OPERATION AND MAINTENANCE MANUAL

FOR

BBRO-10,000-21,500 SERIES
REVERSE OSMOSIS SYSTEMS

Manufactured By:

Big Brand Water Filter
7745 Alabama Ave. #11 Canoga Park, CA 91304 U.S.A
PHONE: 818.340.7258

TABLE OF CONTENTS

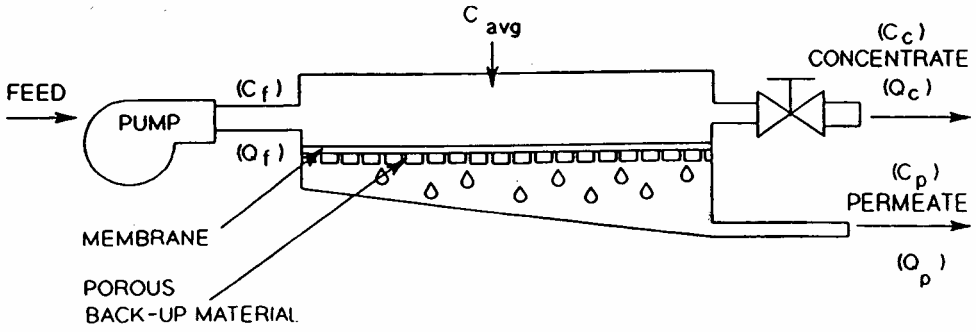
1.0 INTRODUCTION

Big Brand Water Filter BBRO Systems incorporate the highest quality Reverse Osmosis components. The system design emphasizes reliability, affordability, ease of operation and system expandability.

Reverse Osmosis systems manufactured by Big Brand Water Filter produce high quality permeate water from municipal and well water. The basic BBRO unit is designed to produce fresh water at the capacity indicated by the suffix in the model number. For example, an BBRO-10,000 will produce 10,000 gallons of Reverse Osmosis permeate per day. This production rate is based on feed water at 77° F (25° C), with turbidity of less than 1 NTU, slit density index (SDI) of less than 5, and total dissolved solids (TDS) of 500 mg/l. The production rate is accurate plus or minus 15%. The BBRO-10,000 can be expanded to a capacity of 17,500 gallons per day (GPD) by adding membranes. Similarly, an BBRO-19,000 can be expanded to produce 21,500 GPD.

The Reverse Osmosis process uses semi permeable spiral wound membranes to separate and remove dissolved solids, organics, pyrogens, submicron colloidal matter and bacteria from water. Feed water is delivered under a pressure of approximately 200 psi through Reverse Osmosis membranes. Water permeates the minute pores of the membrane and is delivered as purified water. Impurities in the water are concentrated in the reject stream and flushed to drain. Reverse Osmosis is capable of removing 90-99% of all bacteria in feed water.

This figure illustrates how impurities are concentrated as the feed water passes through the BBRO system and flows over the membrane. Impurities removed from the feed water are concentrated in the concentrate, or reject stream. As impurities concentrate, they may reach saturation and precipitate. The operator must be certain that impurities in the feed water are not concentrated enough in the BBRO equipment to cause precipitation because precipitation can damage membranes.



Cf = Concentration of feed
Cc = Concentration of Concentrate
Cp = Concentration of Permeate
C avg = Average Concentration Over the Membrane

Qf = Feed Flow Rate
Qc = Concentrate Flow Rate
Qp = Permeate Flow Rate

2.0 MOUNTING

BBRO Reverse Osmosis systems are free standing and require no special mounting. The BBRO series systems are shipped with adjustable leveling legs. The machine should be mounted on a level surface. Level adjustments can be made with the adjustable feet supporting the machine. These machines run quiet and with very little vibration. On occasion the machine may be installed on noise and vibration dampners with out affecting system performance.

3.0 INSTALLATION

BBRO systems are easily installed. The following guidelines will ensure a successful installation:

3.1 Plumbing

3.1.1 The system requires a continuous and smooth flow of water. A constant, non-turbulent feed flow between 20 and 40 psi is recommended. It is recommended that the incoming line be sized one size larger than the machine connection. The following water flow is required to feed standard systems: Refer to the specifications on pages 12-13 for the inlet pipe size.

BBRO-10,000	17.4 gpm	BBRO-17,500	24.3 gpm
BBRO-11,500	20 gpm	BBRO-19,000	26.4 gpm
BBRO-13,000	18 gpm	BBRO-20,500	28.5 gpm
BBRO-14,500	20 gpm	BBRO-21,500	29.9 gpm
BBRO-16,000	22.2 gpm		

3.1.2 The concentrate outlet is labeled and located near the upper, front left corner of the machine. The tubing or piping used to discharge the concentrate should run to an open drain and be free of obstructions and sized one size larger than the machine connection. Avoid multiple turns or changes in elevation on the discharge line. Any restrictions or blockage in the drain could cause backpressure, which can hinder system performance. Refer to the specifications on pages 11-12 for the concentrate pipe size.

3.1.3 Permeate connections are typically made with a hose or pipe to the permeate discharge line located next to the concentrate connection. Make sure there is minimal backpressure applied to the permeate line. Too much pressure may affect the machine performance and possibly damage the Reverse Osmosis membranes. Refer to specifications on page 11-12 for the permeate pipe size.

3.2 Electrical

All standard motors are totally enclosed fan-cooled (TEFC) motors. Three phase motors are supplied on standard systems. Standard 60-hertz motors are wired for a 230-volt electrical supply. Standard 50-hertz motors are wired for a 220-volt electrical supply.

All standard systems are equipped with an electrical control box with low level protection. Incoming power is connected to this box from a customer supplied fused disconnect or similar power supply. Connect power to the top of the fuse block located in the upper right hand corner of the control box. Verify motor rotation before continuously running the system. To check motor rotation turn the electrical supply on for a second and examine the rotation of the pump/motor coupling (remove guard to view shaft) to ensure that the motor turns in the direction indicated by the arrow on the motor/pump adapter base.

Ensure that the electrical circuit supplying the system matches the power requirements of your machine. Consult a qualified electrician or your Big Brand Water Filter dealer if you have any questions. Refer also to the electrical schematic for a standard BBRO-machine.

Additional features supplied with each control panel are pre-treat lockout, point of use level control (two switch level control or single switch level control), and auto flush if so equipped and low pressure protection. All inputs are dry contact and closed to run. If the option is not in use, a wire jumper needs to be installed on the board where this connection is made. Please see controller specifications for addition information.

4.0 PRE-FILTRATION

All BBRO Reverse Osmosis systems include a cartridge type pre-filter with a nominal 5-micron sediment cartridge, which will remove most particles greater than 5 microns in size. The sediment cartridge must be checked periodically and changed when dirty. The sediment filter should be changed when the pressure drop across the filter exceeds 10 psi, or at a minimum, once a month. It is recommended that pre-filter and post-filter pressure gauges be installed to facilitate in determining pre-filter performance.

If the prefilter becomes clogged and water flow to the pump is reduced or interrupted, system performance will be affected. The system may shut down repeatedly on low pressure or pump damage may occur. DO NOT run the machine with the pre-filter removed. This will void the warranty. This can also cause irreversible damage to the membranes.

5.0 PUMP

The BBRO 10,000 to 21,500 Reverse Osmosis systems are supplied with multi-stage centrifugal pumps. The following guidelines will ensure trouble-free operation:

- The pump must never run dry. Operating the pump without sufficient feed water will damage the pump seals and void the warranty.
- Always feed the pump with filtered water. Sediment and debris in the feed water can damage the pump and membranes.
- Prime the pump during initial start-up. Refer to the pump manufacturer's directions on priming.

6.0 START UP

6.1 Plumbing connections should be made as recommended in section 3.1. State and local plumbing codes shall be followed. For more information on state and local codes contact your local plumbing inspector or a licensed plumber in your area

6.2 Follow the recommended electrical connections in section 3.2. State and local electrical codes shall be followed. For more information on state and local codes contact your local electrical inspector or a licensed electrician in your area.

6.3 Check pump rotation by "bumping" the on switch momentarily and observing pump shaft rotation (removal of shaft guard is required). If rotation is backwards on a three-phase system switch any two incoming power leads. On a single phase system switch wires number 5 and 8. BE SURE POWER IS OFF when making these changes. Allow the system to run for about three minutes with the concentrate valve fully open and the recycle valve (if present) fully closed to purge air from the system.

6.4 Turn the concentrate control valve until the correct pressure is displayed on the concentrate pressure gauge. Refer to the System Specifications Table for the correct concentrate pressure for your system. Alternately adjust the pump throttle valve and the concentrate control valve until the proper pressure and feed flow is achieved.

6.5 Discard the permeate water from the first 30 minutes of operation to ensure that all bactericide and preservative has been fully flushed from the membrane. Slowly open the recycle valve. **Never exceed 75% recovery or you will damage the membrane**. Permanent element fouling is likely to occur at excessively high recovery rates.

Note: As the recycle valve is opened, pressure will drop. Adjust the concentrate control valve to bring the pressure back up to operating pressure.

6.6 Feed water should not flow through the system when the system is turned off because such flow may cause premature fouling of the reverse osmosis membranes. All standard BBRO systems are equipped with a normally closed solenoid valve, which closes when the system is not operating and prevents water flow through the system.

7.0 MEMBRANE CLEANING INSTRUCTIONS

In normal operations, mineral scale, biological matter, colloidal particles and insoluble organic substances can foul the reverse osmosis membranes. Deposits of these foulants on the membrane can result in a reduced product water quantity and quality. Periodic cleaning of the reverse osmosis membranes can improve performance of the system.

Cleaning chemicals are dangerous and can cause personal injury and damage to the environment. Read and comply with all safety and disposal precautions listed on the Material Safety Data Sheets (MSDS).

Big Brand Water Filter makes a complete line of membrane cleaning stations, which can be used to clean your membranes.

7.1. Inorganic Foulant Cleaning

An acid cleaning solution can be used to remove inorganic salts such as CaCO3, CaCO4, BaSO4 and metal oxides (i.e., iron) from reverse osmosis membranes. Sulfuric acid should not be used for cleaning because it may cause calcium sulfate to precipitate on the membranes.

Acceptable acid cleaning solutions are:
(1) a solution of 0.2% by weight hydrochloric acid (HCI),
(2) a solution of 0.5% by weight phosphoric acid (H3PO4),
(3) a solution of 0.2% by weight sulfamic acid (NH2SO3H), or
(4) a solution of 1.0% by weight sodium hydrosulfite (Na2S2O4)
(5) Big Brand Water Filter cleaner #1 may also be used

A cleaning station should be used to clean membranes in the BBRO Series Systems. First, the cleaning solution should be prepared. Use a polypropylene or fiberglass reinforced plastic tank. The tank should have a removable cover and a temperature gauge. Next, dissolve the cleaning chemical into the amount of water called for in the system specifications. It is preferable to use R.O. water. The pH should be around two. Check the instructions on the chemical being used as some chemical suppliers may recommend a different pH range. This will take approximately five ounces of Big Brand Water Filter cleaning solution #1 for every 15 gallon of water. Acid cleaning is more effective when the solution is maintained at 95° F (35° C).

The cleaning pump should be sized to pump between 8-10GPM per pressure vessel on the first array at pressure rating from 20-60 psi (DO NOT EXCEED 60 PSI). The pump should be constructed of 316SS or other corrosion resistant material.

Plumb the concentrate and permeate lines to the cleaning solution tank during cleaning so the solution may recirculate.

First, pump the solution through the system at a flow of between 4-5 gpm per pressure vessel on the first array and at low pressure. Check to ensure that the cleaning solution does not become diluted. Recycle the cleaning solution until the temperature stabilizes. For more effective cleaning, soak the membranes for a period of one hour, longer (up to overnight) for heavy fouling. Check the pH during acid cleaning. Add additional chemical if the pH increases above 2.5.

Next, feed the cleaning chemical at a higher rate between 8-10 gpm/pressure vessel on the first array for 30-60 minutes to flush out any foulants removed from the system by cleaning. Last, flush out the cleaning solution using prefiltered raw water. Increase the pressure to reach the operating pressure and recheck the permeate Total Dissolved Solids (TDS) and flow rates. Do not use the permeate water until the system has been sufficiently flushed.

7.2 Organic Foulant Cleaning

An alkaline cleaning solution is used to clean silica, biofilms and organics from reverse osmosis membranes. Alkaline cleaners should be mixed to a pH of approximately 12, and should not exceed 86° F (30° C).

Acceptable alkaline cleaning chemicals are:

1) A solution of 0.1% by weight sodium hydroxide (NaHO) and 0.1%by weight of the tetra-sodium salt of ethylene diamine tetraacetic acid (Na-EDTA).
2) A solution of 0.1% by weight sodium hydroxide (NaHO) and 0.05 by weight sodium salt of dodecylsulfate (Na-DSS).
3) A solution of 1.0% by weight sodium truphosphate (STP) 1.0% by weight trisodium phosphate (TSP) and 1.0% by weight Na-EDTA.
4) Big Brand Water Filter cleaning solution #2 can also be used

Follow the cleaning procedure described in section 7.1 above. To mix the alkaline cleaning solution, you can use approximately eight ounces of Big Brand Water Filter cleaning solution #2 for every 15 gallons of R.O. water. Mix the solution until a pH of approximately 11-12 has been reached. The alkaline cleaning solution is most effective at a temperature 86° F (36° C)

8.0 TROUBLESHOOTING

Two of the most common problems experienced on these types of systems are low-pressure conditions and poor quality/quantity of permeate water.

8.1 LOW PRESSURE CONDITIONS

Low pressure conditions will result in low permeate flows and poor rejection. The following items should be check if this condition occurs.

PUMP

The pump is a mechanical device and on occasion may fail or wear out. Pump problems can be detected without much difficulty. All pumps have a performance curve. This curve defines certain flow rates the pump can achieve at certain pressures. If you know what the pump is discharging and at what pressure you can locate that point on the pump curve. If this point does not fall near the pump curve then further investigation is required to determine the cause of this condition.

Low inlet conditions could be a contributing factor. A blockage on the discharge of the pump could be hindering pump performance. The pump's rotation could be reversed. A pump can run backwards and produce some flow and pressure, but it will not approach the performance indicated on the pump curve. The pump impellers could be damaged or clogged with debris. The mechanical coupling between the pump and motor can fail or slip.

All of these factors can be a possible cause for low-pressure conditions associated with the pump.

PRE-FILTER

The system pre-filter is in most cases the first and last line of defense against debris entering the system. It is of utmost importance that it is changed/cleaned on a regular basis. A clogged/dirty pre-filter will cause a poor inlet condition to the pump. This may cause the pump to cavitate (air in water source) or trip the low-pressure switch. Never run the system without the pre-filter installed.

FEED WATER FLOW RATE

Each machine requires a minimum amount of water to run properly. Refer to the system requirements following this section. Be sure that the feed line is properly sized to deliver the required flow and pressure. It is highly recommended that the inlet line be sized one size larger that he machine connection.

INLET SOLENOID

There is an inlet solenoid installed on every machine. The solenoid is normally closed and requires an electrical signal from the control panel to operate it. On occasion debris may hinder the proper performance of the solenoid (diaphragm and plunger). The solenoid may need to be cleaned to remove this debris

The electrical coil may fail and not allow the solenoid to open.

PRESSURE GAUGE

The first array feed pressure gauge may not be reading correctly. The sensing port may be blocked with debris or scale. Remove the gauge and inspect the sensing port for any type of blockage.

CONCENTRATE CONTROL VALVE

A globe valve controls the concentrate flow. This valve sets the pressure that the system operates at and also controls the amount of permeate generated. It is very important that this valve operates properly. This valve may see a build up of scale or deteriorate due to the aggressiveness of the water. This may affect the operation of the valve. Debris could prevent the valve from being properly adjusted. The valve may require occasional cleaning. If cleaning does not correct the problem, replace the valve.

8.2 ABNORMAL PERMEATE PRODUCTION

Abnormal permeate flow is often an indication of a problem with the reverse osmosis membrane

LOW PERMEATE FLOW

High organic or inorganic concentrations will often lead to scaling or fouling of the membrane surface, causing poor rejection of impurities and low permeate flow. Cleaning the membranes will often improve system performance. Cleaning instruction can be found in Section 7. Membranes left too long with this condition may have irreversible damage and require a membrane change out.

HIGH PERMEATE FLOW

High permeate flow is often a symptom of membrane or o-ring damage. A product o-ring or membrane brine seal may have shifted due to normal operation or have suffered some damage. Damage includes cuts, nicks or even lack of lubrication.

The reverse osmosis membrane may be channeling. This can be caused by exposure to chlorine. If a membrane has been exposed to chlorine, the permeate flow will be high and the water quality reduced.

The membrane may have freeze damage. Steps need to be taken to protect the machine from freezing.temperatures.

8.3 TROUBLE SHOOTING MATRIX

The following matrix is included in this manual to aid in trouble shooting the most common system problems. Should a symptom occur that is not included in this matrix and assistance is need call your local representative or consult the factory.

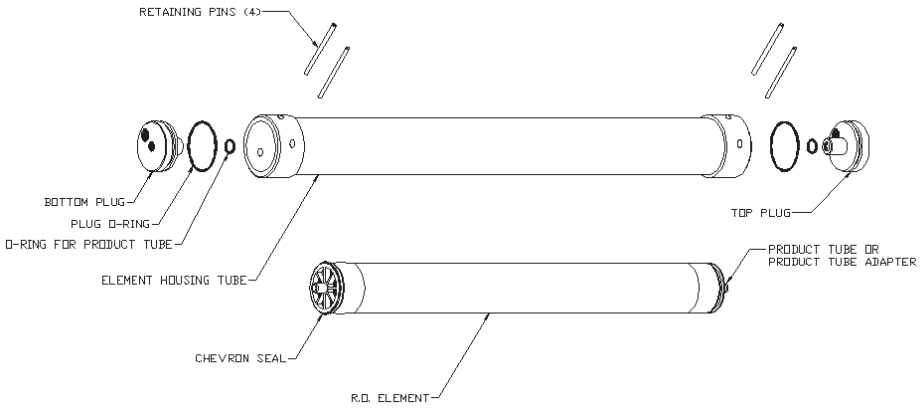
TROUBLE-SHOOTING MATRIX

NO.	SYMPTOM	PROBABLE ROOT CAUSE	CORRECTIVE ACTION
1	SYSTEM CONTROL PANEL DOES NOT ILLUMINATE (RUN LIGHT NOT LIT)	a) BLOWN FUSE b) NO POWER TO CONTROL PANEL c) LIGHT BULB BURNT OUT	a) CHECK AND REPLACE FUSE. b) CHECK POWER DISTRIBUTION PANEL c) INSTALL NEW BULB
2	SYSTEM ON, BUT MOTOR DOES NOT START	a) OVERLOAD RELAY TRIPPED (THREE PHASE ONLY) b) EXTERNAL CONTROL CONTACTS OPEN	a) RESET OVERLOAD RELAYS, CHECK CURRENT DRAW (THREE PHASE ONLY)

		c) STORAGE TANK LEVEL CONTROL INOPERATIVE d) MOTOR BURNT UP e) PRETREAT LOCK OUT ACTIVATED	b) CHECK EXTERNAL DEVICES AND REPAIR PER USERS MANUAL c) CHECK FLOAT SWITCHES AND REPLACE OR REPAIR d) REPLACE MOTOR e) CHECK PRETREATMENT
3	PUMP DISCHARGE PRESSURE WILL NOT ACHIEVE RECOMMENDED LEVEL	a) LOW INLET PRESSURE b) AIR LEAK IN INLET PIPING c) PUMP DAMAGED d) PUMP RUNNING BACKWARDS e) FAULTY SOLENOID f) DIRTY PREFILTER	a) VERIFY INLET PRESSURE OF AT LEAST 20 PSI b) INSPECT INLET PIPE FOR POSSIBLE LEAKS c) REFER TO PUMP MANUAL d) CHECK PUMP ROTATION e) INSPECT SOLENOID f) INSPECT PREFILTER
4	LACK OF CONCENTRATE PRESSURE	a) CONCENTRATE CONTROL VALVE WIDE OPEN b) LEAK IN PRESSURE PIPING c) MEMBRANE FOULED d) PRESSURE GAUGE INACCURATE	a) ADJUST CONCENTRATE VALVE b) CHECK HIGH PRESSURE PIPING FOR LEAKS c) CLEAN/REPLACE MEMBRANE d) CALIBRATE PRESSURE GAUGE
5	PUMP EXTREMELY NOISY WHEN PRESSURE INCREASED	a) INSUFFICIENT FEED FLOW OR PRESSURE b) FEED WATER STREAM INTERRUPTED OR TURBULENT c) AIR IN SYSTEM	CHECK FEED HOSES, PIPES AND PREFILTERS FOR LEAKS, LOW FLOW OR BLOCKAGE
6	SYSTEM STOPS WITH LOW PRESSURE INDICATOR LIT)	a) INSUFFICIENT FEED PRESSURE b) INLET SOLENOID INOPERATIVE c) PUMP PULLING TOO MUCH WATER	a) CHECK FEED CONNECTIONS AND REPAIR AS NEEDED b) VERIFY SOLENOID OPERATION c) CHECK PUMP DISCHARGE VALVE AND THROTTLE VALVE POSITION. VERIFY TOTAL SYSTEM FLOW RATE.

7	INSUFFICIENT PERMEATE PRODUCTION OR EXCESSIVE PERMEATE TDS	a) MEMBRANE FOULING b) FEED WATER EXCEEDS DESIGN GUIDELINES c) DAMAGED O-RINGS	a) CHECK MEMBRANE PERFORMANCE b) PERFORM WATER ANALYSIS ON FEED WATER c) PULL MEMBRANE AND CHECK ORING CONDITION REFER TO SECTION 8 OF THE MANUAL FOR ADDITIONAL INFORMATION

PRESSURE VESSEL BREAKDOWN



BBRO SERIES REVERSE OSMOSIS SYSTEMS
R.O. HOUSING AND ELEMENT PARTS LIST

PRESSURE VESSEL COMPONENTS

HEA02 BOTTOM END PLUG, PVC, 4”
HEA04 TOP END PLUG, PVC, 4”
HEA06 END PLUG O-RING, 4”
HEA07 PRODUCT TUBE O-RING, 4”
HEA09 RETAINING PINS, 4”
HEA11 CHEVRON SEAL, 4”
CMF02 DESAL ADAPTER
TCA04 TRISEP ADAPTER
HEO07T PRESSURE VESSEL, TUBE ONLY PVC, 4” x 40”

SYSTEM SPECIFICATIONS

	BBRO-10,000	BBRO-11,500	BBRO-13,000	BBRO-14,500
INLET	1.5” MPT	1.5” MPT	1.5” MPT	1.5” MPT
PERMEATE	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER
CONCENTRATE	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER	¾” MPT 1” W FLOWMETER
HEIGHT	48”	48”	48”	48”
LENGTH	64”	64”	64”	64”
WIDTH	27”	36”	36”	36”
WEIGHT	250lbs (114kg)	265lbs (120kg)	280lbs (127kg)	295lbs (134kg)
VOLTAGE 60Hz	220/380/460v	220/380/460v	220/380/460v	220/380/460v
50Hz	220/380/415v	220/380/415v	220/380/415v	220/380/415v
MOTOR HP 60Hz	5 - 5.5	5 - 5.5	5 - 5.5	5 - 5.5

50Hz	5.5	5.5	5.5	5.5
PHASE 60Hz	1 OR 3	1 OR 3	1 OR 3	1 OR 3
50Hz	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY
RATED AMPS 60Hz	20.4 @ 220v	20.4 @ 220v	20.4 @ 220v	20.4 @ 220v
50Hz	9.7 @ 380v	9.7 @ 380v	9.7 @ 380v	9.7 @ 380v
CONCENTRATE PRESSURE	209 psi	206 psi	201 psi	196 psi
R.O. ELEMENT	4" X 40" TAPE-WRAPPED	4" X 40" TAPE-WRAPPED	4" X 40" TAPE-WRAPPED	4" X 40" TAPE-WRAPPED
PREFILTER CARTRIDGE	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON
RECOVERY %	40%	40%	50%	50%
SALT REJECTION MINIUM (%)	96%	96%	96%	96%
REQUIRED FEED FLOW RATE (GPM)	17.4	20.0	18.0	20.0
REQUIRED CLEANING FLOW RATE (GPM)	16-20	24-30	16-20	
MINIMUM CLEANING SOLUTION MIX (GAL)	20	25	25	25

SYSTEM SPECIFICATIONS

	BBRO-16,000	BBRO-17,500	BBRO-19,000	BBRO-20,500	BBRO-21,500
INLET	1.5” MPT	1.5” MPT	1.5” MPT	1.5” MPT	1.5” MPT
PERMEATE	¾" MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER
CONCENTRATE	¾" MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER	1” MPT 1” W/ FLOWMETER
HEIGHT	48”	48”	48”	48”	48”
WIDTH	36”	36”	27”	27”	27”
WEIGHT	320 lbs (145kg)	335 lbs (152kg)	350 lbs (159kg)	365 lbs (166kg)	380 lbs (172kg)
VOLTAGE 60Hz	220/380/460v	220/380/460v	220/380/460v	220/380/460v	220/380/460v
50Hz	220/380/415v	220/380/415v	220/380/415v	220/380/415v	220/380/415v
MOTOR HP 60Hz	5 - 5.5	5 - 5.5	10	10	10
50Hz	5.5	5.5	7.5	7.5	7.5
PHASE 60Hz	1 OR 3	1 OR 3	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY
50Hz	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY	3-PHASE ONLY
RATED AMPS 60Hz	20.4 @ 220v	20.4 @ 220v	27.5 @ 220v	27.5 @ 220v	27.5 @ 220v
50Hz	9.7 @ 380v	9.7 @ 380v	12.4 @ 380v	12.4 @ 380v	12.4 @ 380v
CONCENTRATE PRESSURE	194 psi	194 psi	192 psi	191 psi	188 psi
R.O. ELEMENT	4” X 40” TAPE-WRAPPED	4” X 40” TAPE-WRAPPED	4” X 40” TAPE-WRAPPED	4” X 40” TAPE-WRAPPED	4” X 40” TAPE-WRAPPED
PREFILTER CARTRIDGE	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON	4.5 X 9.75 5-MICRON
RECOVERY %	50%	50%	50%	50%	50%
SALT REJECTION MINIMUM %	96%	96%	96%	96%	96%
REQUIRED FEED FLOW RATE (GPM)	22.2	24.3	26.4	28.5	29.9
REQUIRED CLEANING FLOW RATE (GPM)	24-30	24-30	32-40	32-40	32-40
MINIMUM CLEANING SOLUTION MIX (GAL)	30	30	35	35	35

BBRO 10,000 SERIES REVERSE OSMOSIS SYSTEMS

SCHEMATIC AND PARTS LISTINGS

REF NO.	DESCRIPTION	BBRO-10,000 TO 17,500	BBRO-19,000 TO 21,500
1	PREFILTER HOUSING	4.5" x 10" 1.5" INLET HPO08	4.5" X 20" 1.5" INLET HPO07
2	PREFILTER CARTRIDGE	4.5" x 9.75" 5-MICRON PFC10	4.5" x 9.75" 5-MICRON PFC10
3	INLET SOLENOID, 220v	1.25" , NC BRASS GVC125B	2" NC BRASS GCV125B
4	RO PUMP AND MOTOR 60Hz	304SS, 15-STAGE 316SS, 14-STAGE 5-7.5 HP	304SS, 9-STAGE 316SS, 9-STAGE 5-7.5 HP
	RO PUMP AND MOTOR 50Hz	316SS, 22-STAGE 5-7.5 HP	316SS, 16-STAGE 5-7.5 HP
5	PUMP THROTTLE VALVE	1.25" BRONZE 300# GLV03	1.25" BRONZE 300# GLV03
6	PRESSURE VESSEL	4" x 40" PVC 200# HEO07	4" x 40" PVC 200# HEO07
7	REVERSE OSMOSIS MEMBRANE	TW30-4040 TAP WATER ETT11	TW30-4040 TAP WATER ETT11
8	CONCENTRATE CONTROL VALVE	¾" BRONZE 300# GLV10	1" BRONZE 300# GLV10
9	PRESSURE GAUGE	0-300 PSIN BRASS INTERNALS DGO02	0-300 PSIN BRASS INTERNALS DGO02
10	FLOWMETER (OPTIONAL)	1-17 GPM ACRYLIC BLOCK DFO07	6-21 GPM ACRYLIC BLOCK DFO08
11	RECYCLE VALVE (OPTIONAL NOT SHOWN)	¾" BRONZE 300# GLV10	¾" BRONZE 300# GLV10
12		BRASS SWITCH SET AT 8 PSI DBO24	BRASS SWITCH SET AT 8 PSI DBO24

STANDARD SYSTEM MEMBRANE SPECIFICATIONS

MEMBRANE TYPE	THIN-FILM COMPOSITE
MAXIMUM OPERATING PRESSURE	300 psi (2.1 M Pa)
MAXIMUM OPERATING TEMPERATURE	113° F (45° C)
MAXIMUM FEED TURBITITY	1 NTU
FREE CHLORINE TOLERANCE	< 0.1 PPM
PH RANGE:	
CONTINUOUS OPERATION	2-11
SHORT-TERM (30 MIN) CLEANING	1-12
MAXIMUM FEED FLOW	10 GPM
MAXIMUM FEED SILT DENSITY INDEX	SDI 5

11.0 OPTIONAL EQUIPMENT

The following equipment are offered as options:

XP System - This option provides a complete water system. The system includes an RO machine, atmospheric storage tank with level controls and repressurization (RP) system. The permeate water created by the RO machine is stored in the atmospheric storage tank. The water in the atmospheric storage tank is then pump out of the tank via a repressurization pump. The repressurization system may or may not have a bladder tank. The purpose of the bladder tank is to provide initial pressure at the point of use until the repressurization pump is able to recover from being off. A differential pressure switch controls the pump. As the call for water is decreased at the point of use, the RP pump is building up pressure in the discharge piping until the pressure switch is activated and shuts the pump off. When water is called for, the stored water in the bladder tank (which is under pressure) is released to the point of use. When the pressure in the line drops below the low side of the differential pressure switch the RP pump energizes and builds up pressure again.

The float switches that are provided with the atmospheric storage tanks are color-coded. One is red and the other blue. Each switch has a different function.

The red switch is "closed" when down and "open" when up. It is used to control the RO portion of the system

The blue switch is "closed" when up and "open" when down. It is used to run the RP pump.

There are several ways to install the float switches in the tank. The two most common ways are to use a piece of PVC pipe installed in the atmospheric tank to anchor the float switches to or penetrate the side wall of the tank with two bulkhead fittings with chord grips and install the float switches through the side of the tanks. A third way is to hang the float switches from the top of the tank and install zinc weights where you want the float ball to pivot. Either way is acceptable.

The red float ball will turn the RO on when it is in the down position and off when it is in the up position. The float ball will need to swing in an arc to operate the switch contacts. Be sure to test the switch operation before permanently installing the switch. You want the switch to shut down the RO without the tank overflowing.

The blue float will let the RP run if it is in the up position. It will shut the RP pump off when it drops to the down position. Be sure that the switch is adjusted so it shuts the RP pump off before the level in the tank drops below the RP pump inlet suction line. If the float ball drops below the inlet suction line of the pump, the pump will continue to run without water and burn the pump up.

Please refer to the attached figure for typical system installation

APPENDIX A

ELECTRONIC CONTROL BOX

Big Brand Water Filter utilizes a UL/CUL listed Industrial Control Panel to control and operate the BBRO line of machines. The control box is offered in all common voltages in both single and three phases and 50 and 60 HZ. In most cases the box will consist of a motor contactor and overload, incoming fuses, secondary control power fuses and/or transformer and an electronic control board mounted in a Nema 4 enclosure.

One of two electronic control board is standard in all boxes and voltages. The difference is whether auto flush was ordered as an option. The functions of the board are described in detail in the accompanying pages. Included within these pages is a board diagram showing where to make the field connections of various devices. All inputs are closed to run. Crane will wire devices on the machine to the control board. All other external connections will have to be made in the field (i.e. Pretreat lockout, level controls**). All inputs are non-powered.**

Please pay close attention to the control board input voltage. It may be 120 or 240 volt. This will affect the inlet and flush solenoids and the contactor coil voltage selection.

Several wiring diagrams are included in this appendix to cover the many variations that we offer. The motor overload and incoming fuses are based on actual system horsepower. A chart has been provided to distinguish the various combinations of fuses and overloads. Due to the numerous combinations that can be offered the following wire diagrams may cover more than one scenario. The horsepower rating indicated on the drawings are the maximum that the panel will support, smaller horsepower may be used with the same panels.

A troubleshooting section is also included within this documentation.

Should Big Brand Water Filter build an electro-mechanical box for a custom application, a copy of the schematic will be located in the control panel.

APPENDIX B

CUTSHEETS

R & D SPECIALTIES
ROTrol II
Version D
USER'S MANUAL

R & D Specialties, Inc. Midland, TX 79706

Document: RO2D V5.02
Released: August 1999

R & D Specialties, Inc
9918 W. I-20
Midland, TX USA 79706
915 561-5707
Fax 915 561-5696
www.rdspec.com
email rdspec@rdspec.com

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R & D Specialties warrants to the original purchaser that the products it manufactures will be free from defects in material and workmanship for a period of twelve months from the date of shipment on parts and ninety days on labor. Some non-R & D Specialties manufactured resale items may have warranty periods less than twelve months. R & D Specialties' obligation under this warranty is limited exclusively to the repair or replacement of any product that R & D Specialties finds to be defective. Items returned for warranty consideration must have a return authorization number and be properly packaged, shipped prepaid and insured. This warranty is valid only when the products are properly installed, maintained and used for the purpose for which they were designed. Misuse, neglect, damage, accident, improper repair, or modification not authorized in writing by R & D Specialties will void this warranty.

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TABLE OF CONTENTS

ILLUSTRATIONS

INTRODUCTION

The R & D Specialties ROTrol II is a state of the art control system for commercial and industrial reverse osmosis systems. The ROTrol II combines features that have not previously been available in one compact unit.

The ROTrol II is a microprocessor controlled system that can monitor multiple pressure sensors and/or pressure switches. A TDS/Conductivity monitor/controller with programmable setpoints is an integral part of the ROTrol II. The ROTrol II displays system status and all sensor and switch input status on an easy to read backlit display. User programmable setpoints are provided that allow fast and easy adjustment of system parameters.

Plug-in terminal strips allow easy wiring of all sensors and controls. The ROTrol II contains relays for control of an inlet valve, RO pump, aux/repressurization pump, and a membrane flush valve.

SPECIFICATIONS

POWER:
120VAC, Optional 240VAC, 24VAC, 50/60 Hz, 25 Watts

ENVIRONMENT:
-22EF (-30EC) to 140EF (60EC)
0-95% RH, noncondensing

ENCLOSURE:
12" X 10" X 6" (305mm X 254mm X 152mm) NEMA 4X
(Larger enclosures are provided when motor controls are incorporated.)

DISPLAY:
4 line X 20 character - backlit

SWITCH INPUTS:
Tank full/pump ON switch
Tank full/pump OFF switch
Tank low switch
Low feed pressure switch
High pump pressure switch
Pretreatment RO lockout switch

SENSOR INPUTS:
Permeate TDS/Conductivity - Standard: 0-250, PPM/uS
Optional: 0-50, 0-100, 0-500 or 0-1000 PPM/uS

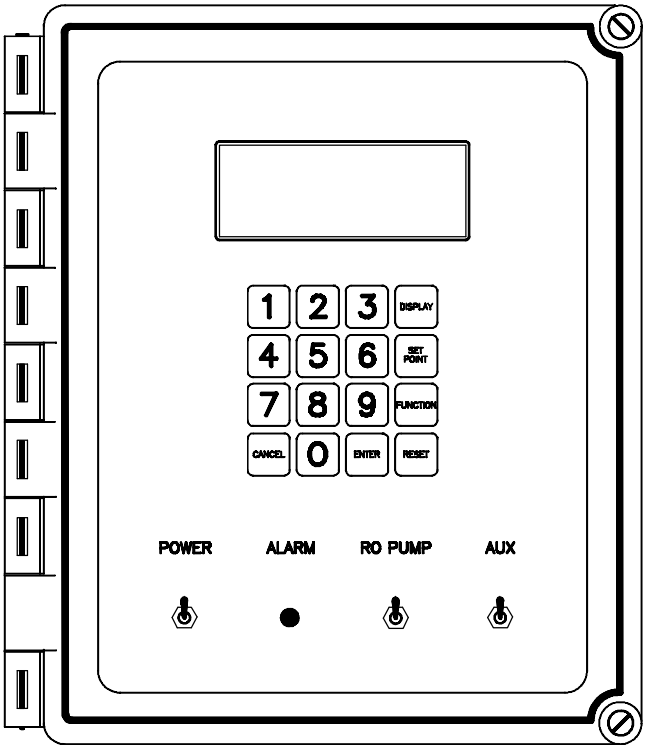
OPTIONAL SENSORS:
Feed TDS/Conductivity - 0-250, 0-500, 0-1000, 0-2500, 0-5000 PPM/uS
Feed pressure sensor, 0-125 PSI
Pump pressure sensor, 0-400 PSI or 0-1500 PSI
Prefilter differential pressure sensor, 0-125 PSI
Membrane differential pressure sensor, 0-125 PSI

SPECIFICATIONS

Permeate flow meter
Concentrate flow meter
Recirculate flow meter
Feed pH, 0-12 pH

RELAY OUTPUTS:
Inlet control, 5A 120/240VAC SPDT
RO pump control, 20A max, 120/240VAC
Aux/RP pump control, 20A max, 120/240VAC
Flush control, 5A 120/240VAC SPDT

FRONT PANEL CONTROLS AND INDICATORS



POWER SWITCH - Controls power to the ROTrol II electronics

ALARM LAMP - Flashes when a fault causes an RO system shutdown. On steady when a setpoint is exceeded that does not cause a RO system shutdown.

RO PUMP SWITCH - Enables or disables RO pump control.

AUX SWITCH - Enables or disables Aux/RP pump control.

DISPLAY - Shows status of ROTrol II system.

KEYBOARD - Used to input changes to the ROTrol II system.

DISPLAY KEY - Toggles display to show other status displays.

SETPOINT KEY - Allows setpoints to be displayed or changed.

FUNCTION KEY - Allows function operations to be initiated.

RESET KEY - Push once for alarm silence and twice to reset system after a shutdown has occurred.

ENTER KEY - Confirms entry of a new setpoint value or activates function.

CANCEL KEY - Aborts entry or display of a setpoint or function.

INSTALLATION

Physical Installation

Mount the ROTrol II in a convenient location on the RO equipment using either the four mounting ears provided with the unit or the optional panel mounting brackets.

Note: All terminal strips plug-in and all terminals are labeled.

Terminal Strip, Jumper and Adjustment Locations

Refer to Figure 3 for the location of all terminal strips and connectors. Figure 3 also shows all jumper and adjustment locations. Figures 4-6 show sample wiring diagrams for various power, pump and valve voltages.

Power Wiring

Refer to Figures 3-6 for terminal strip locations and wiring options. AC power for the unit is connected to terminal strip P3. The unit is configured for 120VAC operation standard. Optionally, 240VAC and 24VAC units are available. Wire the correct voltage for the unit to P3,terminals L1 and L2.

Pump and Valve Relay Outputs

The ROTrol II provides a contact closure to control the pumps and valves that are controlled by the unit. These contact closures DO NOT supply power on their own. The power to operate the pump or pump contactor and the power for the valves must be supplied to the relays. This configuration allows the pumps and valves to be operated with different voltages if required. One wire of the incoming power for a pump being controlled should be connected to the odd terminal for that pump (P6). One wire of the pump will be connected to the even terminal. The other wire from the pump will connect to the other wire of the incoming power for that pump. For pumps and valves operated from 120 or 240VAC, the ground wires should be tied to the ground of the incoming power. The remaining pump and valves can be connected in the same manner. See Figures 3, 4, 5 & 6 for sample wiring diagrams.

Pump Motor Wiring

The RO and auxiliary/repressurization pump motors are connected to the terminal strip P6. The control relays for these pumps can control up to 20A directly or larger pump motors through appropriate motor starters. The control relays provide a contact closure and do not supply power. The RO pump motor connections are to P6, terminals "RO PUMP". The Aux/RP pump motor connections are to P6, terminals "AUX PUMP".

Inlet and Flush Valve Wiring

An inlet valve relay is provided to control the inlet valve. A flush valve relay is provided to allow a flush operation to be controlled by a tank full condition or by a periodic time function. These relays provide both normally open and normally closed contacts to operate either solenoid or motor driven valves. Each relay can be connected to whatever voltage is required for its corresponding valve. The inlet valve connections are to P6, terminals "INLET V.".The flush valve connections are to P6, terminals "FLUSH V.". The inlet relay can also be used to operate a motor starter for a booster pump in addition to an inlet valve.

TDS/Conductivity Cell Wiring

For accurate TDS/Conductivity readings, the cell should be installed in a tee fitting where a continuous flow of water passes over the cell and no air can be trapped around the cell. Refer to Figure 7 for example installation. The permeate TDS/Conductivity cell is connected with five wires to the plug-in terminal strip P5. The color coded wires are connected to the group of terminals labeled "P COND". Each wire must connect to the terminal labeled with its color's notation - i.e. connect the red wire to the terminal labeled "RD", black to "BK", etc., see Figure 3.

The optional feed TDS/Conductivity cell is connected with five wires to the plug-in terminal strip P7. The color coded wires are connected to the group of terminals labeled "F COND". Connect each wire to its corresponding color designated terminal as noted in Figure 3.

Each TDS/Conductivity cell generates a temperature output which may be displayed on the LCD display. Jumper J13 selects the temperature sensor in either the permeate or feed cell. If jumper J13 is in the position labeled "P", the permeate temperature will be displayed. If it is in position "F", the feed temperature will be displayed.

Analog Pressure Sensors

The analog pressure sensors are connected to P5. Dip Switch 1 should be moved to the "ON" position to enable reading of the analog pressure sensors and the jumper for each sensor (J6-J9) should be removed for each sensor installed. The switches and jumpers are pre-configured by the factory if the sensors are ordered with the unit. If the optional flow metering is installed, the flow meter interface board may be removed to allow easier wiring of the analog sensors. The plug-in terminal strip (P5) may also be unplugged for the same reason.

Feed Pressure Sensor

The feed pressure sensor should be installed downstream from the pre-filters and inlet valve and before the inlet side of the RO pump. The feed pressure sensor wires connect to the P5 terminals labeled "A1". The red wire connects to "RD" and the black wire to "BK". Jumper J6 should be removed to enable this sensor.

Pump Pressure Sensor

The pump pressure sensor is installed on the discharge side of the RO pump. The pump pressure sensor wires connect to the P5 terminals labeled "A2". The red wire connects to "RD" and the black wire to "BK". Jumper J7 should be removed to enable this sensor.

Prefilter Differential Pressure Sensor

The prefilter differential pressure sensor is installed upstream of the prefilters. The prefilter pressure sensor wires connect to P5 "A3". The red wire connects to "RD" and the black wire to "BK". Jumper J8 should be removed to enable this sensor.

Membrane Differential Pressure Sensor

The membrane differential pressure sensor is installed in the concentrate line of the membrane array. The membrane differential pressure sensor wires connect to P5 "A4". The red wire connects to "RD"
and the black wire to "BK". Jumper J9 should be removed to enable this sensor.

Switch Inputs

Switch inputs are connected to P4. The connections for these inputs are not polarity sensitive and can be connected to either terminal. The switch inputs should be contact closures only. **NOTE:** Applying voltage to these terminals will damage the ROTrol II. The Switches can be either normally open or normally closed in any combination. Setpoint 54 selects whether an input looks for a normally closed or normally open switch to activate the input. The following table lists the values used to program Setpoint 54 to select which switches are normally open (N.O.) or normally closed (N.C.). Setpoint 54 is defaulted to 00 which programs all switches as normally open. Normally open means that a switch is open when not activated and closed when it is activated. Normally closed switches operate opposite from normally open.

