 3/8-16UNCX1 3/4 ANSI B18	(1E) 8.8 ZnK ISO898
902.1	AC22065133	3	STUD 1/2-13UNCX2 SAC200	(33) SS2324
903.1	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.10	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.2	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.3	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.4	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.5	CC25050034	1	SCREWED PLUG 1/2-14 NPT SCC102	(34) SS2343
903.6	CC25030034	1	SCREWED PLUG 1/4-18 NPT SCC102	(34) SS2343
903.9	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
904	A662051638	3	SET SCREW 3/8-16UNCX5/8 ANSI	(38) A4-50 ISO3506
914.1	3842750933	1	SOCKET HEAD SCREW 5/8-11UNCX1.57	(33) SS2324
920.2	B122060039	3	HEXAGONAL NUT 1/2-13UNC ANSI B18.2.2	(39) A4-80 ISO3506
920.3	B12205001J	3	HEXAGONAL NUT 3/8-16UNC ANSI B18.2.2	(1J) 8 ZnK ISO898
923	GA11001210	1	BEARING NUT KM12	(10) S EN10025
931	GC10001210	1	LOCK WASHER MB12	(10) S EN10025
940	B821007015	1	KEY 3/8X3/8X2 3/4 ANSI 17.1-1967	(15) CK45K DIN1652
970	WK3130307A	2	SIGN SULZER LOGO SIGN L130 MM	(6D) Al (aluminium)
971	SS0002Z301	1	NAME PLATE EASLEY PUMP FACTORY	AISI 304
972	4845920134	1	ROTATIONAL ARROW	(34) SS2343
			Direction of rotation	
975.2	SS00050102	2	WARNING SIGN	
			Rotating shaft	
975.3	SS00050202	2	WARNING SIGN	
			Corrosive / Irritating liquid	
975.4	SS00050802	1	WARNING SIGN	
			Guard adjustment	

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 10
Reference no. 23773/000010
Telephone
Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description	APT 31-6
	Serial Number	100014503
	Time of delivery/EXW	04/09/2004
	Date printed	04/21/2004 Page 6

976.1	SS0006M002	1	MANDATORY ACTION SIG EN Oil refilling	
976.2	SS0006M022	1	MANDATORY ACTION SIG Coupling alignment	
981	SS00090101	1	PATENT SIGN US PATENTS	AISI 304

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 10
Reference no. 23773/000010
Telephone
Telefax

CERTIFIED
FINAL

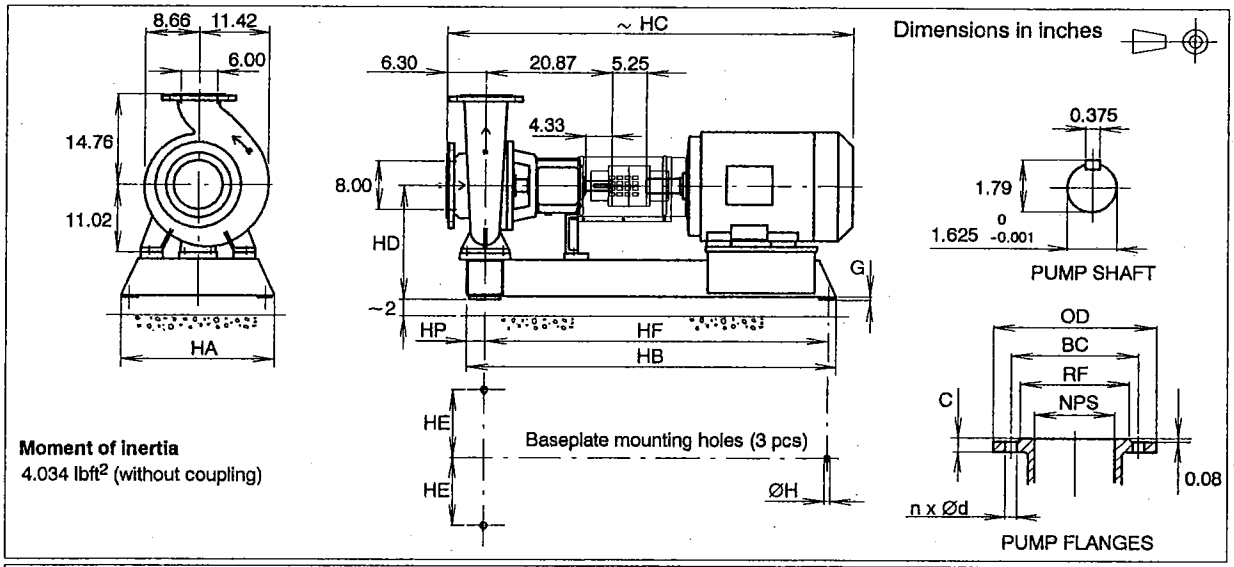
SULZER

APT Process Pumps
Dimensional drawing P20027

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Version 04 > / 981115 / Replaces 940221 / en / **P20027**

APT31-6 *(8x6-11)*
Steel baseplate for pump and motor



Moment of inertia
4.034 lbft² (without coupling)

DIMENSIONS													
Primary motor frame	Max motor frame (1	(2	Baseplate	HD	HC	HB	HP	HF	HA	HE	H	G	Weight lbs (3
254T	284T	256T	3	16.80	55.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
256T	284T	-	3	16.80	56.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
284T	324T	286T	4	18.80	58.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
286T	324T	-	4	18.80	59.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
324T	364T	326T	4	18.80	61.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
326T	364T	-	4	18.80	62.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
364T	405T	365T	5	18.80	65.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
364TS	405TS	365TS	4	18.80	63.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
365T	405T	-	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
365TS	405TS	-	4	18.80	64.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
404T	444T	405T	5	18.80	69.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
404TS	444TS	405TS	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
405T	444T	-	5	18.80	71.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
405TS	444TS	-	5	18.80	68.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
444T	509LL	449T	7	21.15	75.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
444TS	509LS	449TS	7	21.15	71.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445T	509LL	449T	7	21.15	77.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445TS	509LS	449TS	7	21.15	73.50	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090

DRILLING OF FLANGES									
				ANSI B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	OD	RF	C	BC	d	n (4	BC	d	n (4
6.00	12.01	8.35	1.00	9.50	0.88	8	9.50	0.88	8
8.00	13.78	10.47	1.12	11.75	0.88	8	11.75	0.88	8

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.
4. Flange bolting straddles centerline.

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503

AHLSTAR™ *APT31-6 (8x6-11)*

Characteristic Curve K15660

CERTIFIED FINAL

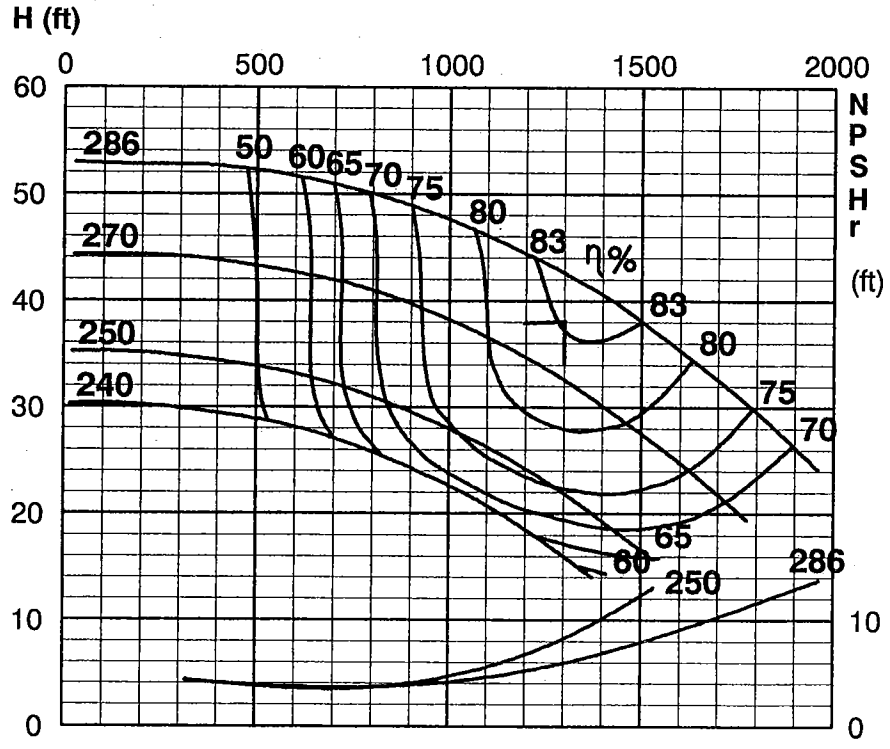
SULZER

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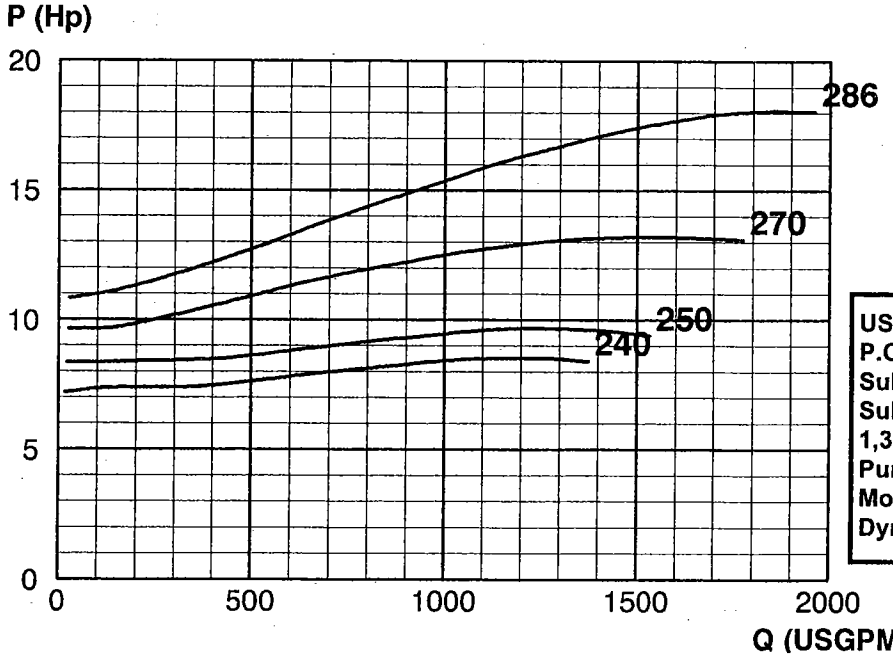
Version 01 > / 990115 / **K15660**

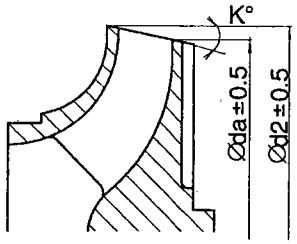
APT: Impeller 283912 CLOSED B1.61 Z6

1160 rpm



IMPELLER DIA			
$Ød_2$ (mm)	$Ød_2$ (in)	K°	$Ød_a$ (mm)
~~286~~	~~11.26~~	~~6~~	~~277.4~~
280	11.02	8	268.5
275	10.83	10	260.2
270	10.63	12	252.2
265	10.43	13	245.6
260	10.24	14	238.8
255	10.04	16	230.4
250	9.84	18	221.4
245	9.65	19	214.0
240	9.45	20	206.0





US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503
1,300 gpm @ 38 Feet
Pump power = 16.2 HP
Motor power = 20 HP
Dynamic Seal Power = 0.2 HP

CERTIFIED
FINAL

SULZER

AHLSTAR™ *Process Pumps*

Sectional drawing N14829

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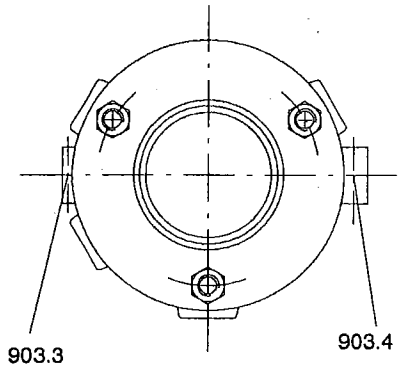
Version 11 > / 20000301 / en / **N14829**

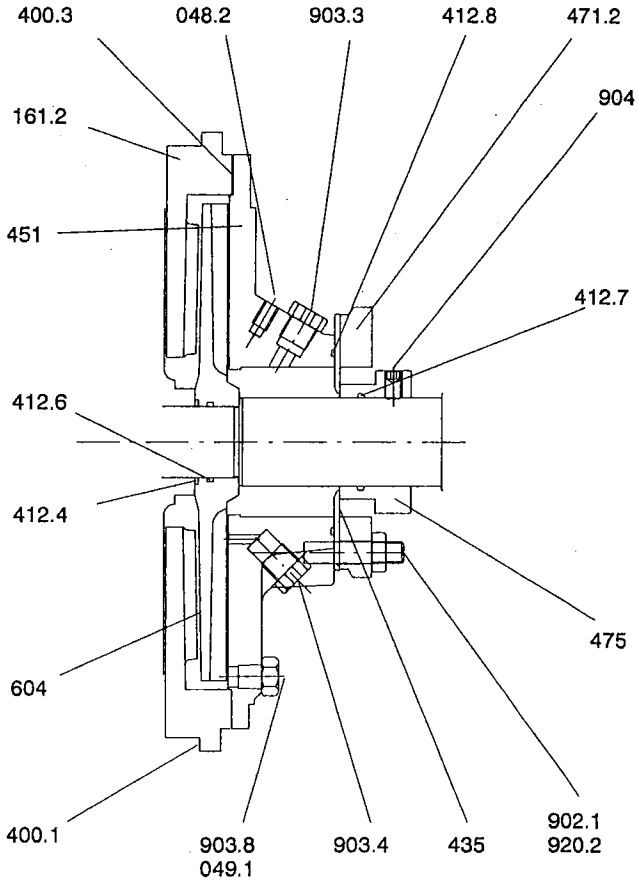
012 Shaft seal

APP/APT, NPP/NPT, WPP/WPT

Fitting DS01

Single stage, large expeller for sizes 11, 21, 22, 23, 31, 32, 41, 42, 51, 52, 53





CAD drawing 910153

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503

SULZER

Sulzer Process Pumps US
Easley Pump Factory

PRODUCT SPECIFICATION

Description	APT 31-6
Serial Number	100014504
Time of delivery/EXW	04/09/2004
Date printed	04/21/2004 Page 1

Customer
US FILTER'S ENVIREX PRODUCTS
PO Box 1604
WAUKESHA WI 53187-1604
USA
Cust. Order 313341
Cust. PO line
Country code US

US FILTER'S ENVIREX PRODUCTS
PO Box 1604
WAUKESHA WI 53187-1604
USA

Equipment P-301B
Id

GENERAL

Pump type: **APT**
Version: **11**
Classification: **B**
Units: **US**
Delivery: **Easley**

Painting method: **Epoxy**
Color shade: **NCS 1700**
Coupling and Guard: **Included in the delivery**
Base plate: **Included in the delivery**
Drive motor: **Included in the delivery**

PROCESS DATA

Process: **All Other Water Applications**
Pumped liquid: **WATER**
Specific gravity: **1.02**

Capacity Q: **1,300.0 gpm**
Head H: **38.0 Feet**

PUMP PERFORMANCE

Characteristic curve: **K15660, C 1160 rpm 31-6**
Pump power P: **16.2 HP**
Dynamic seal power: **0.2 HP**
Efficiency: **83 %**

Pump rotational speed: **1160 rpm**
Variable speed: **No**
NPSH required: **6.2 Feet**

PUMP

Manufacturer: **Easley**
Pump Size: **31-6**
Flange drilling: **ASME B16.5 CLASS 150**
Impeller no.: **283912, C 31-150 31-6**
Impeller Type: **Closed**
Impeller diameter: **280 mm**
Impeller max.diameter: **286 mm**
Impeller balance holes: **Yes**
Casing material: **A890 3A**
Gasket Material: **PTFE/Glass**
O-ring Material: **EPDM**
Shaft seal fitting: **DS01 Dynamic seal SS**

Dynamic seal type: **Single stage Large Expeller**
Dynamic seal material: **A890 3A**
Draining of pump conn. 040: **Yes**
Seal box draining conn. 049: **No**
Discharge pipe conn. 027: **Yes**
Press. measuring conn.036: **Yes**
Temper. measuring conn. 048: **No**
Bearing Unit Lubrication: **Oil lubrication**
Bearing unit model: **04, 52 / 33 / NSs / Met**
Constant level oiler 638: **Yes**
Sign: **CE marking, US-patents**

ASSEMBLY

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 20
Reference no. 23773/000020
Telephone
Telefax

SULZER

Sulzer Process Pumps US Easley Pump Factory **PRODUCT SPECIFICATION**	Description APT 31-6 Serial Number 100014504 Time of delivery/EXW 04/09/2004 Date printed 04/21/2004 Page 2
Customer US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Cust. Order 313341 Cust. PO line Country code US	US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Equipment P-301B Id

Dim.drawing, Assembly of Pump: **P20027, BASEPLATE N? 31-6** Coupling type: **Rex-Omega ES**
Base plate type: **Pump Motor Steel Zinc** Coupling guard material: **S+Z EN10025**
Motor NEMA code: **286T**

MOTOR

Motor Supplier: **Easley** Power: **20.00 HP**
Motor manufacturer: **R** Frequency: **60 Hz**
Motor NEMA code: **286T** Voltage: **230/460**
Motor type: **XEX** Enclosure: **TEFC**
Rotational speed: **1,200 rpm**

CUSTOMER INSTRUCTIONS

End user language: **English** Doc. for Component Lang / Qty: **EN03**

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 20 Reference no. 23773/000020 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014504 04/09/2004 04/21/2004 Page 3

Customer Instructions

001.1	1	Dimensional drawing	P20027EN
001.2	1	Dimensional drawing	P10173EN
002	1	Characteristic curve	K15660EN
010.1	1	ASSEMBLY SECTDWG	N10484EN_20000301
011	1	PUMP SECTDWG	N10487EN_20000301
012	1	SHAFT SEAL SECTDWG	N14829EN_20000301
013	1	BEARING UNIT SECTDWG	N10490EN_20010910
058.1	1	DECLARATION OF QUALITY	N14737EN_20000330
059.1	1	PAINTING CERTIFICATE	N14948EN_20020110
060	1	EC DECLARATION OF CONFORMITY	N14960EN_20000330
062.1	1	INFORMATION FOR USE	N14800EN_20000301
063.1	1	SAFETY INSTRUCTIONS	N11168EN_950220
063.2	1	SAFETY INSTRUCTIONS	N14801EN_20030903
064.1	1	HOISTINGS AND TRANSPORTATIONS	N14802EN_20000301
065.1	1	COMMISSIONING	N14803EN_20000301
067.1	1	INSTALLATION	N14804EN_20030130
068.1	1	OPERATION	N14805EN_20010910
069.1	1	PREVENTIVE MAINTENANCE	N14806EN_20030130
070.1	1	CORRECTIVE MAINTENANCE	N14807EN_20031215
071.1	1	SPARE PARTS RECOMMENDATION	N14808EN_20010510

Connections

000.1		1	SPECIFICATION AND PART LIST Serial number
027	CON027	1	DISCHARGE PIPE CONN. 3/8-18NPT
036.1	CON036	1	PRESSURE MEASURING 3/8-18NPT
036.2	CON036	1	PRESSURE MEASURING 3/8-18NPT
040	CON040	1	DRAINING OF PUMP 3/8-18NPT
042	CON042	1	OIL FILLING 1/2-14NPT
043	CON043	1	DRAINING OF LUBRICAT 1/2-14NPT
044	CON044	2	CONSTANT LEVEL OILER 1/4-18NPT

Parts

102	1422180141	1	VOLUTE CASING S APT31- 6 Flange drilling: **ASME B16.5 CLASS 150** Draining of pump conn. 040: **Yes** Discharge pipe conn. 027: **Yes** Press. measuring conn.036: **Yes** Temper. measuring conn. 048: **No**	(41) A890 3A

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 20 Reference no. 23773/000020 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014504 04/09/2004 04/21/2004 Page 4

161.2	2839730141	1	CASING COVER APT31	(41) A890 3A
183	2837740152	1	SUPPORT FOOT AP	(52) A48 CL 30 B
210	2837930133	1	SHAFT APT3	(33) SS2324
230	2839120141	1	IMPELLER S 286 B41 Z6 APP31-150,APT31- 6	(41) A890 3A
			Impeller diameter: **280 mm**	
			Impeller max.diameter: **286 mm**	
320.1	G433000311	1	ANTIFRICTION BEARING NUP311 ECJ	
320.2	G325007312	2	ANTIFRICTION BEARING 7312 BECBM	
330	1420070152	1	BEARING HOUSING O APT3	(52) A48 CL 30 B
339	384696T304	1	BEARING UNIT APT3 O	
344	1420280152	1	ADAPTER APT31	(52) A48 CL 30 B
360	2880820152	1	BEARING COVER APT3	(52) A48 CL 30 B
400.1	E805310884	1	GASKET 310(-3/-4)/295(-1/-2)X0,5	(84) PTFE/Glass
400.3	3822780484	1	GASKET 0,5X290/245	(84) PTFE/Glass
412.3	E113016194	1	O-RING 16,1X1,6 SMS1586	(94) PTFE
412.4	E11B039294	1	O-RING 39,2X3 SMS1586	(94) PTFE
412.5	E11B124591	1	O-RING 124,5X3 SMS1586	(91) NBR
412.6	E11B039294	1	O-RING 39,2X3 SMS1586	(94) PTFE
412.7	E11B049592	1	O-RING 49,5X3 SMS1586	(92) EPDM
412.8	E11B099592	1	O-RING 99,5X3 SMS1586	(92) EPDM
423	4845290171	1	LABYRINTH RING AP3	(71) GC-CuPb5Sn5Zn5
SFS2209				
423.2	3844840171	1	LABYRINTH RING AP3	(71) GC-CuPb5Sn5Zn5
SFS2209				
435	3822790384	1	STATIC SEAL AP3	(84) PTFE/Glass
451	1423480141	1	STUFFING BOX HOUSING APT31	(41) A890 3A
			Seal box draining conn. 049: **No**	
			Temper. measuring conn. 048: **No**	
471.2	7070210142	1	COVER PLATE FOR SEAL AP3	(42) A743 CF-8M
475	9110080133	1	THRUST RING APT3	(33) SS2324
502	4843110141	1	CASING WEAR RING 220/240X20	(41) A890 3A
507	EL12055064	2	DEFLECTOR 9RB 55	(64) SS 2343/NBR
554.1	B31001051K	3	WASHER ISO 7089-10-A140	(1K) S+Z EN10025
554.2	B36001051K	4	WASHER 10,5 DIN7349	(1K) S+Z EN10025
554.8	B31001051K	4	WASHER ISO 7089-10-A140	(1K) S+Z EN10025
556.1	707007011K	2	RISER BLOCK NEMA 284T, 284TS, 286T, 286T	(1K) S+Z EN10025
604	2839910141	1	EXPELLER AP31	(41) A890 3A
638	GH78503000	1	CONSTANT LEVEL OILER VABL 7973+00677	
			Glass Bottle	
642	GH3330506D	2	SIGHT GLASS SM-12 ISO 228/1-G 1/2	(6D) Al (aluminium)
672	GH55305000	1	VENTING DEVICE EV 1028-14-00 R 1/2	
685	2840320111	1	GUARD END D250/D95,S4	(11) S235JRG2 EN10025
686	288064011K	1	GUARD JACKET D250 L330	(1K) S+Z EN10025

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 20
Reference no. 23773/000020
Telephone
Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 31-6 100014504 04/09/2004 04/21/2004 Page 5

686.3	384476011K	1	GUARD JACKET D250 L130	(1K) S+Z EN10025
800	J351502004	1	MOTOR 20HP/1200RPM 286T TEFC-XEX 230/	
			20HP/1200RPM 286T TEFC-XEX 230/460V	
			MODEL #P28G3320	
840	H1A5604148	1	COUPLING ES10-R SHSB-1.625/1.875	
			Keyways Ansi B17.1 sq.key	
890	607225011K	1	BASEPLATE SLT 4, J, 286T, 324T	(1K) S+Z EN10025
901.1	A132073839	12	HEXAGONAL SCREW 5/8-11UNCX1 1/2 ANSI B18	(39) A4-80 ISO3506
901.10	A13205381E	4	HEXAGONAL SCREW 3/8-16 UNC X 1 1/2" ANSI	(1E) 8.8 ZnK ISO898
901.2	A132065139	2	HEXAGONAL SCREW 1/2-13 UNC X 2" ANSI B18	(39) A4-80 ISO3506
901.3	A13207381E	4	HEXAGONAL SCREW 5/8-11UNCX1 1/2 ANSI B18	(1E) 8.8 ZnK ISO898
901.4	A13205381E	4	HEXAGONAL SCREW 3/8-16 UNC X 1 1/2" ANSI	(1E) 8.8 ZnK ISO898
901.5	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.6	A13205321E	3	HEXAGONAL SCREW 3/8-16UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.7	A13208441E	4	HEXAGONAL SCREW 3/4-10UNCX1 3/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.8	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.9	A13205451E	4	HEXAGONAL SCREW 3/8-16UNCX1 3/4 ANSI B18	(1E) 8.8 ZnK ISO898
902.1	AC22065133	3	STUD 1/2-13UNCX2 SAC200	(33) SS2324
903.1	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.10	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.2	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.3	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.4	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.5	CC25050034	1	SCREWED PLUG 1/2-14 NPT SCC102	(34) SS2343
903.6	CC25030034	1	SCREWED PLUG 1/4-18 NPT SCC102	(34) SS2343
903.9	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
904	A662051638	3	SET SCREW 3/8-16UNCX5/8 ANSI	(38) A4-50 ISO3506
914.1	3842750933	1	SOCKET HEAD SCREW 5/8-11UNCX1.57	(33) SS2324
920.2	B122060039	3	HEXAGONAL NUT 1/2-13UNC ANSI B18.2.2	(39) A4-80 ISO3506
920.3	B12205001J	3	HEXAGONAL NUT 3/8-16UNC ANSI B18.2.2	(1J) 8 ZnK ISO898
923	GA11001210	1	BEARING NUT KM12	(10) S EN10025
931	GC10001210	1	LOCK WASHER MB12	(10) S EN10025
940	B821007015	1	KEY 3/8X3/8X2 3/4 ANSI 17.1-1967	(15) CK45K DIN1652
970	WK3130307A	2	SIGN SULZER LOGO SIGN L130 MM	(6D) Al (aluminium)
971	SS0002Z301	1	NAME PLATE EASLEY PUMP FACTORY	AISI 304
972	4845920134	1	ROTATIONAL ARROW	(34) SS2343
			Direction of rotation	
975.2	SS00050102	2	WARNING SIGN	
			Rotating shaft	
975.3	SS00050202	2	WARNING SIGN	
			Corrosive / Irritating liquid	
975.4	SS00050802	1	WARNING SIGN	
			Guard adjustment	

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 20 Reference no. 23773/000020 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description	APT 31-6
	Serial Number	100014504
	Time of delivery/EXW	04/09/2004
	Date printed	04/21/2004 Page 6

976.1	SS0006M002	1	MANDATORY ACTION SIG EN	
			Oil refilling	
976.2	SS0006M022	1	MANDATORY ACTION SIG	
			Coupling alignment	
981	SS00090101	1	PATENT SIGN US PATENTS	AISI 304

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

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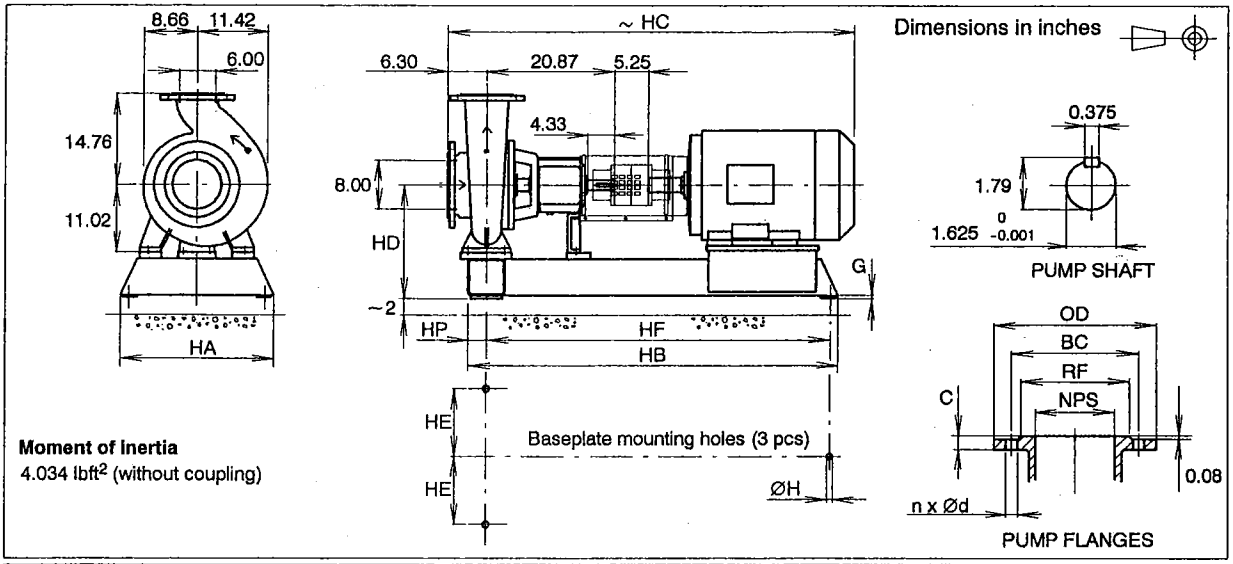
SULZER

APT Process Pumps
Dimensional drawing P20027

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Version 04 > / 981115 / Replaces 940221 / en / **P20027**

APT31-6 *(8x6-11)*
Steel baseplate for pump and motor



Moment of Inertia
4.034 lbft^2 (without coupling)

DIMENSIONS													
Primary motor frame	**Max motor frame** (1	(2	**Baseplate**	**HD**	**HC**	**HB**	**HP**	**HF**	**HA**	**HE**	**H**	**G**	**Weight lbs** (3
254T	284T	256T	3	16.80	55.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
256T	284T	-	3	16.80	56.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
284T	324T	286T	4	18.80	58.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
286T	324T	-	4	18.80	59.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
324T	364T	326T	4	18.80	61.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
326T	364T	-	4	18.80	62.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
364T	405T	365T	5	18.80	65.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
364TS	405TS	365TS	4	18.80	63.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
365T	405T	-	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
365TS	405TS	-	4	18.80	64.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
404T	444T	405T	5	18.80	69.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
404TS	444TS	405TS	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
405T	444T	-	5	18.80	71.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
405TS	444TS	-	5	18.80	68.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
444T	509LL	449T	7	21.15	75.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
444TS	509LS	449TS	7	21.15	71.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445T	509LL	449T	7	21.15	77.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445TS	509LS	449TS	7	21.15	73.50	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090

DRILLING OF FLANGES									
				ANSI B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	**OD**	**RF**	**C**	**BC**	**d**	**n** (4	**BC**	**d**	**n** (4
6.00	12.01	8.35	1.00	9.50	0.88	8	9.50	0.88	8
8.00	13.78	10.47	1.12	11.75	0.88	8	11.75	0.88	8

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.
4. Flange bolting straddles centerline.

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 20
Sulzer Serial No. 100014504

AHLSTAR™ *APT31-6 (8x6-11)*
Characteristic Curve K15660

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SULZER

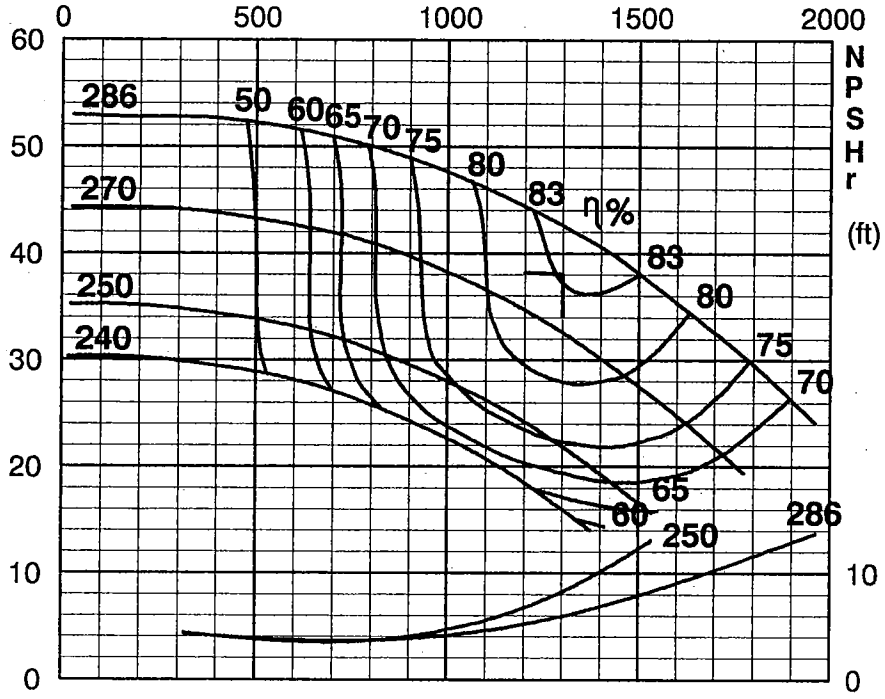
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Version 01 > / 990115 / **K15660**

APT: Impeller 283912 CLOSED B1.61 Z6

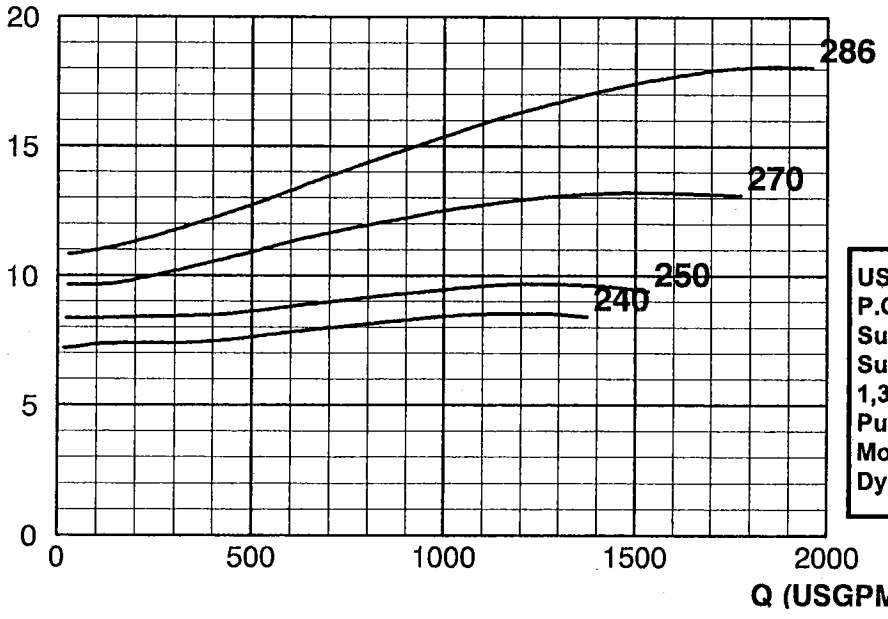
1160 rpm

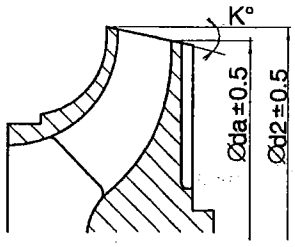
H (ft)



IMPELLER DIA			
$\varnothing d_2$		K°	$\varnothing d_a$ (mm)
(mm)	(in)		
286	11.26	6	277.4
280	11.02	8	268.5
275	10.83	10	260.2
270	10.63	12	252.2
265	10.43	13	245.6
260	10.24	14	238.8
255	10.04	16	230.4
250	9.84	18	221.4
245	9.65	19	214.0
240	9.45	20	206.0

P (Hp)





US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 20
Sulzer Serial No. 100014504
1,300 gpm @ 38 Feet
Pump power = 16.2 HP
Motor power = 20 HP
Dynamic Seal Power = 0.2 HP

CERTIFIED
FINAL

SULZER

AHLSTAR™ *Process Pumps*

Sectional drawing N14829

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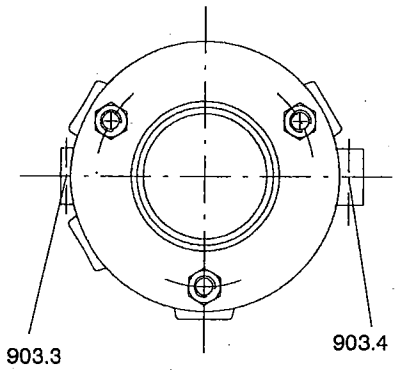
Version 11 > / 20000301 / en / **N14829**

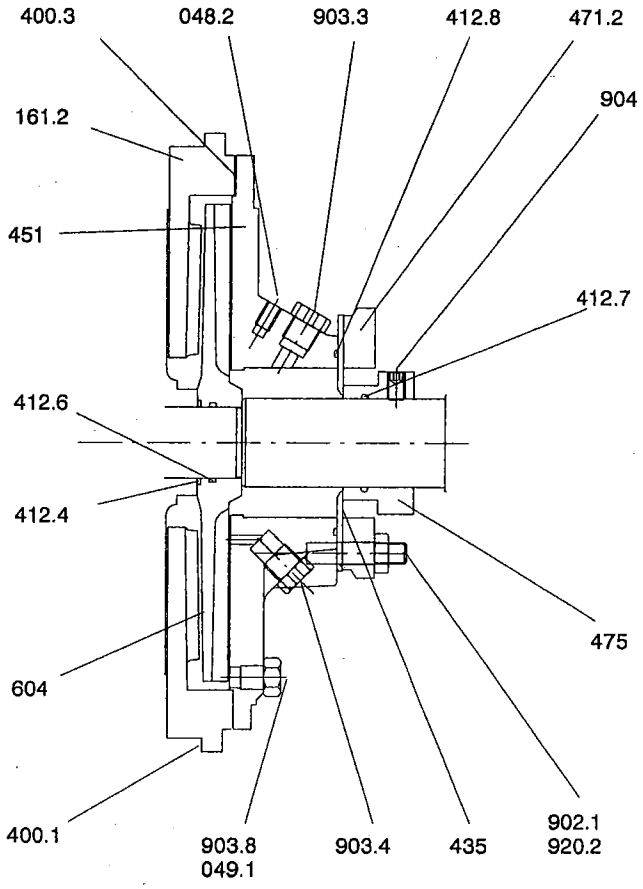
012 Shaft seal

APP/APT, NPP/NPT, WPP/WPT

Fitting DS01

Single stage, large expeller for sizes 11, 21, 22, 23, 31, 32, 41, 42, 51, 52, 53





CAD drawing 910153

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 20
Sulzer Serial No. 100014504

AHLSTAR™ *APT31-6 (8x6-11)*

Characteristic Curve K15660

CERTIFIED FINAL

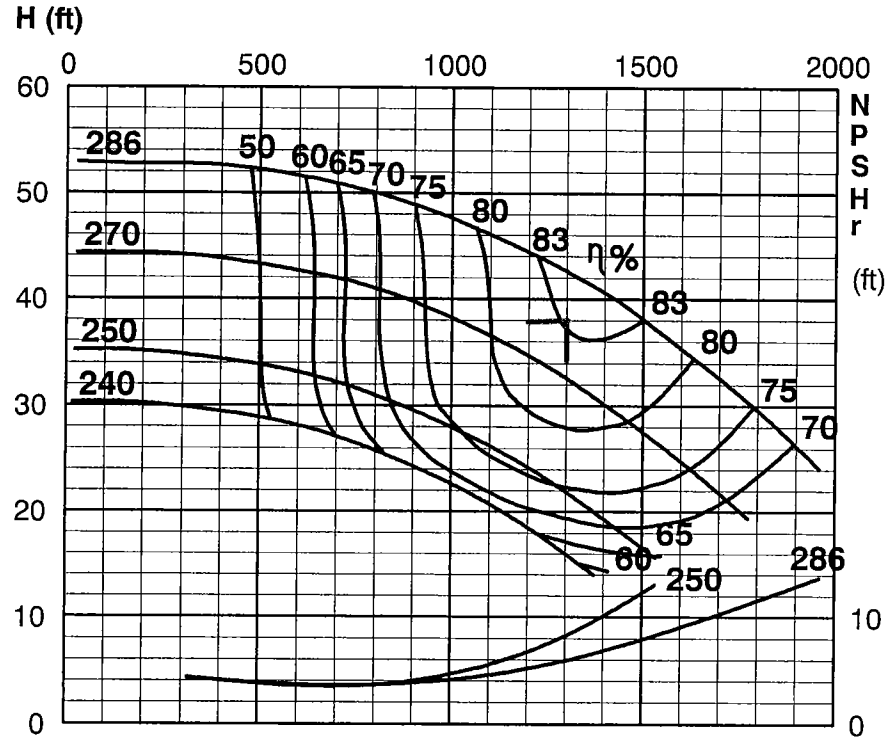
SULZER

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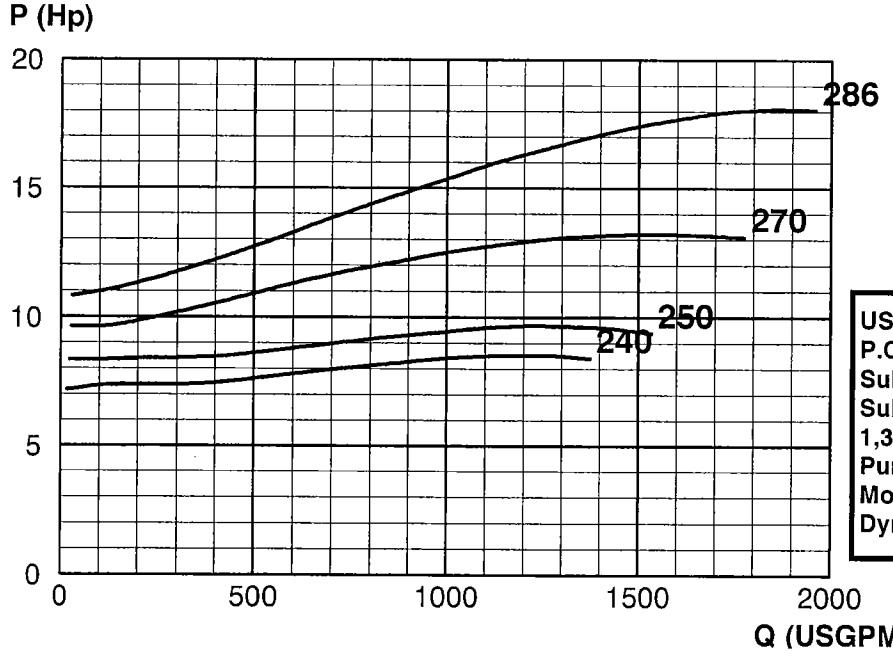
Version 01 > / 990115 / **K15660**

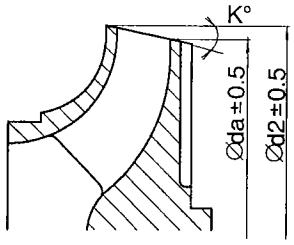
APT: Impeller 283912 CLOSED B1.61 Z6

1160 rpm



IMPELLER DIA			
$\varnothing d_2$ (mm)	$\varnothing d_2$ (in)	K°	$\varnothing d_a$ (mm)
~~286~~	~~11.26~~	~~6~~	~~277.4~~
280	11.02	8	268.5
275	10.83	10	260.2
270	10.63	12	252.2
265	10.43	13	245.6
260	10.24	14	238.8
255	10.04	16	230.4
250	9.84	18	221.4
245	9.65	19	214.0
240	9.45	20	206.0





US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503
1,300 gpm @ 38 Feet
Pump power = 16.2 HP
Motor power = 20 HP
Dynamic Seal Power = 0.2 HP

CERTIFIED
FINAL

SULZER

AHLSTAR™ *Process Pumps*

Sectional drawing N14829

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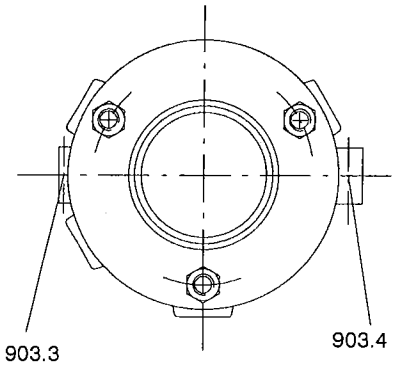
Version 11 > / 20000301 / en / **N14829**

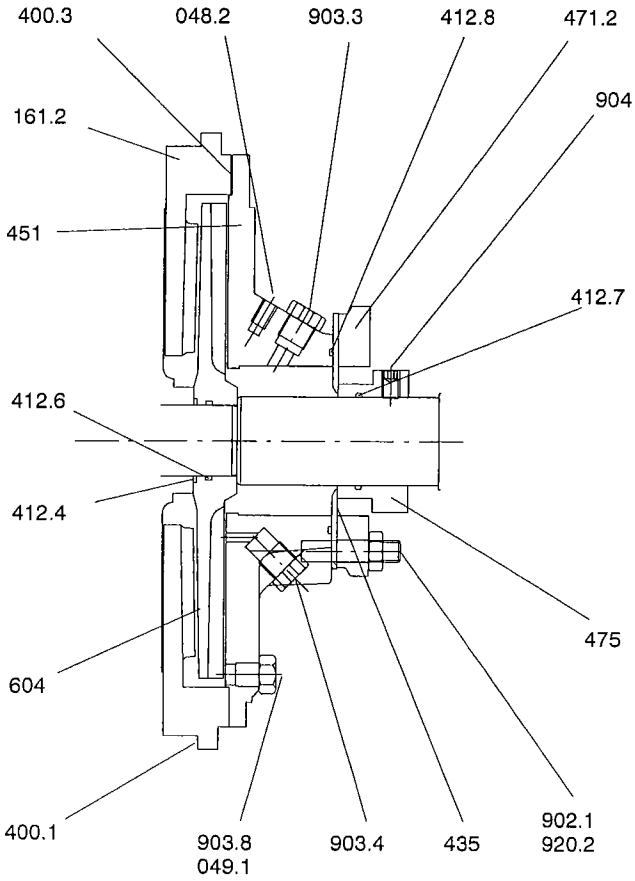
012 Shaft seal

APP/APT, NPP/NPT, WPP/WPT

Fitting DS01

Single stage, large expeller for sizes 11, 21, 22, 23, 31, 32, 41, 42, 51, 52, 53





CAD drawing 910153

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503

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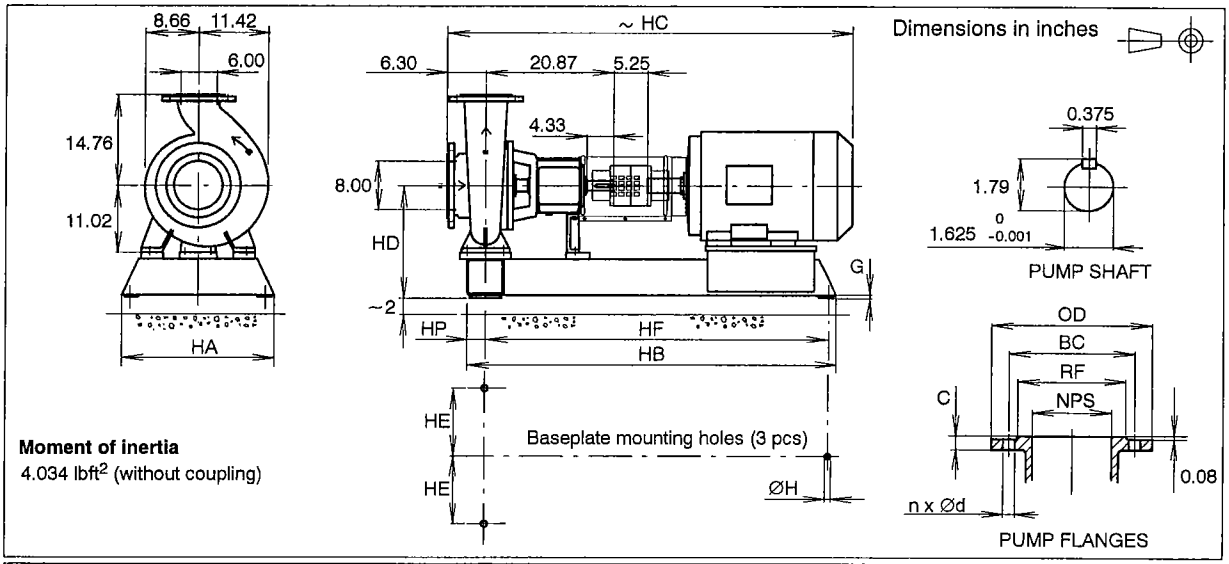
SULZER

APT Process Pumps
Dimensional drawing P20027

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Version 04 > / 981115 / Replaces 940221 / en / **P20027**

APT31-6 *(8x6-11)*
Steel baseplate for pump and motor



Moment of inertia
4.034 lbft^2 (without coupling)

DIMENSIONS													
Primary motor frame	Max motor frame (1	(2	Baseplate	HD	HC	HB	HP	HF	HA	HE	H	G	Weight lbs (3
254T	284T	256T	3	16.80	55.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
256T	284T	-	3	16.80	56.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	645
284T	324T	286T	4	18.80	58.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
286T	324T	-	4	18.80	59.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	695
324T	364T	326T	4	18.80	61.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
326T	364T	-	4	18.80	62.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	705
364T	405T	365T	5	18.80	65.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
364TS	405TS	365TS	4	18.80	63.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
365T	405T	-	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	735
365TS	405TS	-	4	18.80	64.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	720
404T	444T	405T	5	18.80	69.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
404TS	444TS	405TS	5	18.80	66.50	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
405T	444T	-	5	18.80	71.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	790
405TS	444TS	-	5	18.80	68.00	68.25	3.00	63.75	28.38	12.75	1.00	0.44	785
444T	509LL	449T	7	21.15	75.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
444TS	509LS	449TS	7	21.15	71.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445T	509LL	449T	7	21.15	77.00	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090
445TS	509LS	449TS	7	21.15	73.50	85.00	3.50	80.00	32.63	15.00	1.25	0.56	1090

DRILLING OF FLANGES									
				ANSI B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	OD	RF	C	BC	d	n (4	BC	d	n (4
6.00	12.01	8.35	1.00	9.50	0.88	8	9.50	0.88	8
8.00	13.78	10.47	1.12	11.75	0.88	8	11.75	0.88	8

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.
4. Flange bolting straddles centerline.

