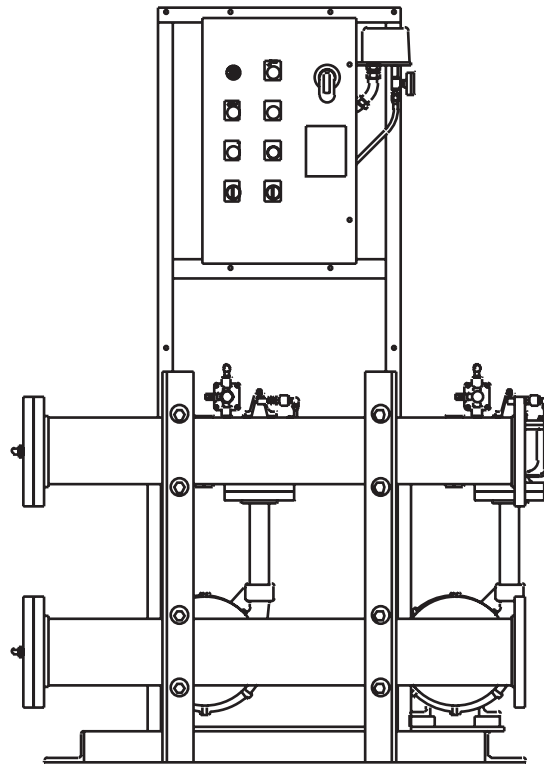
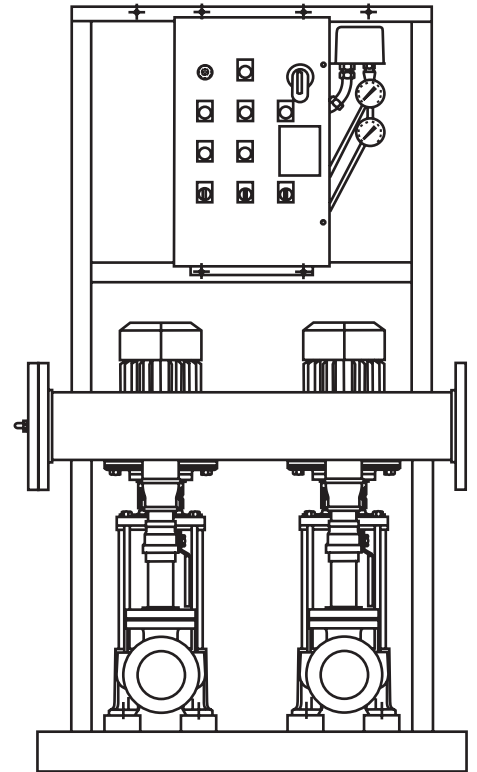




# AURORA<sup>®</sup>



Standard 770 Duplex System with Horizontal Pumps



Standard 790 Packaged System

# MODELS 770 and 790 BOOSTER SYSTEMS

## INSTRUCTION AND INSTALLATION MANUAL

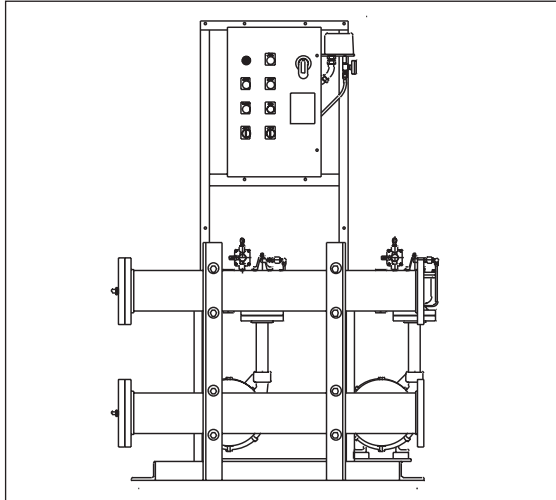
NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.

## CALIFORNIA PROPOSITION 65 WARNING:

**▲ WARNING** This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

### ATTENTION: SAFETY WARNINGS:

Read and understand all warnings before installation or servicing pump.



Standard 770 Duplex System with Horizontal Pumps

### SYSTEM RECEIPT INSPECTION:

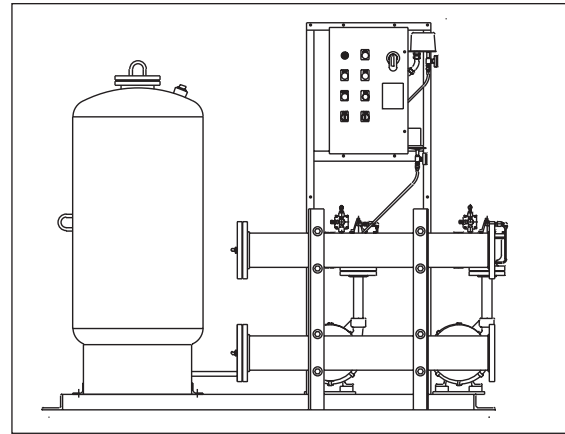
- Inspect system and components for signs of damage during shipment.
- Check system for missing parts.
- Check system for loose parts.

### SYSTEM INSTALLATION:

- Mount and anchor system in properly prepared location.
  - Verify system is level and piping aligned with building system piping.
- Connect building piping to booster system, ensure no pipe stress is transferred to booster system.
- Ensure system disconnect switch is in the off position.
- Ensure pump H-O-A switches are in OFF.
- Have qualified electrician route power to system control panel.
- Grout system base using a "non-shrinking" grout.
- Route pump thermal relief valve discharges to appropriate floor drain.
- If system includes the optional, remote hydropneumatic tank, install tank in a suitable location and connect to booster system manifold.

## CAUTION

Hydropneumatic tank is shipped from the factory with the isolation valve closed. Tank **MUST** be pre-charged to system pressure with air prior to opening isolation valve and admitting water.