SWITCH	N.O.	N.C.	
FEED PRESSURE	0	1	
PUMP PRESSURE	0	2	
TANK FULL/PUMP OFF	0	4	
TANK LOW	0	8	
TANK FULL/PUMP ON	0	16	
PRETREAT LOCKOUT	0	32	
		SETPOINT 54	

Select the type of switch used for each input and put that value in the far right column. Add the values and program this value in Setpoint 54. For example, if the Low Pressure and Pretreat switches were normally closed and all others were normally open, the value programmed in Setpoint 54 would be 1 + 32 = 33.

****** WARNING ! DO NOT CONNECT POWERED SIGNALS TO THESE INPUTS ******

Tank Full/Pump OFF Switch

The tank full level switch or in dual tank full switch systems, the upper tank full switch connects to the P4 terminals labeled "T.F. P. OFF". When this switch activates, the unit will shutdown for tank full.

Tank Full/Pump ON Switch

In dual tank full switch systems, the lower tank full level switch connects to the P4 terminals "T.F. P. ON". When dual tank full switches are selected, and both the tank full/pump OFF and the tank full/pump ON switches are not activated, the RO unit will operate.

Tank Low Switch

The tank low switch connects to the P4 terminals "TANK LOW".

Low Feed Pressure Switch

In systems with no feed pressure sensor or where a low pressure switch in addition to the feed pressure sensor is required, the low feed pressure switch connects to the P4 terminals "LOW PRESS".

High Pump Pressure Switch

In systems with no pump pressure sensor or where a high pressure switch in addition to the pump pressure sensor is required, the high pump pressure switch connects the P4 terminals "HIGH PRESS".

Pretreat Lockout Switch

In systems where it is desired to shutdown the RO unit when a pre- treatment system is out of service, a lockout switch can be wired to the P4 terminals "P.T. L.O.". The pretreatment equipment must provide a switch output when out of service.

Alarm/Divert Outputs

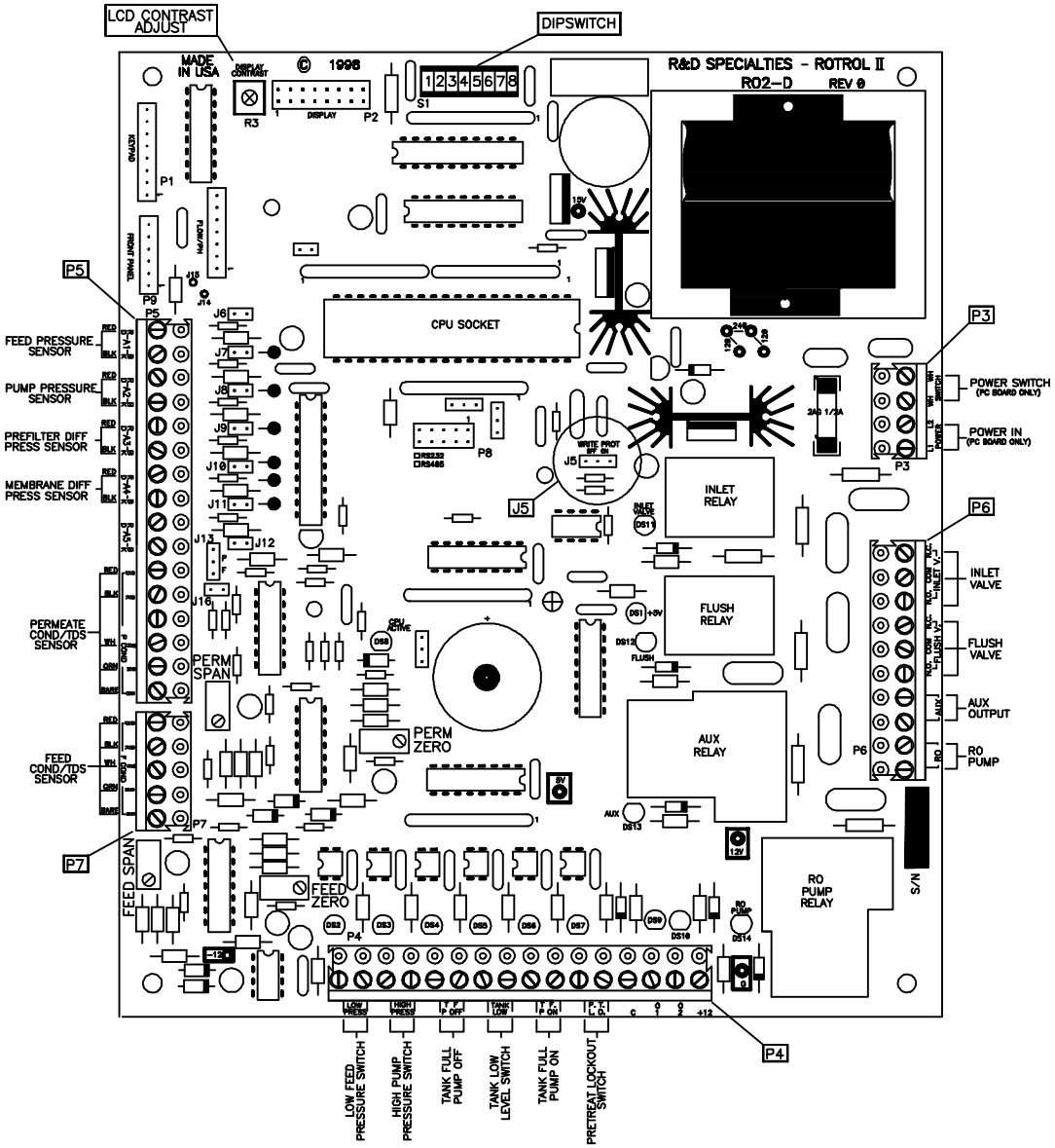
An alarm output and a divert output are available on P4. These outputs are open collector transistor outputs that pull to ground when active. The maximum load limit for each output is 100mA. These outputs can be used to signal a remote alarm unit such as R & D Specialties RA series of remote alarms or can operate an external 12VDC relay. An optional relay expander board is available that provides a SPDT relay output for each of these outputs. Refer to the Alarm/Divert Relay section for more information on this option.

Alarm Output

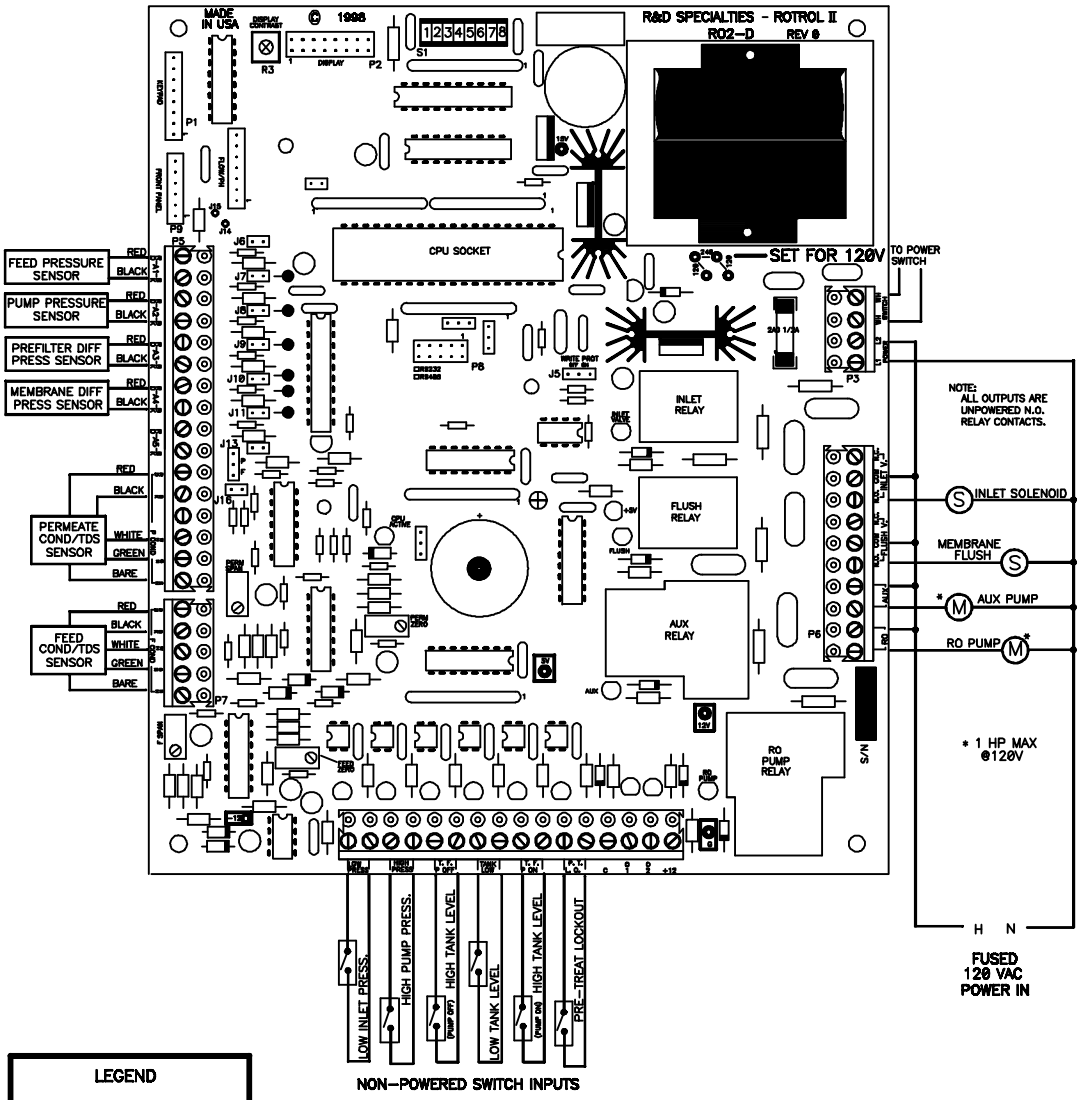
The alarm output is available at P4, pin 14 (O1). This output can be used to signal a R & D Specialties RA series of remote alarm by using the common at P4, pin 13 (C) and the alarm output at P4, pin 14 (O1). An external 12VDC relay can be connected to this output by connecting 1 side of the relay coil to P4, pin 14 (O1) and the other side of the relay coil to P4, pin 16 (+12).

Divert Output

The divert output is available at P4, pin 15 (O2). This output can be used to signal a R & D Specialties RA series of remote alarm by using the common at P4, pin 13 (C) and the divert output at P4, pin 15 (O2). An external 12VDC relay can be connected to this output by connecting 1 side of the relay coil to P4, pin 15 (O2) and the other side of the relay coil to P4, pin 16 (+12).



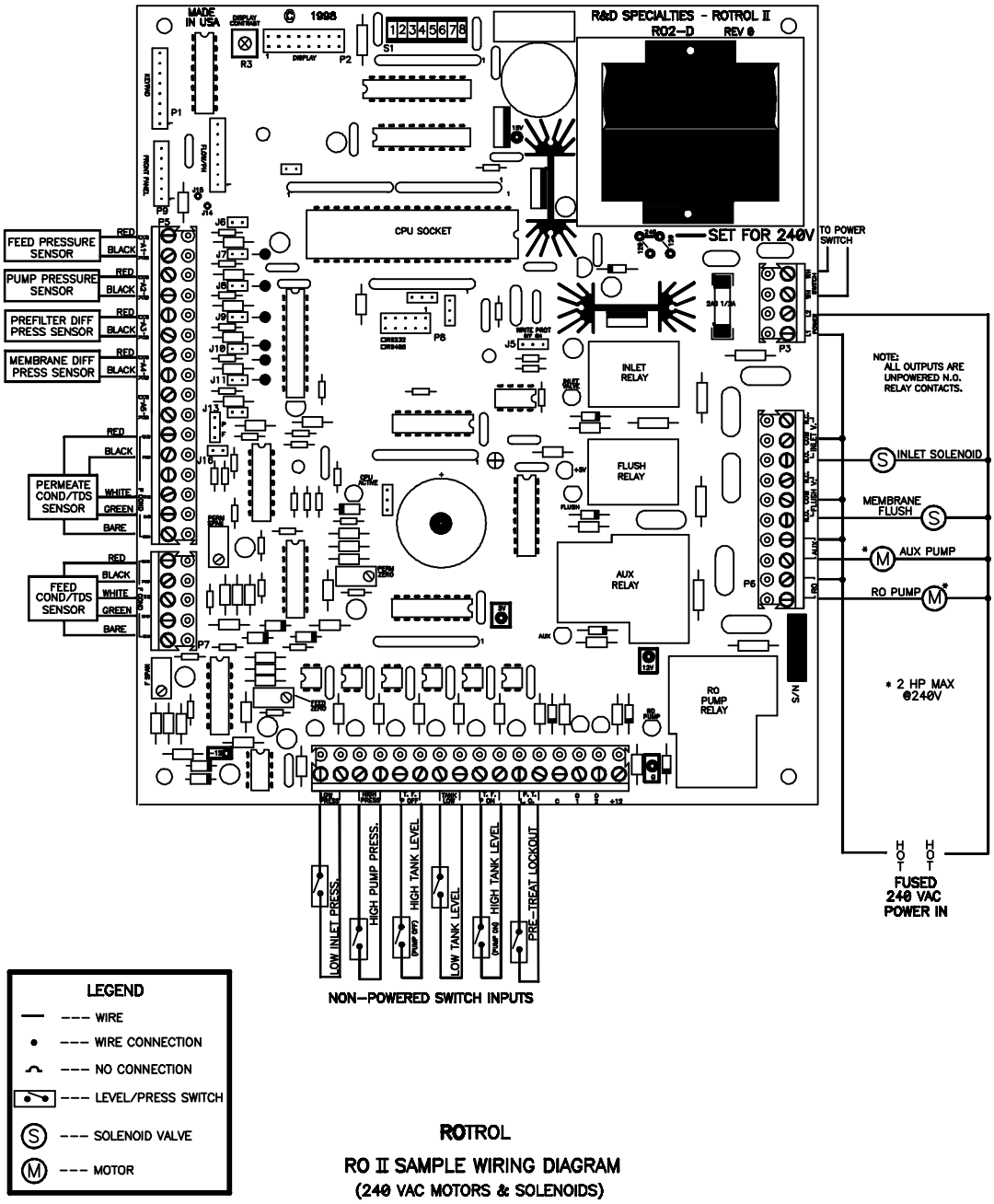
ROTROL IID CIRCUIT BOARD LAYOUT



ROTROL

RO II SAMPLE WIRING DIAGRAM

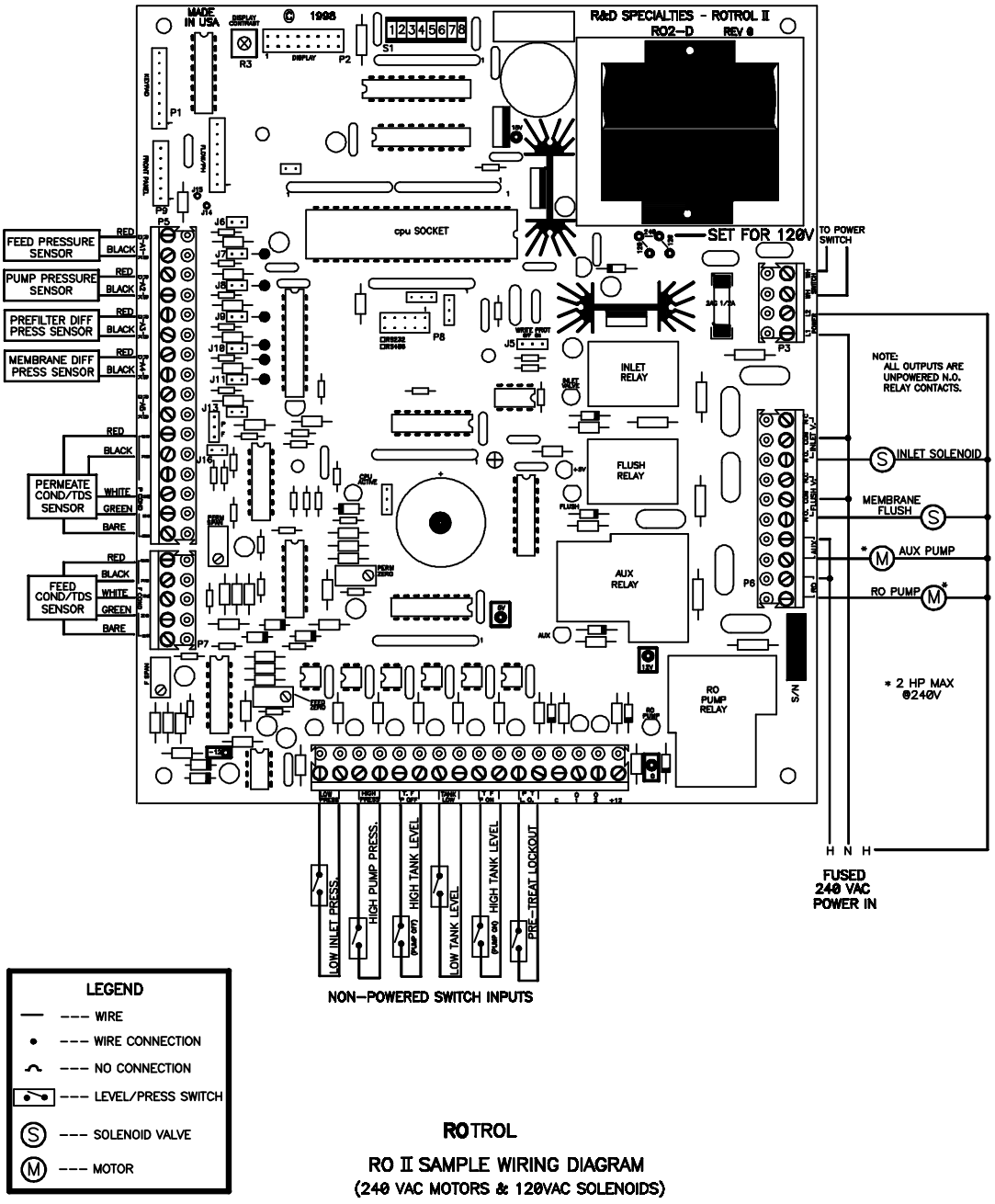
(120 VAC MOTORS & SOLENOIDS)



ROTROL

RO II SAMPLE WIRING DIAGRAM

(240 VAC MOTORS & SOLENOIDS)

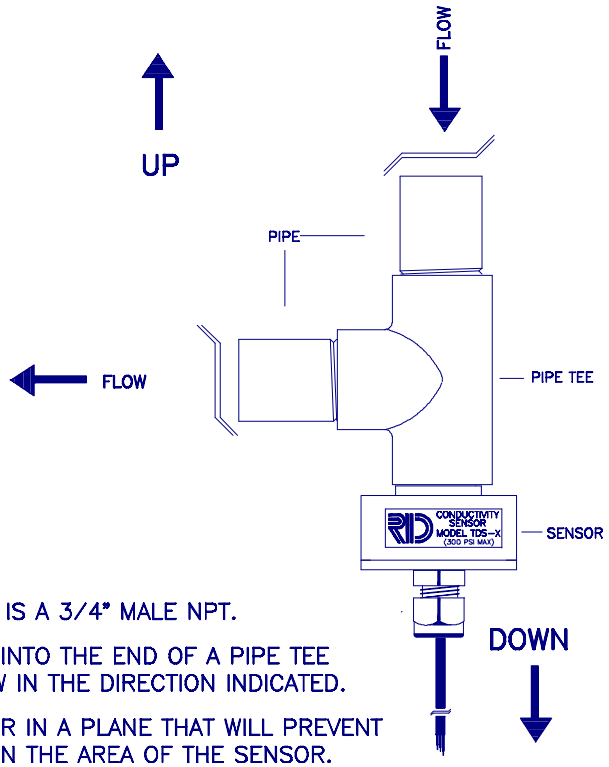


ROTROL

RO II SAMPLE WIRING DIAGRAM

(240 VAC MOTORS & 120VAC SOLENOIDS)

TDS/CONDUCTIVITY SENSOR INSTALLATION



- THE SENSOR FITTING IS A 3/4" MALE NPT.
- SCREW THE SENSOR INTO THE END OF A PIPE TEE WITH THE FLUID FLOW IN THE DIRECTION INDICATED.
- POSITION THE SENSOR IN A PLANE THAT WILL PREVENT AIR BEING TRAPPED IN THE AREA OF THE SENSOR.

8/20/96

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
01	Low Feed Pressure Limit - Sensor input lower than the programmed value will cause RO system shutdown. To disable, set to 00.	01-99 PSI/BAR	20
02	Low Feed Pressure Delay - The amount of time a low sensor input or a low switch input must be active before RO system shutdown occurs.	00-99 seconds	05
03	High Pump Pressure Limit - Sensor input higher than the programmed value will cause RO system shutdown. To disable, set to 0000.	001-9999 PSI/BAR	0220
04	High Pump Pressure Delay - The amount of time a high pressure sensor input or a high pressure switch input must be active before an RO system shutdown occurs.	01-99 seconds	05
05	Low Pump Pressure Limit - When the pump pressure drops below this limit with the RO unit operating, the alarm lamp will light and low pump pressure will show on the alarm screen. To disable, set to 000.	000-999 PSI/BAR	150
06	Maximum Prefilter Differential PSI - When the prefilter sensor pressure minus the low feed sensor pressure exceeds this value, the alarm lamp will light and high prefilter differential pressure will show on the alarm screen. To disable, set to 00.	01-99 PSI/BAR	20
07	Maximum Membrane Differential PSI - When the pump pressure sensor pressure minus the membrane pressure sensor exceeds this value, the alarm lamp will light and high membrane differential pressure will show on display. To disable, set to 00.	01-99 PSI/BAR	20
08	Not Used.		
09	Not Used.		

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
10	High TDS/Cond Limit - When this value is met or exceeded, the alarm lamp will light and high TDS/Cond will show on alarm screen after the delay programmed in setpoint 11 has expired. To disable, set to 000.	001-999 PPM/uS	100
11	TDS/Cond Alarm Delay - When setpoint 10 has been exceeded, no alarm will be given until this time has expired.	001-999 seconds	030
12	High TDS/Cond Shutdown Delay - If the TDS/Cond shutdown is enabled with dipswitch 3, the shutdown will occur after this delay.	01-99 minutes	00
13	% Reject Limit - If the membrane rejection drops to or below this value, the alarm lamp will light and low % rejection will show on the alarm screen. To disable, set to 00.	00-99 %	80
14	Not Used.		
15	Not Used.		
16	Current Operating Hours - current number of hours of RO system operation.	00000-99999 hours	00000
17	Maximum Operating Hours - When the RO system operating hours exceed this value, the alarm lamp will light and max operating hours exceeded will show on the alarm screen. To disable, set to 00000.	00001-99999 hours	00000
18	RO Start Delay - The amount of time before the RO pump starts when any RO system shut down is cleared.	01-99 seconds	05
19	Aux Start Delay - The amount of time before the Aux relay starts when the tank low input clears.	01-99 minutes	15
20	Automatic Reset Timer - If the RO system is shutdown due to high pump pressure or low feed pressure, after the programmed amount of time, the RO system is automatically reset and the RO system will attempt to re-start after the RO start delay. To disable automatic reset, set to 00.	00-99 minutes	60

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
21	Pretreatment Lockout Delay - The amount of time the pretreat lockout switch must be active before pretreat lockout is valid and the RO system shuts down.	00-99 seconds	05
22	Not Used.		
23	Not Used.		
24	Tank Full Delay - The amount of time the tank full/pump OFF switch input must be active before tank full is valid and the RO system shuts down.	01-99 seconds	05
25	Tank Full Restart Delay - When Dipswitch 2 is OFF, this delay is in minutes. If ON, the delay is in seconds.	01-99 seconds/minutes	15
26	Tank Full Override Time - When the Tank Full Override function is init-iated, (Function 1), the tank full shutdown is overridden for the number of minutes in this setpoint.	0-9 minutes	3
27	Tank Low Delay - The amount of time the tank low switch input must be active before tank low is valid and the Aux system shuts down.	01-99 seconds	05
28	Not Used.		
29	Membrane Flush Time - The length of time the membrane will flush when membrane flush has been activated.	01-99 minutes	05
30	Membrane Flush Interval - The interval between flush operations. Only valid for op hour, elapsed time or off time flush.	00-99 hours	24
31	Flush Mode - Enables flush and selects the type of flush. To disable flush, set to 00	00-99	00
32	Not Used.		

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
33	Temperature Limit - When the temperature exceeds this limit, after the temperature delay, the RO system will shut down until reset. To disable, set to 000.	000-150 EF/C	120
34	Temperature Delay - The amount of time the temperature limit must be exceeded before RO system shutdown occurs.	00-99 seconds	05
35	Temp Offset - Provides a plus or minus offset to the temperature reading. When set to 5, the offset is 0. The displayed temperature is increased for each number above 5 and decreased for each number below 5.	0-9	5
36-43	See flow section of manual.		
44	Not Used.		
45-49	See pH section of manual.		
50	Not Used.		
51	Pressure Unit of Measure - Selects PSI or bar as unit of measure.	0-1	0
52	Temperature Unit of Measure - Selects degrees EF or EC as unit of measure.	0-1	0
53	Flow Unit of Measure - Selects gallons or liters as unit of measure. If changed, the K-factor for each flow sensor may need to be changed.	0-1	0
54	Switch Select - Selects whether switch inputs or normally open or normally closed.	0-255	000
55	Pump Range - Selects 500 or 1500 pump pressure range. NOTE:Must have correct range sensor.	0-1	0
56	Shutdown Disable - Allows the low feed pressure, high pump pressure and high temperature shutdowns to be disabled configured for alarm only.	0-9	0
57-64	Not Used.		

TO DISPLAY OR CHANGE SETPOINTS

1. Refer to Figure 3 for location of J5. Move the shorting block J5(WRITE PROT) to the OFF position (center and left pins). If J5 is in the write protected position and an attempt is made to change a setpoint, WRITE PROTECTED will show on the display and the long error beep will be heard. CAUTION: J5 must be returned to the ON position to secure the memory from inadvertent changes.

2. Press the "Setpoint" key.

3. Enter the 2 digit setpoint number.

4. The setpoint will be displayed. Press the "cancel" key to return to the main screen; or,

5. To change the setpoint, enter the new value for the setpoint and then press the "Enter" key.

6. The ROTrol II will beep twice if the change is accepted or one long beep if an error is made. The setpoint value entered must have the correct number of digits. For example, the value entered for maximum operating hours must have 5 digits. Precede your entry by zeros if needed.

7. When finished with all setpoint entries, move the write protect jumper J5 back to the ON position. (center and right pins)

STANDARD FUNCTIONS

FUNCTION	DESCRIPTION
1	Tank Full Override - Allows the RO unit to be turned on when it is shut down due to a tank full condition. When the override is initiated, the RO unit will operate for the amount of time programmed in setpoint 26.
2	Manual Flush - Manually initiates a flush cycle.
3	Startup Screen - Enables special screen that shows all sensor readings.

FUNCTION OPERATION

1. Press the "Function" key.

2. Press the number of the function you want to select (1-9).

3. Press the "Enter" key to activate the function or "Cancel" to abort the function.

DIPSWITCH SETTINGS

Switch	Off	On
1	Analog pressure inputs disabled	Analog pressure inputs enabled
2	Single tank full switch Long restart time	Dual tank full switches (Pump ON/Pump OFF) short restart
3	Alarm lamp on high TDS/ Conductivity	RO system shutdown on high TDS/Conductivity
4	RO pump on during flush	RO pump off during flush
5	Inlet valve open during flush	Inlet valve closed during flush
6	Flow metering disabled	Flow metering enabled
7	Not used	
8	Not used	

SYSTEM OPERATION

General Operation

On power up, if the RO pump switch is ON, the inlet control relay will activate and the RO start delay programmed in Setpoint 18 (RO Start Delay) will begin. If no alarms are active the RO pump control relay will operate when the delay times out and the display will show the status of the RO system. Refer to the SCREEN DESCRIPTIONS section of the manual for a description of the various display screens.

Shutdown conditions are indicated by a flashing red alarm lamp and audible warning beeper. The cause of the shutdown is shown on the first line of the display. Warnings that do not shut down the system are indicated by a steady red alarm lamp. The status of any warnings can be displayed on the warnings screen by pushing the "Display" key on the keypad.

If no warnings are active or if the "Display" key is pushed again, a second screen is shown that shows additional data. If the optional flow sensing is enabled, pushing the "Display" key again will show the flow data screen. Pushing the "Display" key again returns the display to the main screen.

Tank Full Operation

Two types of tank full operation are available. If Dipswitch 2 is OFF, single switch tank full operation is enabled. In this mode, if the tank full/pump off switch input is activated, after the time delay programmed in setpoint 24 (Tank Full Delay), the RO control relay will open, shutting down the RO pump. The display will now show TANK FULL. When the tank full condition is removed, the delay programmed in setpoint 25 (Tank Full Restart Delay) will be started. This delay is in minutes. When the delay times out, the RO unit will restart. The remaining delay time will be displayed during the delay period.

If Dipswitch 2 is ON, the dual tank full switch operation is enabled. In this mode, 2 switches are used to provide pump off/pump on operation. When the upper switch is activated, the RO control relay will open, shutting down the RO pump. Tank full will show on the display. When the tank level drops and both the upper and lower switches are no longer activated, the RO control relay will operate after the Tank Full Start Delay programmed in setpoint 25. This time delay is in seconds and will be shown on the display during the delay period.

Tank Full Override

Function 1, (Tank Full Override), allows the RO unit to be operated when it has shut down due to a tank full condition. When this function is initiated, the RO unit will operate for the number of minutes programmed in setpoint 26 (Tank Full Override Time). At the end of this time, the RO unit will then shut down if the tank full condition is still active. This feature allows the RO unit performance to be checked, or samples to be taken, when the RO unit is not operating due to a full tank.

Low Feed/High Pump Pressure Operation

If dipswitch 1 is OFF, only the pressure switch inputs are active. If it is ON, the switch inputs and the analog pressure sensor inputs are enabled. If the low feed pressure switch input becomes active or, if the analog inputs are enabled and the feed pressure sensor input drops below the value programmed in setpoint 01 (Low Feed Pressure), the low feed pressure shutdown will occur after the time delay programmed in setpoint 02 (Low Feed Delay). NOTE: The low feed pressure alarm generated by the pressure sensor can be disabled by programming Setpoint 01 to 00. The RO Pump control relay will open shutting down the RO pump, and the alarm will begin to sound. LOW FEED PRESSURE will show on the display and the alarm lamp will flash. The RO system will remain shutdown until reset.

High pump pressure operates in the same manner, except the pump pressure sensor input must exceed the value programmed in setpoint 03 (High Pump Pressure) and the delay is programmed in setpoint 04 (High Pump Delay). NOTE: The high pump pressure alarm generated by the pressure sensor can be disabled by programming Setpoint 03 to 0000.

If the system shuts down for a low or high pressure fault and the Setpoint 20 (Auto Reset Time) is programmed to a time other than 0, the time remaining before the system attempts the automatic restart is indicated after the cause of the shutdown on the first line of the display. If Setpoint 20 is programmed to 00, the low or high pressure shut downs can only be reset by pressing the Reset key.

Low Pump Pressure

The pump pressure sensor has an additional setpoint for a low pump discharge pressure alarm. When the RO unit is operating, if the pump pressure drops below the value programmed in setpoint 05 (Low Pump Pressure Limit), the alarm lamp will light and LOW PUMP PRESSURE will show on the alarm display. This alarm is disabled when the RO pump is off and during flush. This setpoint does not cause RO system shutdown. If Setpoint 05 is programmed to 000, the low pump pressure alarm is disabled.

Differential Pressure Alarms

If the optional differential pressure sensors are installed, high differential pressure setpoints 06 (Prefilter Differential) and 07 (Max Membrane Differential) are provided. If the sensors record a pressure drop across the prefilter or the membrane that exceeds the setpoints, the alarm lamp will light and the alarm display will show the setpoint that was exceeded. Programming these 2 setpoints to 00 will disable these alarms.

High TDS/Conductivity Alarm/Shutdown

If Dipswitch 3 is OFF and the permeate TDS/Conductivity reading exceeds the value programmed in setpoint 10 (High TDS/Conductivity Limit), the delay programmed in Setpoint 11 (TDS/Cond Alarm Delay) is started. When this time delay times out, the alarm lamp will flash, the audible alarm will sound and high TDS/Conductivity will show on the alarm display. If Dipswitch 3 is ON and the high permeate TDS/Conductivity limit is exceeded for the delay programmed in setpoint 12 (High TDS/Conductivity Shutdown Delay), the RO system will shut down until reset. Programming Setpoint 10 to 000 will disable the high TDS/Conductivity alarm. When the unit is in flush or when the RO unit is off due to any shut down condition, the TDS/Conductivity alarm is disabled.

% Rejection Limit

If the optional feed TDS/Conductivity monitor is installed, feed TDS/Conductivity and membrane % rejection are displayed. If the membrane rejection drops below the value programmed in setpoint 13 (% Reject Limit), the alarm lamp will light and LOW PERCENT REJECTION will show on the alarm screen. Programming Setpoint 13 to 00 will disable the percent rejection alarm.

Shutdown Disable

The low feed pressure, high pump pressure and high temperature shutdowns can be disabled and configured for alarm only by programming Setpoint 56 (Shutdown Disable) with the correct value. The default for this setpoint is 0, which enables all 3 shutdowns. Each shutdown has a factor. The factor for low feed pressure is 1, the high pump pressure factor is 2 and the high temperature factor is 4. Add the factors for the shutdowns that are to be disabled and program this value in Setpoint 56. For example, to disable the shutdowns for high pump pressure and high temperature, the value programmed in Setpoint 56 would be 2+4=6.

RO System Shutdown Reset

Low feed or high pump pressure shutdowns can be reset either manually or automatically. The high TDS/conductivity shutdown and the high feed temp shutdown can only be reset manually. For manual reset, push the "RESET" key on the front panel twice. Automatic reset is controlled by setpoint 20 (Automatic Reset Timer). If programmed to 00, automatic reset is disabled and all shutdowns must be reset manually. If a time is programmed into this setpoint, when the RO system is shutdown due to low feed or high pump pressure, the automatic reset timer is activated. When the timer times out, the RO system is reset and the RO system will operate if the fault causing the shutdown has cleared.

Pretreatment Lockout

In systems where softeners or filters are used ahead of the RO unit, a pretreat lockout input is provided to shutdown the RO unit. When a pretreat unit goes out of service due to regeneration or backwash and the pretreat lockout contact activates, the RO unit will shutdown after the delay programmed in setpoint 21 (Pretreat Lockout Delay). When the contact activation is removed, the RO unit will automatically restart.

Membrane Flush

Several modes of membrane flush are available. In all modes, the RO system will flush for the amount of time programmed in setpoint 29 (Membrane Flush Time). The flush mode is selected using Setpoint 31 (Flush Mode). The Flush Table, (Figure 8), shows the various types of flush modes and the value that must be programmed into Setpoint 31 to enable the selected flush mode. The operation of each flush mode is described below.

FLUSH TABLE

FLUSH MODE	VALUE
NO FLUSH	00
TANK FULL	03
OP HOURS	05
OP HOURS/TANK FULL	07
ELAPSED TIME	09
ELAPSED TIME/TANK FULL	11
OFF HOURS	13
OFF HOURS/TANK FULL	15
RO START/STOP	17

Figure 8

TANK FULL - The RO unit will go into flush each time a tank full condition occurs.

OP HOURS - A flush will occur each time the RO pump has operated the number of hours programmed in Setpoint 30 (Flush Interval).

ELAPSED TIME - A flush will occur each time the number of hours programmed in Setpoint 30 (Flush Interval) has passed.

OFF HOURS - A flush will occur each time the RO pump has been off for the number of hours programmed in Setpoint 30 (Flush Interval). NOTE: If the unit is off due to a pretreat lockout condition, the RO will not flush.

START/STOP - The RO unit will flush each time the RO starts and stops.

The tank full flush can be combined with any of the 3 interval flush types. A manual flush may be initiated at any time by selecting Function 2.

Auxiliary/Repressurization Pump Operation

On power up, the Aux/RP system will start immediately if the Aux/RP switch is on and the tank low input is not active.

Tank Low Operation

If the tank low switch input is activated, the Aux/RP control relay will open after the delay programmed in setpoint 27 (Tank Low Delay). When the input becomes inactive, the Aux/RP control relay will operate after the delay programmed in setpoint 19 (Aux Start Delay).

Operating Hours

The counter that shows the current operating hours is displayed on screen 2 (Figure 10). This is the number of hours that the RO pump has run. This counter can be cleared or set to a specific number by programming Setpoint 16 (Current Op Hours). Setpoint 17 (Maximum Op Hours) can be programmed to give a warning when the unit has operated for the number of hours programmed in this setpoint. If programmed to 00000, this warning is disabled.

Temperature Alarm

Setpoint 33 (Temperature Limit) can be programmed to shut down the unit if the measured temperature exceeds this setpoint. A time delay for this limit is provided with Setpoint 34 (Temperature Delay). If Setpoint 33 is programmed to 000, this alarm is disabled.

Sensor Unit of Measure

Setpoints 51 (PSI/BAR), 52 (F/C) and 53 (GPM/LPM/M3H) allow the pressure, temperature and flow unit of measure to be changed to meet customer requirements. NOTE: If the flow unit of measure is changed, the K-factor for each flow sensor must also be changed.

Alarm Output

The alarm output available at P4, pin 14 (O1) is active whenever any alarm or shut down condition is active. DS9 is lit whenever this output is active.

Divert Output

The divert output available at P4, Pin 15 (O2) is active whenever the TDS/Conductivity reading has exceeded Setpoint 10. The RO unit does not need to be running for this output to be active. DS10 is lit whenever this output is active.

SCREEN DESCRIPTIONS

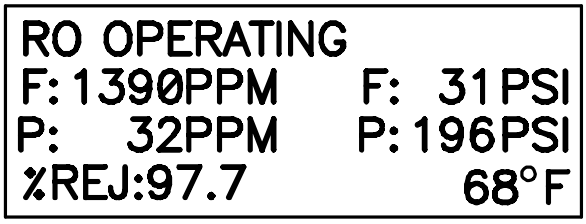


Figure 9

Screen 1

Screen 1 shows the standard operating conditions for the RO unit. The first line of screen 1 shows the status of the RO unit. The following is a list of status messages with explanations.

RO OPERATING - The RO unit is on and operating properly.

RO ON DELAY 10 - The inlet solenoid is open and the number is the remaining delay in seconds before the RO pump starts.

RO OFF - The RO pump is turned off with the RO pump switch.

TANK FULL 15 - The RO pump is shutdown due to a tank full condition. The number after tank full is the delay in minutes before the RO starts after the tank full condition clears.

HIGH PUMP PRESS 60 - The RO pump is shutdown due to a high pump discharge pressure condition. The number is the amount of time in minutes before the unit attempts to restart.

LOW FEED PRESS 60 - The RO pump is shutdown due to a low feed pressure condition. The number is the amount of time in minutes before the unit attempts to restart.

MEM FLUSH TIMER 5 - The RO unit is in the membrane flush mode and the number of minutes remaining in the flush mode.

HIGH TDS/COND - The RO unit has shutdown due to a high TDS/Conductivity condition.

PRETREAT LOCKOUT - The RO unit is shutdown because the pretreat system is out of service.

HI FEED TEMP - The RO unit has shutdown due to a high feed water temperature condition.

LO FEED pH - The RO unit has shutdown due to a low feed pH condition.

HI FEED pH - The RO unit has shutdown due to a high feed Ph condition.

Screen 1 also displays 6 other RO operating conditions.

F:1390PPM - If the optional feed sensor is installed, the feed water quality PPM will be displayed. If the unit of measure is microsiemens, the PPM will be replaced with uS. If the feed sensor is not installed the display will show F:----PPM. If the feed reading is out of range, the display will show F:^^^^.

P: 32PPM - The permeate water quality in PPM is shown. If the selected unit of measure is microsiemens, the PPM will be replaced with uS. If the permeate reading is out of range, the display will show P:^^^.

%REJ:97.7 - The percent rejection is calculated and displayed. If the feed sensor is not installed or if either sensor reading is out of range, the display will show %REJ:---.

F: 31PSI - If the optional feed pressure sensor is installed, the feed pressure in PSI or BAR will be shown. If the sensor is not installed, the display will show F: OK if the low pressure switch is not activated. If the low pressure switch becomes activated, the display will show F: LO.

P: 196PSI - If the optional pump pressure sensor is installed, the pump discharge pressure in PSI or BAR will be shown. If the sensor is not installed, the display will show P: OK if the high pressure switch is not activated. If the high pressure switch becomes activated, the display will show F: HI.

68EF - The permeate water temperature in EF or EC or if the feed sensor is installed, the feed water temperature.

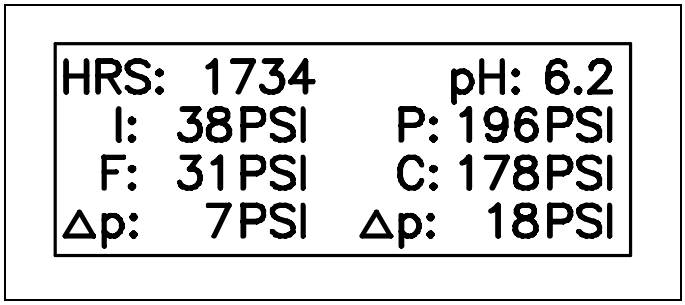


Figure 10

Screen 2

If no alarms are present, pressing the Display key advances the display to screen 2. Screen 2 displays additional data for the ROTrol II. On all pressure readings, the pressure shown will be in PSI or BAR based on the pressure unit of measure, setpoint 51.

HRS: 1734 - The number of hours the RO pump has operated.

pH: 6.2 - If the optional pH sensor is installed, the pH value is displayed.

I: 38PSI - If the optional inlet pressure sensor is installed, the inlet pressure is displayed. If this sensor is not installed, I:--- will show on the display.

F: 31PSI - If the optional feed pressure sensor is installed, the feed pressure is displayed. If this sensor is not installed, the display will show F: OK or F: LO depending on the status of the low pressure switch.

/\p: 7PSI - If the optional inlet and feed sensors are installed, the differential pressure is shown. Otherwise, /\p:--PSI is displayed.

P: 196PSI - If the optional pump pressure sensor is installed, the current pump pressure is displayed. If this sensor is not installed, the display will show P: OK or P: HI depending on the status of the high pressure switch.

C: 178PSI - If the optional concentrate pressure sensor is installed, the current concentrate pressure is displayed. If this sensor is not installed, C:---- is displayed.

/\p:18PSI - If the pump and concentrate sensors are installed, the differential pressure across the membrane is shown. Otherwise, /\p:--PSI is displayed.

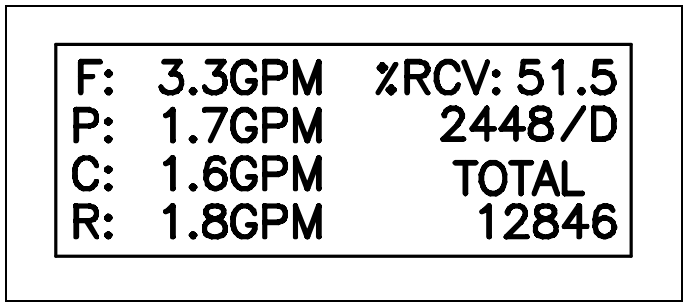


Figure 11

Screen 3

If the optional flow metering is installed, screen 3 shows the system flow data. Readings can be displayed for 3 flow meters. If a flow sensor is not used, the reading for that sensor and any readings based on that sensor will read 0.0. The readings will be in gallons or liters based on the flow unit of measure setpoint.