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 10
Sulzer Serial No. 100014503

SULZER

Sulzer Process Pumps US Easley Pump Factory **PRODUCT SPECIFICATION**	Description APT 21-3 Serial Number 100014505 Time of delivery/EXW 04/09/2004 Date printed 04/21/2004 Page 1
Customer US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Cust. Order 313341 Cust. PO line Country code US	US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Equipment P-401 Id

GENERAL

Pump type: **APT**
Version: **11**
Classification: **B**
Units: **US**
Delivery: **Easley**

Painting method: **Epoxy**
Color shade: **NCS 1700**
Coupling and Guard: **Included in the delivery**
Base plate: **Included in the delivery**
Drive motor: **Included in the delivery**

PROCESS DATA

Process: **All Other Water Applications**
Specific gravity: **1.00**

Capacity Q: **350.0 gpm**
Head H: **34.0 Feet**

PUMP PERFORMANCE

Characteristic curve: **K15761, O 1720 rpm 21-3**
Pump power P: **4.4 HP**
Dynamic seal power: **0.3 HP**
Efficiency: **68 %**

Pump rotational speed: **1720 rpm**
Variable speed: **No**
NPSH required: **5.0 Feet**

PUMP

Manufacturer: **Easley**
Pump Size: **21-3**
Flange drilling: **ASME B16.5 CLASS 150**
Impeller no.: **283871, O 21-80 21-8S 21-3**
Impeller Type: **Open**
Impeller diameter: **180 mm**
Impeller max.diameter: **210 mm**
Impeller balance holes: **Yes**
Casing material: **A890 3A**
Gasket Material: **PTFE/Glass**
O-ring Material: **EPDM**
Shaft seal fitting: **DS01 Dynamic seal SS**

Dynamic seal type: **Single stage Large Expeller**
Dynamic seal material: **A890 3A**
Draining of pump conn. 040: **Yes**
Seal box draining conn. 049: **No**
Discharge pipe conn. 027: **Yes**
Press. measuring conn.036: **Yes**
Temper. measuring conn. 048: **No**
Bearing Unit Lubrication: **Oil lubrication**
Bearing unit model: **04, 52 / 33 / NSs / Met**
Constant level oiler 638: **Yes**
Sign: **CE marking, US-patents**

ASSEMBLY

Dim.drawing, Assembly of Pump: **P20017, BASEPLATE N? 21-3**
Coupling type: **Rex-Omega ES**

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 30 Reference no. 23773/000030 Telephone Telefax

SULZER

Sulzer Process Pumps US Easley Pump Factory **PRODUCT SPECIFICATION**	Description APT 21-3 Serial Number 100014505 Time of delivery/EXW 04/09/2004 Date printed 04/21/2004 Page 2
Customer US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Cust. Order 313341 Cust. PO line Country code US	US FILTER'S ENVIREX PRODUCTS PO Box 1604 WAUKESHA WI 53187-1604 USA Equipment P-401 Id

Base plate type: **Pump Motor Steel Zinc**
Motor NEMA code: **213T**

Coupling guard material: **S+Z EN10025**

MOTOR

Motor Supplier: **Easley**
Motor manufacturer: **RELIANCE**
Motor NEMA code: **213T**
Motor type: **XEX**
Rotational speed: **1,800 rpm**

Power: **7.50 HP**
Frequency: **60 Hz**
Voltage: **230/460**
Enclosure: **TEFC**

CUSTOMER INSTRUCTIONS

End user language: **English**

Doc. for Component Lang / Qty: **EN03**

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 30 Reference no. 23773/000030 Telephone Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 21-3 100014505 04/09/2004 04/21/2004 Page 3

Customer Instructions

001.1		1	Dimensional drawing	P20017EN
001.2		1	Dimensional drawing	P10172EN
002		1	Characteristic curve	K15761EN
010.1		1	ASSEMBLY SECTDWG	N10484EN_20000301
011		1	PUMP SECTDWG	N14976EN_20000301
012		1	SHAFT SEAL SECTDWG	N14829EN_20000301
013		1	BEARING UNIT SECTDWG	N10490EN_20010910
058.1		1	DECLARATION OF QUALITY	N14737EN_20000330
059.1		1	PAINTING CERTIFICATE	N14948EN_20020110
060		1	EC DECLARATION OF CONFORMITY	N14960EN_20000330
062.1		1	INFORMATION FOR USE	N14800EN_20000301
063.1		1	SAFETY INSTRUCTIONS	N11168EN_950220
063.2		1	SAFETY INSTRUCTIONS	N14801EN_20030903
064.1		1	HOISTINGS AND TRANSPORTATIONS	N14802EN_20000301
065.1		1	COMMISSIONING	N14803EN_20000301
067.1		1	INSTALLATION	N14804EN_20030130
068.1		1	OPERATION	N14805EN_20010910
069.1		1	PREVENTIVE MAINTENANCE	N14806EN_20030130
070.1		1	CORRECTIVE MAINTENANCE	N14807EN_20031215
071.1		1	SPARE PARTS RECOMMENDATION	N14808EN_20010510

Connections

000.1		1	SPECIFICATION AND PART LIST Serial number	
027	CON027	1	DISCHARGE PIPE CONN. 3/8-18NPT	
036.1	CON036	1	PRESSURE MEASURING 3/8-18NPT	
036.2	CON036	1	PRESSURE MEASURING 3/8-18NPT	
040	CON040	1	DRAINING OF PUMP 3/8-18NPT	
042	CON042	1	OIL FILLING 1/2-14NPT	
043	CON043	1	DRAINING OF LUBRICAT 1/2-14NPT	
044	CON044	2	CONSTANT LEVEL OILER 1/4-18NPT	

Parts

102	1422070141	1	VOLUTE CASING A APT21- 3 Flange drilling: **ASME B16.5 CLASS 150** Draining of pump conn. 040: **Yes** Discharge pipe conn. 027: **Yes** Press. measuring conn.036: **Yes** Temper. measuring conn. 048: **No**	(41) A890 3A

Sulzer Process Pumps (US) Inc. Easley Pump Factory 155 Ahlstrom Way EASLEY SC 29640	Contact Person Derek Engelhard LBU Order 0000023773 LBU Position 30 Reference no. 23773/000030 Telephone Telefax

SULZER

Sulzer Process Pumps US

PART LIST

Description	APT 21-3
Serial Number	100014505
Time of delivery/EXW	04/09/2004
Date printed	04/21/2004 Page 4

102U	1422070141-U	1	VOLUTE CASING UNFIN. A APT21-33	(41) A890 3A
135	3820530141	1	SIDEPLATE APP21- 80,APT21- 3	(41) A890 3A
161.2	2839710141	1	CASING COVER APT21	(41) A890 3A
183	2837710152	1	SUPPORT FOOT AP	(52) A48 CL 30 B
210	2837920133	1	SHAFT APT2	(33) SS2324
230	2838710141	1	IMPELLER A 210 B30 Z4 APP21- 80,APT21- 3	(41) A890 3A
			Impeller diameter: **180 mm**	
			Impeller max.diameter: **210 mm**	
320.1	G433000309	1	ANTIFRICTION BEARING NUP309 ECJ	
320.2	G325007310	2	ANTIFRICTION BEARING 7310 BECBM	
330	1420060152	1	BEARING HOUSING O APT2	(52) A48 CL 30 B
339	384696T204	1	BEARING UNIT APT2 O	
344	1420260152	1	ADAPTER APT21	(52) A48 CL 30 B
360	2880810152	1	BEARING COVER APT2	(52) A48 CL 30 B
400.1	E805231584	1	GASKET 231(-2/-3)/219(-1/-2)X0,5	(84) PTFE/Glass
400.3	3822780284	1	GASKET 0,5X210/173	(84) PTFE/Glass
412.1	E11H144392	1	O-RING 144,3X5,7 SMS1586	(92) EPDM
412.2	E11H199392	1	O-RING 199,3X5,7 SMS1586	(92) EPDM
412.3	E113012194	1	O-RING 12,1X1,6 SMS1586	(94) PTFE
412.4	E11B029294	1	O-RING 29,2X3 SMS1586	(94) PTFE
412.5	E11B104591	1	O-RING 104,5X3 SMS1586	(91) NBR
412.6	E11B029294	1	O-RING 29,2X3 SMS1586	(94) PTFE
412.7	E11B039292	1	O-RING 39,2X3 SMS1586	(92) EPDM
412.8	E11B084592	1	O-RING 84,5X3 SMS1586	(92) EPDM
423	4845280171	1	LABYRINTH RING AP2	(71) GC-CuPb5Sn5Zn5
SFS2209				
423.2	3844830171	1	LABYRINTH RING AP2	(71) GC-CuPb5Sn5Zn5
SFS2209				
435	3822790284	1	STATIC SEAL AP2	(84) PTFE/Glass
451	2839830141	1	STUFFING BOX HOUSING APT21	(41) A890 3A
			Seal box draining conn. 049: **No**	
			Temper. measuring conn. 048: **No**	
471.2	7070180142	1	COVER PLATE FOR SEAL AP2	(42) A743 CF-8M
475	9110070133	1	THRUST RING APT2	(33) SS2324
507	EL12045064	2	DEFLECTOR 9RB 45	(64) SS 2343/NBR
554.1	B31001051K	3	WASHER ISO 7089-10-A140	(1K) S+Z EN10025
554.2	B36000841K	4	WASHER 8,4 DIN7349	(1K) S+Z EN10025
554.8	B31000841K	4	WASHER ISO 7089-8-A140	(1K) S+Z EN10025
556.1	707005011K	2	RISER BLOCK NEMA 213T, 215T	(1K) S+Z EN10025
604	2839890141	1	EXPELLER AP21	(41) A890 3A
638	GH78503000	1	CONSTANT LEVEL OILER VABL 7973+00677	
			Glass Bottle	
642	GH3330506D	2	SIGHT GLASS SM-12 ISO 228/1-G 1/2	(6D) Al (aluminium)

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 30
Reference no. 23773/000030
Telephone
Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 21-3 100014505 04/09/2004 04/21/2004 Page 5

672	GH55305000	1	VENTING DEVICE EV 1028-14-00 R 1/2	
685	2840310111	1	GUARD END D180/D95,S4	(11) S235JRG2 EN10025
686	288063011K	1	GUARD JACKET D180 L280	(1K) S+Z EN10025
686.3	384475011K	1	GUARD JACKET D180 L110	(1K) S+Z EN10025
800	J351300754	1	MOTOR 7.5HP/1800RPM 213T TEFC-XEX 3/60	
			7.5HP/1800RPM 213T TEFC-XEX 3/60/230/460	
			MODEL #P21G420	
840	H1A3603235	1	COUPLING ES4-R SHSB-1.25/1.375	
			Keyways Ansi B17.1 sq.key	
890	607133011K	1	BASEPLATE SLT 3, D, 213T, 254T	(1K) S+Z EN10025
901.1	A132063239	12	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(39) A4-80 ISO3506
901.10	A13204381E	4	HEXAGONAL SCREW 5/16-18 UNC X 1 1/2" ANS	(1E) 8.8 ZnK ISO898
			5/16-18 UNC X 1 1/2" ANSI B18.2.1	
901.2	A132053839	2	HEXAGONAL SCREW 3/8-16 UNCX1 1/2 ANSI B1	(39) A4-80 ISO3506
901.3	A13206321E	4	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.4	A13204321E	4	HEXAGONAL SCREW 5/16-18 UNC X 1 1/4 ANSI	(1E) 8.8 ZnK ISO898
901.5	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.6	A13205321E	3	HEXAGONAL SCREW 3/8-16UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.7	A13206381E	4	HEXAGONAL SCREW 1/2-13 UNC X 1 1/2" ANSI	(1E) 8.8 ZnK ISO898
901.8	A13206321E	2	HEXAGONAL SCREW 1/2-13UNCX1 1/4 ANSI B18	(1E) 8.8 ZnK ISO898
901.9	A13204381E	4	HEXAGONAL SCREW 5/16-18 UNC X 1 1/2" ANS	(1E) 8.8 ZnK ISO898
			5/16-18 UNC X 1 1/2" ANSI B18.2.1	
902.1	AC22053833	3	STUD 3/8-16UNCX1 1/2 SAC 200	
903.1	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.10	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.2	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.3	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.4	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
903.5	CC25050034	1	SCREWED PLUG 1/2-14 NPT SCC102	(34) SS2343
903.6	CC25030034	1	SCREWED PLUG 1/4-18 NPT SCC102	(34) SS2343
903.9	CC25040034	1	SCREWED PLUG 3/8-18 NPT SCC102	(34) SS2343
904	A662041338	3	SET SCREW 5/16-18UNCX1/2 ANSI	(38) A4-50 ISO3506
909	9112500133	3	ADJUSTING SCREW 3/8-16UNC X 1 3/16	(33) SS2324
914.1	3842750833	1	SOCKET HEAD SCREW 1/2-13UNCX1.18	(33) SS2324
920.1	B122050039	3	HEXAGONAL NUT 3/8-16UNC ANSI B18.2.2	(39) A4-80 ISO3506
920.2	B122050039	3	HEXAGONAL NUT 3/8-16UNC ANSI B18.2.2	(39) A4-80 ISO3506
920.3	B12205001J	3	HEXAGONAL NUT 3/8-16UNC ANSI B18.2.2	(1J) 8 ZnK ISO898
923	GA11001010	1	BEARING NUT KM10	(10) S EN10025
931	GC10001010	1	LOCK WASHER MB10	(10) S EN10025
940	B820605115	1	KEY 1/4X1/4X2 ANSI 17.1-1967	(15) CK45K DIN1652
970	WK3130307A	2	SIGN SULZER LOGO SIGN L130 MM	(6D) Al (aluminium)
971	SS0002Z301	1	NAME PLATE EASLEY PUMP FACTORY	AISI 304
972	4845920134	1	ROTATIONAL ARROW	(34) SS2343

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 30
Reference no. 23773/000030
Telephone
Telefax

SULZER

Sulzer Process Pumps US PART LIST	Description Serial Number Time of delivery/EXW Date printed	APT 21-3 100014505 04/09/2004 04/21/2004 Page 6

			Direction of rotation	
975.2	SS00050102	2	WARNING SIGN	
			Rotating shaft	
975.3	SS00050202	2	WARNING SIGN	
			Corrosive / Irritating liquid	
975.4	SS00050802	1	WARNING SIGN	
			Guard adjustment	
976.1	SS0006M002	1	MANDATORY ACTION SIG EN	
			Oil refilling	
976.2	SS0006M022	1	MANDATORY ACTION SIG	
			Coupling alignment	
981	SS00090101	1	PATENT SIGN US PATENTS	AISI 304

Sulzer Process Pumps (US) Inc.
Easley Pump Factory
155 Ahlstrom Way
EASLEY SC 29640

Contact Person Derek Engelhard
LBU Order 0000023773
LBU Position 30
Reference no. 23773/000030
Telephone
Telefax

AHLSTAR™ *A_T21-3 (6x3-8)*

Characteristic Curve K15761

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Version 01 > / 990115 / **K15761**

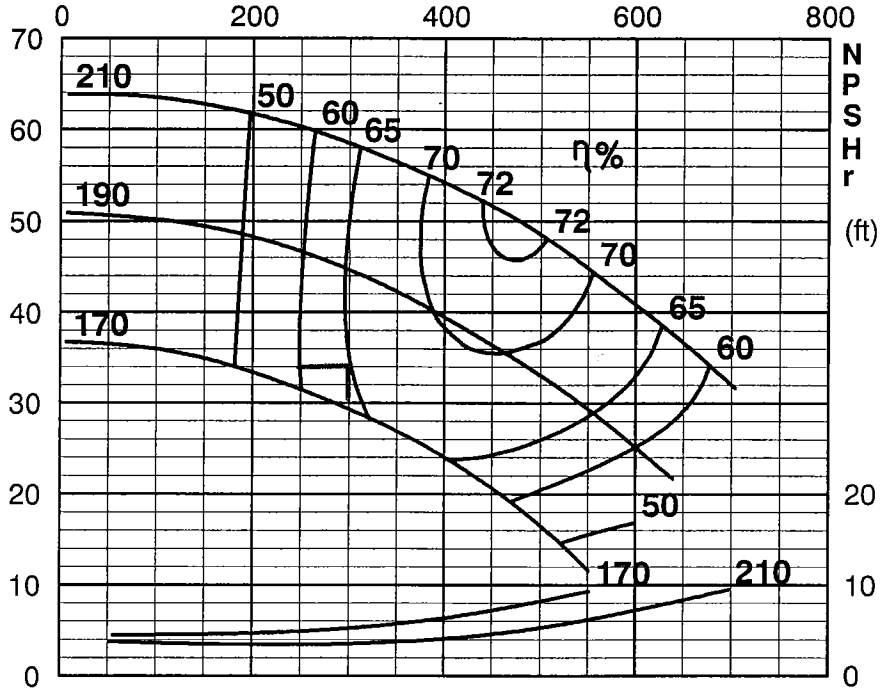
APT: Impeller 283871 OPEN B1.18 Z4

ART: Impeller 287962 OPEN B1.18 Z4, Please add the power demand of the degassing unit = 1.2 Hp

AST: Impeller 287962 OPEN B1.18 Z4, Please add the power demand of the degassing unit = 1.5 Hp

1720 rpm

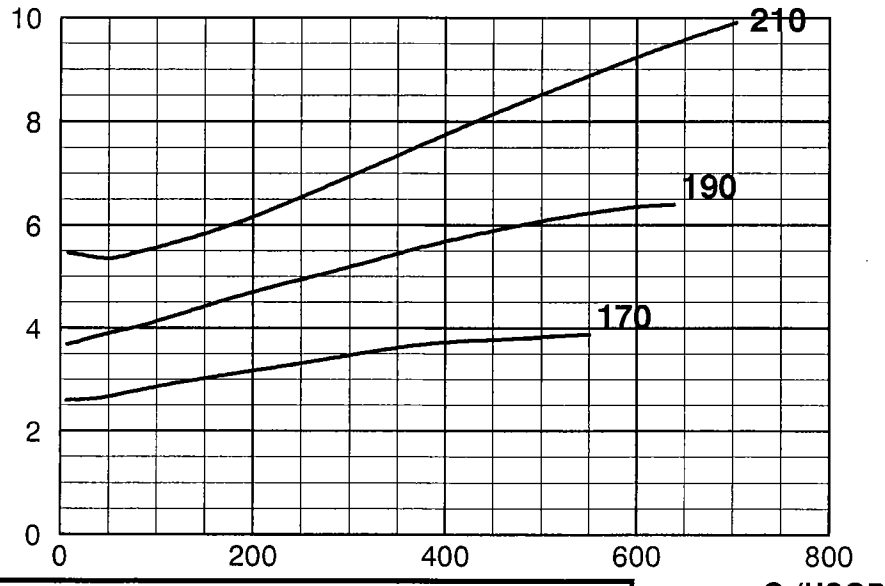
H (ft)

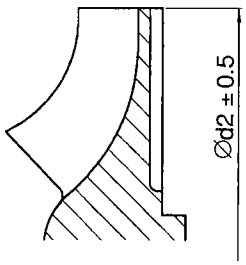


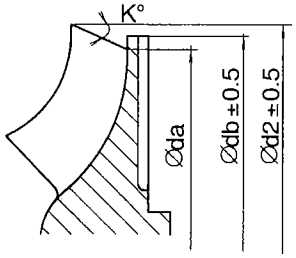
IMPELLER DIA				
$Ød_2$		K°	$Ød_a$	$Ød_b$
(mm)	(in)		(mm)	(mm)
210	8.27			
205	8.07			
200	7.87			
195	7.68			
190	7.48			
185	7.28			
180	7.09			
175	6.89			
173	6.81	4	168.5	170 (*
170	6.69	10	158.5	170 (*

*) Only for ART/AST

P (Hp)







US Filter's Envirex Products
P.O. No. 313341
Sulzer Serial No. 100014505
Pump power = 4.42 HP
Motor power = 7.5 HP
Dynamic Seal Power = 0.3 HP

Sulzer Order No. 23773/ 30
350 gpm @ 34 Feet

AHLSTAR™ *Process Pumps*

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SULZER

Sectional drawing N14829

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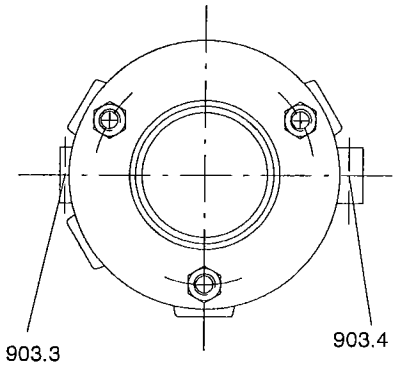
Version 11 > / 20000301 / en / **N14829**

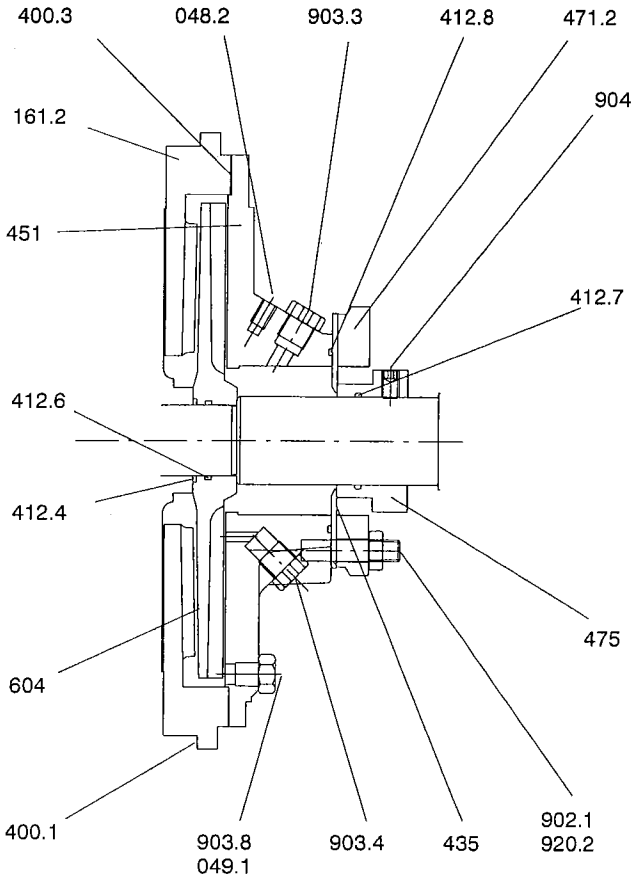
012 Shaft seal

APP/APT, NPP/NPT, WPP/WPT

Fitting DS01

Single stage, large expeller for sizes 11, 21, 22, 23, 31, 32, 41, 42, 51, 52, 53





CAD drawing 910153

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 30
Sulzer Serial No. 100014505

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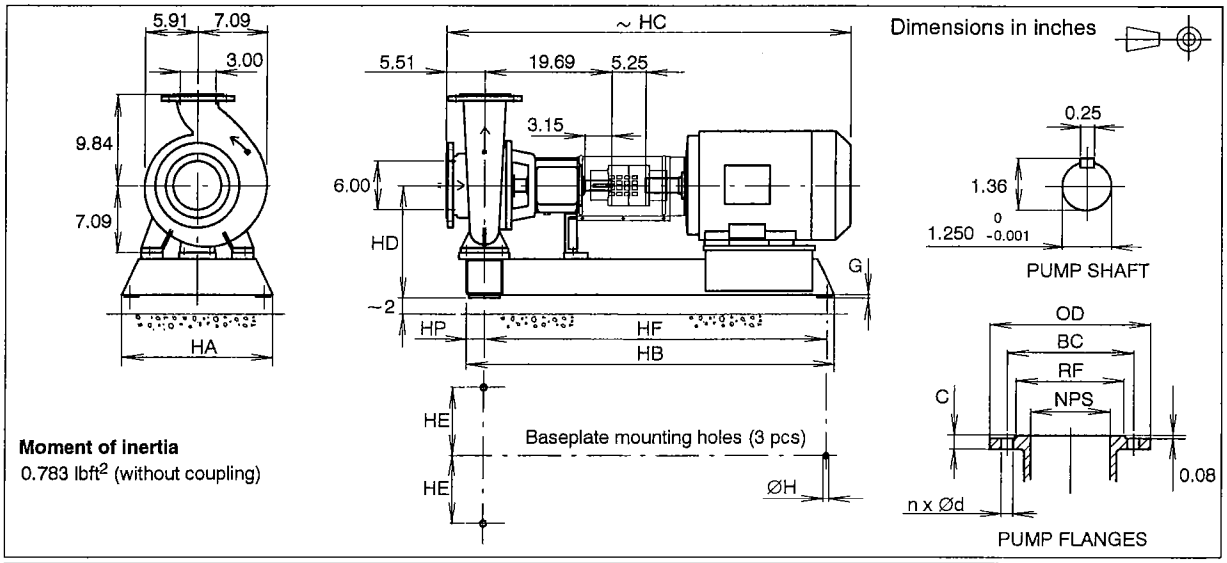
SULZER

APT Process Pumps
Dimensional drawing P20017

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Version 04 > / 981115 / Replaces 940221 / en / **P20017**

APT21-3 *(6x3-8)*
Steel baseplate for pump and motor



Moment of inertia
0.783 lbft^2 (without coupling)

DIMENSIONS													
Primary motor frame	Max motor frame (1	(2	Baseplate	HD	HC	HB	HP	HF	HA	HE	H	G	Weight lbs (3
182T	213T	184T	2	12.60	44.50	44.75	2.00	41.25	19.75	8.50	0.75	0.44	330
184T	213T	-	2	12.60	45.50	44.75	2.00	41.25	19.75	8.50	0.75	0.44	330
213T	254T	215T	3	12.60	48.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	345
215T	254T	-	3	12.60	49.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	345
254T	284T	256T	3	12.60	52.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
256T	284T	-	3	12.60	54.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
286TS	324TS	-	3	12.60	56.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
324TS	364TS	326TS	3	13.50	57.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	440
326TS	364TS	-	3	13.50	58.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	440
364TS	405TS	365TS	4	18.35	61.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	470
365TS	405TS	-	4	18.35	62.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	470
404TS	444TS	405TS	4	18.35	64.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	520
405TS	444TS	-	4	18.35	65.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	520
444TS	509LS	449TS	7	20.40	68.50	85.00	3.50	80.00	32.63	15.00	1.25	0.56	790

DRILLING OF FLANGES									
				ANSI B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	OD	RF	C	BC	d	n (4	BC	d	n (4
3.00	7.87	5.12	0.94	6.00	0.75	4	6.00	0.75	4
6.00	12.01	8.35	1.00	9.50	0.88	8	9.50	0.88	8

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.
4. Flange bolting straddles centerline.

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 30
Sulzer Serial No. 100014505

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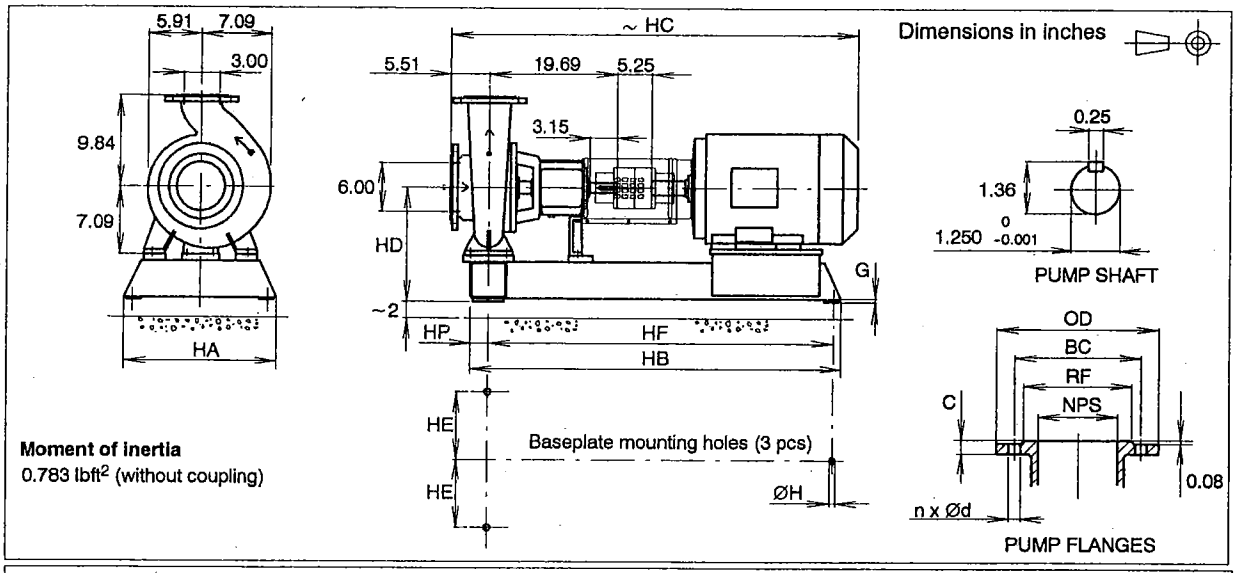
SULZER

APT Process Pumps
Dimensional drawing P20017

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Version 04 > / 981115 / Replaces 940221 / en / **P20017**

APT21-3 (6x3-8)
Steel baseplate for pump and motor



Moment of inertia
0.783 lbft^2 (without coupling)

DIMENSIONS													
Primary motor frame	Max motor frame (1	(2	Baseplate	HD	HC	HB	HP	HF	HA	HE	H	G	Weight lbs (3
182T	213T	184T	2	12.60	44.50	44.75	2.00	41.25	19.75	8.50	0.75	0.44	330
184T	213T	-	2	12.60	45.50	44.75	2.00	41.25	19.75	8.50	0.75	0.44	330
213T	254T	215T	3	12.60	48.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	345
215T	254T	-	3	12.60	49.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	345
254T	284T	256T	3	12.60	52.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
256T	284T	-	3	12.60	54.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
286TS	324TS	-	3	12.60	56.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	365
324TS	364TS	326TS	3	13.50	57.00	52.50	2.00	49.25	24.75	11.00	0.75	0.44	440
326TS	364TS	-	3	13.50	58.50	52.50	2.00	49.25	24.75	11.00	0.75	0.44	440
364TS	405TS	365TS	4	18.35	61.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	470
365TS	405TS	-	4	18.35	62.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	470
404TS	444TS	405TS	4	18.35	64.00	60.25	3.00	56.00	24.75	11.00	1.00	0.44	520
405TS	444TS	-	4	18.35	65.50	60.25	3.00	56.00	24.75	11.00	1.00	0.44	520
444TS	509LS	449TS	7	20.40	68.50	85.00	3.50	80.00	32.63	15.00	1.25	0.56	790

DRILLING OF FLANGES									
				ANSI B 16.1 Class 125			ASME B 16.5 Class 150		
NPS	OD	RF	C	BC	d	n (4	BC	d	n (4
3.00	7.87	5.12	0.94	6.00	0.75	4	6.00	0.75	4
6.00	12.01	8.35	1.00	9.50	0.88	8	9.50	0.88	8

1. Max. NEMA motor frame, which can be installed onto the baseplate.
2. Max. NEMA motor frame with the same shaft height as primary motor.
3. Weight without coupling and motor.
4. Flange bolting straddles centerline.

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 30
Sulzer Serial No. 100014505

AHLSTAR™ *A_T21-3 (6x3-8)*
Characteristic Curve K15761

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Version 01 > / 990115 / **K15761**

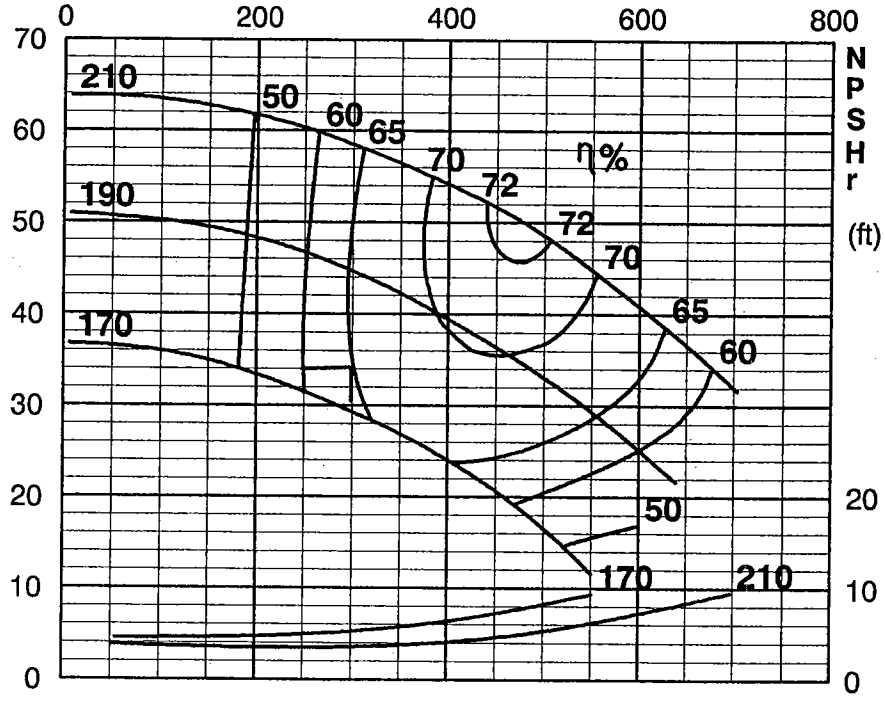
APT: Impeller 283871 OPEN B1.18 Z4

ART: Impeller 287962 OPEN B1.18 Z4, Please add the power demand of the degassing unit = 1.2 Hp

AST: Impeller 287962 OPEN B1.18 Z4, Please add the power demand of the degassing unit = 1.5 Hp

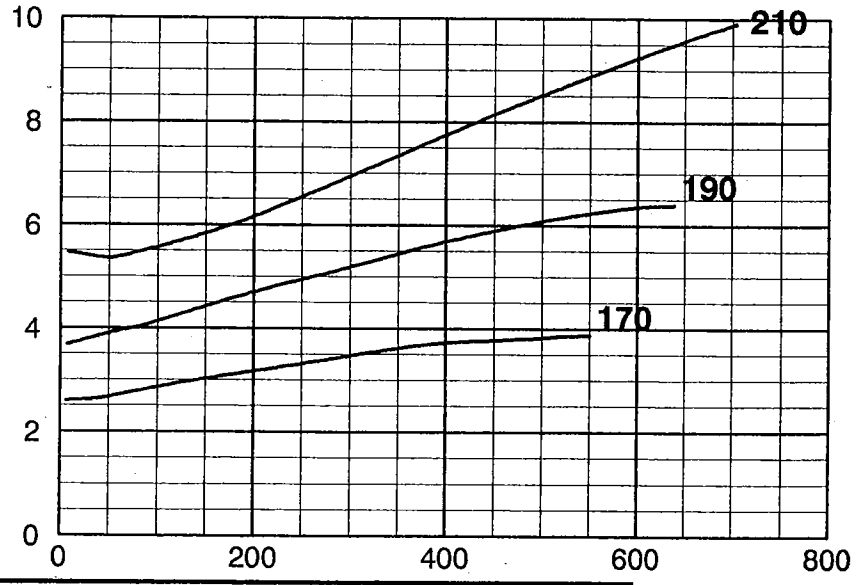
1720 rpm

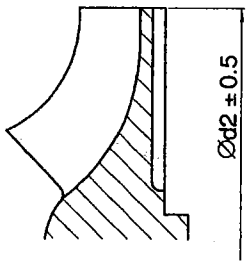
H (ft)

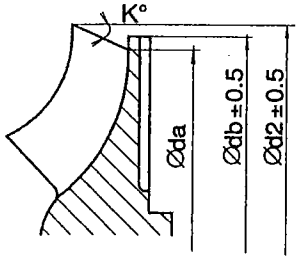


IMPELLER DIA				
$Ød_2$		K°	$Ød_a$	$Ød_b$
(mm)	(in)		(mm)	(mm)
210	8.27			
205	8.07			
200	7.87			
195	7.68			
190	7.48			
185	7.28			
180	7.09			
175	6.89			
173	6.81	4	168.5	170 (*
170	6.69	10	158.5	170 (*
*) Only for ART/AST				

P (Hp)







US Filter's Envirex Products
P.O. No. 313341 — **Sulzer Order No. 23773/ 30**
Sulzer Serial No. 100014505 — **350 gpm @ 34 Feet**
Pump power = 4.42 HP
Motor power = 7.5 HP
Dynamic Seal Power = 0.3 HP

AHLSTAR™ *Process Pumps*

Sectional drawing N14829

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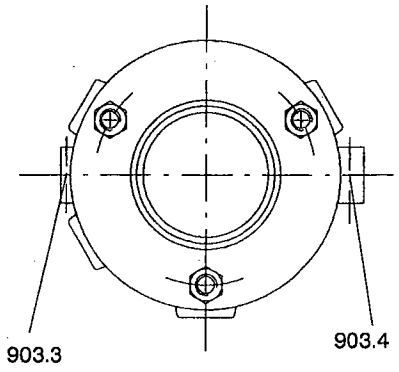
Version 11 > / 20000301 / en / **N14829**

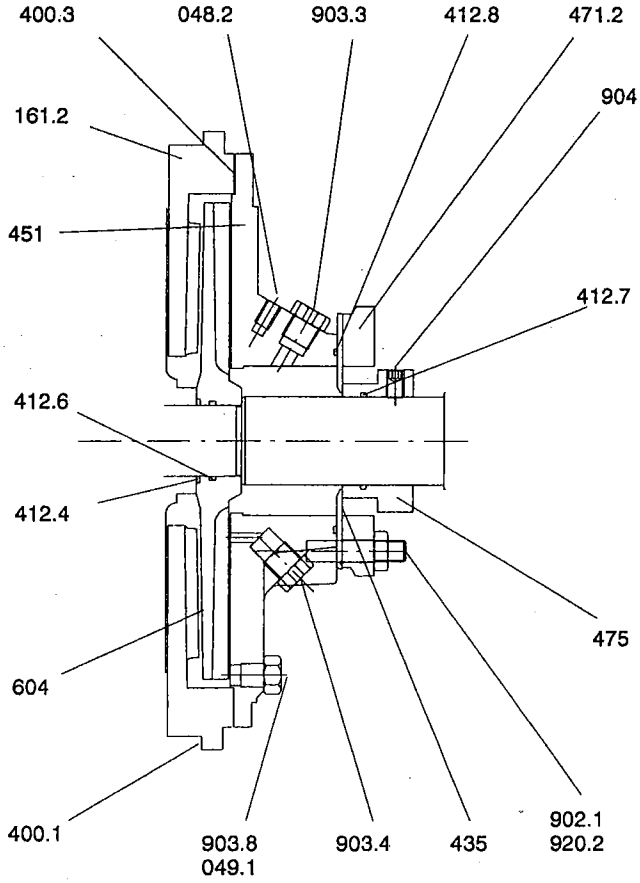
012 Shaft seal

APP/APT, NPP/NPT, WPP/WPT

Fitting DS01

Single stage, large expeller for sizes 11, 21, 22, 23, 31, 32, 41, 42, 51, 52, 53





CAD drawing 910153

US Filter's Envirex Products
P.O. No. 313341
Sulzer Order No. 23773/ 30
Sulzer Serial No. 100014505

SULZER

AHLSTAR™ Process Pumps

Installation, Operation and Maintenance Instructions

Version 11 > / 20030130 / Replaces 20020520 / en / **N14799**

Contents

- Intended use N14800
- Safety instructions N14801
- Hoisting and transportation N14802
- Commissioning N14803
- Installation N14804
- Operation N14805
- Preventive maintenance N14806
- Corrective maintenance N14807
- Spare parts recommendation N14808

SULZER

Intended use

20000301 / en / **N14800**

Contents *Page*

1 General 1

2 Document identification 2

3 Type designation 3

4 Nameplate information 3

5 Capacity flow and head 4

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1 General

The pump and its accessories may only be used for the purpose for which they have been supplied. The intended use is given in the order specification and in the following instructions concerning the main pumping parameters and mechanical durability. If the intended use changes, the user must make sure that the pump can be used in the new application and, if necessary, obtain the manufacturer's permission for the change.

Table 1 Intended use in the process

Application data:	**Sources:**
Pumped liquid and its properties (chemicals, solids, consistency, temperature etc.)	Product specification (under "Process data")
Main pumping parameters (capacity, head, speed etc.)	Product specification (under "Process data") and nameplate of the pump
Other necessary process data	Product specification (under "Process data")

Table 2 Delivery and design

Delivery and design data:	**Sources:**
Delivery scopes (pump, coupling, baseplate etc.)	Product specification
Product size	Product specification and nameplate of the pump
Other design alternatives (impeller type and size, materials, lubrication, flange drillings, shaft sealing type etc.)	Product specification
Dimensions (pump, accessories, flanges etc.)	Dimensional drawings
Weights and mass moments of inertia (bare pump, pump + baseplate etc.)	Dimensional drawings
Connections (lubrication, shaft seal, drainage etc.)	Location shown in the parts list under heading "Connections" and in the sectional drawings. Moreover, connections having importance in view of safety have been marked on the product.
Part details (maximum impeller diameter, bearing types, fastener sizes etc.)	Parts list (under heading "Parts")

This instruction set covers the process pump with the supplementary accessories included in the delivery. All supplied instructions are found in the parts list under the heading "Instructions".

Before commissioning, the operating staff have to be instructed in the guidelines for correct and safe operation of the product as stated in these instructions. This product must be serviced by qualified personnel who are familiar with the design and operation of this product and the system with the essential safety aspects involved. The scope of responsibilities and supervision of the personnel must be exactly defined by the plant operator.

Our guarantee will be valid only if the installation, operation, maintenance and repairs of this pump are carried out in accordance with these instructions. The plant operator is to make sure that the contents of these instructions are fully understood by the operating personnel.

To assure a steady start-up, supervision or service from an authorized manufacturer representative is recommended. During operation, periodic inspections should be made to assure safe operation under the prevailing conditions.

Any modification may be made to the product only after consultation with the manufacturer. Using spare parts and accessories authorized by the manufacturer is a relevant safety aspect. Only genuine spare parts which are in accordance with the original delivery (in the parts list) are to be used. Use of other parts may exempt Sulzer from any liability.

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If any assistance regarding the product or its instructions is required, please contact our local representative for a quick supply of the information you need.

The enclosed instructions regarding a possible long-term storage (more than 3 months) must be observed.

All customer instructions regarding this product are also available in an electronic format for viewing and printing (depending on the end user's software & hardware). If electronic format is needed, please contact our local representative for further information.

If the delivery includes customer instructions or other information in an electronic format which can be edited, we are only responsible for the contents of paper versions of these instructions and other information supplied by us.

Keep these instructions at the place of operation for further reference!

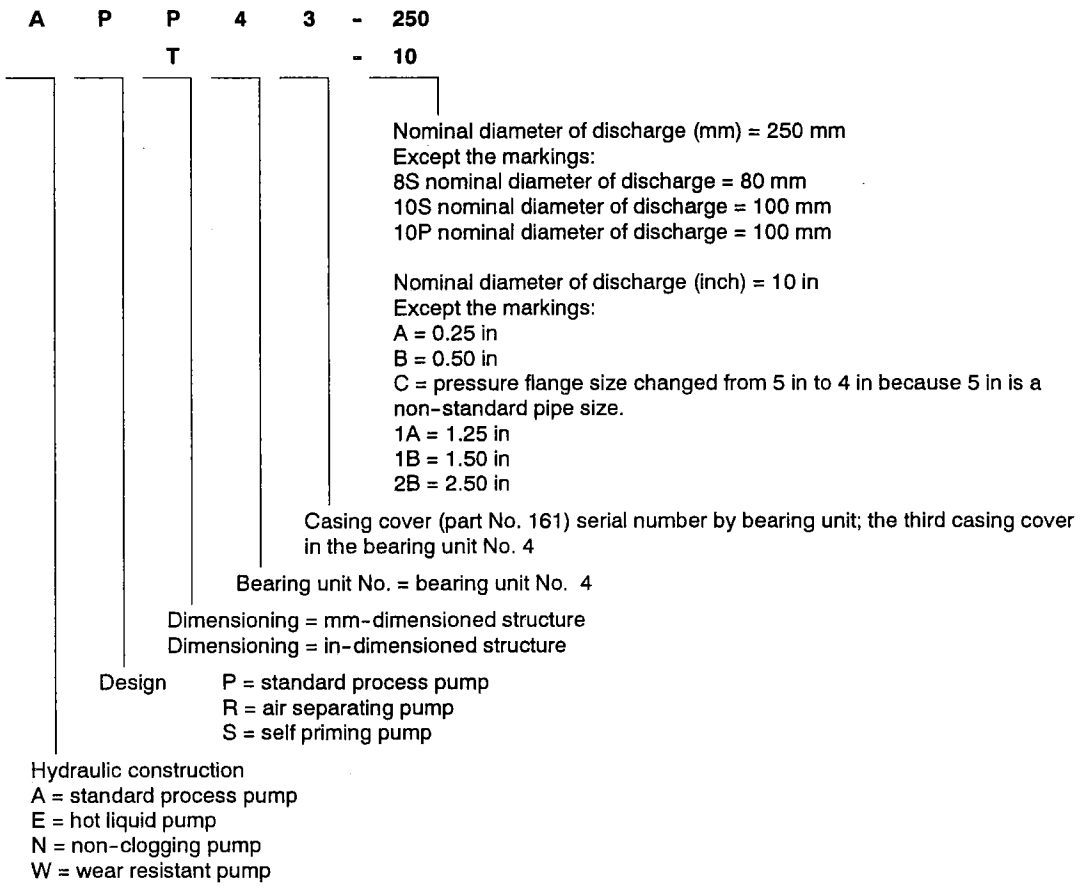
2 Document identification

Version 11 > / 20000331 / Replaces 941201 / en / **N10991** / Page 1 (2)

- Page number and total number of pages in the document
- Indentification number of document
- Language code of document
- Previous date for document
- Date when the document in question was made or updated
- Product version number

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3 Type designation



4 Nameplate information

Every pump has the following plates fastened to the volute casing (102) providing necessary identification of the pump and its hydraulic characteristics.

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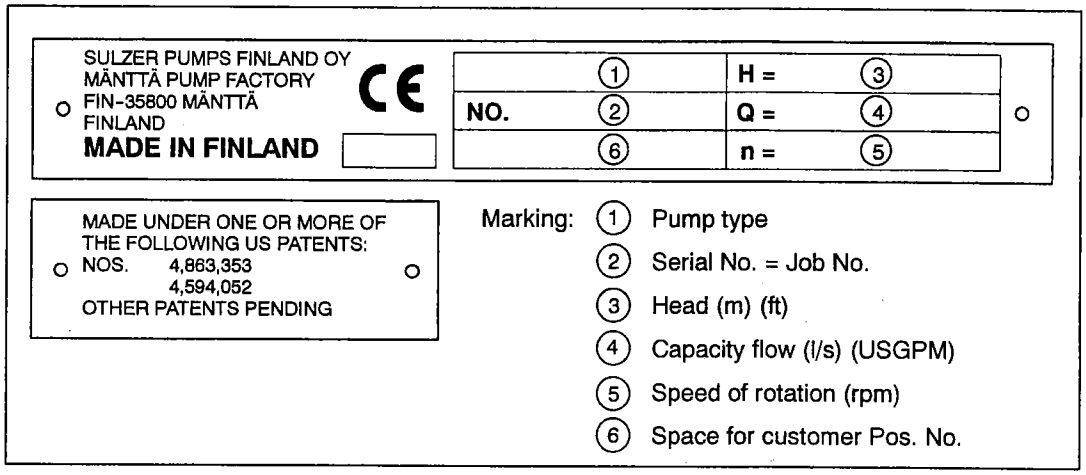


Fig. 1

5 Capacity flow and head

The pump is always dimensioned according to the pumping values (head, flow) stated in the nameplate (971) of the pump. Head and flow values that can be reached with the specific impeller diameter and operating speed are given in the characteristic curve of the pump. The operating point on the curve can be changed by adjusting the pumping system resistance e.g. by throttling the flow with the valve in the pressure piping. If the impeller diameter or the rotational speed of the pump are changed, then the operating point will move totally to another head-flow curve.

The pump must not be used at other operating points without the following verifications:

- When the pump was selected in the original operating point, all factors affecting the mechanical durability (e.g pressure and temperature limits) and pump design (pump, impeller type, shaft sealing and lubrication etc.) were carefully considered. All these factors are to be checked also in the new operating point.
- The pump could temporarily operate even with the pressure valve closed. For continuous operation, a minimum flow is still required. The required suction head (NPSH required) curve presented in the characteristic curve always starts from the point of the minimum continuous flow allowed.
- The suction properties of the system (NPSH available) and drive motor power are always to be checked in a new operating point.
- The efficiency of a pump is a relevant factor when estimating the lifetime costs of the pump. Therefore its influence on the power need must be checked.
- The characteristic curve enclosed is always based on tests with clean water. Other types of pumped liquid can change the head, flow or power need values radically. These factors were recognized when the pump was originally selected and they must be considered also in the new operating point.

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Safety instructions

Version 11 > / 20030130 / Replaces 20000301 / en / **N14801**

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1 General

This product is designed and tested for safe and reliable operation in the application for which it is specified and sold. Remember, a pump is a piece of equipment with pressure containing parts and rotating elements which can cause a hazard. Therefore, all the safety measures in the instructions are to be followed strictly. Personal injuries may result if the instructions are not observed and followed.

It is not only the general safety instructions contained under this main heading "Safety instructions" which are to be observed, but also the specific safety information presented in other instructions relating to this delivery, relevant national safety regulations or any other safety information issued by the plant operator.

The exact and detailed process and application data is relevant for the safe and reliable operation of the product. Special environmental conditions at the place of installation should always be checked between the end user and manufacturer. Such conditions are e.g.

- Abnormal temperature
- High humidity
- Corrosive atmospheres
- Pressure fluctuations
- Falling below the minimum permissible flow, dry running
- Explosive and/or fire risk zones
- Dust, sandstorms
- Earthquakes

Special safety measures are also needed when the type of liquid to be pumped is e.g. the following:

- Flammable
- Corrosive, abrasive
- Poisonous
- Crystallizing
- Solid containing
- Gas containing

Non-compliance with the safety and specific operating instructions may produce a risk to the personnel as well as to the environment, e.g.

- Failure of important functions of the pump and/or plant
- Failure of specific procedures of maintenance and repair
- Exposure of people to electrical, mechanical and chemical hazards
- Endangering the environment owing to hazardous substances being released

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2 Definitions

The following words are used in the instructions to indicate issues which require special attention.

WARNING
There is a risk of personal injury if the instruction is not adhered to.

CAUTION
There is a risk of damaging or destroying the product or equipment if the instruction is not adhered to.

NOTE
Is used in the text for highlighting necessary information or requirements which are essential to observe.

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3 Essential safety aspects

All of the following relevant safety aspects are to be instructed to the operators and maintenance personnel before putting the product into service.

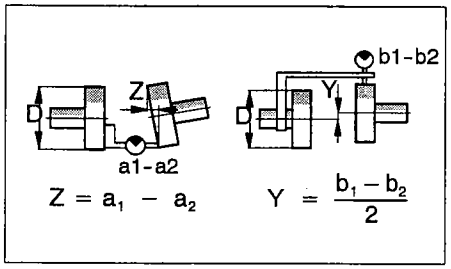
- The product is meant only for the purpose for which it is sold - never operate beyond the intended use described in these instructions.
- Always stop the drive unit before beginning any repair work on the pump. Make sure that the motor cannot be started by any means accidentally during the repairs.
- For delivery, the bearing housing of the pump has been emptied of oil. Remember to refill it before starting.
- Personal injuries may occur if personal protective equipment is not used when servicing the product.
- The product must always be equipped with a shaft sealing system compatible with the pumped liquid.
- Pump units which convey hazardous media must be decontaminated before beginning any maintenance work.
- The use of heat is prohibited when disassembling the pump due to risk of explosion of trapped liquid.
- If there is a possibility of a dangerous return flow after the shutdown of the pump, a nonreturn device shall be assembled in the outlet piping.
- All safety devices (e.g coupling guards) must be correctly installed before starting. For explosive areas, guards with a non-sparking material are to be used.
- The correct rotating direction of the drive unit must be checked before starting and the pump must rotate freely (with coupling spacer removed).
- The coupling must be properly aligned before starting.
- The pump must be sufficiently filled with the pumped liquid before starting (except R and S constructions).
- The pump must run above the minimum recommended flow and never dry (except R and S constructions).
- The suction valve must be open during operation.
- If leakage of harmful or dangerous substances can occur - prepare proper means for a safe waste removal.
- There is no protection against contact in the shaft seal area.
- The parts in contact with the pumped liquid can be dangerously hot.

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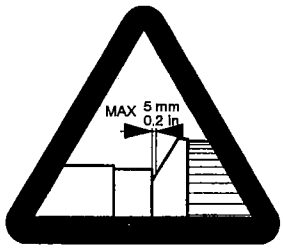
4 Safety signs affixed to the product

The following warnings and informative signs concerning the essential safety aspects are permanently fixed on the product. Safety signs must always be observed and kept clean and legible in any operating condition. The user must always check that the symbols or items presented in those are understood by all user groups before putting the product into service.

4.1 Safety signs on the product



Item no. 976.2 Coupling alignment values



Item no. 975.4 Coupling guard jacket to be adjusted during assembly



Item no. 975.2. Rotating shaft, do not touch when in operation

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Item no. 975.1. Hot surface, do not touch (to be fixed when the temperature of the pumped liquid is > 60 °C (140 °F))



Item no 975.3. Splashing of corrosive or irritative substances (this sign is delivered unattached and it is attached to the both sides of adapter if necessary)



5 Operating situations affecting product safety

The following inadequate operating situations always have consequences which have an immediate effect on the product safety and therefore they are not allowed in any operating conditions with this product.

Table 1 Typical inadmissible operating situations

Cause:	Consequence:
Discharge valve not opened. Inlet pressure or piping system resistance incorrectly estimated when the pump was originally selected. The pump is operated at too high a rotational speed.	Inadmissible pressure increase
Discharge valve not opened. Discharge valve throttled too much. Properties of the pumped liquid incorrectly estimated when the pump was originally selected.	High temperatures (Hydraulic parts)
Gland packing tightened too much . Adequate sealing water service neglected. - Sealing water pump not started - Sealing water valve not opened - Sealing water equipment incorrectly adjusted - Quality of the sealing water does not match our requirements. Inlet pressure incorrectly estimated when the pump was originally selected. Pump is not properly filled with the pumped liquid. - Suction valve not opened - Suction tank not properly filled - Suction piping resistance or air tightness improperly checked	High temperatures (Shaft sealing)
Pump lubrication carried out inadequately. - Oil/grease filling neglected - Oil/grease quality incorrectly selected - Relubrication carried out inadequately Pump washdown carried out inadequately (sprayed water enters the bearing unit). Properties of the pumped liquid incorrectly estimated when the pump was originally selected.	High temperatures (Bearing unit)

6 Admissible forces and moments on pump flanges

Table 2 gives the maximum external forces and moments towards the pump flanges. The maximum permissible joint effect of the forces and moments:

$$\left(\frac{\Sigma\,|F_v|}{|F_v\,max|}\right)^2 + \left(\frac{\Sigma\,|F_h|}{|F_h\,max|}\right)^2 + \left(\frac{\Sigma\,|M_t|}{|M_t\,max|}\right)^2 \leq 1$$

The forces and moments are valid for a cast steel pump with grouted baseplate. If not grouted, the figures for a non-grouted baseplate are obtained by multiplying the figure given in Table 2 by 0.25. The figures for a cast iron pump are obtained by multiplying the figure given in Table 2 by 0.5 and the figures for a chrome iron pump are obtained by multiplying the figure given in Table 2 by 0.25.