Standard 770 Duplex System with Horizontal Pumps

### SYSTEM STARTUP:

- Open all system isolation valves.
- Slowly open booster system supply from building system.
- Open the petcocks on pumps and system manifolds to allow air to bleed from system.
- Turn booster control panel disconnect to ON.
- Jog pump motor #1 and observe direction of rotation. Take corrective action as required.
- Jog pump motor #2 and observe direction of rotation. Take corrective action as required.
- Turn pump #1 H-O-A switch to the hand position. Bleed air from the pressure reducing valve at the highest point on the valve by opening any fitting.
- Place pump #1 H-O-A switch to OFF.
- Turn Pump #2 H-O-A switch to the hand position. Bleed air from the pressure reducing valve at the highest point on the valve by opening any fitting.
- After all air is bled from the system, place system in operation by placing both pump H-O-A switches to AUTO.

### OPERATION:

#### NOTE

Aurora booster systems are tested and adjusted at the factory prior to shipment. System pressure switches are factory adjusted to the specifications provided at time of order.

#### NOTE

Failure to properly vent system could result in erratic or sluggish operation due to air trapped in the system PRVs.

### OPERATION (NO TANK):

When pump H-O-A switches are placed in AUTO, the lead pump will run continuously to maintain system pressure.

Check system suction pressure with pump #1 running. The low suction pressure switch is typically set at the factory at 5 psi OFF and 20 psi ON. The pressure switch setting can be changed as

## MODELS 770-790

needed for the field condition. (See Controller Operation, Appendix A)

When flow demands increase beyond the pump design point the system pressure will begin to decrease.

The low system pressure switch is typically set at the factory at 10 psi below system pressure. The pressure switch setting can be changed as needed for the field conditions.

When system pressure reaches the pre-determined set point, the lag pump starts in response to the lower pressure. The lag pump will run as required until flow demand decreases and system pressure rises above the set point. When system pressure reaches the set point the lag pump will shutdown automatically and the lead pump will continue to run. During periods of low system demand/shutoff operation both pumps are provided with a thermal relief valve for protection. (See Controller Operation, Appendix A)

### **OPERATION (WITH OPTIONAL TANK):**

When pump H-O-A switches are placed in AUTO, the tank pressure switch sequences the lead pump under no flow condition. The tank fills to its capacity and tank pressure starts to build up. This increase in tank pressure will stop the lead pump when the pre-determined set point is reached and after the minimum run time is satisfied. The tank will supply all "leak" loads. As tank pressure drops due to further system demands the lead pump will start after a time delay. The tank switch will continue to cycle the lead pump off and on as required to maintain tank/system pressure.

#### **NOTE**

Tank pressure switch high set point must be lower than the pump shutoff head.

Set the tank pressure switch high set point 5 psi above system pressure. Set the tank pressure switch low set point to normal system pressure.

Check system suction pressure with pump #1 running. The low suction pressure switch is typically set at the factory at 5 psi OFF and 20 psi ON. The pressure switch setting can be changed as needed for the field condition. (See Controller Operation, Appendix A)

With the lead pump running if the system pressure continues to fall due to flow demands the lag pump will start and run with the lead pump until the system demand is satisfied and the minimum run time setting is met. Pumps stop in the reverse order.

The low system pressure switch is typically set at the factory at 10 psi below system pressure. The pressure switch setting can be changed as needed for the field conditions.

In the event of tank pressure switch failure both pumps are provided with a thermal relief valve for protection.

## **APPENDIX A**

### **APPLICATION:**

Standard (Typical) Systems: These controllers are used to control one or more pump motors. On multiple pump installations, the pumps may be equal in size (horsepower) or may be different sizes. The most common systems are duplex systems with one small and one larger pump and triplex systems with one small and two larger motors, where the larger motors are typically of the same size. In standard units where one pump is smaller than the other(s) it is meant to run continuously. If it is in a duplex system, the pumps won't be alternated from Lead to Lag.

### **Alternation schemes:**

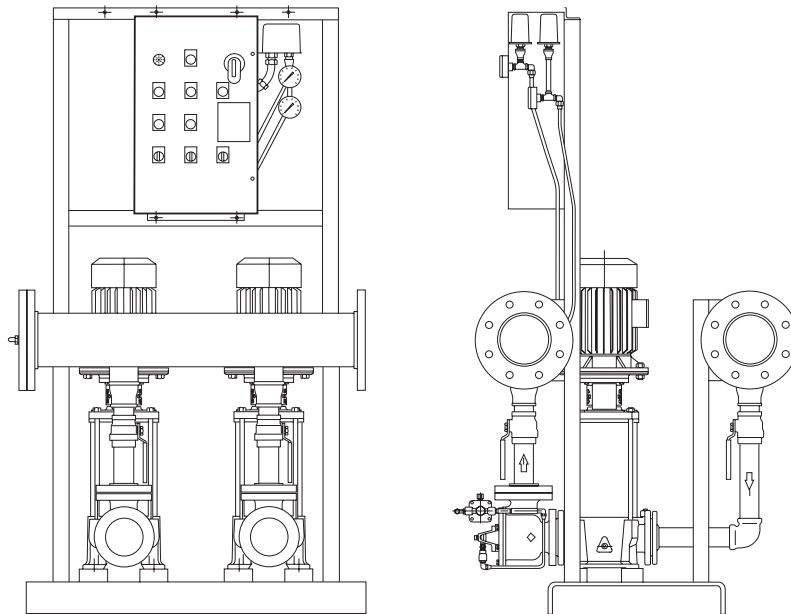
#### Equal Size Pumps:

Yes for Duplex (both), and Triplex (all three).

#### Unequal Size Pumps:

No for Duplex, Yes for Triplex (Pumps #2 and #3). Pump #1 (the smaller pump) runs continuously.

Pressure Regulated Systems: Standard systems utilize a pressure regulating valve (PRV) for each pump. The pump motor controller responds to the system pressure to start and stop (control) the pump or pumps. When the system pressure drops below a preset amount, usually just below the PRV setting(s), the controller causes the next pump to start. When the pressure rises sufficiently, the controller stops the last pump started, usu-



Standard 790 Packaged System

## APPENDIX A (continued) MODELS 770-790

ally after a minimum running interval. A low pressure alarm and shutdown is included in standard systems to protect the pump(s) from running dry or cavitating on absent or low inlet pressure.

### OPTIONAL SYSTEMS

**Pressure Transducer Systems:** The controller uses a solid state pressure transducer to control the operation (starting and stopping) of the motor(s). This takes the place of the System Pressure Switch. The transducer signal is connected to the PLC which has programmable start and stop set points. When the system pressure drops below the preset pressure, usually just below the PRV setting(s), the controller causes the next pump to start. Rising pressure causes the controller to cycle the pump(s) off.