F: 3.3GPM - The feed flow rate. This reading is the sum of the permeate and concentrate flows.

P: 1.7GPM - The permeate flow rate.

C: 1.6GPM - The concentrate flow rate.

R: 1.8GPM - The recirculate flow rate.

%RCV:51.5 - The calculated percent recovery based on the current flow rates.

2448/D - The estimated permeate flow per day based on the current flow rate.

TOTAL - A totalizer of the permeate flow.
12846

Warning Screen

If the red alarm lamp is on steady, a non shutdown warning is active. To determine which warning is indicated, push the "display" key. The warning will be shown on the first line of the display. If multiple warnings are active, each warning condition will be displayed with a pause between each warning. The warnings and descriptions are:

HIGH TDS/COND - The high TDS/Conductivity setpoint has been exceeded.

OP HOURS EXCEEDED - The RO operating hours setpoint has been exceeded.

HI PREFIL DIFF PRESS - The prefilter differential pressure setpoint has been exceeded.

TANK LO - The tank low switch input is active.

HI MEMBR DIFF PRESS - The membrane differential pressure setpoint has been exceeded.

LO PUMP PRESS - The RO pump discharge pressure has dropped below the low pump pressure setpoint.

LO % REJECTION - The RO system percent rejection has dropped below the % rejection setpoint.

HI PERM FLOW - The permeate flow has exceeded the high permeate flow setpoint.

LO PERM FLOW - The permeate flow has dropped below the low permeate flow setpoint.

HI CNC FLOW - The concentrate flow has exceeded the high concentrate flow setpoint.

LO CNC FLOW - The concentrate flow has dropped below the low concentrate flow setpoint.

LO pH - The pH has dropped below the low pH alarm setpoint.

HI pH - The pH has exceeded the high pH alarm setpoint.

NOTE: Warnings can be cleared by correcting the source of the warning or by changing the setpoint associated with the warning.

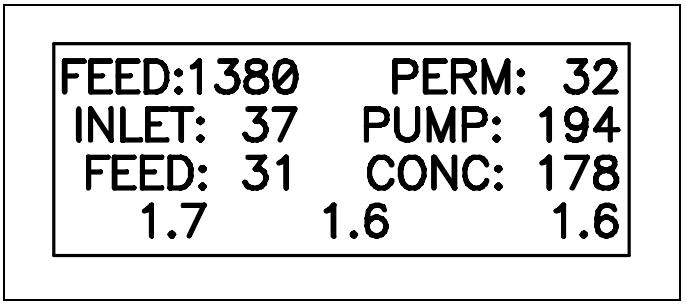


Figure 12

Startup Screen

The startup screen can be utilized during initial system startup to display all of the sensor readings on 1 screen. Pressing the Display key exits the startup screen. If a sensor is not installed, the display for that sensor will show ^^^.

Line 1 of the display shows the TDS/Conductivity values.

FEED:1380 - The feed water PPM/uS.

PERM: 32 - The permeate water PPM/uS.

Line 2 of the display shows the inlet and pump discharge pressures.

INLET: 37 - The inlet pressure.

PUMP: 194 - The pump discharge pressure.

Line 3 of the display shows the pump feed and concentrate pressures.

FEED: 31 - The pump feed pressure.

CONC: 178 - The concentrate pressure.

Line 4 of the display shows the system flow rates.

1.7 - The permeate flow.

1.6 - The concentrate flow.

1.6 - The recirculate flow.

ADJUSTMENTS

TDS/Conductivity Calibration

To calibrate the permeate TDS/Conductivity, adjust the permeate TDS/Conductivity zero (PERM ZERO) control for a reading of zero on the display with the cell clean and dry. Refer to Figure 3 for the location of the adjustments. Immerse the cell in a test solution with a known TDS or conductivity value and adjust the permeate TDS/Conductivity span (P SPAN) control so the display reads the correct TDS or conductivity for the solution. The optional feed TDS/Conductivity is calibrated in the same manner using "FEED ZERO" and "F SPAN".

If the unit is in service (cells installed), each cell may be calibrated by disconnecting the green wire of the cell from the terminal strip and adjusting the corresponding ZERO control to obtain a zero reading on the RO II's display. Reconnect the green wire and start up the RO unit. Collect a sample of the water circulating through each cell, measure the TDS/Conductivity of the sample with a calibrated TDS/Conductivity meter, then adjust the appropriate SPAN control to get the correct reading on the RO II display for each cell.

Display Adjustment

The "DISPLAY CONTRAST" control can be used to adjust the display contrast for the clearest display for the viewing conditions in which the ROTrol II is mounted. Refer to Figure 3 for the contrast control's location.

FLOW METERING

The optional flow metering allows permeate, concentrate, and recirculate flows to be monitored and displayed by the ROTrol II. Setpoints are provided for calibration for various pipe sizes and flow conditions. Setpoints are also provided to program high and low flow limit warnings for permeate and concentrate flow.

The flow meter interface PC board is mounted to the main board in the upper left corner of the board (see Figure 13). The flow meter interface board and the optional pH board may be removed to facilitate the wiring of the analog sensors to their terminal strip. To remove the pH board, remove the 2 mounting screws holding the board. Lift straight up on the pH board to remove it from the connector. To remove the flow board, remove the three screws or if the pH board was removed, the 2 screws and 1 spacer, holding the flow meter interface board and then lift straight up on the board to unplug it from the connector. After wiring the analog sensors, the board is reinstalled by aligning the pins of the connector with the holes in the bottom of the meter interface board and pushing the board into place. The mounting screws are then installed to secure the board.

Flow Sensor Wiring

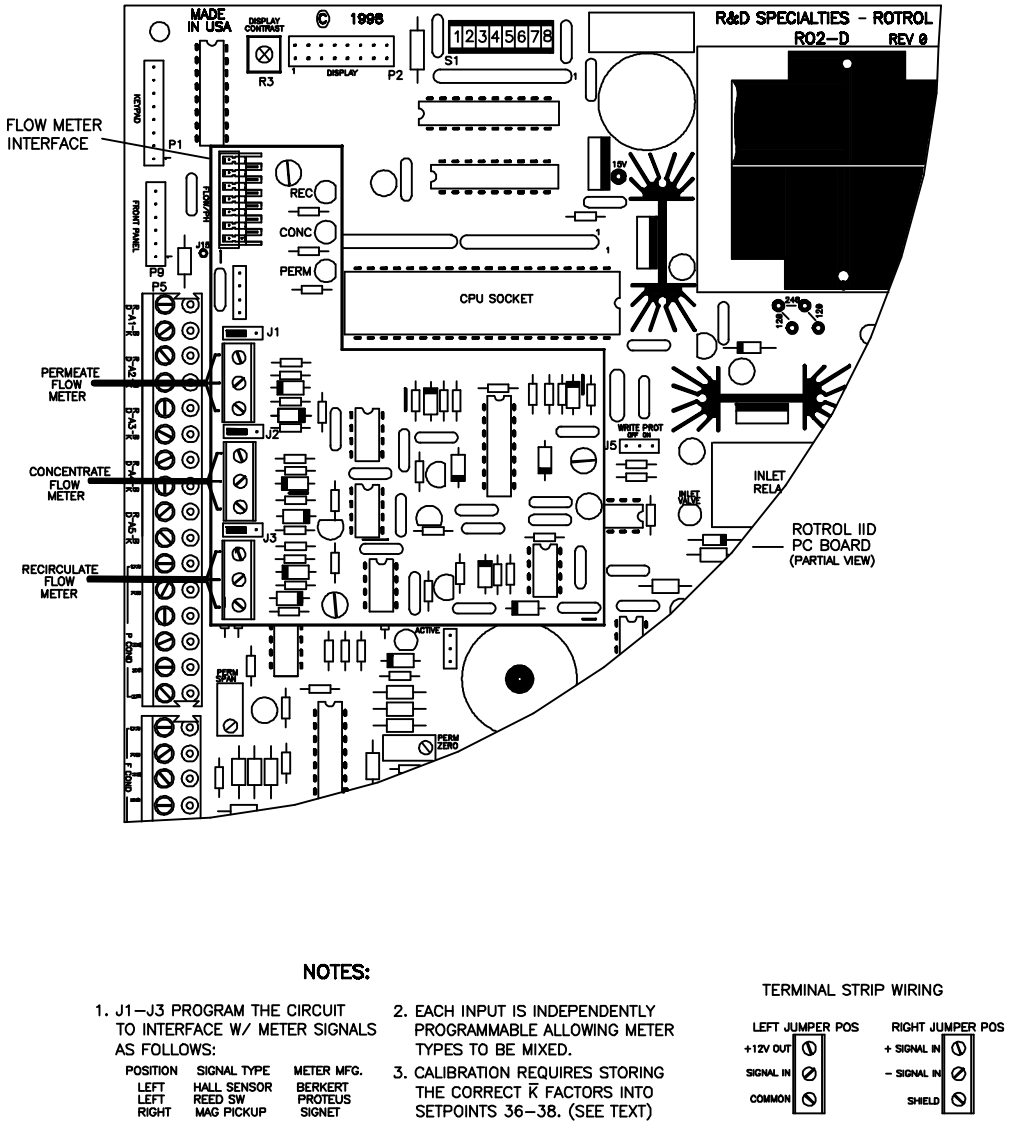
A maximum of three flow sensors may be installed. Each sensor is wired to its corresponding terminal strip on the flow interface board. For Signet type flow sensors the wires connect as follows. The red wire to the top terminal, the black wire to the middle terminal, and the shield wire to the bottom terminal (see Figure 13). The jumper above each terminal block should be connected to the middle and right pins for most Signet sensors.

For Burkert flow sensors, connect the red wire to the top terminal, the black wire to the middle terminal, and the shield wire to the bottom terminal. The jumpers should be connected to the middle and left pins for Burkert sensors.

Consult R & D Specialties for wiring instructions for other types of flow sensors.

Flow Meter Calibration

For each flow sensor installed, the corresponding meter factor setpoints should be programmed. The meter factor is determined by the pipe size, type of fitting the sensor is mounted in and whether the flow is in GPM, LPM or M3H. The meter factors may need to be adjusted to compensate for flow differences under actual conditions. The K-factor is entered as a 4 digit number. If the flow rate indicated is too low, the meter factor should be lowered. If the rate is too high the meter factor should be raised. Refer to Figure 14. The displayed flow can be in GPM, LPM or M3H as selected by Setpoint 53 (Flow Unit of Measure). Program Setpoint 53 to 0 for GPM, 1 for LPM or 2 for M3H. **NOTE:** The K-factor for each flow sensor may need to be changed when the unit of measure is changed. If the K-factor for a meter is programmed to 0000, that meter is disabled and any reading based on that meter will show as dashes on the display.



FLOW METER INTERFACE MOUNTING & WIRING

Figure 13

Flow K Factors

Figure 14 lists the meter factors (K FACTORS) for many of the popular meters manufactured by the two manufacturers previously mentioned.

SIGNET MODEL 515 FLOW SENSOR

PIPE MATERIAL	PIPE SCH.	FITTING TYPE	PIPE SIZE	$\overline{K}$ FACTOR (US GAL)	$\overline{K}$ FACTOR (LITER)
PVC	80	TEE	1/2"	480.2	126.9
PVC	80	TEE	3/4"	257.7	068.1
PVC	80	TEE	1"	174.7	046.1
PVC	80	TEE	1 1/4"	083.4	022.0
PVC	80	TEE	1 1/2"	058.6	015.5
PVC	80	TEE	2"	032.5	008.6
PVC	80	TEE	2 1/2"	021.8	005.8
PVC	80	TEE	3"	013.5	003.6
PVC	80	TEE	4"	007.6	002.0

BURKERT MODEL 8030 FLOW SENSOR

SIZE	SS BODY		PVC BODY	
	$\overline{K}$ FACTOR (US GAL)	$\overline{K}$ FACTOR (LITER)	$\overline{K}$ FACTOR (US GAL)	$\overline{K}$ FACTOR (LITER)
1/2"	400.1	105.7	407.3	107.6
3/4"	251.6	066.5	284.8	075.3
1"	185.6	049.0	200.2	052.9
1 1/4"	120.4	031.8	107.8	028.5
1 1/2"	075.1	019.8	065.4	017.3
2"	043.0	011.4	038.6	010.2

Figure 14

Meters manufactured by other companies may also work with this unit. Contact R&D Specialties for assistance.

Flow Setpoints

*** REMEMBER TO MOVE JUMPER J5 TO "OFF" IF CHANGING A SETPOINT ***
AND MOVE BACK TO THE ON POSITION WHEN COMPLETE.

SETPOINT	DESCRIPTION	RANGE	DEFAULT
36	Meter 1 Factor - This setpoint is used to calibrate the permeate flow meter.	001.0-999.9	----
37	Meter 2 Factor - This setpoint is used to calibrate the concentrate flow meter.	001.0-999.9	----
38	Meter 3 Factor - This setpoint is used to calibrate the recirculate flow meter.	001.0-999.9	----

39	Low Permeate Flow - If the permeate flow drops below this value, a low permeate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
40	High Permeate Flow - If the permeate flow rises above this value, a high permeate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
41	Low Concentrate Flow - If the concentrate flow drops below this value, a low concentrate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
42	High Concentrate Flow - If the concentrate flow rises above this value, a high concentrate flow alarm will be displayed. If set to 0000, this alarm is disabled.	001.0-999.9 GPM/LPM	0000
43	Flow Totalizer - The permeate flow totalizer can be reset to 0 by programming this setpoint to 000000. The number shown when this setpoint is displayed may not match the current total. This is normal as this setpoint is only used to clear the total.	000000 GAL/LTR	

Flow Operation

Dipswitch 6 (see Figure 3) must be ON for the flow metering screen to be displayed. The flow rate display is shown by pressing the display key on the keyboard until the flow display is reached. Permeate, concentrate, and recirculate flows are displayed. If a sensor is not installed for one of the flow rates, that display will read 0.0. If the permeate flow sensor is installed, the total permeate flow per day and the current permeate total will be shown in addition to the permeate flow per minute. If the permeate and concentrate sensors are both installed, the system feed flow rate and also the system percent recovery are calculated and displayed. Press the display key to return to the main display.

Flow Alarms

Low and high flow rate alarms are available for the permeate and concentrate flows. When the setpoints for these alarms are programmed to a value other than 0, the alarm lamp will light and the active alarm is shown on the alarm screen when the setpoint is exceeded.

pH MONITORING

The optional pH monitoring allows the ROTrol II to monitor feed water pH. Setpoints are provided to allow warnings or shutdowns for high and low pH conditions.

The pH interface board is mounted to the main board in the upper left corner of the board (see Figure 15) or to the optional flow meter interface board. The pH and/or flow interface boards may be removed to allow easier wiring of the analog sensors to their terminal strip. To remove the pH board, remove the 2 screws holding the board and lift straight up on the board to unplug it from the connector. If the optional flow meter interface board is installed, remove the spacer and 2 screws holding the flow board in place and lift it from the connector. After the analog sensors have been wired, install the flow meter interface board if used, and wire any flow sensors. Install the pH board and wire the pH sensor to the terminal strip.

pH Sensor Mounting

****** WARNING - THE END OF THE pH SENSOR MUST BE WET AT ALL TIMES - i.e. KEEP THE CAP ON THE SENSOR AND DO NOT INSTALL IN THE FLOW LINE UNTIL THE UNIT IS ACTUALLY PLACED INTO SERVICE. *******

The pH sensor must be mounted in the flow line and oriented to allow physical contact with the fluid being measured and not allow air to be trapped around the sensor i.e. the pH sensor should be side or bottom mounted in horizontal pipe runs. Also, the output from the pH sensor is a low level voltage which may be affected by any static charges and/or stray currents flowing in the fluid stream. It is recommended that the pH sensor be installed in a grounded metal fitting to prevent possible stray voltages from affecting the reading. See Figure 15 for one suggested mounting configuration.

pH Sensor Wiring

Connect the shield wire to TB1 - and the signal wire or center conductor to TB1 +. The shorting jumper must be removed from J10 on the main PC board to enable pH readings. Refer to Figure 16 for pH wiring information and Figure 3 for J10 location.

pH Calibration

The pH sensor is calibrated at the factory, but periodic recalibration should be done to maintain sensor accuracy. Refer to Figure 16 for adjustment locations. To calibrate the pH monitor, insert the pH sensor in a pH 4.0 standard solution and adjust the zero control for a reading of 4.0. Remove the pH sensor, rinse with distilled water, and shake dry. Then insert the probe in a pH 10.0 standard solution and adjust the span control for a reading of 10.0. These steps should be repeated several times as there is some interaction between the 2 adjustment controls. Also, most pH sensors respond to changes very slowly - allow adequate time for the reading to stabilize each time the sensor is moved into a different solution before making any adjustments.

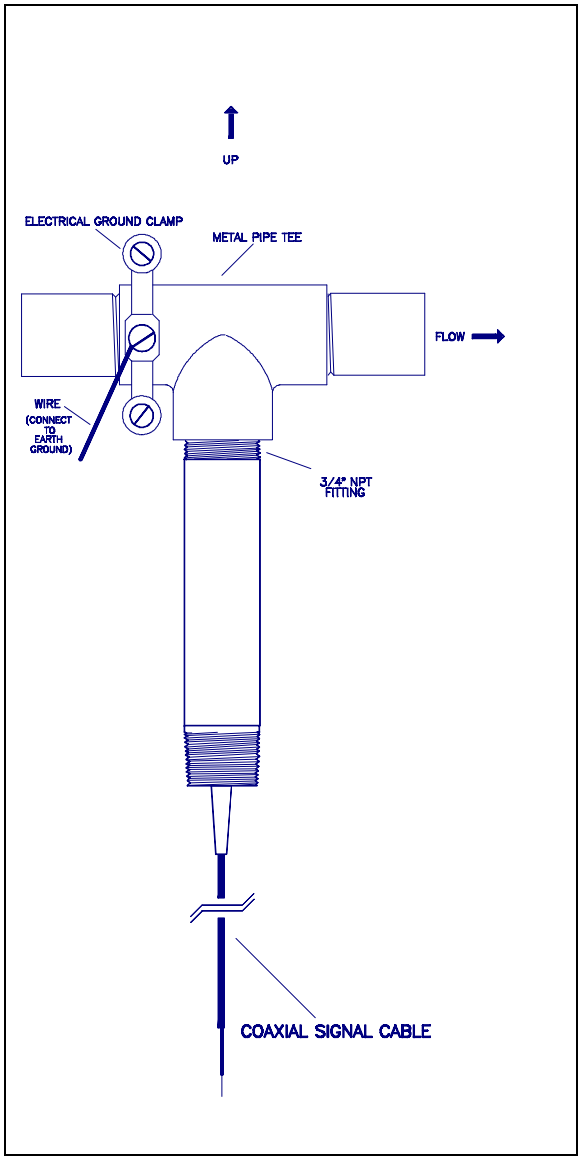


Figure 15

pH Setpoints

*** REMEMBER TO CHANGE JUMPER J5 TO "OFF" IF CHANGING A SETPOINT AND MOVE J5 BACK TO THE ON POSITION WHEN COMPLETE. ***

SETPOINT	DESCRIPTION	RANGE	DEFAULT
45	LOW pH ALARM - If the pH reading drops to or below this value, a low pH alarm will be displayed. Set to 000 to disable alarm.	01.0-13.0	06.0
46	HI pH ALARM - If the pH reading rises to or above this value, a high pH alarm will be displayed. Set to 000 to disable alarm.	01.0-13.0	08.0

SETPOINT	DESCRIPTION	RANGE	DEFAULT
47	LOW pH SHUTDOWN - If the pH reading drops to or below this value, a low pH shutdown will occur after the pH delay has timed out. Set to 000 to disable shutdown.	01.0-13.0	05.0
48	HIGH pH SHUTDOWN - If the pH reading rises to or above this value, high pH shutdown will occur after the pH delay has timed out. Set to 000 to disable shutdown.	01.0-13.0	10.0
49	pH DELAY - This is the time the pH value must meet the shutdown setpoint before a pH shutdown will occur.	00-99 seconds	10

pH Operation

The pH is displayed by pushing the display key until the screen 2 is shown. Pushing the display key again will advance the display to the next screen.

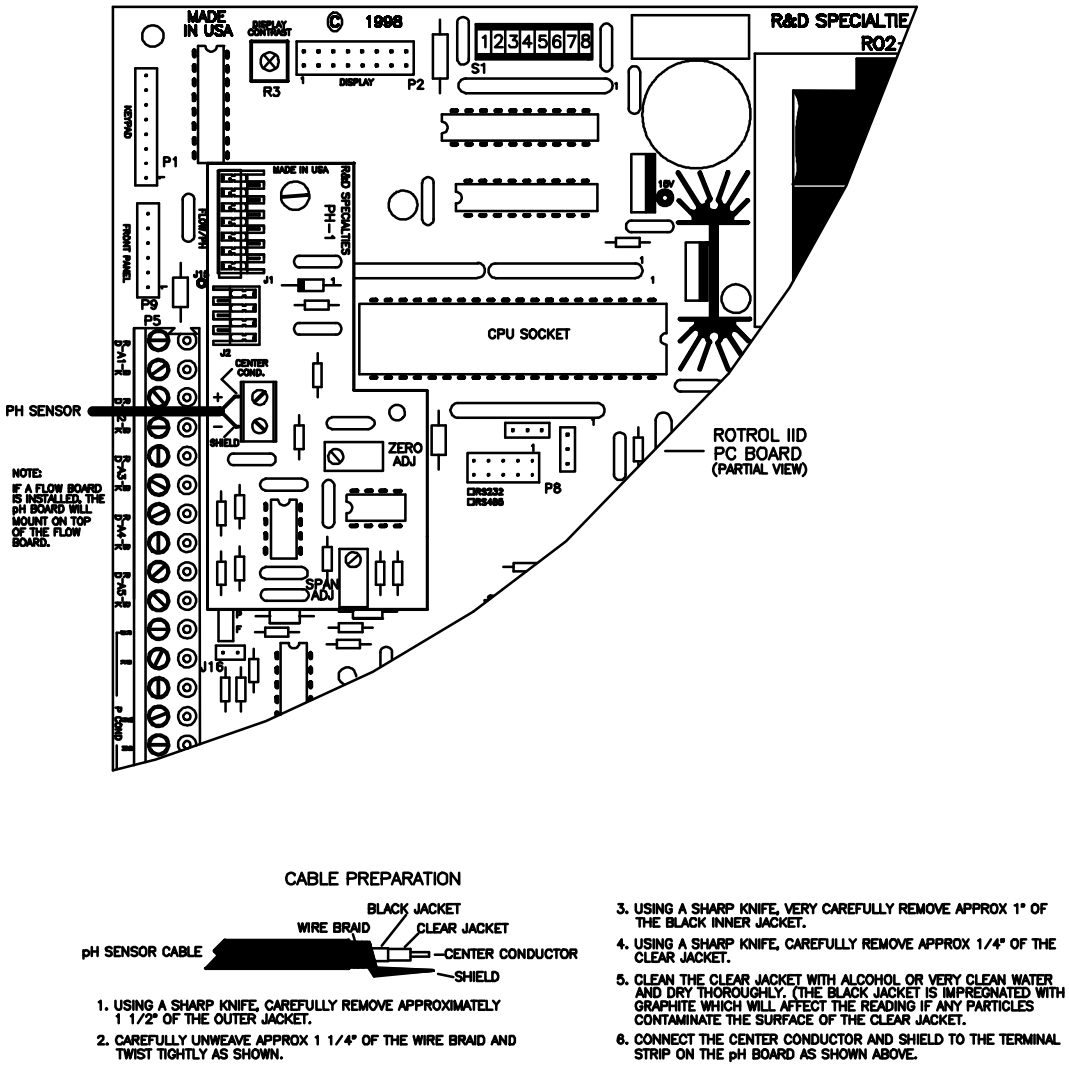
If the pH value has reached one of the warning levels, the alarm light will light and low or high pH will be shown on the alarm display. If the pH value reaches one of the shutdown levels and is maintained for the time programmed in setpoint 49 (pH Delay), the ROTrol II will shutdown the RO pump, flash the alarm lamp, and sound the audible alarm. The display will show the pH shutdown message on the display. The unit will remain shutdown until the reset key is pressed.

NOTE: pH electrodes age with time and eventually become desensitized and must be replaced. The actual service life of a pH electrode is extremely variable and is dependant on many factors. Exposure to extremely pure water will accelerate electrode aging and cause a shorter service life.

pH Electrode Warranty

The manufacturer warrants that at the time of shipment, the pH electrode shall be free from defects in material and workmanship and shall perform within stated specifications upon initial installation.

If the electrode proves to be defective within the above warranty, the manufacturer will replace the electrode with a similar model or product.



CABLE PREPARATION

1. USING A SHARP KNIFE, CAREFULLY REMOVE APPROXIMATELY 1 1/2" OF THE OUTER JACKET.
2. CAREFULLY UNWEAVE APPROX 1 1/4" OF THE WIRE BRAID AND TWIST TIGHTLY AS SHOWN.
3. USING A SHARP KNIFE, VERY CAREFULLY REMOVE APPROX 1" OF THE BLACK INNER JACKET.
4. USING A SHARP KNIFE, CAREFULLY REMOVE APPROX 1/4" OF THE CLEAR JACKET.
5. CLEAN THE CLEAR JACKET WITH ALCOHOL OR VERY CLEAN WATER AND DRY THOROUGHLY. (THE BLACK JACKET IS IMPREGNATED WITH GRAPHITE WHICH WILL AFFECT THE READING IF ANY PARTICLES CONTAMINATE THE SURFACE OF THE CLEAR JACKET.
6. CONNECT THE CENTER CONDUCTOR AND SHIELD TO THE TERMINAL STRIP ON THE pH BOARD AS SHOWN ABOVE.

pH BOARD MOUNTING & WIRING

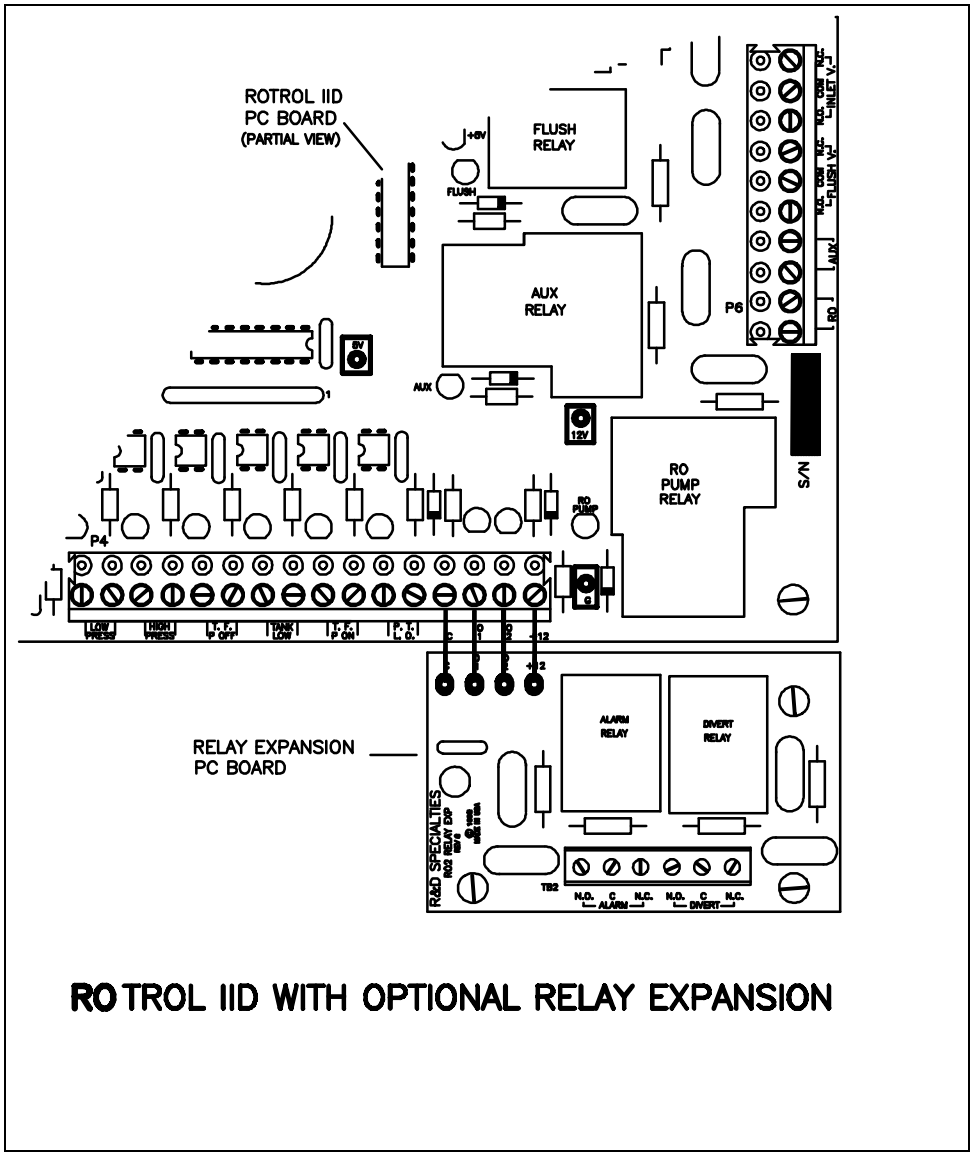
Figure 16

ALARM/DIVERT RELAY BOARD

An optional PC board is available to provide relay outputs for operating additional devices or equipment when alarms are detected by the ROTrol II or the TDS/Conductivity Setpoint is exceeded.

The optional relay board attaches to the ROTrol II terminal strip P4 as shown in Figure 17. The relay outputs do not supply power but will switch power routed through them to the controlled devices (1 phase). Each relay is capable of switching loads up to 5A at voltages up to 240V.

The alarm output activates whenever any warning or shutdown is active. The divert output can be used to operate a divert valve or can be used as a high TDS/Conductivity alarm output. The divert output is active any time the TDS/Conductivity is above the value programmed in Setpoint 10.



ROTROL IID WITH OPTIONAL RELAY EXPANSION

Figure 17

TROUBLESHOOTING

CAUTION: Hazardous voltages are present when power is applied to the unit. Care should be taken when troubleshooting any of the input power or relay output circuits. When disconnecting or connecting any board or accessory, be sure power to the unit has been turned off.

Before replacing any PC boards and accessories or making any adjustments to the unit, please refer to the appropriate troubleshooting section for the proper testing methods. Incorrect adjustments can mask problems or can cause further problems. Check all setpoints and verify proper values for each setpoint. In the event you are unable to determine the cause of a failure, you can contact R & D Specialties for further assistance. Please make note of the events leading up to the failure, the exact failure, what LED's if any that are on, what readings are shown on the display, etc., before contacting technical support. The more information you have when you contact us, the easier it will be to determine the source of the problem. Technical support can be contacted by Fax at 915 561-5696, by email at trproc@rdspec.com or by phone at 915 561-5707. Phone support is only available from 8AM to 5PM Central Standard Time.

BUILT-IN AIDS

To help in locating any malfunctions, all of the switch inputs have green LED lamps, DS2 through DS7, that indicate when the switch for an input is closed. The relays have red LED lamps, DS11 through DS14, that indicate when a relay is energized. Green LED DS1 indicates that power is applied to the board and amber LED DS8 blinks when the CPU chip is operating properly. Make a note of which lamps are on, what is indicated on the display, and any actions that were performed prior to the problem occurring. This information can be an aid in troubleshooting the unit. Refer to Figure 3 for the location of terminal strips, the fuse, LEDs and adjustments.

TOOLS/TEST EQUIPMENT

Although most problems can be solved using the built-in aids discussed above, some problems can be solved faster using additional test equipment.
A digital voltmeter (DVM), one or more 1500 ohm 1/2 watt resistors, a 10,000 ohm 1/2 watt resistor, and a 33,000 ohm 1/2 watt resistor will greatly enhance your ability to pinpoint some problems quickly. Refer to Figures 18-20 for further troubleshooting procedures.

SPECIFIC PROBLEMS

System Inoperative:
Is the green +5V LED (DS1) lit? Is the amber CPU ACTIVE (DS8) lamp blinking? If no, check the power source (circuit breaker usually). Then check the power wires connected to P3 L1 & L2 either visually or measure between them with a DVM. If they are tight in the terminals or the DVM shows the correct voltage at P3 L1 & L2, check the fuse (next to P3) and the front panel power switch and wiring to P3. If checking visually, look for loose wires, a broken switch, or a blown fuse (located to the left of P3). If using a DVM, measure the voltage between L1 and the top terminal of P3 and between L1 and both ends of the fuse clip. Correct any problem/s found. If no problems are found, the PC board is probably defective and should be replaced.

Display Blank:
Turn the power off and back on. If the POWER ON LED DS1 and CPU ACTIVE LED DS8 are not on, see System Inoperative above. If DS1 is on and DS8 is blinking, ensure that the display cable is plugged into the display connector P2 and inspect the ribbon cable solder connections on the display board for broken wires. If the cable appears intact, try adjusting the display contrast control. If none of these checks reveal a problem, the display should be replaced.

RO Pump Will Not Operate:
The RO pump will not operate if the RO pump switch is off, an RO pump restart time delay is active, the tank full input is present, a low or high pressure shutdown has occurred, or the pre-treat lockout signal is present.
First, turn the RO pump switch on, then check to see if the relay LED, DS14, is on. If it is and the pump will not run, check all the wiring from P6 to the RO pump (or motor starter if equipped) and to the power source feeding the motor with a DVM. If voltage is measured between the power wire feeding the motor directly and both RO pump terminals of P6, either the wire from P6 to the motor is broken or loose, or the pump motor is bad. If voltage is present on 1 terminal of P6 (from the power source) but not the other and DS14 is on, the relay is may be bad requiring the circuit board to be replaced. (Reference Figure 4,5 or 6 for correct wiring.)

If DS14 is off and the RO pump switch is on, check the green LEDs above P4 (DS2-7), check the alarm lamp on the front panel, and note all readings on the LCD display. Remember these indicators and LCD readings, and read through the section "SYSTEM OPERATION" in this manual. Using both the knowledge of how the unit operates, and the indications shown by the LEDs and LCD, you should be able to determine whether the problem is on or off the PC board (malfunctioning level switch, pressure switch, etc.). If the unit is not responding correctly to the signals feeding the unit (input switches, etc.), the PC board should be replaced.

Inlet valve will not operate:
The inlet valve will not operate unless the RO PUMP switch is on. Also, there must be no shutdown alarms present, the unit must not be in any restart time delay period, and it must not have a tank full or pre-treat lockout signal present. Check for all normal shutdown conditions by observing the LEDs DS2-DS7, the LCD display, and the position of the RO PUMP switch. If conditions indicate that the inlet valve should be open, LED DS11 should be on. If DS11 does not light, the RO PUMP is operating, and the unit is not engaged in a membrane flush cycle, the PC board should be replaced.

If LED DS11 is on and the valve does not operate, check the wiring between the valve's power source and the valve. If all wiring appears intact and correctly wired (see Figure 4,5 or 6), check for the correct voltage on the valve with a DVM. If voltage is present on the valve, it is probably bad and should be replaced. If voltage is not present on the valve, check between the valve's unswitched (directly wired to valve) power lead the P6 terminals labeled "INLET V.". Between the unswitched wire and the P6 terminal "COM", the supply voltage (120/240) should be present. If the voltage is not correct, the problem is either a break in the wiring between the P6 terminal "COM" and the power source or the power source proper. (It will probably be connected to several other wires with a wire nut or splice of some kind which may be loose.) If the correct voltage is present at P6 "COM", it should also be present at the terminal "N.O." when DS11 is on and at the terminal "N.C." when DS11 is off. If DS11 is on and no voltage is present on "N.O.", the PC board should be replaced.

Aux/RP pump will not operate:
The Aux/RP pump will not operate if the AUX switch (front panel) is off, the Aux Start Time Delay is active, or the Tank Low input is present.

Turn the AUX Switch on, (if off) and check the LED DS13. If DS13 is on, check the pump motor wiring as explained above in the RO pump section. If DS13 does not light, check DS5. If DS5 is on, the Tank Low input is present and the pump should not start. If necessary, correct the Tank Low condition and then re-check the unit for correct operation. If the Tank Low LED (DS5) is off, the AUX Switch is on, and DS13 does not light, check Setpoint 15. If the unit has shut down the AUX output because the Tank Low input had been present, the unit will not restart until the time set into Setpoint 15 has expired. Allow the amount of time selected by Setpoint 15 to elapse and if the AUX output still does not occur, the PC board is bad and should be replaced.

RO unit not flushing or not flushing correctly:
***** NOTICE If your CPU version # ends with "S__" (see Figure 3 for location of CPU), you have a custom chip and should have a manual addendum explaining the correct flush operation if different from the standard variations explained in the section SYSTEM OPERATION. ********

First determine when and exactly what the correct operation should be when flush occurs. The correct operation is explained in the section SYSTEM OPERATION for the different dipswitch settings and related Setpoint values.

If flush has been initiated, DS12 should be on and the flush valve should open. If DS12 is on and the valve does not switch, check the wiring between the valve's power source and the valve. If all wiring appears intact and correctly wired (see Figure 4,5 or 6), check for the correct voltage on the valve with a DVM. If voltage is present on the valve, it is probably bad and should be replaced. If voltage is not present on the valve, check between the valve's unswitched (directly wired to valve) power lead and the P6 terminals labeled "FLUSH V.". Between the unswitched wire and the P6 terminal "COM", the supply voltage (120/240) should be present. If the voltage is not correct, the problem is either a break in the wiring between the P6 terminal "COM" and the power source or the power source proper. (It will probably be connected to several other wires with a wire nut or splice of some kind which may be loose.) If the correct voltage is present at P6 "COM", it should also be present at the terminal "N.O." when DS12 is on and at the terminal "N.C." when DS12 is off. If DS12 is on and no voltage is present on "N.O.", the PC board should be replaced.

Pressure sensor readings incorrect or not reading:
All pressure sensor readings require Dipswitch 1 to be turned ON (up). With Dipswitch 1 ON, each sensor reading may be enabled/disabled with its corresponding jumper J6, J7, J8, or J9 (FEED, PUMP, PREFILTER DIFF., and MEMBRANE DIFF. respectively). A sensor reading is disabled by plugging a shorting block onto both pins. The absence of a shorting block or the shorting block plugged into 1 pin only will enable the reading.

If no pressure readings are present on the LCD display, either Dipswitch 1 is OFF; one or more pressure sensors (or cable) is bad or mis-wired; a TDS/Conductivity sensor is bad; or the PC board is bad. Assuming Dipswitch 1 is ON, the problem may be isolated to a failed sensor or PC board by one of the following methods.

Method 1 - no DVM available
Turn off the Power switch on the front panel and disconnect the red wires for both TDS/Conductivity sensors and every pressure sensor except 1 at the terminal strips P5 and P7. Then place the shorting blocks across both pins of the corresponding enable jumpers J6-J9 for the disconnected sensors (to disable the alarms for those sensors). Turn the Power switch on and check the LCD display for a pressure reading from the sensor still connected to the terminal strip. If a good reading is obtained, that sensor is good. If the reading is bad, either the sensor is bad or the PC board is bad. If the reading is good, leave the good sensor connected. Then, one at a time, connect each disconnected sensor and remove its jumper to enable a reading. If the reading is correct, leave the sensor connected and check the remaining sensors one at a time in the same fashion. If any good readings are obtained, the PC board is probably good and each sensor giving a good reading is OK. Replace any bad sensor encountered. If no good reading is obtained with any sensor, the PC board is probably bad and should be replaced. If all pressure sensors read OK, one or both of the TDS/Conductivity sensors may be bad.

***** A 1500 OHM RESISTOR CONNECTED TO ANY PRESSURE INPUT IN PLACE OF THE SENSOR SHOULD GIVE APPROXIMATELY A MID-SCALE READING EXAMPLE: A 400 PSI SENSOR SHOULD READ APPROXIMATELY 200 PSI *******

Method 2 - DVM available
With power applied and a DVM setting (range) of 20VDC or better, measure the voltage between the bottom and top terminals of P5 (TDS SENSOR -SH and A-1 - RD). If the reading is less than 14VDC, disconnect the red wire of each pressure sensor one at a time while observing the DVM. If the reading jumps to approximately 15VDC after a wire is disconnected, that sensor or its cable is bad. With the bad sensor disconnected, all other pressure readings should read correctly. If all pressure sensors are disconnected and the 15VDC is still not correct, disconnect the red wires on the TDS/Conductivity sensors one at a time and if the 15VDC returns, the sensor disconnected at the time the 15VDC appeared is bad and should be replaced.

If the 15VDC reading is correct with all sensors connected, measure between each pressure sensor's "BK" terminal and the bottom terminal of P5. The valid voltage range is 1-5VDC for these readings. If any sensor (black wire) is outside this range, it is probably bad. If the reading is extremely high (7VDC or better) it may over drive the analog circuitry on the PC board and cause all readings to be bad. Disconnect any bad sensor(s) and the other sensors should read correctly.

If all readings appear to be wrong, one or more sensors may be bad or mis-wired or the PC board may be bad. Check for bad sensors and wiring errors as explained in the previous section. Also, ensure that each sensor is of the correct range and installed in the correct location.

No TDS/Conductivity or temperature readings:
Check the wiring for each sensor. Also, if the feed sensor is not reading, verify that jumper J12 is removed.

Both TDS/Conductivity sensors have temperature outputs but only one will be monitored and displayed. J13 selects the temperature sensor to be monitored. If the shorting block is plugged into the top 2 pins of J13, it will monitor the PERMEATE temperature sensor output. If it is plugged into the bottom 2 pins, it will monitor the FEED temperature sensor output. If the temperature reading is bad and both sensors are present, moving the shorting block to select the alternate sensor may yield a good reading on the LCD. If so, the sensor originally selected is bad and should be replaced. If neither sensor reads correctly, try removing the red wires from all pressure sensors at terminal strip P5. If neither sensor reads correctly now, disconnect each TDS sensor's red wire at terminal strip P5 and P7 one at a time. Move J13 to select the connected sensor and check the reading. If the reading is good, that sensor and the PC board are good. Whether the reading was good or bad, disconnect that sensor's black wire, reconnect the second sensor's black wire, move

J13's shorting block and check the LCD
reading. If at least one sensor gives a good reading, that sensor and the PC board are good. If any pressure sensor(s) was disconnected, reconnect the wire(s) and ensure that the temperature reading remains good. Replace all bad sensors found. If no good reading was obtained, the PC board should be replaced.

**** A 1500 OHM RESISTOR MAY BE CONNECTED IN PLACE OF THE RED AND BLACK WIRES OF THE SELECTED SENSOR TO GIVE APPROXIMATELY A 75 EF READING AND THE 10000 AND 33000 OHM RESISTORS CAN BE CONNECTED IN PLACE OF THE WHITE AND GREEN WIRES TO GIVE TDS/CONDUCTIVITY READINGS ****

TDS/Conductivity sensor reading(s) inaccurate:
Verify that each sensor is wired correctly and the temperature reading is correct. The sensor readings are temperature compensated and if the temperature reading is not correct, the TDS/Conductivity readings will not be correct. Also, each sensor must have a good fluid flow around the sensing element (pins) to yield an accurate reading. (See Figure 7 for correct sensor installation.)

If the temperature reading is good, the sensors are installed correctly, any/all pressure readings are correct, and the readings are simply off, the sensors' probe pins may need to be cleaned. It may also be necessary to re-calibrate the unit as explained in the ADJUSTMENTS section.

Keypad problems:
Ensure that the keypad ribbon cable is plugged into the PC board. Then press a key and if no beep is heard and nothing changes on the LCD display, the keypad is probably bad and should be replaced.