1 Σ (2/3 $|F_V|$ discharge flange$|$ + $|F_V|$ suction flange$|$) $\leq$ F_v max

2 Σ ($|F_h|$ discharge flange$|$ + $|F_h|$ suction flange$|$) $\leq$ F_h max

3 Σ ($|M_t|$ discharge flange$|$ + $|M_t|$ suction flange$|$) $\leq$ M_t max

$|F_V| = |F_y|$ = forces in direction y

$|F_h| = |F_x| + |F_z|$ = forces in directions x and z

$|M_t| = |M_x| + |M_y| + |M_z|$ = moments in directions x, y and z

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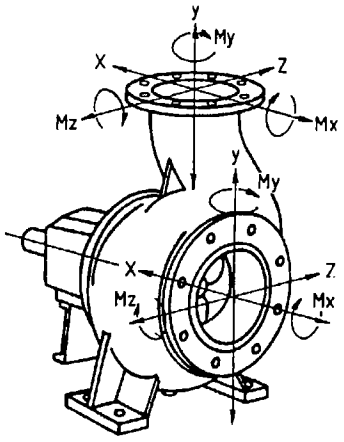


Fig. 32

Table 2 ***Flange forces and moments***

Pump size	Pump types	Forces (N)		Moments (Nm)
		F_v max 1)	F_h max 2)	M_t max 3)
11-32	A_P	4200	3000	700
11-40	A_P	4500	3200	1000
11-50	A_P	5100	3900	1300
21-50	N_P	6200	4700	2000
21-65	A_P	6200	4700	2000
21-80, 8S	A_P, N_P	6900	5400	2500
22-32	A_P, W_P	4200	3000	700
22-40	A_P	4500	3200	1000
22-50	A_P, N_P, W_P	5100	3900	1300
22-65	A_P	6200	4700	2000
22-80, 8S	A_P, N_P	6900	5400	2500
23-40	A_P	4500	3200	1000
23-50	A_P, W_P	5100	3900	1300
31-65	EPP	7200	7200	2700
31-100, 10S	A_P, N_P	8600	7000	3700
31-100	EPP	10800	10800	3600
31-125, 10P	A_P	11500	10000	5800
31-150	A_P	15800	13200	7800
32-65	A_P	6200	4700	2000
32-80, 8S	A_P, N_P, W_P	6900	5400	2500
32-100, 10S	A_P, N_P, W_P	8600	7000	3700
32-100	EPP	10800	10800	3600
32-125, 10P	A_P, W_P	11500	10000	5800
33-80	N_P	8600	7000	3700
33-100, 10S	A_P, N_P, W_P	8600	7000	3700
33-125, 10P	A_P	11500	10000	5800
41-150	EPP	15000	15000	5600
41-200	A_P	23000	19200	12700
41-200	EPP	19000	19000	8700

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Pump size	Pump types	Forces (N)		Moments (Nm)
		F_v max 1)	F_h max 2)	M_t max 3)
41-300	A_P	37500	31100	22600
42-150	A_P, N_P	15800	13200	7800
42-150	EPP	15000	15000	5600
42-200	A_P, N_P	23000	19200	12700
42-200	EPP	19000	19000	8700
42-250	EPP	23000	23000	12300
43-100	EPP	10800	10800	3600
43-150	EPP	15000	15000	5600
43-250	A_P	30300	25100	17700
43-300	A_P	37500	31100	22600
44-150	A_P, N_P, W_P	15800	13200	7800
44-200	A_P, N_P, W_P	23000	19200	12700
51-250	A_P	30300	25100	17700
51-300	A_P	37500	31100	22600
52-350	A_P	40500	35000	25000
52-350	EPP	31000	31000	20500
52-400	A_P	44800	37000	27600
53-100	A_P, W_P	10000	9000	5200
53-100	EPP	10800	10800	3600
53-150	A_P, W_P	23000	13200	7800
53-200	A_P, W_P	23000	19200	12700
53-200	EPP	19000	19000	8700
53-250	A_P, N_P, W_P	30300	25100	17700
53-250	EPP	23000	23000	12300
53-300	A_P	37500	31100	22600
53-300	EPP	27200	27200	16100
54-300	EPP	27200	27200	16100
54-400	A_P, W_P	44800	37000	27600
54-500	A_P	52000	43000	32500
54-500	EPP	41600	41600	33800
55-100	A_P	15000	13500	7800
55-200	A_P	23000	19200	12700
55-250	A_P	23000	25100	17700
55-300	A_P, W_P	44800	31100	22600
55-300	EPP	27200	27200	16100
61-500	APP, ARP	54000	45000	34000
61-500	EPP	41600	41600	33800
61-600	APP, ARP, WPP, WRP	58000	49000	37000
62-400	APP, ARP	48400	40000	30000

Pump size	Pump types	Forces (lbf)		Moments (lb ft)
		F_v max 1)	F_h max 2)	M_t max 3)
11-1A	A_T	945	675	515
11-1B	A_T	1010	720	740
11-2	A_T	1140	880	960
21-2	N_T	1400	1060	1480
21-2B	A_T	1400	1060	1480

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Pump size	Pump types	Forces (lbf)		Moments (lb ft)
		F_v max 1)	F_h max 2)	M_t max 3)
21-3	A_T, N_T	1550	1210	1850
22-1A	A_T, W_T	1010	720	740
22-1B	A_T	1140	720	740
22-2	A_T, N_T, W_T	1400	1060	1480
22-2B	A_T	1550	1210	1850
22-3	A_T, N_T	1010	720	740
23-1B	A_T	1010	720	740
23-2	A_T, W_T	1140	880	960
31-2B	EPT	1650	1650	2000
31-4	A_T, N_T	1930	1570	2730
31-4	EPT	2450	2450	2650
31-4C	A_T	2580	2250	4280
31-6	A_T	3550	2970	5750
32-2B	A_T	1400	1060	1480
32-3	A_T, N_T, W_T	1550	1210	1850
32-4	A_P, N_P, W_P	1930	1570	2730
32-4	EPT	2450	2450	2650
32-4C	A_T, W_T	2580	2250	4280
33-3	N_T	1930	1570	2730
33-4	A_T, N_T, W_T	1930	1570	2730
33-4C	A_T	2580	2250	4280
41-6	EPT	3400	3400	4150
41-8	A_T	5170	4300	9350
41-8	EPT	4300	4300	6450
41-12	A_T	8450	6990	16700
42-6	A_T, N_T	3550	2970	5750
42-6	EPT	3400	3400	4150
42-8	A_T, N_T	5170	4300	9350
42-8	EPT	4300	4300	6450
42-10	EPT	5200	5200	9100
43-4	EPT	2450	2450	2650
43-6	EPT	3400	3400	4150
43-10	A_T	6800	5650	13000
43-12	A_T	8450	6990	16700
44-6	A_T, N_T, W_T	3550	2970	5750
44-8	A_T, N_T, W_T	5170	4300	9350
51-10	A_T	6800	5650	13000
51-12	A_T	8450	6990	16700
52-14	A_T	9100	7870	18400
52-14	EPT	6970	6970	15120
52-16	A_T	10100	8300	20300
53-4	A_T, W_T	3550	1570	2730
53-4	EPT	2450	2450	2650
53-6	A_T, W_T	5170	2970	5750
53-8	A_T, W_T	5170	4300	9350
53-8	EPT	4300	4300	6450
53-10	A_T, N_T, W_T	6800	5650	13000
53-10	EPT	5200	5200	9100

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Pump size	Pump types	Forces (lbf)		Moments (lb ft)
		F_v max 1)	F_h max 2)	M_t max 3)
53-12	A_T	8450	6990	16700
53-12	EPT	6100	6100	11900
54-12	EPT	6100	6100	11900
54-16	A_T, W_T	10100	8300	20300
54-20	A_T	11700	9650	24000
54-20	EPT	9400	9400	25000
55-4	A_T	5300	2350	4100
55-8	A_T	6800	4300	9350
55-10	A_T	6800	5650	13000
55-12	A_T, W_T	10100	6990	16700
55-12	EPT	6100	6100	11900
61-20	APT, ART	12140	10115	25100
61-20	EPT	9400	9400	25000
61-24	APT, ART, WPT, WRT	13035	10115	27300
62-16	APT, ART	10880	8990	22100

7 Sound level charts

Noise emission values are stated according to ISO 4871 and the essential requirements in the Machinery Directive 89/362/EEC.

The noise values are given in accordance with standard prEN12639.

Sound power levels have been determined according to ISO/DIS 9614 Part II using sound intensity measurements.

It is not possible to measure all different pump applications. Therefore, some values have been determined by calculations based on measurements with similar pumps and Europump's Guide 001/30/E, Forecasting the Airborne Noise Emission of Centrifugal Pumps

LpA = A-weighted sound pressure level, dB re 20 μPa, at the relevant working station.

LwA = A-weighted sound power level, dB re 1 pW, if A-weighted sound pressure level exceeds 85 dB.

7.1 Closed impellers

Table 3 ***Sound pressure level LpA / closed impellers (dB)***

Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
11-32	APP	<70	<70			
11-40	APP	<70	<70			
11-50	APP	<70	<70			
21-50	N_P	71	<70	<70		
21-65	APP	<72	<70			
21-80, 8S	APP	74	<70			
21-80	NPP	75	<70			

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Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
22-40	APP	71	<70	<70		
22-50	APP, WPP	73	<70	<70		
22-50	NPP	76	<70	<70		
22-65	APP	75	<70	<70		
22-80, 8S	APP	78	<70	<70		
22-80	NPP		<70	<70		
23-50	APP, WPP	77	<70	<70		
31-65	EP	78	<70			
31-100, 10S	APP	80	<70	<70		
31-100,	EPP	81	<70	<70		
31-100	NPP		<70	<70		
31-125, 10P	APP	82	<70	<70		
31-150	APP		72	<70		
32-65	APP	79	<70	<70		
32-80, 8S	APP, WPP	81	<70	<70		
32-80	NPP		71	<70		
32-100, 10S	APP, WPP	82	71	<70		
32-100	NPP		73	<70		
32-125, 10P	APP	85	73	<70		
32-200	EPP		74	<70		
33-80	NPP		76	<70	<70	
33-100, 10S	APP, WPP		74	<70	<70	
33-100	NPP		77	70	<70	
33-125, 10P	APP, WPP		76	<70	<70	
41-150	EPP		74	<70		
41-200	APP		77	<70		
41-200	EPP		76	<70		
41-300	APP		79	72		
42-150	APP		76	<70		
42-150	EPP		78	71		
42-150	NPP		76	<70		
42-200	APP		78	71		
42-200	EPP		80	72		
42-200	NPP		77	70		
42-250	EPP		82	75		
43-100	EPP		78	71		
43-150	EPP		81	74		
43-250	APP		82	75	<70	
43-300	APP		83	76	<70	
44-150	APP, WPP		78	71	<70	
44-150	NPP		80	73	<70	
44-200	APP, NPP, WPP		81	74	<70	
51-250	APP		85	78	73	
51-300	APP		87	80	74	
52-350	APP			81	76	
52-350	EPP			81	76	
52-400	APP			85	80	
53-100	APP, EPP, WPP		82	75	70	
53-150	APP, WPP		84	77	72	

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Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
53-200	APP, EPP, WPP		86	79	74	
53-250	APP, WPP		88	81	76	
53-250	EPP		85	78	73	
53-250	NPP			83	78	
53-300	APP		89	82	77	
53-300	EPP		87	80	75	
54-300	EPP			84	79	
54-400	APP, WPP			87	82	78
54-500	APP			88	83	79
54-500	EPP			85	80	76
55-100	APP		87	80	75	
55-200	APP		89	82	77	73
55-250	APP		91	84	79	75
55-300	APP, EPP, WPP			86	81	77
61-600	WPP			92	87	83

Pump size	Pump types	Pump rot. speed (rpm)				
		3550	**1760**	**1180**	**880**	**710**
11-1A	APT	<70	<70	<70		
11-1B	APT	<70	<70	<70		
11-2	APP	72	<70	<70		
21-3	N_T		<70	<70	<70	
21-2B	APT	75	<70	<70		
21-3	APT	77	<70	<70		
21-3	NPT		<70	<70	<70	
22-1B	APT	75	<70	<70	<70	
22-2	APT, WPT	76	<70	<70	<70	
22-2	NPT		<70	<70	<70	
22-2B	APT	79	<70	<70	<70	
22-3	APT	81	<70	<70	<70	
22-3	NPT		<70	<70	<70	
23-2	APT, WPT		<70	<70	<70	
31-2B	EPT	81	<70	<70		
31-4	APT	83	71	<70	<70	
31-4	EPT	84	<72	<70	<70	
31-4	NPT		<71	<70	<70	
31-4C	APT		72	<70	<70	
31-6	APT		75	<70	<70	
32-2B	APT		71	<70	<70	
32-3	APT, WPT		<70	<70	<70	
32-3	NPT		74	<70	<70	
32-4	APT, WPT		74	<70	<70	
32-4	NPT		76	<70	<70	
32-4C	APT		73	<70	<70	
32-4	EPT		77	<70		
33-3	NPT		79	<72	<70	<70
33-4	APT, WPT		74	<70	<70	
33-4	NPT		80	73	<70	<70
33-4C	APT, WPT		79	<72	<70	

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Pump size	Pump types	Pump rot. speed (rpm)				
		3550	**1760**	**1180**	**880**	**710**
41-6	EPT		77	<70	<70	
41-8	APT		80	72	<70	
41-8	EPT		79	72	<70	
41-12	APT		82	75	<70	
42-6	APT		79	71	<70	
42-6	EPT		80	73	<70	
42-6	NPT		79	72	<70	
42-8	APT		81	74	<70	
42-8	EPT		83	76	<70	
42-8	NPT		80	73	<70	
42-10	EPT		85	78	71	<10
43-4	EPT		81	74	72	
43-6	EPT		84	77	72	
43-10	APT		85	78	73	
43-12	APT			79	74	
44-6	APT, WPT		81	74	74	
44-6	NPT		83	76	71	<70
44-8	APT, NPT, WPT		84	77	<70	
51-10	APT		88	81	76	72
51-12	APT			83	78	73
52-14	APT			84	79	75
52-14	EPT			-	-	
52-16	APT			88	82	78
53-4	APT, EPT, WPT		85	78	73	<70
53-6	APT, WPT		87	80	75	71
53-8	APT, EPT, WPT		89	82	77	73
53-10	APT, WPT			84	79	75
53-10	EPT		88	81	75	72
53-10	NPT			81	77	
53-12	APT			85	80	76
53-12	EPT		90	83	78	74
54-12	EPT			84	79	
54-16	APT, WPT			87	82	78
54-20	APT			91	86	83
54-20	EPT			86	82	78
55-4	APT		90	83	78	
55-8	APT			85	80	76
55-10	APT			87	82	78
55-12	APT, EPT, WPT			89	84	80
61-24	WPT				91	86

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Table 4 ***Sound power level LwA / closed impellers (dB)***

Pump size	Pump types	Pump rot. speed (rpm)			
		2950	**1480**	**980**	**740**
51-300	APP		95		
53-200	APP, EPP, WPP		94		
53-250	APP, WPP		96		
53-300	APP		97		
54-400	APP, WPP			95	
54-500	APP			96	
55-100	APP		95		
55-200	APP		97		
55-250	APP		99		
55-300	APP, EPP, WPP			94	
61-600	WPP			100	95

Pump size	Pump types	Pump rot. speed (rpm)			
		3550	**1760**	**1180**	**880**
51-12	APT			83	
53-8	APT, EPT, WPT			82	
53-10	APT, WPT		89	84	
53-12	APT			85	
54-16	APT, WPT			90	
54-20	APT			91	
55-4	APT		90	83	
55-8	APT			85	
55-10	APT			87	
55-12	APT, EPT, WPT			89	
61-24	WPT			100	95

7.2 Open, special open and low pulse impellers

Table 5 ***Sound pressure level LpA / open impellers (dB)***

Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
11-32	A_P	<70	<70			
11-40	A_P	<70	<70			
11-50	A_P	<70	<70			
21-65	A_P	<70	<70			
21-80, 8S	A_P	73	<70			
22-32	A_P, W_P	<70	<70	<70		
22-40	A_P	<70	<70	<70		
22-50	A_P, W_P	73	<70	<70		
22-65	A_P	75	<70	<70		
22-80, 8S	A_P	77	<70	<70		
23-40	A_P	75	<70	<70		
23-50	A_P, W_P	77	<70	<70		
31-100, 10S	A_P	79	<70	<70		
31-100	EPP		<70	<70		
31-125, 10P	A_P	81	<70	<70		

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Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
31-150	A_P		<70	<70		
32-65	A_P		<70	<70		
32-80, 8S	A_P, W_P		<70	<70		
32-100, 10S	A_P, W_P		<70	<70		
32-100	EPP		74	<70		
32-125, 10P	A_P, W_P		72	<70		
33-100, 10S	A_P, W_P		74	<70	<70	
33-125, 10P	A_P		76	<70	<70	
41-150	EPP		74	<70		
41-200	A_P		76	<70		
41-200	EPP		77	70		
41-300	A_P		79	<70		
42-150	A_P		75	<70		
42-150	EPP		76	70		
42-200	A_P		78	71		
42-200	EPP		80	73		
42-250	EPP		81	74		
43-100	EPP		78	71		
43-150	EPP		81	74		
43-250	A_P		82	75	70	
43-300	A_P		83	76	71	
44-150	A_P, W_P		78	71	<70	
44-200	A_P, W_P		81	74	<70	
51-250	A_P		84	77	72	
51-300	A_P		86	79	74	
52-350	A_P			81	76	
52-400	A_P			84	79	
53-100	A_P, EPP, W_P		82	75	70	
53-150	A_P, W_P		84	77	72	
53-200	A_P, W_P		86	79	74	
53-200	EPP		85	78	73	
53-250	A_P, W_P		88	80	75	
53-250	EPP		83	76	71	
53-300	A_P		89	82	77	
53-300	EPP		85	78	73	
54-400	A_P, W_P			87	82	78
54-500	A_P			87	82	78
54-500	EPP			83	78	
55-100	A_P		87	80	75	
55-200	A_P			82	77	73
55-250	A_P			84	79	75

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Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
55-300	A_P, EPP, W_P			86	81	77
61-500	APP, EPP, ARP			93	88	84
61-600	APP, ARP, WPP, WRP			92	87	83
62-400	APP, ARP			91	86	82

Pump size	Pump types	Pump rot. speed (rpm)				
		3550	**1760**	**1180**	**880**	**710**
11-1A	A_T	<70	<70	<70		
11-1B	A_T	<70	<70	<70		
11-2	A_T	72	<70	<70		
21-2B	A_T	75	<70	<70		
21-3	A_T	77	<70	<70		
22-1A	A_T, W_T		<70	<70		
22-1B	A_T	74	<70	<70	<70	
22-2	A_T, W_T	76	<70	<70	<70	
22-2B	A_T	79	<70	<70	<70	
22-3	A_T	81	<70	<70	<70	
23-1B	A_T		<70	<70	<70	
23-2	A_T, W_T		<70	<70	<70	
31-4	A_T	83	<70	<70	<70	
31-4	EPT		72	<70	<70	<70
31-4C	A_T		73	<70	<70	
31-6	A_T		75	<70	<70	
32-2B	A_T		72	<70	<70	
32-3	A_T, W_T		72	<70	<70	
32-4	A_T, W_T		74	<70	<70	
32-4	EPT		77	<70		
32-4C	A_T, W_T		76	<70	<70	
33-4	A_T, W_T		76	<70	<70	
33-4C	A_T		79	72	<70	
41-6	EPT		77	<70	<70	
41-8	A_T		79	72	<70	
41-8	EPT		80	72	<70	
41-12	A_T		82	74	<70	
42-6	A_T		79	71	<70	
42-6	EPT		79	72	<70	
42-8	A_T		81	74	<70	
42-8	EPT		83	75	71	
42-10	EPT		84	76	71	
43-4	EPT		81	74		
43-6	EPT		84	77	72	
43-10	A_T		85	78	73	
43-12	A_T			79	74	
44-6	A_T, W_T		81	74	<70	
44-8	A_T, W_T		84	77	72	
51-10	A_T		88	80	76	<70
51-12	A_T			82	77	73
52-14	A_T			84	79	75
52-16	A_T			87	82	78

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Pump size	Pump types	Pump rot. speed (rpm)				
		3550	1760	1180	880	710
53-4	A_T, EPT, W_T		85	78	73	<70
53-6	A_T, W_T		87	80	75	<70
53-8	A_T, W_T		89	82	77	73
53-8	EPT			81	77	72
53-10	A_T, W_T			84	79	75
53-10	EPT			78	73	<70
53-12	A_T			85	80	76
53-12	EPT			81	76	72
54-16	A_T, W_T			90	85	82
54-20	A_T				86	82
54-12	EPT			86	81	77
55-4	A_T		90	82	77	
55-8	A_T			84	79	76
55-10	A_T			86	82	78
55-12	A_T, EPT, W_T			88	84	80
61-20	APT, EPT, ART				91	87
61-24	APT, ART, WPT, WRT				91	86
62-16	APT, ART				90	85

Table 6 ***Sound power level LwA / open impellers (dB)***

Pump size	Pump types	Pump rot. speed (rpm)		
		1480	980	740
51-300	A_P	94		
53-200	A_P, W_P	94		
53-250	A_P, W_P	96		
53-300	A_P	97		
54-400	A_P, W_P		95	
54-500	A_P		95	
55-100	A_P	95		
55-300	A_P, EPP, W_P		94	
61-500	APP, ARP, EPP		101	96
61-600	APP, ARP, WPP, WRP		100	95
62-400	APP, ARP		99	94

Pump size	Pump types	Pump rot. speed (rpm)		
		1760	1180	880
51-10	A_T	96		
52-16	A_T, W_T		95	
53-6	A_T, W_T	95		
53-8	A_T	97		
54-16	A_T, W_T		98	
54-20	A_T			94
55-4	A_P	98		
55-10	A_T, EPT, W_T		94	
55-12	APT, ART, EPT		96	
61-20	APT, ART, WPT, WRT			99
61-24	APT, ART			99

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7.3 Vortex impellers

Table 7 ***Sound power level LpA / vortex impellers (dB)***

Pump size	Pump types	Pump rot. speed (rpm)				
		2950	**1480**	**980**	**740**	**590**
21-50	N_P	72	<70			
21-80	N_P	76	<70			
22-50	N_P, W_P	77	<70	<70		
22-80	N_P		<70	<70		
31-100	N_P		71	<70		
32-80	N_P, W_P		73	<70		
32-100	N_P, W_P		75	<70		
32-125	W_P		77	<70		
33-80	N_P		77	<70	<70	
33-100	N_P, W_P		79	70	<70	
42-150	N_P		79	71		
42-200	N_P		80	72		
44-150	N_P, W_P		82	74	<70	
44-200	N_P, W_P		82	75	<70	
53-100	W_P			79	74	
53-150	W_P			81	76	
53-200	W_P			82	77	
53-250	N_P, W_P			84	79	

Pump size	Pump types	Pump rot. speed (rpm)				
		3550	**1760**	**1180**	**880**	**710**
21-2	N_T	76	<70			
21-80	N_T		<70			
22-2	N_T, W_T		<70	<70	<70	
22-3	N_T		71	<70	<70	
31-4	N_T		73	<70	<70	
32-3	N_T, W_T		76	<70	<70	
32-4	N_T, W_T		77	<70	<70	
32-4C	W_T		79	72	<70	
33-3	N_T		79	72	<70	<70
33-4	N_T, W_T		80	72	<70	<70
42-6	N_T		81	74	<70	
42-8	N_T		82	75	<70	
44-6	N_T, W_T		84	78	72	<70
44-8	N_T, W_T			78	72	
53-4	W_T				72	<70
53-6	W_T				74	72
53-8	W_T				75	73
53-10	N_T, W_T				77	76

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8 Balance and vibration

The pump is normally balanced in accordance with grade G 6.3 of ISO 1940, in special cases with grade G 2.5 of ISO 1940. Vibration does not exceed the vibration severity limits given in Table 8 when measured at the manufacturer's test facilities. These values are measured radially at the bearing housing at rated speed and flow when operating without cavitation.

A pump equipped with a specially designed impeller may exceed the limits given in Table 8.

Table 8 ***Max. r.m.s values of vibration velocity***

Speed of rotation	Shaft centerline height H1 **≤225 mm**	Shaft centerline height H1 **>225 mm**	Shaft centerline height H1 **≤ 8.86 in**	Shaft centerline height H1 **> 8.86 in**
≦ 1800 rpm	2.8 mm/s	4.5 mm/s	0.11 in/s	0.177 in/s
> 1800 rpm	4.5 mm/s	7.1 mm/s	0.177 in/s	0.28 in/s

9 Maximum size of solid particles

The maximum sizes of solid spherical particles which can flow through the pump (casing/impeller) are presented in Table 9.

Table 9 ***Max. size of solid particles***

Pump size	**Pump types**	Impeller type				
		Closed	**Open**	**Spec. open**	**Vortex**	**Low pulse**
11-32	A_P	4	8	-	-	-
11-40	A_P	7	12	-	-	-
11-50	A_P	10	16	-	-	-
21-50	N_P	25	-	-	35	-
21-65	A_P	16	22	-	-	-
21-80, 8S	A_P	23	30	-	-	-
21-80	N_P	45	-	-	50	-
22-32	A_P	-	7	-	-	-
22-32	W_P	-	7	-	-	-
22-40	A_P	5	10	60	-	-
22-50	A_P	8	14	-	-	-
22-50	N_P	25	-	-	35	-
22-50	W_P	10	18	-	22	-
22-65	A_P	12	18	-	-	-
22-80, 8S	A_P	18	24	24	-	-
22-80	N_P	45	-	-	50	-
23-40	A_P	-	9	-	-	-
23-50	A_P	6	12	-	-	-
23-50	W_P	8	20	-	-	-
31-65	EPP	9	-	-	-	-
31-100, 10S	A_P	25	32	-	-	-
31-100	EPP	14	18	-	-	-
31-100	N_P	55	-	-	60	-

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Pump size	Pump types	Impeller type				
		Closed	Open	Spec. open	Vortex	Low pulse
31-125,10P	A_P	32	36	-	-	-
31-150	A_P	41	41	-	-	-
32-65	A_P	9	16	-	-	-
32-80, 8S	A_P	13	22	33	-	-
32-80	N_P	45	-	-	50	-
32-80	W_P	14	27	-	30	-
32-100, 10S	A_P	18	24	24	-	-
32-100	EPP	18	18	-	-	-
32-100	N_P	55	-	-	60	-
32-100	W_P	18	32	-	35	-
32-125, 10P	A_P	26	32	32	-	
32-125	W_P	26	32		40	-
33-80	N_P	45	-	-	50	-
33-100, 10S	A_P	13	18	29	-	6
33-100	N_P	55	-	-	60	-
33-100	W_P	14	30	-	34	-
33-125, 10P	A_P	22	29	29	-	11
41-150	EPP	29	35	-	-	-
41-200	A_P	43	47	54	-	-
41-200	EPP	35	36	-	-	-
41-300	A_P	46	56	70	-	-
42-150	A_P	34	38	38	-	-
42-150	EPP	29	28	-	-	-
42-150	N_P	75	-	-	80	-
42-200	A_P	35	48	49	-	-
42-200	EPP	36	36	60	-	-
42-200	N_P	85	-	-	85	-
42-250	EPP	34	45	-	-	-
43-100	EPP	16	16	-	-	-
43-150	EPP	24	24	-	-	-
43-250	A_P	54	62	63	-	-
43-300	A_P	53	54	71	-	-
44-150	A_P	27	27	27	-	10
44-150	N_P	75	-	-	75	-
44-150	W_P	27	44	-	50	-
44-200	A_P	41	46	46	-	19
44-200	N_P	85	-	-	80	-
44-200	W_P	41	54	-	60	-
51-250	A_P	52	54	54	-	23
51-300	A_P	48	57	69	-	30
52-350	A_P, EPP	63	63	84	-	
52-400	A_P	73	73	95	-	-
53-100	A_P	17	27	-	-	10
53-100	EPP	17	24	-	-	-
53-100	W_P	18	37	-	40	-
53-150	A_P	29	39	-	-	15
53-150	W_P	29	52	-	58	-
53-200	A_P	35	35	35	-	13

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Pump size	Pump types	Impeller type				
		Closed	Open	Spec. open	Vortex	Low pulse
53-200	EPP	32	32	35	-	-
53-200	W_P	35	55	-	61	-
53-250	A_P	49	49	49	-	20
53-250	EPP	39	48	-	-	-
53-250	N_P	105	-	-	110	-
53-250	W_P	49	70	-	77	-
53-300	A_P	62	64	64	-	27
53-300	EPP	41	41	-	-	-
54-300	EPP	56	71	-	-	-
54-400	A_P	74	74	92	-	-
54-400	W_P	74	110	-	-	-
54-500	A_P	75	75	113	-	-
54-500	EPP	60	-	-	-	-
55-100	A_P	30	30	-	-	-
55-200	A_P	34	46	-	-	-
55-250	A_P	43	43	43	-	-
55-300	A_P, EPP	61	68	68	-	-
55-300	W_P	61	79	-	-	-
61-500	A_P, EPP	-	79	98	-	-
61-600	A_P	-	97	121	-	-
61-600	WPP, WRP	90	150	-	-	-
62-400	A_P	-	61	76	-	-

Pump size	Pump types	Impeller type				
		Closed	Open	Spec. open	Vortex	Low pulse
11-1A	A_T	0.16	0.31	-	-	-
11-1B	A_T	0.31	0.47	-	-	-
11-2	A_T	0.41	0.63	-	-	-
21-2	N_T	0.98	-	-	1.38	-
21-2B	A_T	0.63	0.87	-	-	-
21-3	A_T	0.91	1.18	-	-	-
21-3	N_T	1.77	-	-	1.97	-
22-1A	A_T	-	0.28	-	-	-
22-1A	W_T	-	0.28	-	-	-
22-1B	A_T	0.20	0.39	2.36	-	-
22-2	A_T	0.31	0.55	-	-	-
22-2	N_T	0.98	-	-	1.38	-
22-2	W_T	0.39	0.71	-	0.87	-
22-2B	A_T	0.47	0.71	-	-	-
22-3	A_T	0.71	0.94	0.94	-	-
22-3	N_T	1.77	-	-	1.97	-
23-1B	A_T	-	0.35	-	-	-
23-2	A_T	0.24	0.50	-	-	-
23-2	W_T	0.31	0.79	-	-	-
31-2B	EPT	0.32	-	-	-	-
31-4	A_T	0.98	1.26	-	-	-
31-4	EPT	0.55	0.71	-	-	-
31-4	N_T	2.17	-	-	2.36	-

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Pump size	Pump types	Impeller type				
		Closed	Open	Spec. open	Vortex	Low pulse
31-4C	A_T	1.26	1.42	-	-	-
31-6	A_T	1.57	1.61	-	-	-
32-2B	A_T	0.35	0.63	-	-	-
32-3	A_T	0.51	0.87	1.30	-	-
32-3	N_T	1.77	-	-	1.97	-
32-3	W_T	0.55	1.06	-	1.18	-
32-4	A_T	0.71	0.94	0.94	-	-
32-4	EPT	0.71	0.71	-	-	-
32-4	N_T	2.17	-	-	2.36	-
32-4	W_T	0.71	1.26	-	1.38	-
32-4C	A_T	1.02	1.26	1.26	-	-
32-4C	W_T	1.02	1.26		1.57	-
33-3	N_T	1.77	-	-	1.97	-
33-4	A_T	0.51	0.71	1.14	-	0.24
33-4	N_T	2.17	-	-	2.36	-
33-4	W_T	0.55	1.18	-	1.34	-
33-4C	A_T	0.87	1.14	1.14	-	0.43
41-6	EPT	1.42	1.38	-	-	-
41-8	A_T	1.69	1.85	2.12	-	-
41-8	EPT	1.85	1.65	-	-	-
41-12	A_T	1.81	2.20	2.75	-	-
42-6	A_T	1.34	1.50	1.50	-	-
42-6	EPT	1.18	1.10	-	-	-
42-6	N_T	2.95	-	-	3.15	-
42-8	A_T	1.38	1.38	1.38	-	-
42-8	EPT	1.54	1.54	-	-	-
42-8	N_T	3.35	-	-	3.35	-
42-10	EPT	2.28	2.13	-	-	-
43-4	EPT	0.63	0.63	-	-	-
43-6	EPT	0.94	0.94	-	-	-
43-10	A_T	2.13	2.44	2.48	-	-
43-12	A_T	2.09	2.13	2.79	-	-
44-6	A_T	1.06	1.06	1.06	-	0.39
44-6	N_T	2.95	-	-	2.95	-
44-6	W_T	1.06	1.73	-	1.97	-
44-8	A_T	1.61	1.81	1.81	-	0.75
44-8	N_T	3.35	-	-	3.13	-
44-8	W_T	1.61	2.13	-	2.36	-
51-10	A_T	2.05	2.13	2.12	-	0.91
51-12	A_T	1.89	2.72	2.72	-	1.18
52-14	A_T, EPT	2.56	2.48	3.31	-	-
52-16	A_T	2.87	3.74	3.74	-	-
53-4	A_T	0.67	1.06	-	-	0.39
53-4	EPT	0.67	0.94	-	-	-
53-4	W_T	0.71	1.46	-	1.57	-
53-6	A_T	1.14	1.54	-	-	0.59
53-6	W_T	1.14	2.05	-	2.28	-
53-8	A_T	1.38	1.38	1.38	-	0.51

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Pump size	Pump types	Impeller type				
		Closed	Open	Spec. open	Vortex	Low pulse
53-8	EPT	1.26	1.26	-	-	-
53-8	W_T	1.38	2.17	-	2.40	-
53-10	A_T	1.93	1.93	1.93	-	0.79
53-10	EPT	1.85	1.89	-	-	-
53-10	N_T	4.33	-	-	4.33	-
53-10	W_T	1.93	2.76	-	-	-
53-12	A_T	2.44	2.52	2.52	-	1.06
53-12	EPT	2.56	2.17	-	-	-
54-12	EPT	2.60	2.60	-	-	-
54-16	A_T	2.95	2.91	3.62	-	-
54-16	W_T	2.91	4.33	-	-	-
54-20	A_T	4.45	4.45	4.45	-	-
54-20	EPT	4.09	-	-	-	-
55-4	A_T	1.18	1.18	-	-	-
55-8	A_T	1.34	1.81	-	-	-
55-10	A_T	1.69	1.69	1.69	-	-
55-12	A_T, EPT	2.64	2.68	2.68	-	-
55-12	W_T	2.40	3.11	-	-	-
61-20	A_T, EPT	-	3.11	3.89	-	-
61-24	A_T	-	5.19	5.19	-	-
61-24	WPT, WRT	3.54	5.91	-	-	-
62-16	A_T	-	2.40	3.00	-	-

SULZER

Hoisting and transportation

20000301 / en / **N14802**

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2 Hoisting and transportation 2

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1 Safety measures

WARNING

Hoisting and transportation instructions are to be strictly followed to avoid dropping of crates or individual assemblies.

The total gross and net weights of the delivery are always found in the packing list affixed to the product or packing.

Special attention is to be paid to the stability of

- pump + baseplate without motor
- exchange unit
- bearing unit
- bare impeller

The center of gravity of these items should always be checked before hoistings and transportation.

Personal protective equipment such as helmet, safety shoes and gloves are to be used.

All lifting accessories and removable components must be capable of withstanding the stresses to which they are subjected during transport, assembly and dismantling.

Lifting ropes used directly for lifting or supporting the pump or pump unit must not include any splicing other than at their ends. Textile ropes and slings must not include any knots, connections or splicing other than at the ends of the sling, except in the case of an endless sling.

Lifting accessories must bear the identification of the manufacturer, material and the maximum working load.

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2 Hoisting and transportation

The lifting accessories must always be able to adequately support the hoisted assembly.

If suitable lifting equipment is not available, heavy assemblies must be transferred by using skids etc. on the ground level.

The crates or individual assemblies must never be dropped to the ground during transportation. Refer to Figures 1 - 4 for examples of proper lifting techniques.

The transportation crate is hoisted according to Fig. 1. Permissible lifting points are also marked on the crate.

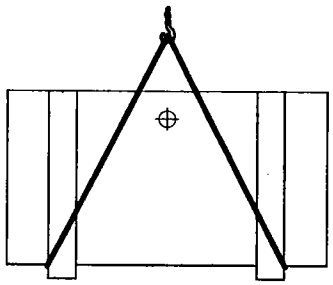


Fig. 1

The pump-motor-baseplate-assembly may be hoisted from under the pump suction flange and motor or under the baseplate. Fig. 2.

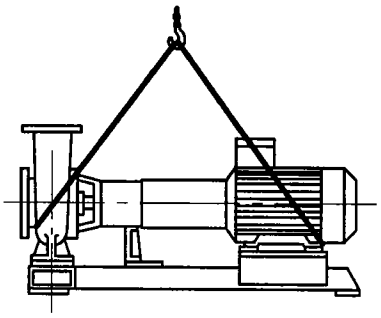


Fig. 2

The pump-baseplate-assembly is hoisted from under the pump suction flange and baseplate. Fig. 3.

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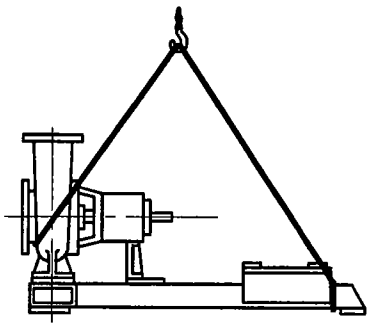


Fig. 3

The bare pump is hoisted from under the pump suction flange and bearing housing. Fig. 4.

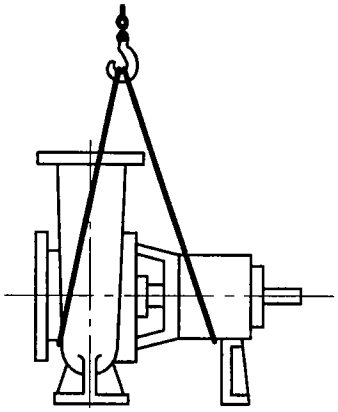


Fig. 4

SULZER

Commissioning

20000301 / en / **N14803**

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2.2 Long-term 1

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1 Purchase inspection

Check carefully that the delivery meets your order and is in accordance with the packing list and parts list of the pump. Inform the supplier immediately about any defects or damage observed.

Do not remove the cover plates or plugs protecting the openings before the installation of pipes. Foreign particles inside the pump may damage it at starting.

Examine the crate and wrapping before discarding them since parts and accessories are sometimes wrapped individually or fastened into the crate.

If the pump unit is not installed immediately, it should be stored under conditions that will prevent deterioration due to damage and/or corrosion. The long-term storage requirements should always be specified in the purchase order.

2 Storage

2.1 Short-term (less than 3 months)

When it is necessary to store a pump for a short term before the installation, it must be stored in a dry location where it cannot be affected by dirt or corrosion. Protection plates on the pump openings should not be removed.

The pump bearings and drive elements must be properly protected against any foreign matter. To prevent rusting or seizing, lubricate the pump unit before storing and turn the pump shaft by hand at least once every two weeks.

2.2 Long-term

NOTE

The grease/oil lubricants must be changed before the pump is taken into use.

WARNING

The rust preventives must be cleaned off carefully before the pump is taken into use. Solvents containing rust preventives can cause irritation to the skin and/or the respiratory system. Prolonged physical contact and breathing of vapor are to be avoided.

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If the pump or pump unit is stored for more than 3 months, the following procedures must be observed:

- Store the product in a dry place.
- Drain any liquid from the pump.
- Rotate the pump shaft by hand at least once every month to prevent bearing damage.
- With cast iron pumps equipped with gland packing, remove the gland packings (461) from the stuffing box and apply rust preventives in the stuffing box.
- With oil lubrication, the bearing unit is emptied of oil before the delivery. Fill the bearing unit with oil or coat the interior of the unit with a rust preventing film.
- Apply rust preventing agents to the unprotected parts, such as the shaft end, pump flanges and coupling. If necessary, protect the volute casing and shaft sealing with volatile corrosion inhibitors.
- Observe the storage instructions of any accessory equipment (e.g. electric motors) included in the delivery.
- If the pump unit is covered with a plastic sheet, the bottom should remain open to allow for ventilation.

SULZER

Installation

Version 11 > / 20030130 / Replaces 20000301 / en / **N14804**

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1 Safety procedures before installation

NOTE
A pump should have adequate space for proper installation and maintenance actions.

All parts for the installation must be thoroughly cleaned before the installation. All traces of antirust agents should be cleaned off from the pump flanges, shaft assembly and drive elements. Avoid any damage to installed parts when handling them.

Personal protective equipment such as helmet, safety shoes and gloves are to be used.

2 Fastener information

Table 1 shows the rated and maximum moments of torque for fasteners presented in these instructions. These shown values are only valid for fasteners where the moment values are not separately given.

Table 1 Fastener information

Screw size	Moments (Nm)		Screw size	Moments (lb ft)	
	Rating	Max. value		Rating	Max. value
M5	3.5	4.0	3/16	2.6	3.0
M6	6.0	7.0	1/4	4.4	5.0
M8	14	18	5/6	10.3	13.0
M10	30	35	3/8	22.1	26.0
M12	50	60	1/2	36.9	44.0
M16	130	160	5/8	96	118.0
M20	250	300	3/4	184.4	221.0
M24	420	520	1	309.8	383.0
M30	800	1000	1 1/8	590.1	738.0

3 Installation at the site

NOTE
When welding the foundation screws, connect the earth clamp to the baseplate, never to the pump!

The pump base must be sturdy enough to endure vibration, stress and potential forces caused by the piping.

The pump base is normally reinforced by making a concrete support stand or equivalent. Also note the bottom beams in the foundation or cavities for the different types of foundation screws.

3.1 Steel baseplate

Installation using welded foundation screws

The bottom beams in the foundation are cast in advance according to the dimensional drawing of the pump. The strength requirements for the bottom beams are given in Table 2. In order to facilitate the alignment of the beams, a so-called concrete frame can be used. The recommended accuracy for the installation of the beams is ± 10 mm (± 0.4 in) in all directions. The actual installation becomes much easier, if the upper surfaces are horizontal.

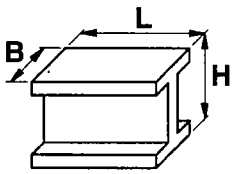
Place foundation screws (918) in the fixing holes of the baseplate. The distance between the foundation and the lower edge of the baseplate must be at least 50 mm (2 inches). Each foundation screw is fixed to the baseplate by means of hexagonal nuts (2 pcs/foundation screw). Fig.1.

Lower the pre-installed pump-motor-baseplate-assembly onto the floor so that the foundation screws are above the beams, and the pump is in its position in the lateral and longitudinal direction. Now the foundation screws can be welded to the beams.

Adjust the position of the baseplate before grouting by turning the hexagonal nuts of the foundation screws, until the assembly lies horizontally and at the correct height.

Table 2 ***Welded foundation screw***

Foundation screw	The capacity of the bottom beam (min.)		e.g. I-beam H x B x L
	F_v tension N	**F_h shear N**	**min. dimensions (mm)**
M16 x 160	8600	7500	100 x 100 x 100
M20 x 160	17300	14400	100 x 100 x 150
M24 x 200	28100	23300	120 x 120 x 200
M30 x 200	39000	32200	140 x 140 x 250



Foundation screw	The capacity of the bottom beam (min.)		e.g. I-beam H x B x L
	F_v tension lbf	**F_h shear lbf**	**min. dimensions (in)**
5/8-11 x 6	1900	1700	4 x 4 x 4
3/4-10 x 6	3900	3250	4 x 4 x 6
1-8 x 8	6300	5250	5 x 5 x 8
1 1/4-7 x 8	8775	7250	6 x 6 x 10

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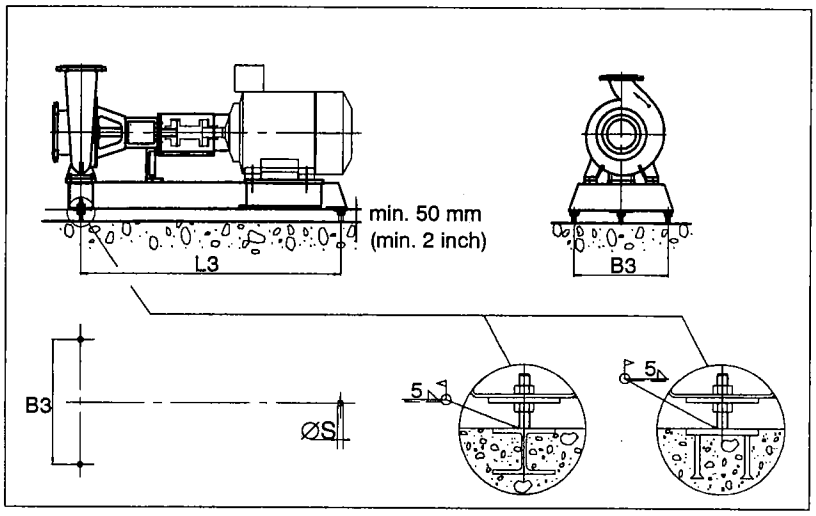


Fig. 1

Installation using grouted foundation screws

The foundation screw cavities are made in advance (by pouring of concrete, drilling) in the concrete frame according to the dimensional drawing of the pump, Table 3 and Fig. 2. The recommended accuracy for the location of the cavities is ± 10 mm (0.4 in).

Place the foundation screws (918) in the fixing holes of the baseplate, taking into account the distance between the foundation and the lower edge of the baseplate which must be at least 50 mm (2 in) and the minimum dimension U2 according to Table 3. Each foundation screw is fixed to the baseplate by means of hexagonal nuts (2 pcs/foundation screw).

Lift the pre-installed pump and baseplate onto the mounting blocks so that the distance between the foundation and the lower edge of the baseplate is at least 50 mm (2 in) and so that the foundation screws fit into their cavities and the pump is in its position in the lateral and longitudinal directions.

Grout the foundation screws. Use only non-shrinking solder concrete of high quality. Allow the concrete to set for about 1 or 2 days.

Remove the mounting blocks and adjust the position of the baseplate before grouting by turning the hexagonal nuts until the assembly lies horizontally and at the correct height.

Table 3 ***Grouted foundation screws***

Foundation screw			
Size	**~e (mm)**	**$U_{min\ (mm)}$**	**$U2_{min\ (mm)}$**
M16 x 250	100	200	160
M20 x 320	125	250	200
M24 x 400	125	300	240
M30 x 450	160	400	300

Foundation screw			
Size	**~e (in)**	**$U_{min\ (in)}$**	**$U2_{min\ (in)}$**
5/8-11 x 11	4	8	6.25
3/4-10 x 14	5	10	8
1-8 x 16	5	12	9.5
1 1/4-7 x 19	6.25	15.75	12

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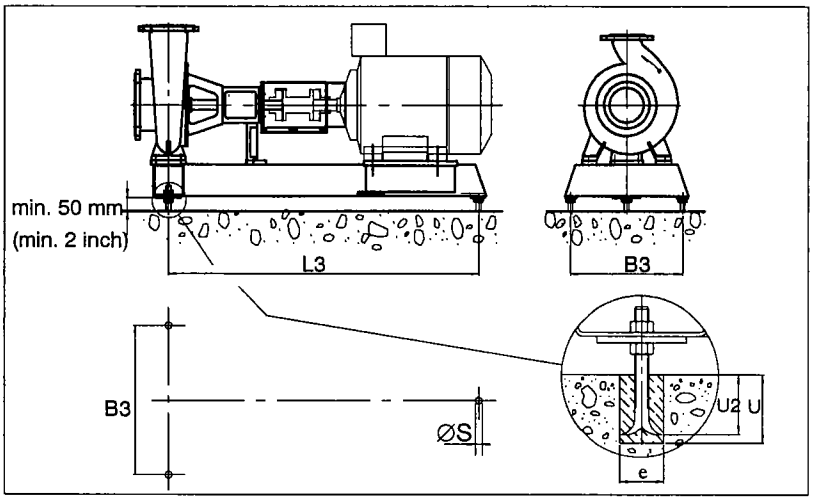


Fig. 2

Foundation

The recommended dimensioning for the foundation is given in Fig. 3. The dimensions for baseplate are given in the dimensional drawing Baseplate for pump and motor.

Pour concrete into the mold. The recommended strength grade for the concrete is about 20 MPa (2900 psi) (design strength K 20). The motor stand should be filled with concrete. Use concrete to prevent water from getting inside the beams.

The upper surface of the foundation is levelled so that it is slanting in accordance with Fig. 3. Water the grouting during its drying to prevent cracking.

Recheck the alignment of the coupling after the grouting according to section "Installation and alignment of coupling".

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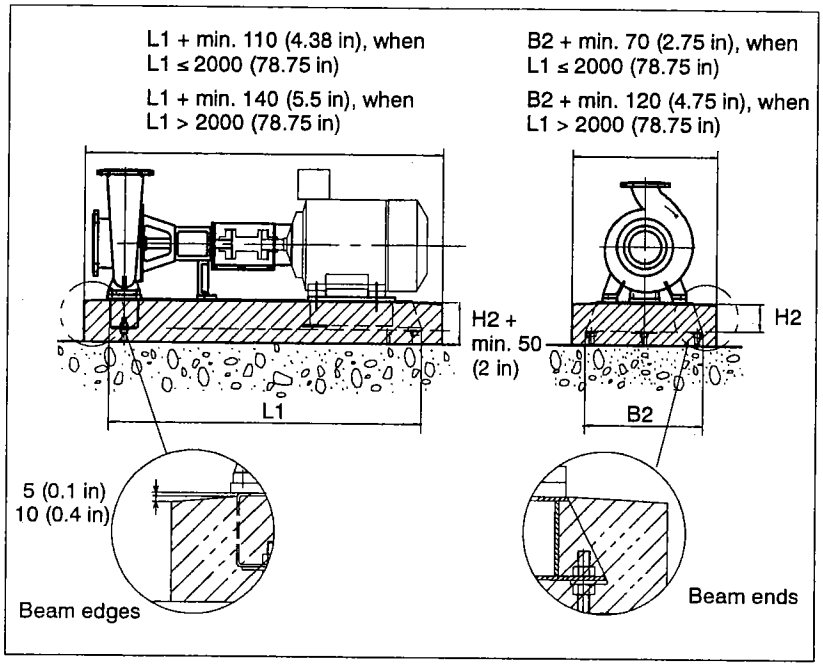


Fig. 3

3.2 Concrete baseplate (APP, ARP, ASP, NPP, NRP, NSP, WPP, WRP, WSP)

- Place washer (554.6) on foundation screw (918) on the top surface of baseplate between hexagonal nut (920.4) and baseplate.
- Place washer (554.7) on foundation screw (918) on the bottom surface of baseplate (890) between hexagonal nut (920.4) and baseplate.
- Mount riser block (556.1) between baseplate and motor (800).
- Mount riser block (556.2) between baseplate and volute casing (102) of the pump.
- Mount riser block (556.3) between baseplate and support foot (183) of the pump.

Mounting of baseplate using welded foundation screws and grouting

Lower the baseplate (890) together with the pump and motor onto the foundation so that foundation screws (918) fastened to the baseplate fit to the bottom balks in the foundation mounted in advance (by grouting, with wedge anchors) and that the pump is approximately horizontal and in place both sideways and lengthwise. Next, weld the foundation screws to the bottom balks. Perform fine adjustement of the position of the baseplate with hexagonal nuts (920.4) in the foundation screws (918) so that the baseplate 890 becomes horizontal (maximum deviation approx. 10 mm/1 m and to the correct height.