**Pressure Tank Systems:** The booster pump system (package) may include an optional pressure tank to improve system performance. In this case the controller responds to pressure in the tank to maintain the tank pressure at a level above the system pressure in order to provide adequate pressure to the pressure regulating valve or valves. When the pressure rises sufficiently, the controller stops the last pump started, normally after a minimum running interval.

### SEQUENCE OF OPERATION

**General:** These units control one or more booster pump motors to maintain the pressure in a system within a selected range. This is accomplished with a pressure switch which has a fixed differential (4 lbs @ 100psi). Refer to the wiring or schematic diagram for details. Standard units have one or more motor starters, a Control Power Transformer (CPT) and secondary and dual primary fuses for same. Standard units include a PLC for logic sequencing, timing and control. Standard units also include an audible alarm, which can be silenced, and one or more visual alarm lights. The standard unit also includes one or more Pump Running signal lights, L2 & etc.

**Power Wiring:** The input lines (mains) connect to the top of the Disconnect Switch (DS) or Circuit Breaker CB. Power flows through the short circuit protection motor Line (Mains) Fuses 1F & etc., or Circuit Breaker CB, and then to the Motor Starter, which is horsepower rated. The Motor Starter consists of Motor Contactor (1M & etc.) and Overload Relay OL-1 & etc.. When the Motor Contactor Coil 1M, or etc., is energized, Motor Contactor 1M contacts close to feed power through the Overload Relay to its output terminals where the motor is connected. This energizes the motor to start the pump.

**Control Transformer:** Control power is supplied by a Control Power Transformer (CPT). Its primary is supplied by two primary side line fuses. The secondary output of the transformer is protected by a secondary fuse. See the controller Schematic Diagram for the fuse designations. Secondary control power is 115 Vac (110 - 120 Vac) at 50 or 60 Hz depending on the line (mains) frequency. Secondary power is used for the motor contactor coils, indicator (pilot) lights, audible alarm, the PLC and any additional control relays or components.

**Overload Relay:** The Overload Relay furnished in the motor starter provide protection from excessive currents. The overload relay has been sized and set to trip open when the motor exceeds 125% of the Full Load Current (FLA) multiplied by the rated Service Factor (SF). Trip times vary depending on the magnitude of the current overload, the number of previous starts, the ambient temperature of the controller, and the size of

the overload element. Briefly, the Overload Relay is sized to allow initial starting currents while protecting the motor from excessive long starting currents or excessive running currents. (See Installation Instructions - Protection for proper sizing).

**Power Available Light:** A Power Available pilot light (L1) indicates then the disconnect switch (DS) or main circuit breaker is closed, and when power is supplied to the unit and when the CPT primary and secondary fuses are not blown.

#### **Warning:**

Use care when using the MANUAL (MAN) position of the control switch to avoid causing system Over Pressure.

**Control Selector Switch:** One selector switch, HOA-1 & etc., is included for each motor. The switch includes a "MAN" (Manual, Hand) position, an "OFF" (Safety) position, and an "AUTO" (Automatic Control) position. In the manual position, the Pressure Switch and all automatic control is bypassed so the contactor coil is continuously energized by the selector switch. The Overload Relay contacts also override the manual position to protect the motor.

**"OFF" (Safety) Position:** In the "OFF" position, the Motor Contactor coil is de-energized to prevent the motor from running.

#### **Warning:**

Use care when using the MANUAL (MAN) position of the control switch to avoid causing system Over Pressure.

**"MAN" Position (Manual Control):** Control power wiring is tapped off the incoming power on the load (down-stream) side of the Line Fuses or Circuit Breaker. It is routed to the three position (Auto-Off-Manual) selector switch. In the manual position, the all pressure switches and all automatic control is bypassed so the contactor coil is continuously energized by the selector switch. The Overload Relay contacts also override the manual position to protect the motor. The Minimum Run Timer does not operate with the selector switch in the MANUAL position.

**"AUTO" (Automatic Control) Position:** In this position, the motor starter is connected to the appropriate output terminal of the PLC (Programmable Logic Controller) which enables automatic control of the pump motor by the PLC. Note that overload relay operation is independent of the PLC or any other control circuitry to protect the motor.

**Motor Running Light(s):** The Pump 1 Running light activates when ever the motor contactor (starter) for Motor No. 1 is closed under either manual or automatic control.

### AUTOMATIC (PLC) CONTROL

**Alarm Circuit:** The standard unit includes alarm circuitry to annunciate failure or fault conditions. The standard alarm condition is Low Suction Pressure as sensed by the Low Suction

## APPENDIX A (continued) MODELS 770-790

Pressure switch (PS-1). When the pressure drops to less than the trip setting of this pressure switch, its contacts close. This signals the PLC that the condition has occurred. The PLC activates the Low Suction Audible Alarm. The standard audible device is a solid state (Sonalert) annunciator. The PLC also activates a Low Suction alarm signal light. The alarm can be silenced by momentarily operating the Alarm Silence switch (SW-1) which signals the PLC to de-activate the audible alarm. The alarm light stays lit until the Low Suction Pressure switch resets. The alarm circuit resets itself and re-activates on the next occurrence of low suction pressure.

**General:** In the AUTO position, motor operation is under the control of the PLC. The PLC utilizes an internally stored program to control the operation (starting and stopping) of the motor. The PLC responds to the Low Suction Pressure switch and to System Pressure Switch as a minimum. The PLC program also includes various timing functions as outlined below.

**Pressure Sensing:** The standard unit is pressure controlled by sensing either the system pressure or by sensing the pressure in a tank, if supplied. Multiple pump systems (Duplex & Triplex) may employ equal size pumps or one pump may be smaller than the others.

**Alternation:** The standard system employs one smaller pump and one or more larger pumps. If there is more than one larger pump (Triplex) they are usually equal in size to one another. The small pump is meant to run continuously. The controller cycles the larger pump or pumps as needed to maintain system pressure. Alternation of the pumps in not used in Duplex systems of this type. The smaller pump which runs continuously is considered the "Lead" pump and the other pump or pumps are considered the "Lag" pump or pumps.