If a wrong indication on the LCD display or a long beep is heard when pressing most keys, press "3" on the keypad. If "setpoint:" shows on the display, turn the Power switch off, unplug the ribbon cable from the keypad connector P1, rotate it 180 degrees, and plug it back in. Turn the power on and re-check the keypad. If the keypad still malfunctions, either the keypad or the PC board or both should be replaced.

Flow screen is not displayed:
Dipswitch 6 must be ON to enable flow metering.

No reading from any flow sensor:
Check all flow sensor wiring and verify that the jumpers on the flow interface board are in the correct positions for the sensors installed (see Figure 13). If all is correct, the flow interface is probably bad and should be replaced.

No reading from one flow sensor:
If the pulses are being received from a flow sensor, the corresponding red LED on the flow board should be blinking. Exchange wiring with a sensor that is working (change jumper position if necessary). If the LED now blinks and a reading is now shown, replace the bad sensor. If a reading is not shown, replace the flow interface board.

Flow sensor readings inaccurate:
The meter factor for each sensor installed may need to be adjusted. If the reading is higher than the actual flow, increase the meter factor. If the reading is lower, decrease the meter factor (see Figure 14). Also, verify that each sensor is installed in the proper location and wired to the correct terminal strip.

pH sensor not reading or inaccurate:
Slow response or large errors can be caused by coated or dirty electrodes. If the electrode is coated with a soft substance, the electrode may be cleaned by rinsing under running water. If this is not successful, try wiping with a soft, wet cloth.

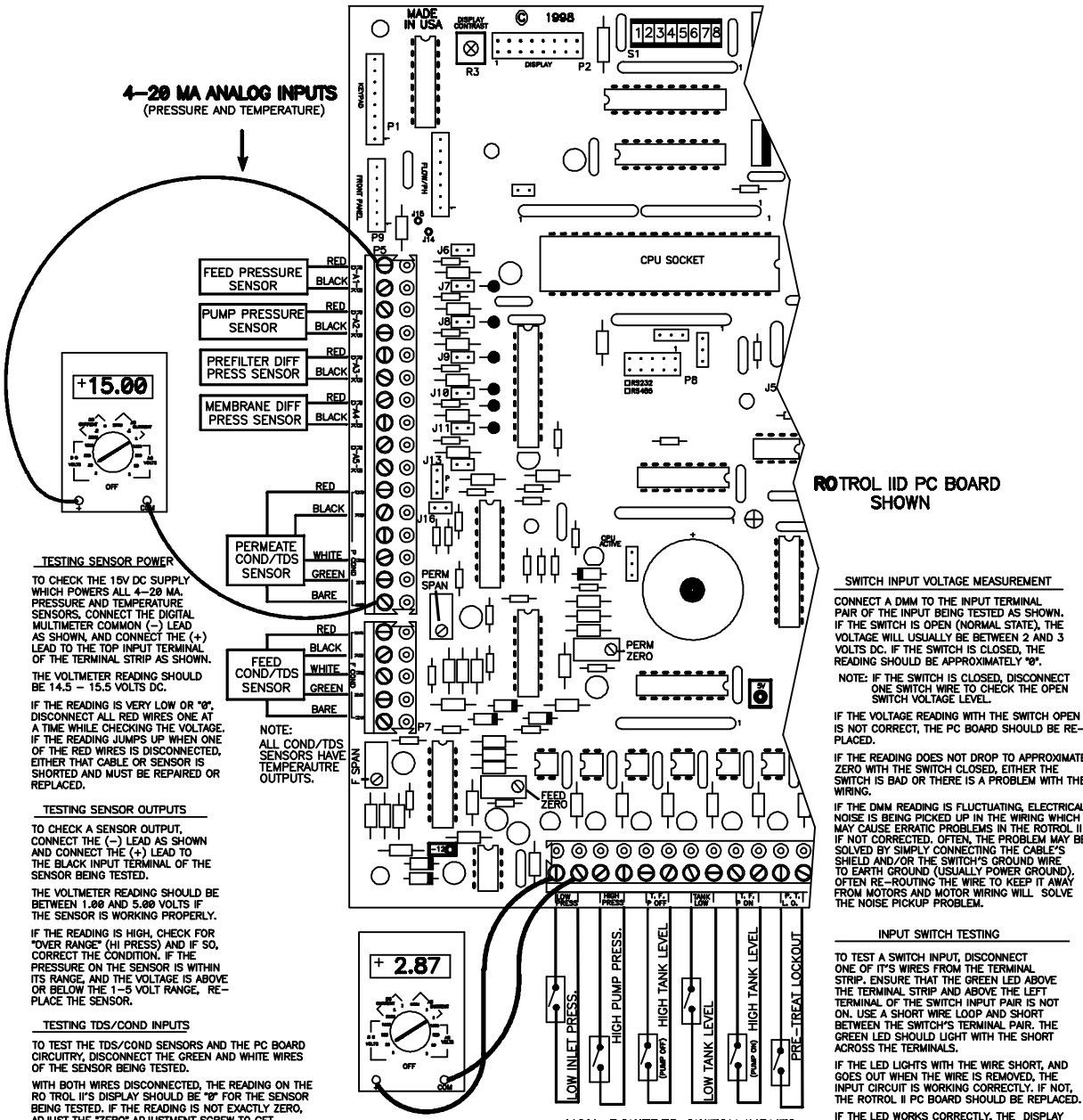
For hard coatings such as scale, soaking the electrode in a 5% solution of HCl may work. For some hard coatings, alternate between a 5% HCl solution and a 10% NaOH solution for 10 minutes each. Greasy or oily coatings can be removed by using a detergent solution or isopropyl alcohol. After treating the electrode with these solutions, be sure to rinse well with clean water.

If the LCD display shows no reading for pH, ensure that the shorting block on J10 is off or on only 1 pin. Also check the pH sensor wiring as shown in figure 16. If these checks do not reveal the problem, either the pH sensor or the pH PC board may be defective. Inspect the pH sensor and ensure that it still has fluid inside the glass bulb. If the bulb is dry, either re-fill the sensor with fluid (if re-fillable) or replace it. If the sensor bulb appears to have fluid inside, and the wiring appears intact,
try adjusting the "ZERO ADJ" (Figure 16) adjustment screw to see if any reading appears on the LCD display. If after turning the adjustment screw several turns from its original position (both directions) no reading appears, the pH board should be replaced.

If there is some reading on the LCD display but it is incorrect and does not change with a known change in the pH of the solution surrounding the sensor, the pH sensor is probably bad. Inspect it and its wiring as explained above and correct any problems found or replace it. If the sensor is repaired or replaced and the reading does not change, the pH board should be replaced.

If the LCD reading appears incorrect but changes as the pH of the measured solution changes, it may be necessary to calibrate the pH board. Refer to the pH section for calibration instructions.

Erratic readings can be caused by electrical currents in the fluid stream. If the pH electrode is removed from the piping, calibrates correctly and the reading is stable until the electrode is installed into the piping, this could be the problem. The electrode should be installed in a metal tee that is grounded to a good earth ground. See recommended installation shown in Figure 15.



TESTING SENSOR POWER

TO CHECK THE 15V DC SUPPLY WHICH POWERS ALL 4–20 MA. PRESSURE AND TEMPERATURE SENSORS, CONNECT THE DIGITAL MULTIMETER COMMON (–) LEAD AS SHOWN, AND CONNECT THE (+) LEAD TO THE TOP INPUT TERMINAL OF THE TERMINAL STRIP AS SHOWN.

THE VOLTMETER READING SHOULD BE 14.5 – 15.5 VOLTS DC.

IF THE READING IS VERY LOW OR "0", DISCONNECT ALL RED WIRES ONE AT A TIME WHILE CHECKING THE VOLTAGE. IF THE READING JUMPS UP WHEN ONE OF THE RED WIRES IS DISCONNECTED, EITHER THAT CABLE OR SENSOR IS SHORTED AND MUST BE REPAIRED OR REPLACED.

TESTING SENSOR OUTPUTS

TO CHECK A SENSOR OUTPUT, CONNECT THE (–) LEAD AS SHOWN AND CONNECT THE (+) LEAD TO THE BLACK INPUT TERMINAL OF THE SENSOR BEING TESTED.

THE VOLTMETER READING SHOULD BE BETWEEN 1.00 AND 5.00 VOLTS IF THE SENSOR IS WORKING PROPERLY.

IF THE READING IS HIGH, CHECK FOR "OVER RANGE" (HI PRESS) AND IF SO, CORRECT THE CONDITION. IF THE PRESSURE ON THE SENSOR IS WITHIN ITS RANGE, AND THE VOLTAGE IS ABOVE OR BELOW THE 1–5 VOLT RANGE, RE–PLACE THE SENSOR.

TESTING TDS/COND INPUTS

TO TEST THE TDS/COND SENSORS AND THE PC BOARD CIRCUITRY, DISCONNECT THE GREEN AND WHITE WIRES OF THE SENSOR BEING TESTED.

WITH BOTH WIRES DISCONNECTED, THE READING ON THE RO TROL II'S DISPLAY SHOULD BE "0" FOR THE SENSOR BEING TESTED. IF THE READING IS NOT EXACTLY ZERO, ADJUST THE "ZERO" ADJUSTMENT SCREW TO GET A ZERO READING. IF A "0" CAN NOT BE OBTAINED, THE THE ROTROL II PC BOARD SHOULD BE REPLACED.

IF A "0" READING CAN BE OBTAINED, CONNECT A RESISTOR TO THE GREEN AND WHITE TERMINALS OF THE TERMINAL STRIP. THE DISPLAY READING SHOULD INCREASE TO SOME VALUE ABOVE "0" DEPENDING UPON THE RESISTOR'S VALUE AND THE PROGRAMMED RANGE OF THE ROTROL II. A 22,000 OHM RESISTOR SHOULD GIVE A READING ABOVE "0" ON ANY UNIT.

IF NO INCREASE IN THE READING OCCURS WHEN THE RESISTOR IS CONNECTED, THE PC BOARD IS PROBABLY BAD AND SHOULD BE REPLACED.

IF A READING IS OBTAINED BY CONNECTING THE RESISTOR, THE PC BOARD IS PROBABLY WORKING PROPERLY. RE–CONNECT THE SENSOR AND SUBMERSE IT IN A CUP OF WATER OF A KNOWN QUALITY (TDS OR uS) AND IF A READING IS OBTAINED, ADJUST (IF NECESSARY) THE COR–RESPONDING SPAN ADJUSTMENT ON THE PC BOARD TO OBTAIN THE CORRECT READING. IF NO READING IS OB–TAINED WITH THE SENSOR IN WATER, THE SENSOR OR CABLE IS BAD AND SHOULD BE REPLACED.

SWITCH INPUT VOLTAGE MEASUREMENT

CONNECT A DMM TO THE INPUT TERMINAL PAIR OF THE INPUT BEING TESTED AS SHOWN. IF THE SWITCH IS OPEN (NORMAL STATE), THE VOLTAGE WILL USUALLY BE BETWEEN 2 AND 3 VOLTS DC. IF THE SWITCH IS CLOSED, THE READING SHOULD BE APPROXIMATELY "0".

NOTE: IF THE SWITCH IS CLOSED, DISCONNECT ONE SWITCH WIRE TO CHECK THE OPEN SWITCH VOLTAGE LEVEL.

IF THE VOLTAGE READING WITH THE SWITCH OPEN IS NOT CORRECT, THE PC BOARD SHOULD BE RE–PLACED.

IF THE READING DOES NOT DROP TO APPROXIMATELY ZERO WITH THE SWITCH CLOSED, EITHER THE SWITCH IS BAD OR THERE IS A PROBLEM WITH THE WIRING.

IF THE DMM READING IS FLUCTUATING, ELECTRICAL NOISE IS BEING PICKED UP IN THE WIRING WHICH MAY CAUSE ERRATIC PROBLEMS IN THE ROTROL II IF NOT CORRECTED. OFTEN, THE PROBLEM MAY BE SOLVED BY SIMPLY CONNECTING THE CABLE'S SHIELD AND/OR THE SWITCH'S GROUND WIRE TO EARTH GROUND (USUALLY POWER GROUND). OFTEN RE–ROUTING THE WIRE TO KEEP IT AWAY FROM MOTORS AND MOTOR WIRING WILL SOLVE THE NOISE PICKUP PROBLEM.

INPUT SWITCH TESTING

TO TEST A SWITCH INPUT, DISCONNECT ONE OF IT'S WIRES FROM THE TERMINAL STRIP. ENSURE THAT THE GREEN LED ABOVE THE TERMINAL STRIP AND ABOVE THE LEFT TERMINAL OF THE SWITCH INPUT PAIR IS NOT ON. USE A SHORT WIRE LOOP AND SHORT BETWEEN THE SWITCH'S TERMINAL PAIR. THE GREEN LED SHOULD LIGHT WITH THE SHORT ACROSS THE TERMINALS.

IF THE LED LIGHTS WITH THE WIRE SHORT, AND GOES OUT WHEN THE WIRE IS REMOVED, THE INPUT CIRCUIT IS WORKING CORRECTLY. IF NOT, THE ROTROL II PC BOARD SHOULD BE REPLACED.

IF THE LED WORKS CORRECTLY, THE DISPLAY SHOULD ALSO SHOW THE SWITCH CLOSURE I.E. LOW PRESSURE, TANK FULL, ETC.

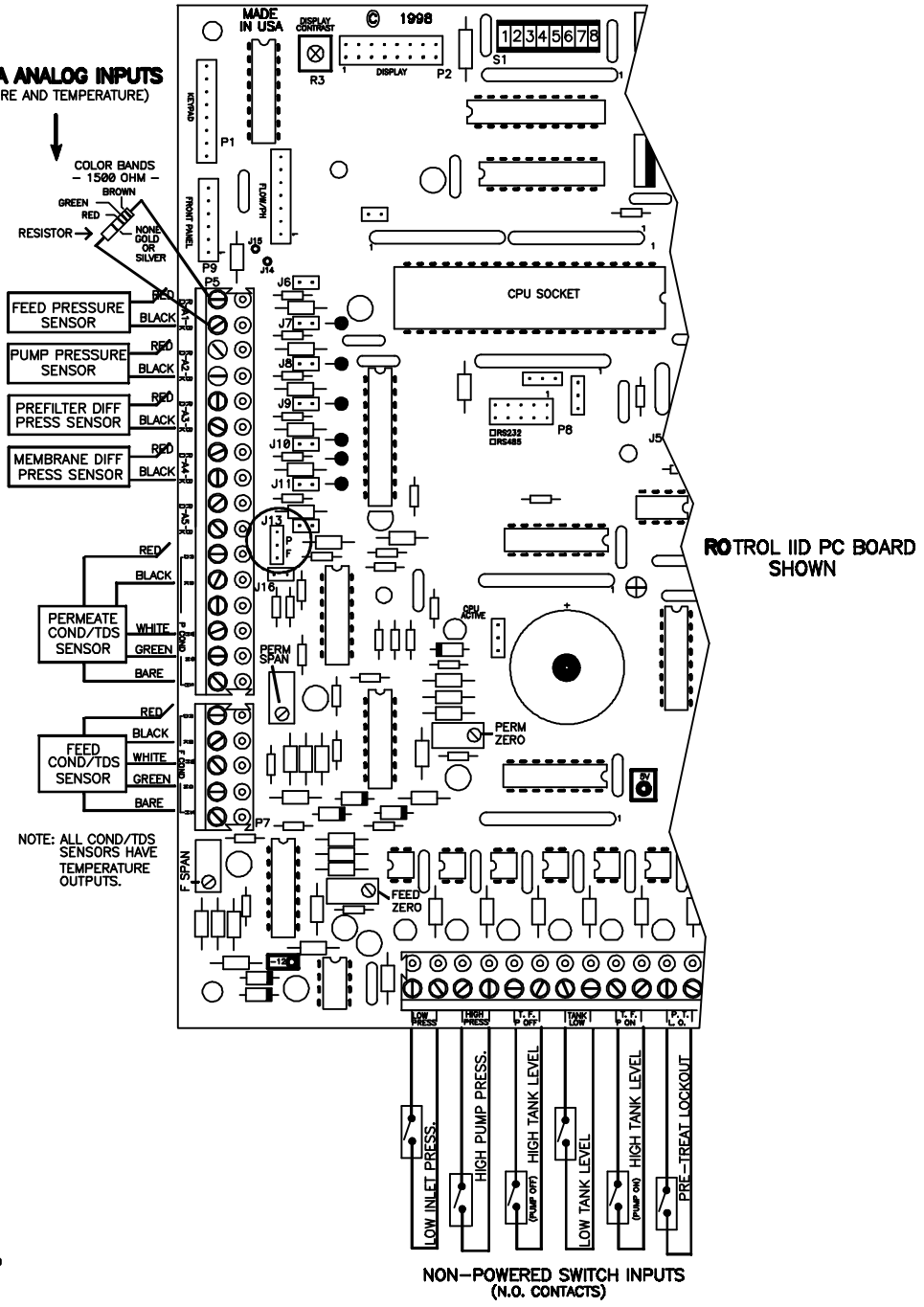
IF THE LED WORKS CORRECTLY BUT THE LCD DOESN'T INDICATE THE INPUT'S STATUS WHEN THE INPUT IS SHORTED, THE ROTROL II PC BOARD SHOULD BE REPLACED.

IF ALL THE ABOVE TESTS SHOW THE ROTROL II TO BE WORKING CORRECTLY BUT DOESN'T SHOW A CONTACT CLOSURE WHEN THE MONITORED CONDITION (TANK FULL, ETC.) EXISTS, THEN THE SWITCH IS BAD OR IMPROPERLY ADJUSTED OR THERE IS A PROBLEM WITH IT'S WIRING.

ROTROL II

INPUT CIRCUIT TESTING WITH A DIGITAL MULTIMETER (DMM)

Figure 18



PRESSURE AND TEMPERATURE TESTING

THE ROTrol II ANALOG INPUTS (PRESSURE AND TEMPERATURE), MAY BE EASILY AND QUICKLY TESTED USING RESISTORS TO SIMULATE THE SENSOR INPUTS.

ONE OR MORE 1500 OHM 1/2 WATT RESISTORS ARE RECOMMENDED FOR TESTING THE PRESSURE AND TEMP–ERATURE INPUTS.

BEFORE ATTEMPTING TO TEST ANY INPUT, DISCONNECT ALL RED SENSOR WIRES AS SHOWN. THEN, EACH INPUT MAY BE TESTED BY CONNECTING A RESISTOR TO EACH INPUT TERMINAL PAIR AS SHOWN AND OBSERVING THE DISPLAY READING FOR THE INPUT.

THE READINGS SHOULD BE TYPICALLY 70–80 PSI FOR 125 PSI PRESSURE SENSORS, 140–160 PSI FOR 400 PSI PRESSURE SENSORS, AND 70–80 DEG. FOR TEMPERATURE INPUTS. (REMEMBER TO SELECT THE DESIRED TEMPERATURE SIGNAL WITH THE "P/F" JUMPER.)

IF EACH READING IS CORRECT WITH THE RESISTOR CONNECTED, RECONNECT THE SENSORS ONE AT A TIME AND OBSERVE THE READINGS ON THE DISPLAY. IF THE READING FOR A PARTICULAR INPUT IS CORRECT WITH THE RESISTOR CONNECTED BUT NOT WITH THE SENSOR CONNECTED, THE SENSOR SHOULD BE REPLACED.

IF THE READING WITH THE RESISTOR IS NOT CORRECT, REMOVE THE SENSOR'S BLACK WIRE AND RE–TEST. IF THE READING IS CORRECT WITH THE WIRE REMOVED, THE PC BOARD IS GOOD. RE–CONNECT THE SENSOR (BOTH WIRES) AND CHECK THE DISPLAY READING. IF THE READING IS CORRECT, THE SENSOR IS GOOD. IF NOT, REPLACE THE SENSOR.

IF THE READINGS ON ALL CONNECTED SENSORS GO BAD WHEN ONE SENSOR IS CONNECTED, THAT SENSOR SHOULD BE REPLACED. (THE +15VDC POWER FOR THE SENSORS CAN BE "PULLED DOWN" BY A SINGLE BAD SENSOR AND CAUSE ALL READINGS TO BE BAD.)

TDS/CONDUCTIVITY TESTING

THE TDS/CONDUCTIVITY CIRCUITS MAY BE TESTED BY CONNECTING RESISTORS TO THE GREEN AND WHITE INPUT TERM–INALS OF THE SENSORS' CORRESPONDING TERMINAL STRIPS.

THE VALUES OF THE RESISTORS USED WILL DETERMINE THE READINGS THAT WILL BE SHOWN ON THE LCD DISPLAY BUT THE RELATIONSHIP BETWEEN THE RESISTOR VALUE AND THE READING IS NOT AS SIMPLE AS THE RELATIONSHIP BETWEEN THE 1500 OHM RESISTOR AND THE TEMPERATURE AND PRESSURE READINGS ABOVE.

THERE ARE SEVERAL DIFFERENT RANGES OF TDS AND/OR CONDUCTIVITY OFFERED FOR THE ROTrol II AND THE READING OBTAINED FROM A RESISTOR WILL BE DETERMINED NOT ONLY BY THE RESISTOR VALUE BUT ALSO BY THE CALIBRATION OF THE ROTrol II BEING TESTED.

A RESISTOR ASSORTMENT OF 1000; 4700; 10,000; 22,000; AND 47,000 OHMS SHOULD BE ADEQUATE FOR TESTING ANY ROTROL II CALIBRATED FOR ANY OF THE STANDARD RANGES OFFERED. TYPICALLY, THESE RESISTORS COST 10 TO 20 CENTS EACH EACH SO THE MONETARY INVESTMENT IS MINIMAL FOR SUCH AN ASSORTMENT.

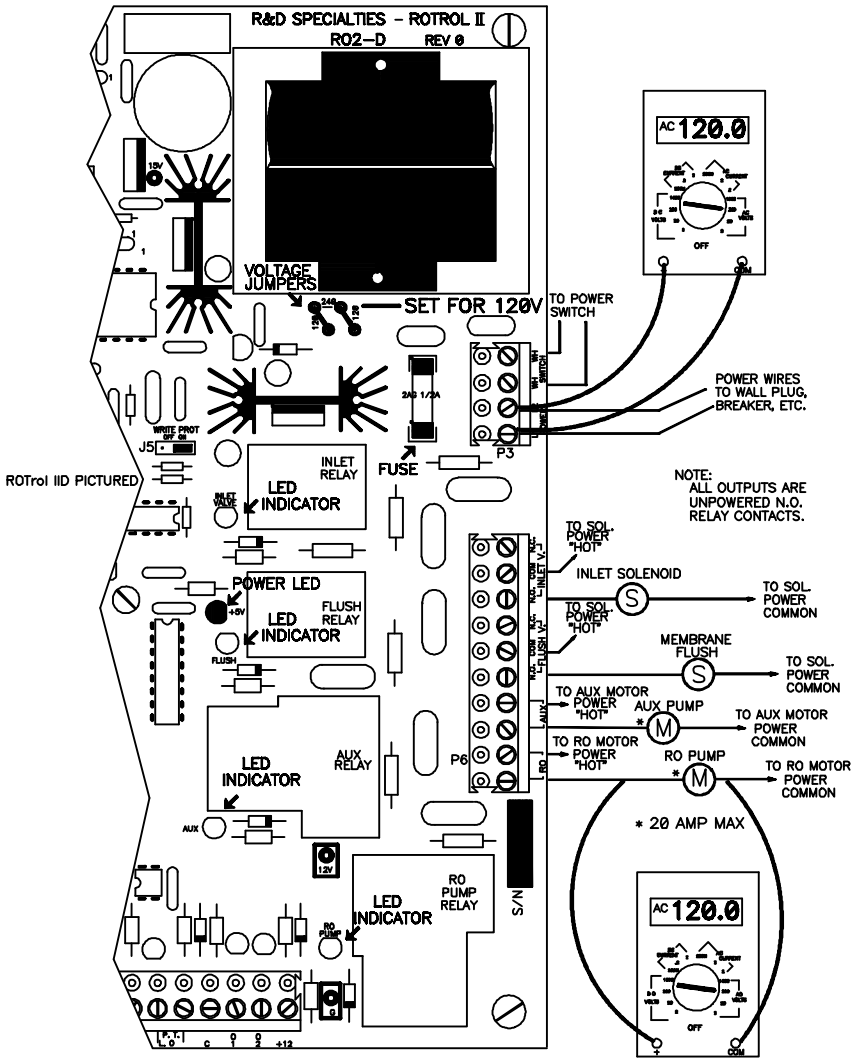
TO TEST A TDS/CONDUCTIVITY CIRCUIT, SIMPLY CONNECT A RESISTOR TO THE GREEN AND WHITE TERMINALS OF THE TERMINAL STRIP AND OBSERVE THE READING.

USE THE LOWER VALUE RESISTORS TO TEST THE HIGHER RANGES OF TDS OR CONDUCTIVITY AND VISE VERSA. REGARD–LESS OF THE CALIBRATED RANGE, ANY OF THE HIGH VALUE RESISTORS SHOULD GIVE A READING OTHER THAN "0".

ROTROL II

ANALOG CIRCUIT TESTING WITH TEST RESISTORS

Figure 19



TROUBLESHOOTING NOISE PROBLEMS

VALVES AND MOTORS ARE ELECTROMAGNETIC DEVICES THAT GENERATE ELECTRICAL NOISE (VOLTAGE SAGS OR SURGES) WHEN THEY OPERATE. THIS ELECTRICAL NOISE CAN CAUSE MOMENTARY MALFUNCTIONS IN ELECTRONICS EQUIPMENT IF THE NOISE FINDS ITS WAY INTO THE ELECTRONICS CIRCUITRY.

IF ELECTRICAL NOISE PROBLEMS ARE ENCOUNTERED, THE ROTrol II MAY MOMENTARILY MALFUNCTION IN A VARIETY OF WAYS.

USUALLY, A MICROPROCESSOR RESET WILL OCCUR WHEN THE NOISE IS ENCOUNTERED. IF THE UNIT IS SHUTTING DOWN A PUMP OR CLOSING A VALVE, IT MAY RESTART THE PUMP OR OPEN THE VALVE SEVERAL TIMES BEFORE FINALLY OPERATING PROPERLY. ALSO, THIS REACTION WILL USUALLY BE VERY ERRATIC OCCURING ONLY OCCASSIONALLY. ALSO, IT MAY OPERATE OTHER DEVICES DURING THIS REACTION.

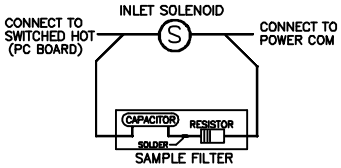
ALTHOUGH CIRCUITS IN THE ROTrol II ARE DESIGNED TO REJECT MOST ELECTRICAL NOISE, DUE TO THE WIRING AND/OR DEVICES OPERATED BY THE ROTrol II, SOME NOISE MIGHT OCCASSIONALLY GET INTO THE CIRCUITRY.

FORTUNATELY, NOISE PROBLEMS CAN USUALLY BE PREVENTED OR SOLVED USING INEXPENSIVE NOISE FILTERS CONNECTED ACROSS THE VALVE OR MOTOR GENERATING THE NOISE.

IT IS ALWAYS ADVISABLE TO EMPLOY NOISE FILTERS WHEN OPERATING ELECTROMAGNETIC DEVICES WITH ELECTRONIC CONTROLLERS. IF R&D SPECIALTIES SUPPLIES THE ROTrol II WITH AN OVERSIZED ENCLOSURE AND WITH PRE-WIRED POWER DISTRIBUTION TERMINAL STRIPS, NOISE FILTERS WILL BE SUPPLIED. IF THE ROTrol II IS SUPPLIED IN ITS GENERIC FORM (STANDARD ENCLOSURE), IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE ALL POWER WIRING, AND ANY NOISE FILTERING.

IT IS ADVISABLE TO INSTALL FILTERS IN ALL CASES SIMPLY TO AVOID POSSIBLE PROBLEMS. FILTERS MAY BE PURCHASED FROM ELECTRONIC SUPPLY HOUSES, OR R&D SPECIALTIES OR CONSTRUCTED FROM COMMONLY AVAILABLE ELECTRONIC PARTS.

A SUGGESTED FILTER IS SHOWN BELOW.



SAMPLE FILTER

CAPACITOR – .1uF 400V OR HIGHER
RESISTOR – 47 OHM 1/2 WATT

CONNECT FILTER ACROSS DEVICE AS SHOWN

TROUBLESHOOTING POWER PROBLEMS

WARNING! DANGEROUS VOLTAGES PRESENT PROCEED WITH CAUTION!

WHEN THE CORRECT AC POWER IS APPLIED TO THE ROTrol II, AND THE POWER SWITCH IS SWITCHED ON, THE GREEN POWER LED ON THE ROTrol II PC BOARD SHOULD LIGHT.

IF THE LED DOES NOT LIGHT, VISUALLY CHECK THE VOLTAGE SELECT JUMPERS FOR THE CORRECT SETTING (120V SHOWN IN PICTURE).

IF THE JUMPER SETTING IS CORRECT, MEASURE THE VOLTAGE ON THE POWER TERMINALS WITH A DMM AS SHOWN.

IF THE VOLTAGE IS NOT PRESENT OR CORRECT, ENSURE THAT THE POWER WIRES ARE INTACT BY TRACING THEM BACK TO THE POWER SOURCE (WALL PLUG, BREAKER BOX, ETC) AND ENSURE THAT THE PLUG OR BREAKER IS "HOT". CORRECT ANY PROBLEMS FOUND.

IF THE VOLTAGE READING IS CORRECT ON THE POWER TERMINALS, MEASURE THE VOLTAGE BETWEEN TERMINAL 1 (COM) OF THE TERMINAL STRIP AND TERMINAL 3, TERMINAL 4, AND EACH END OF THE FUSE. IF THE VOLTAGE IS CORRECT ON TERMINAL 3 AND NOT ON TERMINAL 4, EITHER THE POWER SWITCH OR ITS WIRING IS BAD. CORRECT THE PROBLEM BY REPLACING THE SWITCH OR BROKEN WIRE.

IF THE VOLTAGE IS CORRECT ON TERMINAL 4 BUT NOT ON BOTH ENDS OF THE FUSE, REPLACE THE FUSE.

IF THE VOLTAGE IS CORRECT ON BOTH ENDS OF THE FUSE, UNPLUG THE DISPLAY'S RIBBON CABLE. IF THE POWER LED LIGHTS, THE DISPLAY ASSEMBLY SHOULD BE REPLACED. IF THE LED STILL DOES NOT LIGHT, THE PC BOARD SHOULD BE REPLACED.

TROUBLESHOOTING OUTPUT CIRCUITS

WARNING! DANGEROUS VOLTAGES PRESENT PROCEED WITH CAUTION!

THE OUTPUT CIRCUITRY OF THE ROTrol II IS DESIGNED TO TURN THE OPERATING POWER FOR THE RO UNIT'S VALVES AND MOTORS ON AND OFF. **THE ROTrol II DOES NOT SUPPLY POWER IT SIMPLY SWITCHES THE POWER FEEDING EACH OUTPUT CIRCUIT.**

EACH OUTPUT CIRCUIT (RELAY CONTACT) IS UNIQUELY INDEPENDENT FROM ALL OTHERS. THIS ALLOWS THE CONTROLLED DEVICES (VALVES, MOTORS, ETC.) TO BE OPERATED AT DIFFERENT VOLTAGES – i.e. THE VALVES MAY BE OPERATED FROM ONE POWER SOURCE, AND THE MOTORS MAY BE OPERATED FROM A DIFFERENT POWER SOURCE. AS AN EXAMPLE, IT IS NOT UNUSUAL TO OPERATE THE VALVES AND AUX (RP) PUMP FROM 120V AND THE RO PUMP FROM 240V.

THIS INDEPENDENT ARRANGEMENT ALLOWS A LOT OF FLEXIBILITY IN SELECTING THE VALVES AND MOTORS FOR AN RO UNIT, BUT IT ALSO COMPLICATES THE TROUBLESHOOTING OF THIS CIRCUITRY AS THE WIRING FOR THESE DEVICES MAY VARY CONSIDERABLY BETWEEN RO UNITS.

THE FIRST STEP IN TROUBLESHOOTING THE OUTPUT CIRCUITRY IS TO DETERMINE EXACTLY HOW THE VALVES, MOTORS, PC BOARD, AND POWER SOURCE(S) ARE WIRED. TURN OFF ALL POWER FEEDING THE RO UNIT AND PHYSICALLY TRACE OUT ALL POWER AND CONTROL WIRING. PAY PARTICULAR ATTENTION TO ANY WIRE NUTS OR OTHER CONNECTORS USED AND ENSURE THAT ALL CONNECTIONS ARE CLEAN AND TIGHT. OFTEN, THE PROBLEMS ARE CORRECTED DURING THIS INSPECTION.

AFTER DETERMINING HOW THE VALVES AND MOTORS ARE WIRED, THE UNIT MAY BE POWERED UP AND TROUBLESHOOTING OF ANY PROBLEMS MAY BEGIN. IT WOULD BE HELPFUL TO READ THE "SYSTEM OPERATION" SECTION OF THE ROTrol II MANUAL (APPROX 3 PAGES) TO ENSURE THAT THE FUNCTIONAL OPERATION OF THE OUTPUT CONTROL CIRCUITRY IS THOROUGHLY UNDERSTOOD i.e. WHEN SHOULD EACH CONTROL RELAY OPERATE AND WHEN SHOULD IT NOT OPERATE.

EACH RELAY WHICH OPERATES A VALVE OR MOTOR HAS A RED LED ON THE PC BOARD THAT LIGHTS WHEN THE RELAY OPERATES. IF A VALVE OR A MOTOR IS NOT TURNING ON, CHECK THE CORRESPONDING LED ON THE PC BOARD TO ENSURE THAT THE RELAY IS OPERATING. IF THE LED IS OFF, CHECK FOR ANY ERROR CONDITIONS (LOW PRESSSURE, HIGH PRESSURE, ETC.) OR ANY NORMAL SHUT-DOWN CONDITIONS (PRE-TREAT LOCKOUT, TANK FULL, ETC.) THAT WOULD PREVENT THE RELAY FROM OPERATING. USE THE GREEN INPUT LED INDICATORS AND THE LCD DISPLAY TO DETERMINE THESE CONDITIONS. IF THE RELAY SHOULD BE ON BUT ISN'T, REPLACE THE PC BOARD.

IF A RELAY'S LED IS ON BUT THE CONTROLLED DEVICE (VALVE OR MOTOR) IS NOT OPERATING, MEASURE THE VOLTAGE ACROSS THE DEVICE WITH A DMM. IF THE CORRECT VOLTAGE IS PRESENT, THE DEVICE SHOULD BE REPLACED.

IF THE CORRECT VOLTAGE IS NOT PRESENT, MEASURE BETWEEN THE DEVICE'S POWER COMMON AND THE PC BOARD TERMINAL STRIP. IF THE VOLTAGE IS CORRECT BETWEEN THE "HOT" TERMINAL AND COMMON BUT NOT BETWEEN THE TERMINAL FEEDING THE DEVICE, REPLACE THE PC BOARD. IF THE VOLTAGE IS NOT CORRECT BETWEEN THE "HOT" TERMINAL AND COMMON, TRACE THE "HOT" WIRE BACK TO ITS POWER SOURCE AND CORRECT THE PROBLEM (TRIPPED BREAKER, BLOWN FUSE, OPEN WIRE, ETC.)

ROTrol II

POWER AND OUTPUT TESTING WITH A DIGITAL MULTIMETER (DMM)

Figure 20

R & D SPECIALTIES

R & D SPECIALTIES

SERIES 150

RO CONTROLLER

USERS MANUAL

Document: Series 150 V1.0
Released: July 2001

R & D Specialties
9918 W. I-20
Midland, Texas USA 79706
915 561-5707
Fax 915 561-5696
www.rdspec.com
E-mail rdspec@rdspec.com

LIMITED WARRANTY

R & D Specialties warrants to the original purchaser that the products it manufactures will be free from defects in material and workmanship for a period of twelve months from the date of shipment on parts and ninety days on labor. Some non R & D Specialties manufactured resale items may have warranty periods less than twelve months. R & D Specialties obligation under this warranty is limited exclusively to the repair or replacement of any product that R & D Specialties finds to be defective. Items returned for warranty consideration must have a return authorization number and be properly packaged, shipped prepaid and insured. This warranty is valid only when the products are properly installed, maintained and used for the purpose for which they were designed. Misuse, neglect, damage, accident, improper repair, or modification not authorized in writing by R & D Specialties will void this warranty.

There are no warranties, expressed or implied, including the implied warranties for merchantability or fitness for a particular purpose that extend beyond the limited warranty expressly stated above. R & D Specialties liability to any purchaser of its products, whether in contract or in tort, and whether arising out of warranties, representations, instructions, installations, or defects from any cause, will be limited exclusively to repairing or replacing the product or any part thereof under the conditions set out above.

TABLE OF CONTENTS

FIGURES AND TABLES

INTRODUCTION

The R & D Specialties Series 150 controller is a state of the art control system for commercial and industrial reverse osmosis systems. The Series 150 combines features that have not previously been available in one compact unit.

The Series 150 is a microprocessor controlled system that can monitor pressure and level switches. A TDS/Conductivity monitor/controller with programmable Setpoints is an integral part of the Series 150. The Series 150 displays system status and sensor and switch input status on an easy to read backlit display. User programmable Setpoints are provided that allow fast and easy adjustment of system parameters.

SPECIFICATIONS

Power:
120/240 VAC -15+10%, 50/60Hz, 25Watts

Environment:
-22°F to 140°F, 0-95% RH, noncondensing

Enclosure:
8" X 6" X 4" (203mm X 152mm X 102mm) NEMA 4X

Display:
2 line X 20 character, alphanumeric backlit LCD

Front Panel:
Overlay with LCD window, alarm lamp, 7 key membrane switch

Switch Inputs, Dry Contact:
Pressure fault
Pretreat lockout
Tank full high
Tank full low

Relay Outputs:

RO pump relay	120/240VAC, 1HP
Inlet valve relay	120/240VAC, 5A
Flush valve relay	120/240VAC, 5A

Relays supply same output voltage as board power (120 or 240 VAC)

Cell:

Tds/Conductivity cell with digital display, standard range, 0-250PPM or uS. Other ranges available:0-50, 0-100, 0-500, 0-1000. Wetted parts ABS and 316SS, 3/4" NPT, 300 PSI max.

Optional I/O expander:

Auxiliary/divert relay	120/240VAC, 1HP
Divert/alarm relay	120/240VAC, 5A
Tank low switch input, dry contact	

FRONT PANEL CONTROLS AND INDICATORS

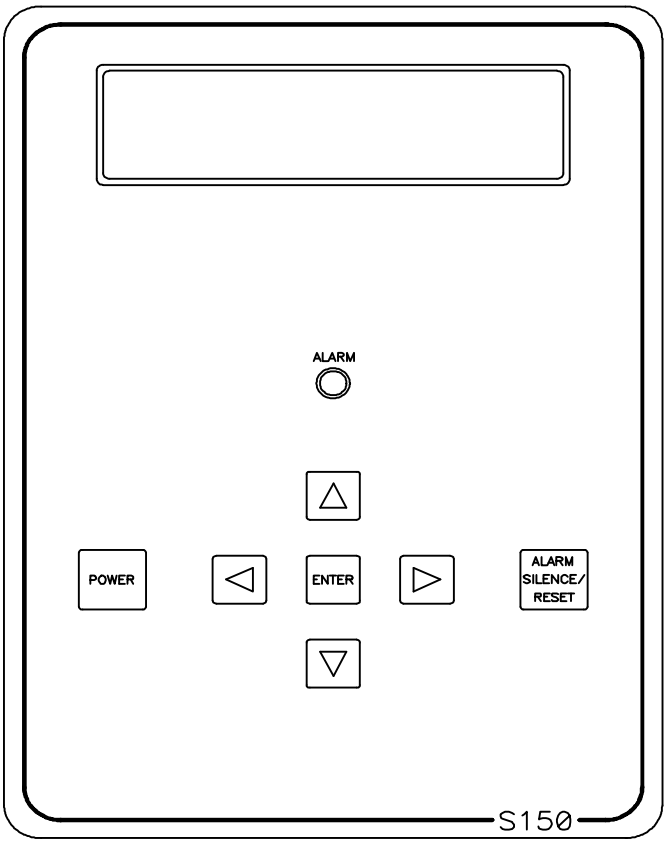


Figure 1

DISPLAY - Shows status of system.

ALARM LAMP - Flashes when fault causes an RO system shut down.
On steady when a Setpoint is exceeded that does not cause an RO system shut down.

POWER KEY - Places controller in operating or standby mode.

LEFT ARROW KEY - Scrolls through Setpoints starting with first Setpoint.

RIGHT ARROW KEY - Scrolls through Setpoints starting with last Setpoint.

UP ARROW KEY - Increases value of Setpoint.

DOWN ARROW KEY - Decreases value of Setpoint

ENTER KEY - Confirms entry of new Setpoint value

ALARM SILENCE/RESET KEY - Push once for alarm silence and twice to reset system after a shut down has occurred.

INSTALLATION

Physical Installation

Mount the Series 150 in a convenient location on the RO equipment using the four mounting ears provided with the unit or the optional panel mounting bracket.

NOTE: All terminals on the board are labeled.

Terminal Strip, Jumper and Adjustment Locations

Refer to figure 2 for the location of all terminal strips and connectors. Figure 2 also shows all jumper and adjustment locations. Figure 3 shows a sample wiring diagram.

Power Wiring

Refer to figure 2-3 for terminal strip and jumper locations. Before applying power to the unit, verify that the voltage jumpers are configured correctly for the voltage that will power the unit. The voltage jumpers are located below the transformer. For 120VAC operation, there should be a wire jumper installed between P2 and P3 and a second wire jumper installed between P4 and P5. For 240VAC operation, a single wire jumper should be installed between P3 and P4.

AC power for the unit is connected to terminal strip P1. Connect the ground wire of the AC power to the terminal labeled GND. For AC power with a neutral and hot wire, the hot wire connects to L1 and the neutral wire connects to L2. For AC power with 2 hot wires, either wire can connect to L1 and L2. On AC power with 2 hot wires, the wire jumper between P6 and P7 should be removed and a fuse(GMA 1/4A) installed in F2.

Pump and Valve Relay Outputs

The Series 150 supplies relay outputs to control the RO pump and solenoid valves. NOTE: The relays output the same voltage as the AC power to the board. If the pump and solenoids operate on different voltages, a contactor will need to be supplied to operate the pump.

RO Pump Wiring

The RO pump connects to the L1 and L2 RO pump terminals of P1. This output can operate 120/240VAC motors up to 1HP directly. For motors larger than 1HP or 3 phase motors, this output can be used to operate a contactor.

Inlet and Flush Valve Wiring

The inlet and flush valves must operate at the same voltage as supplied to the board. These outputs can supply 5A maximum and are not designed to operate pump motors directly. If these outputs are to be used to operate a boost or flush pump, the output should be used to operate a contactor. The inlet valve connects to the L1 and L2 inlet terminals of P1. The flush valve connects to the L1 and L2 flush terminals of P1.

TDS/Conductivity Cell Wiring

For accurate TDS/Conductivity readings, the cell should be installed in a tee fitting where a continuous flow of water passes over the cell and no air can be trapped around the cell. Refer to figure 5 for example installation. The cell is connected with 5 wires to terminal strip P10. Connect each colored wire to the terminal labeled with the same color.

Switch Inputs

Switch inputs are connected to P9. The connections for these inputs are not polarity sensitive and can be connected to either terminal. The switch inputs should be dry contact closures only. **NOTE:** Applying voltage to these terminals will damage the controller. The switches can be either normally open or normally closed in any combination. The switch connected to an input that is configured as normally open must be open for the unit to run. The switch connected to an input that is configured as normally closed must be closed for the unit to run. The Switch Select Setpoint allows each input to be configured as normally open or normally closed. The Switch Select Setpoint is defaulted to 0 which programs all inputs as normally open. Table 1 lists the values used to program the Setpoint to configure the inputs.