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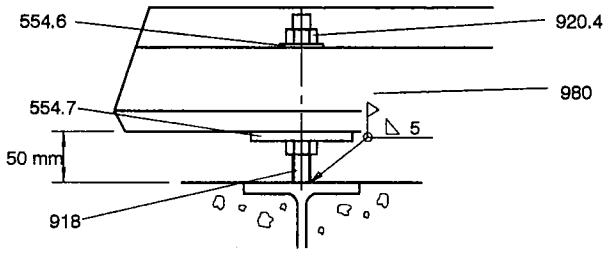


Fig. 4

Mounting of baseplate using grouted foundation screws and grouting

Lift baseplate (890) together with the pump and motor onto mounting blocks (minimum height 50 mm) so that the foundation screws (918) fit to the holes (shown in the mounting instruction for foundation screw (918)) made in advance and that the baseplate (890) is approximately horizontal and in place both sideways and lengthwise. Next, grout the foundation screw (918) using high-quality, non-shrinking grouting concrete. Allow the concrete to harden for 1 to 2 days. Remove the mounting blocks and perform fine adjustement of the baseplate by turning the hexagonal nuts (920.4) in the foundation screw (918) until the baseplate becomes horizontal and to the correct height.

After this, build a grouting mould around baseplate so that the mould extends approx.10 mm above the bottom surface of baseplate. If the grouting is made considerably higher than recommended above, ensure that the outer ends of the T groove rail in the baseplate are not blocked.

Foundation

Table 4 ***Recommended dimensions for grouting are shown***

Baseplateno.	Dimensions (mm)		
	L5 min	B5 min	A approx.
1	1090	640	70
2	1360	770	80
3	1590	890	90
4	1800	960	110
5	2040	1070	120
6	2280	1140	130
7	2520	1260	130
8	2850	1300	150
9	3070	1570	150

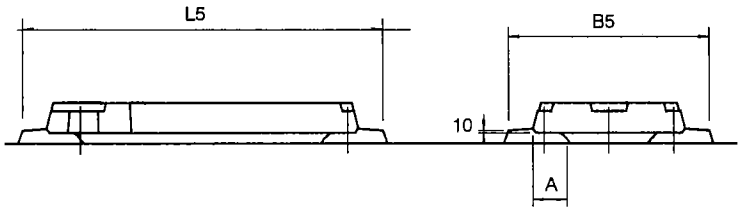


Fig. 5

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Pour the grouting concrete into the mould. Non-shrinking concrete with a hardness class approx. 300 MPa is recommended. Try to fill the space under the baseplate at least for the width of dimension A given in the table above. Level the top surface of the grouting and make it slanting as shown in the figure above. Water the grouting during hardening to prevent cracking.

Other mounting methods

Due to its rigidity, the concrete baseplate can also be mounted on mounting feet, vibration dampers, rubber sheets etc. of various kinds without grouting. Mounting methods using foundation screw given above can also be used without grouting. When using mounting methods without grouting, ensure that the external moments directed towards the flanges of the pump do not exceed the values given. Support forces must be directed to the bottom of the baseplate at least to an area shown in the Table 5, primarily to three points around the mounting holes shown as darker areas in the 6.

Table 5 ***Support surfaces***

Baseplate no.	Support surface (cm^2) (without reducing the number of holes)
1	3x10
2	3x20
3	3x30
4	3x40
5	3x60
6	3x80
7	3x110
8	3x140
9	3x180

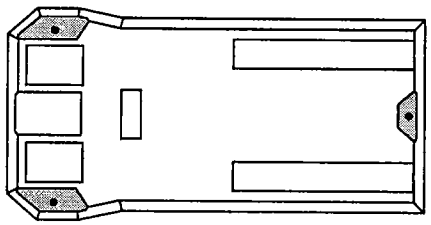


Fig. 6

When the baseplate is mounted on resilient vibration dampers, rubber sheets etc., pay attention to the vibration properties that are affected by for example weights, vibration frequencies and the properties of dampers. Deformations that take place in the dampers affect the mounting methods used for the pipes of the pump. If the baseplate is not fastened to the foundation, make sure that the pump stays in place and that the pump and motor do not fall over.

4 *Installation of the motor on the baseplate*

If the motor has not been installed on the baseplate by the pump manufacturer, the installation should be carried out as follows:

The coupling half on the motor side is warmed up to approx. 100 °C (212 °F) and pushed onto the motor shaft in such a way that the space between the ends of the shafts is according to the dimensional drawing (usually the front face of the coupling is even with the end of the shaft).

When installing the coupling, also see instructions supplied by the coupling manufacturer.

The coupling spacer is fastened to the coupling half of the motor without the flexible element.

Check that the pump is aligned as accurately as possible to the middle of the fixing holes of the motor. Lift the motor onto the riser blocks on the baseplate.

The coupling is aligned according to Section "Installation and alignment of couplings". The alignment is carried out by moving the motor vertically by means of the riser blocks or shims which are placed under the feet of the motor and laterally by moving the motor and the riser blocks sideways. Please note that there is an additional lateral adjustment allowance of 3 mm (0.12 in) in the holes of the screws in the riser block

When installing the motor, special attention should be paid to the clearance of the coupling spacer, so that the spacer can be removed without detaching the motor.

5 Pipework

5.1 Supporting

The pipes must be mounted and supported so that the piping does not exert on the pump forces which exceed the values given under item "Safety instructions/Admissible forces and moments on pump flanges". When planning the support locations remember the allowance for thermal expansion. Fig. 7.

Fit the pipe flanges accurately to the pump flanges. Flanges which have not been properly aligned must not be forced to position.

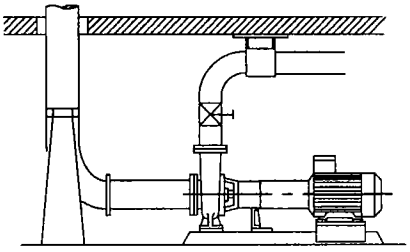


Fig. 7

5.2 Suction pipe below the pump

The suction pipe must be made as short as possible. Avoid points where air pockets or turbulence may be formed.

If the liquid level is below the pump, the suction pipe must gradually rise towards the pump. A sufficient length of the pipe end must be under the liquid level so that air cannot enter the pump. Fig. 8.

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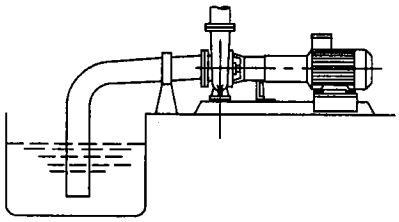


Fig. 8

5.3 Suction pipe above the pump

The suction pipe must descend gradually towards the pump. Fig. 9.

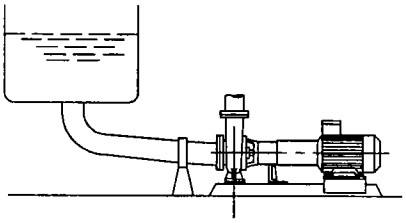


Fig. 9

5.4 Extension piece

The cones must be eccentric and in such a position that the upper level will be horizontal, alternative A in Fig. 10. If extension pieces are used, they must be formed so that gathering of gases cannot occur. At higher consistencies (c > 4 %), conical pipe parts must be avoided, alternative B in Fig. 10.

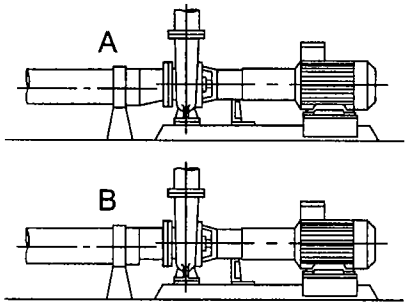


Fig. 10

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5.5 Suction pipe design

WARNING

If there is a possibility of a dangerous return flow after the shutdown of the pump, a nonreturn device shall be installed in the outlet piping.

CAUTION

Never use the pump as a support for the piping system.

If the suction pipe has branches, they must be located as far from the pump as possible, and they must be formed advantageously with regard to the flow. The suction pipe must always be made as short as possible. Fig. 11.

A shut-off valve must be placed in the discharge pipe after the potential check valve. Before commissioning, clean the piping and suction pit carefully. Tools or other things left inside the pump will damage the pump already at testing.

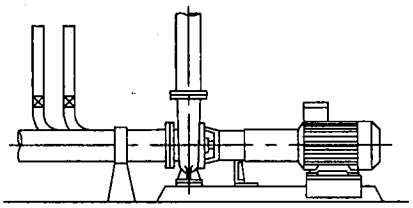


Fig. 11

6 Auxiliary piping

WARNING

During operation - leakage of hazardous substances can occur - prepare proper means for a safe waste removal.

6.1 Piping for shaft seal

In order to ensure trouple-free operation of the shaft seal, it must be provided with sealing, flushing or cooling liquid in certain applications in accordance with the sectional drawing and the parts list. The nominal sizes of the connections are also given in the parts list of the pump.

The nominal pressure of the liquid must be as high as the nominal pressure of the pump, and its maximum temperature must be as high as the maximum temperature of the pump.

Connect the sealing liquid equipment with the sealing liquid piping. In certain sealing systems, the sealing liquid equipment contains a back-pressure valve; see sectional drawing.

The piping for Quench seals is installed so that the pipe which leaves the seal (021) is continuously falling, the pipe is as short as possible and there are no points throttling the flow, because the v-ring seal is not meant for pressurized sealing liquid. Fig. 12.

Clean the sealing liquid piping carefully before commissioning.

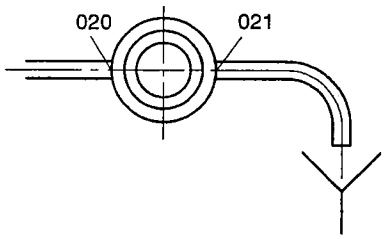


Fig. 12

6.2 R design degassing piping

The piping for degassing is connected to the degassing outlet (050) of the pump, Fig. 13. The degassing outlet can be on the left or right side of the pump depending on the design alternative, Fig. 13. The precise size and direction of the connection are shown in the dimensional drawing.

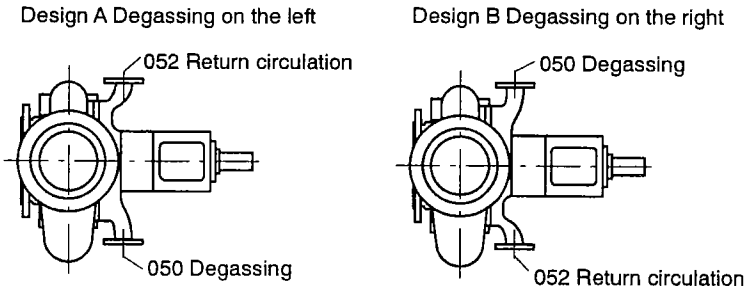


Fig. 13

In order to prevent the pumped liquid from flowing out while the pump is not running, the piping is often supplied with a shut-off valve (ball valve) equipped with an open-closed actuator. The control of the valve must be arranged so that the valve is open while the motor of the pump is running and otherwise closed.

If a separate degassing pump (vacuum pump) is used, there is also a separate vacuum relief valve.

The size of the degassing pipe is determined by the amount of gas, the length of the pipe, the risk of clogging, etc. The pipe size generally suitable is shown in Table 6.

Table 6 ***Suitable pipe sizes for degassing and return circulation***

Pump size	Outlet size 050 and 052	Suitable pipe size
_RP1	DN25	DN25 or DN32
_RP2	DN40	DN40 or DN50
_RP3	DN40	DN40 or DN50
_RP4	DN40	DN40 or DN50
_RP5	DN50	DN50 or DN65
_RP6	DN80	DN80 or DN100

6.3 R design return circulation piping

The piping for the return circulation connects the return circulation outlet (052) of the R design with the suction pipe of the pump, Fig.14.

The piping for the return circulation should be installed so as to minimize friction losses. Table 6 shows the suitable pipe size. The return circulation pipe can be equipped with a shut-off valve and sight glass if necessary.

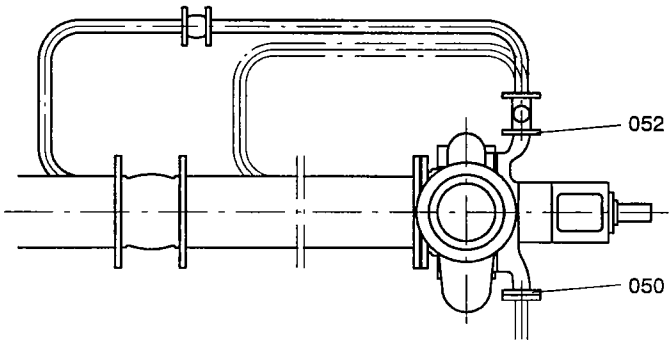


Fig. 14

6.4 S design degassing piping

Connect the degassing piping to the degassing connection (050) of the pump. The connection can be either on the right or left side of the pump. The precise size and direction of the connection are shown in the dimensional drawing.

WARNING

Some of the pumped liquid will run out of the degassing connection during pumping. Lead and handle this liquid appropriately.

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The mixture of gas and liquid discharging from the degassing connection is normally led back into the process, see examples in Figures 15, 16 and 17.

The suitable pipe size for the degassing piping is determined on the basis of pipe length, clogging risk etc. Normally, the suitable pipe size is one corresponding to the size of the degassing connection or the following larger size.

A vacuum relief valve and a pressure gauge, connected to the connection (026) opposite the degassing connection, are usually included in the degassing piping.

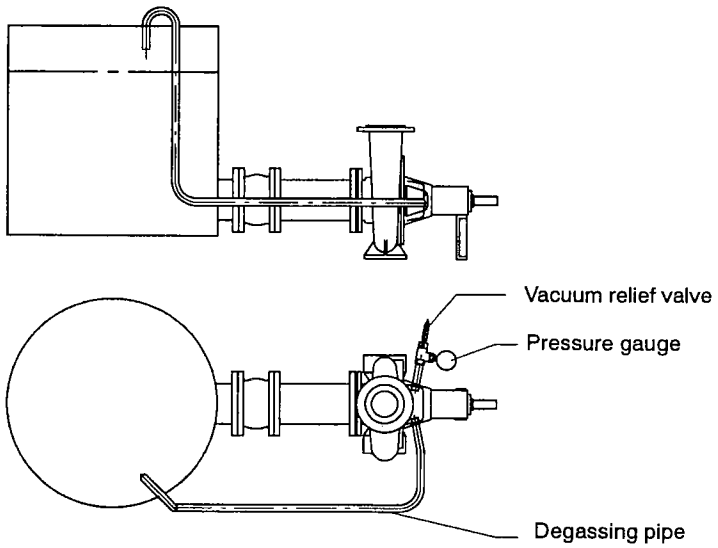


Fig. 15

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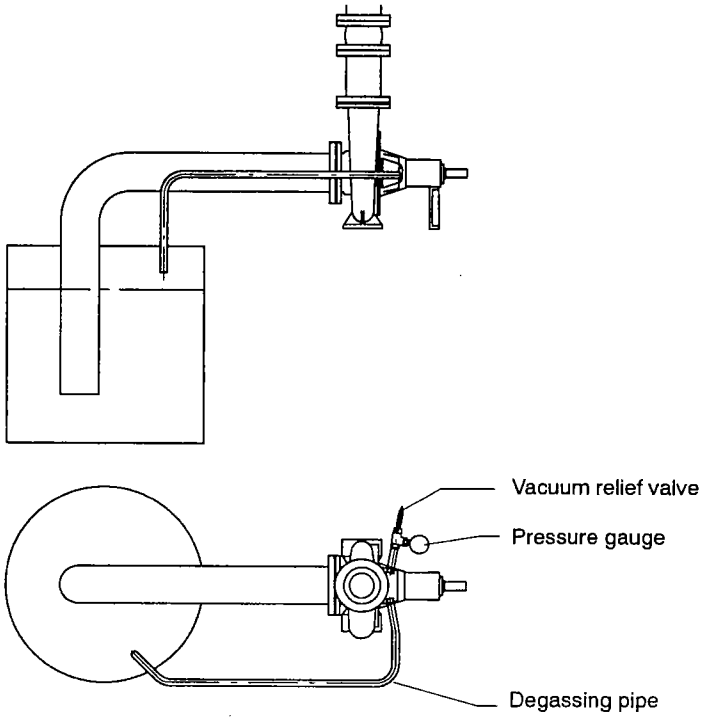


Fig. 16

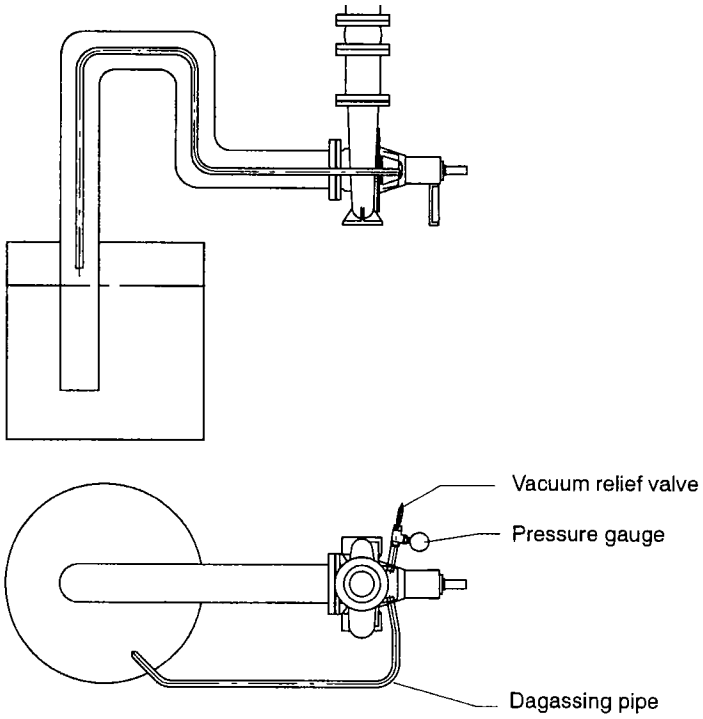


Fig. 17

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7 Installation and alignment of coupling

WARNING

Before beginning any installation or alignment procedures, make sure the drive motor cannot be started by any means.

NOTE

Satisfactory performance of the coupling depends on correct installation and alignment.

When applicable, the coupling has already been installed and prealigned at the factory. However, the alignment may change due to faulty hoistings, baseplate support, piping support, thermal expansion or the like. Therefore check the shaft alignment of the coupling and re-align during the following stages:

1 After supporting of piping and before starting the pump, tighten the fixing screws of the pump and align the coupling to the required accuracy. Fig. 19.

2 After running the pump with water, look for changes caused by the water run. Correct the changes by altering the supporting of the piping. Tighten the fixing screws of the pump and align the coupling.

3 Carry out hot alignment if the temperature of pumped liquid is higher than 100 °C (212 °F). The alignment is carried out during production run immediately after the pump is stopped while the pump and the motor are still at the operating temperature. The need for hot alignment depends on the extent of temperature differences and the coupling type chosen.

Aligment is checked by measuring the angular and parallel misaligments in vertical (6 and 12 o'clocks) and horizontal (3 and 9 o'clocks) directions. During the alignment, the coupling halves have to be locked together so that they do not move against each other. If needed, correct the aligment by adding and removing shims from under the feet of the motor and shifting the motor horizontally, until the shafts are aligned within the given tolerances. Fig. 19.

Optional alignment blocks can be used to shift the motor horizontally, see Fig. 18.

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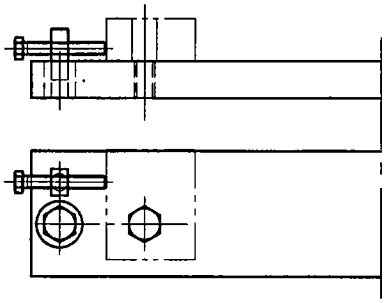
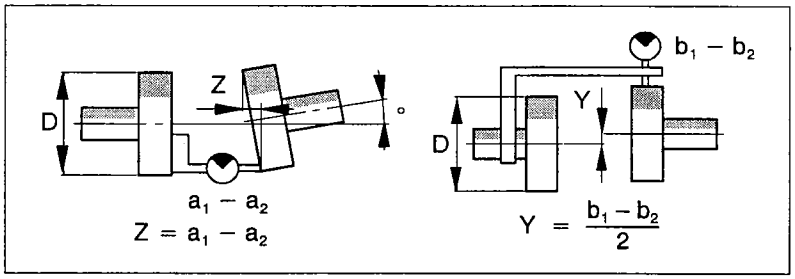


Fig. 18

7.1 Maximum tolerances for coupling alignment

The maximum tolerances for angular and parallel alignments are given in Fig. 19.



D (mm)	Z max				Y max	
	≤ 1500 rpm		> 1500 rpm		≤ 1500 rpm	> 1500 rpm
	mm	°	mm	°	mm	mm
- 100	0.08	0.06	0.05	0.04	0.10	0.06
101 - 200	0.11	0.05	0.06	0.03	0.15	0.10
201 - 300	0.15	0.03	0.10	0.02	0.20	0.15
301 - 400	0.20	0.03	0.10	0.02	0.25	0.15

D (in)	Z max				Y max	
	≤ 1800 rpm		> 1800 rpm		≤ 1800 rpm	> 1800 rpm
	in	°	in	°	in	in
0 - 4	0.003	0.06	0.002	0.04	0.004	0.003
> 4 - 8	0.004	0.05	0.003	0.03	0.006	0.004
> 8 - 12	0.006	0.03	0.004	0.02	0.008	0.006
> 12 - 16	0.008	0.03	0.004	0.02	0.010	0.006

Fig. 19

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Operation

Version 11 > / 20010910 / Replaces 20000301 / en / **N14805**

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1 Safety procedures before start-up

Before starting the pump for the first time and after service repairs, the following precautionary measures are always to be checked carefully to prevent any accidents and to guarantee a trouble-free operation of the pump.

WARNING

Make sure that the motor cannot be started by any means accidentally during the following procedures.

NOTE

Pressure containing pump parts are not pressure vessels within the meaning of the regulations for pressure vessels.

CAUTION

The pump will be damaged if run in the wrong direction.

1.1 Leakage test

The pump parts and the piping shall be able to withstand a leakage test before the start-up. Leakage, particularly in the suction piping, can seriously reduce the performance of the pump and make it impossible to prime the pump before the start-up.

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1.2 Direction of rotation

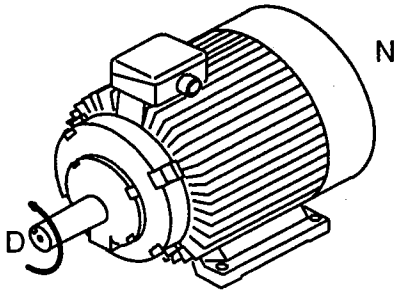


Fig. 1

- Before commissioning, always check the motor for correct rotation.
- It is imperative to detach the coupling spacer before checking the rotation direction of the motor.

The motor rotation must be counter-clockwise when viewed from the coupling end (D-end, Fig. 1) of the motor. (The pump rotation is clockwise when viewed from the coupling end.)

The direction of rotation must correspond to the arrow sign (972) on the bearing housing (330).

1.3 Free rotation

Rotate the coupling by hand with the coupling spacer detached.

1.4 Coupling alignment

Check that the coupling has been properly aligned according to the instructions in Section "Installation and alignment of coupling".

WARNING

Before starting - all safety devices (e.g coupling guards) must always be correctly installed. For explosive areas, guards with non-sparking materials are to be used.

1.5 Lubrication

WARNING

A pump unit operating without proper lubrication will damage the bearings and cause a pump seizure. Use grease lubrication always when the pump is mounted in an inclined position.

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Check the oil or grease used for the lubrication of both the pump and motor bearings before start-up. Condensation or ingress of dirt and water may occur if the pump unit is stored for a long time before installation and start-up.

1.6 Shaft seal and sealing water

Depending on the shaft seal fitting used, make sure that the shaft seal piping has been mounted correctly and that the sealing liquid pressures, liquid volumes and service intervals correspond to the table below.

Table 1 Shaft seal fittings

Fitting				Liquid							
				FR	FE	Q	BF	BN	G	T	O
PL01											
PL02				X							
PL03					X						
PL04							X				
PL05						X	X				
PC01										X	
PP21						X				X	
ME01	MC01	MR01	MU01								
ME02	MC02	MR02		X							
ME03	MC03	MR03			X						
ME04	MC04	MR04				X					
ME05		MR05							X		
	MC20	MR20				X					
ME21	MC21	MR21					X				
ME22	MC22	MR22						X			
		MR23			X	X					
		MR24			X		X				
		MR25			X			X			
		MR26				X				X	
		MR27					X			X	
DS01		DS21	SS01								
DS02		DS22		X							
DS03		DS23			X						
DP01									X		
DP02				X					X		
DP03					X				X		
DT01											X

FR = Internal circulation

FE = External flushing liquid; P_T + 0.05 MPa, 3 l/min (P_T + 7 psi, 0.8 USGPM)

Q = Unpressurized external sealing liquid; 3 l/min (0.8 USGPM)

BF = Pressurized external flowing sealing liquid; P_T + 0.05 MPa (minimum), 3 l/min (P_T + 7 psi, 0.8 USGPM)

BN = Pressurized external non-flowing sealing liquid; P_T + 0.15 MPa (minimum) (P_T + 21 psi)

G = Grease once a week

T = External temperature-adjusting liquid 3 l/min (0.8 USGPM), temperature of outlet liquid at least 30 °C (86°F) below the boiling point of the liquid pumped

O = Steam discharge

Impellers with balancing holes (APP/APT, NPP/NPT, WPP/WPT)

$p_T = p_0 - 0.005$ MPa (-0.725 psi)

Where p_T = pressure behind the impeller (MPa) (psi)
p_0 = inlet pressure (MPa) (psi)

Atmospheric pressure used as reference pressure = 0 MPa (0 psi)

Impellers without balancing holes (APP/APT, NPP/NPT, WPP/WPT)

$$p_T = p_0 + 0.7 \times 10^{-6}\varrho g H - 1.1103 \times 10^{-9}\varrho n^2\left[(d_2/2)^2 - (d_b/2)^2\right] - 4.4413 \times 10^{-9}\varrho n^2\left[(d_b/2)^2 - (d_5/2)^2\right] \text{ MPa}$$

Where p_T = pressure behind the impeller (MPa) (psi)
p_0 = inlet pressure (MPa) (psi)
ϱ = density of the liquid being pumped (kg/m^3)
H = pump head at the operating point in question (m) (ft)
n = rotating speed of the pump (r/min)
d_2 = impeller back plate diameter (m) (ft)
d_b = impeller back vane diameter (m) (ft)
d_5 = impeller hub diameter is 0.05 m (0.16 ft) in bearing unit no. 2, in bearing unit no. 3 0.06 m (0.19 ft), and in bearing unit no. 4 0.07m (0.22 ft)

Atmospheric pressure used as reference pressure = 0 MPa (0 psi)

The flushing liquid and sealing liquid must fulfill the following quality requirements:

- maximum particle size 50 µm (0.002 in)
- maximum solid material content 2 mg/l (0.00027 lb/in^3)

2 Starting the pump

WARNING

The product is meant only for the purpose for which it is sold - never operate beyond the intended use described in these instructions.

WARNING

If the pump does not have the S or R design, make sure before starting that the pump is sufficiently filled with the pumped liquid.

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CAUTION

Observe immediately after start-up the instrumentation showing the discharge pressure. If the pressure is not quickly reached, stop the motor and check causes for the low pressure.

CAUTION

If it is necessary to adjust the amount of pumped liquid, do it by adjusting the discharge valve. Never use the suction valve for flow adjustment.

2.1 APP, EPP, NPP and WPP

- Open the valves for sealing water if any, and adjust suitable pressure and flow according to Table 1.
- Check that there is abundant leakage at the gland packing. If there is no continuous leakage, slacken the stuffing box gland. If this does not help, remove the packings and re-pack the stuffing box less tight.
- Fill the pump so that at least the suction pipe and pump casing are filled with liquid.
- Check that the suction valve is fully open and discharge valve closed.
- Start the motor.
- Open the discharge valve gradually until the desired amount of liquid is reached.
- Check that the gland packing leakage is still abundant. If not, slacken the stuffing box gland immediately. If this does not help and the gland packing becomes hot, stop the pump and find out the reason for the disturbance. When the gland packing has been operating trouble-free for 10 minutes it may be tightened. Tighten it by turning the hexagonal nuts approx. 1/6 turns at a time at 5 - 10 minutes' intervals until the leakage is at least 30 - 80 drops a minute. While tightening, make sure that the stuffing box gland remains perpendicular to the shaft.

2.2 R design pump

- Open the sealing liquid valves of the pump and of the potential degassing pump and adjust the flow rate to a suitable level in accordance with Table 1.
- Make sure that the suction valve is fully open and that the discharge valve is closed.
- Start the motor of the degassing pump if there is one.
- Adjust the desired vacuum by means of the vacuum relief valve (Fig.2):

  Undo the locking nut (6) which locks the valve spindle (2).

  Turn the valve bushing (3) to the desired direction while holding the valve spindle (2) in place. When you turn the bushing (3) clockwise, the vacuum grows as the force of the spring (4) closing the valve spindle (2) increases. When you turn the bushing (3) counterclockwise, the vacuum reduces as the force of the spring (4) decreases.

  When the desired vacuum is reached, lock the valve spindle (2) to the bushing (3) with the locking nut (6).

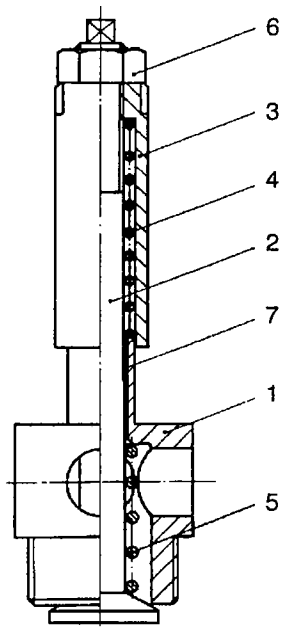


Fig. 2

- Start the motor.
- Open the degassing valve between the pump and the potential degassing pump.
- Open the discharge valve carefully until the desired liquid volume is reached.
- If the pump is used as a self-priming pump, do not open the discharge valve until the degassing pump has sucked the pump full of liquid, the pump starts to pump and the pressure starts to rise on the discharge side.

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- Make sure that the pumped liquid does not flow out through the degassing connection. If it does, reduce the vacuum created by the degassing pump by means of a potential vacuum relief valve. The sealing liquid may flow out through the degassing connection.

2.3 S design pump

- Open the flushing liquid valves and adjust the pressure and flow rate to a suitable level in accordance with Table 1.

  Let the flushing liquid flow for about 1 to 2 minutes so that all necessary spaces are filled with the liquid.
- Make sure that the suction valve is fully open and that the discharge valve is closed.
- Start the motor.
- Adjust the desired vacuum by means of the vacuum relief valve in the same manner as in the R design pump.
- When the pump starts to pump and the pressure on the discharge side rises, open the discharge valve until the desired liquid volume is reached. If the pump and suction pipe are full of liquid, the pressure will rise immediately after starting. If the pump is empty when being started, it takes some time for the pressure to rise.

3 Controls during the first run

WARNING

Personal injuries may occur if personal protective equipment is not used when servicing the product. When pumping hazardous liquids, skin and eye protection are required.

CAUTION

Do not operate the pump below the minimum recommended flow or with the discharge valve closed. Cavitation or recirculation can lead to a quick pump failure.

By controlling the pump operation and output regularly, the possible need for service and repair can be anticipated. In this way, the pump efficiency is kept high, the process is trouble-free and the maintenance costs are low.

Control the temperature of the gland packing and maintain the leakage at 30 - 80 drops/minute by adjusting the stuffing box gland.

The flow and pressure of sealing water must be kept at the enclosed values given by the seal manufacturer.

Check the temperature and vibration of bearings through regular measurings. If one or the other increases, it may be a sign of incorrect lubrication or bearing damage. The measuring studs (SPM, M8 x 24) are in the bearing housing for controlling the bearings.

Also, any noises from the pump and its vibration have to be controlled and the reasons for unusual noises or vibration detected.

The condition of the coupling can be monitored with a stroboscope through the perforation in the coupling guard.

4 Shut-down procedure

- Close the discharge valve to prevent the pumped liquid from flowing back.
- Close the degassing valve between an R design pump and a potential degassing pump.
- Stop the motor.
- Stop the motor of a potential degassing pump.
- Close the suction valve if there is reason to doubt that the pumped liquid will flow out of the suction piping.
- Close the cooling and flushing liquid valves, if any.
- If the pump has a sealing liquid valve, it cannot be closed until the pump has been drained or until at least the pressure has been relieved from the pump.

During longer shut-downs, the pump must be checked every now and then. Turn the shaft manually a few times. If the pumped liquid congeals easily or the pump is exposed to freezing, drain the pump and suction piping for the shut-down period.

5 Controls after the first run

NOTE
Correct final alignment is essential for the proper functioning of the pump unit.

When the pump unit has run for a sufficient length of time to bring the pump and motor up to the normal operating temperature, check the coupling alignment according to Section "Installation and alignment of coupling".

With hot liquid pumps, check the tightness of the casing cover fixing screws. Adjust torque in accordance with the reference values.

With pumps equipped with gland packing, check proper leakage from the stuffing box.

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With pumps equipped with mechanical seals, ensure that the flushing or cooling supplies are functioning adequately.

Make sure that the sealing water system is working properly.

Check that there is no overheating in the pump or motor bearings.

6 Trouble-shooting -operation

During the start-up period, problems are mostly caused by pump selection mistakes, poor process design, operational mistakes or foreign objects in the process.

During the long-term operation of a pump unit, problems are mostly caused by random failures, process changes or corrosion and wear.

Problems can normally be traced to either poor maintenance or exceeding the limitations for the intended use of the pump.

The following problem tracing analysis includes the most common malfunctions and their possible causes. If the pump does not function properly, it is important to trace the actual reasons, so that the repairs and required modifications can be done without delay. Tables 2 - 9.

Table 2 ***Symptom: Pump not delivering liquid***

Probable cause:	Remedy:
Wrong direction of rotation	Change the direction of rotation acc. to the arrow sign on the bearing unit
Pump not adequately primed or a vapor lock in the suction pipe (P design)	Reprime the pump and suction piping
Flushing liquid is not on (S design)	Open the flushing liquid valve
Difference between inlet pressure and vapor pressure too small	Check the suction piping arrangements
Air leakage in suction opening, suction piping or shaft seal (P and S design)	Check the suction piping. Readjust the shaft seal
Suction piping, suction valve or impeller clogged	Check the suction piping and the pump for any obstructions
Rotational speed too low	Check the speed requirements/limitations
Flow resistance of the piping higher than the head generated by the pump	Check resistancies and reduce losses
Unexpected air/gas content in the pumped liquid	Consult manufacturer for further instructions
Suction tank level low	Check the required inlet/suction head

Table 3 ***Symptom: Insufficient head***

Probable cause:	Remedy:
Unexpected air/gas content in the pumped liquid	Consult manufacturer for further instructions
Unexpected viscosity of the pumped liquid	Consult manufacturer for further instructions
Suction piping, suction valve or impeller clogged	Check the suction piping and the pump for any obstructions
Rotational speed too low	Check the speed requirements/limitations
Wrong direction of rotation	Change the direction of rotation acc.to the arrow sign on the bearing unit

Probable cause:	Remedy:
Flow resistance of the piping higher than the head generated by the pump	Check resistancies and reduce losses
Pressure containing pump parts worn/damaged/clogged	Check the pump and replace defective parts, if necessary
Suction tank level low	Check the required inlet/suction head

Table 4 Symptom: Insufficient (or irregular) flow

Probable cause:	Remedy:
Vapor lock in the suction pipel (P design)	Reprime the pump and suction piping
Suction head too high	Check that the suction valve is fully open and that the suction line is unobstructed
Difference between inlet pressure and vapor pressure too small	Check the suction piping arrangements
Air leakage in suction opening, suction piping or shaft seal (P and S design)	Check the suction piping and readjust the shaft seal
Unexpected air/gas content in the pumped liquid	Consult manufacturer for further instructions
Unexpected viscosity of the pumped liquid	Consult manufacturer for further instructions
Suction piping, suction valve or impeller partially clogged	Check the suction piping and the pump for any obstructions
Rotational speed too low	Check the speed requirements/limitations
Flow resistance of the piping higher than the head generated by the pump	Check resistancies and reduce losses
Pressure containing pump parts worn/damaged/clogged	Check the pump and replace defective parts, if necessary

Table 5 Symptom: High power consumption

Probable cause:	Remedy:
Rotational speed too high	Check the speed requirements/limitations
Wrong direction of rotation	Change the direction of rotation acc.to the arrow sign on the bearing unit
Flow resistance of the piping much higher/lower than the head generated by the pump	Check the piping arrangements
Unexpected specific gravity of the pumped liquid	Consult manufacturer for further instructions
Unexpected viscosity of the pumped liquid	Consult manufacturer for further instructions
Pump and motor incorrectly aligned	Realign the pump and motor assembly, make sure there is no strain on the pump.
Crooked or eccentric shaft	Reassemble the pump and renew the shaft and bearings, if necessary
Rotating objects or pump parts chafing inside the pump	Reassemble the pump and check the clearances
Pressure containing pump parts worn/damaged/clogged	Check the pump and replace defective parts, if necessary
Mechanical tightness of pump components	Reassemble the pump and check the clearances

Table 6 Symptom: Excessive noise and/or vibration

Probable cause:	Remedy:
Difference between inlet pressure and vapor pressure too small (cavitation)	Check the suction piping arrangements
Unexpected air/gas content in the pumped liqud	Consult manufacturer for further instructions

Probable cause:	Remedy:
Air leakage in suction opening, suction piping or shaft seal (P and S design)	Check the suction piping/readjust the shaft seal
Suction piping, suction valve or impeller clogged	Check the suction piping and the pump for any obstructions
Rotational speed too low	Check the speed requirements/limitations
Flow resistance of the piping higher than the head generated by the pump	Check resistancies and reduce losses
Pump functioning below the recommended minimum flow (cavitation)	Check the pumping system requirements
Pump foundation not rigid enough	Strengthen the foundation
Inadequate piping support exerting strain on the pump	Check the piping support requirements
Pump and motor incorrectly aligned	Realign the assembly, make sure there is no strain on the pump.
Crooked or eccentric shaft	Reassemble the pump and renew the shaft and bearings, if necessary
Rotating objects or pump parts chafing inside the pump	Reassemble the pump and check the clearances
Pressure containing pump parts worn/damaged/ clogged	Check the pump and replace defective parts, if necessary
Mechanical tightness of pump components	Reassemble the pump and check the clearances
Bearings worn or loose	Reassemble the pump and replace the bearings, if necessary
Inadequate or excessive lubrication	Check the pump for proper lubrication
Impeller damaged or out of balance	Reassemble the pump and replace the impeller, if necessary

Table 7 Symptom: Bearings wear rapidly

Probable cause:	Remedy:
Pump and motor incorrectly aligned	Realign the pump assembly, make sure there is no strain on the pump. Replace the bearings, if necessary.
Crooked or eccentric shaft	Reassemble the pump and straighten or replace the shaft
Rotating objects or pump parts chafing inside the pump	Reassemble the pump and check the clearances
Impeller damaged or out of balance	Reassemble the pump and replace the impeller, if necessary
Inadequate or excessive lubrication	Check the pump for proper lubrication
Badly installed and/or dirty bearings	Renew bearings, if necessary. Check the quality and amount of lubricant

Table 8 Symptom: Pump overheats/seizes

Probable cause:	Remedy:
Pump not adequately primed (P design)	Reprime the pump and suction piping
Flushing liquid is not on (S design)	Open the flushing liquid valve.
Difference between inlet pressure and vapor pressure too small	Check the suction piping arrangements. The pump may operate below the recommended minimum flow (cavitation)

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Probable cause:	Remedy:
Pump functioning below the recommended minimum flow (cavitation)	Check the pumping system requirements
Pump and motor incorrectly aligned	Realign the assembly, make sure there is no strain on the pump
Bearings worn	Reassemble the pump and replace the bearings, if necessary
Crooked or eccentric shaft	Reassemble the pump, straighten or renew the shaft
Impeller damaged or out of balance	Reassemble the pump and replace the impeller, if necessary
Rotating objects or pump parts chafing inside the pump	Reassemble the pump and check the clearances
Discharge valve closed	Open the discharge valve
Discharge valve clogged	Check the pipe and flush it if necessary

Table 9 The liquid pumped flows out through the degassing connection (R design)

Probable cause:	Remedy:
Inlet height too high	Check the suction height limits
Pump speed too small	Check the speed requirements and restrictions
Degassing vacuum too high	Adjust the degassing vacuum by means of the vacuum relief valve
Degassing piping and recirculation piping incorrectly installed	Check the installation instructions for auxiliary piping
Recirculation piping clogged	Make sure that there are no obstacles in the recirculation piping

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Preventive maintenance

Version 11 > / 20030130 / Replaces 20010910 / en / **N14806**

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1 General

NOTE
Preventive maintenance is also a relevant safety factor.

NOTE
If the pump performance does not fulfill the process requirements, the pump is to be disassembled and inspected. All worn parts should be changed to new genuine spare parts.

Regular and systematic preventive and predictive maintenance can extend the product lifetime and requires fewer repairs and spare parts. Monitoring of instrumentation and physical examinations are a vital part of today's quality maintenance. We recommend that the maintenance system includes a historical record kept for each pump, its condition and performance. This will help to prevent sudden failures and aid in case of possible fault tracing analyses. In the process industries, one process downtime caused by a pump normally costs much more than the price of the pump.

Preventive maintenance consists of the following actions:

- Bearing lubrication
- Temperature, noise, vibration monitoring and inspections
- Monitoring the discharge pressure, capacity and power demand
- Inspections regarding corrosion and wear
- Shaft seal monitoring
- Regular pump washdowns
- Monitoring the pump and pipings for leakage
- Quarterly checks of the tightness of critical fasteners, such as foundation screws and pump & motor fasteners onto the baseplate

General measuring instruments for pump operation are presented in Table 1.

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Table 1 ***Measuring instruments***

Fixed instruments:	Portable instruments:
Pressure gauges & indicators	Vibration analysers
Flow meters	Tachometers
Ammeters/wattmeters/ voltmeters	Thermometers
Speed indicators	Noise level indicators
Temperature detectors	Ultrasonic indicators (wall thickness)
Vibroswitches	
Any fixed or portable instruments may in themselves create a possible failure and require regular monitoring to ensure their correct functioning.	

2 Grease lubrication

All the grease-lubricated bearings have been lubricated before the shipment. The pump has one cylinder roller bearing unit and two single row angular contact ball bearings (O-system, Table 2).

Table 2 ***Pump bearings***

Bearing unit	Impeller side	Coupling side
1	NUP 307 ECJ	BECBM 7308
2	309 ECJ	7310
3	311 ECJ	7312
4	313 ECJ	7314
5	317 ECJ	7318
6	320 ECJ	7322
SKF designation. If bearings by other manufacturers are used, the corresponding bearing types are required.		

Amounts of lubricants and re-lubrication intervals are described in Table 3 and in Table 4 depending on the speed of rotation.

Table 3 ***Initial and re-lubrication (50 Hz speeds of rotation)***

Bearing unit	Initial lubrication (g)		Re-lubrication (g)		Re-lubrication interval [1] (hours, bearing housing temperature ≤ +55 °C (+130°F))			
	Impeller side	Coupling side	Impeller side	Coupling side	740 rpm	980 rpm	1480 rpm	2950 rpm
1	30	50	10	15	16000	12000	8000	3000
2	55	85	15	25	14000	10000	6500	2500
3	85	135	20	30	12000	8000	6000	2000
4	145	210	25	40	10000	7500	5000	-
5	220	390	40	60	8500	6000	3500	-
6	250	450	50	70	8500	6000	-	-

[1] Every 15 °C / 27 °F rise in the surface temperature shortens the lubrication interval to a half.

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Table 4 Initial and re-lubrication (60 Hz speeds of rotation)

Bearing unit	Initial lubrication				Re-lubrication				Re-lubrication interval [1] (hours, bearing housing temperature ≤ +55 °C / +130 °F)			
	Impeller side		Coupling side		Impeller side		Coupling side		890 rpm	1180 rpm	1780 rpm	3540 rpm
	(g)	(oz)	(g)	(oz)	(g)	(oz)	(g)	(oz)				
1	30	1.0	50	1.8	10	0.4	15	0.5	14000	10000	6500	2500
2	55	2.0	85	3.0	15	0.5	25	0.9	12000	8500	5000	2000
3	85	3.0	135	4.8	20	0.7	30	1.0	10000	7000	4000	1500
4	145	5.0	210	7.4	25	0.9	40	1.4	9000	6500	3500	-
5	220	7.8	390	13.8	40	1.4	60	2.1	7500	5000	2500	-
6	250	8.9	450	16.0	50	1.8	70	2.5	7500	5000	-	-

[1] Every 15 °C / 27 °F rise in the surface temperature shortens the lubrication interval to a half.

2.1 Grease grades

CAUTION

Never mix different grease grades (consistency, thickeners). The mixed grease becomes softer and does not lubricate the bearings properly.

NOTE

All greasing equipment and fittings used must be clean to prevent any impurities from entering the bearing housing.

NOTE

The surface temperature of the bearing unit can temporarily rise after regreasing due to an excess amount of grease.

For normal conditions when the bearing housing surface temperature is below +80 °C (+175 °F), we recommend lithium or lithium-calcium-based mineral greases for roller bearings, such as:

- Esso Beacon 2

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- Shell Alvania EP2
- SKF LGMT2
- Neste Yleisrasva 2
- Klüber Centoplex EP2

The first re-lubrication should be done before the initial commissioning of the pump.

If the bearings run hotter and the surface temperatures are above +80 °C (+175 °F), we recommend the use of the following special greases:

- Esso Unirex N3
- SKF LGHT3
- Shell Limona LX1
- Klüber Staburax NBU 8 EP

These special greases can also be used with surface temperatures below +80 °C (+175 °F).

Always consult the pump manufacturer about the use of any special greases (not mentioned in these instructions).

3 Oil lubrication

CAUTION

For delivery, the bearing housing of the pump has been emptied of oil. Remember to refill it before starting.

For lubrication, use only high-quality mineral oils, the viscosity of which is ISO VG 46.

- Esso Teresso 46
- Shell Tellus Oil S46
- Mobil DTE Oil Medium
- Neste Paine 46
- Klüber Crucolan 46
- Tebo Larita Oil 46

Viscosity of oil at the operating temperature must not be below 12 cSt (65 SSU). The operating temperature is ca 15 °C (27 °F) higher than the surface temperature of the bearing housing.

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3.1 First oil filling

Without using the constant level oiler

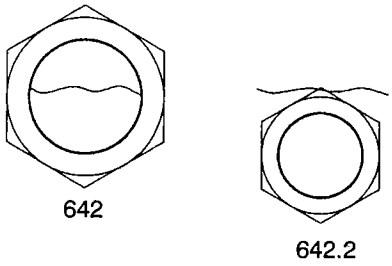


Fig. 1

Unscrew the venting device (672) and add oil up to the middle of the larger sight glass (642), Fig. 1. Smaller sight glass (642.2) will stay totally under oil level. When pump is running oil level in the larger sight glass can be little variable. With lower speed oil level can go little bit lower and higher speed go little up (air is mixing into oil). If oil level is so low that it can be seen in smaller sight glass more oil must be added so that small sight glass is fully under oil level. Screw the venting device (672) back in place. See the oil volumes in Table 6.

With using the constant level oiler

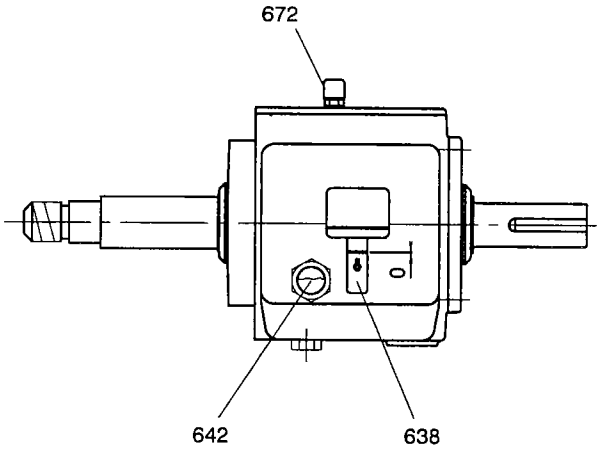


Fig. 2

4 Install the constant level oiler (638) in the bearing unit.

5 Adjust the constant level oiler (638) to the correct height (0 mm) and tighten the locking screw.

6 Unscrew the venting device (672), add oil up to the middle of the sight glass (642) and screw the venting device (672) back in place.

7 Undo the glass cup of the constant level oiler (638) and fill it with oil, and place the glass cup of the constant level oiler (638) back in place.

3.2 Oil change

After commissioning, oil should be changed for the first time after about 100 hours of operation and thereafter according to Table 5 and more often if the operating conditions cause contamination or change in other properties of the oil used.

Table 5 ***Oil changes***

Bearing housing surface temperature	Oil change interval
65 °C (150 °F)	1 year
75 °C (170 °F)	6 months

Table 6 ***Oil volumes***

Bearing unit	Oil volume (l)	Oil volume (quart)
1	0.2	0.2
2	0.5	0.5
3	0.6	0.6
4	0.9	0.9
5	2.2	2.3
6	3.7	3.7

4 Temperatures

During operation, the following surface temperatures are to be observed regularly:

- volute casing (102)
- bearing housing (330)
- shaft seal, measured on the casing cover (161) (P design)
- casing (100) measured at both the suction impeller and mechanical seal (S design)
- motor (800)

The reasons for any deviations in temperatures are to be checked immediately to prevent further and more serious damage.

5 Noise and vibration analysis

A regular follow-up of the pump noise and vibration gives a good view regarding the condition and wear of bearings and also other wearing parts of the pump. This enables timely predictive maintenance routines and reduces the potential for unexpected shut-downs. Admissible vibration severity values are presented in Section "Safety instructions/Balance and vibration".

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6 Discharge pressure

A regular control of the pressure generated by the pump, the rated flow and the power need of the drive unit gives a good view regarding the condition and wear of the hydraulic parts of the pump. The follow-up enables such preventive maintenance actions as clearance adjustments or parts renewals to be scheduled accordingly.

7 Corrosion and wear

When the pumps are operating under corrosive and/or abrasive conditions, a regular follow-up of wall thicknesses in the casing and casing cover is necessary. When the wall thickness has worn more than the permitted corrosion allowance of 3 mm (0.12 in), the mechanical durability (pressure limits) stated in these instructions is no longer guaranteed. In wear-resistant pumps (W), the corrosion and wear allowance in the volute casing is 50 % of the wall thickness.

8 Shaft seal monitoring

CAUTION

The dry running of mechanical seals will damage the sliding surfaces and cause leakage of pumped liquid.

8.1 Gland packing

Gland-packed pumps must be checked regularly to ensure that there is a slight leakage from the gland. An excessively tight gland causes wear to the shaft sleeve and increased power demand. Refer to the instructions in Section "Operation/Controls during the first run"

8.2 Mechanical seal

Mechanical seals are normally installed and adjusted at the factory before the delivery. The general principle is that the mechanical seal does not leak at all. The lifetime of a mechanical seal depends on the cleanliness and lubricating properties of the pumped liquid and the sealing liquid. If the mechanical seal leaks, stop the pump and replace the mechanical seal.

8.3 Dynamic seal

The expeller (604) design of the dynamic seal prevents the leakage of pumped liquid through the stuffing box during operation. During shut-down, the leakage is prevented by the static seal design (435).

9 Pump washdown

The pump is designed to prevent external liquids from entering the bearing unit. However, direct spraying of high-pressure water to the labyrinth rings (423) must be avoided.

10 Maintenance of shaft seals

WARNING

Always stop the motor before any of the following maintenance actions to the pump.Make sure that the motor cannot be started by any means accidentally during the repairs.

WARNING

Always drain the pump before dissassembling the shaft seal.When pumping hazardous liquids, make sure that there is no trapped liquid remaining in pump parts.

WARNING

Never use gland packing material containing asbestos. It may cause a health hazard.

10.1Gland packing

- Remove the used gland packing from the stuffing box housing by using a flexible extraction tool (Fig. 3). Clean the stuffing box housing and open any clogged sealing liquid holes.

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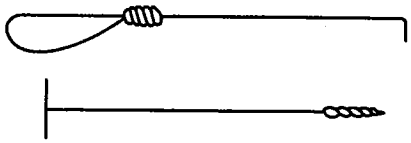


Fig. 3

- If there are scratches or wearing marks on the shaft wearing sleeve (part 524 in Table 7) or in the stuffing box housing, replace the damaged parts.
- We recommend the use of precompressed gland packings. However, if you need to cut the packings from a sealing band, proceed as follows: turn four rounds (five in an EPP pump) of the sealing band around a wooden pattern having the same thickness as the shaft wearing sleeve (part 524 in Table 7) and use a sharp knife to cut the packing rings straight and axially without overdimensioning or underdimensioning, Fig. 4. The dimensions of the stuffing box housing and the total length of the band to be cut without working allowances are given in Table 7.