When all pumps are of the same size, a duplex controller may be set up to alternate which of the two, or more) pumps operates as the Lead pump and which pump or pumps operates as the Lag pump or pumps.

**Minimum Run Timing:** The standard unit includes timers to control the Minimum Running time of the pump or pumps to prevent short cycling of the pump motor(s). This avoids overheating the motors which can occur if they are started too frequently. This allows the motor fan to cool down the motor windings from the last start before the pump is shut down.

**Restart Delay Timing:** The Restart delay prevents starting a pump which is still spinning down from the last running. This can occur when the demand is less than needed for the pump but more than what can be supplied by the other pump(s). In this case, when the pump shuts down, the pressure can drop rapidly enough to immediately signal the pump to start again. If the pump is still spinning, this can cause mechanical shock to the pump and motor and can also cause large spikes (momentarily large transient) currents which can blow fuses or trip circuit breakers. This occurs when the motor magnetic flux vector angle is out of phase with the power line phase angle by large enough difference. The Restart delay lets the motor come to rest or near rest which also allows the motor magnetic flux to decay. In this state, the motor can be safely restarted with out excessive transients and mechanical shock.

**Alternation Times:** Note: The Alternation Times apply only to controllers for two or more motors (Duplex & Triplex). The Alternation Time is the clock time that must elapse before the PLC changes the pump from being a Leading pump into a Lagging pump. The Alternation Times are independent of the

motor actual running time.

**Alternator Overlap Time:** When one or more pumps are not running, alternating the pumps can cause a momentary pressure drop when the running pump spins down before the other pump comes up to full speed. The overlap timer is an over run timer that causes a delay before the pump is shut down. This allows the second pump to come up to full speed while the first pump continues to run. After a typical setting of a few seconds, the controller shuts down the first pump if it is not needed for the system demand.

### CONTROLLER SET-UP AND ADJUSTMENTS

**Preliminary Steps:** Before attempting to adjust the pressure switch in pressure controlled systems, adjust the pump pressure regulating valves for the desired system pressure(s). Remove the covers from the pressure switch(s). A system pressure gauge is required for setting the System Pressure Switch.



#### **Warning: Shock Hazard**

Some settings require observing or adjusting PLC settings and LED indicators. Use Caution to avoid contact with any electrical terminals, fuses, or connections to avoid electrical shock.

**Timer (TIM) Settings:** Note: Changing the timers requires one of three procedures. 1) The times are set at the factory using a lap-top computer with the appropriate program and communications cable, or 2) an optional memory chip can be programmed at the factory for the new times and added to the PLC in question, or 3) an HMI display and setting module can be installed onto the PLC for the purpose of changing the timer settings. Contact the factory for details on how this module is used. All timer settings are in seconds. The standard timers are factory set at the following settings:

$T0 + T9 = \text{Alternation Time on Pump \# 2} = 24\text{hr.}$

(Note:  $T0(65535\text{sec}) + T9(20865\text{sec}) = 86400 \text{ seconds} = 24 \text{ Hours}$ )

$T1 + T10 = \text{Alternation Time on Pump \# 1} = 24\text{hr.}$

(Note:  $T1(65535\text{sec}) + T10(20865\text{sec}) = 86400 \text{ seconds} = 24 \text{ Hours}$ )

$T3 = \text{System Pressure Start Delay} = 2 \text{ Seconds.}$

(Motor Restart Delay)

$T4 = \text{Pump \# 1 Alternation Overlap Time} = 5 \text{ Seconds.}$

(Pump Over-run Timer)

$T5 = \text{System Pressure Minimum Run Time} = 4 \text{ Minutes.}$

$T6 = \text{Pump \# 2 Alternation Overlap Time} = 5 \text{ Seconds.}$

(Pump Over-run Timer)

**Low Pressure (Cut-Off) Pressure Switch:** Set the pressure switch to the desired cut-off pressure as indicated on the indicator dial. One example of a setting for a booster pump drawing suction from a municipal main would be 20 to 30 psi for the trip point of this switch.

**Pressure Switch Set-up:** To set the System Pressure switch (PS-2) remove its cover. Start the (lead) pump manually ("MAN" position) and modulate the system flow until the pressure drops just below the desired set point. Adjust the pressure switch On (Start) adjustment until the Input I-0 LED on the PLC lights. Set the pressure switch Off (Stop) setting as close as practical to the On setting. Typical settings on a 100 PSI nominal system would be trip (start) at 98 psi and reset at 102 psi. Verify the settings by modulating the system flow and observe when the PLC Input I-0 LED actuates and extinguishes.

**APPENDIX A (continued) MODELS 770-790**

**REPLACEMENT PARTS LIST**

<u>SYMBOL</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>NOTES</u>
DS	302400	Disconnect Switch, 600 Vac, 30/40 Amp	(Internal Switch only)
DS	302401	Disconnect Switch, 600 Vac, 60/80 Amp	(Internal Switch only)
DS	302402	Disconnect Switch, 600 Vac, 100 Amp	(Internal Switch only)
---	400939	Disconnect Switch Handle Operator only,	(30 thru 100 Amp)
HOA	401199	Auto-Off-Manual Selector Switch	
---	401992	Contact Block (N.O.)	
PS*	305420	Standard Pressure Switch	
PS4	305421	Tank Pressure Switch	
PLC	305580	Programmable Logic Controller	(standard units only)
---	305040	Control Power Transformer, 50 VA, 208/240/460 Vac	
---	305041	Control Power Transformer, 50 VA, 208/380/575 Vac	

Note: One or more renewal parts such as fuses, heaters, contacts, and etc. may be obtained from local electrical distributor(s).

IMPORTANT: When ordering replacement parts, be sure to specify the complete MODEL NUMBER and SERIAL NUMBER of controller in which they are to be used.