SWITCH	N.O.	N.C.	VALUE
PRESSURE FAULT	0	1	
PRETREAT	0	2	
TANK FULL HIGH	0	4	
TANK FULL LOW	0	8	
TANK LOW	0	16	
		TOTAL	

TABLE 1

Select the type of switch used for each input and put that number in the value column. Add the values and program the total in the Switch Select Setpoint. For example, if the pressure fault and tank low inputs were normally closed and all others normally open, the value programmed in the Switch Select Setpoint would be 17(1 + 16)

Pressure Fault Switch

On systems where a low feed pressure shut down is required, a feed pressure switch can be connected to the pressure fault input of P9. If a high pump pressure shut down is required, a high pressure switch can be connected to this input. If both low feed pressure and high pump pressure shut down are required, both switches can be connected to this input. Both switches must be either normally open or normally closed to operate properly.

Pretreat Switch

In systems with pretreatment, a pretreat lockout switch can be connected to the pretreat input of P9. This switch should operate when the pretreatment device is out of service. NOTE: The output from the pretreatment device must be a dry contact and must not supply voltage.

Tank Full Switch

In systems with a single tank level switch for controlling the RO pump, the level switch connects to the tank full high input of P9. If dual level switches are used for controlling the RO pump, the upper level switch connects to the tank full high input of P9 and the lower level switch connects to the tank full low input of P9.

I/O Expander Board

If the optional I/O expander board is installed, 2 additional relay outputs and 1 additional switch input are provided. Refer to figure 4 for the location of terminal strips, jumpers and wiring for this board. AC power for the relays is connected to the L1 and L2 power terminals of P1. Relay 1 is connected to this power input and will supply the same voltage. This relay is rated for 120/240VAC at 1HP maximum. Relay 2 can be selected to supply voltage, 120/240, 5A maximum, or as a dry contact output. Jumpers J1-J4 are used to select the relay 2 output type. To output voltage, a wire jumper is installed between J1 and J4 and a second wire jumper is installed between J2 and J3. For a contact closure output, a single wire jumper is installed between J3 and J4. The 2 relay outputs can be selected to operate as an auxiliary pump output, a divert output or an alarm output by programming the Expander Mode Setpoint. Table 2 shows the values used to program the relay outputs.

EXPANDER MODE	RELAY 1	RELAY 2
0	AUXILIARY PUMP	DIVERT
1	AUXILIARY PUMP	ALARM
2	DIVERT	ALARM

TABLE 2

Auxiliary Pump

If the Expander Mode Setpoint is programmed to 0 or 1, relay 1 operates as an auxiliary pump output. This output always supplies the voltage applied to the power input and is energized when the tank low input is not active.

Divert Output

If the Expander Mode Setpoint is programmed to 0, relay 2 operates as a divert relay and will supply power whenever the unit is in the divert mode. If the Expander Mode Setpoint is programmed to 2, relay 1 operates as a divert relay and when in the divert mode, will supply voltage or provide a contact closure based on the position of jumpers J1-J4.

Alarm Output

If the Expander Mode Setpoint is programmed to 1 or 2, relay 2 operates as an alarm relay. When an alarm or warning is active, this relay will supply voltage or provide a contact closure based on the position of jumpers J1-J4.

Tank Low Switch

A tank low switch input can be connected to the tank low input of P2 on the expander board. This input will provide a tank low warning on the unit and if the expander is programmed to provide an auxiliary pump output, will provide low tank level protection for this pump.

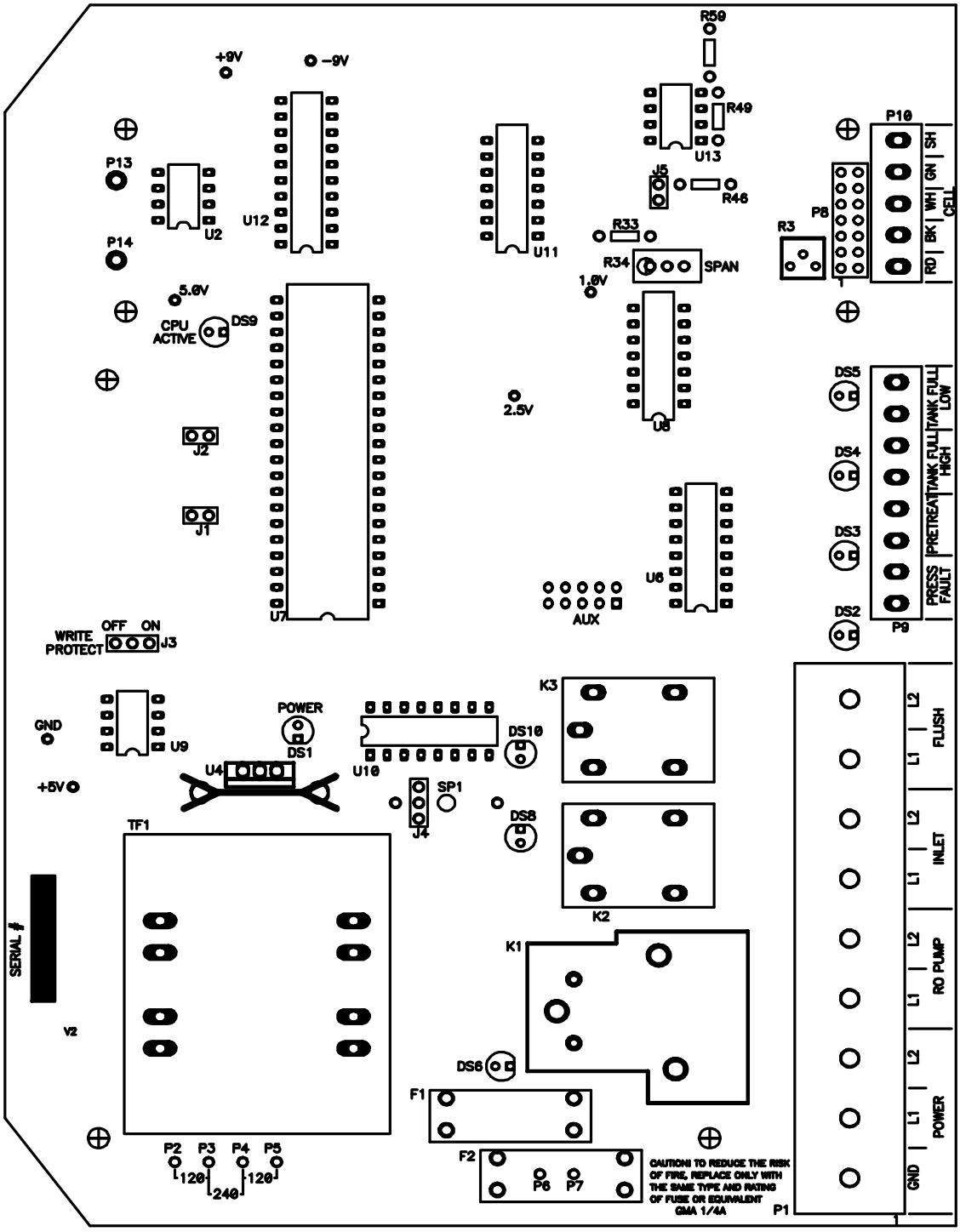

R59
+9V
-9V
R49
U13
P10
P13
U2
U12
U11
J5
R46
SH
GN
WH
BK
RD
CELL
P8
R3
P14
R33
R34
SPAN
1.8V
5.0V
CPU ACTIVE
DS9
U8
2.5V
DS5
DS4
DS3
DS2
TANK FULL LOW
TANK FULL HIGH
PRETREAT
PRESS FAULT
P9
J2
J1
U7
U6
AUX
WRITE PROTECT
OFF
ON
J3
GND
U9
POWER
DS1
U4
U10
DS10
K3
+5V
SP1
J4
DS8
TF1
K2
K1
SERIAL #
V2
DS6
F1
F2
P2
P3
P4
P5
120
240
120
P6
P7
CAUTION! TO REDUCE THE RISK OF FIRE, REPLACE ONLY WITH THE SAME TYPE AND RATING OF FUSE OR EQUIVALENT GMA 1/4A
P1
L2
L1
FLUSH
INLET
RO PUMP
POWER
GND

Figure 2

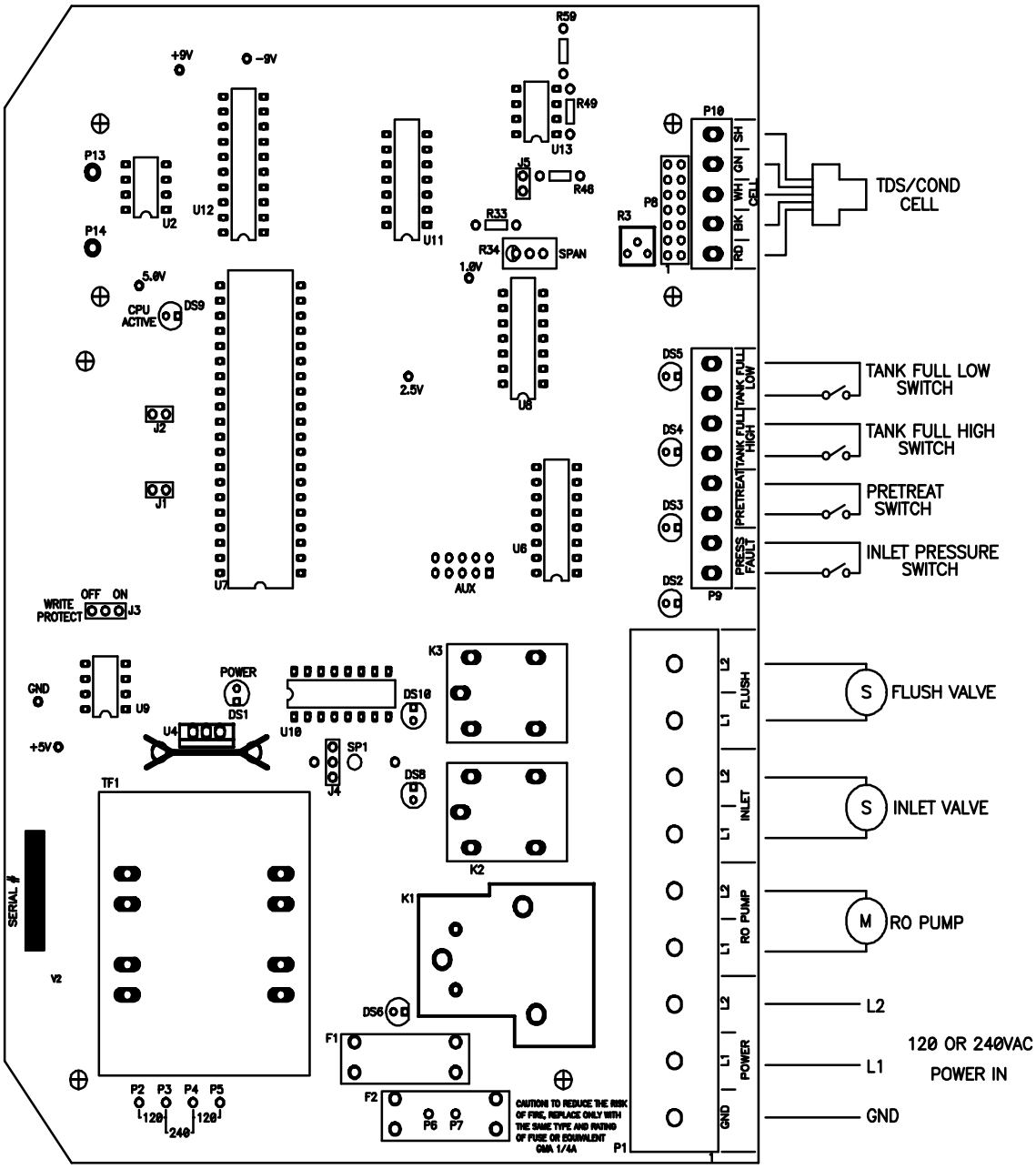

TDS/COND CELL
TANK FULL LOW SWITCH
TANK FULL HIGH SWITCH
PRETREAT SWITCH
INLET PRESSURE SWITCH
FLUSH VALVE
INLET VALVE
RO PUMP
L2
L1
120 OR 240VAC
POWER IN
GND

Figure 3

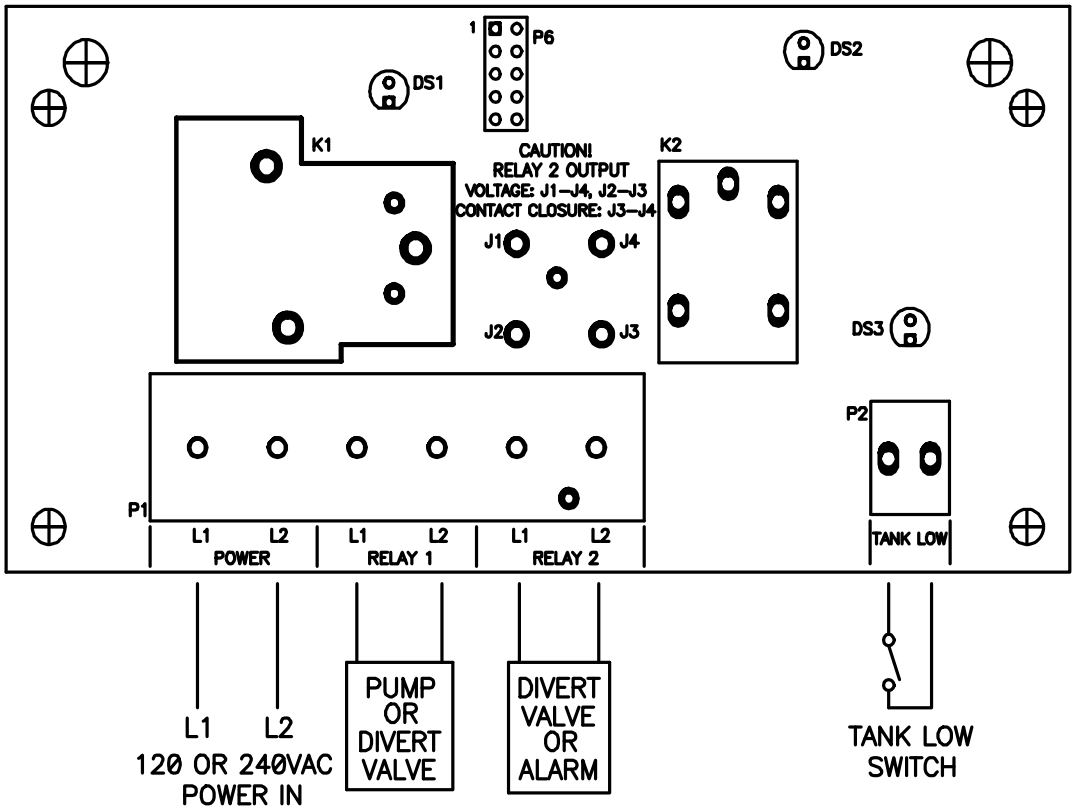


Figure 4

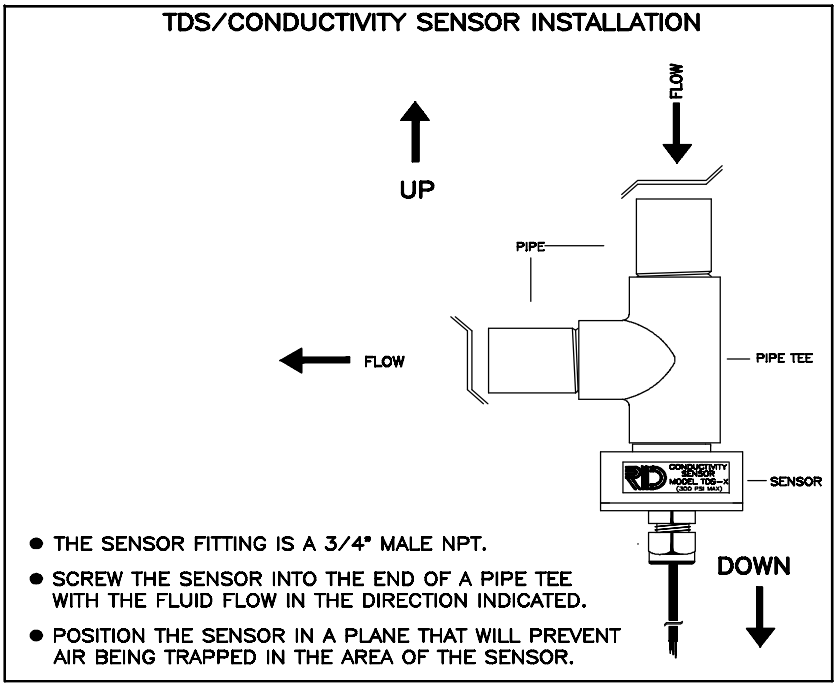


Figure 5

STANDARD SETPOINTS

SETPOINT	DESCRIPTION	RANGE	DEFAULT
TDS/Cond Limit	When this value is met or exceeded, the alarm lamp will light and high TDS/Cond will show on the display. To disable, set to 0.	0-999 uS or PPM	100
TDS/Cond Delay	When the limit Setpoint is exceeded, no alarm will be given until this time has expired.	0-999 seconds	30
RO Start Delay	The amount of time between the inlet valve opening and the RO pump start.	0-99 seconds	5
Press Fault Delay	The time a pressure fault must be active before a pressure fault shut down occurs.	0-99 seconds	5
Auto Reset	When a pressure fault shut down is active, the system will attempt to restart after this delay. If set to 0, system must be manually reset.	0-99 minutes	60
Alarm Silence	If the audible alarm is silenced, after this delay, the alarm will resound. If set to 0, the alarm will remain silenced.	0-99 minutes	0
TF Restart Delay	When a tank full condition clears, the system will restart after this delay.	0-99 sec/min	5
TF Restart	Selects whether the tank full restart delay is in seconds or minutes. 0=seconds, 1=minutes.	0-1	0
TFO Time	The amount of time that a tank full override lasts.	0-9 minutes	5
Tank Lo Restart	When a tank low condition clears, the auxiliary pump will restart after this delay.	0-99 Minutes	15
Flush Type	Selects the type of flush. Set to 0 to disable flush.	0-8	0
Flush Time	The length of time a membrane flush cycle will last when flush is active.	0-99 minutes	5

SETPOINT	DESCRIPTION	RANGE	DEFAULT
Flush Interval	The interval between flush cycles. Only valid with op hour, elapsed time or off flush types.	0-99 hours	24
Flush Mode	Selects if the inlet and RO pump relays operate during flush.	0-3	0
Maximum Hours	If the current operating hours exceed this limit, the operating hours warning will occur. To disable, set to 0.	0-65000 hours	0
Current Hours	Current number of hours of RO system operation.	0-65000	0
Expander Mode	Selects how the relays on the I/O expander board operate.	0-2	0
Temp Offset	Allows adjustment of temperature reading by +-5 degrees.	-5 - +50	
Temp UOM	Selects display of temperature in °F or °C	0-1	0
Switch Select	Selects if switch inputs are normally open or normally closed.	0-32	0
TDS/Cond UOM	Selects display of water quality in uS or PPM NOTE: If this Setpoint is changed, the unit must be recalibrated.	0-1	0
TDS/Cond Range	Selects range of TDS/Conductivity monitor 0-50, 1-100, 2-250, 3-500, 4-1000, 5-2500 6-5000 NOTE: If this Setpoint is changed, the unit must be recalibrated.	0-6	2

TO DISPLAY OR CHANGE SETPOINTS

1. Refer to figure 1 for the location of the keys used to display or change the Setpoints and figure 2 for the location of the write protect jumper, J3. For the unit to be able to accept a change in a Setpoint, the shorting jumper must be in the off position(center and left pins). **NOTE:** Setpoints cannot be changed if the write protect jumper is in the ON position.

2. Use the Left and Right arrow keys to display the Setpoints. Each press of an arrow key will advance the display to the next Setpoint. The Left arrow key starts with the beginning Setpoint and the Right arrow key starts with the last Setpoint.

3. The Up and Down arrow keys are used to increment or decrement the Setpoint value. The value will change by 1 count each time a key is pressed. If the key is pressed and held for ~1 second, the Setpoint value will change at a fast rate. When the key is released, the fast rate will be reset. Pressing both the Up and Down arrow keys together will reset the Setpoint value to 0.

4. Pressing the Alarm Silence/Reset key at any time will cancel the operation and return the display to the main screen.

5. To accept the new Setpoint value, press the Enter key.

6. The unit will beep twice if the change is accepted. If the write protect jumper is on, the unit will show WRITE PROTECTED on the display and one long beep will sound.

7. When finished changing Setpoints, the write protect jumper should be placed in the on position(center and right pins).

SYSTEM OPERATION

General Operation

The unit has 2 modes of operation, a standby mode and an operating mode. In the standby mode, the unit is effectively off. All outputs are turned off and the display shows STANDBY. In the operating mode, the unit operates automatically. All inputs are monitored and the outputs are controlled accordingly. Pressing the Power key will toggle the unit from standby to operate or from operate to standby. If power is removed from the unit, when power is reapplied, the unit will restart in the mode it was in when power was removed.

Display

The display is a 2 line x 20 character backlit liquid crystal display. System operating status and sensor readings are shown on this display. Setpoint information is also shown on this display.

Operating Status Messages

The operating status of the unit is shown on the top line of the display. The following list describes the items shown for the operating status.

STANDBY - The unit is in the standby mode.

DELAY 99 - The unit is in the RO start delay. The number is the seconds remaining before the RO pump starts.

OPERATING - The RO unit is operating.

TANK FULL - The unit is shut down due to a tank full condition.

TANK FULL 99 - The unit is shut down due to a tank full condition. If the number is blinking, the tank full high switch has cleared, but the tank full low switch is still active. If the number is on steady, both tank level switches have cleared and the delay is counting down.

PRETREAT - The unit is shut down due to a pretreat lockout condition.

PRESS FAULT - The unit is shut down due to a pressure fault condition.

MEMB FLUSH 99 - Membrane flush is active. The number is the minutes remaining in the flush cycle.

TDS/Conductivity

The TDS/Conductivity is shown on the top line after the unit operating status. When the unit is offline because of a shut down condition, the reading is replaced with ›----: If the reading is over range, the reading is shown as ›^^^^:.

Operating Hours

The current operating hours are shown on the bottom line.

Temperature

The current water temperature is shown on the bottom line after the operating hours. When the unit is offline because of a shut down condition, the reading is replaced with ›---=.

Warning Messages

Warning messages are also shown on the second line. If any warnings are active, the active warnings will alternate with the normal displays for the bottom line. The following lists the warning messages.

HI TDS/COND - The TDS/Conductivity reading has exceeded the programmed limit.

TANK LOW - The tank low input is active.

TANK LOW 99 - The tank low input has cleared, but the tank low restart delay is active. The number is the minutes left in the delay.

OP HOURS EXCEEDED - The current operating hours have exceeded the programmed limit.

Tank Full Operation

The unit can be operated with 1 or 2 level switches. With 1 level switch, the switch is connected to the tank full high input. When this switch has been active for 5 seconds, the unit will shut down on tank full. TANK FULL will show on the display. When the tank full condition clears, the display will show TANK FULL 99. The number is the tank full restart time and the unit will restart when this delay times out.

For 2 level switch operation, the upper switch is connected to the tank full high input and the lower switch is connected to the tank full low input. When both switches are clear, the RO unit will run. The RO unit will continue to run when the water level rises and the lower switch becomes active. When the upper switch becomes active, after the 5 second delay, the RO unit will shut down. TANK FULL will show on the display. When the tank level drops and the upper level switch clears, the display will show TANK FULL 99 and the RO unit will remain off. The number is the tank full restart time and the number will blink until the lower level switch clears. When the lower level switch clears, the number will remain steady and the RO will restart when the delay times out.

Tank Full Restart

The tank full restart is the delay before the RO unit starts when a tank full condition clears. This delay can be in minutes or in seconds. The TF Restart Setpoint selects seconds or minutes.

Tank Full Override

A timed tank full override can be initiated when the RO unit is shut down due to a tank full condition. Pressing the Alarm Silence/Reset key for 3 seconds during a tank full condition will enable the tank full override. The RO will start and TF OVERRIDE 9 will show on the display. The number is the minutes remaining in the override timer. When the override times out, the unit will return to the tank full shut down condition.

Pressure Fault

If the pressure fault input becomes active and stays active for the delay programmed in the PF Delay Setpoint, the unit will shut down for a pressure fault. The display will show PRESS FAULT, the alarm lamp will flash and the audible alarm will sound. The pressure fault can be cleared by pressing the Alarm Silence/Reset key twice.

Auto Reset

If a pressure fault shut down occurs and the Auto Reset Setpoint is programmed to 0, the unit will remain shut down until manually reset. If the Auto Reset Setpoint is programmed to a value greater than 0, the unit will automatically clear the pressure fault and attempt to restart after this delay times out.

Alarm Silence

When a shut down occurs that causes the audible alarm to sound, the alarm can be silenced by pressing the Alarm Silence/Reset key once. The alarm will remain silenced if the Alarm Silence Setpoint is programmed to 0. If the Alarm Silence Setpoint is programmed to a value greater than 0, the alarm will resound after this delay times out. Pressing the Alarm Silence/Reset key will silence the alarm and reset this delay.

Pretreat

If the pretreat input becomes active and stays active for 2 seconds, the unit will shut down in a pretreat lockout condition. PRETREAT will show on the display and the unit will remain shut down as long as the pretreat input is active.

Membrane Flush

If the Flush Type Setpoint is programmed to 0, flush is disabled. If membrane flush is desired, several types of flush are available. When the unit enters a flush cycle, the flush relay will activate. The flush cycle will last for the time programmed in the Flush Time Setpoint. Table 3 shows the value that must be programmed in the Flush Type Setpoint for each type of flush.

FLUSH TYPE	DESCRIPTION
0	NO FLUSH
1	TANK FULL
2	OPERATING HOURS
3	OPERATING HOURS AND TANK FULL
4	ELAPSED TIME
5	ELAPSED TIME AND TANK FULL
6	OFF HOURS
7	OFF HOURS AND TANK FULL
8	RO START/STOP

TABLE 3

TANK FULL - The RO unit will flush each time a tank full condition occurs.

OPERATING HOURS - A flush will occur when the RO pump has operated for the number of hours programmed in the Flush Interval Setpoint.

ELAPSED TIME - A flush will occur after the number of hours programmed in the Flush Interval Setpoint has passed.

OFF HOURS - A flush will occur when the RO has been shut down due to a tank full condition for the number of hours programmed in the Flush Interval Setpoint.

RO START/STOP - A flush will occur each time the RO starts or stops.

The tank full flush can be combined with any of the 3 interval flush types. A manual flush can be initiated by pressing the Alarm Silence/Reset key for 3 seconds.

Flush Mode

The Flush Mode Setpoint can be used to control the operation of the inlet valve and RO pump during flush. Each can be independently programmed to operate during flush. Table 4 shows the values to program into the Flush Mode Setpoint to control the operation of the inlet and RO outputs during flush.

FLUSH MODE	RO PUMP	INLET VALVE
0	OFF	CLOSED
1	OFF	OPEN
2	ON	CLOSED
3	ON	OPEN

TABLE 4

High TDS/Conductivity

If the TDS/Conductivity reading exceeds the limit programmed the TDS/ Cond Limit Setpoint for the delay programmed in the TDS/Cond Delay Setpoint, the alarm lamp will light and the HI TDS/COND warning message will show on the display. This warning will clear when the TDS/Conductivity drops below the Setpoint.

Operating Hours Exceeded

If the current hours exceed the limit programmed in the Maximum Hours Setpoint, the alarm lamp will light and the OP HOURS EXCEEDED warning message will be shown. This warning can be cleared by programming the current hours to 0 or by increasing the maximum hours limit.

I/O Expander

The I/O Expander board adds 2 relays and 1 switch input. The operation and programming of the 2 relays is described in the installation section.

Auxiliary Output

Relay 1 can be used to control a repressurization pump when relay 1 of the expander board is configured to operate an aux relay. In this mode, this relay will be energized as long as the tank low input is not active. When energized, the relay supplies power to the repressurization pump.

Tank Low

When the tank low input has been active for 5 seconds, the auxiliary output will turn off. The alarm lamp will light and the TANK LOW warning message will show on the display. When the tank low condition clears, the TANK LOW 99 warning message is displayed. The number is the delay in minutes before the auxiliary relay will energize.

Divert Output

When relay 1 or relay 2 has been programmed to operate as a divert relay, the relay will energize when the TDS/Conductivity exceeds the TDS/Cond Limit Setpoint. This will occur as soon as the reading exceeds the limit, there is no delay. When the reading drops below the limit and stays below the limit continuously for 5 seconds, the divert relay will turn off.

Alarm Output

When relay 2 has been programmed to operate as an alarm relay, the relay will energize whenever a warning or alarm condition occurs. The relay will remain energized as long as the warning/alarm condition is active.

ADJUSTMENTS

TDS/Conductivity Calibration

Refer to figure 2 for adjustment location. To calibrate the TDS/Conductivity, place the cell in a known standard solution. Adjust the span adjustment for the correct reading. If the cell is installed, the unit can be calibrated by taking a sample of the permeate water and testing it with a known, good meter. Adjust the span control until the reading matches the meter.

Display Adjustment

The display contrast can be adjusted for best viewing by adjusting control R3. This control is located toward the upper right corner of the board, just to the left of the cell connector.

TROUBLESHOOTING

CAUTION: Hazardous voltages are present when power is applied to the unit. Care should be taken when troubleshooting any of the input power or output circuits. When disconnecting or connecting any board or accessory, be sure power is turned off at the disconnect.

Before contacting R & D Specialties for technical help, verify the programming of all Setpoints, check the display and check the status of all lights and indicators. The more information available when you contact us, the easier it will be to determine the source of the problem. NOTE: Phone support is only available from 8AM to 5PM Central Standard Time, -6 GMT.

System Inoperative

Is the yellow CPU active LED blinking? If no, is the green power LED, DS1 Lit? If no, is the fuse OK? If no, replace the fuse. If yes, with a voltmeter, verify power is applied to the power terminals L1 and L2. If power is applied to the power terminals and the above checks are OK, the board is probably defective and should be replaced. If no power is applied to the board, check the power wiring to the system.

Display Blank

Is the green power LED, DS1 lit? If no, refer to the system inoperative section. If yes, is the CPU active LED, DS9 blinking? If no, replace the board. If yes, adjust the display contrast adjustment, R3. Is the display still blank? If yes, replace the board.

Inlet Valve Will Not Operate

Is the system in standby? If no, are any shut down conditions active? If no, is the inlet LED, DS8 lit? If no, replace the board. If yes, with a voltmeter, verify if there is power on the inlet terminals. Is there power? If no, replace the board. If yes, check the valve and wiring.

RO Pump Will Not Operate

Is the system in standby? If no, are any shut down conditions active? If no, is the RO LED, DS6 lit?
If no, replace the board. If yes, with a voltmeter, verify if there is power on the RO pump terminals. Is there power? If no, replace the board. If yes, check the pump and wiring.

Unit Not Flushing or Not Flushing Correctly

Verify that flush is enabled and what type of flush is selected. Is flush enabled? If no, enable flush. If yes, press the Alarm Silence /Reset key for 3 seconds. Does the unit show flush on the display? If no, replace the board. If yes, is the flush LED, DS10 lit. If no, replace the board. If yes, with a voltmeter, verify if there is power on the flush terminals. Is there power? If no, replace the board. If yes, check the valve and wiring.

No or Incorrect TDS/Conductivity Reading

Is sensor wired correctly? If no, correct wiring. If yes, is sensor installed as described in the installation section? If no, install correctly. If yes, verify correct TDS/Conductivity range. Range correct? If no, correct range. If yes, calibrate unit. Does unit calibrate OK? If no, disconnect green and white wires of sensor. Does reading show 0? If no, replace board. If yes, reconnect wires and remove sensor from piping and dry. Does reading show 0? If no, replace cell. If yes, short pins of cell together. Does reading show ›^^^=? If no, replace board.

INSTALLATION INSTRUCTIONS
F-550

SPECIFICATIONS

Meter Body: Acrylic, clear

Floats: #316 Stainless Steel

Adapters: Polypropylene

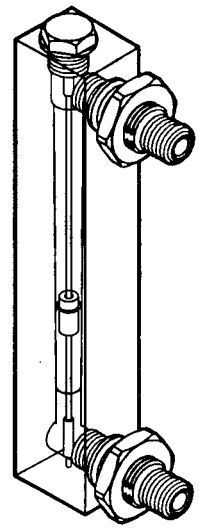
O-Rings: Viton

Lock Nut: Polypropylene

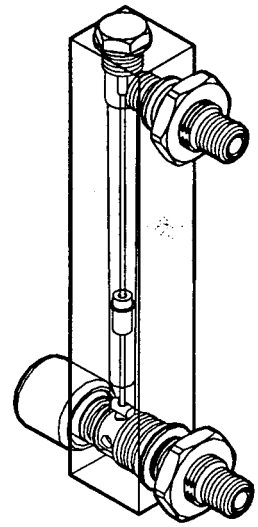
Scale: Permanent Silkscreen

Max. Pressure: See Temperature vs. Pressure chart*

Max. Temperature: See Temperature vs. Pressure chart*



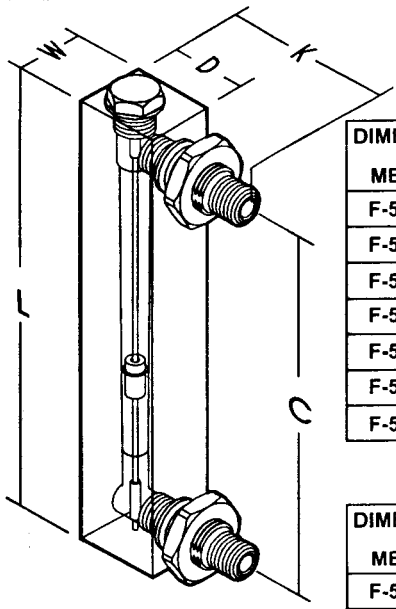
Standard Meter



Adjustable Meter

Your Blue-White® F-550 Series Panel Mount Flowmeter

Your Blue-White® flowmeter was designed to be easy to install.
Please read the Instruction Guideline on the next page before installing your flowmeter.
This flowmeter is an instrument, and special care should be taken when installing.



Dimensional Drawing

English System

DIMENSION METERS	W Inches	L Inches	K Inches	D Inches	C Inches	Maximum Panel Thickness T-max (inches)	Recommended Panel Cutout hole (inches)
F-55250xx	1-1/16	6-7/8	2-1/2	1-1/4	5-5/8	1/2	11/16
F-55375xx	1-9/32	8	2-3/4	1-1/2	6-1/2	1/2	11/16
F-55376xx	1-9/32	8	2-3/4	1-1/2	6-1/2	1/2	11/16
F-55500xx	1-9/32	8	2-3/4	1-1/2	6-1/2	1/2	27/32
F-55750xx	1-1/2	8-5/8	3-3/4	1-3/4	6-1/2	13/16	1-21/64
F-55100xx	1-3/4	10-1/4	4	2	8	13/16	1-21/64
F-55017xx	1-3/4	10-1/4	4	2	8	13/16	1-21/64

Metric System

DIMENSION METERS	W mm	L mm	K mm	D mm	C mm	Maximum Panel Thickness T-max (mm)	Recommended Panel Cutout hole (mm)
F-55250xx	27.0	174.5	63.5	32.0	143.0	13.0	18.0
F-55375xx	32.5	203.0	70.0	38.0	165.0	13.0	18.0
F-55376xx	32.5	203.0	70.0	38.0	165.0	13.0	18.0
F-55500xx	32.5	203.0	70.0	38.0	165.0	13.0	22.0
F-55750xx	38.1	219.0	95.0	44.5	165.0	21.0	34.0
F-55100xx	44.5	260.5	101.5	51.0	203.0	21.0	34.0
F-55017xx	44.5	260.5	101.5	51.0	203.0	21.0	34.0

BLUE-WHITE INDUSTRIES
5300 Business Drive • Huntington Beach, CA 92649 USA

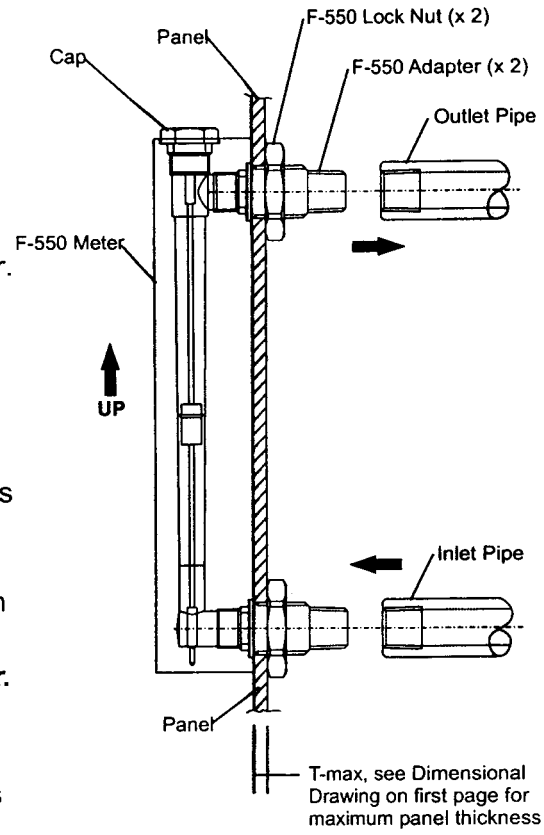
80000-349 4/6/2000
Rev. A

Installation Guideline

Please use the following steps to guide you through the installation.

Caution: Follow these tips to avoid failure

Danger: *Wear eye protection when installing or removing flowmeter.*



STEP 1. Unpack the flowmeter.

- Check for damage while unpacking the flowmeter.
- Be sure the meter is suitable for your application.
- The maximum temperature and pressure is shown on the following page.
- Although the meter may be suitable for other chemicals, Blue-White® meters are tested with water and air only. If you are unsure of the meters compatibility with your chemical, consult the factory.
- Blue-White® guarantees the meter is suitable with air and water only.

STEP 2. Choose a suitable location for the flowmeter.

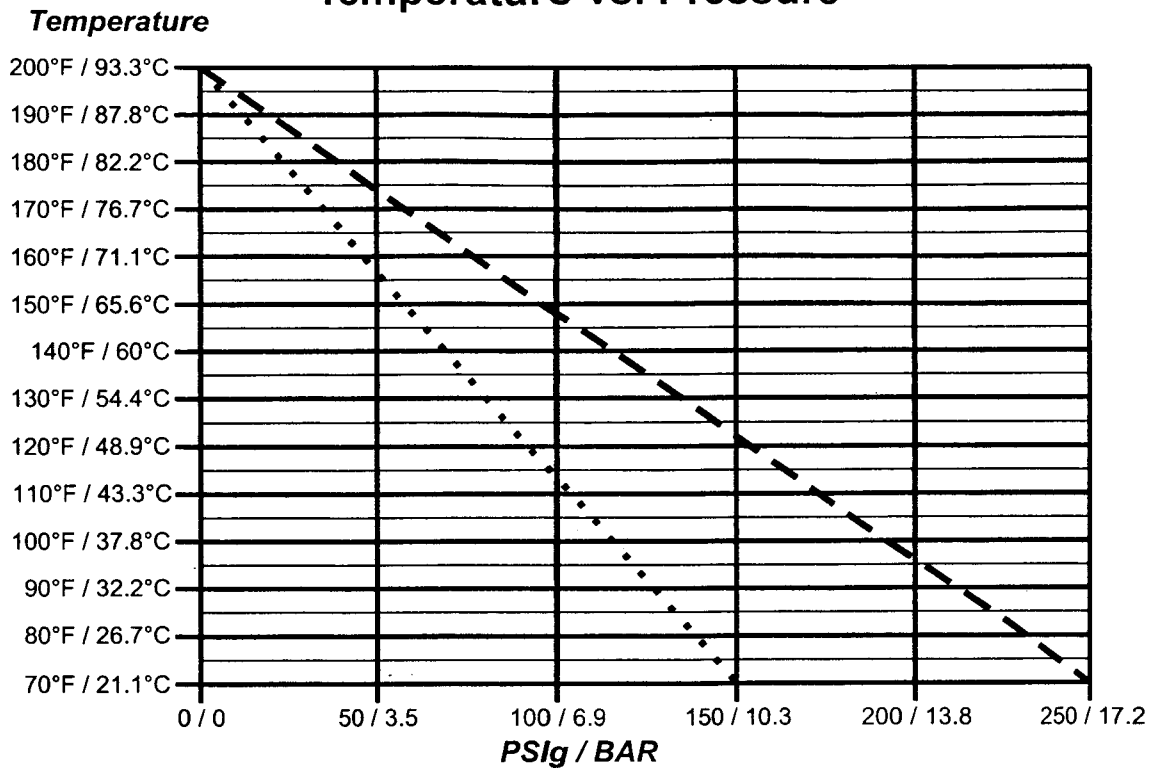
- Never allow the flowmeter to support the weight of related pipe or tubing.
- Flowmeter must be installed in plumbing which is free of vibration.
- Flowmeter must be installed in an exact vertical plane to ensure accuracy.
- *Valves* - Avoid a system that will impose a sudden burst of flow (water hammer) to the meter. Such a burst will cause the float to impact the float stop with destructive force. Magnetic, solenoid, ball, or other quick opening valves cannot be used unless the meter is protected against sudden bursts of flow.
- *Do not exceed* maximum working pressure (see Temperature vs. Pressure chart on next page).

STEP 3. Connecting the flowmeter to the plumbing.

- Use an appropriate amount of Teflon® (or similar) tape on external pipe threads before making connections.
- Acrylic and other exotic plastics cannot tolerate PVC Glue and/or pipe dope. Even fumes can cause crazing. If you are installing your flowmeter to a glued pipe configuration, install flowmeter *after* all glued fittings are dried and lines are purged of all fumes.
- Never hold the meter with pliers or like tools.

Cleaning: The flowmeter body and all other parts can be cleaned by washing in a mild soap and water solution. A soft bristle bottle brush will simplify cleaning inside the meter body. Note the floats up position for re-assembly.

Temperature vs. Pressure



• • • • • • • • • • = models: F-55750xx, F-55100xx, F-55017xx

— — — — — = models: F-55250xx, F-55375xx, F-55376xx, F-55500xx

Pressure and Temperature

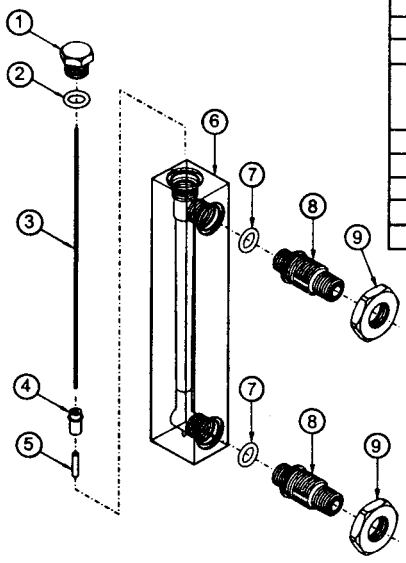
Pressure and temperature limits are inversely proportional. At the maximum suggested pressure the temperature should approach 70°F / 21.1°C; at the maximum suggested temperature the pressure should approach zero psi. We cannot guarantee our flowmeters will not be damaged either at or below the suggested limits simply because of many factors which influence meter integrity; stress resulting from meter misalignment, damage due to excessive vibration and/or deterioration caused by contact with certain chemicals as well as direct sunlight. These situations and others tend to reduce the strength of the materials from which the meters are manufactured.