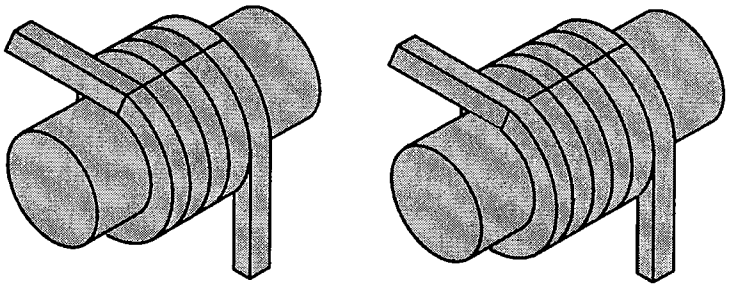
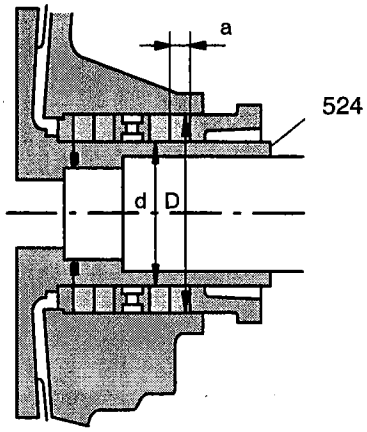


Fig. 4

- When packing new packing rings, be very precise, and keep the parts clean.
- Lubricate the shaft sleeve and packing rings lightly with oil.
- Push the first packing ring tightly against the neck bush. The ends of the rings must be exactly against each other.
- The second ring is placed against the first one so that the joints are at 180° angle to each other, Fig. 5.
- Next put the lantern ring or plate into the seal chamber.
- Fit also the last two rings (three in EPP pump) with the joints at 180° (120° in EPP pump) angle to each other.
- After all the packing rings and the lantern ring have been fitted, tighten the nuts of the stuffing box gland by hand.
- The shaft seal is taken into use according to Section "Operation/Controls during the first run".

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Table 7 ***Dimensioning of stuffing box***



Bearing unit	APP, NPP and WPP Stuffing box Ød x ØD x a (mm)	APP, NPP and WPP Total length of the packing ring (mm)		EPP Stuffing box Ød x ØD x a (mm)	EPP Total length of the packing ring (mm)
		Gland packing	Static seal of dynamic seal		
1	40 x 60 x 10	640	256	-	-
2	50 x 70 x 10	770	308	-	-
3	60 x 85 x 12.5	930	372	55 x 75 x 10	1050
4	70 x 95 x 12.5	1050	420	70 x 95 x 12.5	1320
5	90 x 122 x 16	1350	540	90 x 122 x 16	1690
6	100 x 132 x 16	1460	584	105 x 132 x 16	1830

Bearing unit	APT, NPT and WPT Stuffing box Ød x ØD x a (in)	APT, NPT and WPT Total length of the packing ring (in)		EPT Stuffing box Ød x ØD x a (in)	EPT Total length of the packing ring (in)
		Gland packing	Static seal of dynamic seal		
1	1 5/8 x 2 3/8 x 3/8	25	10	-	-
2	2 x 2 3/4 x 3/8	31	12	-	-
3	2 3/8 x 3 3/8 x 1/2	42	14	1 1/4 x 3 x 3/8	42
4	2 3/4 x 3 3/4 x 1/2	52	16	2 3/4 x 3 3/4 x 1/2	52
5	3 1/2 x 4 3/4 x 5/8	67	21	3 1/2 x 4 3/4 x 5/8	67
6	3.937 x 5.198 x 5/8	58	23	3.937 x 5.198 x 5/8	72

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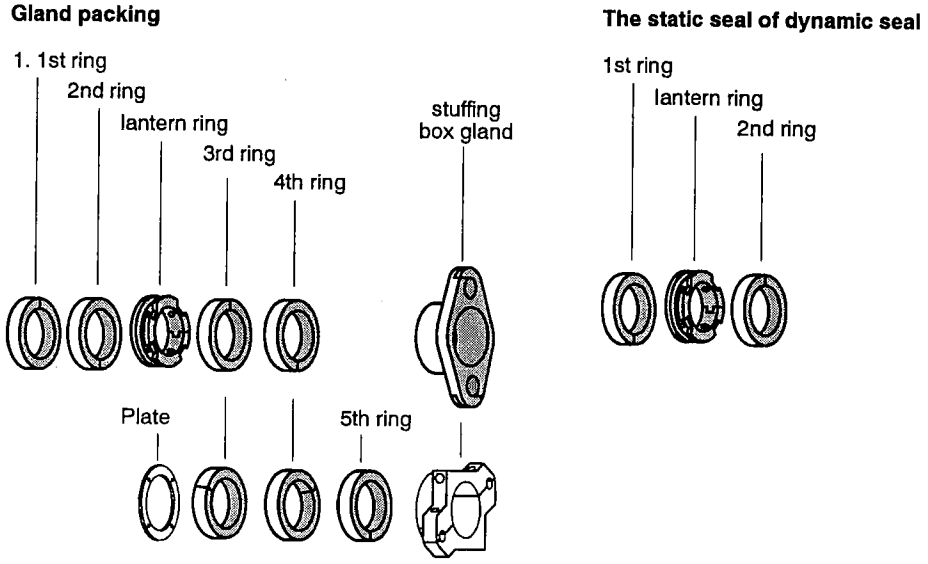


Fig. 5

10.2 Mechanical seal

Mechanical seals do not normally require any preventive maintenance actions during their operation. If any problems occur, the whole seal package is normally renewed.

10.3 Dynamic seal

Dynamic seals do not normally require any preventive maintenance actions. During the first years of operation, the static seal (435) can yet wear so much that some leakage can occur during stoppages. The static seal is again functional when sliding the thrust ring (475) towards the volute casing so long that the leakage stops. The thrust ring must always be secured with the grub screws (904) during operation. This adjustment can be done several times during the lifetime of the static seal. The wear allowance of the static seal is about half of its thickness. If the seal has worn more or otherwise damaged, it must be replaced with a new one. Gland packings used with the dynamic seal are serviced in accordance with item "Gland packing".

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11 Adjustment of clearance between sideplate and impeller

If the pump has an adjustable sideplate (135), the clearance between the impeller and sideplate is adjusted without disassembling the pump as follows (Fig. 6):

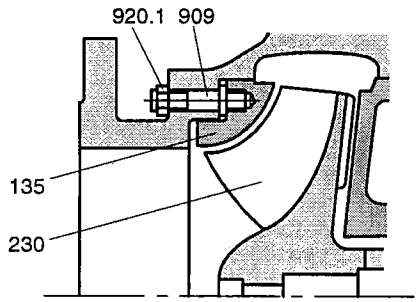


Fig. 6

- Slacken the hexagonal nuts (920.1) of the adjusting screws (909).

  If the pump is provided with a vortex impeller, move the sideplate using the adjusting screws so that there is a minimum of stagger between the volute casing and sideplate.

- One by one, turn each adjusting screw counterclockwise until the sideplate touches the impeller. Then turn the adjusting screws clockwise 1/3 turns to obtain a 0.5 mm (0.02 in) clearance between the sideplate and impeller.

- After the adjustment, tighten the hexagonal nuts, whereby the adjusting screws will be locked. The adjusting screw must not turn during tightening.

- By turning the coupling by hand, check that the pump can rotate freely.

- The sideplate can be adjusted altogether 3 - 4 mm (0.12 - 0.16 in)(5 - 6 mm (0.20 - 0.24 in) in pumps with W design) towards the impeller. If further adjustment is needed, change the impeller and sideplate in order to keep the right clearance.

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Corrective maintenance

Version 11 > / 20020520 / Replaces 20010910 / en / **N14807**

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1 Safety procedures before any repairs

WARNING

When pumping hazardous liquids, secure that there is no trapped liquid remaining in pump parts.
Pumps which convey hazardous media must be carefully decontaminated before any repairs. Skin and eye protection are required during decontamination. Precautions are needed for personal or environmental safety.
Some of the disassembled parts and assemblies are heavy, unstable and due to design requirements they contain sharp edges (e.g. impeller, sideplate, casing cover). Use proper hoistings and supports to prevent personal injury.

2 Necessary equipment / tools

2.1 Normally available working tools:

- Hoisting accessories. Note the safety requirements!
- Wrenches for hexagonal screws
  sizes (mm): 13, 14, 16, 18, 19, 22, 24, 30
  sizes (in): 1/2, 9/16, 3/4, 7/8, 15/16, 1 1/8
- Allen wrenches for socket head screws
  sizes (mm): 2.5, 4, 5, 6, 8, 10, 14
  sizes (in): 3/32, 5/32, 3/16, 1/4, 5/16, 3/8, 1/2
- Torque wrenches for moments (Nm): 30, 50, 130, 250, 420, 800
  - for hexagonal, sizes (mm): 18, 24, 30
  - for socket head, sizes (mm): 8, 10, 14, 17, 19, 22

  moments (lbft): 20, 40, 95, 185, 310, 590
  - for hexagonal, sizes (in): 3/4, 15/16, 1 1/8
  - for socket head, sizes (in): 5/16, 3/8, 1/2, 5/8, 3/4, 7/8
- Hooked wrenches, sizes (SKF): HN8, HN10, HN12, HN14, HN18, HN22
- Extractors
- Bearing heater
- Dial indicators

- Cleaning agents & equipment
- Lubricating agents & equipment

2.2 Special tools

- Detachment tool for the casing wear ring/sideplate. Fig. 4.
- Pipe punch series for roller bearings. Fig. 11.
- Pipe punch series (coupling & impeller side) for deflectors, Fig. 15.
- Securing tool for impeller head screw, Fig. 27.

3 Disassembly

NOTE
Ensure that all eventual spare parts are available before the disassembly.

3.1 Preliminaries

1 Close the discharge valve.

2 Stop the motor. Make sure that the motor cannot be started by any means during the repair.

3 Close the suction valve.

4 Drain the pump carefully. For this, use the hexagonal plug (903.1) potentially situated at the bottom of the volute casing (102), Fig. 1.

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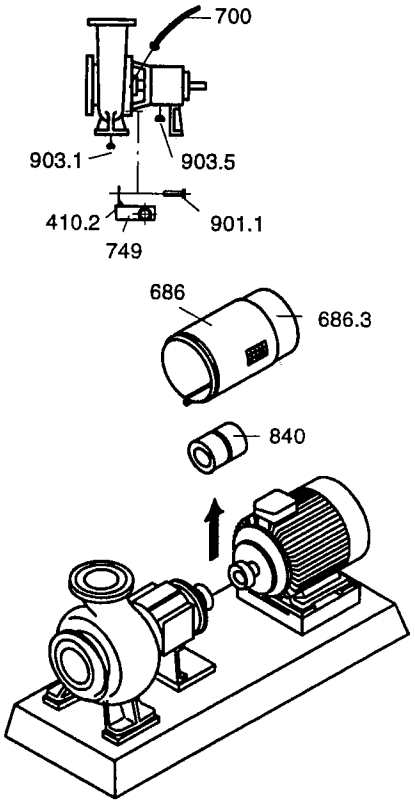


Fig. 1

5 Remove the optional drip pan (749) by unscrewing the two hexagonal screws (901.1).

6 Disconnect potential pipes and equipment (700) relating to degassing, recirculation and shaft seal.

7 Remove the guard jacket (686) and coupling (840) spacer.

8 Drain oil from an oil-lubricated bearing housing by unscrewing the hexagonal plug (903.5).

3.2 Detachment of exchange unit

1 Unscrew the hexagonal screws (901.1) of the adapter (344) or the casing cover (EPP) and the hexagonal screws (901.8) of the support foot from the baseplate (890), Fig. 2.

2 Suspend the exchange unit by a hoist at the maintenance opening of the adapter or underneath the adapter.

3 Pull out the exchange unit by using the hexagonal screws (901.1).

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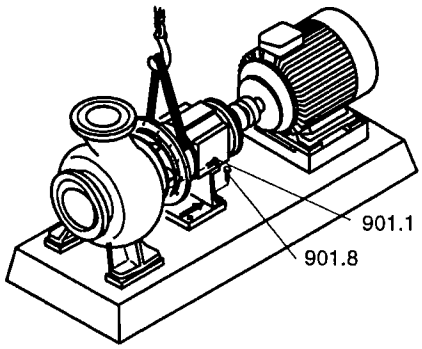


Fig. 2

3.3 Detachment of casing wear ring (closed impeller of APP and EPP)

The casing wear ring (502.1) between the closed impeller and volute casing and also the casing wear ring (502.2) between the impeller and casing cover in the EPP pump can be removed with a suitable tool by using the three notches situated under the casing wear ring, Fig. 3.

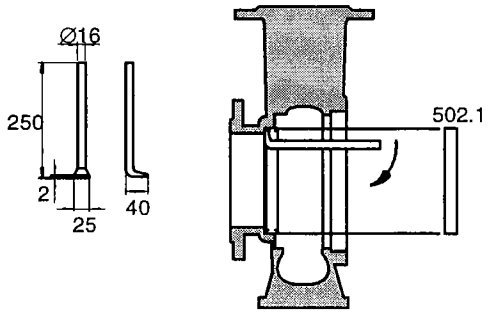


Fig. 3

3.4 Detachment of sideplate

1 Unscrew the three hexagonal nuts (920.1 or 920.9 for EPP pump). Fig. 4.

2 Turn the potential adjusting screws (909) counter-clockwise. As a result the sideplate protrudes out.

3 The sideplate can now be removed with a proper tool from the volute casing.

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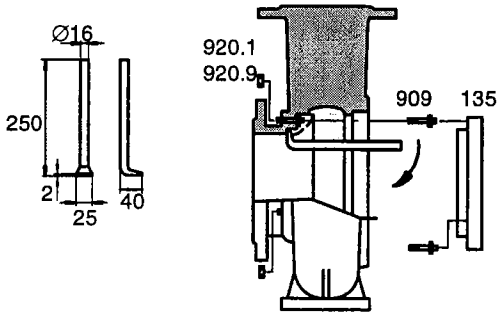


Fig. 4

3.5 Detachment of impeller

1 Fasten the exchange unit firmly to a vice. Fig. 5.

2 Unscrew the socket head screw (914.1) of the impeller (230).

3 Prevent the shaft (210) from rotating at the coupling (840) end.

4 Detach the impeller by turning it counter-clockwise. Push e.g. pieces of wood between the impeller vanes to ease the detachment. Never use metal bars or the like, because they might damage the impeller vanes. Fig. 6.

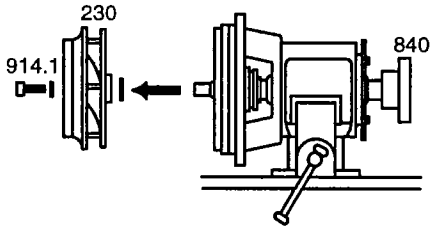


Fig. 5

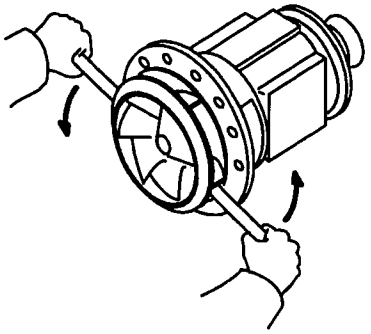


Fig. 6

3.6 Detachment of shaft seal

Refer to the sectional drawing of the shaft seal when reading through these instructions.

CAUTION
The threaded hole in the casing cover is only meant for lifting the casing cover.

Gland packing, fittings PL01, PL02, PL03 and PL04 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal screws (901.2) of the casing cover (161).

2 By using the said screws as extractors, draw the casing cover out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.All parts belonging to the gland packing, except the shaft wearing sleeve (524), will stay in the casing cover.

3 Unscrew the hexagonal nuts (920.2) and remove the two-piece stuffing box gland (452). The neck bush (456), gland packings (461) and lantern ring (458) can now be drawn out of the casing cover.

4 Detach the shaft wearing sleeve from the shaft with an extractor.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Gland packing, fitting PC01 (APP/APT)

1 Unscrew the hexagonal screws (901.2) of the casing cover (161).

2 By using the said screws as extractors, draw the casing cover out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the gland packing, except the shaft wearing sleeve (524), will stay in the casing cover.

3 Unscrew the hexagonal nuts (920.2) and remove the cooling insert (442) with o-ring (412.9). The neck bush (456), gland packings (461) and the lantern ring (458) can now be drawn out of the casing cover.

4 Detach the shaft wearing sleeve from the shaft with an extractor.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Gland packing, fitting PL05 (EPP/EPT)

1 Unscrew the hexagonal screws (901.2).

2 Remove the casing cover (161) from the adapter (344) by using the above screws as extractors. The parts of the gland packing, excluding the shaft wearing sleeve, will come off too.

3 Unscrew the hexagonal screws (901.12) and remove the dual stuffing box gland (452). The gland packings (461) and the plate (550.1) can now be pulled out of the casing cover.

4 Pull out the shaft wearing sleeve (524) from the shaft, if necessary use an extractor.

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5 When necessary, the stuffing box housing (451) and the flange (723) can be removed from the casing cover by unscrewing the hexagonal screws (901.11).

6 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Gland packing, fitting PP21 (EPP/EPT)

1 Unscrew the hexagonal screws (901.2).

2 Remove the casing cover (161) from the adapter (344) by using the above screws as extractors. The parts of the gland packing, excluding the shaft wearing sleeve, will come off too.

3 Unscrew the hexagonal screws (901.12) and remove the dual stuffing box gland (452). The gland packings (461) and the lantern ring (458) can be pulled out of the casing cover.

4 Pull out the shaft wearing sleeve (524) from the shaft, if necessary use an extractor.

5 When necessary, the stuffing box housing (451) and the flange (723) can be removed from the casing cover by unscrewing the hexagonal screws (901.11).

6 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fittings ME01, ME02, ME03 and ME05 (APP/APT, NPP/NPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the mechanical seal (433) will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fitting ME03 (ARP/ART)

1 Open the two hexagonal screws (901.2) of the casing cover (161).

2 By using the above mentioned screws as extractors, push the casing cover (161) and cover (160) out of the adapter (344). The gasket (400.3) may be replaced if needed.

3 The casing cover and cover may be detached from each other, so that the condition of the o-ring (412.6) and the gasket (400.3) may be checked and replaced if needed.

4 Pull the expeller (235) off the shaft by levering against the adapter. The rotating parts of the mechanical seal (433) follow with the expeller.

5 Special care should be taken not to damage the sliding surfaces of the mechanical seal. The mechanical seal can be removed from the expeller by undoing the locking screws of the seal.

6 Unscrew the hexagonal nuts (920.2) of the adapter (344) and lever the adapter out of the bearing housing (330) guide making use of the two slots at the interface of the bearing housing.

7 The stationary seat (475) of the mechanical seal (433) can be removed from the adapter. Special care should be taken not to damage the sliding surfaces of the seal.

Mechanical seal, fittings ME02 and ME03 (ASP/AST, NSP/NST, WSP/WST)

1 Unscrew the hexagonal screws (901.2).

2 Remove the casing cover (161) by levering from the slot between the casing cover and adapter (344).

3 Remove the suction impeller (231) from the shaft. Pull the shaft wearing sleeve (524) from the shaft.The rotating part of the mechanical seal (433) will come off, too, and the static part will remain in the cover plate for seal.

Notice the compressor rings (487.1) between the suction impeller and shaft wearing sleeve.

4 Pull the casing (100) out of the guideway in the adapter with the help of hexagonal screws (901.2). Detach the cover plate for seal (471.2) by unscrewing the hexagonal screws (914.2).

5 The rotating part of the mechanical seal can now be removed from the shaft wearing sleeve and the static part from the cover plate for seal. Make sure not to damage the sliding surfaces.

6 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fitting ME04 (APP/APT, NPP/NPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the mechanical seal (433) will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fittings MC01, MC02, MC03, MC04, MC20, MC21 and MC22 (APP/APT, NPP/NPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the mechanical seal (433) will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and from the casing cover and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fittings MC20, MC21 and MC22 (EPP/EPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

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3 Push the casing cover (161) out of the adapter (344) by using the above screws as extractors. The mechanical seal (433) together with integrated parts will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled in accordance with the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) and detach the adapter by using the above screws as extractors.

Mechanical seal, fittings MR01, MR02, MR03 and MR05 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the mechanical seal (433) will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fitting MR04 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. All parts belonging to the mechanical seal (433) will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fitting MR04 (EPP/EPT)

1 Unscrew the hexagonal screws (901.14).

2 Unscrew the hexagonal screws (901.2).

3 Push the casing cover (161) out of the adapter (344) by using the above screws as extractors. The mechanical seal (433) together with integrated parts will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled in accordance with the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) and detach the adapter by using the above screws as extractors.

Mechanical seal, fittings MR20, MR21 and MR22 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw. Most of the mechanical seal (433) together with integrated parts will remain on the shaft. Part of the seal will remain on the casing cover.

4 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

5 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Mechanical seal, fittings MR20, MR21, MR22, MR23, MR24 and MR25 (ASP/AST, NSP/NST,WSP/WST)

1 Detach the pipe (700.2) with the peripheral equipment from the casing (100).

2 Unscrew the hexagonal screws (901.2).

3 Detach the casing cover (161.2) by levering from the slot between the casing cover and adapter (344).

4 Remove the suction impeller (231) from the shaft. The rotating part of the mechanical seal (433) will come off, too, and the static part will remain in the casing.

Notice the compressor rings (487.1) between the suction impeller and mechanical seal.

5 Pull the casing (100) out of the guideway in the adapter with the help of hexagonal screws (801.2).

6 The static part of the mechanical seal is detached from the casing (100) by unscrewing the hexagonal screws (901.2).

7 The rotating part on the atmospheric side of the mechanical seal can be removed from the shaft by slackening the hexagonal screws (901.2).

Mechanical seal, fitting MR20 and MR21 (EPP/EPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 Pull the casing cover (161) out of the adapter (344) by using the above screws as extractors. The mechanical seal (433) together with integrated parts will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled in accordance with the seal manufacturer's instructions

5 Unscrew the hexagonal screws (901.3) and pull the adapter out by using the above screws as extractors.

Mechanical seal, fittings MR26 and MR27 (EPP/EPT)

1 Unscrew the hexagonal nuts (920.2).

2 Unscrew the hexagonal screws (901.2).

3 Pull the casing cover (161) out of the adapter (344) by using the above screws as extractors. The mechanical seal (433) together with integrated parts will remain on the shaft.

4 The mechanical seal can now be removed from the shaft and dismantled in accordance with the seal manufacturer's instructions

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5 Unscrew the hexagonal screws (901.3) and pull the adapter out by using the above screws as extractors.

Mechanical seal, fitting MU01 (APP/APT)

1 Unscrew the hexagonal screws (901.2).

2 By using the said screws as extractors, draw the casing cover (161) out of the adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.

3 The rotating part of the mechanical seal (433) will remain on the shaft.

4 The cover plate for seal (471) and the static part of the mechanical seal can be detached from the casing cover by unscrewing the screws (914.2).

5 The mechanical seal can now be removed from the shaft and dismantled according to the seal manufacturer's instructions.

6 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Static seal, fitting SS01 (ASP/AST, NSP/NST, WSP/WST)

1 Unscrew the hexagonal screws (901.2).

2 Detach the casing cover (161) by levering from the slot between the casing cover and adapter (344).

3 Detach the suction impeller from the shaft (231).

Notice the compressors rings (487.1) between the suction impeller and shaft wearing sleeve.

4 Pull the casing (100) out of the guideway in the adapter with the help of hexagonal screws (901.2). Detach the cover plate for seal (471.2) and static seal (435) from the casing by unscrewing the hexagonal screws (914.2).

5 Pull the shaft wearing sleeve (524) out of the shaft.

6 Unscrew the hexagonal screws (901.3) of the adapter and pull the adapter out by using the same screws as extractors.

Dynamic seal, fittings DS01, DS02 and DS03 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal screws (901.2).

2 Detach the casing cover (161.2) by levering from the slot between the casing cover and adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.

3 Detach the expeller (604) from the shaft.

4 By using the hexagonal screws (901.2) as extractors, draw the stuffing box housing (451) out of the guiding in the adapter.

5 The cover plate for seal (471.2) and the static seal (435) can be detached by unscrewing the hexagonal nuts (920.2).

6 Unscrew the grub screws (904) and detach the thrust ring (475) from the shaft.

7 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

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Dynamic seal, fittings DS21, DS22 and DS23 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal screws (901.2).

2 Detach the casing cover (161.2) by levering from the slot between the casing cover and adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.

3 Detach the expeller (604) from the shaft.

4 Unscrew the hexagonal nuts (920.2).

5 By using the hexagonal screws (901.2) as extractors, pull the stuffing box housing (451) out of the guideway in the adapter.

6 Loosen the hexagonal screws (904.2) and pull the thrust ring (475.2) out of the shaft.

7 Remove the static seals (435) and cover plates for seal (471.2 and 471.3) from the shaft.

8 Unscrew the grub screws (904) and detach the thrust ring (475) from the shaft.

9 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws.

Dynamic seal, fittings DP01, DP02 and DP03 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal screws (901.2).

2 Detach the casing cover (161.2) by levering from the slot between the casing cover and adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.

3 Remove the expeller (604) from the shaft.

4 By using the hexagonal screws (901.2) as extractors, draw the stuffing box housing (451) out of the guideway in the adapter.

5 The stuffing box gland (452), gland packings (461), lantern ring (458) and neck bush (456) can be removed from the cover plate for seal (471) by unscrewings the hexagonal nuts (920.2).

6 Unscrew the grub screw (904) and detach the shaft wearing sleeve (524) from the shaft.

7 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

Dynamic seal, fitting DT01 (APP/APT, NPP/NPT, WPP/WPT)

1 Unscrew the hexagonal screws (901.2).

2 Detach the casing cover (161.2) by levering from the slot between the casing cover and adapter (344). In heavier casing covers, there is a threaded hole (size M8) for lifting the cover by using an eye screw.

3 Remove the expeller (604) from the shaft.

4 By using the hexagonal screws (901.2) as extractors, draw the stuffing box housing (451) out of the guideway in the adapter.

5 The cover plate for seal (471.2), static seal (435) and throttling bush (542.3) can be detached by unscrewing the hexagonal nuts (920.2).

6 Unscrew the grub screws (904) and detach the thrust ring (475) from the shaft.

7 Unscrew the hexagonal screws (901.3) of the adapter and draw the adapter out by using the same screws as extractors.

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3.7 Disassembly of bearing unit

NOTE
Always renew the bearings once they have been removed from the shaft.

1 Fasten the bearing unit firmly to a vice at the bearing housing (330). Fig. 7.

2 Detach the coupling half (840) using an extractor.

3 Unscrew the hexagonal screws (901.4) of the bearing cover (360). Remove the guard end (685).

4 Draw the bearing cover out by using the hexagonal screws (901.4). As a result, the deflector (507) will also come off. Fig. 8.

5 Strike the pump side end of the shaft (210) with a soft hammer, whereupon the shaft with its bearings will come off the bearing housing. Simultaneously the other deflector (507) also comes off. Fig. 9.

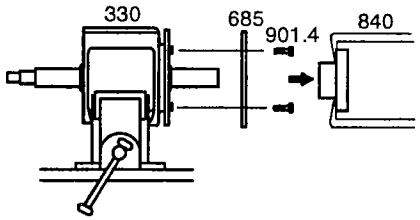


Fig. 7

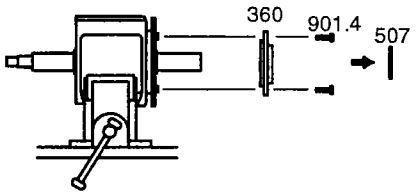


Fig. 8

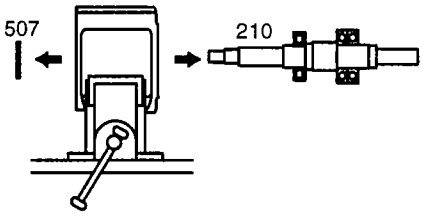


Fig. 9

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6 Fasten the shaft with its bearings to a vice and detach the bearing nut (923) and lockwasher (931). Fig.10.

7 Detach the bearings (320.1, 320.2) from the shaft with an extractor or by means of a hammer and a punch.

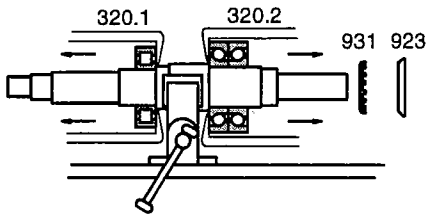


Fig. 10

4 Reassembly

4.1 Preliminaries

- Clean all gasket surfaces and fittings from rust and layers.
- Inspect for unusual erosion, pitting and wear in parts.
- Inspect keyways and bores for damage.
- Inspect the pump and baseplate for cuts and cracks.

4.2 Reassembly of bearing unit

NOTE

It is absolutely necessary to place the bearings correctly according to the O-system (so called Back-To-Back-Design).

1 Check the shaft (210) with its shaft wearing sleeve (524) in a span. Their maximum radial difference is 0.05 mm (0.002 in).

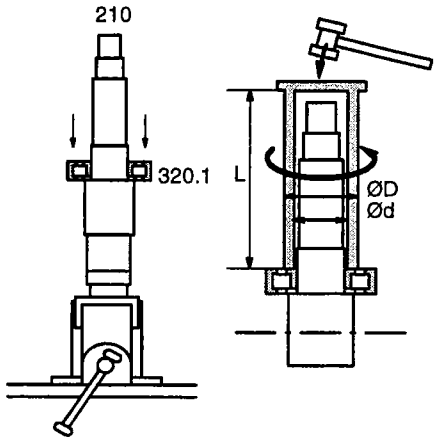
2 Fasten the shaft to a vice with the impeller end of the shaft upwards. Use soft sheets between the vice clamp jaws to avoid shaft damages. Heat the cylinder roller bearing (320.1) to ca +100 °C (+212 °F) and push it onto the shaft. Remember to place the spacer ring of the bearing on the shaft shoulder side. Fig. 11.

3 Let the bearing cool down. Then tap it tightly by the inner ring against the shoulder using a pipe punch. Rotate the pipe punch between the blows.

4 Turn the shaft so that the coupling side is upwards, fasten it to a vice. Fig. 12.

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5 Heat the two angular contact ball bearings (320.2) to approx. +100 °C (+212 °F) and push them onto the shaft. Let the bearings cool down.



Bearing unit (mm)	1	2	3	4	5	6
Ød	37	47	57	67	87	105
ØD	50	60	71	80	100	115
L_{min}	185	205	220	280	320	360

Bearing unit (in)	1	2	3	4	5	6
Ød	1.45	1.85	2.25	2.65	3.45	4.13
ØD	2.00	2.35	2.80	3.15	3.95	4.53
L_{min}	7.3	8.1	8.7	11.0	12.4	14.2

Fig. 11

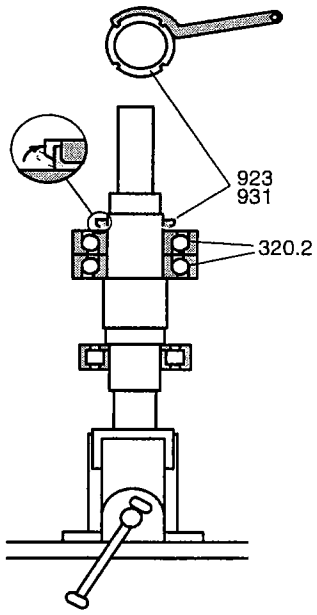


Fig. 12

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6 Place the lockwasher (931) on the shaft.

7 Tighten the angular contact ball bearings by means of the bearing nut (923) tightly against the shaft shoulder, use a suitable hooked wrench.

8 Bend the lockwasher tooth into the bearing nut slots.

9 Tighten the bearing housing (330) vertically to the vice with the coupling side upwards. Fig. 13.

10 Tap the labyrinth ring (423) into the bearing housing (330) with a soft hammer. Make sure that the water holes in the labyrinth ring will end up underneath. Fig. 13.

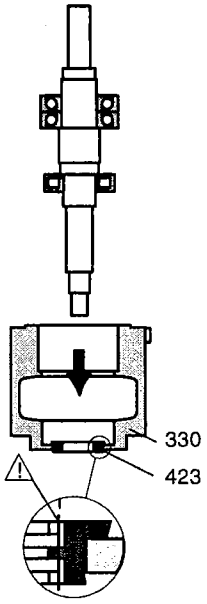


Fig. 13

11 Tap the labyrinth ring (423.2) into the bearing cover (360.1) with a soft hammer. Make sure that the water holes in the labyrinth ring will end up underneath. Fig. 14.

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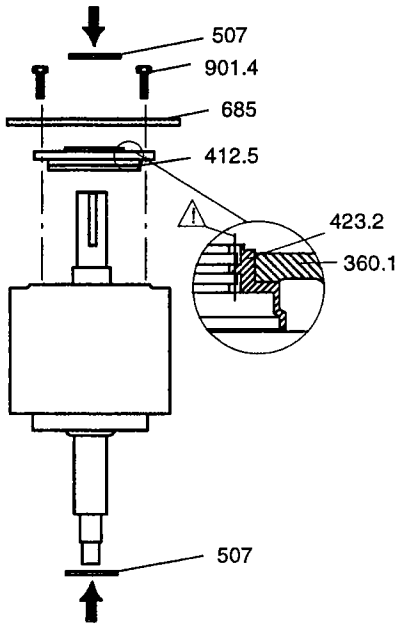


Fig. 14

12 Heat the bearing housing first slightly (max. +80 °C / +176 °F) to ease the installation of the shaft unit.

13 Lower the shaft carefully into the bearing housing. Make sure not to damage the labyrinth ring in the bearing housing.

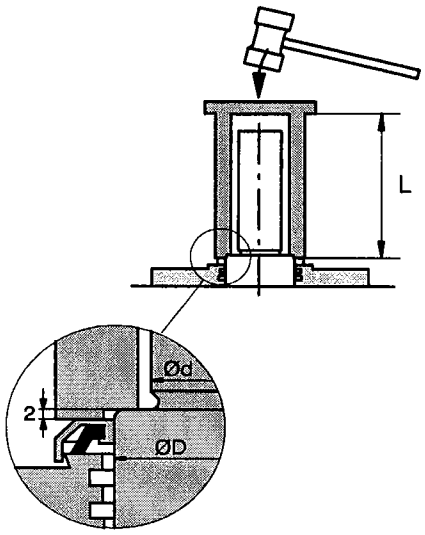
14 Grease the o-ring (412.5) of the bearing cover lightly and stretch it into its groove.

15 Set the bearing cover cautiously into its place. Make sure that the water holes in the labyrinth ring will end up underneath. Place the coupling guard end (685) on the bearing cover. Secure these to the bearing housing with the hexagonal screws (901.4).

16 Tighten the hexagonal screws (901.4) of the bearing cover.

17 Place the deflectors (507) with care onto the shaft by using e.g. a special pipe punch shown in Fig. 15. Grease the rubber lip before installation.

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Bearing unit (mm)	Coupling side			Impeller side		
	Ød	ØD	Lmin	Ød	ØD	Lmin
1	24	35	160	30	35	160
2	32	45	180	40	45	180
3	42	55	195	50	55	195
4	48	65	250	60	65	250
5	75	85	290	80	85	290
6	90	100	320	90	100	320

Bearing unit (in)	Coupling side			Impeller side		
	Ød	ØD	Lmin	Ød	ØD	Lmin
1	1.0	1.378	6.3	1.181	1.378	6.3
2	1.25	1.772	7.1	1.575	1.772	7.1
3	1.625	2.165	7.7	1.969	2.165	7.7
4	1.875	2.559	10.0	2.362	2.559	10.0
5	3.0	3.346	11.5	3.150	3.346	11.5
6	3.375	3.937	12.6	3.543	3.973	12.6

Fig. 15

4.3 Assembly of shaft seal

Refer to the sectional drawing of the shaft seal when reading through these instructions.

Gland packing, fittings PL01, PL02, PL03 and PL04 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Place the casing cover (161) on a horizontal surface with the sealing cavity upwards.

3 Place the neck bush (456) to the bottom of the sealing cavity.

4 Put the shaft wearing sleeve (524) in an upright position to the middle of the sealing cavity.

5 Insert the first two gland packings (461), the lantern ring (458), the other two gland packings and the two-piece stuffing box gland (452). Tighten the hexagonal nuts (920.2) by hand.

6 Push the casing cover with gland packing parts onto the shaft. Check that the shaft wearing sleeve is placed towards the shaft shoulder.

7 Attach the casing cover to the adapter with hexagonal screws (901.2).

Gland packing, fitting PC01(APP/APT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Place the casing cover (161) on a horizontal surface with the sealing cavity upwards.

3 Place the neck bush (456) to the bottom of the sealing cavity.

4 Put the shaft wearing sleeve (524) in an upright position to the middle of the sealing cavity.

5 Insert the first two gland packings (461), the lantern ring (458), the other two gland packings and cooling insert (442) with o-rings (412.9). Tighten the hexagonal nuts (920.2) by hand.

6 Push the casing cover with gland packing parts onto the shaft. Check that the shaft wearing sleeve is placed towards the shaft shoulder.

7 Attach the casing cover to the adapter with hexagonal screws (901.2).

Gland packing, fitting PL05 (EPP/EPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Place the o-rings (412.1 and 412.2) into their proper grooves in the stuffing box housing (451).

3 Grease the o-rings slightly and push the stuffing box housing together with the incorporated parts into the casing cover (161). Fix the stuffing box housing into the casing cover by means of the flange (723) and the hexagonal screws (901.11).

4 Place the casing cover (161) together with the incorporated parts on a table with the stuffing box upwards.

5 Place the shaft wearing sleeve (524) upright in the middle of the stuffing box.

6 Install the two gland packings (461), the plate (550.1), the three remaining gland packings and the dual stuffing box gland (452). Tighten the hexagonal screws (901.12) manually. Refer to and follow the detailed instructions in "Preventive maintenance/Shaft seal monitoring/Gland packing".

7 Push the casing cover (161) together with the incorporated parts onto the shaft. Push especially the shaft wearing sleeve (524) so far that it is against the shaft shoulder.

8 Fix the casing cover into the adapter by means of screws (901.2).

Gland packing, fitting PP21 (EPP/EPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Place the o-rings (412.1 and 412.2) into their proper grooves in the stuffing box housing (451).

3 Grease the o-rings slightly and push the stuffing box housing together with the incorporated parts into the casing cover (161). Make sure that the lubrication holes of the casing cover and the stuffing box housing match together. Fix the stuffing box housing into the casing cover by means of the flange (723) and the hexagonal screws (901.11).

4 Place the casing cover (161) together with the incorporated parts on a table with the stuffing box upwards.

5 Place the shaft wearing sleeve (524) upright in the middle of the stuffing box.

6 Install the two gland packings (461), the lantern ring (458), the three remaining gland packings and the dual stuffing box gland (452). Tighten the hexagonal screws (901.12) manually. Refer to and follow the detailed instructions in "Preventive maintenance/Shaft seal monitoring/Gland packing".

7 Push the casing cover (161) together with the incorporated parts onto the shaft. Push especially the shaft wearing sleeve (524) so far that it is against the shaft shoulder.

8 Fix the casing cover into the adapter by means of screws (901.2).

Mechanical seal, fittings ME01, ME02, ME03 and ME05 (APP/APT, NPP/NPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Mount the mechanical seal (433) parts into the cover plate for seal (471) and onto the shaft wearing sleeve (524) according to the seal manufacturer's instructions. Make sure that the cylinder pin (562.2) is in the proper positon.

3 Place the gasket (400.2) in the cover plate for seal (471). Fix the cover plate for seal on the casing cover (161) with the flange (723). Tighten the hexagonal nuts (920.2).

4 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

5 Push the shaft wearing sleeve (524) together with the incorporated parts onto the shaft against the shoulder.

Mechanical seal, fitting ME03 (ARP/ART)

1 Press the stationary seat of the mechanical seal (433) with its o-ring into the adapter (344) without damaging the sliding surface of the seal.

2 Fix the adapter (344) to the bearing housing (330) with the hexagonal nuts (920.2) of the studs (902.1). Do not damage the sliding surface of the seal.

3 Fix the rotating part of the mechanical seal (433) on the expeller (235), making sure it fits tightly against the shoulder and lock it with the locking screws of the seal. The sliding surfaces must not be damaged.

4 Push the expeller with seal onto the shaft.

5 Fit the o-ring (412.6) on the cover (160).

6 Fit the gaskets (400.3) in their places between the cover (160) and the casing cover (161) and between the cover (160) and the adapter (344).

7 Fix the combination of cover and casing cover to the adapter with hexagonal screws (901.2).

Mechanical seal, fittings ME02 and ME03 (ASP/AST, NSP/NST, WSP/WST)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Push the casing (100) into its guideway into the adapter (344).

3 First, push the shaft wearing sleeve (524) and then the series of compressor rings (487.1) onto the shaft.

4 Push the suction impeller (231) onto the shaft. Do not install o-rings (412.6), the parts of the mechanical seal (433) nor the cover plate for seal (471.2) yet.

5 Measure the gap between the suction impeller (231) and casing (100), and adjust it according to table 1 by taking off or adding compressor rings (487.1). While measuring the gap, make sure that both the casing and the suction impeller are tightly in their guideway pressed all the way to the bottom.

Table 1 Gap between the suction impeller and casing

Bearing unit	Gap	
	mm	in
1	0.2 - 0.3	0.008 - 0.012
2	0.2 - 0.3	0.008 - 0.012
3	0.2 - 0.3	0.008 - 0.012
4	0.25 - 0.35	0.010 - 0.014
5	0.3 - 0.4	0.012 - 0.016

Measure the gap between the end of the suction impeller hub and the casing. The gap is bigger at the vanes of the suction impeller, since the front face of the vanes is slightly conical.

Once the gap between the suction impeller and casing is correct, the gap between the suction impeller and the casing cover (161) will also become automatically correct.

6 After adjusting the gap, remove the suction impeller, shaft wearing sleeve and casing again so as to perform the actual assembly.

7 Fasten the cylinder pins (562.1 and 562.2) into the cover plate for seal (471.2) and casing (100).

8 Install the static part of the mechanical seal (433) into the cover plate for seal (471.2). Make sure that the position of the static part in relation to the cylinder pin is correct. Place the o-ring (412.8) into the groove in the cover plate for seal. Install the cover plate for seal into the casing (100) with hexagonal screws (914.2).

9 Install the casing (100) with its parts into its guideway into the adapter (344).

10 Install the rotating part of the mechanical seal (433) into place into the shaft wearing sleeve (524) and push the shaft wearing sleeve onto the shaft.

11 Install the needed the compressor rings (487.1) onto the shaft.

12 Place the o-ring (412.6) into its groove and then push the suction impeller (231) onto the shaft.

13 Install the o-ring (412.7) into its groove in the casing (100).

14 Install the casing cover (161) into its guideway into the adapter (344). Make sure that the cylinder pin (562.2) goes into its hole in the casing cover. Fix the screws (901.2).

Mechanical seal, fitting ME04 (APP/APT, NPP/NPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Mount the mechanical seal (433) parts into the cover plate for the seal (471) and onto the shaft wearing sleeve (524) according to the seal manufacturer's instructions. Make sure that the cylinder pin (562.2) is in the proper position.

3 Place the gasket (400.2) in the cover plate for seal (471). Fix the cover plate for seal on the casing cover (161) with the flange (723). Tighten the hexagonal nuts (920.2).

4 Push the plate (550) onto the shaft. Make sure that the rubber lip on the outer edge of the plate comes to the bearing side. Fig. 16

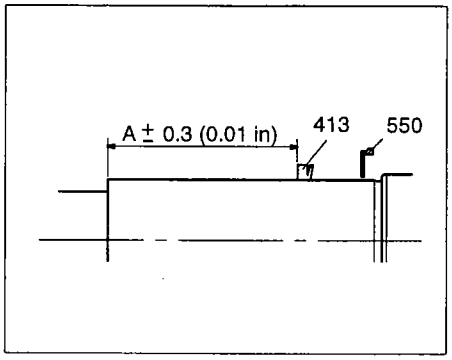


Fig. 16

5 Push the v-ring (413) onto the shaft. The distance of the v-ring from the shaft shoulder is shown in Table 2. The use of an installation sleeve helps to get the v-ring perpendicularly with respect to the shaft. Grease the lip of the v-ring slightly.

Table 2 ***V-ring position, fitting ME04***

Bearing unit	Seal size ∅		Distance A	
	mm	in	mm	in
1	35	1.38	81.5	3.21
2	45	1.77	80.5	3.17
3	55	2.17	88.5	3.48
4	65	2.56	88.5	3.48
5	85	3.35	102.5	4.04
6	95	3.74	102.5	4.04

6 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

7 Push the shaft wearing sleeve (524) together with the incorporated parts onto the shaft against the shoulder.

8 Continue installation according to item "Installation of impeller".

9 After all other parts have been installed, push the plate (550) into the groove in the cover plate for seal (471) so that the entire rubber lip settles straight in the groove. Fig. 17. To make sure that the lip is correctly situated, use a tool shown in Fig. 18. Place the tip of the tool into the groove and turn around the cover plate for seal.

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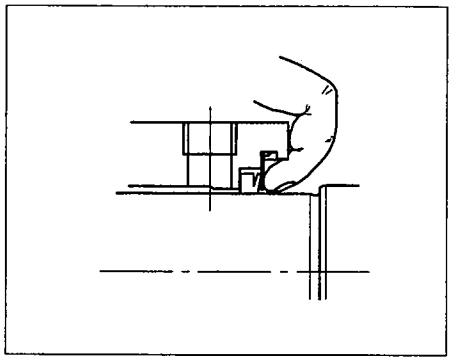


Fig. 17

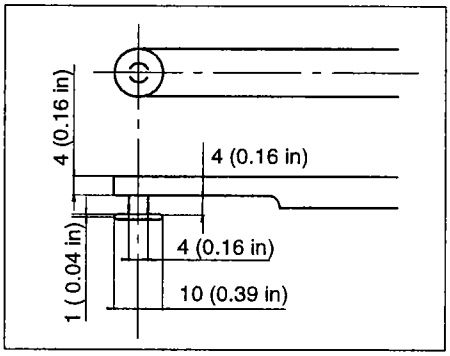


Fig. 18

Mechanical seal, fittings MC01, MC02, MC03, MC04, MC20, MC21 and MC22 (APP/APT, NPP/NPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Mount the mechanical seal (433) into the casing cover (161). Follow the instructions provided by the seal manufacturer.

3 Push the shaft wearing sleeve (524) onto the shaft.

4 Push the casing cover (161) together with the incorporated parts onto the shaft. Follow the instructions provided by the seal manufacturer. Fix the screws (901.2). Tighten the hexagonal nuts (920.2).

5 Complete all the lockings, fixings and other seal-related jobs as described in the seal manufacturer's instructions.

Mechanical seal, fittings MC20, MC21 and MC22 (EPP/EPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Place the o-ring (412.1) into the groove in the distance bush (543) and press the bush into the casing cover (161).

3 Fix the mechanical seal (433) into the casing cover (161) in accordance with the seal manufacturer's instructions.

4 Push the shaft wearing sleeve (524) onto the shaft.

5 Push the casing cover (161) together with the incorporated parts onto the shaft. Always when handling the mechanical seal, follow the seal manufacturer's instructions. Fix the screws (901.2). Tighten the hexagonal nuts (920.2).

6 Complete all the lockings, fixings and other seal-related jobs as described in the seal manufacturer's instructions.

Mechanical seal, fittings MR01, MR02, MR03 and MR05 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Install the gasket (400.2) if included in the parts list.

3 Mount the static part of the mechanical seal (433) into the casing cover (161), and the outer rotating part onto the shaft according to the seal manufacturer's instructions. Tighten the nuts (920.2).

4 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

5 Push the rotating part of the mechanical seal onto the shaft against the shoulder.

Mechanical seal, fittings MR04 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Install the gasket (400.2) if included in the parts list.

3 Mount the static part of the mechanical seal (433) into the casing cover (161) with the flange (723). Follow the instructions provided by the seal manufacturer. Tighten the nuts (920.2).

4 Push the plate (550) onto the shaft. Make sure that the rubber lip on the outer edge of the plate comes to the bearing side. Fig. 19.

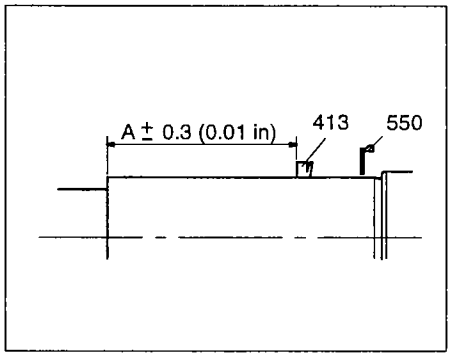


Fig. 19

5 Push the v-ring (413) onto the shaft. The distance of the v-ring from the shaft shoulder is shown in Table 3. The use of an installation sleeve helps to get the v-ring perpendicularly with respect to the shaft. Grease the lip of the v-ring slightly.

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Table 3 ***V-ring position, fitting MR04***

Bearing unit	Seal size Ø		Seal			
			Safematic SEW-P Distance A		Burgman S32-E32 Distance A	
	mm	in	mm	in	mm	in
1	30	1.18	81.5	3.21	79.5	3.13
2	40	1.57	80.5	3.17	79.5	3.13
3	50	1.97	88.5	3.48	82.5	3.25
4	60	2.36	91	3.58	82.5	3.25
5	80	3.15	102.5	4.04	99.5	3.92
6	90	3.54	109.5	4.31	99.5	3.92

6 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

7 Push the rotating part of the mechanical seal (433) onto the shaft against the shoulder.

8 Continue installation according to item "Installation of impeller".

9 After all other parts have been installed, push the plate (550) into the groove in the cover plate for seal (471) so that the entire rubber lip settles straight in the groove. Fig. NO TAG. To make sure that the lip is correctly situated, use a tool shown in Fig. NO TAG. Place the tip of the tool into the groove and turn around the cover plate for seal.

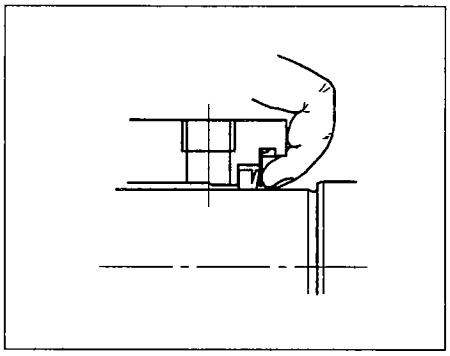


Fig. 20

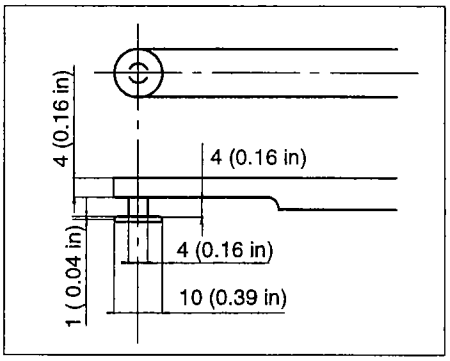


Fig. 21

Mechanical seal, fitting MR04 (EPP/EPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Place the o-ring (412.1) into the groove in the distance bush (543) and press the bush into the casing cover (161).

3 Install the gasket (400.2).

4 Mount the static part of the mechanical seal (433) into the casing cover (161) by means of the flange (723). Tighten the hexagonal screws (901.14). Always when handling the mechanical seal, follow the seal manufacturer's instructions.

5 Push the plate (550) onto the shaft. Make sure that the rubber lip on the outer edge of the plate comes to the bearing side. Fig. NO TAG.

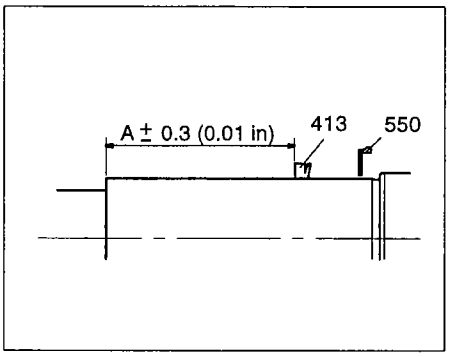


Fig. 22

6 Push the v-ring (413) onto the shaft. The distance of the v-ring from the shaft shoulder is shown in Table 4. The use of an installation sleeve helps to get the v-ring perpendicularly in relation to the shaft. Grease the lip of the v-ring slightly.

Table 4 V-ring position, fitting MR04

Bearing unit	**Seal size ∅**		**Seal** Safematic SEW-P **Distance A**		Burgman S32-E32 **Distance A**	
	mm	in	mm	in	mm	in
3	50	1.97	88.5	3.48	82.5	3.25
4	60	2.36	91	3.58	82.5	3.25
5	80	3.15	102.5	4.04	99.5	3.92

7 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

8 Push the rotating part of the mechanical seal (433) onto the shaft against the shoulder.

9 After all other parts have been installed, push the plate (550) into the groove in the cover plate for seal (471) so that the entire rubber lip settles straight in the groove. Fig. 23. To make sure that the lip is correctly situated use a tool shown in Fig. 24. Place the tip of the tool into the groove and turn around the cover plate for seal.