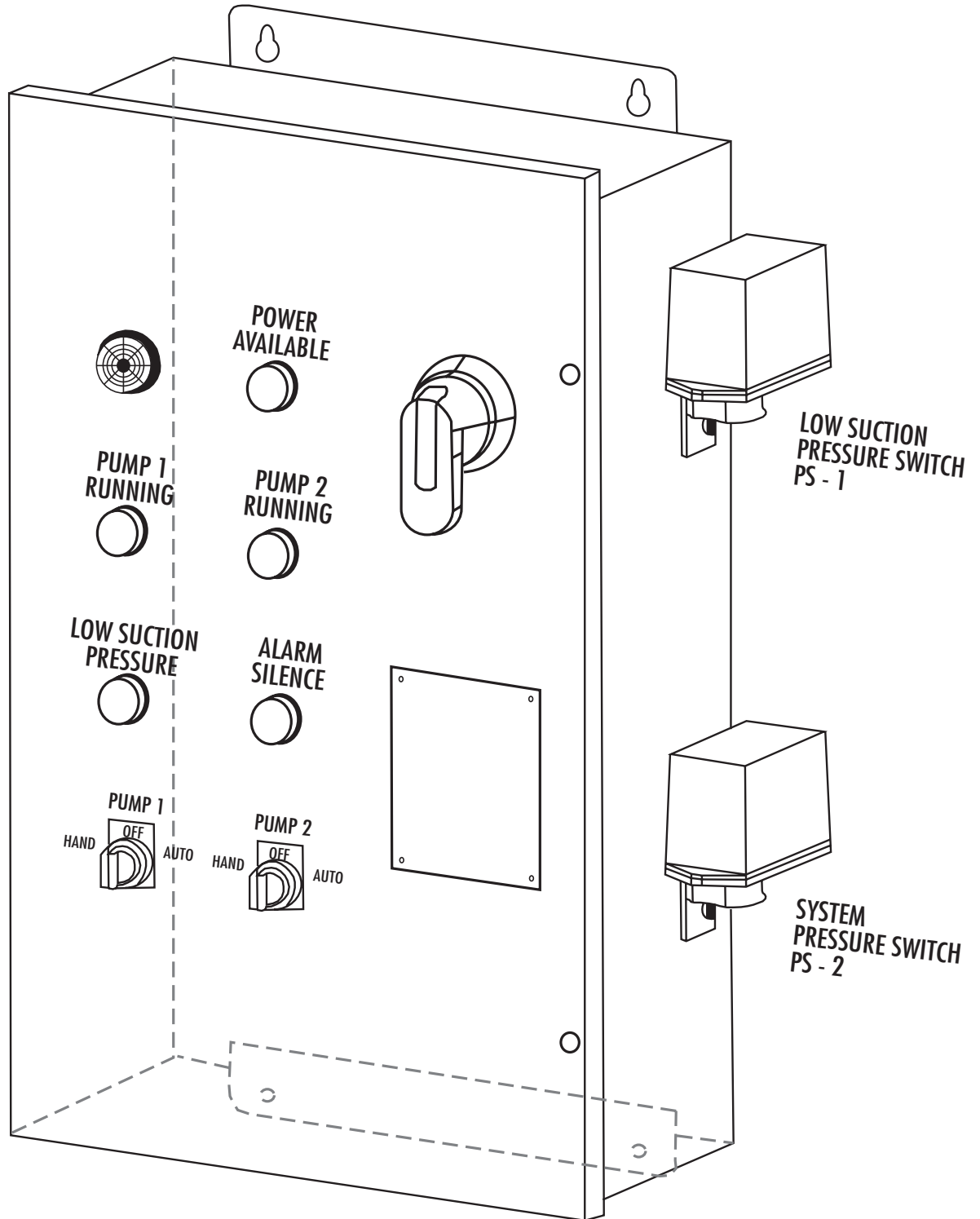
**SERVICE AND ASSISTANCE:**

Contact either the Aurora Pump field agent or Factory customer Service for assistance. The factory can be contacted at the address and numbers show below.

Aurora Pump  
800 Airport Road  
North Aurora, IL 60542 USA

Phone: 630-859-7000 Fax: 630-859-7034  
Web Page: <http://www.aurorapump.com>  
Email: [aurora\\_info@pentairpump.com](mailto:aurora_info@pentairpump.com)