Flowmeters are tested and calibrated for water or air only.
Although meters may be suitable for other chemicals, Blue-White cannot guarantee their suitability.

Exploded View and Parts List

Standard Meters

Option: x = L (liquid) or G (gas)

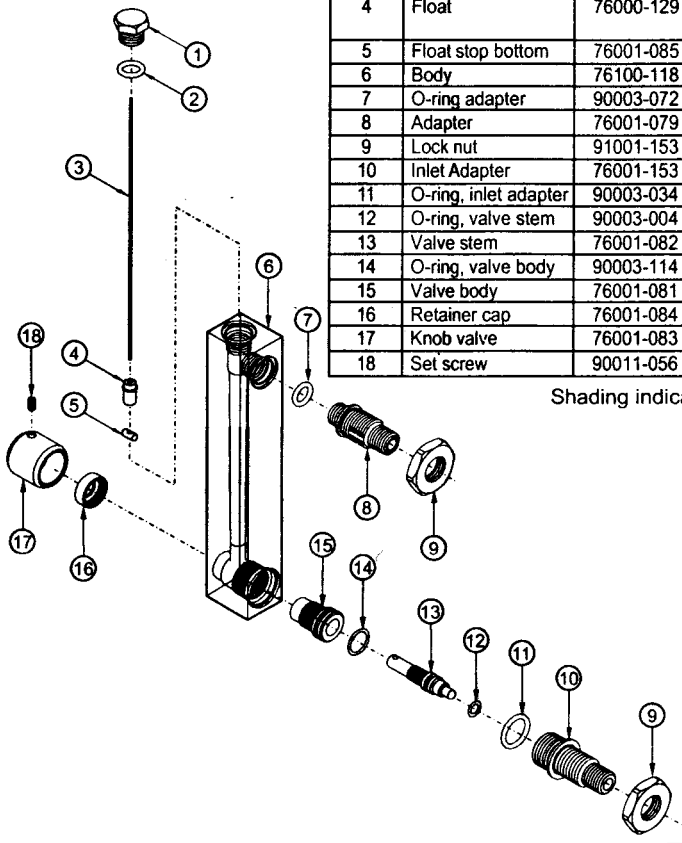


ITEM	DESCRIPTION	F-55250x	F-55375x F-55376x	F-55500x	F-55750L	F-55005L F-55100L F-55017L	QTY
1	Cap	76001-080	91001-032	91001-032	91001-033	91001-160	1
2	O-ring (cap)	90003-072	90003-081	90003-081	90003-082	90003-079	1
3	Guide wire	76000-039	90007-534	90007-534	90007-535	76000-046	1
4	Float	76000-129	90007-547 90007-564	90007-522	90007-563	76001-170 90007-565 76000-147	1
5	Float stop bottom	76000-024	76000-024	76000-024	76000-093	76000-517	1
6	Body	76100-117	76100-119	76100-119	76100-121	76100-123	1
7	O-ring (adapter)	90003-072	90003-034	90003-034	90003-081	76001-110	2
8	Adapter	76001-079	91001-141	91001-142	91001-143	91001-144	2
9	Lock nut	91001-153	91001-153	91001-154	91001-171	91001-172	2

Shading indicates item not sold separately

Adjustable Meters

Option: x = L (liquid) or G (gas)



ITEM	DESCRIPTION	F-55250xA	F-55375xA F-55376xA	F-55500xA	F-55750LA	F-55005LA F-55100LA F-55017LA	QTY
1	Cap	76001-080	91001-032	91001-032	91001-033	91001-160	1
2	O-ring cap	90003-072	90003-081	90003-081	90003-082	90003-079	1
3	Guide wire	76001-108	76001-109	76001-109	76001-110	76000-111	1
4	Float	76000-129	90007-547 90007-564	90007-522	90007-563	76001-170 90007-656 76000-147	1
5	Float stop bottom	76001-085	76001-091	76001-091	76001-096	76001-107	1
6	Body	76100-118	76100-120	76100-120	76100-122	76100-124	1
7	O-ring adapter	90003-072	90003-034	90003-034	90003-081	90003-079	1
8	Adapter	76001-079	91001-141	91001-142	91001-143	91001-144	1
9	Lock nut	91001-153	91001-153	91001-154	91001-171	91001-172	2
10	Inlet Adapter	76001-153	91001-173	91001-174	91001-175	91001-176	1
11	O-ring, inlet adapter	90003-034	90003-081	90003-081	90003-110	90003-082	1
12	O-ring, valve stem	90003-004	90003-010	90003-010	90003-072	90003-113	1
13	Valve stem	76001-082	76001-088	76001-088	76001-094	76001-104	1
14	O-ring, valve body	90003-114	90003-081	90003-081	90003-017	90003-021	1
15	Valve body	76001-081	76001-086	76001-086	76001-093	76001-103	1
16	Retainer cap	76001-084	76001-090	76001-090	76001-095	76001-106	1
17	Knob valve	76001-083	76001-089	76001-089	76001-097	76001-105	1
18	Set screw	90011-056	90011-116	90011-116	90011-116	90011-116	1

Shading indicates item not sold separately

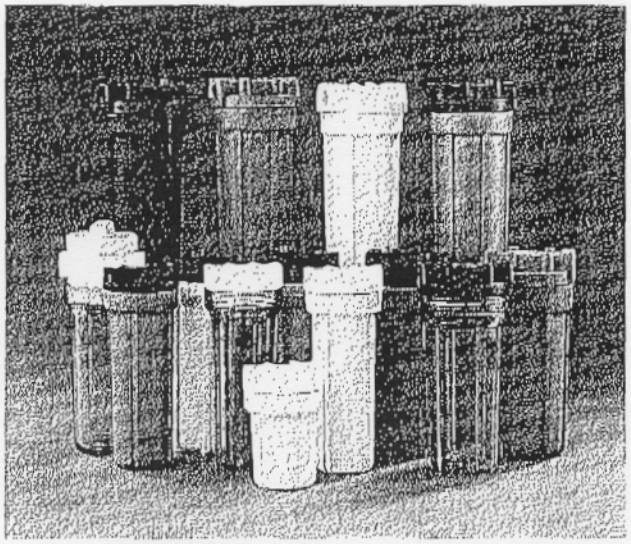
BLUE-WHITE INDUSTRIES

Web Site: www.bluwhite.com
E-mail: sales@blue-white.net
Techsupport@blue-white.net

Phone: 714-893-8529
Fax: 714-894-0149

Flowmatic™ Under Counter Filter Housings

High quality • Competitive prices • In stock • Speedy shipments

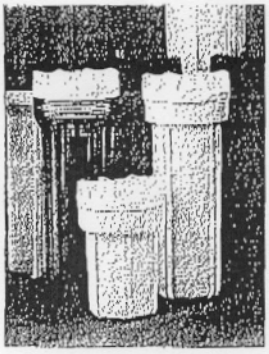


Flowmatic™ Single Cartridge Filter Housings

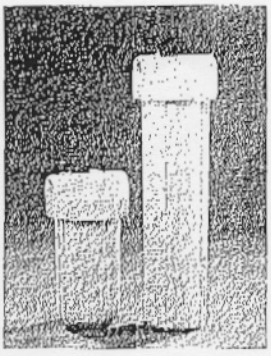
Flowmatic under counter filter housings are manufactured from the highest quality, FDA grade, 100% polypropylene and acrylic styrene. Leak-proof sealing is accomplished by compression against a top seated EPDM o-ring located in the housing's sump. Thick wall and added ribs make the housings ideal for a wide range of applications. Polypropylene construction provides excellent chemical resistance with most acids, alcohol, ammonia, oils, plating solutions and many aggressive chemicals. Housings supplied with and without pressure release valves. Rated for temperatures to 125°F (52°C) and pressures to 125 psid (8.75 bar).

Full product line

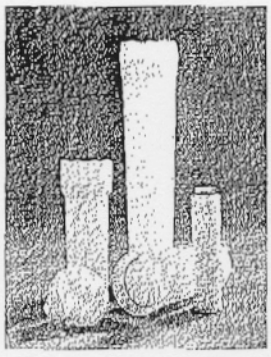
We offer a complete line of under counter filter housings for virtually every application where single cartridge filter housings are typically used. Select from standard, heavy duty, full-flow, high purity, high temp and valve-in-head models.



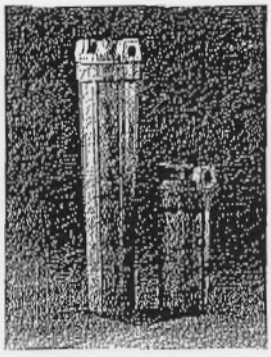
Standard & HD models
4000, 4200, HD series.



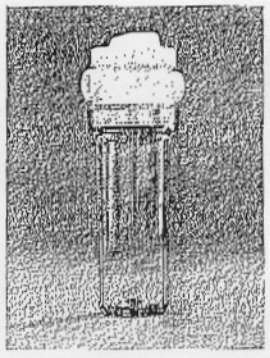
Full-Flow
Clear or opaque.



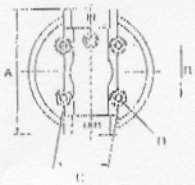
High-Purity
Virgin polypropylene.

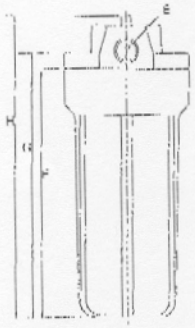


High-Temp
For 200°F (93°C).



Valve-In-Head
Clear or opaque.





Dimensions

Model	A	B	C	D	E	F	G	H
500 Series, 5"	4.28"	1.57"	1.18"	0.16"	X	5.7"	7.0"	7.48"
4000 Series, 10"	4.72"	1.57"	1.18"	0.18"	X	10.5"	11.0"	11.8"
4200 Series, 10"	4.72"	1.57"	1.18"	0.18"	X	10.5"	11.0"	11.8"
8000 Series, 20"	5.35"	2.22"	2.28"	0.23"	X	20.47"	21.26"	22.8"
HD Series, 10"	5.35"	2.22"	2.28"	0.23"	X	10.43"	11.49"	12.5"
Full-Flow, 10"	7.28"	3.03"	3.03"	0.275"	X	11.33"	11.57"	14.0"
Full-Flow, 20"	7.28"	3.03"	3.03"	0.275"	X	21.25"	21.65"	24.0"

X - Depends on size of pipe fitting selected.

Flowmatic™ Under Counter Filter Housings

Part Number	Size	Pipe	Sump	Cap	# Case
5"					
FH500WW14	5"	1/4"	White	White	12
FH500CW14	5"	1/4"	Clear	White	12
FH500CW12	5"	1/2"	Clear	White	12
FH500WW12	5"	1/2"	White	White	12
4000 Series (Good)					
FH4000WW14	10"	1/4"	White	White	12
FH4000WB14	10"	1/4"	White	Black	12
FH4000WB38	10"	3/8"	White	Black	12
FH4000WB12	10"	1/2"	White	Black	12
FH4000WB34	10"	3/4"	White	Black	12
FH4000BL14	10"	1/4"	Blue	Black	12
FH4000BL38	10"	3/8"	Blue	Black	12
FH4000BL12	10"	1/2"	Blue	Black	12
FH4000BL34	10"	3/4"	Blue	Black	12
FH4000CB14	10"	1/4"	Clear	Black	12
FH4000CB38	10"	3/8"	Clear	Black	12
FH4000CB12	10"	1/2"	Clear	Black	12
FH4000CB34	10"	3/4"	Clear	Black	12
FH4000BB14	10"	1/4"	Black	Black	12
FH4000BB34	10"	3/4"	Black	Black	12
FH4000TWB14	10"	1/4"	White	Black	12
FH4000TWW14	10"	1/4"	White	White	12
4200 Series (Best)					
FH4200WB14	10"	1/4"	White	Black	12
FH4200WW14	10"	1/4"	White	White	12
FH4200WW38	10"	3/8"	White	White	12
FH4200WW12	10"	1/2"	White	White	12
FH4200WW34	10"	3/4"	White	White	12
FH4200BL14	10"	1/4"	Blue	Black	12
FH4200BL14PR	10"	1/4"	Blue	Black, PR	12
FH4200BL38	10"	3/8"	Blue	Black	12
FH4200BL38PR	10"	3/8"	Blue	Black, PR	12
FH4200BL12	10"	1/2"	Blue	Black	12
FH4200BL12PR	10"	1/2"	Blue	Black, PR	12
FH4200BL34	10"	3/4"	Blue	Black	12
FH4200BL34PR	10"	3/4"	Blue	Black, PR	12
FH4200CW14	10"	1/4"	Clear	White	12
FH4200CW14PR	10"	1/4"	Clear	White, PR	12
FH4200CW38	10"	3/8"	Clear	White	12
FH4200CW38PR	10"	3/8"	Clear	White, PR	12
FH4200CW12	10"	1/2"	Clear	White	12
FH4200CW12PR	10"	1/2"	Clear	White, PR	12
FH4200CW34	10"	3/4"	Clear	White	12
FH4200CW34PR	10"	3/4"	Clear	White, PR	12
FH4200BB14	10"	1/4"	Black	Black	12
FH4200BB34	10"	3/4"	Black	Black	12
HD Series, Heavy-Duty (Beefy)					
HD4500BL34	10"	3/4"	Blue	Black	12
HD4500BL34PR	10"	3/4"	Blue	Black, PR	12
HD4500CB34	10"	3/4"	Clear	Black	12
HD4500CB34PR	10"	3/4"	Clear	Black, PR	12

Part Number	Size	Pipe	Sump	Cap	# Case
20"					
FH7000BL12	20"	1/2"	Blue	Black	6
FH7000BL12PR	20"	1/2"	Blue	Black, PR	6
FH7000WW38	20"	3/8"	White	White	6
FH7000WW38PR	20"	3/8"	White	White, PR	6
FH8000BB34PR	20"	3/4"	Black	Black, PR	6
FH8000BL34	20"	3/4"	Blue	Black	6
FH8000BL34PR	20"	3/4"	Blue	Black, PR	6
FH8000CB34PR	20"	3/4"	Clear	Black, PR	6
FH8000WW34PR	20"	3/4"	White	White, PR	6
Full Flow Housings (for 4-1/2" OD cartridges)					
FH5000BL34PR	10"	3/4"	Blue	Black, PR	4
FH5000BL1	10"	1"	Blue	Black	4
FH5000BL1PR	10"	1"	Blue	Black, PR	4
FH5000WW1PR	10"	1"	White	White, PR	4
FH5000WW15PR	10"	1.5"	White	White, PR	4
FH5000BL15	10"	1.5"	Blue	Black, PR	4
FH5000BL15PR	10"	1.5"	Blue	Black, PR	4
FH5000CB1PR	10"	1"	Clear	Black, PR	4
FH10000BL34PR	20"	3/4"	Blue	Black, PR	4
FH10000BL1	20"	1"	Blue	Black	4
FH10000BL1PR	20"	1"	Blue	Black, PR	4
FH10000WW1PR	20"	1"	White	White, PR	4
FH10000WW15PR	20"	1.5"	White	White, PR	4
FH10000BL15	20"	1.5"	Blue	Black	4
FH10000BL15PR	20"	1.5"	Blue	Black, PR	4
FH10000CB1PR	20"	1.5"	Clear	Black, PR	4
High Purity Housings (Pure Polypropylene, with viton o-ring)					
FH4200NP34	10"	3/4"	PP	PP (for DOE)	12
FH4500BL34-222	12"	3/4"	PP	PP (for 222)	12
FH8000NP34	20"	3/4"	PP	PP (for DOE)	12
FH8000NP34-222	20"	3/4"	PP	PP (for 222)	12
Valve-In-Head Housings					
VIH34APC	10"	3/4"	Clear	White	12
VIH34APO	10"	3/4"	White	White	12
High Temp Housings (200°F / 93°C)					
HD4500HT34	10"	3/4"	Red	Red	12
HD8000HT34	20"	3/4"	Red	Red	12
Mounting brackets (partial listing)					
FM10	Single 10", zinc plated, with screws				150
FM20AW	Single, 20" aluminum, white				100
FM30AW	Double, 10" aluminum, white				25
FM50AW	Triple, 10" aluminum, white				25
FM25A	Single for Full Flow housings, aluminum				40
FM10AW	Single 10", aluminum, white				150
Wrenches					
WR100	Wrench for standard 10", 20" & 7000 series				100
WR200	Wrench for Heavy Duty 10", 20" & 8000 series				100
WR500	Wrench for Full Flow housings				90

Please see our catalog for a complete listing of brackets & parts.

Toll-free: 800-461-4406
Fax: 352-465-2010
E-Mail: info@flowmatic.com

In California:
Tel: 909-272-4100
Fax: 909-272-4111

Water Quality Association MEMBER

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FLOWMATIC
YOUR SINGLE SOURCE SUPPLIER

Flowmatic Systems, Inc.

11611 S.W. 147 Court / Dunnellon, FL 34432 / USA / Tel: 352-465-2000 / www.flowmatic.com

WaterBetter® Cartridges

Our economy brand for residential and light commercial applications

Specifications

Filter media	Polyester	**Temperature limit**	Up to 140°F (60°C) depending on pressure and time under load
End caps	Plastisol (pliable PVC)	**pH**	3-11 (see compatibility charts)*
Center tubes	Rigid PVC with perforations	**Lengths**	9-3/4", 19-1/2" and 29-1/4"
Surface area	Approximately 4 sq. ft. (0.37 M²) per 9-3/4" length	**Dimensions**	2-3/4" (70 mm) OD; 1-1/16" (27 mm) ID
			* For housings and cartridges.

9-3/4" (248 mm) (For all Harmsco multi-cartridge housings and most other single filter cartridge housings.)

Micron	Product Code	Color End Caps	No./Case	Ship/Wt. (lbs.)	Ship/Wt. (Kg)	Case Dimensions (in.)
1	WB-1	Tan	24	10	4.5	12x17x11
5	WB-5	White	24	10	4.5	12x17x11
20	WB-20	Blue	24	10	4.5	12x17x11
50	WB-50	Yellow	24	10	4.5	12x17x11

9-3/4" (248 mm) Wrapped cartridges (Individually shrink wrapped in plastic outer wrap.)

1	WB-1-W	Tan	24	10	4.5	12x17x11
5	WB-5-W	White	24	10	4.5	12x17x11
20	WB-20-W	Blue	24	10	4.5	12x17x11
50	WB-50-W	Yellow	24	10	4.5	12x17x11

19-1/2" (495 mm) Cartridges (For Harmsco filter housings requiring "double length" cartridges.)

1	WB-921-1	Tan	24	16	7.3	12x17x21
5	WB-921-5	White	24	16	7.3	12x17x21
20	WB-921-20	Blue	24	16	7.3	12x17x21
50	WB-921-50	Yellow	24	16	7.3	12x17x21

29-1/4" (743 mm) Cartridges (For Harmsco filter housings requiring "triple length" cartridges.)

1	WB-931-1	Tan	24	21	9.6	12x17x31
5	WB-931-5	White	24	21	9.6	12x17x31
20	WB-931-20	Blue	24	21	9.6	12x17x31
50	WB-931-50	Yellow	24	21	9.6	12x17x31

Applications

Here are typical applications for Harmsco filter cartridges:

- Drinking water
- Bottled water
- Beverages
- Drinking fountains
- Whole house
- Ground water
- Surface water
- R/O prefiltration
- Process water
- Waste water
- Rinse water
- Environmental
- Asbestos abatement
- Plating baths
- Cooling water
- Heating loops
- Chill water
- Desalination prefilters
- Ultrafiltration prefilters
- Spray nozzle protection
- Well water
- Municipal water
- Water vending equipment
- Ground water remediation

Harmsco High-Temp Cartridges

(with approx. 6 sq. ft. of media per cartridge)

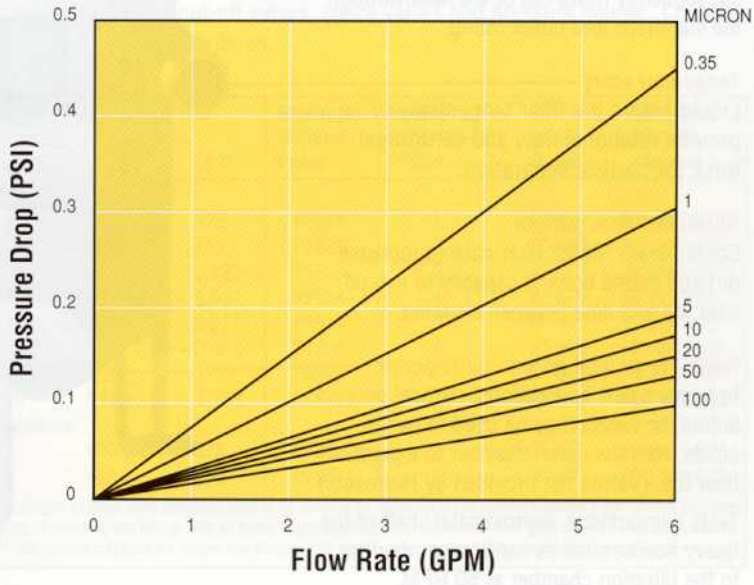
Product Code	Micron	No./Case	Ship. Wt.	Dimensions
801-1-HT	1	24	11 lbs.	12x17x11
801-5-HT	5	24	11 lbs.	12x17x11
801-20-HT	20	24	11 lbs.	12x17x11
801-50-HT	50	24	11 lbs.	12x17x11

Rated up to 200°F, depending on pressure and time under load.

Low pressure drop

Pressure drop with Harmsco cartridges is exceptionally low due to our pleated design and increased filter area. Initial pressure drop for 9-3/4" Harmsco cartridge in clean water is shown below.

Initial pressure drop in clean water



GRUNDFOS **INSTRUCTIONS**
Installation and Operation

CR, CRI, CRX, CRN, CRT

Vertical Multistage Centrifugal Pumps

Please leave these instructions with the pump for future reference

BE › THINK › INNOVATE ›

GRUNDFOS®

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

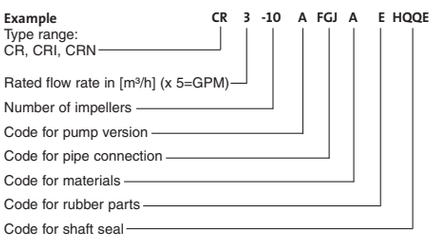
A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

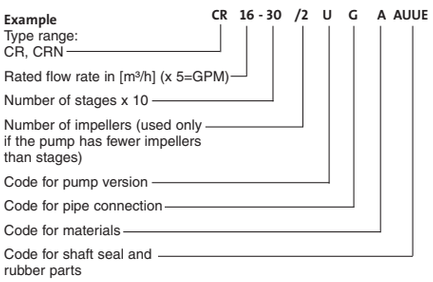
Nameplate Data

Type key

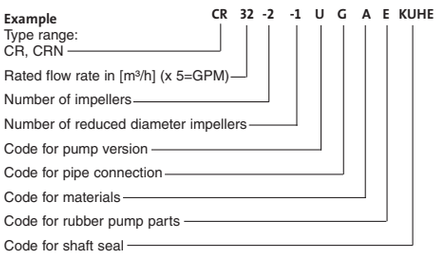
CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

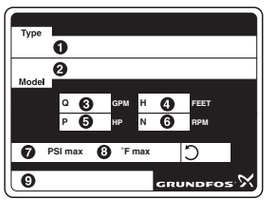


CR, CRX, CRN 8 and 16



CR, CRN 32, 45, 64, AND 90





1. **Type designation**
2. **Model, material number, production code**
3. **Gallons per minute at rated RPM**
4. **Head in feet at nameplate flow**
5. **Pump horsepower**
6. **Rated RPM**
7. **Maximum PSI**
8. **Maximum fluid temperature**
9. **Production country**

Codes

Example U F G J A E HQQE

Pump version

A	*Basic version pump
U	*NEMA version pump
B	Oversize motor, one flange size bigger
F	CR pump for high temperatures (Cool-Top™)
H	Horizontal version
HS	High pressure pump with over-synchronous speed and reversed direction of rotation
I	Different pressure rating
K	Low NPSH
M	Magnetic drive
P	Undersize motor
R	Horizontal version with bearing bracket
SF	High pressure pump with reversed chamber stack and direction of rotation
T	Oversize motor, two flange sizes bigger
X	**Special version

Pipe connection

A	Oval flange
B	NPT thread
C	Clamp coupling
CA	FlexiClamp
CX	TriClamp
F	DIN flange
G	ANSI flange
J	JIS flange
N	Changed diameter of ports
O	Externally threaded, union
P	PJE coupling
X	Special version

Materials

A	Basic version
D	Carbon-graphite filled PTFE (bearings)
G	Stainless steel parts of 316 SS
GI	Base plate and flanges of 316 SS
I	Stainless steel parts of 304 SS
II	Base plate and flange of 304 SS
K	Bronze (bearings)
S	SiC bearing ring + PTFE neck ring (only CR, CRN 32 to 90)
T	Titanium
X	Special version

Code for rubber parts

E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

Shaft seal H Q Q E

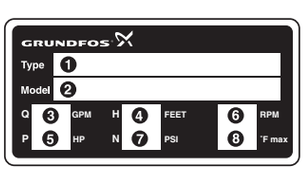
A	O-ring seal with fixed driver
B	Rubber bellows seal
D	O-ring seal, balanced
E	Cartridge seal with O-ring
H	Balanced cartridge seal with O-ring
K	Cartridge shaft seal with metal bellows
O	Double seal, back to back
P	Double seal, tandem
R	O-ring seal with reduced face
X	Special version

B	Carbon, synthetic resin-impregnated
H	Cemented tungsten carbide, embedded hybrid
Q	Silicon carbide
U	Cemented tungsten carbide

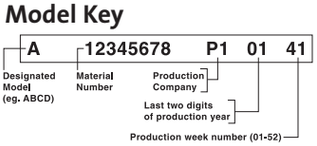
E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

* In August 2003 the NEMA pump code was discontinued for all material numbers created by GRUNDFOS manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

** If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.



Model Key



Pre-installation Checklist

1. Confirm you have the right pump

Read the pump nameplate to make sure it is the one you ordered.

CR	—	Centrifugal pump with standard cast iron and 304 stainless steel construction
CRI or CRX	—	Centrifugal pump; all parts in contact with water are 304 stainless steel construction
CRN	—	Centrifugal pump; all parts in contact with water are 316 stainless steel construction
CRT	—	Centrifugal pump; all parts in contact with water are titanium construction
CRE	—	Centrifugal pump with a Grundfos MLE VFD motor attached

2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, the pump should remain in the carton until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

If the pump is shipped as a complete unit (motor attached to pump end), the position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is required. If the unit is delivered as a pump end only, follow the adjustment procedures on pages 10-11.

Pump without Motor (CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 Only): If you purchased a pump without a motor, the shaft seal has been set by the factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without Motor (CR(N) 32, 45, 64 & 90 Only): If you purchased a pump without a motor, you must install the seal. The seal is protected in its own sub boxing within the pump packaging crate. To protect the shaft and bearings during shipment, a shaft holder protective device is used. This device must be removed prior to installation of the seal. Read the seal installation instructions which are included in the pump package.

3. Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover. If voltage variations are larger than ±10%, do not operate the pump.

4. Is the application correct for this pump?

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Will it perform the way you want it to perform? Also, make sure the application falls within the following limits:

Type	Designed to pump...
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
CRI/CRN/CRX	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High pressure washdown, reverse osmosis, or other high pressure applications.
CRT	Salt water, chloride based fluids and fluids approved for titanium.

Operating Conditions

Pump	Fluid Temperatures
CR(I)(N) 1s, 3, 5, 10, 15, and 20	-4 to +248°F (-20 to +120°C)
*CR(N) 32, 45, 64, and 90	-22 TO +248°F (-30 TO +120°C)
CR(N)(X)(T) 2, 4, 8, 16	-4 to +248°F (-20 to +120°C)
CRN-SF	-4 to +221°F (-15 to +105°C)
with Cool-Top™	up to +356°F (+180°C)

All motors are designed for continuous duty in +104°F (+40°C) ambient air conditions. For higher ambient temperature conditions consult Grundfos.

* xUBE Shaft Seals are recommended for temperatures above +200°F. Pumps with hybrid shaft seals can only operate up to +200°F (+90°C). Pumps with xUUE shaft seals can be operated down to -40°F (-40°C) (where "x" is the seal type).

Pre-installation Checklist (continued)

Minimum Inlet Pressures

All CR, CRI, CRX, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

Maximum Inlet Pressures

Pump Type	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 1	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 3	2 to 29	2 to 15	145 / 10
	31 to 36	17 to 25	217 / 15
CR, CRI, CRN 5	3 to 16	2 to 9	145 / 10
	18 to 36	10 to 24	217 / 15
CR, CRI, CRN 10	1 to 6	1 to 5	116 / 8
	7 to 22	6 to 18	145 / 10
CR, CRI, CRN 15	1 to 3	1 to 2	116 / 8
	4 to 17	3 to 12	145 / 10
CR, CRI, CRN 20	1 to 3	1	116 / 8
	4 to 17	2 to 10	145 / 10
CR, CRN 32	1-1 to 4	1-1 to 2	58 / 4
	5-2 to 10	3-2 to 6	145 / 10
	11 to 14	7-2 to 11-2	217 / 15
CR, CRN 45	1-1 to 2	1-1 to 1	58 / 4
	3-2 to 5	2-2 to 3	145 / 10
	6-2 to 13-2	4-2 to 8-1	217 / 15
CR, CRN 64	1-1 to 2-2	1-1	58 / 4
	2-1 to 4-2	1 to 2-1	145 / 10
	4-1 to 8-1	2 to 5-2	217 / 15
CR, CRN 90	1-1 to 1		58 / 4
	2-2 to 3-2	1-1 to 1	145 / 10
	3 to 6	2-2 to 4-1	217 / 15
CRT 2	2 to 11	2 to 6	145 / 10
	13 to 26	7 to 18	217 / 15
CRT 4	1 to 12	1 to 7	145 / 10
	14 to 22	8 to 16	217 / 15
CRT 8	1 to 20	1 to 16	145 / 10
CRT 16	2 to 16	2 to 10	145 / 10
CR, CRX, CRN 8	1 to 6	1 to 4	87 / 6
	7 to 20	5 to 16	145 / 10
CR, CRX, CRN 16	2 to 3	2 to 3	87 / 6
	4 to 16	4 to 10	145 / 10
CRN-SF	all	all	72 / 5*
			362 / 25**

* while pump is off or during start-up

** during operation

Maximum Operating Pressures

at 250° F (194° F for CRN-SF)

Pump type/ connection	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 1			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 3			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 5			
Oval flange	1 to 22	1 to 16	232 / 16
FGJ, PJE	1 to 36	1 to 24	362 / 25
CR, CRI, CRN 10			
Oval flange		1 to 10	145 / 10
Oval flange	1 to 16		232 / 16
FGJ, GJ, PJE	1 to 16	1 to 10	232 / 16
FGJ, GJ, PJE	17 to 22	12 to 17	362 / 25
CR, CRI, CRN 15			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 8	232 / 16
FGJ, GJ, PJE	12 to 17	9 to 12	362 / 25
CR, CRI, CRN 20			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 7	232 / 16
FGJ, GJ, PJE	12 to 17	8 to 10	362 / 25
CR, CRN 32	1-1 to 7	1-1 to 5	232 / 16
	8-2 to 12	6-2 to 8	362 / 25
	13-2 to 14	9-2 to 11-2	580 / 40
CR, CRN 45	1-1 to 5	1-1 to 4-2	232 / 16
	6-2 to 9	4-1 to 6	362 / 25
	10-2 to 13-2	7-2 to 8-1	580 / 40
CR, CRN 64	1-1 to 5	1-1 to 3	232 / 16
	6-2 to 8-1	4-2 to 5-2	362 / 25
CR, CRN 90	1-1 to 4	1-1 to 3	232 / 16
	5-2 to 6	4-2 to 4-1	362 / 25
CRT 2	2 to 26	2 to 18	305 / 21
CRT 4	1 to 22	1 to 16	305 / 21
CR, CRX, CRN, CRT 8	1 to 12	1 to 8	232 / 16
	14 to 20	10 to 16	362 / 25
CR, CRX, CRN, CRT 16	1 to 8	1 to 8	232 / 16
	10 to 16	10 to 12	362 / 25

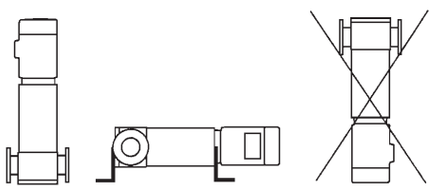
Consult Grundfos for other working conditions.

Select pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair. For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1. Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported. Uneven surfaces can result in pump base breakage when mounting bolts are tightened.



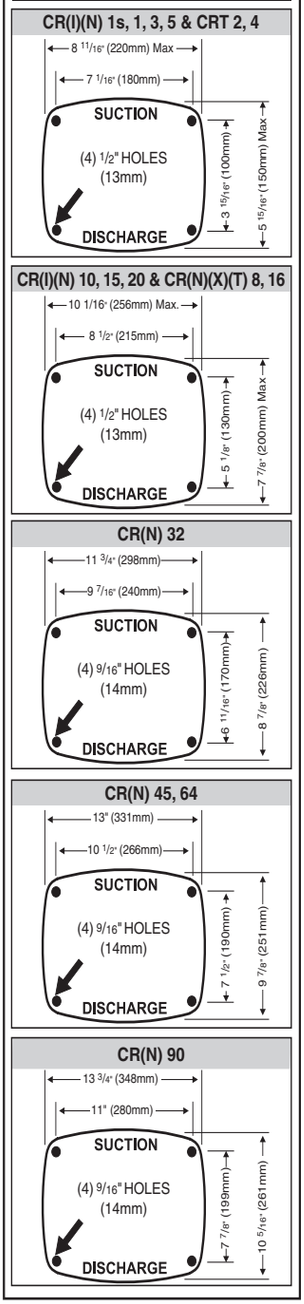
The pump can be installed vertically or horizontally (see drawing at right). Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Figure 1: Bolt Hole Centers



Pipework

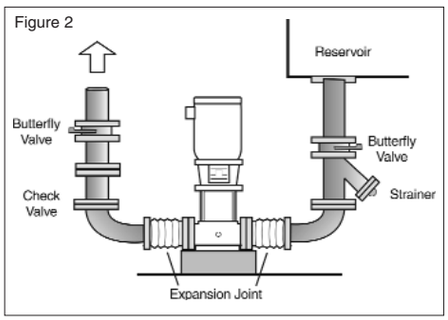
NOTE: The CR(N) pumps are shipped with covered suction and discharge. The covers must be removed before the final pipe flange to pump connections are made.

Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Figures 2 and 3. Flush piping prior to pump installation to remove loose debris.

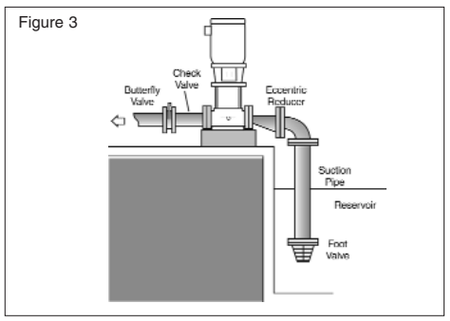
Flooded Suction

Figure 2



Suction Lift*

Figure 3



* CRN-SF pumps cannot be used for suction lift. The suction pipe should have a fitting on it for priming.

Minimum suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type. The suction pipe size should be verified with each installation to ensure good pipe practices are being observed and excess friction losses are not encountered. High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

CR(I)(N) 1s, 1, 3, CRT 2	1"	Nominal diameter sch 40 pipe
CR(I)(N) 5, CRT 4	1 1/4"	Nominal diameter sch 40 pipe
CR(I)(N)(X) 10, 15, 20, 8, 16	2"	Nominal diameter sch 40 pipe
CR(N) 32	2 1/2"	Nominal diameter sch 40 pipe
CR(N) 45	3"	Nominal diameter sch 40 pipe
CR(N) 64	4"	Nominal diameter sch 40 pipe
CR(N) 90	4"	Nominal diameter sch 40 pipe

Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump. Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used. Grundfos recommends that pressure gauges be installed on inlet and discharge flanges or in pipes to check pump and system performance.

NOTE: To avoid problems with waterhammer, fast closing valves must not be used in CRN-SF applications.

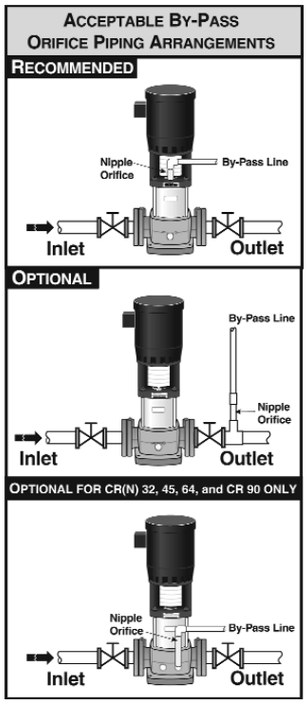


Table A
Minimum Continuous Duty Flow Rates for CR(I)(X)(N)(T)

	Min. Flow in GPM at Liquid Temperature			Cool-Top™
	min°F to 176°F	at 210°F	at 248°F	at 356°F
Pump Type	min°C to 80°C	at 99°C	at 120°C	at 180°C
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CR, CRX, CRN, CRT 8	4.0	6.0	10	10*
CR, CRX, CRN, CRT 16	8.0	12	20	20*

*Grundfos Cool-Top is only available in the following pump types.

Pump Type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90	CR 8	CR 16
Standard (CR)								•	•	•	•		
I Version (CRI)	•	•	•	•	•	•	•						
N Version (CRN)	•	•	•	•	•	•	•	•	•	•	•	•*	•*

* CRN 8 and 16 are only available in CRN-S. A CRN-S is a CRN pump without staybolts. All rubber parts are FXM.

Check valves

A check valve may be required on the discharge side of the pump to prevent the pump's inlet pressure from being exceeded. For example, if a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump. If the system pressure is greater than the pump's maximum inlet pressure rating, the limits of the pump will be exceeded and a check valve needs to be fitted on the discharge side of the pump to prevent this condition. **This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.**

Bypass

A bypass should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table A for minimum flow rates. Elbows should be a minimum of 12" from the orifice discharge to prevent erosion.

Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation. At shut-off, the power to the pump is transferred to the pumped liquid as head, causing a temperature rise in the liquid. The result is risk of excess heating of and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. (See temperature rise chart.)

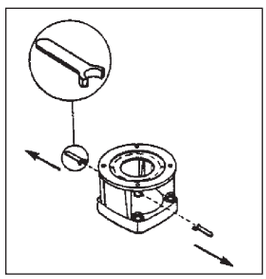
Pump Type	Time for Temperature Rise of 18° F (10°C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90	60	1.0

Conditions/Reservations

The listed times are subject to the following conditions/reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat of 1.0 $\frac{Btu}{lb.°F}$ (4.18 $\frac{kJ}{kg°C}$).
- Pump parts (chambers, impellers and shaft) have the same thermal capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise. The maximum temperature must not exceeed the pump maximum rating.



For Pump Ends With Bellows Seals Only (CR 2, 4, 8, 16)

Remove shaft seal protectors before installing motor (see diagram at below).

1. Remove coupling guards.
2. Remove coupling halves.
3. Remove shaft seal protectors.
4. Follow motor replacement instructions on page 10.

Electrical

WARNING

THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Motor

Grundfos CR pumps are supplied with heavy-duty 2-pole (3600 RPM nominal), ODP or TEFC, NEMA C frame motors selected to our rigid specifications. Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis. CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing. If you are replacing the pumping unit, but are using a motor previously used on another CR pump, be sure to read the "Motor Replacement" section on page 10 for proper adjustment of the coupling height.

Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the shaft coupling; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 4.

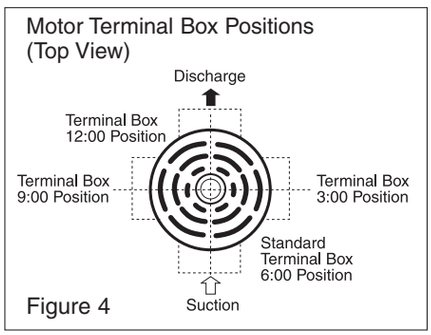


Figure 4

Field Wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter or soft start should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.

Motor Protection

1. **Single-Phase Motors:**

   With the exception of 7 1/2 and 10 HP motors which require external protection, single-phase CR pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

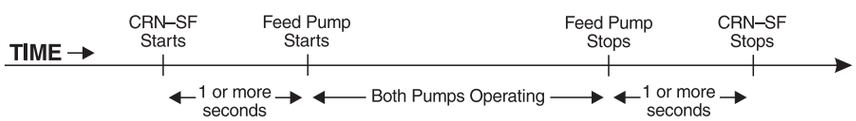
2. **Three-Phase Motors**

   CR pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty. Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer. Three phase MLE motors (CRE-Pumps) require only fuses as a circuit breaker. They do not require a motor starter. Check for phase imbalance (worksheet is provided on page 15).

   NOTE: Standard allowable phase imbalance difference is 5%.

3. **CRN-SF**

   The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), a control device must be used to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops.



Starting the Pump the First Time

Figure 5a

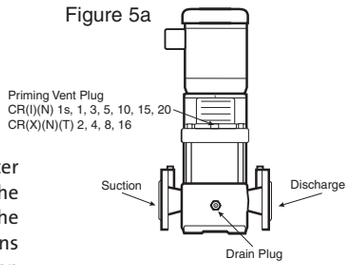
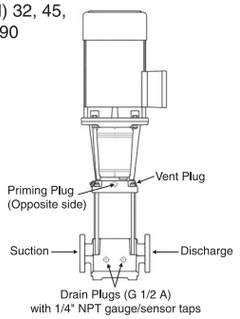


Figure 5b
CR(N) 32, 45, 64 & 90



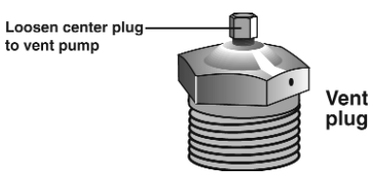
Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5A and 5B. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves.

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.



REMINDER: Do not start the pump before priming or venting the pump. Never operate the pump dry.

Operating Parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors will require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubricaton of the pump bearings and seals.

Pump cycling

Pump cycling should be checked to ensure the pump is not starting more than:

20 times per hour on 1/3 to 5 HP models
15 times per hour on 7 1/2 to 15 HP models
10 times per hour on 20 to 60 HP models

Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Boiler-feed installations

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication (see "Minimum Continuous Duty Flow Rates").

Freeze Protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again. Always replace the drain plug with the original or exact replacement. **Do not** replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING:

DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should **only** be lubricated with approved types of grease. Do not **over-grease** the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Severity of Service	Ambient Temperature (Maximum)		Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	See motor nameplate for grease type or compatible equivalent type of grease
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

If pump is fitted with a bearing flange that requires grease, see the stickers on either the bearing flange or coupling guards for proper grease type and greasing schedule.

Motor Lubrication Schedule

NEMA/(IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of Grease to Add Oz./(Grams)	Volume of Grease to Add In^3/(Teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)*	1.2 (3.9)*
Over 280 up through 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	0.81 (23.1)*	1.5 (5.2)*
Over 360 (225)2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)*	4.1 (13.4)*	

*The grease outlet plug **MUST** be removed before adding new grease.

Procedure

CAUTION:

TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT YOUR BALDOR DISTRIBUTOR OR AN AUTHORIZED BALDOR SERVICE CENTER FOR ADDITIONAL INFORMATION.

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

   NOTE: If new grease does not appear at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.

   Add grease SLOWLY until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.
4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
   - Drain the pump after each use.
   - Flush the pump , through system, with water or other fluid that is compatible with the pump materials and process liquid.
   - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid dthat is compatible with the pump materials and process liquid.