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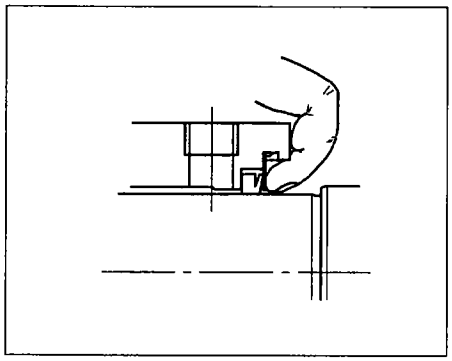


Fig. 23

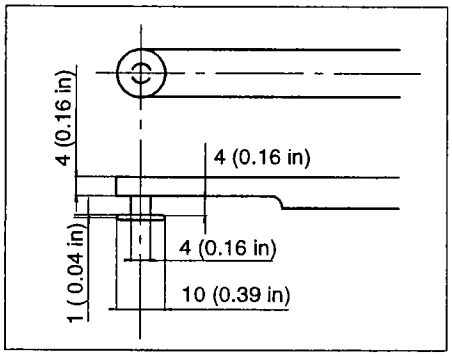


Fig. 24

Mechanical seal, fittings MR20, MR21and MR22 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Install the gasket (400.2) if included in the parts list.

3 Mount the static part of the mechanical seal (433) into the casing cover (161), and the outer rotating part onto the shaft according to the seal manufacturer's instructions. Tighten the nuts (920.2).

4 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

5 Push the rotating part of the mechanical seal (433) onto the shaft against the shoulder.

Mechanical seal, fittings MR20 and MR21 (EPP/EPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Place the o-ring (412.1) into the groove in the distance bush (543) and press the bush into the casing cover (161).

3 Install the gasket (400.2) if included in the parts list.

4 Mount the static part of the mechanical seal (433) into the casing cover (161), and the outer rotating part onto the shaft in accordance with the seal manufacturer's instructions. Tighten the hexagonal nuts (920.2).

5 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

6 Push the rotating part of the mechanical seal (433) onto the shaft against the shoulder.

Mechanical seal, fittings MR20, MR21, MR22, MR23, MR24 and MR25 (ASP, NSP, WSP)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Push the casing (100) into its guideway into the adapter (344).

3 Push the inner rotating part of the mechanical seal (433) on the shaft against the shoulder. Remove the o-ring from the periphery of the part.

4 Put the series of compressor rings (487.1) onto the shaft against the front face of the part of the mechanical seal.

5 Push the suction impeller (231) onto the shaft. Do not insert the o-ring (412.6) at this stage.

6 Measure the gap between the suction impeller (231) and casing (100), and adjust it according to table 5 by taking off or adding compressor rings (487.1). While measuring the gap, make sure that both the casing and the suction impeller are tightly in their guideway pressed all the way to the bottom. Measure the gap between the end of the suction impeller hub and the casing because the front face of the vanes is slightly conical.

Table 5 ***Gap between the suction impeller and casing***

Bearing unit	Gap	
	mm	in
1	0.2 - 0.3	0.008 - 0.012
2	0.2 - 0.3	0.008 - 0.012
3	0.2 - 0.3	0.008 - 0.012
4	0.25 - 0.35	0.010 - 0.014
5	0.3 - 0.4	0.012 - 0.016

7 After adjusting the gap, remove the parts again so as to perform the actual assembly.

8 Push the outer rotating part of mechanical seal onto the shaft against the shoulder.

9 Install the static part of the mechanical seal into the casing (100). Fasten the hexagonal screws (914.2).

10 Push the casing (100) into its guideway into the adapter (344).

11 Push the inner rotating part of the mechanical seal (433) onto the shaft. Put the o-ring (which was removed in item 3) back into its groove to the periphery of the part.

12 Push the compressor rings (487.1) onto the shaft against the front face of the part of the mechanical seal.

13 Place the o-ring (412.6) into its groove inside the suction impeller and then push the suction impeller (231) onto the shaft.

14 Push the cylinder pin (562.2) into its hole in the casing (100).

15 Place the o-ring (412.7) into its groove in the casing (100).

16 Install the casing cover (161) into its guideway into the adapter (344). Tighten the hexagonal screws (901.2).

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Mechanical seal, fittings MR26 and MR27 (EPP/EPT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Place the profile gasket (410.1) and o-ring (412.1) into the groove in the cooling insert (442) and press the cooling insert into the casing cover (161).

3 Mount the static part of the mechanical seal (433) into the casing cover (161), and the outer rotating part onto the shaft in accordance with the seal manufacturer's instructions. Tighten the hexagonal nuts (920.2).

4 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

5 Push the rotating part of the mechanical seal (433) onto the shaft against the shoulder.

Mechanical seal, fitting MU01 (APP/APT)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3).

2 Mount the static part of the mechanical seal (433) into the casing cover (161) with the flange (723). Follow the instructions provided by the seal manufacturer. Tighten the screws (914.2).

3 Push the shaft wearing sleeve (524) onto the shaft against the shoulder.

4 Push the rotating part of the mechanical seal (433) almost to its proper place on the shaft wearing sleeve. Follow the instructions provided by the seal manufacturer.

5 Push the casing cover (161) together with the incorporated parts onto the shaft. Fix the screws (901.2).

6 Mount the mechanical seal (433) into its final place according to the seal manufacturer's instructions. Complete all the lockings, fixings etc. as described in the manufacturer's instructions.

Static seal, fitting SS01 (ASP/AST, NSP/NST, WSP/WST)

1 Fix the adapter (344) into the bearing housing (330) with hexagonal screws (901.3)

2 Fix the static seal (435), o-ring (412.8) and the cover plate for seal (471.2) in the casing (100) with hexagonal screws (914.2). Do not insert the gasket (400.2) at this stage.

3 Push the shaft wearing sleeve (524) onto the shaft against the shoulder.

4 Push the casing (100) into its guideway into the adapter against the shoulder.

5 See if the static seal rests against the shoulder of the shaft wearing sleeve without any clearance. If it does not, remove the casing again and add gaskets (400.2) with a thickness of 0.5 mm (0.02 in) each under the static seal, one gasket at a time until there is no clearance any more.

6 Put the series of compressor rings (487.1) onto the shaft against the front face of the shaft wearing sleeve.

7 Push the suction impeller (231) onto the shaft. Do not insert the o-ring (412.6) at this stage.

8 Measure the gap between the suction impeller (231) and casing (100), and adjust it according to table 6 by taking off or adding compressor rings (487.1). While measuring the gap, make sure that both the casing and the suction impeller are tightly in their guideway pressed all the way to the bottom. Measure the gap between the end of the suction impeller hub and the casing because the front face of the vanes is slightly conical.

Table 6 ***Gap between the suction impeller and casing***

Bearing unit	Gap	
	mm	in
1	0.2 - 0.3	0.008 - 0.012
2	0.2 - 0.3	0.008 - 0.012
3	0.2 - 0.3	0.008 - 0.012
4	0.25 - 0.35	0.010 - 0.014
5	0.3 - 0.4	0.012 - 0.016

9 After adjusting the gap, remove the parts again so as to perform the actual assembly.

10 Place the o-ring (412.6) into its groove inside the suction impeller and then push the suction impeller (231) onto the shaft.

11 Push the cylinder pin (562.2) into its hole in the casing (100).

12 Place the o-ring (412.7) into its groove in the casing (100).

13 Install the casing cover (161) into its guideway into the adapter (344). Tighten the hexagonal screws (901.2).

Dynamic seal, fittings DS01, DS02 and DS03 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Slide the thrust ring (475) with its o-ring (412.7) and grub screws (904) along the shaft to a preliminary position up to the hindmost shoulder.

3 Install the o-ring (412.8), static seal (435) and cover plate for seal (471.2) into the stuffing box housing (451) by using studs (902.1) and hexagonal nuts (920.2). Observe that the static seal must be placed in the right way and centrally in its guiding slot in the stuffing box housing.

4 Push the stuffing box housing with its parts into its place in the adapter.

5 Push the expeller (604) with an o-ring (412.6) fitted in its hub onto the shaft.

6 Install the gasket (400.3) into the stuffing box housing or the o-ring (412.18) into the casing cover (161.2).

7 Push the casing cover into its place in the adapter and fasten the hexagonal screws (901.2). Continue the assembly according to the following section "Installation of impeller".

8 When the exchange unit is fully assembled, place the thrust ring (475) at the right position on the shaft and fasten the grub screws (904). The distance between the face of the cover plate for seal and the shoulder of the thrust ring must be 10 mm (0.394 in). Fig. NO TAG.

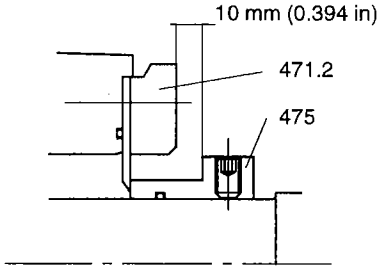


Fig. 25

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Dynamic seal, fittings DS21, DS22 and DS23 (APP/APT, NPP/NPT, WPPWPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Slide the thrust ring (475) with its o-ring (412.7) and grub screws (904) along the shaft to a preliminary position up to the hindmost shoulder.

3 Install the o-rings (412.8) into their grooves situated in the cover plate for seal (471.3) and stuffing box housing (451).

4 Install the cover plate for seal (471.2), static seal (435), cover plate for seal (471.3) and the other static seal (435) on the shaft.

5 Install the o-ring (412.7) into its groove in the thrust ring (475.2) and slide the thrust ring onto the shaft up to the shoulder level. Mount the thrust ring on the shaft with the socket head screws (904.2).

6 Push the stuffing box housing (451) with the mounted studs (902.1) into the adapter so that the cover plate for seal (471.2), static seal (435), cover plate for seal (471.3) and the other static seal (435) can be mounted on the stuffing box housing with hexagonal screws (920.2).

7 Install the gasket (400.3) in the stuffing box housing or the o-ring (412.18) in the casing cover (161.2).

8 Once the exchange unit is completely assembled, place the thrust ring (475) in the correct position on the shaft and mount the grub screws (904). The distance between the front face of the cover plate for seal and thrust ring shoulder must be 10 mm.

Dynamic seal, fittings DP01, DP02 and DP03 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Place the o-ring (412.7) into its groove in the shaft wearing sleeve (524) and slide the shaft wearing sleeve onto the shaft up to the shoulder level and mount it on the shaft with the grub screws (904).

3 Install the neck bush (456), the first gland packing (461), lantern ring (458) and the other gland packing (461) as well as the stuffing box gland (452) loosely in the stuffing box housing (451) with studs (902.1) and hexagonal nuts (920.2). Mount the reducer nipple (794.1) and grease nipple in the stuffing box housing.

4 Push the stuffing box housing with the incorporated parts into place in the adapter.

5 Push the expeller (604) together with the o-ring (412.6) installed in its hub onto the shaft.

6 Install the gasket (400.3) in the stuffing box housing or the o-ring (412.18) in the casing cover (161.2).

7 Push the casing cover into place in the adapter and mount the hexagonal screws (901.2). Continue assembly in accordance with item "Installation of impeller".

8 Fill the lantern ring with grease using a grease press. See lubrication of bearings.

Dynamic seal, fitting DT01 (APP/APT, NPP/NPT, WPP/WPT)

1 Fix the adapter (344) to the bearing housing (330) with the hexagonal screws (901.3).

2 Slide the thrust ring (475) with its o-ring (412.7) and grub screws (904) along the shaft to a preliminary position up to the hindmost shoulder.

3 Install the o-rings (412.8), throttling bush (542.3) (note the position), static seal (435) and the cover plate for seal (471.2) in the stuffing box housing (451) with studs (902.1) and hexagonal nuts (920.2). Note that the static seal must be installed in the middle of its guideway in the stuffing box housing.

4 Push the stuffing box housing with the incorporated parts into place in the adapter.

5 Push the expeller (604) together with the o-ring (412.6) installed in its hub onto the shaft.

6 Install the gasket (400.3) in the stuffing box housing or the o-ring (412.18) in the casing cover (161.2).

7 Push the casing cover into place in the adapter and mount the hexagonal screws (901.2). Continue assembly in accordance with item "Installation of impeller".

8 Once the exchange unit is completely assembled, place the thrust ring (475) in the correct position on the shaft and mount the grub screws (904). The distance between the front face of the cover plate for seal and thrust ring shoulder must be 10 mm.

4.4 Installation of impeller

WARNING

The socket head screw (914.1) must be secured to avoid loosening of the impeller.

1 Fit the o-ring (412.4) into its place behind the impeller (230). Fig. 26.

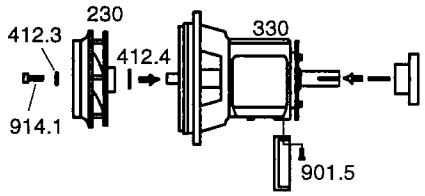


Fig. 26

2 Prevent the shaft from rotating from the coupling end and insert the impeller (230) into its place. The clearance between the impeller and casing cover (161) is about 1.0 mm (0.04 in).

3 Lock the impeller with the socket head screw (914.1) onto which the o-ring (412.3) has been fitted.

4 Tighten the socket head screw to the torque value given in Table 7.

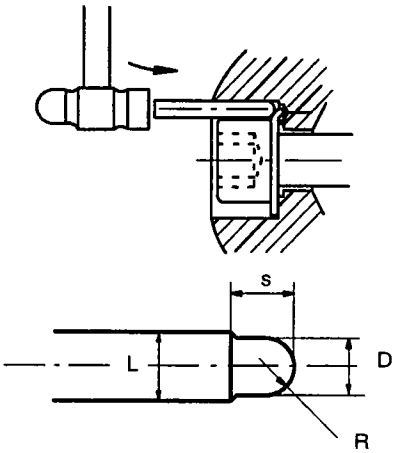
Table 7 Impeller locking screw 914.1

Bearing unig	Screw size	Torque (Nm)		Screw size	Torque (lb ft)	
		Rating	Max. value		Rating	Max. value
1	M10	30	40	3/8 - 16 UNC	20	30
2	M12	50	60	1/2 - 13 UNC	35	45
3	M16	130	140	5/8 - 11 UNC	95	100
4	M20	250	260	3/4 - 10 UNC	180	190
5	M24	420	440	1 - 8 UNC	305	320
6	M30	800	820	1 1/4 - 7 UNC	580	600

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Secure the socket head screw (914.1) by bending its flange into one hole on the impeller. Use a tool with the head shape and dimensions shown in Fig. 27.

The same socket head screw can be used many times. There are two extra holes on the impeller for securing later on.



Bearing unit	L (mm)	∅ D (mm)	R (mm)	S_{min} (mm)
1, 2	$6.5\ ^{0}_{-0.5}$	4	2	6
3, 4	$7.5\ ^{0}_{-0.5}$	6	3	7
5, 6	$9.0\ ^{0}_{-0.5}$	8	4	8

Bearing unit	L (in)	∅ D (in)	R (in)	S_{min} (in)
1, 2	$0.250\ ^{0}_{-0.02}$	0.15	0.075	0.25
3, 4	$0.295\ ^{0}_{-0.02}$	0.25	0.125	0.275
5, 6	$0.354\ ^{0}_{-0.02}$	0.30	0.150	0.30

Fig. 27

4.5 Installation of casing wear ring (closed impeller of APP and EPP)

Tap the casing wear ring (502) into the volute casing (102) with a soft hammer. Check that the wear ring is tightly against the bottom of its groove at each side.

4.6 Installation of sideplate

Installation of adjustable sideplate

1 Grease the o-rings (412.1 and 412.2) lightly and fit them into the grooves of the sideplate (135). Fig. 28.

2 Screw the adjusting screws (909) all the way into the sideplate.

3 Install the sideplate into the volute casing (102).

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4 Fix the hexagonal nuts (920.1) to the adjusting screws.

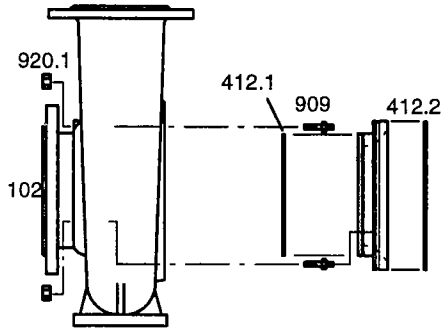


Fig. 28

Installation of fixed sideplate of EPP pump (open impeller)

1 Screw the studs (902.2) tightly into place in the sideplate, Fig. 29.
2 Push the back-up rings (516.3) and o-rings (412.15) onto the studs against the sideplate.
3 Install the sideplate into place in the volute casing (102).
4 Mount and tighten the hexagonal nuts (920.9).

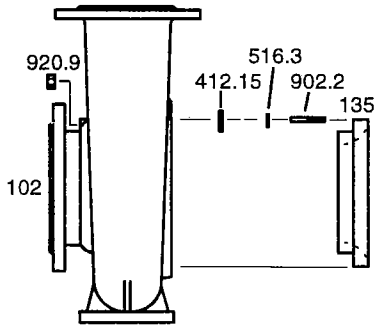


Fig. 29

4.7 Installation of exchange unit

1 Fix the support foot of the bearing unit by means of the hexagonal screws (901.5). Fig 30.
2 Heat the coupling flange to approx. +100 °C (+212 °F) and push it on the shaft with the front surface at the shaft end level.
3 Suspend the exchange unit with a hoist at the maintenance opening of the adapter or underneath the adapter.
4 Fit the gasket (400.1 or 400.3 in the EPP pump) into the casing cover (161).
5 Install the optional drip pan (749) underneath the heads of the two hexagonal screws (901.1). Check that the profile gasket (410.2) is in the correct position.

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6 Install the exchange unit into its place, lubricate the hexagonal screws (901.1) with Molykote Ti 1200 lubricant and tighten them in a cross bolt pattern, to torque values given in Table 8. In hot applications (> 100 °C) involving great pressure variations, check the tightness of the screws and, if necessary, retighten them to the values shown in Table 8 when the pump is not pressurized.

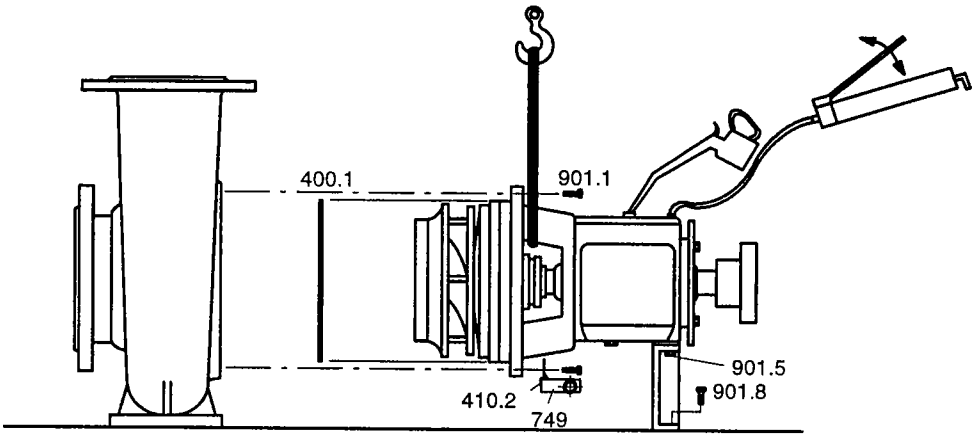


Fig. 30

Table 8 Exchange unit fastening screws (901.1)

Screw size	Moment (Nm)		Screw size	Moment (lb ft)	
	Rating	**Max. value**		**Rating**	**Max. value**
M12	50	60	1/2 - 13 UNC	35	45
M16	130	160	5/8 - 11 UNC	95	120
M20	250	300	3/4 - 10 UNC	185	220
M24	420	520	1 - 8 UNC	310	385

7 Check the impeller clearance according to the Section "Preventive maintenance".

8 Place adjusting plates under the support foot. The plates must have the same thickness as the gap under the support foot. Do not close the gap by tightening.

9 Fix the support foot (183) to the baseplate (890) with the hexagonal screws (901.8).

10 Lubricate the bearing unit with oil or grease according to lubricating instructions in Section "Operation".

11 Install the coupling spacer according to the coupling manufacturer's instructions.

12 Fix the coupling guard jackets (686) and (686.3). The coupling guard must be adjusted so that the space "s" between the coupling guard and motor is approx. 5 mm (0.2 in). Fig. 31.

13 Install the auxiliary pipings (700) and accessories according to sectional drawings and the seal manufacturer's instructions.

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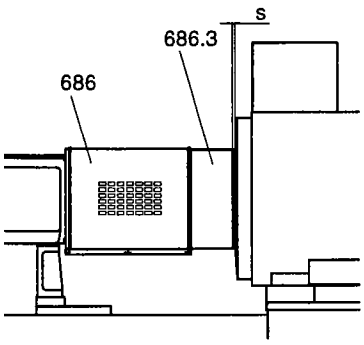


Fig. 31

WARNING

Proper adjustment of the coupling guard jacket is a relevant safety factor.

SULZER

Spare parts recommendation

Version 11 > / 20010510 / Replaces 20000301 / en / **N14808**

Contents *Page*

1 Recommended spare parts 1

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1 Recommended spare parts

To avoid long and expensive shut-down periods, the following spare parts are recommended to be kept in stock. The number of spare parts is evaluated for two year's use in normal operating conditions, Table 1.

Table 1 Spare parts recommendation

Part No.	Description	Number of identical parts in various pumps							
		1	2	3	4	5	6 7	8 9	≥10
		Number of recommended spare parts							
100	Casing							1	10 %
102	Volute casing							1	10 %
135	Sideplate	1	1	1	1	2	2	3	30 %
160	Cover							1	10 %
161	Casing cover							1	10 %
183	Support foot							1	10 %
210	Shaft	1	1	1	2	2	2	3	30 %
230	Impeller	1	1	1	1	2	2	3	30 %
231	Suction impeller	1	1	1	1	2	2	3	30 %
235	Expeller							1	10 %
320.1	Antifriction bearing	1	1	1	2	2	3	4	50 %
320.2	Antifriction bearing		2		4		6	8	50 %
330	Bearing housing							1	10 %
339	Bearing unit							1	10 %
344	Adapter							1	10 %
360	Bearing cover							1	10 %
400	Gasket	2	4	6	8	8	9	12	150 %
412	O-ring	2	4	6	8	8	9	10	100 %
413	V-ring	2	4	6	8	8	9	10	100 %
423	Labyrinth ring							1	10 %
433	Mechanical seal	1	2	3	4	5	6	7	90 %
435	Static seal	1	2	3	4	5	6	7	90 %
451	Stuffing box housing							1	10 %
452	Stuffing box gland							1	10 %
456	Neck bush							1	10 %
458	Lantern ring							1	10 %
461	Gland packing				24			32	400 %
471	Cover plate for seal							1	10 %
475	Thrust ring	1	2	3	4	5	6	7	90 %
487	Compressor ring							1	10 %
502	Casing wear ring	1	2	2	2	3	3	4	50 %
507	Deflector		4		8		8	10	100 %
524	Shaft wearing sleeve	1	2	2	2	3	3	4	50 %
542	Throttling bush							1	10 %
550	Plate	2	4	6	8	8	9	10	100 %
604	Expeller	1	1	1	1	2	2	3	30 %
909	Adjusting screw			3			6	9	30 %
914.1	Socket head screw	1	1	1	1	2	2	3	30 %
923	Bearing nut	1	1	1	2	2	2	3	30 %
931	Lockwasher	1	1	1	2	2	2	3	30 %
940	Key	1	1	1	2	2	2	3	30 %
Refer to the parts lists of the pumps when estimating the number of needed spare parts.									

AHLSTAR™ *Process Pumps*

Sectional drawing N10484

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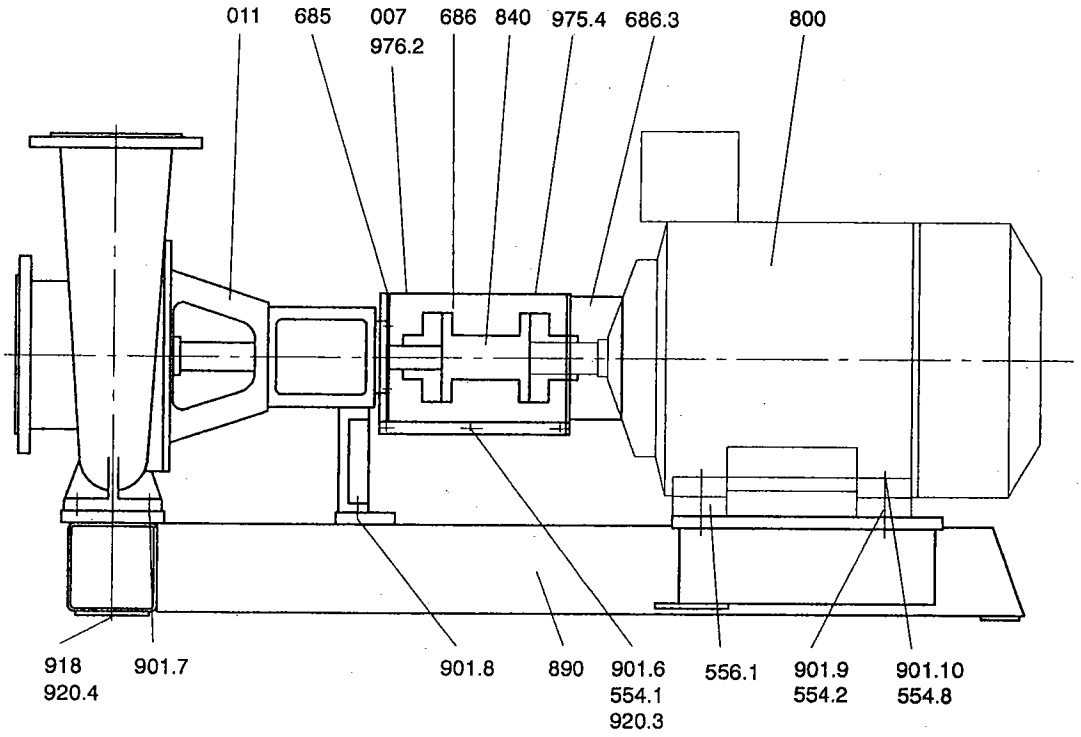
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Version 06 > / 20000301 / Replaces 960701 / en / **N10484**

010.1 Assembly

APP/APT, ASP/AST, NPP/NPT, NSP/NST, WPP/WPT, WSP/WST

Steel baseplate for pump and motor



CAD drawing 385422

AHLSTAR™ *Process Pumps*

Sectional drawing N10487

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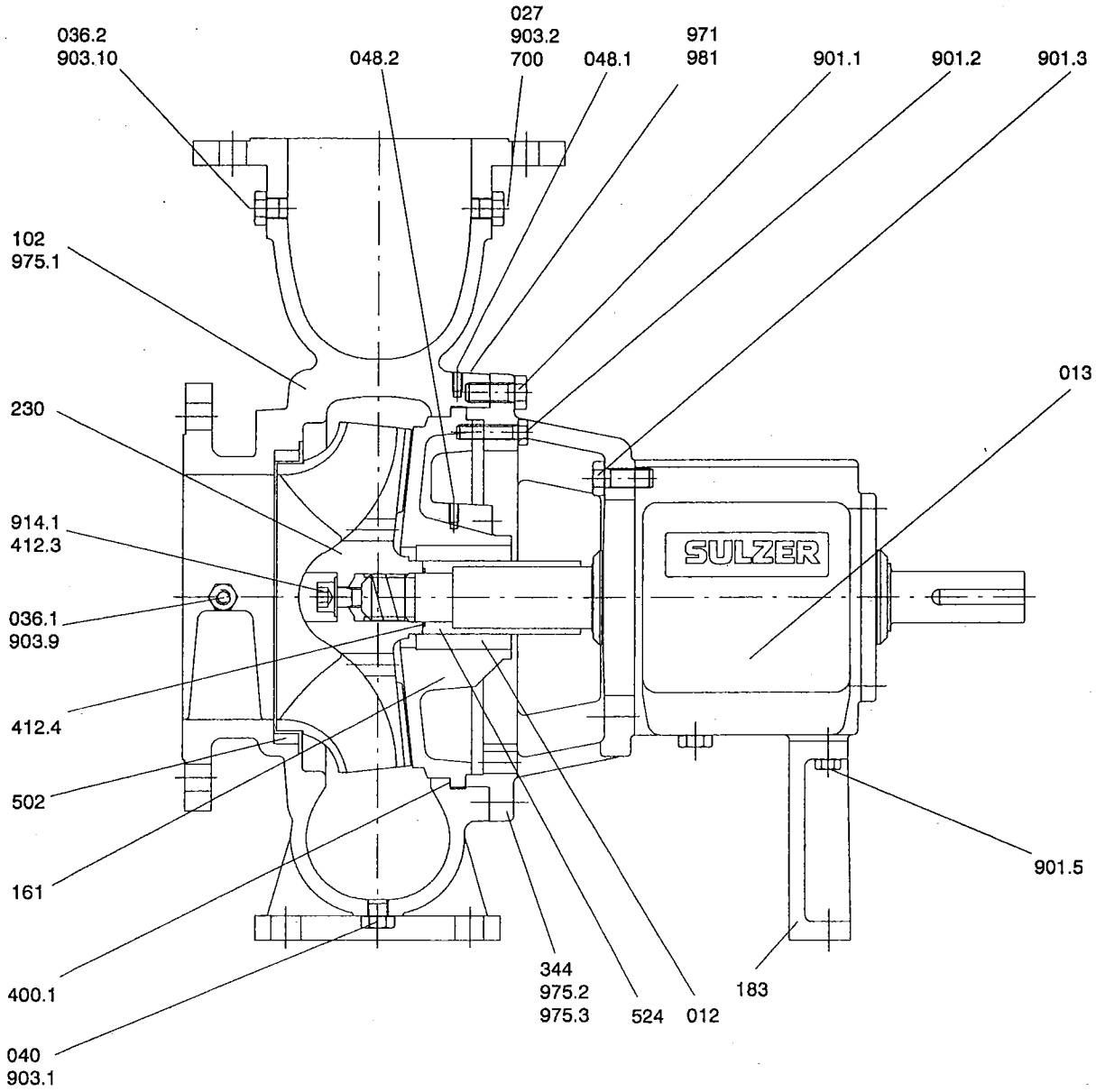
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Version 01 > / 20000301 / Replaces 970616 / en / **N10487**

011 Pump

APP/APT

Closed impeller



CAD drawing 284386

AHLSTAR™ *Process Pumps*

Sectional drawing N10490

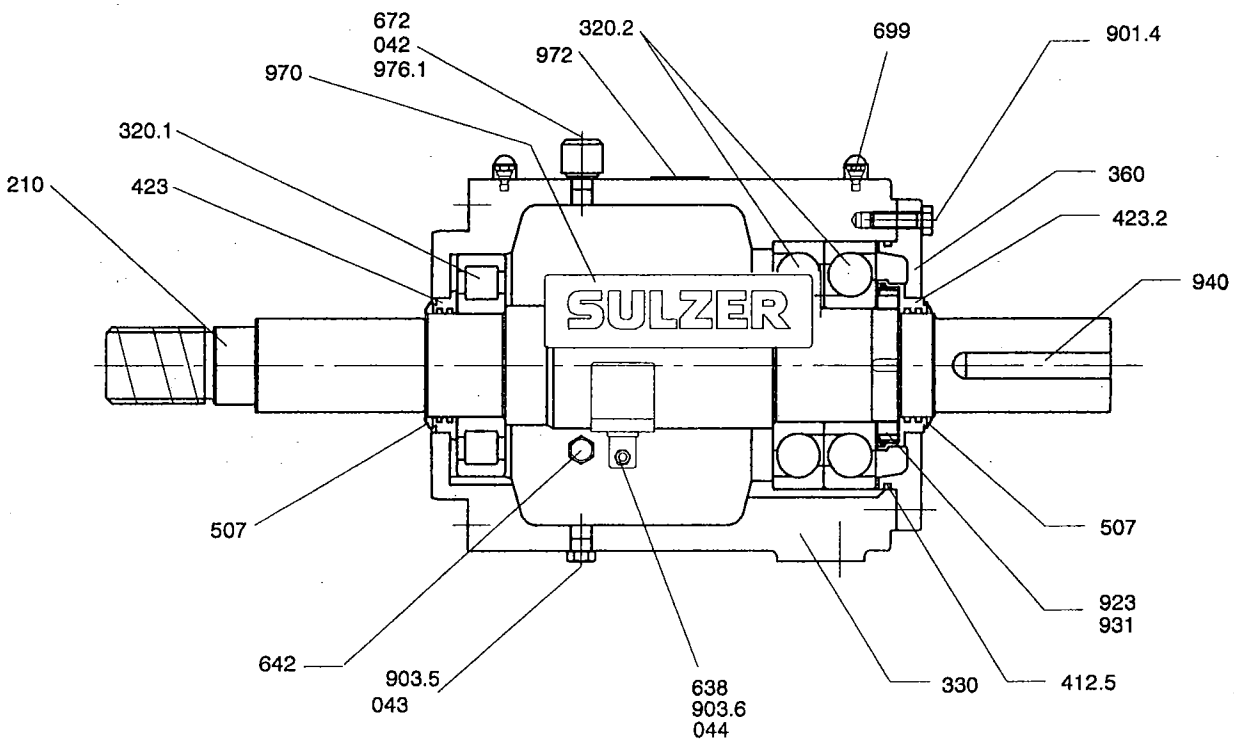
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Version 03 > / 20010910 / Replaces 20000301 / en / **N10490**

013 Bearing unit (Part no. 339)

APP/APT, ARP/ART, ASP/AST, EPP/EPT, NPP/NPT, NRP/NRT, NSP/NST, WPP/WPT, WRP/WRT, WSP/WST

Oil lubricated



CAD drawing 384696

REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS
	286T	20	P	3/60	1180	230/460

AMPS	DUTY	AMB °C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.
49.6/24.8	CONT	40/F	1.15	B	G	FCXE

E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES.@25 °C OHMS (BETWEEN LINES)
488309	418139077DE	---	---	.113/.453

PERFORMANCE

LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY
NO LOAD	0	8.7	1200	6.06	0
1/4	5.02	10.7	1195	49.5	88.9
2/4	10.0	14.4	1189	70.5	92.5
3/4	15.0	19.2	1184	78.6	92.9
4/4	20.0	24.8	1177	81.6	92.5
5/4	25.0	30.9	1170	82.8	91.5

SPEED TORQUE

	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES
LOCKED ROTOR	0	201	179	143
PULL UP	344	172	154	132
BREAKDOWN	1084	252	225	83.1
FULL LOAD	1177	100	89.2	24.8

AMPERES SHOWN FOR 460. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE

REMARKS: TYPICAL DATA
XE MOTOR-NEMA NOM. EFF. 92.4% - GUAR. MIN. EFF. 91.7%

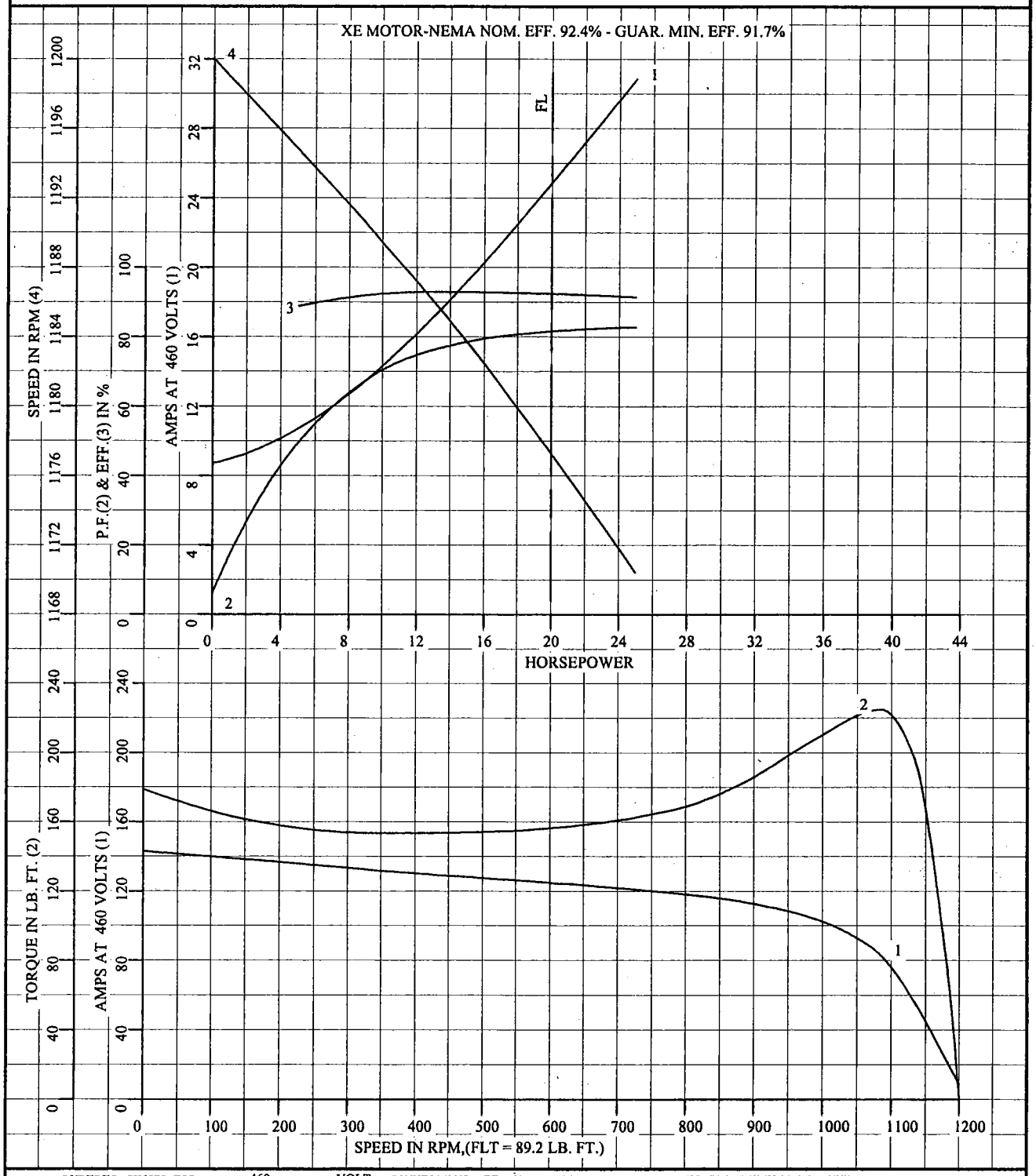
Rockwell Automation

DR. BY D. F. DUNN
CK. BY D. M. BYRD
APP. BY D. M. BYRD
DATE 09-10-93

A-C MOTOR PERFORMANCE DATA E09907-F-Y002
ISSUE DATE 09-10-93

C/R ACR0366

REL S.O.		RPM	1180	S.F.	1.15	ROTOR	418139077DE
FRAME	286T	VOLTS	230/460	NEMA DESIGN	B	TEST S.O.	TYPICAL DATA
HP	20	AMPS	49.6/24.8	CODE LETTER	G	TEST DATE	---
TYPE	P	DUTY	CONT	ENCLOSURE	FCXE	STATOR RES.@ 25 °C	.113/.453
PHASE/HERTZ	3/60	AMB °C/INSUL	40/F	E/S	488309		OHMS (BETWEEN LINES)



AMPERES SHOWN FOR 460 VOLT CONNECTION, IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

Rockwell Automation

DR. BY	D. F. DUNN
CK. BY	D. M. BYRD
APP. BY	D. M. BYRD
DATE	09-10-93

A-C MOTOR PERFORMANCE CURVES

E09907-F-Y002

ISSUE DATE 09-10-93

C/R ACR0366

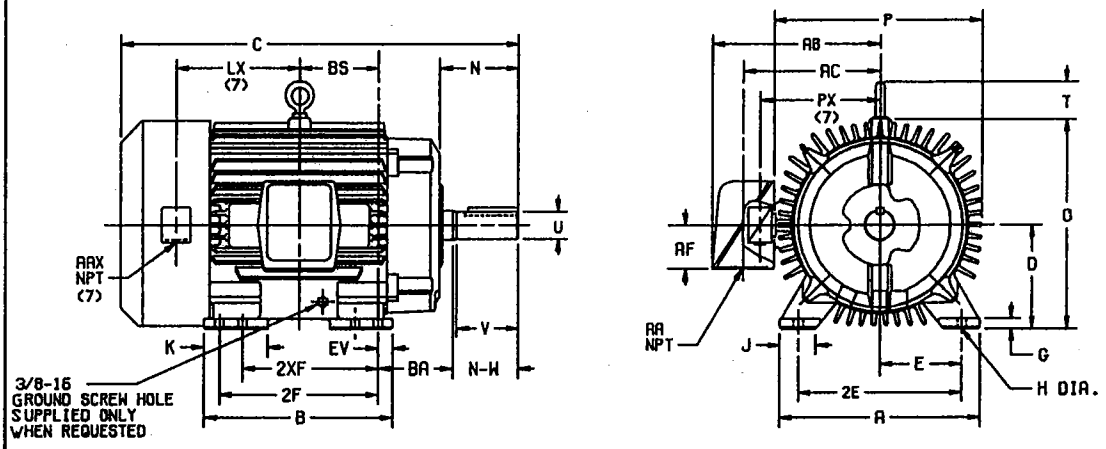
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DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
CAST IRON CONSTRUCTION

ENCLOSURE: TOTALLY ENCLOSED
COOLING: FAN COOLED
MOUNTING: FOOT

FRAMES 250T THRU 440T



DIMENSIONS ARE IN INCHES; SEE SHEET 2 FOR DIMENSIONS IN MILLIMETERS

FRAME	A	D(2)	E	G	H	J	K	O	P	T	CAST IRON TERMINAL BOX AA	AB	AC	AF	(7) AUX. CONDUIT BOX AAX	LX (7)	PX (7)	BA	EV
254T-256T	12.50	6.25	5.00	.75	.56	2.50	--	13.25	13.25	2.44	1-1/4	10.81	8.81	2.50	3/4	6.31	9.31	4.25	1.00
284T-286TS	13.75	7.00	5.50	.75	.56	2.50	--	14.75	14.88	2.44	1-1/2	12.62	10.19	3.00	3/4	6.88	10.50	4.75	1.00
324T-326TS	15.50	8.00	6.25	.88	.69	2.75	4.50	16.69	17.00	2.44	2	15.44	11.69	3.62	3/4	8.00	10.50	5.25	1.38
364T-365TS	17.00	9.00	7.00	.88	.69	2.75	3.88	18.50	19.50	2.94	3	18.00	13.81	4.12	3/4	8.38	11.62	5.88	1.38
404T-405TS	19.00	10.00	8.00	1.12	.81	3.25	4.62	21.31	22.50	2.94	3	19.25	15.06	4.12	3/4	9.62	14.44	6.62	1.13
444T-445TS	21.00	11.00	9.00	1.12	.81	3.25	5.25	23.38	25.25	3.25	3	22.19	17.44	6.00	3/4	11.12	15.25	7.50	1.25
(1)																			

FRAME SIZE	C	BS	B	2F	(4) 2XF	N	SHAFT AND KEY N-W(6)	UK(3)	V	SQ.	LGTH.	WEIGHT LBS. (5)
254T	24.56	5.00	12.00	----	8.25	4.12	4.00	1.625	3.75	.375	2.88	335
256T	24.56	5.00	12.00	10.00	----	4.12	4.00	1.625	3.75	.375	2.88	345
284T	27.44	5.50	13.00	----	9.50	5.00	4.62	1.875	4.38	.500	3.25	475
284TS	26.06	5.50	13.00	----	9.50	3.62	3.25	1.625	3.00	.375	1.88	475
286T	27.44	5.50	13.00	11.00	----	5.00	4.62	1.875	4.38	.500	3.25	490
286TS	26.06	5.50	13.00	11.00	----	3.62	3.25	1.625	3.00	.375	1.88	490
324T	30.44	6.00	14.75	----	10.50	5.62	5.25	2.125	5.00	.500	3.88	590
324TS	28.94	6.00	14.75	----	10.50	4.12	3.75	1.875	3.50	.500	2.00	590
326T	30.44	6.00	14.75	12.00	----	5.62	5.25	2.125	5.00	.500	3.88	630
326TS	28.94	6.00	14.75	12.00	----	4.12	3.75	1.875	3.50	.500	2.00	630
364T	33.44	6.12	15.00	----	11.25	6.25	5.88	2.375	5.62	.625	4.25	865
364TS	31.31	6.12	15.00	----	11.25	4.12	3.75	1.875	3.50	.500	2.00	859
365T	33.44	6.12	15.00	12.25	----	6.25	5.88	2.375	5.62	.625	4.25	890
365TS	31.31	6.12	15.00	12.25	----	4.12	3.75	1.875	3.50	.500	2.00	884
404T	38.31	6.88	16.00	----	12.25	7.50	7.25	2.875	7.00	.750	5.62	1220
404TS	35.31	6.88	16.00	----	12.25	4.50	4.25	2.125	4.00	.500	2.75	1211
405T	38.31	6.88	16.00	13.75	----	7.50	7.25	2.875	7.00	.750	5.62	1260
405TS	35.31	6.88	16.00	13.75	----	4.50	4.25	2.125	4.00	.500	2.75	1251
444T	44.62	8.25	19.00	----	14.50	8.94	8.50	3.375	8.25	.875	6.88	1670
444TS	40.88	8.25	19.00	----	14.50	5.19	4.75	2.375	4.50	.625	3.00	1654
445T	44.62	8.25	19.00	16.50	----	8.94	8.50	3.375	8.25	.875	6.88	1860
445TS	40.88	8.25	19.00	16.50	----	5.19	4.75	2.375	4.50	.625	3.00	1844
(1)												

(1) SPECIAL DIMENSIONS APPLYING TO THIS ORDER ON THIS LINE.

(2) "D" VARIES — 250T - 320T +.00, -.03. / 360T - 440T +.00, -.06.

(3) "U" VARIES — UP TO 1.625 DIA. +.0000, -.0005 / 1.625 AND LARGER +.000, -.001.

(4) ALL FRAMES HAVE EIGHT MOUNTING HOLES FOR DUAL MOUNTING.

(5) MOTOR WEIGHTS MAY VARY BY 15% DEPENDING UPON RATING.

(6) "N-W" VARIES +.00, -.25.

(7) AUXILIARY CONDUIT BOX SUPPLIED WHEN SPECIFIED

CONDUIT BOXES LOCATED ON OPPOSITE SIDE WHEN F-2,W-1, W-4,W-5,W-7, OR C-1 MOUNTING IS SPECIFIED.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED AT END OF STD. SHAFT EXTENSION IS .002 T.I.R. UP TO AND INCLUDING 1.625 DIA. AND .003 T.I.R. 1.625 DIA. TO 5 INCH DIA.

FRAME-_____ TYPE-_____ CERTIFIED FOR-_____

ORDER-_____ ITEM-_____ HP-_____ RPM-_____ PH-_____ HZ _____ VOLTS_____

RELIANCE SALES ORDER-_____ APPROVED BY-_____ DATE _____

RELIANCE ELECTRIC
CLEVELAND, OHIO 44117 U.S.A.

DR. BY R.BRYANT
CK. BY L.T.FOURNIER
APP. BY J.H.PONTZER
DATE 12-08-89

DIMENSION SHEET
SHEET 1 OF 2

611740-501
ISSUE DATE: JUNE 20, 1990

C/R ACR0350

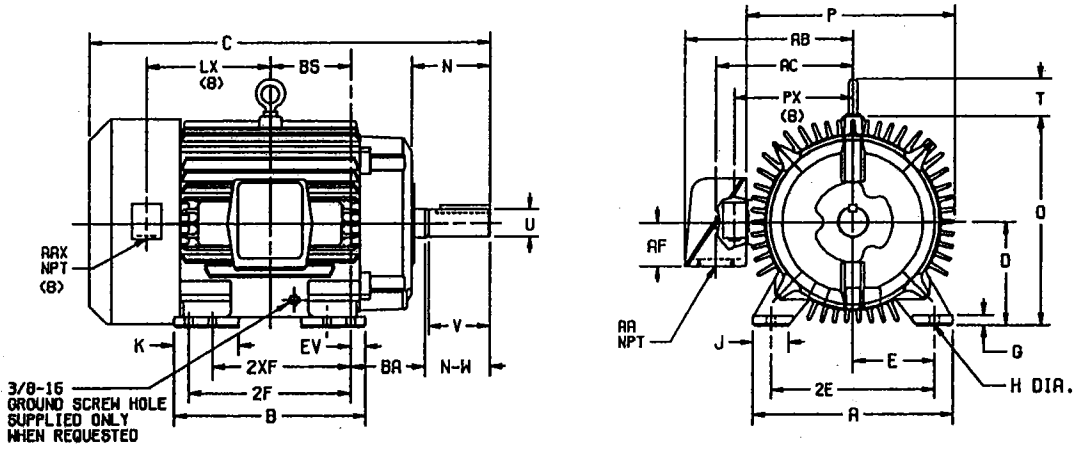
10-541-05

DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
CAST IRON CONSTRUCTION

ENCLOSURE: TOTALLY ENCLOSED — COOLING: FAN COOLED
MOUNTING: FOOT

FRAMES 250T THRU 440T



DIMENSIONS ARE IN MILLIMETERS; SEE SHEET 1 FOR DIMENSIONS IN INCHES

FRAME	A	D(2)	E	G	H	J	K	O	P	T	CAST IRON TERMINAL BOX AA(7)	AB	AC	AF	(8)AUX. CONDUIT BOX AAX(7)	LX (8)	PX (8)	BA	EV
254T-256T	317.5	158.8	127.0	19.0	14.2	63.5	--	336.5	336.5	62.0	1-1/4	274.6	223.8	63.5	3/4	160.3	236.5	108.0	25.4
284T-286TS	349.2	177.8	139.7	19.0	14.2	63.5	--	374.6	378.0	62.0	1-1/2	320.5	258.8	76.2	3/4	174.8	266.7	120.7	25.4
324T-326TS	393.7	203.2	158.8	22.4	17.5	69.9	114.3	423.9	431.8	62.0	2	392.2	296.9	91.9	3/4	203.2	266.7	133.3	35.1
364T-365TS	431.8	228.6	177.8	22.4	17.5	69.9	98.6	469.9	495.3	74.7	3	457.2	350.8	104.6	3/4	212.9	295.1	149.4	35.1
404T-405TS	482.6	254.0	203.2	28.4	20.6	82.5	117.3	541.3	571.5	74.7	3	488.9	382.5	104.6	3/4	244.3	366.8	168.1	28.7
444T-445TS	533.4	279.4	228.6	28.4	20.6	82.5	133.3	593.9	641.3	82.5	3	563.6	443.0	152.4	3/4	282.4	387.3	190.5	31.7
(1)																			

FRAME SIZE	C	BS	B	2F	(4) 2XF	N	SHAFT AND KEY N-W(6)	U(3)	V	SQ.	LGTH.	WEIGHT KGS. (5)
254T	623.8	127.0	304.8	---	209.6	104.6	101.6	41.27	95.3	9.52	73.2	151
256T	623.8	127.0	304.8	254.0	---	104.6	101.6	41.27	95.3	9.52	73.2	156
284T	697.0	139.7	330.2	---	241.3	127.0	117.3	47.63	111.3	12.70	82.5	215
284TS	661.9	139.7	330.2	---	241.3	91.9	82.5	41.27	76.2	9.52	47.8	215
286T	697.0	139.7	330.2	279.4	---	127.0	117.3	47.63	111.3	12.70	82.5	222
286TS	661.9	139.7	330.2	279.4	---	91.9	82.5	41.27	76.2	9.52	47.8	222
324T	773.2	152.4	374.6	---	266.7	142.7	133.3	53.97	127.0	12.70	98.6	267
324TS	735.1	152.4	374.6	---	266.7	104.6	95.3	47.63	88.9	12.70	50.8	267
326T	773.2	152.4	374.6	304.8	---	142.7	133.3	53.97	127.0	12.70	98.6	285
326TS	735.1	152.4	374.6	304.8	---	104.6	95.3	47.63	88.9	12.70	50.8	285
364T	849.4	155.4	381.0	---	285.7	158.8	149.4	60.33	142.7	15.88	108.0	392
364TS	795.3	155.4	381.0	---	285.7	104.6	95.3	47.63	88.9	12.70	50.8	389
365T	849.4	155.4	381.0	311.1	---	158.8	149.4	60.33	142.7	15.88	108.0	403
365TS	795.3	155.4	381.0	311.1	---	104.6	95.3	47.63	88.9	12.70	50.8	400
404T	973.1	174.8	406.4	---	311.1	190.5	184.1	73.02	177.8	19.05	142.7	553
404TS	896.9	174.8	406.4	---	311.1	114.3	108.0	53.97	101.6	12.70	69.9	549
405T	973.1	174.8	406.4	349.2	---	190.5	184.1	73.02	177.8	19.05	142.7	571
405TS	896.9	174.8	406.4	349.2	---	114.3	108.0	53.97	101.6	12.70	69.9	567
444T	1133.3	209.6	482.6	---	368.3	227.1	215.9	85.72	209.6	22.22	174.8	757
444TS	1038.4	209.6	482.6	---	368.3	131.8	120.7	60.33	114.3	15.88	76.2	750
445T	1133.3	209.6	482.6	419.1	---	227.1	215.9	85.72	209.6	22.22	174.8	843
445TS	1038.4	209.6	482.6	419.1	---	131.8	120.7	60.33	114.3	15.88	76.2	836
(1)												

(1) SPECIAL DIMENSIONS APPLYING TO THIS ORDER ON THIS LINE.