APPENDIX A (continued) MODELS 770-790

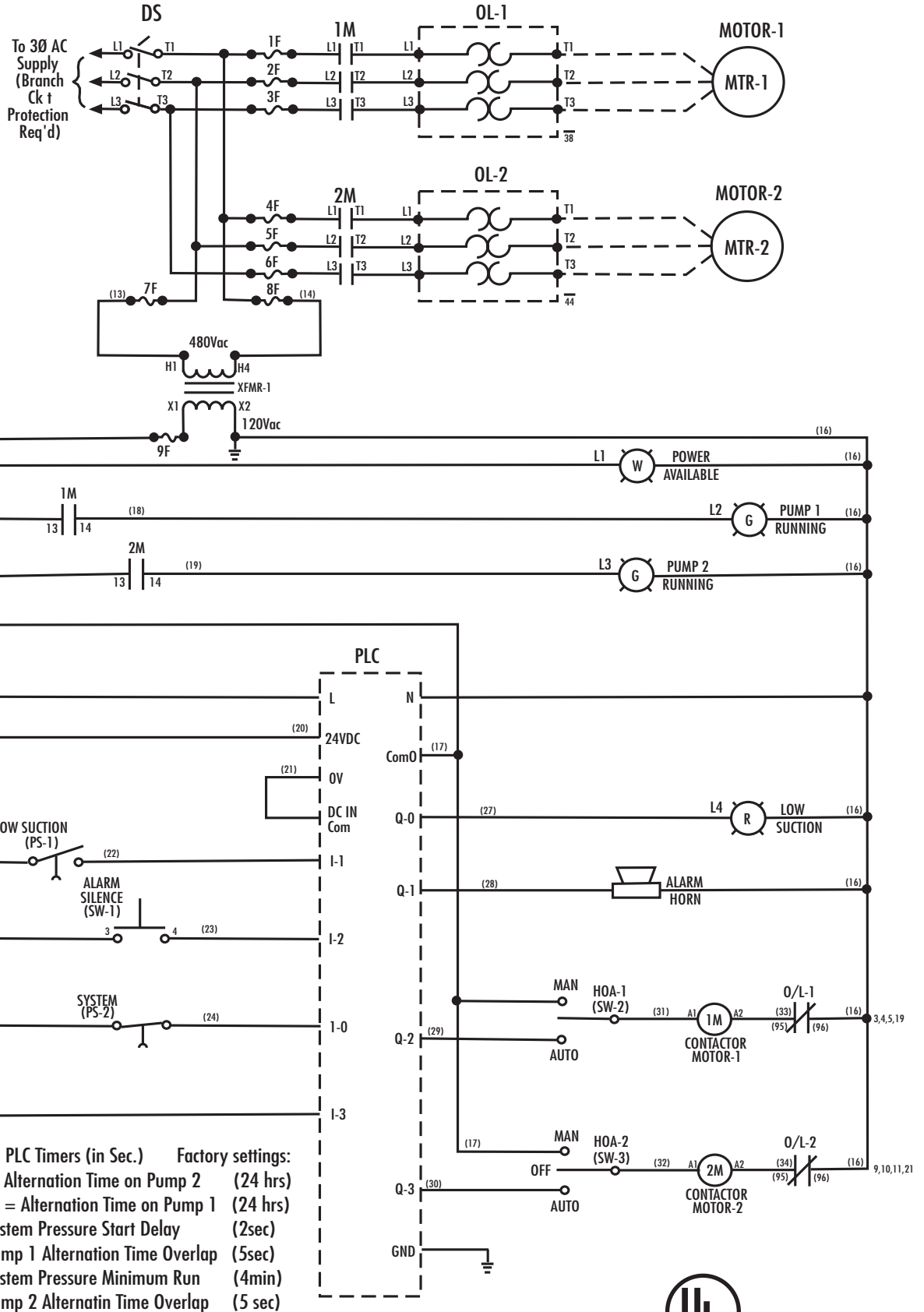


**Notes:**

- Enclosure: 16 Gauge Sheet Steel
- Finish: Grey Baked Enamel
- Application: For Indoor Use. NEMA 1
- Mounting: Wall Mount
- Max. Shipping Weight: 42 lbs. (20kg)

APPENDIX A (continued) MODELS 770-790

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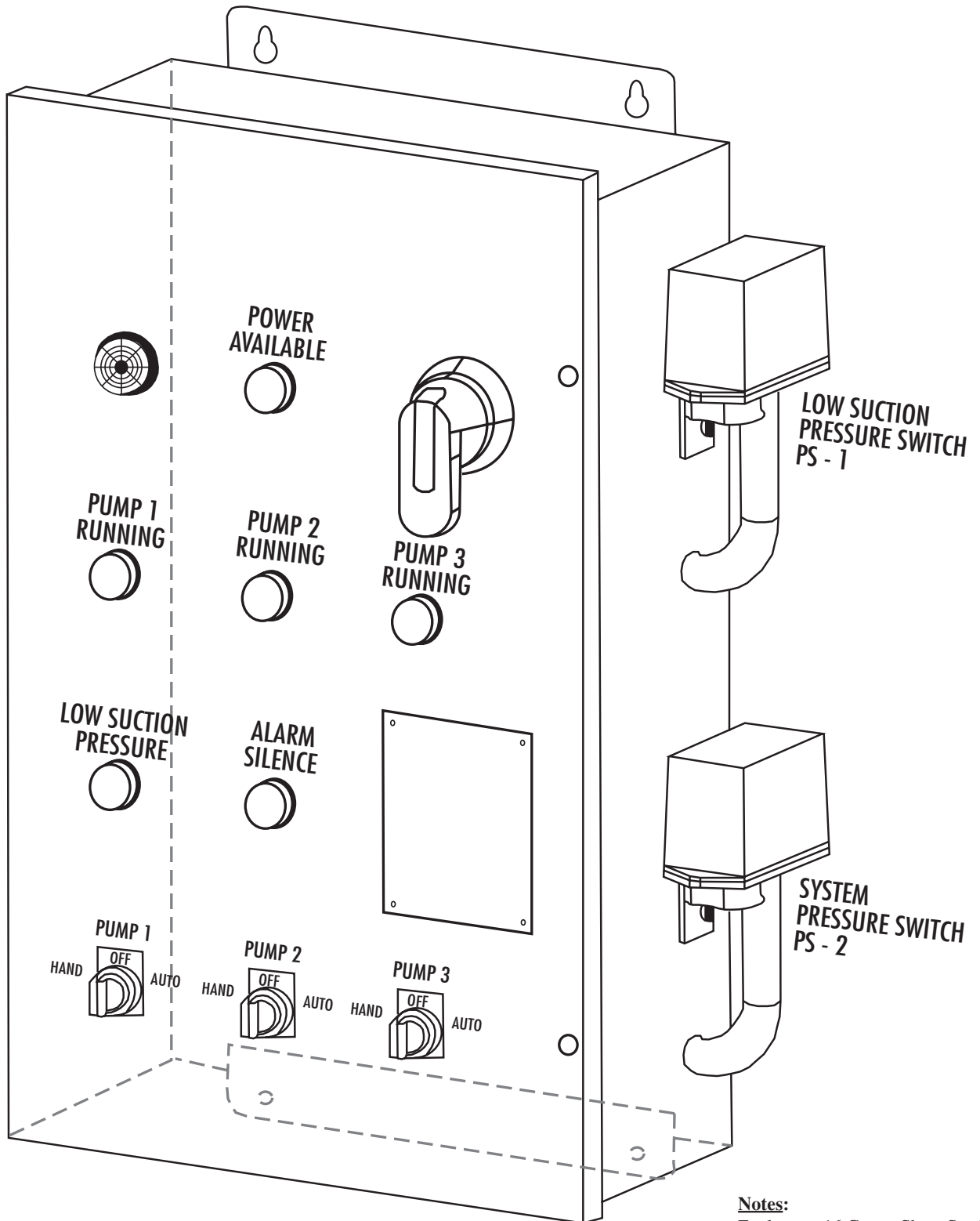


- Notes:**
- |                                      |                   |
|--------------------------------------|-------------------|
| Internal PLC Timers (in Sec.)        | Factory settings: |
| T0+9 = Alternation Time on Pump 2    | (24 hrs)          |
| T1+T10 = Alternation Time on Pump 1  | (24 hrs)          |
| T3 = System Pressure Start Delay     | (2sec)            |
| T4 = Pump 1 Alternation Time Overlap | (5sec)            |
| T5 = System Pressure Minimum Run     | (4min)            |
| T6 = Pump 2 Alternatin Time Overlap  | (5 sec)           |