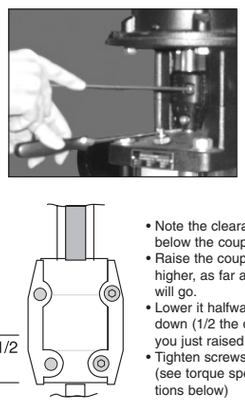
   If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section on pages 13-14.

Motor Replacement

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

Figure 6

CR(X)(N)(T) 8, 16 & CRT 2, 4



Disassembly

1. Turn off and lock out power supply. The power supply wiring can not be safely disconnected from the motor wires.
2. Remove the coupling guards.
3. Using the proper metric Allen wrench, loosen the four cap screws in the coupling. Completely remove coupling halves. On CR1s-CR20, the shaft pin can be left in the pump shaft. CR(N)32, 45, 64 and 90 do not have a shaft pin.

   CR 1s, 1, 3, 5, 10, 15, and 20: do not loosen the three shaft seal securing allen screws.
4. With the correct size wrench, loosen and remove the four bolts which hold the motor to the pump end.
5. Lift the motor straight up until the shaft has cleared the motor stool.

Assembly

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump end mounting flange. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end.
3. Place the terminal box in the desired position by rotating the motor.
4. Insert the mounting bolts, then diagonally and evenly tighten. For 3/8" bolts, torque to 17 ft.-lbs., for 1/2" bolts torque to 30 ft.-lbs., and for 5/8" bolts torque to 59 ft.-lbs.
5. **CR 1s, 1, 3, and 5:**
   Insert shaft pin into shaft hole. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even, and that the motor shaft keyway is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque.

   CR 10, 15 and 20:

   Insert shaft pin into shaft hole. Insert plastic shaft seal spacer beneath shaft seal collar. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft key way is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

   CR 2, 4, 8 and 16:

   Reinstall coupling halves. Make sure the shaft pin is located in the pump shaft. Put the cap screws loosely back into the coupling halves. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point (see Figure 6). Note: the shaft can only be raised approximately 0.20 inches (5mm). Now lower the shaft halfway back down the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a criss-cross pattern.

CR(N) 32, 45, 64 & CR90:

Place the plastic adjustment fork under the cartridge seal collar (see Figure 7).

Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the clearance chamber in the coupling (see Figure 8).

Lubricate the coupling screws with an anti-seize and lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides and the motor shaft keyway centered in the coupling half as shown in Figure 6a. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a crisscross pattern.

Torque coupling screws to 62 ft.-lbs. Remove the adjustment fork from under the cartridge seal collar and replace it to the storage location (see Figure 9).

Torque Specifications CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 CR(N)(X)(T) 2, 4, 8, and 16	
Coupling Bolt Size	**Min. Torque Specifications**
M6	10 ft-lbs.
M8	23 ft-lbs.
M10	46 ft-lbs.

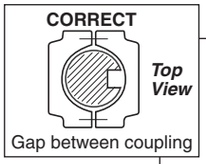
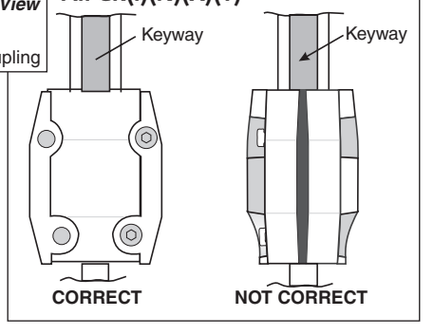
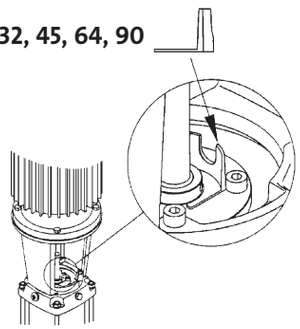


Figure 6a
All CR(I)(N)(X)(T)



6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply wiring to the motor.
10. Check the direction of rotation, by bump-starting the motor. Rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Shut off the power, then re-install the coupling guards. After the coupling guards have been installed the power can be turned back on.

Figure 7
CR(N) 32, 45, 64, 90

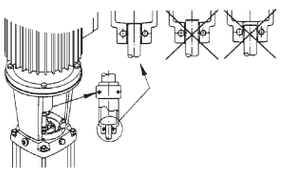


Parts List

For each CR pump model Grundfos offers an extensive **Parts List** and diagram of part used in that pump and is recommended to have on hand for future maintenance. In addition, the listings also provide information about prepackaged **Service Kits** for those pump components most likely to exhibit wear over time, as well as the complete Impeller Stack needed to replace the "guts" of each model. These Parts Lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR **Service Manuals** (for a small charge).

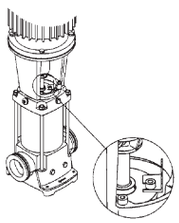
Left, prepackaged impeller stacks ready for immediate installation; right, prepackaged flange kits.

Figure 8



NOTE: To avoid damaging the coupling halves, ensure that no portion of the keyway on the motor shaft lies within the gap between the two coupling halves.

Figure 9



Spare Parts

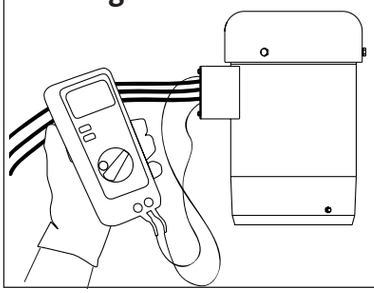
Grundfos offers an extensive list of spare parts. For a current list of these parts, refer to: "All Product Spare Parts/Service Kits" Price List, Form # L-SK-SL-002.

WARNING:

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

Preliminary tests

Supply voltage



How to measure

Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

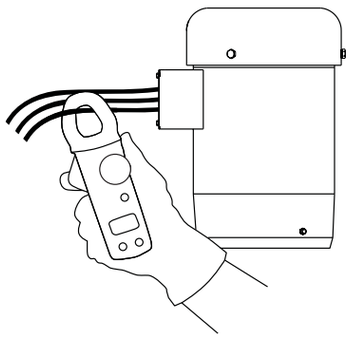
What it means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to Measure

Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

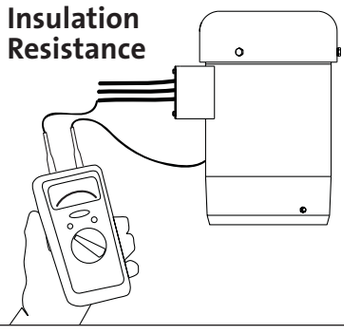
Current should be measured when the pump is operating at constant discharge pressure.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump does not run	1. No power at motor.	Check for voltage at motor teminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.
	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The pump runs but at reduced capacity or does not deliver water	1. Wrong rotation	Check wiring for proper connections. Correct wiring.
	2. Pump is not primed or is airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainers, check or foot valves are clogged.	Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump runs but at reduced capacity or does not deliver water (continued)	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	9. Improper coupling setting.	Check/reset the coupling, see page 10.
Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

Three Phase Motors

Below is a worksheet for calculating current unbalance on a three-phase hookup and selecting the proper wiring. Use the calculations in the left-hand column as a guide.

EXPLANATION & EXAMPLES	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup number 1, 2, and 3.	**Hookup 1** T1 = 51 Amps T2 = 46 Amps T3 = 53 Amps TOTAL = 150 Amps
Divide the total by three to obtain the average.	**Hookup 1** 50 Amps 3 | 150 Amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 Amps – 46 Amps 4 Amps
Divide this difference by the average to obtain the percentage of unbalance. In this case, the current unblanace for hookup number 1 is 8%.	**Hookup 1** .08 or 8% 50 | 4.00 Amps

FIGURE HERE		
Hookup 1 L_1 to T_1 = ____ Amps L_2 to T_2 = ____ Amps L_3 to T_3 = ____ Amps TOTAL = ____ Amps	**Hookup 2** L_1 to T_3 = ____ Amps L_2 to T_1 = ____ Amps L_3 to T_2 = ____ Amps TOTAL = ____ Amps	**Hookup 3** L_1 to T_2 = ____ Amps L_2 to T_3 = ____ Amps L_3 to T_1 = ____ Amps TOTAL = ____ Amps
Hookup 1 _____ Amps 3 | _____ Amps	**Hookup 2** _____ Amps 3 | _____ Amps	**Hookup 3** _____ Amps 3 | _____ Amps
Hookup 1 ____ Amps – ____ Amps ____ Amps	**Hookup 2** ____ Amps – ____ Amps ____ Amps	**Hookup 3** ____ Amps – ____ Amps ____ Amps
Hookup 1 ____ or ____% ____ | ____ Amps	**Hookup 2** ____ or ____% ____ | ____ Amps	**Hookup 3** ____ or ____% ____ | ____ Amps

LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (GRUNDFOS) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

ISO 9001 CERTIFIED

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Grundfos Pumps Corporation
17100 W. 118th Terrace
Olathe, KS 66061
Telephone 913 227 3400
Fax: 913 227 3500

www.grundfos.com

Grundfos Canada, Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9 Canada
Telephone: 905 829 9533
Fax: 905 829 9512

Bombas Grundfos de Mexico, S.A. de C.V.
Boulevard TLC #15
Parque Stiva Aeropuerto
Apodaca, N.L. 66600 Mexico
Telephone: 52 81 8144 4000
Fax: 52 81 8144 4010

GRUNDFOS®

BRONZE REGRINDING GLOBE and GLOBE NEEDLE VALVES

"MODEL STAR"

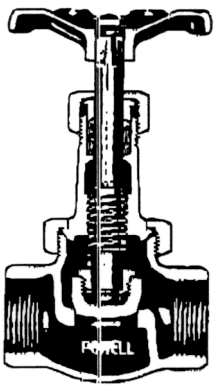


Fig. 110
Globe, Threaded
Sizes, 1/4" through 3"

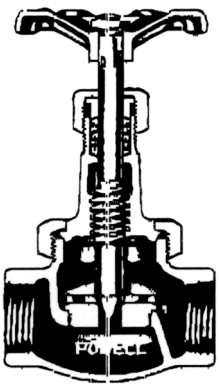


Fig. 180
Globe Needle, Threaded
Sizes, 1/4" through 1"

CLASS 200

UNION BONNET
THREADED ENDS

PRESSURE/TEMPERATURE RATINGS

200 psi Steam at 550°F
400 psi Non-Shock Cold water, Oil or Gas

MATERIALS

DESCRIPTIONS	MATERIAL	ASTM Spec.
Handwheel Nut	Brass	Commercial
Identification Plate	Aluminum	Commercial
Handwheel	Malleable Iron	A-47 Gr. 32510
Stem	Silicon Bronze	B-371 C69400
Packing Nut **	Bronze	B-62
Packing Gland	Brass	B-16
Packing Graphite Non-Asbestos	Commercial	
Bonnet	Bronze	B-61
Bonnet Ring	Bronze	B-61
Disc Locknut***	Silicon Bronze	B-371 C69400
Horseshoe Ring***	Stainless Steel	A-582, Type 303
Disc****	Bronze	B-61
Body	Bronze	B-61
Seat Ring*	Silicon Bronze	B-371 C69400

* Fig. 180 1/2" to 1" size

** Silicon Bronze B-371 C69400 Sizes 1/4" to 1" incl.

*** Sizes 1/4" to 2" incl.

**** Sizes 1/4" - 1 1/4" incl. Silicon Bronze B-371 C69400

SPECIFICATIONS

•MSS-SP-80

FEATURES

- •Plug type Discs are held by a locknut (Fig. 110)
- •Disc and Stem are one piece in Needle valves (Fig. 180)
- •Integral Seats have openings equal to nominal pipe size of the valve
- •Needle valves have renewable Seat Rings (in sizes 1/2" to 1")
- •High-Tensile Bronze Alloy Stems
- •Valves can be reground without being removed from the line

Fig. 110

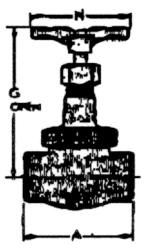


Fig. 180

DIMENSIONS (Inches)

Size	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
A(Fig.110)	2 1/8	2 1/4	2 1/2	3	3 9/16	4 1/8	4 5/8	5 3/4	6 1/2	7 1/4
A(Fig.180)	2	2 1/8	2 1/2	3	3 9/16	-	-	-	-	-
G(Fig.110)	4 1/32	4 1/32	4 11/16	5 9/16	6 7/32	6 25/32	7 23/32	8 3/4	9 7/16	10 3/4
G(Fig.180)	3 13/16	3 13/16	4 5/8	5 1/2	6 5/32	-	-	-	-	-
H	2 1/2	2 1/2	2 3/4	3 1/4	3 5/8	4 1/16	4 3/4	5 11/16	5 11/16	6 3/8
Diameter of Orifice										
(Fig.180)	1/8	3/16	1/4	3/8	1/2	-	-	-	-	-

WEIGHTS (Pounds)

Fig.110	0.9	0.9	1.3	2.2	3.4	4.9	7.7	12.3	16.3	24.1
Fig.180	0.9	0.9	1.3	2.1	3.3					

ASHCROFT®

Type 1008 Metric Case Gauges

DRESSER INDUSTRIES DRESSER

INSTRUMENT DIVISION

SS1

1008 Gauge

Ashcroft's new Industrial Quality Type 1008 stainless steel gauge is designed to perform well even in applications where vibration, pulsation and mechanical shock are constant factors.

1008 contains the unique, spring suspended movement which adds to durability and increased gauge life. The movement is suspended between the Bourdon tube and socket, reducing the load on precision moving parts. This spring suspension helps the gauge resist mechanical shock and vibration. Spring suspension provides long life through reduced gear wear, with long term stability and greater reliability.

The helical Bourdon tube used in ranges 1,000 psi and over has high pressure capability with low internal volume, and is designed for high cycle life. All ranges are designed for maximum life under pulsating service conditions.

1008 is available in 63mm or 100mm dial sizes, stem or surface mounted, with a stainless steel case and polished stainless steel crimped ring. A standard polycarbonate window is offered with temperature compensating design. The gauge utilizes a u-clamp for panel mounting.

Type 1008A has a bronze tube and brass socket, with soft soldered pressure containing joints. The gauge has an RTV seal on the lower connection and an "O" ring seal on the back connection. Vacuum through 600 psi ranges are available.

Type 1008S has a stainless steel tube and socket with welded pressure containing joints. In addition, the socket is welded to the case. This joint protects against corrosion and provides a permanent case seal for liquid fill applications. Ranges available from vacuum to 15,000 psi.

All liquid-filled pressure gauges (300 psi and over) are supplied with a throttle device as standard.

Throttle Devices — All liquid filled 1008 gauges, 300 psi and above, are supplied with a throttle device in the gauge socket. If requested, these devices will be supplied on dry gauges or on liquid filled units below 300 psi.

Accuracy: 3-2-3%
ANSI Grade B

All gauges made in U.S.A.

The 1008AL (bronze socket) is equipped with a push in brass throttle plug with a 0.013" diameter orifice. 1008SL (stainless steel socket) is equipped with the Ashcroft annular orifice device with an orifice equivalent to 0.013" by 2¼" length. This device will attenuate up to 70% of excess pulsation.

Product Selection Information

All gauge components should be selected considering media and operating conditions, to prevent mis-application. Improper application can cause gauge failure and possible personal injury or property damage. The information contained in this catalog is offered as a guide to assist in making the proper selection of a pressure gauge. Additional information is available from Dresser Instrument Division. Consult ANSI B40.1 for guidance in gauge selection.

Gauges should be selected with a full scale pressure range of approximately twice the normal operating pressure. The maximum operating pressure should not exceed approximately 75% of the full scale range. Failure to select a gauge range within these criteria may ultimately result in fatigue of the Bourdon tube.

The temperature to which a gauge will be subjected should not exceed 150°F. Accuracy will be affected by approximately 0.2 psi per 10°F. A pressure relief plug is supplied in all cases to relieve case pressure buildup in the event a slow leak develops in the pressure element. Proper selection of the Bourdon system and socket material is dependent upon the process fluid to which the system will be subjected. If a standard material is not suitable, the use of a diaphragm seal may be necessary.

Gauges cleaned for gaseous oxygen or other strong oxidizing agents cannot be supplied with glycerine or silicone liquid fill. Consult factory if liquid filling is required on strong oxidizing media.

Ordering Example Below

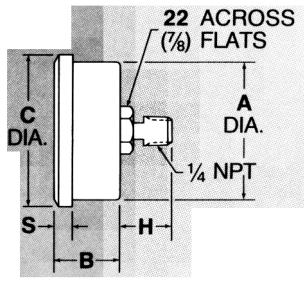
63 1008S

Case Size

Code	
63	63mm (2½")
100	100mm (4")

Tube / Socket Material

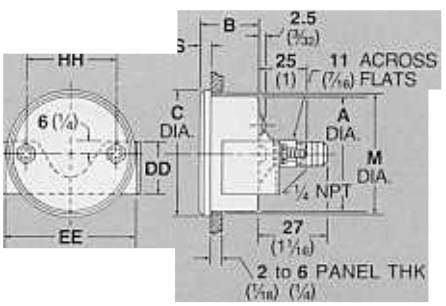
Code	
1008A	Bronze/Brass Soldered
1008S	AISI 316 Stainless Steel/AISI 316 Stainless Steel Welded

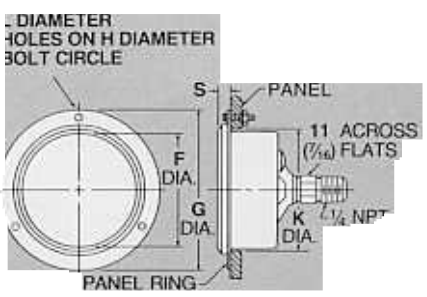


1008A BACK CONNECT

GAUGE SIZE		A	B	C	H	S
63 MM	MM	63	30	69	24	5.5
	INCH	2½	1³⁄₁₆	2²³⁄₃₂	¹⁵⁄₁₆	⁷⁄₃₂
100 MM	MM	100	30	106	24	7
	INCH	3¹⁵⁄₁₆	1³⁄₁₆	4⁵⁄₃₂	¹⁵⁄₁₆	⁹⁄₃₂

DIMENSIONS IN ( ) ARE INCHES





1008 BACK CONNECT XUC VARIATION

GAUGE SIZE		A	B	C	DD	HH	M	S	EE
63 MM	MM	63	31	68	28	49	64	5.5	70
	INCH	2½	1⁷⁄₃₂	2¹¹⁄₁₆	1⅛	1¹⁵⁄₁₆	2¹⁷⁄₃₂	⁷⁄₃₂	2¾
100 MM	MM	100	32	105	26	76	101	7	103
	INCH	3¹⁵⁄₁₆	1²⁄₃₂	4⁵⁄₃₂	1¹⁄₃₂	3	3³¹⁄₃₂	⁹⁄₃₂	4¹⁄₁₆

DIMENSIONS IN ( ) ARE INCHES

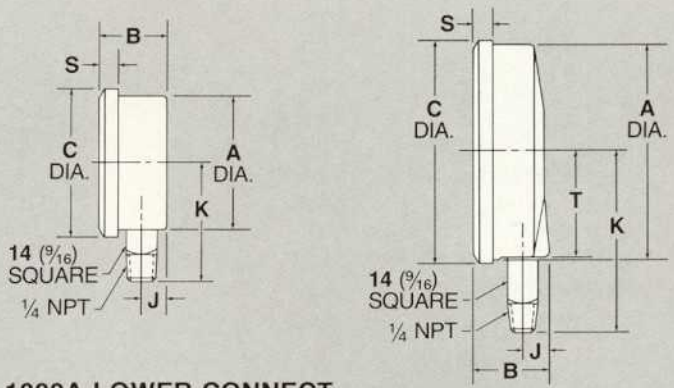
1008 BACK CONNECT W/PANEL RING

GAUGE SIZE		F	G	S	H BOLT CIRCLE	K PANEL HOLE	L BOLT HOLE
63 MM	MM	60	85	6	75	69	3.8
	INCH	2¹³⁄₃₂	3⁵⁄₁₆	³⁄₁₆	2¹⁵⁄₁₆	2²³⁄₃₂	.150
100 MM	MM	97	132	6.3	116	102	4.6
	INCH	3¹³⁄₁₆	5³⁄₁₆	¼	4⁹⁄₁₆	4	.180

DIMENSIONS IN ( ) ARE INCHES

L 02 L 0-1500#

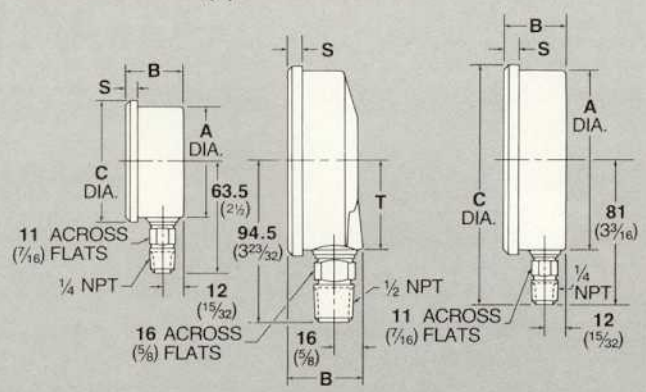
ication	Connection		Connection Location		Variations	
	Code		Code		Code	
Dry Liquid Fill Glycerine	02	¼ NPT	L B	Lower Back	XTU	Throttle Device 1008A or AL
	02	¼ NPT			XNH	Wired St. St. Tags
					XTS	Throttle device 1008S or SL
					XGV	Silicone Fluid
					XAN	100mm 1008S (L) only 1% Full Scale Accuracy
Dry Liquid Fill Glycerine	02	¼ NPT	L B	Lower Back		
	02 04	¼ NPT ½" NPT (lower only)	L B	Lower Back		



1008A LOWER CONNECT

GAUGE SIZE		A	B	C	J	K	S	T
63 MM	MM	63	31	69	10	55	5.5	—
	INCH	2½	1 7/32	2 23/32	13/32	2 5/32	¼	—
100 MM	MM	100	35	105.5	13.5	86	7	48.5
	INCH	3 15/16	1⅜	4 5/32	17/32	3⅜	9/32	1 29/32

DIMENSIONS IN ( ) ARE INCHES



1008S LOWER CONNECT

GAUGE SIZE		A	B	C	S	T
63 MM	MM	63	31	68	5.5	—
	INCH	2½	1 7/32	2 11/16	7/32	—
100 MM	MM	100	32.5	106	7	50
	INCH	3 15/16	1 9/32	4 5/32	9/32	1 31/32

Standard Ranges

Code	Single Scale Dial	Dual Scale Dial	
	psi	psi Inner Arc	kPa Outer Arc
A	0/15	0/15	0/100
AL	0/30	0/30	0/200
S	0/60	0/60	0/400
SL	0/100	0/100	0/700
	0/160	0/160	0/1100
	0/200	0/200	0/1400
	0/300	0/300	0/2000
	0/400	0/400	0/2800
	0/600	0/600	0/4000
	Vacuum in Hg.	**in Hg.**	**in Hg.**
	30/0	30/0	–100/0
	Compound in Hg./psi	**in Hg./psi**	**kPa**
	30/15	30/15	–100/100
	30/30	30/30	–100/200
	30/60	30/60	–100/400
	30/100	30/100	–100/700
	30/150	30/150	–100/1000
	30/300	30/300	–100/2000
	psi	**psi Inner Arc**	**kPa Outer Arc**
S	0/1000	0/1000	0/7000
SL	0/1500	0/1500	0/10000
	0/2000	0/2000	0/14000
	0/3000	0/3000	0/20000
	0/5000	0/5000	0/34000
	0/6000	0/6000	0/40000
	0/7500	0/7500	0/50000
	0/10000	0/10000	0/70000
	0/15000	0/15000	0/100000

Dual Scale Ammonia Ranges

	Compound in Hg./psi	0°F Outer Arc
S	30/150	–40/84°F
SL	30/300	–40/125°F

Weight in grams/ozs.

	63mm	100mm
Dry	112g/4 oz.	182g/6.5 oz. (¼ NPT) 192g/6.9 oz. (½ NPT)
Liquid Fill	205g/7.5 oz.	434g/15 oz. (¼ NPT) 444g/16 oz. (½ NPT)

Accessories For Panel Mounting	Cat. No.
63mm "U" Clamp (for panel mounting)	3520
63mm Bezel Ring (for panel mounting)	3511F
100mm "U" Clamp (for panel mounting)	3521
100mm Bezel Ring (for panel mounting)	3513G
63mm Three Hole Front Mounting Flange	3516F
100mm Three Hole Front Mounting Flange	3517G
63mm Front Mounting Flange	3529

Instrument Division Sales and Customer Service Locations

Domestic Headquarters

Stratford, Connecticut
250 E. Main Street
Stratford, CT 06497
Tel: (203) 378-8281
FAX: (203) 385-0499

Sales Offices

Chicago, Illinois
400 W. Lake Street
Suite 318
Roselle, IL 60172-3392
Tel: (708) 980-9030
FAX: (708) 980-9440

Houston, Texas
3838 North Sam Houston
Parkway East
Suite 120
Houston, TX 77032
Tel: (713) 590-1092
FAX: (713) 590-7100

Los Angeles, California
3450 East Spring Street
Long Beach, CA 90806
Tel: (213) 595-4691
FAX: (213) 427-0537

Philadelphia, Pennsylvania
Computer Road and
Maryland Ave.
Suite A-8
Willow Grove, PA 19090
Tel: (215) 657-2886
FAX: (215) 657-7962

International Headquarters

Stratford, Connecticut
250 E. Main Street
Stratford, CT 06497
Tel: (203) 378-8281
TLX: 475-0017ITT
FAX: (203) 385-0357

International Operations

Brazil
Dresser Industria e
Comercio Ltda.
Divisao Manometros Willy
Caixa Postal 212
09601 Sao Caetano do Sul
Sao Paulo, Brazil
Tel: 55-11-453-5477
FAX: 55-11-453-6778

Venezuela
Manufacturas Petroleras
Venezolanas S.A.
Apartado Postal 617
Maracaibo, Venezuela
Tel: 58-61-412-120
FAX: 58-61-413-954

Canada
Dresser Canada, Inc.
Mississauga Service Centre
6688 Kitimat Road
Mississauga,
Ontario L5N 1P8
Canada
Tel: 416-826-8411
FAX: 416-826-9106

Germany
Dresser Europe S.A.
Instrument Division
European Operations
Postfach 11 20
Max-Planck-Str. 1
D-5112 Baesweiler
Germany
Tel: 49-2401-808-0
FAX: 49-2401-808-25

England
Dresser U.K. Ltd.
29/31 Rufford Court
Hardwick Grange
Warrington, Cheshire
England WA1 4RF
Tel: 44-925-814545
FAX: 44-925-816378

Saudi Arabia
DARVICO
P.O. Box 10145
Jubail Industrial City
Saudi Arabia 31961
Tel: 966-3-341-0278
FAX: 966-3-341-7624

Japan
Niigata Ashcroft Keiki Co., Ltd.
9-3, Kamata Honcho 1-Chome,
Ohta-Ku, Tokyo 144
Japan
Tel: 81-3-3739-4924
FAX: 81-3-3739-4975

South East Asia
Dresser Singapore
Instrument Division
152 Paya Lebar Road
04-06 Citipoint Industrial Complex
Singapore 1440
Tel: 65-825-4783
FAX: 65-447-1448

Korea
Dresser International S.A.
Korea Office
#2015 Kuk Dong Bldg.
60-1, 3-KA, Choongmu-Ro, Chung-ku
Seoul, Korea
Tel: 82-2-274-0792
FAX: 82-2-274-0794

China
Dresser Trading Division
Dresser Industries, Inc.
Room 3, 24th Floor
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Corp. Bldg.
Jianguo Menwai Dajie
Beijing, People's Republic of China
Tel: 86-1-500-3139
FAX: 86-1-512-0030

India
Indfos Industries Limited
706-707 Surya Kiran
19 Kasturba Gandhi Marg
New Delhi 110 001, India
Tel: 91-11-331-6196
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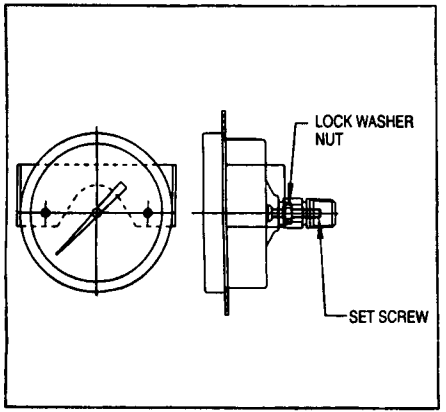
DRESSER INDUSTRIES DRESSER
INSTRUMENT DIVISION

MOUNTING INSTRUCTIONS FOR ASHCROFT® TYPES 1009, 1008 & 3005 U-CLAMP (XUC)



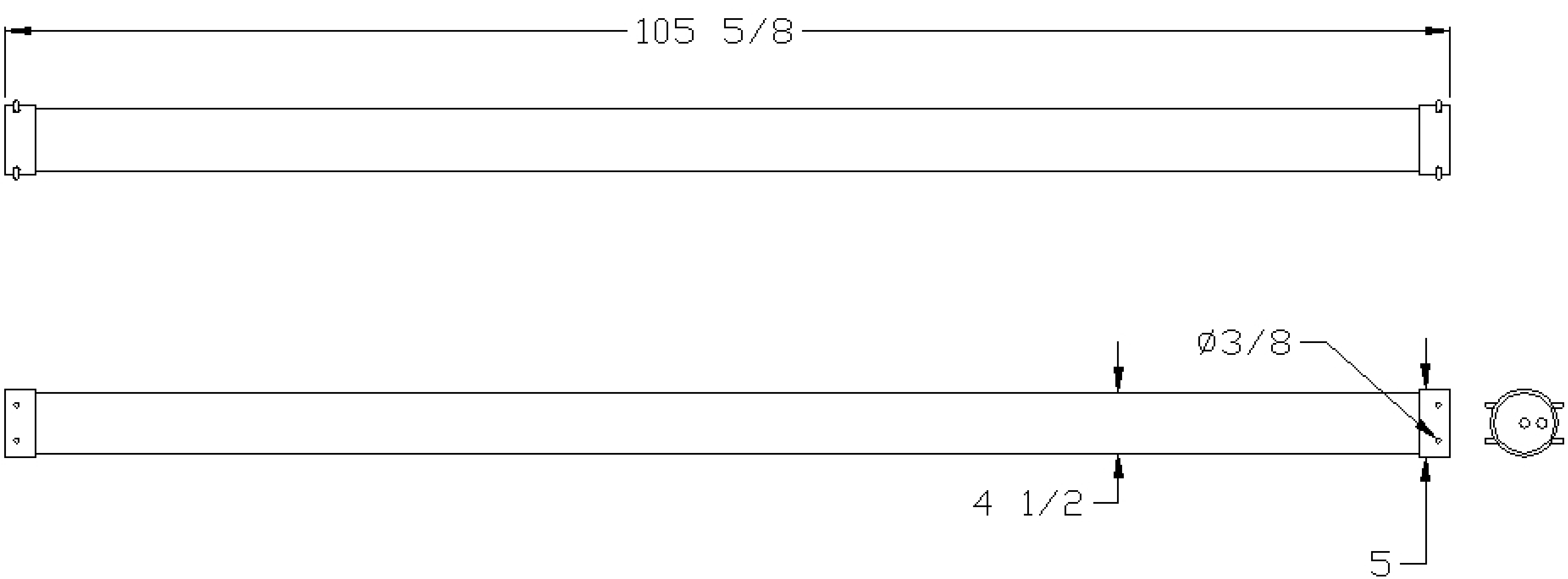
U-CLAMP: KIT 101A164-01 (2½˝, 63mm) & 101A164-02 (3½˝, 100mm)

Assemble the (2) 1 inch long set screws to the rear of the case. Tighten finger tight. Slip gauge into panel and assemble U-clamp over the set screws. Secure the U-clamp with (2) lockwasher nuts using a 11/16 wrench (16-20in-lbs torque).

Kit	Panel Hole Min	Panel Hole Max
101A164-01 (25-1009)	2¾ (70mm)	2 25/32 (71mm)
101A164-02 (35-1009)	3⅝ (92mm)	3 11/16 (94mm)
101A164-01 (63-3005) (63-1008)	2 17/32 (64mm)	2 9/16 (65mm)
101A164-02 (10-1008)	3 31/32 (101mm)	4 (102mm)

DRESSER INSTRUMENT

CRANE ENVIRONMENTAL
R.O. PRESSURE VESSEL, 4" x 2 ELEMENT
SCHEDULE 80, PVC



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DRAWING TITLE

4"x40" PVC VESSEL, 200PSI
2 ELEMENT, HE008

PV-4X0-PVC-2ELEM-HE DRAWING

REV -

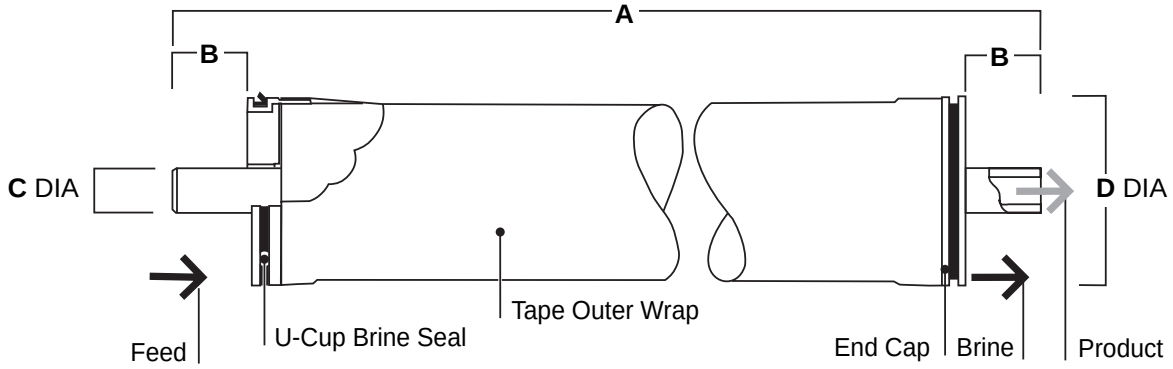
FILMTEC Membranes

FILMTEC® 4" Tapwater RO Elements

Product Specifications

Product	Product Water Flow Rate (gpd)	(m³/d)	(l/h)	Minimum Salt Rejection Cl^- (%)	Stabilized Salt Rejection Cl^- (%)
TW30-4014	475	1.80	76	98.0	99.0
TW30-4021	900	3.41	142	98.0	99.0
TW30-4040	2200	8.33	347	98.0	99.0
TW30HP-4040	2800	10.60	442	98.0	99.0

1. Permeate flow and salt rejection based on the following test conditions: 2000 ppm NaCl, 225 psi (1.6 MPa), 77°F (25°C), pH 8, and recovery as indicated below.
2. Flow rates for individual elements may vary -15%/+25% for TW30-4014, TW30-4021 and TW30-4040 and -15%/NUL (NUL: No Upper Limit) for TW30HP-4040.
3. Sales specification of TW30-4014 and TW30-4021 may vary slightly as design revisions take place.



Operating Limits

Membrane Type.....Thin-Film Composite
Maximum Operating Pressure.....300 psi (2.1 MPa)
Maximum Feed Flow Rate .....17 gpm (3.9 m³/h)†
pH Range, Continuous.....2 to 11
pH Range, Cleaning Cycle (30 min.) .....1 to 12
Maximum Operating Temperature .....113° F (45 °C)
Maximum Feed Turbidity.....1 NTU
Maximum Feed Silt Density Index .....SDI 5
Free Chlorine Tolerance .....<0.1 ppm

Product	Single-Element Recovery (Permeate Flow to Feed Flow)	Dimensions – Inches (mm) A	B	C	D
TW30-4014	0.05	14.0 (356)	1.05 (27)	0.75 (19)	3.913 (99.4)
TW30-4021	0.08	21.0 (533)	1.05 (27)	0.75 (19)	3.913 (99.4)
TW30-4040	0.15	40.0 (1016)	1.05 (27)	0.75 (19)	3.913 (99.4)
TW30HP-4040	0.15	40.0 (1016)	1.05 (27)	0.75 (19)	3.913 (99.4)

4. Consult most recent DESIGN GUIDELINES for multiple element applications and recommended element recovery rates for various feed sources.
5. Element to fit 4.00-inch I.D. pressure vessel.
†Maximum feed flow for TW30HP-4040 is 18 gpm (4.1 m³/h).

1 inch = 25.4 mm

*Trademark of The Dow Chemical Company

FILMTEC Membranes

For more information about FILMTEC membranes,
call Dow Liquid Separations:
North America 1-800-447-4369
Latin America . . . . . .(+55) 11-5188-9345
Europe . . . . . .(+31) 20-691-6268
Japan . . . . . .(+81) 3-5460-2100
Australia . . . . . .(+61) 2-9776-3226
http://www.dow.com/liquidseps

Important Operating Information

1. Keep elements moist at all times after initial wetting.

2. If operating specifications given in this Product Information bulletin are not strictly followed, the limited warranty will be null and void.

3. Permeate obtained from first hour of operation should be discarded.

4. To prevent biological growth during storage, shipping or system shutdowns it is recommended that FILMTEC elements be immersed in a protective solution. The standard storage solution contains 1.5 percent (by weight) sodium metabisulfite (food grade).

5. Elements must be in use for at least six hours before formaldehyde is used as a biocide. If the elements are exposed to formaldehyde before being in use for this period of time, a loss in flux may result.

6. The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

7. The customer is fully responsible for the effects of incompatible chemicals on elements.Their use will void the element limited warranty.

Published March 1998.

Form No. 609-09040-398XQRP
CH 172-031-E-398R

Installation & Maintenance Instructions

ASCO® TRIVPOINT® Pressure Switches

Miniature–Size, Fixed Deadband Pressure Switches With Field Adjustable Set Points

H–SERIES

Form No. P7079R4

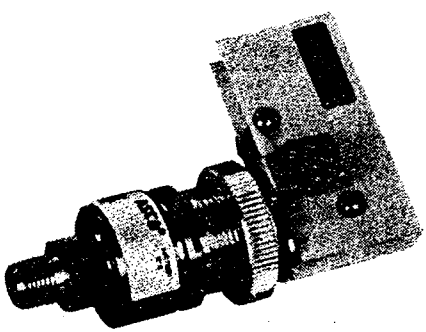
DESCRIPTION

The H–Series are miniature size pressure switches having field adjustable set points, fixed deadbands, and diaphragm/piston sensors. These pressure switches are designed to provide long life and maintain set point accuracy. Materials wetted by the fluid include brass or stainless steel pressure connections. Internal elastomers are made of Buna N, ethylene propylene, fluorosilicone, or VITON* depending upon service requirements.

H–Series pressure switches are available with:

- Open–Frame construction
- Type 1 –General Purpose Enclosure
- Types 3, 3S, and 4–Raintight/Watertight Enclosure

NOTE: H–Series, Suffix *L* pressure switches are limited to Open–Frame Construction.



H–Series, Suffix *L* Pressure Switch

OPERATION

The pressure switch controls electrical circuits in response to changes in pressure. The set and reset points are adjustable over the full range of the switch. As the deadband (on–off differential) is adjusted, both set point on increasing pressure and set point on decreasing pressure are changed. The difference between these points is fixed and is not adjustable. Pressure setting adjustments are made by turning the adjustment wheel at the center of the switch. On H–Series, Suffix S pressure switches, the snap switch has an adjustment knob to vary the deadband range. To increase deadband range, turn knob counterclockwise; to decrease range, turn knob clockwise.

NOTE: The maximum proof pressure for H–Series pressure switches is 250 psig. Proof pressure is the pressure which a device can be subjected to for extended periods of time without changes in its operating characteristics.

*DuPont's Registered Trademark

INSTALLATION

Check the nameplate for correct catalog number, electrical rating, and pressure range. Never apply incompatible fluids or exceed pressure rating of the switch.

IMPORTANT: All internal adjustments have been made at the factory. Any adjustment, alteration, or repair to the parts of the switch other than stated herein voids all warranties.

Temperature Limitations

Ambient Temperature

- Standard & Suffix *L* Switch: – 4° F to +140° F
- Suffix *U* Switch: – 4° F to +122° F

Check catalog number on nameplate to determine fluid temperature limitations. The seventh (7th) digit in the catalog indicates diaphragm material and fluid temperature limitations. See chart provided.

Seventh (7th) Digit in Catalog Number	Diaphragm Material	Fluid Temperature Limitations
1	Buna N	–4° F to +180° F
2	VITON*	–4° F to +250° F
6	Ethylene Propylene	–4° F to +250° F
7	Fluorosilicone	–40° F to +250° F

EXAMPLE: For Catalog Number HB46A278, the seventh digit of the catalog number is 7. This indicates that the diaphragm material is Fluorosilicone and the fluid temperature limitations are – 40° F to +250° F.

Positioning

The pressure switch may be mounted in any position.

Mounting

For mounting bracket (optional feature) or mounting dimensions of general purpose enclosure see Figures 1, 2, and 3.

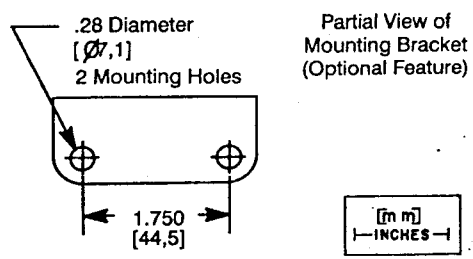


Figure 1. Optional mounting bracket.

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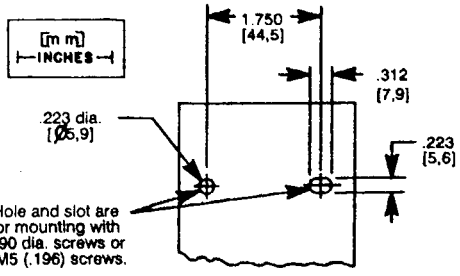


Figure 2. General purpose enclosure.

Piping/Tubing

Adequate support of piping and proper mounting of pressure switch should be made to avoid excessive shock or vibration. To minimize the effect of vibration on a switch, mount perpendicular to vibration. Connect piping or tubing at base of pressure switch.

⚠ CAUTION: Do not use 1/2" pipe thread on pressure switch body as a pressure connection. This thread is provided for mounting the pressure switch in a panel enclosure or mounting bracket through a 7/8" diameter hole.

⚠ CAUTION: Pressure switches with the seventh (7th) digit in the catalog number being a six (6) are provided with ethylene propylene diaphragm material which can be attacked by oils and greases. Wipe the pipe threads clean of cutting oils.

Apply pipe compound sparingly to male pipe threads only. If applied to internal threads, the compound may enter the sensor and cause operational difficulty. Avoid pipe strain on pressure switch by properly supporting and aligning piping. When tightening pipe, do not use the pressure switch as a lever. Locate wrenches applied to pressure switch body on wrenching flats only.

⚠ CAUTION: For steam service, install a condensate loop, (pigtail or steam siphon tube) between the steam line and the pressure switch.

Wiring

Wiring must comply with local codes and the National Electric Code. Use No. 14 AWG copper wire rated for 60° C minimum. Switch is marked *NO* for normally open, *NC* for normally closed, and *C* for common. H–Series, Suffix *L* switches are provided with 1/4" spade terminal connections. The general purpose switch enclosure is provided with two 7/8" diameter knockouts to accommodate 1/2" electrical hub or connector. For extra support, leave switch housing assembled when driving out 7/8" diameter knockout. It is recommended that flexible conduit be used. If rigid conduit is used, do not consider it or use it as a means of supporting (mounting) the pressure switch. The raintight/watertight enclosure has a 1/2" conduit hub. When replacing housing cover, torque screws in a crisscross manner to 10 in–lbs [1,1 Nm] to ensure even gasket compression.