(2) "D" VARIES — 250T - 320T +.0, -.8.; 360T - 440T +.0, -1.5.

(3) "U" VARIES — UP TO 41.27 DIA. +.000, -.013; 41.27 AND LARGER +.00, -.03.

(4) ALL FRAMES HAVE EIGHT MOUNTING HOLES FOR DUAL MOUNTING.

(5) MOTOR WEIGHTS MAY VARY BY 15% DEPENDING UPON RATING.

(6) "N-W" VARIES +.0, -6.4.

(7) DIMENSIONS ARE IN INCHES.

(8) AUXILIARY CONDUIT BOX SUPPLIED WHEN SPECIFIED.
CONDUIT BOXES LOCATED ON OPPOSITE SIDE WHEN F-2,W-1, W-4,W-5,W-7, OR C-1 MOUNTING IS SPECIFIED.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED AT END OF STD. SHAFT EXTENSION IS .05 T.I.R. UP TO AND INCLUDING 41.27 DIA. AND .08 T.I.R. 41.27 DIA. TO 127 MILL.DIA.

FRAME-_____ TYPE-_____ CERTIFIED FOR-_____

ORDER-_____ ITEM-_____ HP-_____ RPM-_____ PH-_____ HZ _____ VOLTS_____

ELIANCE SALES ORDER-_____ APPROVED BY-_____ DATE _____

RELIANCE ELECTRIC
CLEVELAND, OHIO 44117 U.S.A.

DR. BY R.BRYANT
CK. BY L.T.FOURNIER
APP. BY J.H.PONTZER
DATE 12-08-89

DIMENSION SHEET 611740-501
ISSUE DATE: JULY 11, 1990
SHEET 2 OF 2

C/R ACR0350

10-541-05

REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS
	213T	7.5	P	3/60	1760	230/460

AMPS	DUTY	AMB °C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.
18.0/9.0	CONT	40/F	1.15	B	H	TEFC-XE

E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES.@25 °C OHMS (BETWEEN LINES)
575706	418425-40EE	---	---	.387/1.55

PERFORMANCE

LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY
NO LOAD	0	2.9	1800	8.14	0
1/4	1.88	3.6	1791	56.4	86.7
2/4	3.75	5.0	1782	76.9	90.6
3/4	5.62	6.9	1772	83.8	91.0
4/4	7.50	9.0	1760	86.4	90.3
5/4	9.37	11.3	1748	87.3	89.1

SPEED TORQUE

	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES
LOCKED ROTOR	0	225	50.3	62.0
PULL UP	400	185	41.4	58.3
BREAKDOWN	1500	275	61.5	44.0
FULL LOAD	1760	100	22.4	9.0

AMPERES SHOWN FOR 460. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE

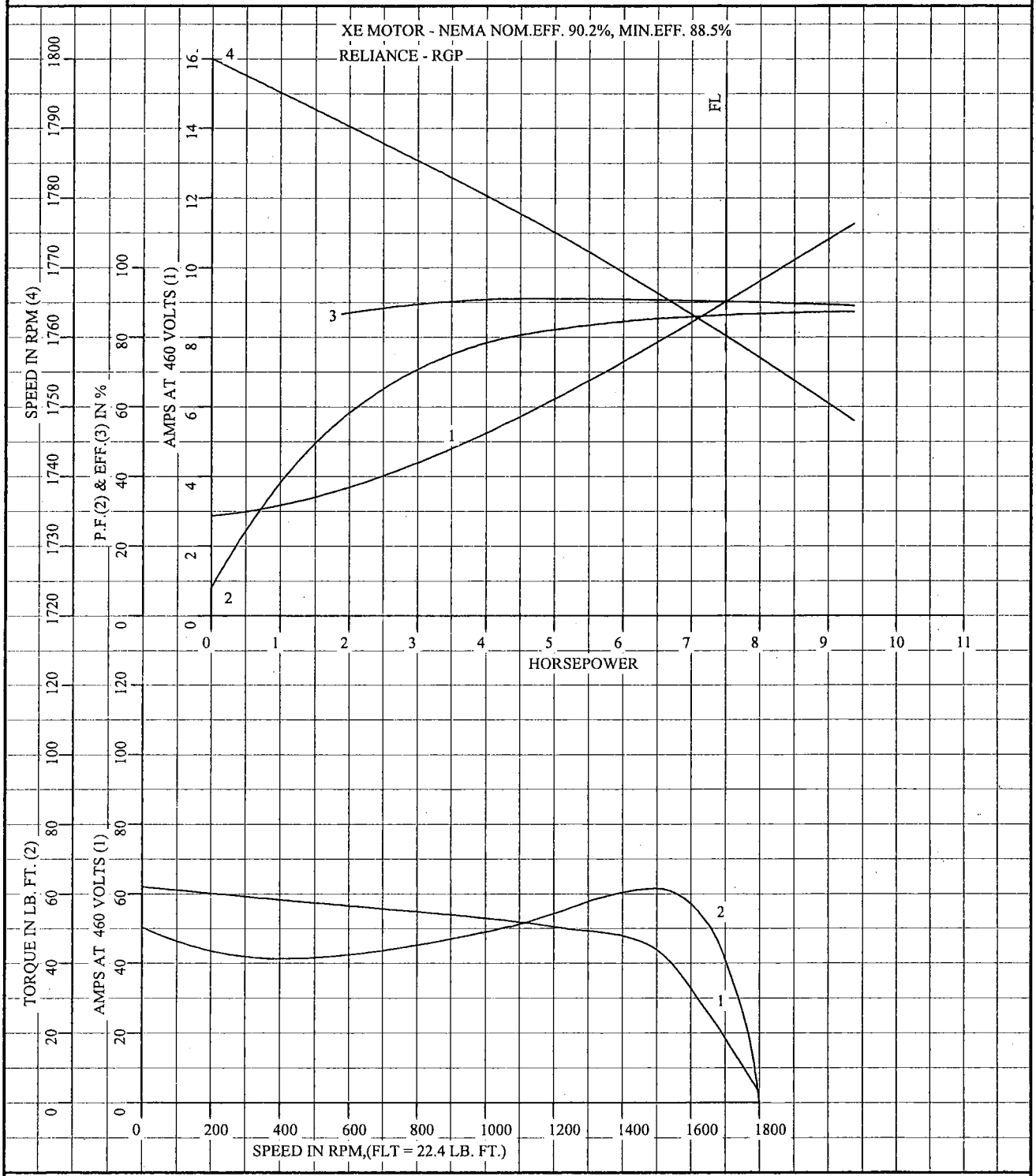
REMARKS: TYPICAL DATA
XE MOTOR - NEMA NOM.EFF. 90.2%, MIN.EFF. 88.5%
RELIANCE - RGP

Rockwell Automation

DR. BY A. T. LONG
CK. BY R. H. KIRK
APP. BY R. A. BRYANT
DATE 05/03/96

A-C MOTOR PERFORMANCE DATA E01425-A-B005
ISSUE DATE 05/03/96

REL S.O.	RPM 1760	S.F. 1.15	ROTOR 418425-40EE
FRAME 213T	VOLTS 230/460	NEMA DESIGN B	TEST S.O. TYPICAL DATA
HP 7.5	AMPS 18.0/9.0	CODE LETTER H	TEST DATE ---
TYPE P	DUTY CONT	ENCLOSURE TEFC-XE	STATOR RES.@ 25 °C .387/1.55
PHASE/HERTZ 3/60	AMB °C/INSUL 40/F	E/S 575706	OHMS (BETWEEN LINES)



AMPERES SHOWN FOR 460 VOLT CONNECTION, IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

Rockwell Automation

DR. BY	A. T. LONG
CK. BY	R. H. KIRK
APP. BY	R. A. BRYANT
DATE	05/03/96

A-C MOTOR PERFORMANCE CURVES E01425-A-B005 ISSUE DATE 05/03/96

Printed on 11/4/03 7:33 @ ragsun

DIST. CODE "W"

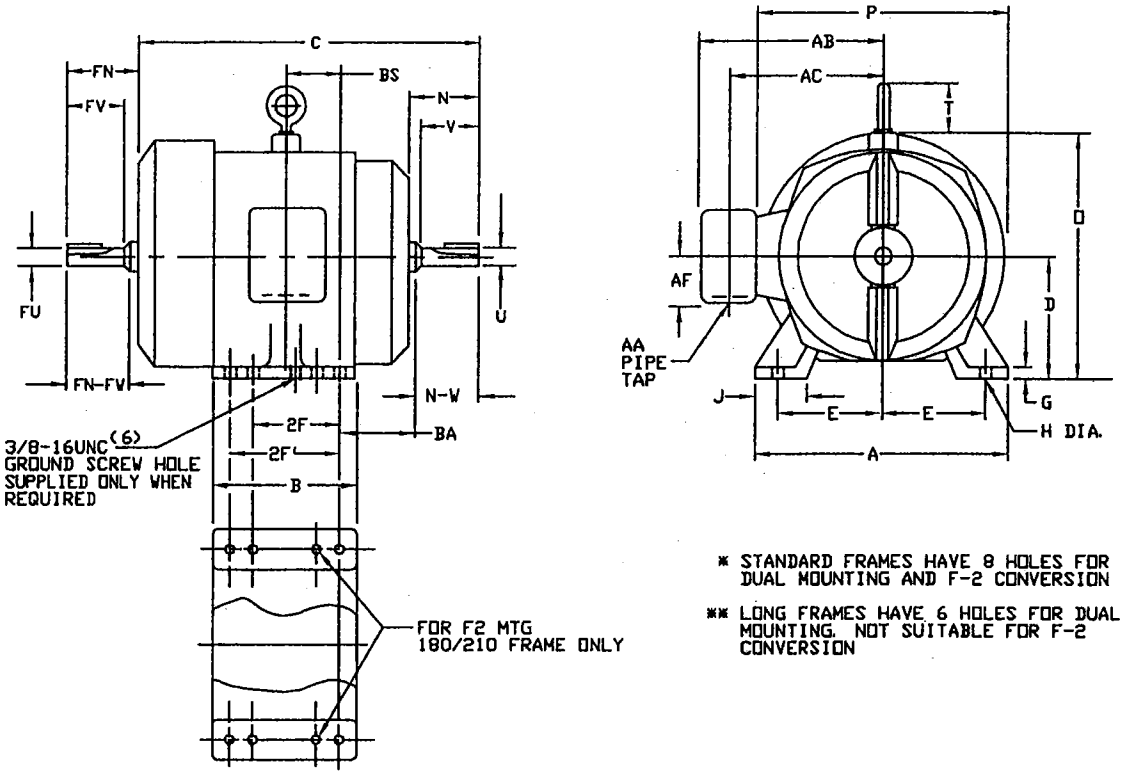
DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
X/T CONSTRUCTION

ENCLOSURE: TOTALLY ENCLOSED
MOUNTING: FOOT

COOLING: FAN COOLED

FRAMES 180T THRU 210T



* STANDARD FRAMES HAVE 8 HOLES FOR DUAL MOUNTING AND F-2 CONVERSION

** LONG FRAMES HAVE 6 HOLES FOR DUAL MOUNTING. NOT SUITABLE FOR F-2 CONVERSION

DIMENSIONS ARE IN MILLIMETERS; SEE SHT 1 FOR DIMENSIONS IN INCHES.

FRAME	A	D(3)	E	G	H	J	O	P	T	CAST IRON TERMINAL BOX AA(6)	AB	AC	AF	ONE SIZE LARGER CAST IRON TERMINAL BOX (5) AA(6)	AB	AC	AF	BA
180T-L180T	228.6	114.3	95.3	11.2	11.2	44.5	251.0	241.3	50.8	1	214.4	169.9	53.8	1-1/4	227.1	176.3	63.5	69.9
210T-L210T	266.7	133.4	108.0	11.2	11.2	50.8	285.8	279.4	50.8	1	236.5	192.0	53.8	1-1/4	249.2	198.4	63.5	88.9
(1)																		

FRAME SIZE	FOOT MTG PROV	C	BS	B	2F	2F'	B.E. SHAFT AND KEY N	N-W	U(2)	V	SQ.	LGTH	FRONT END SHAFT AND KEY FN	FN-FV	FU(2)	FV	SQ.	LGTH	WEIGHT KGS. (4)
180T	182T *	396.7	69.9	177.8	114.3	-----	76.2	69.9	28.575	63.5	6.35	44.5	79.2	57.2	22.225	50.8	4.78	35.1	39
	184T *				----	139.7													41
L180T	L182T **	434.8	88.9	215.9	114.3	-----	76.2	69.9	28.575	63.5	6.35	44.5	79.2	57.2	22.225	50.8	4.78	35.1	53
	L184T **				----	139.7													55
210T	213T *	490.5	88.9	215.9	139.7	-----	91.9	85.9	34.925	79.2	7.92	60.5	95.3	69.9	28.575	63.5	6.35	44.5	61
	215T *				----	177.8													66
L210T	L213T **	512.8	100.1	231.6	139.7	-----	91.9	85.9	34.925	79.2	7.92	60.5	95.3	69.9	28.575	63.5	6.35	44.5	79
	L215T **				----	177.8													84
(1)																			

(1) SPECIAL DIMENSIONS ON THIS LINE

(2) 'U' AND 'FU' MAY VARY +.0000, -.0127 mm

(3) 'D' MAY VARY +.00, -.76 mm

(4) MOTOR WEIGHTS MAY VARY BY 15% FOR NON-STANDARD RATINGS.

(5) ONE SIZE LARGER TERMINAL BOX SUPPLIED ONLY WHEN SPECIFIED.

(6) DIMENSIONS ARE IN INCHES.

STANDARD DOUBLE SHAFT SUPPLIED ONLY WHEN SPECIFIED.

TERMINAL BOX LOCATED ON OPPOSITE SIDE WHEN F-2, W-1, W-4, W-5, W-7 OR C-1 MOUNTING IS SPECIFIED.

MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED AT END OF STANDARD SHAFT EXTENSION IS .050 mm T. I. R.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

FRAME-_____ TYPE-_____ CERTIFIED FOR-_____

ORDER-_____ ITEM _____ HP-_____ RPM-_____ PH- _____ HZ- _____ VOLTS _____

RELIANCE SALES ORDER-_____ APPROVED BY-_____ DATE-_____

RELIANCE ELECTRIC
CLEVELAND, OHIO 44117 U. S. A.

DR. BY K. ENGLISH
CK. BY R. L. BROWN
APP. BY G. KILBORN
DATE 12-18-85

DIMENSION SHEET
SHEET 2 OF 2

613051-501
ISSUE DATE : SEPTEMBER 2, 1995

C/R 293454; 331766 10-541-00 10-541-05 E:\DS_AC\613051\501-SH2

DIST. CODE 'W'

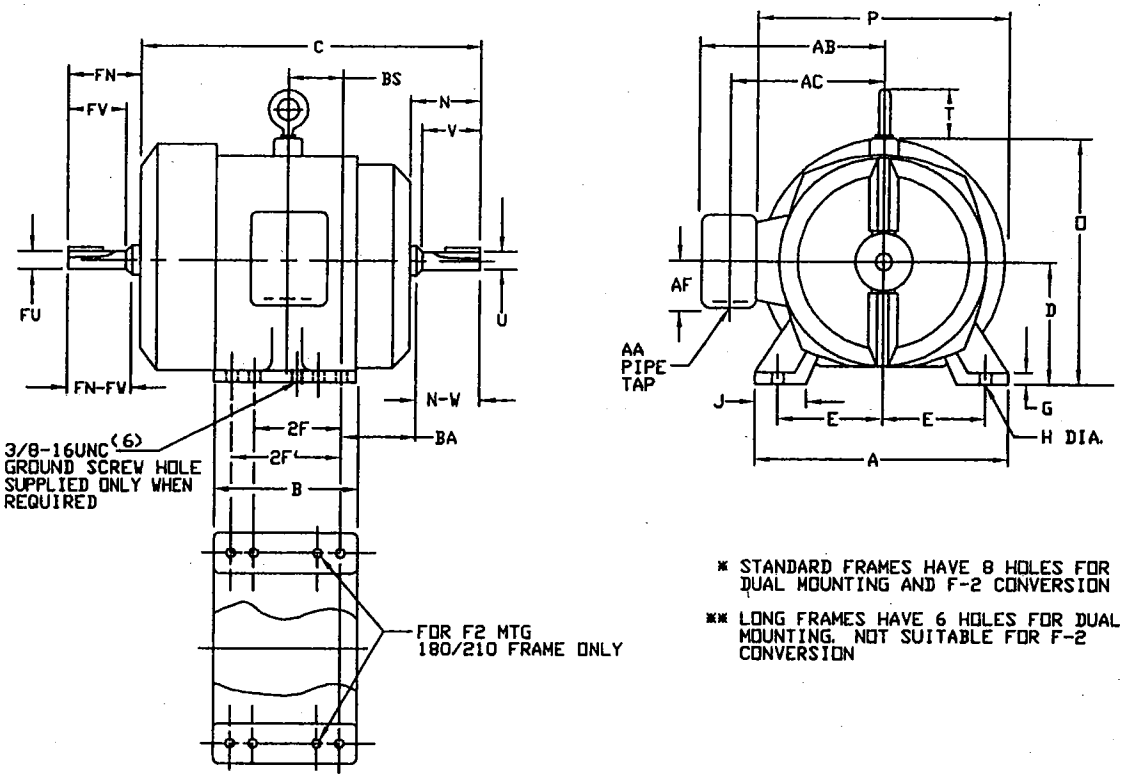
DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
X/T CONSTRUCTION

ENCLOSURE: TOTALLY ENCLOSED
MOUNTING: FOOT

COOLING: FAN COOLED

FRAMES 180T THRU 210T



* STANDARD FRAMES HAVE 8 HOLES FOR DUAL MOUNTING AND F-2 CONVERSION

** LONG FRAMES HAVE 6 HOLES FOR DUAL MOUNTING. NOT SUITABLE FOR F-2 CONVERSION

DIMENSIONS ARE IN MILLIMETERS; SEE SHT 1 FOR DIMENSIONS IN INCHES.

FRAME	A	D(3)	E	G	H	J	O	P	T	CAST IRON TERMINAL BOX AA(6)	CAST IRON TERMINAL BOX AB	CAST IRON TERMINAL BOX AC	CAST IRON TERMINAL BOX AF	ONE SIZE LARGER CAST IRON TERMINAL BOX (5) AA(6)	ONE SIZE LARGER CAST IRON TERMINAL BOX (5) AB	ONE SIZE LARGER CAST IRON TERMINAL BOX (5) AC	ONE SIZE LARGER CAST IRON TERMINAL BOX (5) AF	BA
180T-L180T	228.6	114.3	95.3	11.2	11.2	44.5	251.0	241.3	50.8	1	214.4	169.9	53.8	1-1/4	227.1	176.3	63.5	69.9
210T-L210T	266.7	133.4	108.0	11.2	11.2	50.8	285.8	279.4	50.8	1	236.5	192.0	53.8	1-1/4	249.2	198.4	63.5	88.9
(1)																		

FRAME SIZE	FOOT MTG PROV	C	BS	B	2F	2F'	B.E. SHAFT AND KEY N	N-W	U(2)	V	SQ.	LGTH	FRONT END SHAFT AND KEY FN	FN-FV	FU(2)	FV	SQ.	LGTH	WEIGHT KGS. (4)
180T	182T *	396.7	69.9	177.8	114.3	----	76.2	69.9	28.575	63.5	6.35	44.5	79.2	57.2	22.225	50.8	4.78	35.1	39
	184T *				----	139.7													41
L180T	L182T **	434.8	88.9	215.9	114.3	----	76.2	69.9	28.575	63.5	6.35	44.5	79.2	57.2	22.225	50.8	4.78	35.1	53
	L184T **				----	139.7													55
210T	213T *	490.5	88.9	215.9	139.7	----	91.9	85.9	34.925	79.2	7.92	60.5	95.3	69.9	28.575	63.5	6.35	44.5	61
	215T *				----	177.8													66
L210T	L213T **	512.8	100.1	231.6	139.7	----	91.9	85.9	34.925	79.2	7.92	60.5	95.3	69.9	28.575	63.5	6.35	44.5	79
	L215T **				----	177.8													84
(1)																			

(1) SPECIAL DIMENSIONS ON THIS LINE

(2) 'U' AND 'FU' MAY VARY +.0000, -.0127 mm

(3) 'D' MAY VARY +.00, -.76 mm

(4) MOTOR WEIGHTS MAY VARY BY 15% FOR NON-STANDARD RATINGS.

(5) ONE SIZE LARGER TERMINAL BOX SUPPLIED ONLY WHEN SPECIFIED.

(6) DIMENSIONS ARE IN INCHES.

STANDARD DOUBLE SHAFT SUPPLIED ONLY WHEN SPECIFIED.

TERMINAL BOX LOCATED ON OPPOSITE SIDE WHEN F-2, W-1, W-4, W-5, W-7 OR C-1 MOUNTING IS SPECIFIED.

MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED AT END OF STANDARD SHAFT EXTENSION IS .050 mm T. I. R.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

FRAME-_____ TYPE-_____ CERTIFIED FOR-_____

ORDER-_____ ITEM _____ HP-_____ RPM-_____ PH- _____ HZ- _____ VOLTS _____

RELIANCE SALES ORDER-_____ APPROVED BY-_____ DATE-_____

RELIANCE ELECTRIC
CLEVELAND, OHIO 44117 U. S. A.

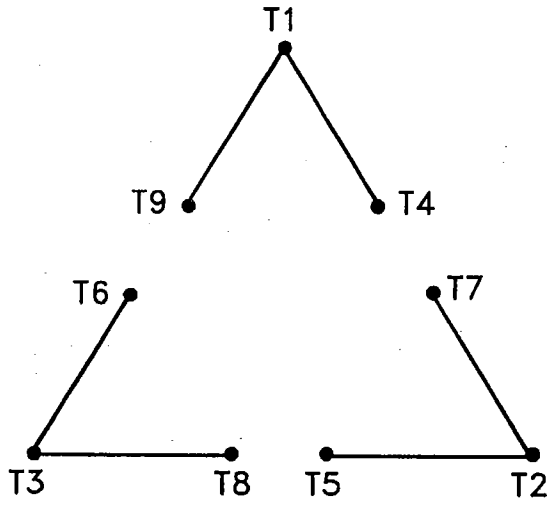
DR. BY K. ENGLISH
CK. BY R. L. BROWN
APP. BY G. KILBORN
DATE 12-18-85

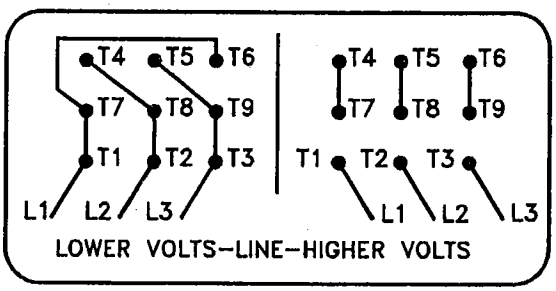
DIMENSION SHEET
SHEET 2 OF 2

613051-501
ISSUE DATE : SEPTEMBER 2, 1995

C/R 293454; 331766 10-541-00 10-541-05 E:\DS_AC\613051\501-SH2

A-C MOTOR
CONNECTION DIAGRAM
STANDARD 9 LEAD DELTA-CONNECTED





(N.P. 1575-B)

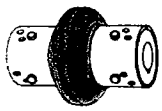
CUSTOMER _____ CUSTOMER ORDER NO. _____ RELIANCE S.O. NO. _____

RELIANCE ELECTRIC CLEVELAND, OHIO 44117	DR. BY N.F.J. CK. BY D.G.Y. APP. BY H.F.J. DATE 3/5/76	CONNECTION DIAGRAM	416820-2 ISSUE DATE OCT. 30, 1986

C/R 2..3062

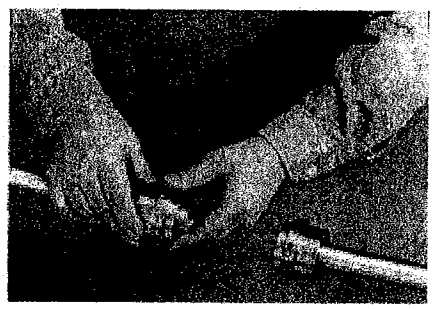
E:\W-DIAG\416820\002 RAG 10-541-06

OMEGA COUPLING INSTALLATION INSTRUCTIONS



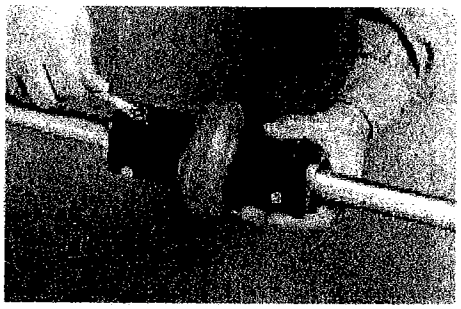
- Because of the possible danger to person(s) or property from accidents which may result from improper use or installation of products, it is extremely important to follow the proper selection, installation, maintenance and operational procedures.
- All rotating power transmission products are potentially dangerous and can cause serious injury. They must be properly guarded in compliance with OSHA and A.N.S.I.standards for the speeds and applications in which they are used. It is the responsibility of the user to provide proper guarding.
- Failure to secure capscrews properly could cause coupling component(s) to become dislodged during operation; resulting in personal injury. Both "Inch" and "Metric" capscrew/hub designs are in service worldwide. Do not attempt to install "Inch" capscrews into a "Metric" hub or visa versa.
- Do not start motor or jog without the complete coupling being properly secured to driver and driven equipment shafts.
- Do not use on turbine drives if the coupling cannot be protected from steam leakage or from speeds in excess of the couplings published speed ratings.
- Do not use on applications such as elevators, man lifts, or devises that transfer people. When the coupling fails, the lift device or people mover could fall resulting in serious injury or death.
- Before installing this coupling on any system containing sleeve bearings, herringbone gear sets or other devices sensitive to axial thrust, consult Rexnord.
- It is the responsibility of the user to consider the coupling's stiffness (available from Rexnord) as it relates to the drive system frequency.

STEP 1



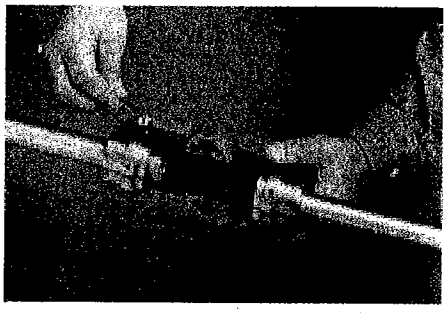
Inspect both driving and driven shafts and hub bores making sure they are free from dirt and burrs. Be sure they keys fit shafts properly. Mount both hubs to the shafts securing only one hub; the other hub should be loose for minor adjustment of spacing. Where tapered bushings are used, follow bushing manufacturer's instructions. If hub is bored for an interference fit, we recommend heating the hub in water, oil bath or an oven and quickly positioning it on the shaft. Do not spot heat hub as it may cause distortion.

STEP 2



Place half of the elastomer element around hubs and secure with self-locking capscrews. The elastomer element will space the other hub. It is important to have capscrew properly tightened. See Table 1 below for recommended capscrew torques and instructions. Now secure the other hub to the shaft.

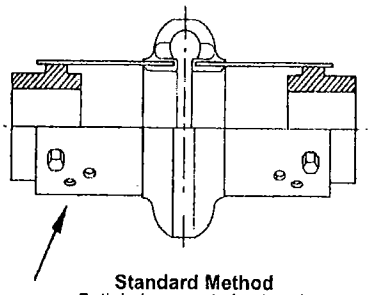
STEP 3



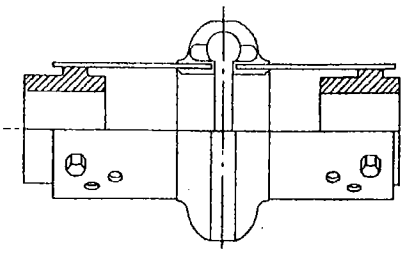
Mount other half of the elastomer element to hubs. Be sure to secure rings to the spacer element if provided. Tighten all capscrews to the recommended capscrew torques in Table 1 and your done!

Spacer coupling installation is shown; the same procedure applies for the standard design coupling.

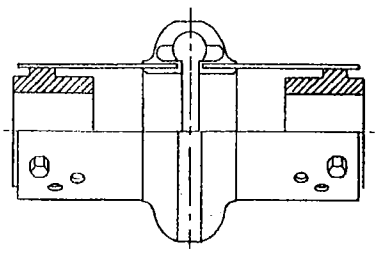
HELPFUL HINT: If the capscrew holes in the element do not line up properly with the hubs due to equipment misalignment, rotate the shafts (if possible) slightly as you install each capscrew. On larger coupling sizes, first install the capscrews that are located in the center of the half element.



Standard Method
Both hubs mounted outward.



Optional Method
One hub mounted inward; one hub mounted outward.

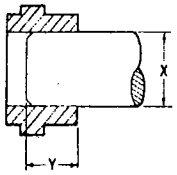


Optional Method
Both hubs mounted inward.

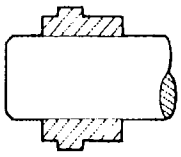
Additional mounting positions are possible with the optional assembly holes on the spacer element. Select the combination which most closely matches the dimension desired between shaft ends.

ALLOWABLE SHAFT ENGAGEMENTS

Shafts can be flush with the hub (not shown), recessed below the face of the hub, or extended beyond the hub face.



Dimension Y should be equal to, or greater than, .8 times dimension X. 100% shaft engagement is recomended for compression bushed hubs.



The shaft may extend beyond the hub, as long as there is sufficient keyway length available.

TABLE 1

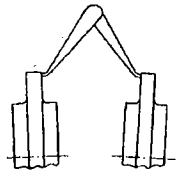
RECOMMENDED CAPSCREW TORQUES FOR PROPER INSTALLATION	CPLG SIZE	TORQUE - DRY IN. LBS.	FT. LBS.	Nm
- IMPORTANT - Capscrews have self-locking patches which should *not* be reused more than twice.	2, 3, 4, 5, 10	204	17	23
	20, 30, 40, 50	360	30	40
Capscrews can be further used with application of a thread-locking adhesive.	60, 70, 80	900	75	100
Do Not Lubricate Capscrew Threads	100, 120	3240	270	370
	140	7080	590	800

EQUIPMENT ALIGNMENT

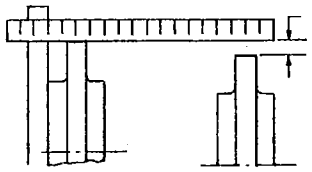
Coupling alignment is directly related to equipment and coupling life.

Although Omega couplings can withstand gross misalignment, care should be taken for best possible alignment to assure optimum performance. The caliper/straightedge alignment procedure is described below. If greater alignment accuracy is desired, a dial indicator method is recommended. There are occasions when equipment manufacturers require more specific alignment tolerances, in which case, the manufacturer's recommendations should be followed.

1. To correct for angular misalignment, use calipers to check the gap between hubs. Adjust or shim equipment until the gap is the same at all points around the hubs.
2. To correct parallel offset, place a straightedge across the hub flanges in two places at 90° to each other. Adjust or shim equipment until the straightedge lays flat on both sides.
3. Tighten down connected equipment and recheck alignment.
4. Install elastomer element, tightening all capscrews to the values shown in Table 1 as described on the reverse side.
5. If practical, recheck and tighten capscrews after several hours of operation.



ADJUST FOR ANGULAR MISALIGNMENT



PARALLEL OFFSET

ADJUST FOR PARALLEL OFFSET

DIMENSIONS AND PART NUMBERS

Factory Part Numbers

FLEXIBLE ELEMENT			CAPSCREWS*			
Size	Spacer	Standard	Carbon Steel	Stainless Steel	Size-in	Qty
2	7300075	7300005	7300910	7300938	1/4-20 x 3/8	8 + 8**
3	7300080	7300010	7300912	7300940	1/4-20 x 1/2	8 + 8**
4	7300085	7300015				8 + 8**
5	7300090	7300020				8 + 8**
10	7300095	7300025	7300918	7300946		12 + 12**
20	7300100	7300030	7300920	7300948	3/8-16 x 5/8	12
30	7300105	7300035				12
40	7300110	7300040	7300924	7300952		16
50	7300115	7300045				16
60	7300120	7300050	7300928	7300956	1/2-13 x 7/8	16
70	7300125	7300055				16
80	7300130	7300060				16
100	–	7300065	7300934	7300965	3/4-10 x 1-1/2	20
120	–	7300070	7300936	7300967		24
140	–	7300071	7385753	7385702	1.0-8 x 1-1/2	32

* Capscrews have self-locking patches which should not be lubricated or reused more than twice

** Extra capscrews provided for spacer couplings with rings.

*Hubs**

	Rough Bore		Stock Bore (Part & Ranges)		Taper-Lock® Hubs		Taper-Lock®	O.D. Hubs	O.D. Bush-ing †	Standard Sleeve Ext.
Size	STD ††	Steel	STD ††	Steel	Iron	Steel	Bushing	Steel		Steel
2	7300215	7369822	7300220-7300235	-	-	-	-	-	-	-
3	7300240	7369823	00245-00265	-	-	7300730	731008	-	-	-
4	7300270	7369824	00275-00300	-	7300800	7300740	731008	7300860	JA	7369575
5	7300305	7369825	00310-00335	-	7300805	7300745	731108	7300865	SH	7369576
10	7300340	7369826	00345-00370	-	7300810	7300750	731310	7300870	SDS	7369577
20	7300650	7300375	00651-00659	7300380-7300400	7300815	7300755	731610	7300875	SK	7369578
30	7300660	7300405	00661-00668	7300408-7300425	7300820	7300760	732012	7300880	SF	7369579
40	7300670	7300430	00669-00679	7300431-7300455	7300825	7300765	732517	7300885	E	7369580
50	7300680	7300460	00681-00686	7300461-7300470	7300830	7300770	732517	7300890	E	7369581
60	7300690	7300475	00692-00698	7300480-7300495	7300835	7300775	733020	7300895	F	7369582
70	7300700	7300500	-	-	7300840	7300780	733535	7300900	J	7369583
80	7300710	7300525	-	-	7300845	7300785	734040	7300905	M	7369584
100	7300720	7300550	-	-	7300850	* *	734545	* *	M	7369834
120	7300725	7300575	-	-	7300855	* *	735050	* *	N	7369835
140	7300727	7300580	-	-	7300857	* *	737060	7300908***	P	-

* Hubs are interchangeable for both the spacer and the standard coupling.

** Consult Factory

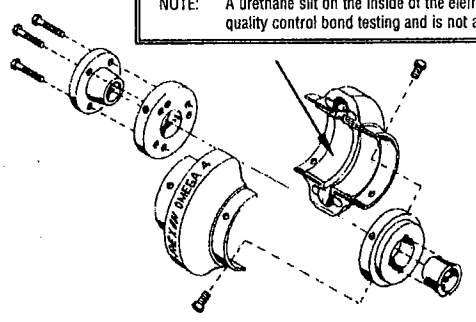
*** Iron

† Not supplied by Rexnord.

†† Standard hub material specifications: High strength sintered steel (Sizes #2 - #10), and Cast iron (Sizes #20 and above).

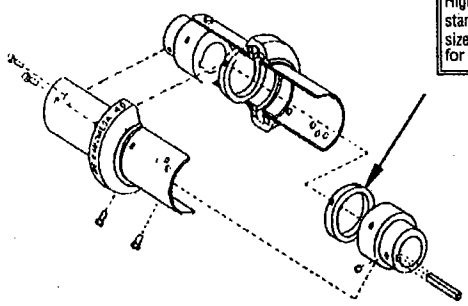
REX OMEGA STANDARD COUPLING

NOTE: A urethane slit on the inside of the element is the result of our quality control bond testing and is not a material defect.



REX OMEGA SPACER COUPLING

High speed rings are standard for spacer sizes #2-#10; optional for sizes #20-#80



NOTE: Omega hubs are interchangeable with either standard or spacer flex elements; i.e., taper bushed hubs can be used with spacer elements and finished straight bore hubs can be used with standard elements.

ELEMENT REPLACEMENT: If element replacement is required, it is important to change both half elements, never replace just one half element. This is important because the element stiffness properties may change over time, and elements are packaged in weight matched pairs for better balance on high speed applications.

® Taper-Lock® is a registered trademark of Reliance Electric Company

BULLETIN No. 80152 12/01 40M

Rexnord

Elastomer Products Operation
5555 S Moorland Road, New Berlin, WI 53151
Phone: 262-796-4060 FAX: 262-796-4064

41074-206-1

PRESSURE SWITCH

MULTI-POINT PRESSURE SWITCH UNITED ELECTRIC MODEL H402-S146B-M202-M446.
PROCESS CONNECTION: $\frac{1}{2}$" FNPT
DUAL SET POINT: 9.75 PSIG (DECREASING) AND 21 PSIG (INCREASING)
MATERIAL 316SS BELLOWS, 316SS PROCESS CONNECTION.
NEMAX4 HOUSING, TWO SPDT, 15A, 125/250/480 VAC RESISTIVE
ADJ RANGE: 0-30 PSIG W/ INTERNAL ADJUSTMENTS AND REFERENCE DIAL
FIXED DEADBAND DOUBLES. 0.1-0.6 PSIG.
SET POINT REPEATABILITY= +/- 1 % OF ADJUSTABLE RANGE
PROOF PRESSURE = 40PSI
OPTIONS INCLUDE: FACTORY SET 2 SWITCHES & SS ID TAG & WIRE ATTACHMENTS
PRESSURE CONNECTION STEM = 6.19" LONG
ELECTRICAL CONNECTION: 3 EA $\frac{7}{8}$" KNOCKOUTS.
SERVICE: WASTEWATER, SG=1.02 VISC=0.5-3.cP, T=40-110°F, pH RANGE = 4-10
TSS= 0-100 mg/L INCLUDING GRANULAR ACTIVATED CARBON & BIOSOLIDS
PARTICLE SIZE = 0-0.125" MAX
TDS= 100-400 mg/L

DURABLE CONTROLS
PO BOX 409
HARTLAND, WI 53029-0409
PH: 262-367-4900
FAX: 262-367-8695

COMPANY CONFIDENTIAL
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DESIGNER FD	DATE 2/26/04	
CHECKER	DATE	
ENGINEER FD	DATE 2/26/04	
MANAGER RDH	DATE	
FILE:		
SCALE:		

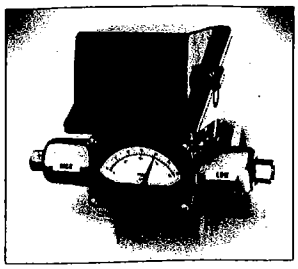
TITLE PRESSURE SWITCH

CLIENT JET PROPULSION LAB, NASA

USFilter

Envirex Products
Waukesha, WI
800-524-6324

PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-206	1 OF 1	0



400 Series Pressure Controls

Types: H400, H402, H403, H400K, H402K, J400, J402, J403, J400K, J402K

UNITED ELECTRIC CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warrantees.

GENERAL

Pressure variations are sensed by a bellows, diaphragm or piston sensor which either actuates or de-actuates one, two or three snap-acting switches at a pre-determined set point(s). Set point(s) is adjusted by turning an internal knob and pointer (H types) or internal screw (J types).

Part I - Installation

Tools Needed
Screwdriver
Hammer
Adjustable wrench

MOUNTING

INSTALL UNIT WHERE SHOCK, VIBRATION AND TEMPERATURE FLUCTUATIONS ARE MINIMAL. ORIENT UNIT SO THAT MOISTURE IS PREVENTED FROM ENTERING THE ENCLOSURE. IF UNIT IS BEING INSTALLED WHERE HEAVY CONDENSATION IS EXPECTED, VERTICAL MOUNTING (PRESSURE CONNECTION DOWN) IS REQUIRED. DO NOT MOUNT UNIT IN AMBIENT TEMPERATURES EXCEEDING PUBLISHED LIMITS.

400 Series pressure controls can be mounted in any position, provided the electrical conduit is not facing up. The preferred mounting position is vertical (pressure connection down).

The cast-in knockouts for 3/4" electrical conduit are located on the side and rear of the enclosure. These can easily be knocked out by placing the blade of a screwdriver in the groove and rapping sharply with a hammer.

Mount the unit via the (2) 1/4" screw clearance holes on the enclosure. See Dimensions. Units may also be mounted via the NPT pressure connection.

ALWAYS HOLD A WRENCH ON THE PRESSURE HOUSING HEX WHEN MOUNTING UNIT. DO NOT TIGHTEN BY TURNING ENCLOSURE. THIS WILL DAMAGE SENSOR AND WEAKEN SOLDER OR WELDED JOINTS.

WIRING

DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING.

ELECTRICAL RATINGS STATED IN LITERATURE AND ON NAMEPLATE SHOULD NEVER BE EXCEEDED. OVER-LOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

WIRE UNITS ACCORDING TO LOCAL AND NATIONAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE IS 14 AWG.

Connect conduit to the case and wire directly to the switch terminals according to local and national electrical codes. Bring the wires up to terminals from the rear of the case. (See fig. 1.) If manual reset switch or DPDT options are used, lead wires are supplied, color coded as follows:

	Switch 1	Switch 2
Common	Violet	Yellow
Normally Open	Blue	Orange
Normally Closed	Black	Red

ALLOW ENOUGH SLACK SO AS NOT TO AFFECT SWITCH MOVEMENT WHEN MAKING SETTING ADJUSTMENTS AND ENSURE THAT THE WIRES ARE NOT TOUCHING THE COVER WHEN INSTALLED.

NOTE: For larger wire gauges, a one time shift may be experienced or expected due to space limitations within the enclosure. Verify setpoint after installation.

NOTE: The middle switch assembly is omitted for dual switch controllers. The outer switch assemblies are omitted for single switch controllers. Type "J" controls have internal screw adjustments and type "H" have cam assemblies for internal calibrated adjustments.

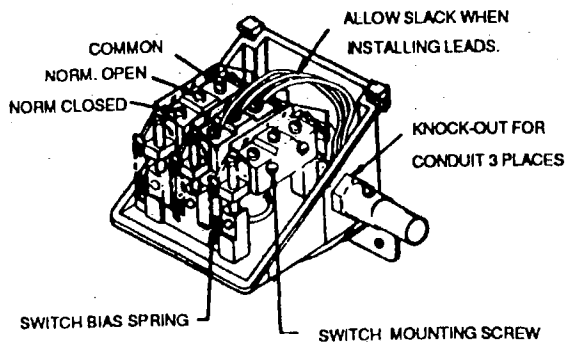


Figure 1

Re-Calibration Adjustment - H Types

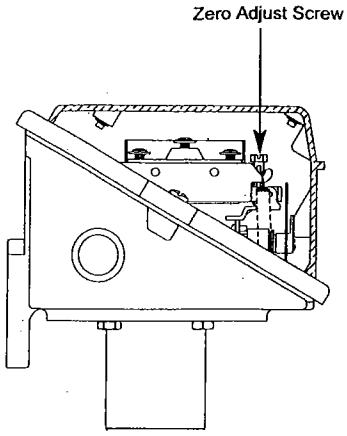
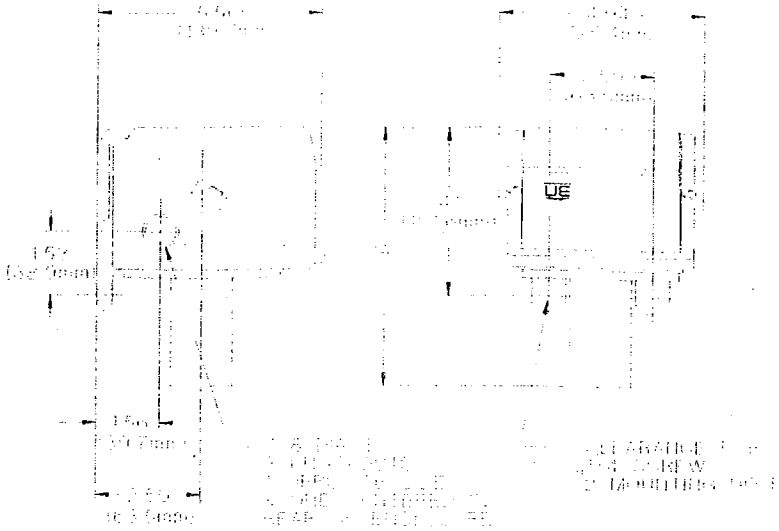


Figure 2

Dimensions



Option M210 - Differential Pressure Indication

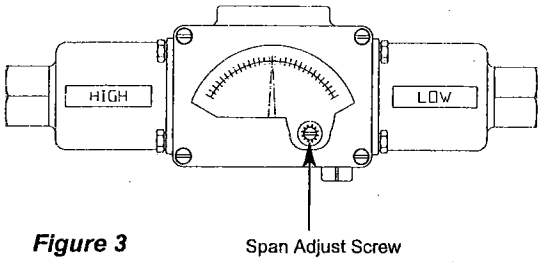
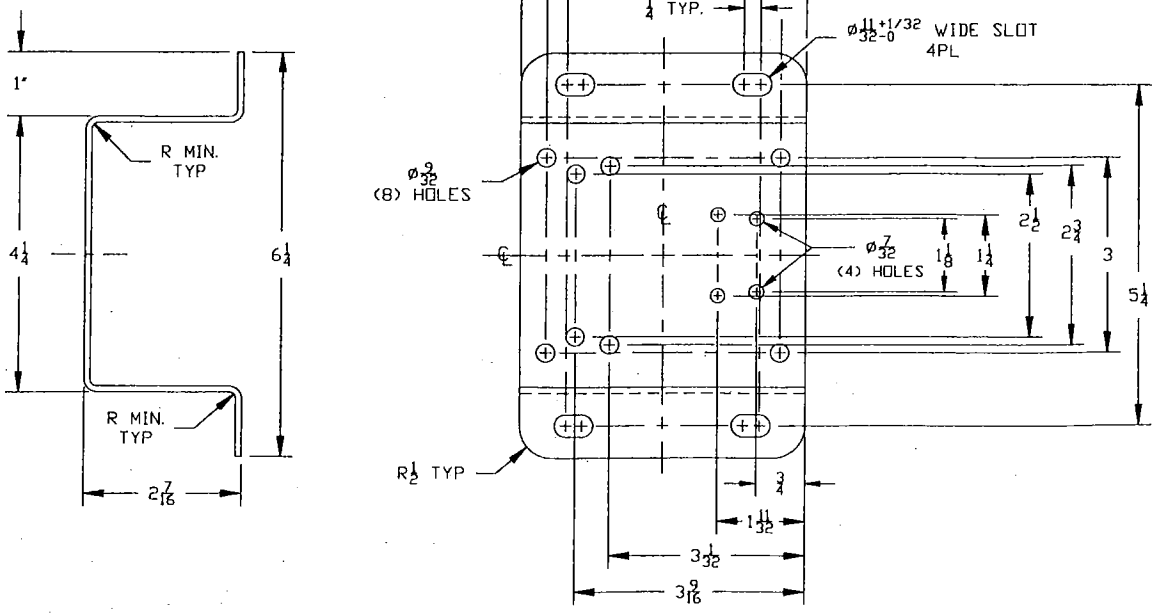


Figure 3

Dimension A

Models	Inches	mm	NPT	Models	Inches	mm	NPT
Pressure				**Pressure**			
126-164	5.81	146,84	1/4	551, 553-555	4.56	115,88	1/4
S126B-S164B	6.19	157,16	1/2	550, 552	5.03	127,79	1/4
270-376	5.50	139,70	1/4	570-572	4.56	115,89	1/4
440-443, 449,				610-614	6.44	163,58	1/4
451, 453, 454	4.28	108,74	1/4	**Differential Pressure**			
448, 450, 452	5.03	127,79	1/4	147-157	6.13	155,57	1/4
520-525	8.62	218,90	1/2	S147B-S157B	6.13	155,57	1/2
530-535	8.12	206,20	1/2	455-559	7.00	178,05	1/4
				540-543	7.90	200,7	1/8
				544-547	8.06	204.7	1/8

Surface Mounting Hardware
Part Number 6361-704°



Special Instructions For Vacuum Ranges

On vacuum ranges, the C-NO circuit is closed at sea level conditions. Therefore, increasing vacuum will cause the C-NC circuit to close while decreasing vacuum will cause the C-NO circuit to close. Please make a note of this and wire/adjust the unit accordingly.

Part II - Adjustments

Tools Needed
Screwdriver

NOTE: For set point adjustments and re-calibration, connect control to a calibrated pressure gauge.

Type J400 & J400K

Remove cover. Switch has screw adjustments inside enclosure. Increase gauge pressure until switch transfers. To RAISE the pressure setting turn the screw IN To LOWER the pressure setting turn the screw OUT. One full turn corresponds to approximately 10% of range on diaphragm and piston models, and approximately 20% of range on bellows models. When making adjustments, do not exceed the proof* pressure rating on nameplate.

Types J402, J403 & J402K

Remove cover, follow same procedure as paragraph above. Switches may be set together or apart, up to 100% of range (maximum separation on models 520-535 is defined in Table 1). On dual switch, either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical pressure setting and after changing switch(es).

Table 1

Model & Range	Switch Separation (% of Range Span)
520, 530 (-300 to 0 VAC)	25%
521, 531 (-10 to +10 "wc)	35%
522, 532 (-50 to +50 "wc)	35%
523, 533 (0.5 to 5 "wc)	50%
524, 534 (2.5 to 50 "wc)	50%
525, 535 (10 to 250 "wc)	20%

Special Instructions for Models 520-535

When calibrating the Models 520-535, Switch 2 (the right switch as viewed from the front of the control) must be set to the higher pressure value. Use a screwdriver to turn the adjustment screw and obtain the desired actuation pressure for Switch 2. Switch 1 can then be set following the procedure outlined for the Type J400 and J400K. Maximum separation between Switch 1 and 2 is defined in Table 1.

*Subjecting the switch to proof pressure may cause a shift in set point

Types H400, H402, H403, H400K & H402K

Remove cover, switch has knob and pointer adjustment inside enclosure. Controls are factory calibrated for maximum accuracy at the dial midpoint. Switches may be set together or apart up to 100% of the range scale. On dual switch models either switch may be set high. On triple switch models, the third (middle) switch has no over-travel mechanism and must always be set to the highest pressure when the switches are set apart. Altering the setting of one switch will usually have little effect on the other(s), however re-calibration may be desired at a critical setting or after changing switch(es).

To re-calibrate, turn pointer to desired set point and add gauge pressure until switch transfers. If gauge pressure and set point pressure do not agree, turn zero adjust screw clockwise to raise and counter clockwise to lower pressure setting (See Figure 2).

Types with Manual Reset (Option 1530)

These optional models incorporate a snap switch that, when actuated, remains tripped until pressure decreases and the reset button is manually depressed to the reset position.

Types J400K & J402K with Option M210

(indicator models 147, 157, S147B, S157B only)

To adjust for maximum accuracy at any desired set point, follow steps 1 - 4 below:

SPAN ADJUSTMENT

1) Remove front window and gasket (four screws) to gain access to span adjustment.
2) Connect control to calibrated pressure source and set to required differential pressure.
3) Using a screwdriver, carefully turn span adjustment (See Figure 3) to obtain required indication.
4) Re-mount front gasket and window.

Part III - Replacements

Tools Needed
Screwdriver

USE ONLY FACTORY AUTHORIZED REPLACEMENT PARTS AND PROCEDURES. DISCONNECT ALL LIVE CIRCUITS BEFORE PROCEEDING. COMPONENTS AVAILABLE FOR REPLACEMENT ARE THE SWITCHES. OTHER COMPONENTS FACTORY REPLACEABLE ONLY.