APPENDIX A (continued) MODELS 770-790

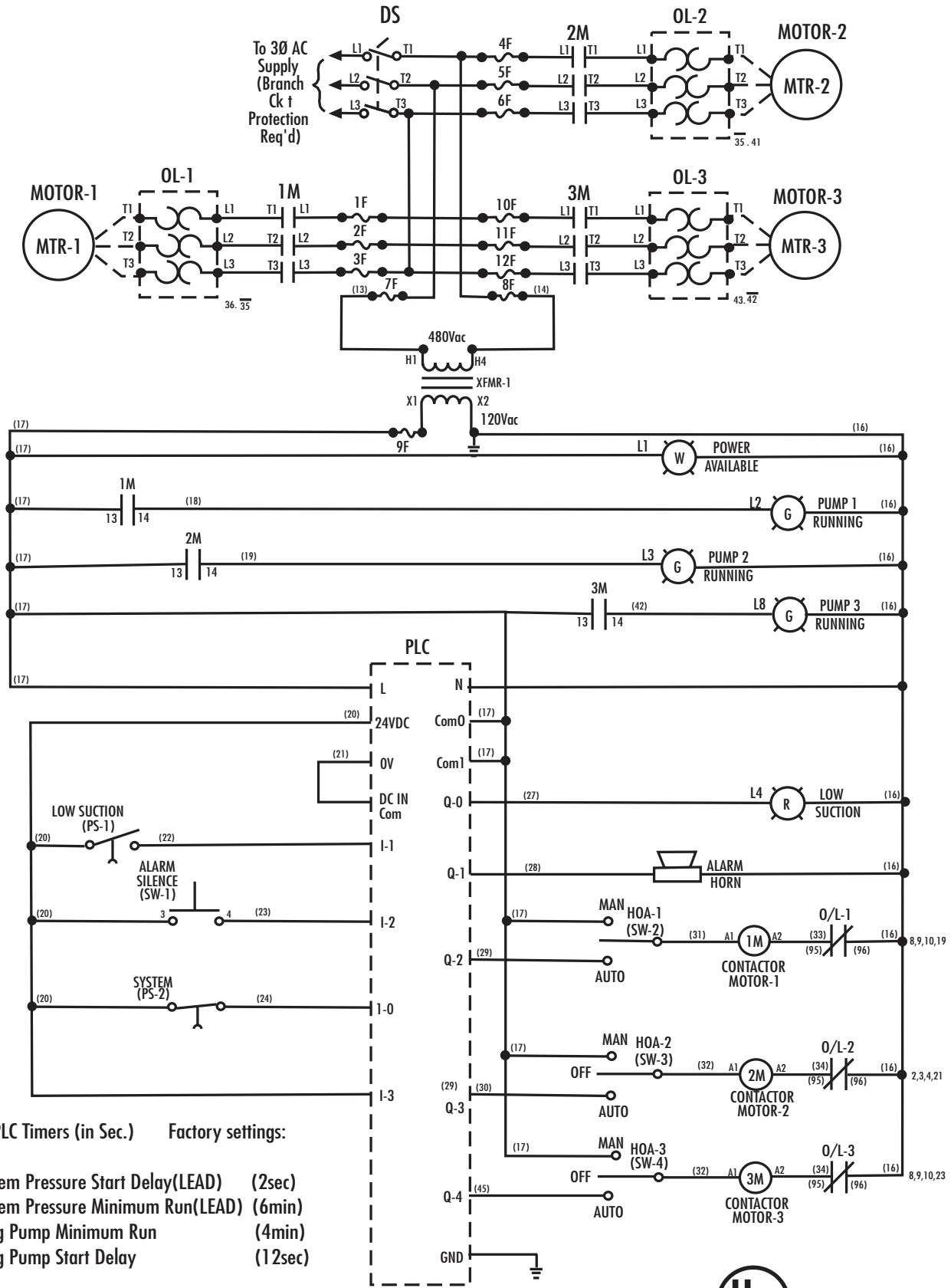


**Notes:**

- Enclosure: 16 Guage Sheet Steel
- Finish: Grey Baked Enamel
- Application: For Indoor Use. NEMA 1
- Mounting: Wall Mount
- Max. Shipping Weight: 42 lbs. (20kg)

APPENDIX A (continued) MODELS 770-790

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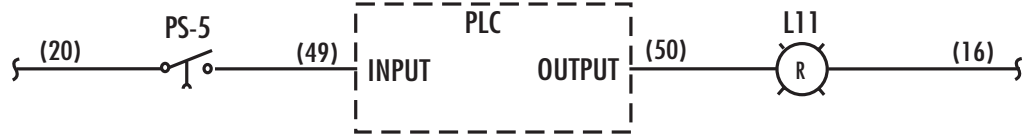


**Notes:**  
 Internal PLC Timers (in Sec.)    Factory settings:  
 T3 = System Pressure Start Delay(LEAD)    (2sec)  
 T5 = System Pressure Minimum Run(LEAD)    (6min)  
 T11 = Lag Pump Minimum Run                (4min)  
 T12 = Lag Pump Start Delay                 (12sec)