⚠ CAUTION: Electrical load must be within range stated on nameplate. Failure to stay within the electrical range of the switch rating may result in damage or premature failure of the electrical switch.

⚠ CAUTION: Do not overtighten screw type terminal connections. When connections are made, be sure there is no stress on the wire leads. Excess of either condition may cause malfunction of switch.

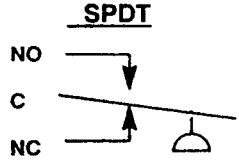
Electrical Ratings

Standard & Suffix *L* Switches

15 amps resistive, 125 volts AC
10 amps resistive, 250 volts AC
1/8 HP, 125 volts AC
1/4 HP, 250 volts AC
1/2 amp resistive, 125 volts DC
1/4 amp resistive, 250 volts DC

Suffix *U* Switch

5 amps resistive, 125 and 250 volts AC
1/8 HP, 125 volts AC
1/4 HP, 250 volts AC
1/2 amp resistive, 125 volts DC
1/4 amp resistive, 250 volts DC



IMPORTANT: H–Series pressure switches are available with optional snap switches which have different electrical ratings than listed above. Check nameplate on housing cover or frame to verify electrical ratings.

Set Point Adjustment (Pressure Setting) of Fixed Deadband Pressure Switch

When making adjustment (pressure setting) a pressure gauge within suitable range is required. If electrical hookup (to line of final application) to the switch is not desirable, a battery powered test lamp or Ohmmeter may be used. The markings on the pressure switch calibration scale (in PSIG or BAR) are for an approximate pressure setting. The adjustment wheel in center of the pressure switch is turned clockwise or counterclockwise to change pressure setting. For an exact pressure setting proceed as follows:

To Adjust Set Point On *Increasing Pressure*

1. If the pressure switch is in the line of final application when set point adjustment is made, be sure switch can be test operated without affecting other equipment.
2. Turn adjustment wheel clockwise until indicator is full down (toward pressure connection) or well beyond desired pressure setting (set point).
3. Follow the steps in the chart below to make the pressure setting.

ASCO Valves Automatic Switch Co. 50–60 Hanover Road, Florham Park, New Jersey 07932

Adjustment Procedure	Normally Closed		Normally Open	
	Switch Terminal	Status of Test Lamp	Switch Terminal	Status of Test Lamp
1. Starting with zero pressure, connect test lamp to common	NC	On (Closed Circuit)	NO	Off (Open Circuit)
2. Apply desired set point pressure. Then turn adjustment wheel counterclockwise until switch operates.	NC	Off (Open Circuit)	NO	On (Closed Circuit)
3. Lower pressure until switch returns on decreasing pressure	NC	On (Closed Circuit)	NO	Off (Open Circuit)

4. For exact pressure setting, cycle pressure switch and make fine adjustments with wheel.
5. After setting has been made, make permanent electrical connections.

⚠ WARNING: To prevent the possibility of personal injury or property damage, be sure electrical power is off when making permanent electrical connections.

To Adjust Set Point On *Decreasing Pressure*

1. If the pressure switch is in the line of final application when set point adjustment is made, be sure switch can be test operated without affecting other equipment.
2. Turn adjustment wheel counterclockwise until indicator is full up (toward snap switch).
3. Follow the steps in the chart below to make the pressure settings.

Adjustment Procedure	Normally Closed		Normally Open	
	Switch Terminal	Status of Test Lamp	Switch Terminal	Status of Test Lamp
1. Starting with initial pressure above desired pressure (set point), connect test lamp to common.	NC	Off (Open Circuit)	NO	On (Closed Circuit)
2. Decrease pressure to desired set point pressure. Then turn adjustment wheel clockwise until switch operates.	NC	On (Closed Circuit)	NO	Off (Closed Circuit)
3. Raise pressure until switch returns on increasing pressure.	NC	Off (Open Circuit)	NO	On (Closed Circuit)

4. For exact pressure setting, cycle pressure switch and make fine adjustments with wheel.
5. After setting has been made make permanent electrical connections.

⚠ WARNING: To prevent the possibility of personal injury or property damage, be sure electrical power is off when making permanent electrical connections.

Testing of Installation

If the adjustment of the switch has been made outside of the line of final application, the switch should be re-tested when installed in the line of final application. Follow adjustment instructions. Be sure switch can be test operated without affecting other equipment.

MAINTENANCE

⚠ WARNING: To prevent the possibility of personal injury or property damage, turn off electrical power, depressurize switch and vent fluid to a safe area before removal or inspection.

IMPORTANT: Pressure switch is not field repairable. In case of damage, replace the entire pressure switch. Address all service inquiries to Automatic Switch Company, 50-60 Hanover Road, Florham Park, New Jersey 07932, Valve Service Department.

Preventive Maintenance

- While in service, operate the fixed deadband pressure switch periodically (cycle between two set points) to ensure proper operation. If necessary, electrical wiring and pipe connections should be made so that switch can be test operated without affecting other equipment.
- Periodic inspection of the pressure switch, external surfaces only, should be carried out. Switch should be kept clean and free from paint, foreign matter, corrosion, icing, or freeing conditions.
- Keep the medium entering the pressure switch as free from dirt and foreign material as possible.

Causes of Improper Operation

- **Incorrect Electrical Connection:** Check leads to switch. Be sure they are properly connected. Switch is marked *NO* for normally open, *NC* for normally closed, and *C* for common.
- **Faulty Control Circuit:** Check the electrical power supply to switch. Check for loose or blown fuses, open-circuited or grounded wires, loose connections at switch. See nameplate for electrical rating and range.
- **Incorrect Pressure:** Check pressure in system with suitable pressure gauge. Pressure must be within range specified on nameplate.
- **Incorrect Adjustment:** Check pressure scale to see approximate setting. Refer to section on "Set Point Adjustment of Fixed Deadband Pressure Switch".
- **External Leakage or Snap Switch Failure: Replace pressure switch, see *ORDERING INFORMATION*.**
- **Excessive Vibration or Surges Causing Switch to Operate Undesirably:** Check for pressure fluctuations in system and install pressure surge suppressor. Check switch mounting and be sure there is no excessive vibration.

If the operation of the pressure switch cannot be corrected by the above means, it should be replaced.

FOR SERVICE, REPLACEMENT OR INFORMATION

Consult Factory or Authorized Factory Representative or Distributors

ORDERING INFORMATION

When Ordering, Specify Catalog Number, Fluid, and Pressure Range.

Torque Chart

Part Name	Torque Value Inch–Pounds	Torque Value Newton–Meters
Cover screws	10	1,1

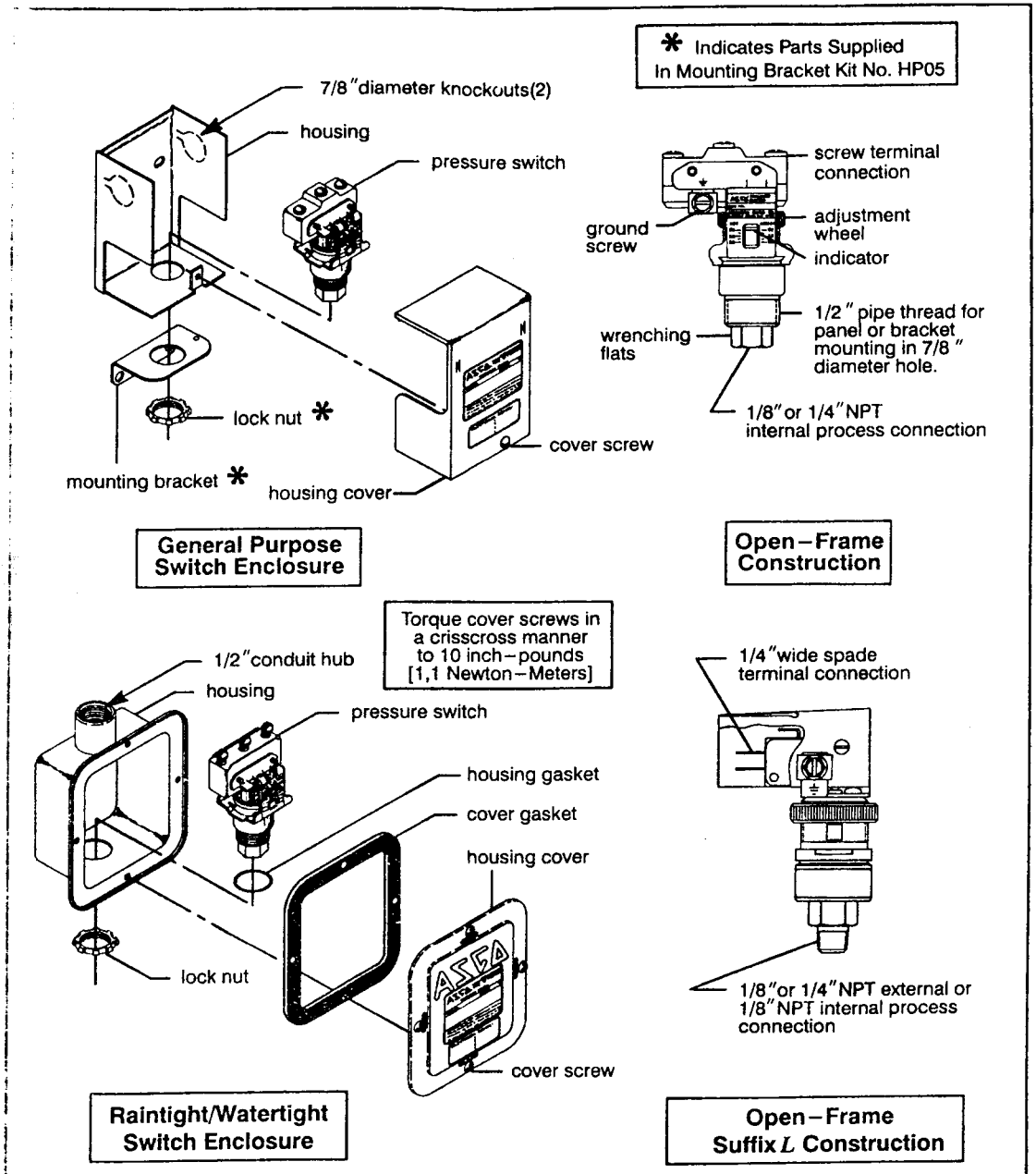


Figure 3. H–Series pressure switches.

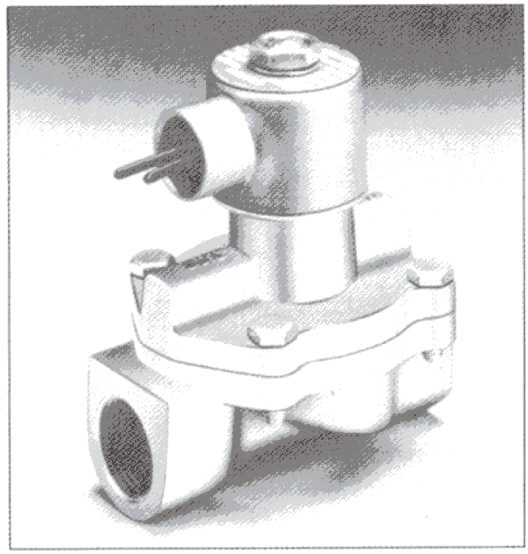
ASCO Valves Automatic Switch Co. 50–60 Hanover Road, Florham Park, New Jersey 07932

S21 Series

2-Way Pilot Operated Diaphragm Solenoid Valves

S211 • Normally Closed
S212 • Normally Open

The S21 Series 2-way general purpose solenoid valves are of piloted diaphragm construction and are available in normally closed and normally open operating modes. They are available in a variety of pipe connections from NPT ⅜" to 2"; there is an extensive range of options. This series is widely used in various industrial applications. For special applications, contact your GC Valves customer service representative.



Specifications

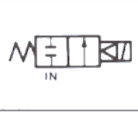
Operating Mode		Normally Closed	Closed when de-energized, open when energized.
		Normally Open	Open when de-energized, closed when energized.
NPT Pipe Size			⅜ • ½ • ¾ • 1 • 1¼ • 1½ • 2
Orifice Size			½ • ⅝ • ¾ • 1 • 1¼ • 1½
Materials	Body		Brass, Stainless Steel
	Sealing/Seat		Buna N, Teflon, Viton, Ethylene Propylene
	Housing	Standard	Conduit (NEMA1)
		Options	Explosion-proof NEMA VII, Grommet, Open frame, Junction box, Watertight NEMA IV, Etc.
Available Voltages			AC24V 60Hz, AC110V 50Hz, AC120V 60Hz, AC220V 50Hz, AC240V 60Hz, DC 12V, DC 24V
Voltage Tolerance			+10% to -15% of applicable voltage
Coil			Class F and H
Lead Length			24 Inch
Temperature Ratings			Ambient Temp.—40°F to 150°F max. with Class F Coil; 175°F max. with Class H Coil. Fluid Temp. See the "HOW TO ORDER" Table.
Mounting position			Mounts in any position (Best position is Solenoid vertical and upright direction)
Agency Listings			UL Listed, CSA Certified (Consult factory for further details.)
Options			Manual Override, Mounting Bracket, Neon Lamp, Surge Suppressor

•Consult the factory for specifications other than those listed above.

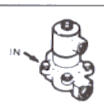
Valve Selection List

Check the "Operating Pressure Range" carefully when selecting a valve.

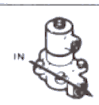
Pipe Connection NPT	Orifice Size IN	Cv Factor	Operating Pressure Differential (PSI) Min.	Max. Air, Gas AC	Max. Air, Gas DC	Max. Water AC	Max. Water DC	Max. Light Oil AC	Max. Light Oil DC	Max. Steam AC	Max. Steam DC	Max. Fluid Temp. (°F)	Housing	Power Consumption (W) AC	Power Consumption (W) DC	Coil	Voltage (V) 60 Hz	Model Code Brass Body	Model Code Stainless Steel Body
Normally Closed																			
⅜	½	3.3	1	250	150	250	150	250	150	—	—	230	A	8	9	F	120	S211AF02K4CG1	———
	½	3.3	1	—	—	—	—	—	—	100	100	338	A	8	9	H	120	S211AH02T4CG1	———
	½	3.3	10	—	—	—	—	—	—	150	150	366	A	8	9	H	120	S211AH02T2CG1	———
	⅝	3.3	4	200	150	150	100	150	100	—	—	180	A	8	9	F	120	S211AF02N5CG4	S211AF02L7CG4
½	½	3.3	1	250	150	250	150	250	150	—	—	230	A	8	9	F	120	S211AF02K4DG1	———
	½	3.3	1	—	—	—	—	—	—	100	100	338	A	8	9	H	120	S211AH02T4DG1	———
	½	3.6	10	—	—	—	—	—	—	150	150	366	A	8	9	H	120	S211AH02T2DG1	———
	⅝	4.1	4	200	150	150	100	150	100	—	—	180	A	8	9	F	120	S211AF02N5DG4	S211AF02L7DG4
¾	¾	6.1	1	250	150	250	150	250	150	—	—	230	A	8	9	F	120	S211AF02K4EG5	———
	¾	6.1	1	—	—	—	—	—	—	100	100	338	A	8	9	H	120	S211AH02T4EG5	———
	¾	7.0	10	—	—	—	—	—	—	150	150	366	A	8	9	H	120	S211AH02T2EG5	———
	¾	5.5	4	200	150	150	100	150	100	—	—	180	A	8	9	F	120	S211AF02N5EG5	S211AF02L7EG5
1	1	13	10	250	150	250	150	250	150	—	—	200	A	8	9	F	120	S211AF02N1FG9	———
	1	13	10	—	—	—	—	—	—	150	150	366	A	8	9	H	120	S211AH02T2FG9	———
	1	13	5	200	150	150	150	100	100	—	—	180	A	8	9	F	120	S211AF02N5FG9	S211AF02L7FG9
	1	13	5	—	—	—	—	—	—	50	50	295	A	8	9	F	120	S211AF02C5FG9	S211AF02E7FG9
1 ¼	1 ½	22	10	250	150	250	150	250	150	—	—	200	S	8	9	F	120	S211SF02N1GJ5	———
	1 ½	22	10	—	—	—	—	—	—	150	150	366	S	8	9	H	120	S211SH02T2GJ5	———
	1 ¼	19	5	200	150	150	150	85	85	—	—	180	A	8	9	F	120	S211AF02N5GJ2	S211AF02L7GJ2
	1 ¼	19	5	—	—	—	—	—	—	50	50	295	A	8	9	F	120	S211AF02C5GJ2	S211AF02E7GJ2
1 ½	1 ½	28	10	250	150	250	150	250	150	—	—	200	S	8	9	F	120	S211SF02N1HJ5	———
	1 ½	28	10	—	—	—	—	—	—	150	150	366	S	8	9	H	120	S211SH02T2HJ5	———
	1 ¼	25	5	200	150	150	150	85	85	—	—	180	A	8	9	F	120	S211AF02N5HJ2	S211AF02L7HJ2
	1 ¼	25	5	—	—	—	—	—	—	50	50	295	A	8	9	F	120	S211AF02C5HJ2	S211AF02E7HJ2
2	1 ½	29	10	250	150	250	150	250	150	—	—	200	S	8	9	F	120	S211SF02N1JJ5	———
	1 ½	29	10	—	—	—	—	—	—	150	150	366	S	8	9	H	120	S211SH02T2JJ5	———
	1 ¼	28	5	200	150	150	150	85	85	—	—	180	A	8	9	F	120	S211AF02N5JJ2	S211AF02L7JJ2
	1 ¼	28	5	—	—	—	—	—	—	50	50	295	A	8	9	F	120	S211AF02C5JJ2	S211AF02E7JJ2
Normally Open																			
⅜	½	3.3	1	150	140	150	140	150	140	—	—	230	A	9	9	F	120	S212AF02K4CG1	———
	½	3.3	1	—	—	—	—	—	—	100	100	338	A	9	9	H	120	S212AH02T4CG1	———
	⅝	3.3	3	200	140	200	125	200	125	—	—	180	A	11	10	F	120	S212AF02N5CG4	S212AF02L7CG4
½	½	3.3	1	150	140	150	140	150	140	—	—	230	A	9	9	F	120	S212AF02K4DG1	———
	½	3.3	1	—	—	—	—	—	—	100	100	338	A	9	9	H	120	S212AH02T4DG1	———
	⅝	4.1	3	200	140	200	125	200	125	—	—	180	A	11	10	F	120	S212AF02N5DG4	S212AF02L7DG4
¾	¾	6.1	1	150	140	150	140	150	140	—	—	230	A	9	9	F	120	S212AF02K4EG5	———
	¾	6.1	1	—	—	—	—	—	—	100	100	338	A	9	9	H	120	S212AH02T4EG5	———
	¾	5.5	3	200	140	200	125	200	125	—	—	180	A	11	10	F	120	S212AF02N5EG5	S212AF02L7EG5
1	1	13	10	200	140	200	140	200	140	—	—	200	A	9	9	F	120	S212AF02N1FG9	———
	1	13	10	—	—	—	—	—	—	100	100	338	A	9	9	H	120	S212AH02T2FG9	———
	1	13	5	200	140	150	140	100	100	—	—	180	A	9	9	F	120	S212AF02N5FG9	S212AF02L7FG9
	1	13	5	—	—	—	—	—	—	50	50	295	A	9	9	F	120	S212AF02C5FG9	S212AF02E7FG9
1 ¼	1 ½	22	10	200	140	200	140	200	140	—	—	200	S	9	9	F	120	S212SF02N1GJ5	———
	1 ½	22	10	—	—	—	—	—	—	100	100	338	S	9	9	H	120	S212SH02T2GJ5	———
	1 ¼	19	5	200	140	140	140	85	85	—	—	180	A	9	9	F	120	S212AF02N5GJ2	S212AF02L7GJ2
	1 ¼	19	5	—	—	—	—	—	—	50	50	295	A	9	9	F	120	S212AF02C5GJ2	S212AF02E7GJ2
1 ½	1 ½	28	10	200	140	200	140	200	140	—	—	200	S	9	9	F	120	S212SF02N1HJ5	———
	1 ½	28	10	—	—	—	—	—	—	100	100	338	S	9	9	H	120	S212SH02T2HJ5	———
	1 ¼	25	5	200	140	140	140	85	85	—	—	180	A	9	9	F	120	S212AF02N5HJ2	S212AF02L7HJ2
	1 ¼	25	5	—	—	—	—	—	—	50	50	295	A	9	9	F	120	S212AF02C5HJ2	S212AF02E7HJ2
2	1 ½	29	10	200	140	200	140	200	140	—	—	200	S	9	9	F	120	S212SF02N1JJ5	———
	1 ½	29	10	—	—	—	—	—	—	100	100	338	S	9	9	H	120	S212SH02T2JJ5	———
	1 ¼	28	5	200	140	140	140	85	85	—	—	180	A	9	9	F	120	S212AF02N5JJ2	S212AF02L7JJ2
	1 ¼	28	5	—	—	—	—	—	—	50	50	295	A	9	9	F	120	S212AF02C5JJ2	S212AF02E7JJ2



De-energized



Energized



De-energized

Energized

Model Code

1	2	3	4	5	6	7	8	9	10	11	12	13	14
S	2	1	1	A	F	0	2	K	4	C	G	1	

1 • 2 • 3	4	5	6	7 • 8	9 • 10	11	12 • 13	14
Series	Operating Mode	Housing	Coil Insulation	Applicable Voltage	Material (Seat, Body)	Pipe Connection	Orifice Size	Option
S21	1: Normally Closed 2: Normally Open	A: Conduit P: Open Frame B: Grommet X: Explosion Proof NEMA VII S: Junction Box W: Water-tight NEMA IV See the "Valve Selection Guide" for other housings.	F: Class F H: Class H	02=AC 120V 60 Hz AC 110V 50 Hz 04=AC 220V 50 Hz AC 240V 60 Hz 01=AC 24V 60 Hz 15=12V DC 16=24V DC See the "Valve Selection Guide" for other voltages.	K4 = Viton, Brass w/S.S. Trim T4 = Teflon, Brass w/S.S. Trim T2 = Teflon, Brass w/S.S. Trim N1 = Buna N, Brass *N5 = Buna N, Brass *V5 = Viton, Brass *C5 = E.P.R., Brass *J7 = Buna N, S.S. *L7 = Viton, S.S. *E7 = EPR, S.S. *Compact Version.	C = ⅜" D = ½" E = ¾" G = 1¼" H = 1½" J = 2" C = ⅜" D = ½" E = ¾" F = 1" G = 1¼" H = 1½" J = 2"	G1 = ½ G5 = ¾ G1 = ½ G5 = ¾ J5 = 1½ G4 = ⅝ G5 = ¾ G9 = 1 J2 = 1¼	M: Manual Override K: Mounting Bracket N: Neon Lamp (with Surge Suppressor) Z: Surge Suppressor N and Z apply to housing with terminal only.

Notes: 1. ☐ Indication above shows the standard products.

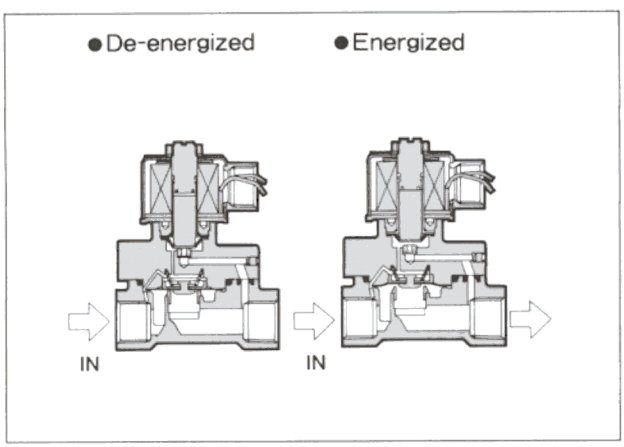
Coil Data

Model		S211		S212			
Frequency (Hz)		50	60	50	60	50	60
Power (VA)	Inrush	26	22	35	30	56	51
	Holding	14	11	19	14	23	16
Power Consumption (W)	AC	8		9		11	
	DC	9 • 10					

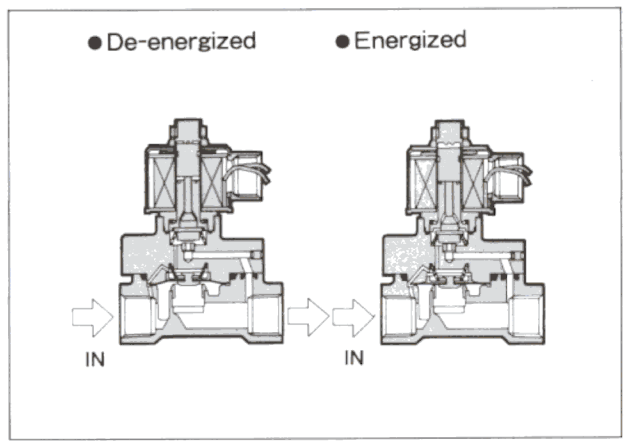
Note: 1. AC power consumption at 120V/60 Hz, 110V/50 Hz data.
2. Regarding body codes 5 and 7 with ⅜~¾ NPT, the inrush apparent power* is 41VA at 50Hz and 37VA at 60Hz respectively.

Construction/Operation

Normally Closed

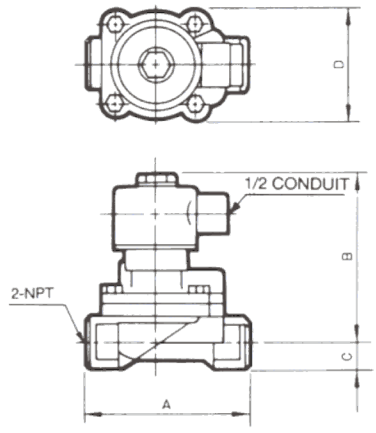


Normally Open



External Dimensions

Brass Body (Conduit coil housing: Type A)



units: inch

Body Code	Pipe Conn. (NPT)	A	B		C	D	Weight (LB)
			Normally Closed	Normally Open			
1, 2, 4	⅜ • ½	3.19	3.66	3.82	0.56	2.18	2.5
	¾	3.82	3.92	4.08	0.69	3.82	3.3
	1	5.38	4.09	4.25	0.81	4.69	6.4
	1¼ • 1½	6.25	4.54	4.71	1.19	5.32	10.5
	2		4.92	5.09	1.57		13.5
5, 7	⅜ • ½	2.76	3.03	3.78	0.55	2.20	1.8
	¾		3.15	3.90	0.63		
	1	3.62	3.98	4.29	0.79	3.23	3.8
	1¼ • 1½	4.33	4.33	4.65	1.06	3.62	5.8
	2	5.51	4.45	4.76	1.50		8.9

GC Valves **Toll Free 1-800-582-4232**

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4525 E. Industrial Street
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Simi Valley, CA 93063
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Fax 805-582-0210

G C
VALVES

Eastern Region
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P.O. Box 7066
Charlotte, NC 28241
Phone 704-588-3300
Fax 704-588-5831

DISTRIBUTOR:

4525 E. Industrial Street
Unit 4C
Simi Valley, CA 93063
Phone 805-582-0065
Fax 805-582-0210

G C VALVES

S211 SERIES PILOTED DIAPHRAGM 2-WAY SOLENOID VALVE

INSTALLATION, SERVICE AND PARTS LIST

SDI/SDP S211-1

DESCRIPTION

S211 Solenoid Valves are normally closed, 2-way, pilot operated diaphragm type, which are designed for on-off control of air, steam and liquids.

Available options include: Manual Opening Device, and UL Class F and H coils.

OPERATION

S211 Valves are normally closed, opening when energized and closing when de-energized.

SPECIFICATIONS

Use the valve within the specified operating ranges as indicated on the valve nameplate (min./max. psi, voltage, cycle, maximum media temperature at °F ambient, Cv factor, etc.).

OPERATING TEMPERATURES

FLUID MEDIA	COIL CLASS	MAXIMUM TEMPERATURE °F		SEAT MATERIAL
		FLUID	AMBIENT	
GAS	M (105 C)	185	77	BUNA
LIQUIDS	F (155°C)	200	150	
OIL	M (105°C)	185	77	VITON
	F (155°C)	230	150	
	H (220°C)	185	176	
	H (220°C)	185	176	TEFLON
	H (220°C)	257	125	RULON
STEAM	H (220°C)	338	77	TEFLON
	H (220°C)	257	125	RULON
HOT WATER	F (155°C)	198	77	EPR
STEAM	H (220°C)	298	77	

For other applications, consult the factory.

INSTALLATION

WARNING

This valve is normally closed (N.C.) to flow when not powered. Do not use in place of a normally open (N.O.) valve.

Check valve specifications to be sure that the valve selected is the proper one for the application.

Installation must be performed only by a trained and experienced service person.

1. Clear lines of all foreign matter.
2. Valves are multipoised and may be mounted in any position.
3. Thread seal should be applied sparingly and to the male threads only. To tighten, use a wrench on the body flats at the end being connected. Do not use the solenoid housing as a lever to turn the valve
4. Provide a clearance for solenoid removal in case removal is subsequently necessary.

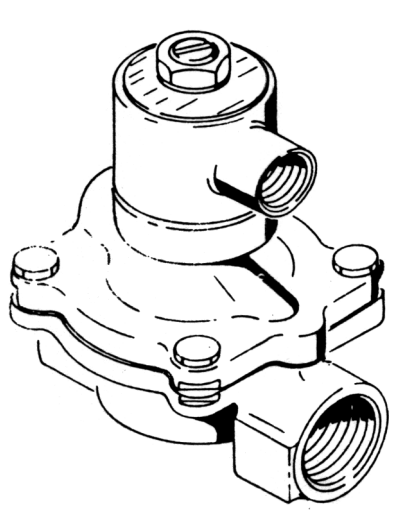


Fig. 1. Typical S211

5. Wire in accordance with applicable local and national electrical codes. Loosen the hex nut (Fig. 3, No. 1) to rotate the coil jacket (Fig. 3, No. 4). Using a torque wrench, tighten the hex nut to 20-25 inch pounds when installation is completed.

MAINTENANCE

It is recommended that S211 Series Valves be cleaned on a routine basis by qualified personnel. The customer or user should set up a sound maintenance schedule based on flow media, environment, and frequency of use, which should begin with checking for leakage. Correct voltage must be applied when the valve is tested. If excessive leakage (based on the application) occurs or if operation is sluggish, the unit must be cleaned. The cleaning fluid must be compatible with the valve's materials of construction.

SERVICE

Disassembly and Reassembly. (See Fig. 3.)

WARNING

During reassembly, be certain that the plunger is free of scratches or burrs. These imperfections could cause the valve to stick in an open or closed position, resulting in a potential hazard. If the valve has any tendency to stick during a test, return the whole Universal Kit for a new one. Dissassembly and reassembly should be performed only by properly trained and experienced personnel.

Turn off flow media and electrical power supply to the valve.

REPLACE ALL PARTS with the new parts contained in the Universal Kit only (see Universal Kit section). Use only the correct Universal Kit (use the chart to match Catalog Number with Kit Number), and never attempt to interchange parts from different numbered kits.

When ordering parts/kits, specify Catalog Number, Serial Number, and Part Name. If your valve's Catalog Number is not listed, obtain the complete Serial Number and consult the factory.

See Fig. 3 for an exploded view of a typical S211 Model "A", and Fig. 4 for an exploded view of a typical S211 Model "B" Explosion-proof operator assembly.

NOTE

A GROUNDING PROVISION IS SUPPLIED FOR CSA CERTIFIED VALVES.

COIL CHART

IDENTIFYING CATALOG DIGITS ①	COIL CLASS	WATTS	ELECTRICAL CONNECTION	COIL PART NUMBER②③
S21 — A	A*	8	24" LEADS	CS3AA — A24*
S21 — F	F			CS3AF — A24
S21 — H	H			CS3AH — A24
S21 — M	M			CS3AM — A24
S21 — VF	F		QUICK CONNECT TERMINALS	CS3AF — B

① Sixth digit of Catalog Number represents coil class as shown.

② Seventh and eighth digits of Catalog Number represent voltages shown in coil class chart. These digits must be transferred into the coil part number.

③ Recommended spare part.

NOTE

* Type "A" coil is replaced by Type "M" coil. For coil part number CS3AA — A24 use CS3AM — A24.

COIL CLASS CHART

CATALOG DIGITS	VOLTAGE	AVAILABLE WITH COIL CLASS				
		F	H	M	A	BW
01	24V-60Hz	X		X	REPLACED BY "M"	REPLACED BY "F"
02	12V-60Hz & 110V-50Hz	X	X			
03	208V-60Hz	X	X	X		
04	240V-60Hz & 220V-50Hz	X	X			
07	480V-60Hz	X	X			
15	12V DC	X	X			

TROUBLE-SHOOTING

If valve fails to open —

1. Check voltage against rating on nameplate.
2. Check voltage at solenoid lead connections.
3. Check control circuit and solenoid coil for burnout.
4. Check operating pressures.
5. Clean all passageways and check condition of diaphragm.
6. Replace coil.

If valve fails to close —

1. Check for bent or nicked plunger tube.
2. Check for damaged springs.
3. Clean pilot valve and main valve seats.
4. Check condition of plunger seat disc and main valve diaphragm.
5. Clean passageways in pilot valve and main valve. Use a small probing object or blow through.

The valve must be free from dirt to ensure tight shutoff. Buzzing or chattering can be caused by low voltage or dirt or chips between top of plunger and tube head. Check voltage. Clean the plunger and the interior of the tube and base assembly.

UNIVERSAL KIT

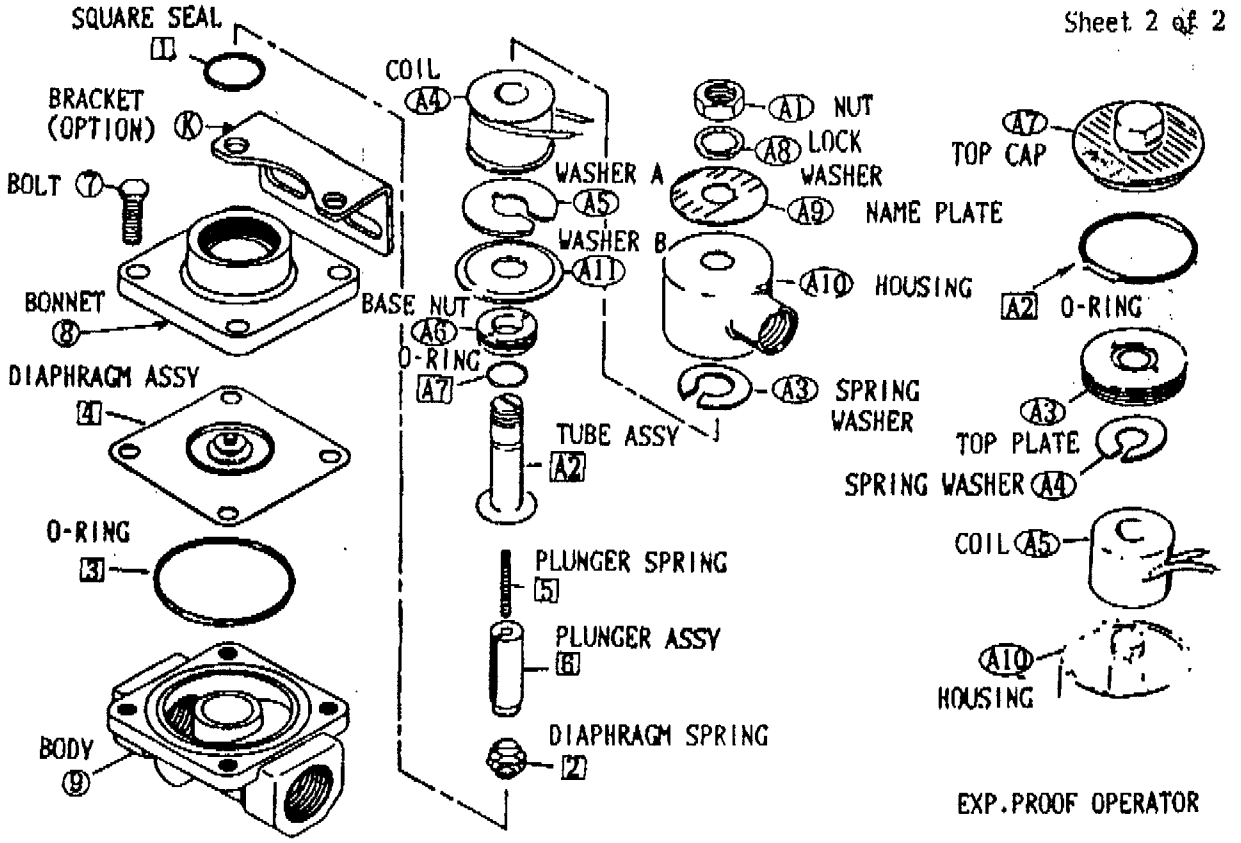
UNIVERSAL KIT CHART

S211 SERIES

5TH DIGIT OF CAT. NO.	9TH & 10TH DIGIT OF CAT. NO.	13TH & 14TH DIGIT OF CAT. NO.	COIL & VOLTAGE TYPE	UNIVERSAL KIT
STANDARD A, B, S, T, U, V, or W	N1	G9	AC	KS211AF02N1FG9BA
			DC	KS211AF16N1FG9BA
		J5	AC	KS211AF02N1GJ5BA
			DC	KS211AF16N1GJ5BA
	C1	G9	AC	KS211AF02C1FG9BA
			DC	KS211AF16C1FG9BA
		J5	AC	KS211AF02C1GJ5BA
			DC	KS211AF16C1GJ5BA
	K4	G1	AC	KS211AF02K4CG1AA
			DC	KS211AF16K4CG1AA
		G5	AC	KS211AF02K4EG5AA
			DC	KS211AF16K4EG5AA
	T4	G1	AC	KS211AF02T4CG1AA
			DC	KS211AF16T4CG1AA
		G5	AC	KS211AF02T4EG5AA
			DC	KS211AF16T4EG5AA
	T2	G1	AC	KS211AF02T2CG1BA
			DC	KS211AF16T2CG1BA
		G5	AC	KS211AF02T2EG5BA
			DC	KS211AF16T2EG5BA
		G9	AC	KS211AF02T2FG9BA
			DC	KS211AF16T2FG9BA
		J5	AC	KS211AF02T2GJ5BA
			DC	KS211AF16T2GJ5BA
EXPL. PROOF X	N1	G9	AC	KS211XF02N1FG9BB
			DC	KS211XF16N1FG9BB
		J5	AC	KS211XF02N1GJ5BB
			DC	KS211XF16N1GJ5BB
	C1	G9	AC	KS211AF02C1FG9BB
			DC	KS211AF16C1FG9BB
		J5	AC	KS211AF02C1GJ5BB
			DC	KS211AF16C1GJ5BB
	K4	G1	AC	KS211XF02K4CG1AB
			DC	KS211XF16K4CG1AB
		G5	AC	KS211XF02K4EG5AB
			DC	KS211XF16K4EG5AB
	T4	G1	AC	KS211XF02T4CG1AB
			DC	KS211XF16T4CG1AB
		G5	AC	KS211XF02T4EG5AB
			DC	KS211XF16T4EG5AB
	T2	G1	AC	KS211XF02T2CG1BB
			DC	KS211XF16T2CG1BB
		G5	AC	KS211XF02T2EG5BB
			DC	KS211XF16T2EG5BB
		G9	AC	KS211XF02T2FG9BB
			DC	KS211XF16T2FG9BB
		J5	AC	KS211XF02T2GJ5BB
			DC	KS211XF16T2GJ5BB

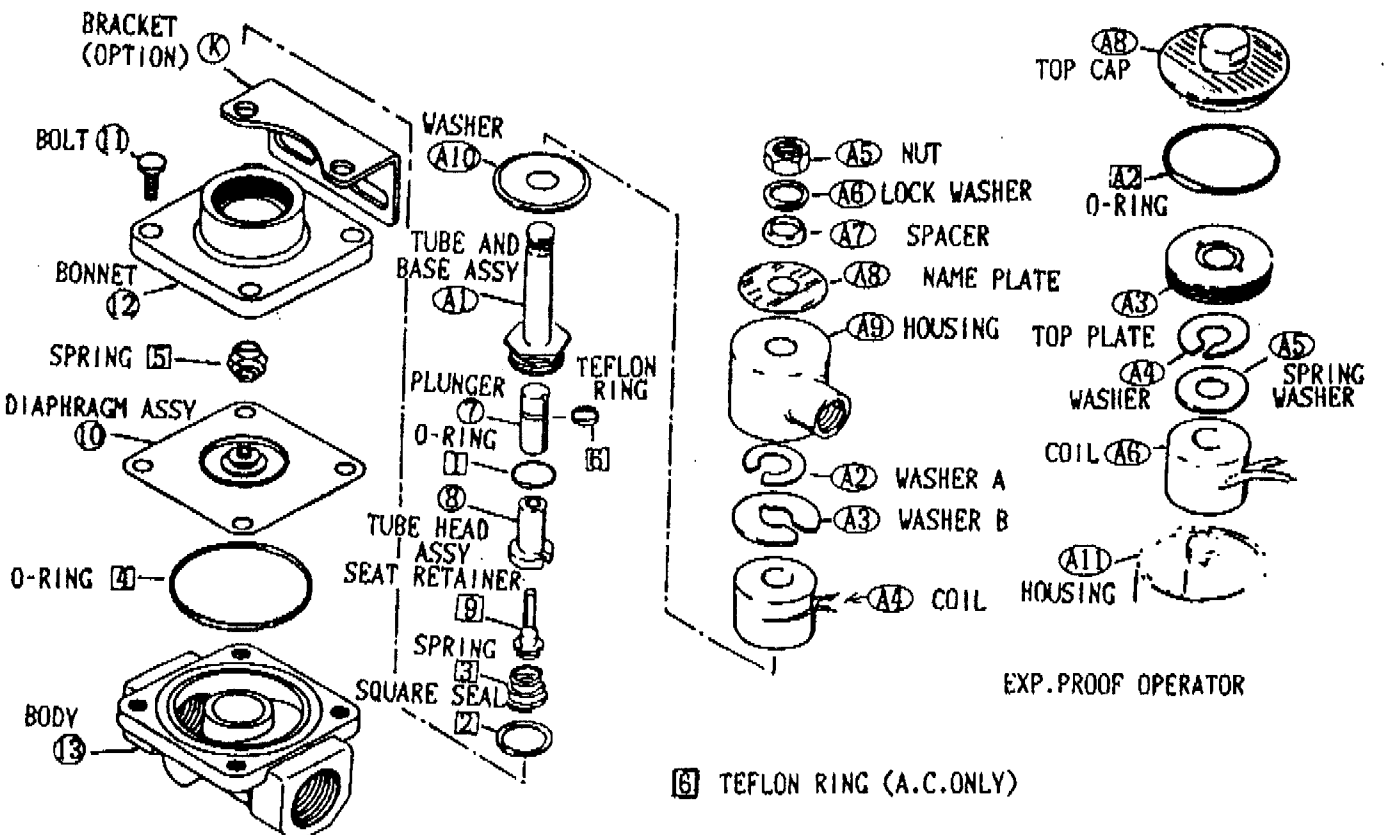
EXAMPLE CATALOG NUMBER

1	2	3	4	5	6	7	8	9	10	11	12	13
S	2	1	1	A	F	0	2	N	1	F	G	9
					COIL CLASS	VOLTAGE		SEAT SEAL SQ. SEAL & "O" RING MATERIAL				



☐ PARTS INCLUDED IN UNIVERSAL KIT

FIG.1 EXPLODED VIEW OF TYPICAL S201 VALVES N.C.



6 TEFLON RING (A.C.ONLY)

☐ PARTS INCLUDED IN UNIVERSAL KIT

FIG.2 EXPLODED VIEW OF TYPICAL S202 VALVES N.O.