REPLACEMENT OF SWITCH(ES)

1) Disconnect leadwires.
2) Remove the two mounting screws. On multi-switch controls, first remove switch bias springs (See Figure 1.)
3) Insert replacement switch and replace screws and bias springs.
4) Check switch set point and re-calibrate per PART II if necessary.

RECOMMENDED PRACTICES

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and max temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to proof pressure or max temperature is acceptable on a limited basis (i.e.start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at proof pressure or maximum temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point can not result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point. Check unit immediately.
- Preventative maintenance/periodic testing is necessary for critical applications where damage could endanger property/ personnel.
- For all applications, a factory set unit should be tested before use.

Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, possible on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.

- Use only factory authorized replacement parts and procedures.
- Do not mount unit in ambient temp. exceeding published limits.
- For remote mounted temperature units, capillary lengths beyond 10 feet can increase chance of error, and may require re-calibration of set point and indication.

LIMITED WARRANTY

UE warrants that the product thereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by UE (F.O.B. UE); provided, however, that this warranty applies only to equipment found to be so defective within a period of 12 months after installation by buyer but not to exceed 18 months after delivery by the seller. Except for the limited warranty of repair and replacement stated above, UE disclaims all warranties whatsoever with respect to the product, including all implied warranties of merchantability or fitness for any particular purpose.

LIABILITY LIMITATION

The sole and exclusive remedy of buyer for any liability or seller for any claim, including incurred in connection with (I) breach of any warranty whatsoever expressed or implied, (II) a breach of contract, (III) a negligent act or acts (or negligent failure to act) committed by seller, or (IV) an act for which strict liability will be imputed to seller, is limited to the limited warranty or repair and replacement stated herein. In no event shall the seller be liable for any special, indirect, consequential or other damages or like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature, incurred by the buyer or any third party.

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USFilter

TRIMITE™

TECHNICAL DATA SHEET

TECHNICAL DATA	MODEL	TM-350A
Influent Flow Rate	GPM (GPD)	350 (504,000)
Shipping Dimensions	Length	22 ft. 6 in.
	Width	10 ft. 10 in.
	Height	9 ft. 4 in.
Tank Dimensions[8]	Length	20 ft. 1 in.
	Width	6 ft. 11 in.
	Height	7 ft. 6 in.
Weights[11]	Shipping	16,000 lbs.
	Operating	74,000 lbs.
Base Pad Design		675 lbs/sq.ft.
Backwash Holding Tank	Volume	18,200 gal.
Overhead Clearance	Minimum	2 ft. 6 in.
Tank Connections	Influent	6 in.
	Effluent	6 in.
	Backwash	6 in.
	Waste/Overflow	10 in.
	Filter-to-Waste	6 in.
	Air Wash (clarifier)	3 in.
	Air Wash (filter)	3 in.
Automatic Valve Sizes	Influent	4 in
	Effluent	4 in.
	Backwash	6 in.
	Filter-to-Waste	4 in.
	Waste	10 in.
	Air Wash Control (clarifier)	3 in.
	Air Wash Control (filter)	3 in.
Manual Valve Sizes	Influent Rate Setting	4 in.
	Backwash Rate Control	6 in.
Adsorption Clarifier™	Total Area	35.0 sq.ft.
	Upflow Rate	10 gpm/sq.ft.
Mixed Media Filter	Total Area	70.0 sq.ft.
	Rate	5 gpm/sq.ft.
	Standard Backwash Rate	15 gpm/sq.ft.
Total Volume per Wash Cycle	Adsorption Clarifier[2]	3,500 gal.
	Mixed Media[1]	6,825 gal.
Pumps	Effluent	350 gpm, 7.5 hp
	Backwash	1,050 gpm, 25 hp
Blower		163 scfm, 7.5 hp 3.2 psig
Electrical	Control panel w/ Transformer	480V, 60 Hz 30, 4 wire, 80A

NOTES:

1. Mixed Media backwash rate shown above is 15 gpm/ft^2 as required at 60° F. Required rate varies linearly with temperature from 10 gpm/ft^2 at 32 ° F to 18 gpm/ft^2 at 75° F. Wash volumes indicated above are based on a 6-minute backwash duration.
2. The Adsorption Clarifier™ is normally washed (using influent water) one or more times between Mixed Media backwashes, as well as in sequence with a Mixed Media backwash. The waste holding system should be sized to handle a total of two complete wash volumes from each compartment. The Adsorption Clarifier wash volume indicated above is based on an 10-minute total wash flush.
3. The influent pumping system should provide a range of 25-35 ft. at the plant inlet.
4. Available materials of tank construction include painted carbon steel, aluminum or 304SS. Process piping is PVC.
5. The second unit in a two-tank configuration shares the controls, backwash pump, air blower, and chemical feed systems from the first unit.
6. TM-350A standard start-up and operator training requirements are 4 days in one trip to the jobsite. Add one additional day for two-unit configurations.
7. Effluent/backwash pumps are approximately 30-40 feet TDH. Our effluent requirements are approximately 10 feet TDH. Our backwash requirements are approximately 20 feet TDH.
8. Dimensions do not include waste box.
9. All controls are automatic.
10. All valves are electric.
11. Media is shipped separately on the TM-350A.

INSTALLATION AND ASSEMBLY INSTRUCTIONS

TRIMITE WATER SYSTEMS

NASA JPL, Pasadena, CA

TRIMITE MODEL: TM-350A

PROJECT NO. - 310036

4/13/04

UNITED STATES FILTER CORPORATION
CPC DIVISION
P.O. BOX 36
441 MAIN STREET
STURBRIDGE, MA. 01566
(508) 347-7344 PH
(508) 347-7049 FX

TRI-MITE WATER SYSTEMS

INSTALLATION AND ASSEMBLY

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INSTALLATION AND ASSEMBLY INSTRUCTIONS

TRI-MITE WATER TREATMENT PLANT

INTRODUCTION

A. PLANT OVERVIEW

These instructions cover TRI-MITE model:

TM-350A 350 gal/min maximum capacity

This capacity is based on single tank systems. They may be supplied in one or two tank designs. All models are of rectangular, painted steel tank construction.

The standard USF Products TRI-MITE water treatment plant consists of:

1. One or two tanks with adsorption clarifier and filter compartments in each tank.

2. Blower assembly.

3. Adsorption media with retaining mechanism.

4. Mixed Media filter media with support underdrain system.

5. Manual and automatic control valves.

6. Float operated level control valves for the filters.

7. Electrical controls for automatic operation.

8. Coagulant feed controller, with on-line effluent turbidimeter.

9. Three chemical feed systems; one each for alum (by others), polymer (by others), and hypochlorite (by others).

Any special instructions for your TRI-MITE are identified in this Owners Manual with the project number shown on the title page at the front of the Manual.

Only the items referenced in the Bills of Material for the drawings in the Drawing section of this Owners Manual are furnished by USF-CPC Corporation Products.

The Jobsite Superintendent should review these instructions before the arrival of the equipment. THIS REVIEW IS IMPORTANT. Installation should not be attempted without first understanding these instructions.

B. GENERAL INSTRUCTIONS

CAUTION: Be careful when installing equipment (and media*) to avoid damage to the paint. Any paint damage that occurs during installation must be touched up immediately to prevent rusting. Small areas of steel exposed by paint damage inside the tank will rust quickly when submerged.

Padding of some sort is recommended in the bottom of the tank to help prevent paint damage from dirt imbedded in the worker's shoes. Heavy plastic sheet or cardboard may be used. Remove any padding material before installing media or filling the tank with water.*

Steel chips from any drilling inside the tank should be removed immediately. Steel chips will cut the paint and become imbedded in shoes, carrying the damage to all parts of the tank. Exposed steel in newly drilled holes should be coated with touch-up paint provided with the plant.

Check for debris inside the underdrain headers in the filter compartments. Any large objects can be removed by hand. Sand or any other debris can be flushed out with a hose. Do this before placing the tanks.*

***NOTE:** Unless otherwise specified media installation is required on the TM-350A.

C. RECOMMENDATIONS FOR HANDLING AND STORING MEDIA*

1. Storage

A. Mixed Media Filter Materials

The filter media for your TRI-MITE water treatment plant will arrive in bags, crated and clearly identified. Bagged material is not generally shipped on pallets because it gets bumped off the pallets and freight damage is high. Do not plan on placing material directly from the

truck into the filter. The waiting time on trucks and drivers is prohibitive.

Store the bagged material as close to individual filters as possible. Note that different sized gravels have different colored tags on the bags. Stack all bags with the same colored tag in the same pile. Do not store bagged material directly on the ground, or even on a hard surface. It can be palletized for easy handling by forklift to the filter, if you plan to go that route; but at any rate, it should be elevated to ensure air flow under and around the bags to prevent them from rotting away. Deteriorated bags will cause you trouble and expense at placement time as the media will have to be shoveled. Do not stack more than five bags high, to avoid breakage. If you cannot store bagged material under a roof, it must be covered to protect it from the weather. Do not use clear plastic sheeting; the sun will rot the bags. Use the black plastic type. It is essential that provision be made, if material is covered, for a flow of air around the stored material, as much of it is damp and the bags will rot if this is not done. An open, roofed shed is an ideal place for storing media.

B. Adsorption Media

Adsorption media is shipped in crates, called gaylords, that hold about 700-900 lbs. of material. The media is enclosed in plastic liners inside the box. If the gaylords are stored out of doors, make sure that the cardboard does not get wet since this will weaken it. Cover the gaylords with plastic sheeting.

2. Moving Media

Moving bagged material to the filter with a conveyor usually works well as there is no loose material to contend with. If a conveyor is not practical, a forklift or a well-operated loader is good.

The adsorption media gaylords are on pallets and easily moved with a forklift.

***NOTE:** Unless otherwise specified media installation is required on the TM-350A.

PLACING THE TRI-MITE

A. PLACING THE TANK

Lifting provisions have been designed into each tank. The design is based on connecting lifting slings to the tank with shackles. Selection of lifting machinery and equipment proper for the size and weight of the tank shall be the responsibility of the customer's mill-wrights. The longest practical slings are recommended.

Pads shall be such that the tank is level and, where more than one tank is shown on the Plans, all are at the same elevation. Pads which are not level and smooth may cause damaging stress in the tank plates and welds when the tanks are filled with water. Grouting may be used to correct any deficiencies in the pads.

Tank bottoms are not painted because protecting this surface during shipping and handling is not practical. Coal tar or asphaltic base mastic compound, such as heavy roofing compound, shall be spread evenly over the surface of the pads, before the tanks are placed, to seal the bottom surface of the tank from rusting. A 1/4 to 3/8 inch thick uniform layer of compound should be enough to seal the bottom surface of the tank to the pad with a quantity visible around the edges of the tank after placement.

Position tank squarely on the pad and make any alignment necessary for connection to the influent, effluent, backwash, waste and any other interconnecting equipment shown on the PROJECT ASSEMBLY drawings.

B. TANK WEIGHTS

	TM-350A
Shipping (lbs.)	16,000*
Operating (lbs.)	74,000

* These weights do not include media (which is shipped separate).

PAINTING

Your TRI-MITE was provided finished painted inside and out, you need only paint, at your option, your pipe spools and connecting pipe. For paint damage prevention please see "General Instructions".

ASSEMBLY, EQUIPMENT, CLARIFIER/FILTER

A. Check Supplies

Check quantities of all items on the Bill of Material (BOM) with the corresponding drawing. Note that there is a separate BOM for each unit. All nuts, bolts, and washers should be stainless steel or bronze except for those for the lifting lugs (where applicable). Stainless steel hardware is not attracted by a magnet.

B. Field Assembly

The TRI-MITE water system is factory assembled and tested so that a minimum of field assembly is required. Certain items are furnished loose to facilitate shipping. The following on-site assembly is required:

1. **Waste Piping -**
   Install waste piping as detailed on assembly drawing.

2. **Valve Installation -**
   Some valves are removed to avoid damage during shipping. Install these valves as detailed on the assembly drawings.

3. **Pipe Connections -**
   Connect influent, effluent, waste, and backwash lines to unit as detailed on the assembly and flow drawings. On two tank units make appropriate interconnections as detailed on the assembly and flow drawings between units (backwash and air blower).

4. **Media Installation -**
   Media installation is required on the TM-350A.

a.Adsorption Media

CAUTION: The plastic adsorption media is flammable. Exercise great caution. Do not allow welding or flames of any sort to come into contact with the dry material.

Now you can install the adsorption media in the clarifier. It ships in "gaylords" (cardboard crates), each weighing between 700 and 900 lbs. It can be placed in any fashion that is most convenient for you.

Follow these steps:.

1. Before you proceed, the influent valve must be installed and closed.

2. Make sure that the clarifier compartment is totally clean (use a vacuum cleaner) of any debris. Make a final check of the air distribution system to be sure everything is tight and secure.

3. Make some light pencil marks on the interior walls at a level of 4 ft. above the floor. You can use these to make sure that you don't place too much media.

4. You must exercise caution to make sure that the air laterals are not damaged by the impact of falling media. To do this, run one to two feet (no more!) of water into the compartment.

5. As media is poured, a small amount of fine dust may be released. It is recommended that anyone working in the immediate vicinity wear a particle mask to prevent inhaling this material.

6. The easiest way to place media is to raise each gaylord up over the tank on a forklift. Then, cut open one side of the gaylord with a utility knife, and let the material run down into the tank. You will need to cut through the plastic liner also. A garden rake or hoe will come in handy to help remove the media and to move it around in the tank.

7. The following precautions are to be observed while placing media:

    a. Be very careful that you don't drop foreign material into the tank with the media. If you do, be sure to remove it before proceeding. Be particularly careful of dropping bits of cardboard, plastic liner, and pieces of the pallet.

    b. Be careful to knock off loose pieces of gravel, soil, etc., from the pallet before lifting it up to the tank.

c. Don't scratch the paint on the tank with the forks or with the rake.

d. The media in the tank will not support a person's weight until most of it is in place, since it will be floating on water. You can, however (if necessary), lay down a piece of plywood to stand on, after you have placed about half of the media. Test it with your rake first to make sure that the media is solid.

8. Pour the media in. Go slowly at first, until the air distribution laterals are covered. Add media until you reach the marks you made on the walls. The media need not be leveled except to help you judge the overall depth. The depth is not extremely critical; plus or minus 1-2 inches is okay.

b.Adsorption Clarifier Retainer

1. Make certain that the proper quantity of media is placed and that there is no foreign material or debris in the clarifier compartment. Make a last second check of the paint.

2. Identify all of the pieces shown on the appropriate Assembly drawing. It is good to lay them out on the floor first to check the arrangement and fit before lifting them into the tank. You will need the retainers, holddowns, gasket material and hardware (nuts, bolts and washers). It is recommended that you don't take the hardware into the tank until the retainer is placed so that you don't drop any into the media.

3. Install gaskets on the supporting angles (1/4" thk.) all around. Also affix gaskets (1/2" thk.) to both sides of one grating panel. This panel will be the center panel (any panel can be chosen since their relative location is not critical). Do not forget to spray the edge of the grating with the glue provided--follow instructions on the can.

4. Lift the grating sections into the tank. Depending on the size of the tank, they may require a forklift (or overhead crane) to bring them up. Install these one by one onto the support angle, the center piece being squeezed between the two end pieces.

Note: Screen faces down!

Make sure you push laterally at each end so that the center gaskets are properly sealing the gaps between grating panels.

5. Bring holddown angles as required (2 or 4 per tank depending on tank) into the tank and position them as shown on the assembly drawing.

6. Install the holddown elements. These consist of a piece of threaded rod (3/4" or 1" dia.) nuts, and appropriate washers, which attach to gussets and brackets welded to the tank wall.

   a. Insert rod first through hole in gusset, install washer and nut under the gusset.

   b. Install washer and (I) nuts above the gussets. Tighten the I nuts together at some distance from the gusset.

   c. Tighten nut under gusset while holding top nut above gusset to prevent rod from turning. This will move the rod down and apply pressure on the holddown angle.

   d. Tighten until the gaskets on the support angle are getting compressed by about 1/8".

   e. Loosen double nut on top of gusset and tighten the bottom one against the top surface of the gusset. The remaining nut can be removed or better tightened against the nut under it so it is not lost.

c. Mixed Media

For filter media place see "Building The Filter".

C. ELECTRICAL CONNECTIONS

Refer to the Electrical Interconnection Diagram for the required field wiring instructions. All wiring should comply with any applicable codes.

Provide 120/240V, 60 Hz, 1 phase, service to the control panel as detailed on the electrical drawings and technical data sheet. This will be provided by the transformer in the power panel.

Make sure that you note the three clearwell level switches which must be provided by others and wired to the control panel. These are:

-- Plant off (LSH 001)
-- Backwash permissive (plant on) (LSL 001)
-- Pump protection (LSLL 001)

When the connections are completed, you can test teach piece of equipment by forcing the appropriate output on. This is done with the programmer panel and is described in the Operation and Maintenance portion of this manual.

Also note that three phase power is required to operate the effluent and backwash pumps as well as the air blower on the TM-350.

CHEMICAL FEED EQUIPMENT

A. General

You will need the following drawings:

CHEMICAL FEED ASSEMBLY, ALUM (BY OTHERS)
CHEMICAL FEED ASSEMBLY, POLY (BY OTHERS)
CHEMICAL FEED ASSEMBLY, HYPOCHLORITE (BY OTHERS)
ELECTRICAL INTERCONNECTION DIAGRAM
VALVE AND CONTROL INSTALLATION
ANY OTHER CHEMICAL FEED ASSEMBLY DRAWINGS

These drawings are in the DRAWING section of this Owner's Manual.

Additional Installation, Adjustment, Maintenance, and Repair instructions are in the EQUIPMENT DATA section. You should read these instructions before going any further.

The chemical feed pumps should be mounted on the tank lids or on raised bases. The area around the pumps is subject to chemical and water spills. The raised bases allow the pumps to stay reasonably dry when the floor is hosed down.

1. Water Supply

A clean water supply is recommended for each mixing tank. The supply line should be at least 1/2" pipe and should end in a vertical run with a shutoff valve 6 to 8 inches above the tank. A 12 inch length of flexible hose such as garden hose can be attached to the shutoff valve to go down through the hole provided in the tank cover. This arrangement will allow the tank cover to be removed.

NOTE: The arrangement of the piping should be made to allow easy access to the large hole in the tank cover for adding chemicals.

2. Electrical Connections

All wiring should comply with local codes.

Electrical wiring to the chemical mixers should be provided for the mixers. There should be 5 to 6 feet of flexible cord at each mixer to provide for removal of the mixers without the need to disconnect wiring. The chemical mixers are not connected to the plant controls.

Electrical connections to chemical feed pumps, which are not motor driven, are wired directly from the plant controls to the pump. These small pumps are essentially a solenoid and you will see that there is no rotating motor drive.

3. Solution Feed Lines

Chemical feed lines should be run from the pumps to the injection connections shown on the drawings. Each discharge line is to be run into a tee assembly, where it is mixed with service water. The mixture is then run to the injection point on the raw water line, using 1/2 in. O.D. plastic tubing. Generally, one injection point is used for alum, fed into the main raw water line.

Polymer connections need to be made in the line feeding each tank ahead of the influent valve. The nozzles are threaded into 3/4 in. couplings in the pipe, supplied by others.

B. Alum Feed System Assembly (By Others)

All of the equipment supplied by USF is shown on the Bill of Material with the Chemical Feed Assembly, Alum drawing. The equipment needed but not supplied by USF with the standard plant is shown on the drawing.

The following discussion is based on plants using an alum mix tank supplied by USF. If your plant uses a liquid alum system, USF does not supply the storage tank or appurtenances. In this case, ignore the references to the storage tank and mixers.

The alum solution tank should be placed where you can readily get at the large hole in the cover to add chemicals. A plastic cover is provided for this access hole to keep your mixed solution clean.

The mixer clamps on the side of the tank in the opening in the cover provided for its mounting. Adjust the swivels on the mixer mounting clamp so that the mixer shaft is at the angles in the tank recommended by the manufacturer in order to have the most efficient solution mixing. There are manufacturer's instructions for the mixer in the Equipment Data

section of this Owner's Manual which should be reviewed also before you start the mixer up.

Mounting, wiring, and connecting the chemical feed pump to the plant have been covered earlier in this instruction. Remember here to review the manufacturers instructions. Connect the suction side of the pump to your solution tank with the larger plastic tubing that came with the pump using the fittings and shut-off valve supplied with the tank. Connect the strainers that came with the pump to the fitting inside the tank. There is a detail on the drawing covering this connection.

Your alum feed system should now be complete.

C. Polymer Feed System Assembly (By Others)

Assemble the polymer feed system. All of the equipment supplied by MP is shown on the Bill of Material for this drawing. The equipment needed but not supplied by USF with the standard plant has been covered earlier in this instruction.

The polymer solution tank should be placed where you can readily get at the large hole in the cover to check the mixing and solution.

The polymer powder will not readily mix into a solution by dumping it into the water in the mix tank and agitating it. The powder is, instead, added through a "disperser". This disperser and plastic funnel are listed on the Bill of Material. A water line with a shut-off valve needs to be connected to the side of the disperser. Position the disperser on the tank cover where it is convenient to pipe water into it and also get at the funnel to add polymer powder. Attach it to the cover by drilling a hole in the cover for the bulkhead fitting also listed on the Bill of Material.

The mixer for your polymer solution tank is a slow speed, gear driven agitator. Assemble the shaft and propellers the same way you did the mixer for the Alum Tank. Mount the mixer the same way.

NOTE: The shaft and propellers that come with your mixers are different from each other. The larger propellers go on the slow speed, gear driven mixer for your polymer system.

Your polymer feed system requires one chemical feed pump for each tank in your system. These pumps are mounted on the tank covers. Wiring and connecting the pumps to the plant have been covered earlier in this instruction. Assembly the nipples, tee, elbows, and the plastic valves to the fitting in the bottom of the tank as shown in the detail on the drawing. Install the 1/2 in. plug in the drain hole.

Connect the section side of the pumps to the valves with the vinyl plastic tubing that came with the pump. Connect the strainer(s) foot valve(s) that came with the pump to the fitting inside the tank with the same tubing.

Your polymer feed system should now be complete.

D. Hypochlorite System Assembly (By Others)

All of the equipment supplied by USF is shown on the Bill of Material with the Chemical Feed Assembly, hypochlorite drawings. The equipment needed but not supplied by USF with the standard plant is shown on the drawing.

Place the hypochlorite tank where you can readily get at the large hole in the cover to add chemicals. A plastic cover is provided for this access hole to keep your mixed solution clean.

The mixer for your hypochlorite solution tank is a direct drive, high speed agitator. The mixer comes disassembled for compactness in shipping. You will need the mixer, a shaft, and two propellers. Everything should be together in the crate. Line the keyway groove in the end of the shaft up with the key in the drive head of the mixer and push the shaft all the way in. The key is permanently held in place from the factory in the slot where the clamping bolt goes through. Tighten the clamping bolt in the drive head. Loosen the set screw in the two propellers and slip both of them on the shaft. The curved side of the blades should go toward the mixer head; the propellers are going to push the water down and away from the mixer head. The bottom propeller should be flush with the free end of the shaft. The second propeller should be about 12 inches up the shaft from the first. Some thread locking compound such as "Locktite" is recommended on the propeller set screws before you tighten them.

The mixer clamps on the side of the tank in the opening in the cover provided for its mounting. Adjust the swivels on the mixer mounting clamp so that the mixer shaft is at the angles in the tank recommended by the manufacturer in order to have the most efficient solution mixing.
There are manufacturer's instructions for the mixer in the Equipment Data section of this Owner's Manual which should be reviewed also before you start the mixer up.

Your hypochlorite feed system includes one chemical feed pump to be mounted on the tank cover. Wiring and connecting the pumps to the plant have been covered earlier in this instruction. Assemble the nipples, tee, elbows, and the plastic valves to the fitting in the bottom of the tank as shown in the detail on the drawing. Install the 1/2 in. plug in the drain hole.

Connect the suction side of the pumps to the valves with the vinyl plastic tubing that came with the pump. Connect the strainer(s) foot valve(s) that came with the pump to the fitting inside the tank with the same tubing.

Your hypochlorite feed system should now be complete.

NOTE: Make sure the shut-off valves on the completed chemical feed systems are open.

FINAL CHECK-OUT

A. Check-Out

Now is the time to make sure all the level switches in the clearwell and backwash supply tanks are correctly positioned and working.

Right VOLTAGE to all the electrical equipment? Check all your piping. Everything tight? Supports?

Make sure you have a supply of chemicals for your chemical feed system.

B. Building The Filter

(TM-350A)

Your TRIMITE water treatment plant should now be ready for placement of the filter media. All equipment should be assembled.

Check all the piping. Is everything tight? All the supports in place? All the valves have power? Cycle the valves by hand. Everything clear?

Check all the electrical circuitry. Clearwell level switches? Backwash level switch?

You should contact the USF Service Coordinator to schedule a Technical Director for filter media placement as soon as you can predict when you will reach this point in your assembly. Please allow at least two weeks leadtime for scheduling his visit.

USF Products warranty of the filter requires media placement ONLY by direction of a Technical Director at your plant.

The closer you can schedule his arrival with your completion of the installation and assembly, ready for the filter, the less time will be lost.

The filter media should have been stored as described in the section covering media handling at the beginning of these instructions. You may want to make your arrangements to move the media from storage to the filters with as little time loss as possible when the Technical Director arrives to build your filter.

Several workers will be required to install the media under his direction. Ladders, shovels, rakes and scraps of plywood to stand on inside of the filter will be needed. A lift truck is almost essential.

All electrical, connections need to be complete. The plant needs to be ready to run when the Technical Director arrives. Water for backwash during media placement should be available.

The backwash flow rate need to be set. The manual rate set valve in your backwash line will be set to establish the correct flow rate for the type of filter and the temperature of your backwash water. The procedure is described in Section III of the Operation and Maintenance section of this manual. The Technical Director will explain the chart and the flow rate setting during the building of the filter.

The Technical Director will direct you in building your filter to the MEDIA DESIGN-FILTER drawing in the DRAWING section of this Owner's Manual.

The USF Technical Director will help you check out the whole plant BEFORE it is started up. He will train and check out your operator in the functioning of the plant when it is started up.

The next section of these instructions will cover plant OPERATION AND MAINTENANCE.

STD: 1-0600-8X11A	INTL REF:	BAR = 1" AT PLOT SCALE

41074-209-1 PRESSURE GAUGE

Range: 0-60 psig
Stainless Steel Case, 4" dial
316 Stainless wetted parts
Liquid filled: Glycerin
¼" MNPT connection (lower)
Accuracy: +/- 1% of span
Service: Wastewater SG= 1.02, Visc = 0.5-3.0 cP, T=40-70°F, pH range = 6-9
TSS = 0-100 mg/L, including granular activated carbon & biosolids
TDS = 100-400 mg/L

41074-209-2 PRESSURE GAUGE

Range: 0-30 psig
Stainless Steel Case, 4" dial
316 Stainless wetted parts
Liquid filled: Glycerin
¼" MNPT connection (lower)
Accuracy: +/- 1% of span
Service: Wastewater SG= 1.02, Visc = 0.5-3.0 cP, T=40-70°F, pH range = 6-9
TSS = 0-100 mg/L, including granular activated carbon & biosolids
TDS = 100-400 mg/L

DAUGHTRIDGE

PH: 1-800-334-9720
FAX:
ATTN: TONYA B.
EMAIL: TONYAB@DASCOSALES.COM

DESIGNER FD	DATE 2/26/04	TITLE PRESSURE GAUGE	
CHECKER	DATE	CLIENT JET PROPULSION LAB, NASA	
ENGINEER FD	DATE 2/26/04	USFilter Envirex Products Waukesha, WI 800-524-6324	
MANAGER RDH	DATE		
FILE:			
SCALE:			

PROJECT	CODE	DRAWING	SHEET	REV
41074	4093D	41074-209	1 OF 1	0

WARNING—*Misuse of pressure gauges may cause explosion and personal injury. Do not use without first reading and understanding these instructions and the apparatus installation and operating instructions.*

AMETEK

U.S. GAUGE DIVISION • SELLERSVILLE, PENNSYLVANIA 18960

USE AND INSTALLATION OF PRESSURE GAUGES

The following information on installation and use has been excerpted from ANSI B40.1-1980. The complete ANSI B40.1-1980 standard which contains additional information may be obtained at a cost of $9.00 from the AMERICAN SOCIETY OF MECHANICAL ENGINEERS, United Engineering Center, 345 East 47th, New York, New York 10017.

3.3.4 *Pressure Connection*
Location of Connection
Stem Mounted—Bottom or Back
Surface Mounted—Bottom or Back
Flush Mounted—Back

Type of Connection. Taper pipe connections for pressures up through 20,000 psi are usually 1/8-27, 1/4-18, or 1/2-14 American Standard external or internal taper pipe threads (NPT) per ANSI B2.1, as required. Above this pressure ¼ high pressure tubing connections, or equal, shall be used.

In applications of *stem mounted gauges*, especially with liquid-filled cases and where vibration is extremely severe, consideration should be given to the possibility of failure of the stem or associated piping, caused by the vibrating mass of the gauge. A larger connection (e.g. 1/2 NPT instead of 1/4 NPT) and/or a stronger stem material (e.g. stainless steel instead of brass) should be considered.

3.4.3.10 Mounting a pressure gauge in a *position* other than that at which it was calibrated can affect its accuracy. Normal calibrating position is upright/vertical. For applications requiring mounting in other than this position, notify the supplier.

3.4.3.11 CAUTION TO USERS. PRESSURE GAUGES CAN BE RENDERED INACCURATE DURING SHIPMENT DESPITE CARE TAKEN IN PACKAGING. TO INSURE CONFORMANCE TO THE STANDARD GRADE TO WHICH THE PRESSURE GAUGE WAS MANUFACTURED, IT SHOULD BE CHECKED BEFORE USE.

4.0 SAFETY

4.1 Scope

This section of the standard presents certain information to guide users, suppliers and manufacturers toward minimizing the hazards that could result from misuse or misapplication of pressure gauges with elastic elements. The user should become familiar with all sections of this standard as all aspects of safety cannot be covered in this section. Consult the manufacturer or supplier for advice whenever there is uncertainty about the safe application of a pressure gauge.

4.2 General Discussion

4.2.1 Adequate safety results from intelligent planning and careful selection and installation of gauges into a pressure system. The user should inform the supplier of all conditions pertinent to the application and environment so that the supplier can recommend the most suitable gauge for the application.

4.2.2 The history of safety with respect to the use of pressure gauges has been excellent. Injury to personnel and damage to property have been minimal. In most instances, the cause of failure has been misuse or misapplication.

4.2.3 The pressure sensing element in most gauges is subjected to high internal stresses, and applications exist where the possibility of catastrophic failure is present. Pressure regulators, chemical (diaphragm) seals, pulsation dampers or snubbers, syphons, etc., are available for use in these potentially hazardous systems.

4.2.4 CAUTION: PRESSURES IN EXCESS OF FULL SCALE PRESSURE OR VACUUM SHOULD BE AVOIDED. OVERPRESSURE MAY CAUSE CALIBRATION CHANGE, DAMAGE TO THE ELASTIC ELEMENT OR GAUGE FAILURE AND THEREFORE SHOULD NOT BE APPLIED UNLESS RECOMMENDED BY THE GAUGE MANUFACTURER.

4.2.5 The following systems are considered potentially hazardous and must be carefully evaluated:

1. Compressed gas systems.
2. Oxygen systems.
3. Systems containing hydrogen or free hydrogen atoms.
4. Corrosive fluid systems (gas and liquid).
5. Pressure systems containing any explosive or flammable mixture or medium
6. Steam systems.
7. Non-steady pressure systems.
8. Systems where high overpressure could be accidentally applied.
9. Systems wherein interchangeability of gauges could result in hazardous internal contamination or where lower pressure gauges could be installed in higher pressure systems.
10. Systems containing radioactive or toxic fluids (liquids or gases).
11. Systems installed in a hazardous environment.

4.2.6 When gauges are to be used in contact with media having known or uncertain corrosive effects or known to be radioactive, random or unique destructive phenomena can occur. In such cases the user should always furnish the supplier or manufacturer with information relative to the application and solicit his advice prior to installation of the gauge.

4.2.7 Fire and explosions within a pressure system can cause pressure element failure with very violent effects, even to the point of completely disintegrating or melting the pressure gauge. Violent effects are also produced when failure occurs due to (1) hydrogen embrittlement, (2) contamination of a compressed gas, (3) formation of acetylides, (4) melting of soft solder joints by steam or other heat sources, (5) corrosion, (6) fatigue, (7) the presence of shock, and (8) excessive vibration. Nearly any failure in a compressed gas system produces violent effects.

4.2.8 *Modes of Elastic Element Failure.* There are four basic modes of elastic element failure: 1) failure due to fatigue, 2) failure due to application of overpressure, 3) corrosion failure and 4) explosive failure due to chemical reaction (explosion) within the element.

4.2.8.1 *Fatigue Failure.* Fatigue failure generally occurs along a highly stressed edge radius appearing as a small crack which propagates along the edge radius. Such failures are usually more critical with compressed gas media than with liquid media.

Fatigue cracks usually release the media fluid slowly so case pressure build-up can be averted by providing pressure relief openings in the gauge case. However, in high pressure elastic elements where the yield strength approaches the ultimate strength of the element material, fatigue failure may resemble explosive failure.

A restrictor placed in the gauge pressure inlet will reduce pressure surges and restrict fluid flow into the partially open bourdon tube. A restrictor should be considered for gauges used in compressed gas applications.

4.2.8.2 *Overpressure Failure.* Overpressure failure is caused by the application of internal pressure greater than the rated limits of the elastic element and can occur when a low pressure gauge is installed in a high pressure port or system. The effects of overpressure failure, usually more critical in compressed gas systems than in liquid filled systems, are unpredictable and may cause parts to be propelled in any direction. Cases with pressure relief openings will not always retain expelled parts.

Placing a restrictor in the pressure gauge inlet will not reduce the immediate effect of failure but will help control flow of escaping fluid following rupture and reduce potential of secondary effects.

It is generally accepted that solid front cases with pressure relief back will reduce the possibility of parts being projected forward in the event of failure.

The window material alone will not provide adequate protection against internal case pressure build-up and can, in fact, be the most hazardous component.

4.2.8.3 *Corrosion Failure.* Corrosion failure occurs when the elastic element has been weakened through attack by corrosive chemicals present in either the media inside or the environment outside it. Failure may occur as pinhole leakage through the element walls or early fatigue failure due to stress cracking brought about by chemical deterioration or embrittlement of the material.

A chemical (diaphragm) seal should be considered for use with pressure media that may have a corrosive effect on the elastic element.

4.2.8.4 *Explosive Failure.* Explosive failure is caused by the release of explosive energy generated by a chemical reaction such as can result when adiabatic compression of oxygen occurs in the presence of hydrocarbons. It is generally accepted that there is no known means of predicting the magnitude or effects of this type of failure. For this mode of failure a solid wall or partition between the elastic element and the window will not necessarily prevent parts being projected forward.

4.2.9 *Pressure connection.* See recommendations in paragraph 3.3.4.

4.3 Safety Recommendations

4.3.1 *Operating Pressure.* The pressure gauge selected should have a range such that the operating pressure occurs in the middle half (25 to 75%) of the scale. A good rule of thumb is to select a gauge with a full scale pressure two times the intended operating pressure.

Should it be necessary for the operating pressure to exceed 75% of full scale, contact the supplier for recommendations.

This does not apply to Test, Retarded, or Suppressed Scale gauges.

4.3.2 *Pressure Element*

4.3.2.1 *Compatibility with the Pressure Medium.* The elastic element is generally a thin-walled member which of necessity operates under high stress conditions and must, therefore, be carefully selected for compatibility with the pressure medium being measured. None of the common element materials is impervious to every type of chemical attack. The potential for corrosive attack is established by many factors including the concentration, temperature and contamination of the medium. The user should inform the gauge supplier of the installation conditions so that the appropriate element materials can be selected.

4.3.2.2 In addition to the factors discussed above, the capability of a pressure element is influenced by the design, materials and fabrication of the *joints between its parts.*

Common methods of joining are soft soldering, silver brazing and welding. Joints can be affected by temperature, stress and corrosive media. Where application questions arise, these factors should be considered and discussed by the user and manufacturer.

4.3.2.3 Some special applications require the pressure element assembly have a high degree of *leakage integrity.* Special arrangement should be made between manufacturer and user to assure that the allowable leakage rate is not exceeded.

4.3.3 *Cases*

4.3.3.1 *Cases, Solid Front.* It is generally accepted that a solid front case per Section 3.3.1 will reduce the possibility of parts being projected forward in the event of elastic element failure. An exception is explosive failure of the elastic element.

4.3.3.2 *Cases, Liquid Filled.* It has been general practice to use glycerine or silicone filling liquids. However, these fluids may not be suitable for all applications. They should be avoided where strong oxidizing agents including, but not limited to, oxygen, chlorine, nitric acid and hydrogen peroxide are involved. In the presence of oxidizing agents potential hazard can result from chemical reaction, ignition or explosion. Completely fluorinated and/or chlorinated fluids may be suitable for such applications.

The user shall furnish detailed information relative to the application of gauges having liquid filled cases and solicit the advice of the gauge supplier prior to installation.

Consideration should also be given to the instantaneous hydraulic effect which may be created by one of the modes of failure outlined in 4.2.8. The hydraulic effect due to pressure element failure could cause the window to be projected forward even when a case having a solid front is employed.

4.3.4 *Restrictor.* Placing a restrictor between the pressure connection and the elastic element will not reduce the immediate effect of failure but will help control flow of escaping fluid following rupture and reduce the potential of secondary effects.

4.3.5 *Specific Service Conditions*

4.3.5.1 *Specific Applications* for pressure gauges exist where hazards are known. In most instances requirements for design, construction and use of gauges for these applications are specified by State or Federal Agencies or Underwriters' Laboratories, Inc. Some of these Specific Service gauges are listed below. The list is not intended to include all types and the user should always advise the supplier of all application details.

4.3.5.2 *Oxygen Gauge.* A gauge designed to indicate oxygen pressure. Cleanliness shall comply with Level IV (see Section 5.0). The dial shall be clearly marked with a universal symbol and/or USE NO OIL in red color.

4.3.5.3 *Ammonia Gauge.* A gauge designed to indicate ammonia pressure and to withstand the corrosive effects of ammonia. The gauge may bear the inscription AMMONIA on the dial. It may also include the equivalent temperature scale markings on the dial.

4.3.5.4 *Acetylene Gauge.* A gauge designed to indicate acetylene pressure. It shall be constructed using materials that are compatible with commercially available acetylene. The gauge may bear the inscription ACETYLENE on the dial.

4.3.5.5 *Chemical Gauge.* A gauge designed to indicate the pressure of corrosive and/or high viscosity fluids. The primary material(s) in contact with the pressure medium may be identified on the dial. It may be equipped with a chemical seal, pulsation damper, and/or pressure relief device. These devices help to minimize potential damage to personnel and property in the event of gauge failure. They may also reduce accuracy and/or sensitivity, however.

4.4 Reuse of Pressure Gauges

It is not recommended that pressure gauges be moved from one application to another. Should it be necessary, however, the following must be considered.

4.4.1 *Chemical Compatibility.* The consequences of incompatibility can range from contamination to explosive failure. For example, moving an oil service gauge to oxygen service can result in explosive failure.

4.4.2 *Partial Fatigue.* The first application may involve pressure pulsation which has expended most of the gauge life, resulting in early fatigue in the second application.

4.4.3 *Corrosion.* Corrosion of the pressure element assembly in the first application may be sufficient to cause early failure in the second application.

4.4.4 *Other Considerations.* When re-using a gauge all guidelines covered in this standard relative to application of gauges should be followed in the same manner as when a new gauge is selected.

IMPORTANT—*Read other side for additional instructions and warnings.*

In addition to the ANSI B40.1-1980 standard, the following additional instructions and warnings should be read and understood before using this product.

A very important aspect of selecting and installing pressure gauges is the consideration of the hazards that will result in the event the gauge fails.

The primary causes of failure are misapplication and/or abuse of the gauge. Those people who are responsible for the selection and installation of pressure gauges must recognize conditions which will adversely affect the ability of the gauge to perform its function or which will lead to early failure. These conditions may then be discussed with the manufacturer to obtain his recommendations.

Failure may constitute:

1. Loss of accuracy.
2. Clogging of the pressure port, or damage to the internal mechanism so that there is either:
   a. no indication when pressure is applied or
   b. there is an indication of pressure even though none is applied.
3. A leak in the pressure containing parts or joints.
4. A crack or fatigue failure of the bourdon.
5. Bursting of the bourdon due to severe overpressure.
6. An explosion within the system due to a chemical reaction of the pressure medium with contaminants causing the bourdon to explode.

When specifying, using or installing a pressure gauge, the following factors must be given attention:

1. Operating Pressure

Do not continuously operate the gauge at more than 75% of the span. Bourdon tubes are necessarily highly stressed, especially in ranges over 1000 psi and continuous operation at full scale will result in early fatigue failure and subsequent rupture.

2. Materials

Be certain the materials of the pressure containing portions of the gauge are compatible with the pressurized medium. Gauges are commonly made of copper alloys (brass, bronze, etc.) and may be subject to stress corrosion or chemical attack. Bourdons have relatively thin walls, and the accuracy of the indication is directly affected by any reduction in the wall thickness. Use of the same material for the bourdon as used for the tank or associated piping is not necessarily good practice. A material having a corrosion rate of .001"/year may be suitable for the piping, but will be entirely unsuitable for a bourdon having a wall thickness of, for example, .008 inches. It is imperative that the proper bourdon material be selected for the service on which the gauge is used. Gauges specially constructed for corrosion service are available.

3. Cyclic Pressure and Vibration

Continuous, rapid pointer motion will result in excessive wear of the internal mechanism and cause gross errors in the pressure indicated and possibly early fatigue failure of the bourdon. If the pointer motion is due to mechanical vibration, the gauge must be remotely mounted on a non-vibrating surface and connected to the apparatus by flexible tubing. If the pointer motion is due to pressure pulsations, a suitable damper must be used between the pressure source and the gauge.

4. Accuracy at Low Pressure End of Span

Pressure gauges should not be used to measure pressures less than 10% of the span. The accuracy of a pressure gauge is normally stated as "percent of span". The accuracy of commercial Grade B gauges (see ANSI B40.1 for various grades of accuracy) is ±3% of span over the first quarter of the scale. If, for example, a 0-100 psi Grade B gauge is used to measure 6 psi, the accuracy of measurement will be ±3 psi or ±50% of the *applied* pressure. In addition, the scale of pressure gauges is often laid out with a "start" (take-up) which can result in further inaccuracies when measuring pressures which are a small percentage of the gauge span. For the same reasons, gauges should not be used for the purpose of indicating that the pressure in a tank, autoclave, etc. has been completely exhausted to atmospheric pressure. Depending on the accuracy and the span of the gauge and the possibility that a "start" (take-up) is incorporated at the beginning of the scale, hazardous pressure may remain in the tank even though the gauge is indicating zero pressure. A vent valve must be used to completely reduce the pressure before unlocking covers, removing fittings, etc.

5. Fatigue

As with any spring, the bourdon will fail after extended use and release the pressurized medium. The larger the number of applied pressure cycles and the greater the extent of the pressure cycle, the earlier failure will occur. The fatigue failure may be explosive. Since such a failure will be hazardous to personnel or property, precautions must be taken to contain or direct the release of the pressurized medium in a safe manner.

6. Frequency of Accuracy Evaluation

Where the pressure measurement is critical and gauge failure or gross inaccuracy will result in hazard to personnel or property, the gauge should be checked for accuracy and proper operation on a periodic basis.

7. Use with Oxygen

Gauges used for measurement of oxygen pressure must be free of contamination within the pressure containing portion. Various levels of cleanliness are specified in ANSI B40.1. The gauge itself and the equipment to which the gauge is attached (pressure regulators, cylinders, etc.) must be kept clean so as not to contaminate the gauge. Filters on the equipment must be examined periodically and cleaned or replaced. The sudden in-rush of a high pressure gas will momentarily create a very high temperature which in the presence of oxygen may ignite the contaminant causing a violent explosion. **Therefore, when the valve on the oxygen supply tank is opened, to admit oxygen to the regulator, the valve should be opened very slowly so as to allow the pressure to build up slowly.** In order to accomplish this it is recommended that the tank valve be opened momentarily and then closed snugly but not excessively before attaching the regulator. This will not only blow out accumulated dirt in the valve, but will also place the valve in a condition that will permit it to be opened slowly rather than suddenly breaking loose as a result of being closed too tightly. When bleeding the oxygen tank prior to attaching the regulator, be certain the valve opening is directed away from any open flame and the operator. **When opening the oxygen tank valve, the operator must not stand in front of or behind the gauge and must wear eye and face protection.** In this position if there is an explosion due to contaminated equipment any particles projected from the gauge will not be propelled directly at the operator.

8. Use with Hydrogen

Steel bourdons including 400 series stainless steel are subject to hydrogen embrittlement when stressed. Measurement of gas or liquids containing hydrogen (such as natural gas, sour oil) require the use of special materials for the bourdon.

9. Venting of Case

Vents provided in the pressure gauge case (clearance around pressure connection, rubber grommets, pressure relief back, etc.) must not be closed or restricted from operating. There is always the possibility that the pressure medium will be admitted to the case interior as a result of a leaking joint or bourdon tube failure. If this occurs, the pressure medium must be vented from the case so as not to build up sufficient pressure to rupture the case or window. **However, venting will not prevent case rupture in the event of a violent explosion.**

10. Liquid Filled Gauges

Performance of pressure gauges used in severe vibration or pulsating pressure service, can be improved by filling the gauge case with a viscous fluid. Gauges constructed in this manner necessarily require sealed cases to prevent the escape of the liquid. However, some means of venting the case must be provided. In some instances, this vent is sealed to prevent loss of fluid during shipment, and must be released after the gauge is installed. Be certain to follow the installation instructions for properly venting the gauge after installation. The liquid filling most commonly used is a mixture of glycerin and water.

Glycerin can combine with strong oxidizing agents including (but not limited to) chlorine, nitric acid and hydrogen peroxide, and result in an explosion which can cause property damage and personal injury. If gauges are to be used in such service, do not use glycerin filled gauges; consult the factory for proper filling medium.

WARNING—***Misuse of pressure gauges may cause explosion and personal injury. Do not use without first reading and understanding these instructions and the apparatus installation and operating instructions.***

Important—***Read other side for additional instructions and warnings.***

Form #1421

WILKERSON®
CORPORATION

INSTALLATION AND MAINTENANCE SHEET

Regulator Model R16
With Variations and Accessories

CAUTION

EXCEPT as otherwise specified by manufacturer, this product is specifically designed for compressed air service and use with any other fluid (liquid or gas) is a misapplication. For example, use with or injection of certain hazardous liquids or gases in the system (such as alcohol or liquid petroleum gas) could be harmful to the unit or result in a combustible condition or hazardous external leakage. Manufacturer's warranties are void in the event of misapplication, and manufacturer assumes no responsibility for any resulting loss.

The relief flow capacity of relieving type regulators is limited. Under some operating conditions the secondary (outlet) pressure could increase above initial setting. Over-pressurized conditions could cause malfunction or failure of downstream equipment, additional external pressure relief devices of suitable capacity must be installed.

Before using with fluids other than air, or for non-industrial applications, consult manufacturer for written approval.

INSTALLATION

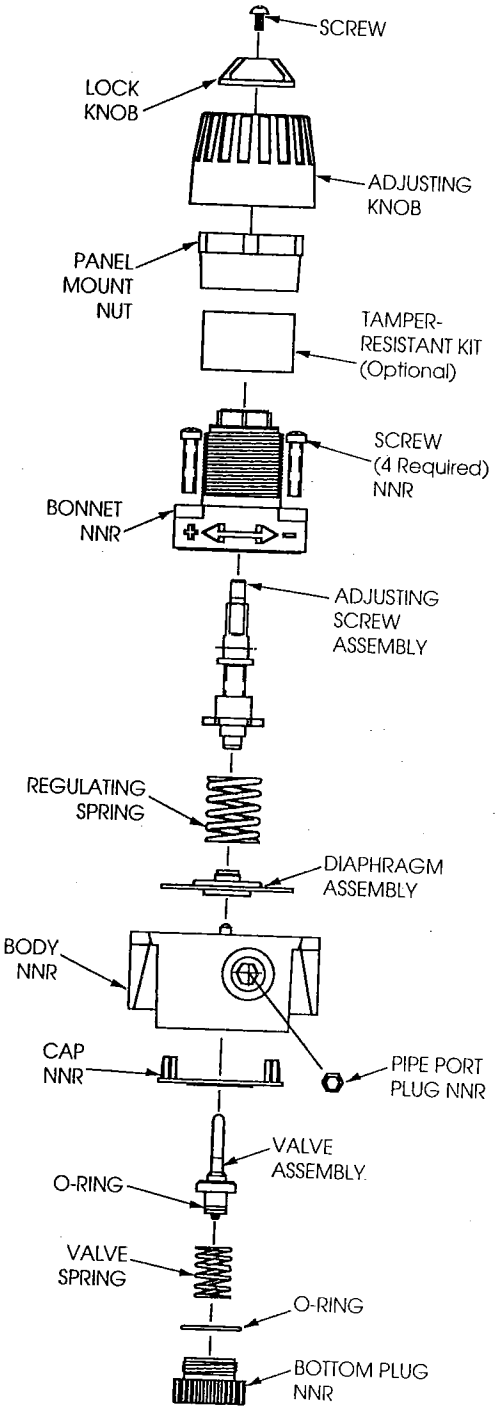
1. Install as close as possible to where regulated air is needed.
2. Install the unit with the air flowing in the direction indicated by the arrow.
3. Install the same pipe size unit as the pipe line in use. Avoid using fittings, couplings etc., that restrict airflow, unless maximum flow is not needed.
4. Regulator may be installed with the adjusting knob in any position. Attach gauge to one ¼" female gauge port and plug the other ¼" female port or use it as a regulated outlet port.
5. Turning the adjusting screw clockwise increases the regulated pressure and turning it counterclockwise decreases the regulated pressure.
6. Panel mount regulators require a $1^{5}/_{16}$" diameter hole and are mountable on panels from ⅛" to ½" thick.
7. Maximum inlet pressure and operating temperature ratings are 300 psig (21 bar) and 175°F(79°C).

MAINTENANCE

1. The regulator can be disassembled for servicing without removal from line.
2. Occasionally remove bottom plug and clean plug, body and valve seat (vent air line on both sides of regulator).
3. TO DISASSEMBLE-shut off air to regulator and vent air line on both sides of regulator. Turn adjusting knob counterclockwise to relieve compression on spring. Remove screw, lock knob, adjusting knob (panel mount nut, if used), tamper-resistant kit (on tamper-resistant models) and cover cap. Remove the four screws, cover and regulating spring. Diaphragm assembly can now be removed. By removing bottom plug and spring the valve stem can be removed from the bottom of the regulator.
4. IF UNIT WILL NOT REGULATE TO PRESSURE NEEDED OR IF PRESSURE BECOMES EXCESSIVE-remove bottom plug, spring, and valve assembly. Clean and check o-ring, valve stem and valve seat for water damaged parts. Install Repair Kit No. RRP-95-130 for self-relieving models and Repair Kit RRP-95-129 for nonrelieving models for complete overhaul.
5. IF UNIT LEAKS AT RELIEF PORT, install proper repair kit as listed under Repair Kits and Replacement Parts.
6. WHEN REPLACING DIAPHRAGM ASSEMBLY- Diaphragm assembly RRP-96-213 includes disk seal (not shown) installed. Seal not required on nonrelieving models.
7. TO REPLACE O-RING-This o-ring is above a metal washer which cannot be removed. Using a pointed probe of some kind, pull o-ring out. Force new o-ring through washer hole into o-ring cavity.

REPAIR KITS AND REPLACEMENT PARTS

SELF-RELIEVING REPAIR KIT (includes self-relieving diaphragm assembly, valve assembly and o-rings)	RRP-95-130
NONRELIEVING REPAIR KIT (includes nonrelieving diaphragm assembly, valve assembly and o-rings)	RRP-95-129
Self-Relieving Diaphragm Kit	RRP-96-213
Nonrelieving Diaphragm Kit	RRP-96-216
Valve Assembly (valve stem, valve spring)	RRP-96-215
Regulating Springs:	
0-50 psi	RRP-95-222
0-125 psi	GRP-95-224
0-250 psi	RRP-95-218
Adjusting Knob Assembly	RRP-95-023



ACCESSORIES

Gauges:	
0-60 psig	RRP-95-230
0-160 psig	GRP-95-229
0-300 psig	RRP-95-231
Panel Mount Nut	GPA-95-032
Wall Mounting Bracket	GPA-95-012
Wall Mounting with Panel Nut	GPA-95-011
Wall Mounting Bracket (Combo's)	RRP-95-090
Tamper Resistant Kit	RRP-95-006

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