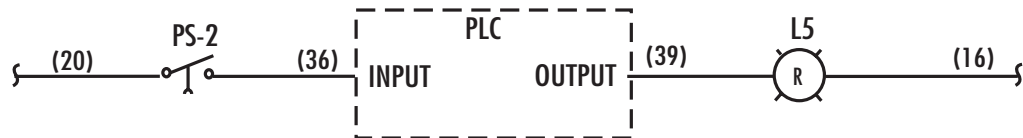
Option A

**HIGH SYSTEM PRESSURE SWITCH, LIGHT AND ALARM**



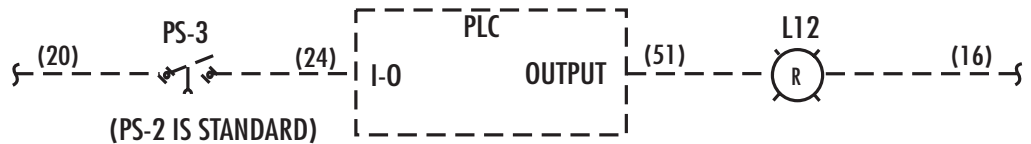
Option B

**HIGH SUCTION PRESSURE SWITCH, LIGHT AND ALARM**



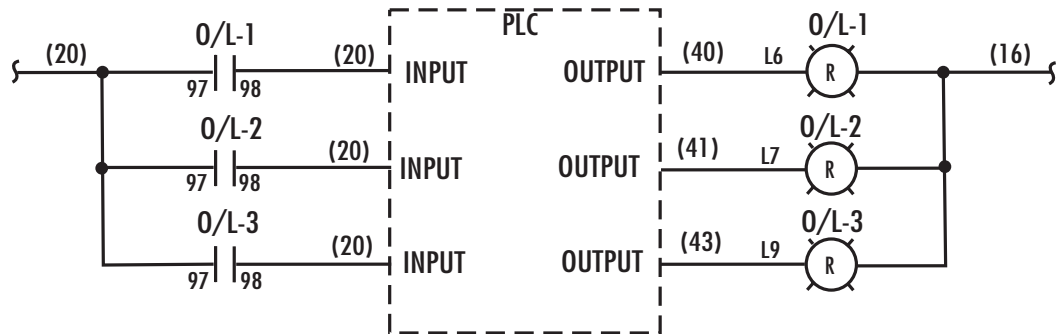
Option C

**LOW SYSTEM PRESSURE SWITCH, LIGHT AND ALARM**



Option E

**OVERLOAD TRIP, LIGHT AND ALARM**

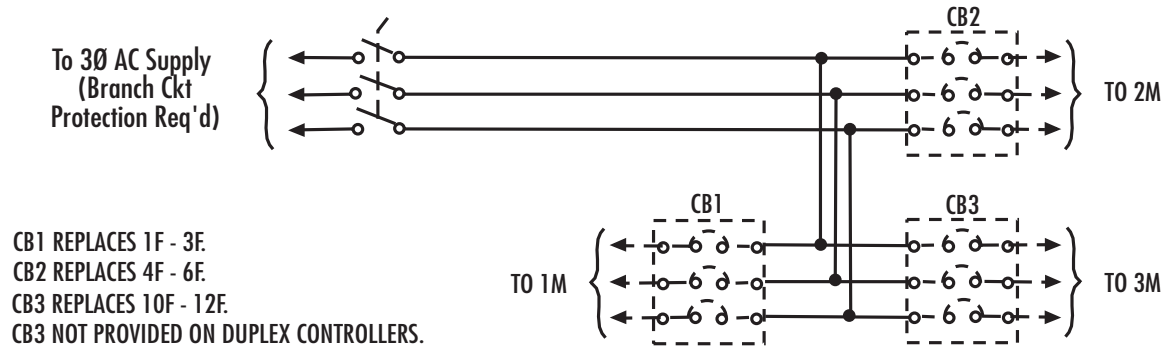


O/L-3 NOT PROVIDED ON DUPLEX CONTROLLERS

NOTE:  
ALARM HORN AND SILENCE P.B. SHOWN ON MAIN SCHEMATIC

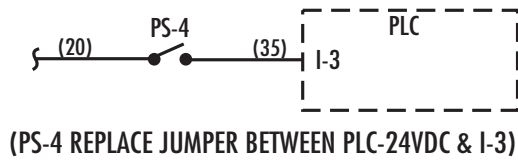
Option G

CIRCUIT BREAKERS IN PLACE OF LINE FUSES



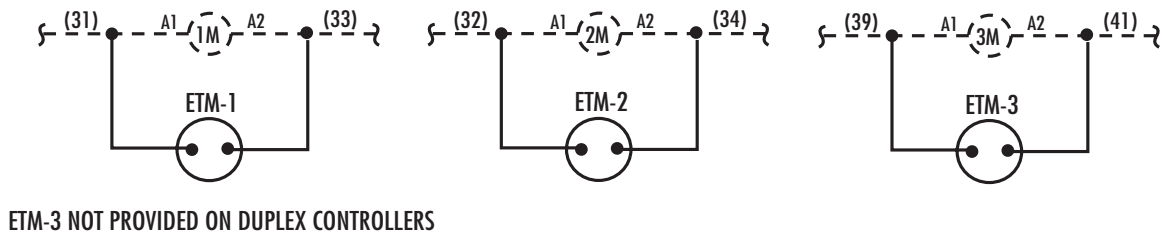
Option T

TANK PRESSURE SWITCH



Option W

ELAPSED TIME METER



## APPENDIX B MODELS 770-790

MODEL	STOCK NO.	NO. OF CONTACTS	PRESSURE RANGE	PRESSURE CONNECTION
IPS40-1	9000104	1	10-175 PSI	NYLON 1/2" NPT MALE

UL LISTED and CSA Approved

**Dimensions:** 4-3/4"W x 2-1/4"D x 4-3/8"H

**Enclosure:** NEMA Type 4 for indoor or outdoor use. Cover – Die-cast with textured gray powdercoat finish. Base – Plated Steel with one opening for 1/2" conduit

**Pressure Connection:** 1/2" NPT Male

**Differential Approx. (Not Adj.):**

2 lbs. at 20 PSI; 5 lbs. at 175 PSI

**Adjustable Range:** 10-175 PSI

**Maximum Pressure:** 250 PSI

**Switch Contacts:**

One or two Snap Action SPDT (Form C Contacts)

15.0 Amps at 125/250 VAC

0.5 Amps at 125 VDC

0.25 Amps at 250 VDC

**Pilot duty Rating:** 125 VA 120/240 VAC

**Ambient Temperature range:**

-40°.180°F (-40°/82°C)

**Media Temperature range:**

32°/250°F (0°/121°C)

### CAUTION

**This device is not intended for applications in explosive environments.**

The Model IPS pressure switches are designed to indicate an increase or decrease in normal system pressure. On the two switch models the two switches operate independently of each other and each switch may be adjusted to actuate at any point

within their adjustable range. They are designed for applications sensing air, water or any fluid or gas not harmful to nylon or silicone.

They are not designed to be used with any fluid or gas classified as hazardous.

#### NOTE

To prevent leakage, apply Teflon tape sealant to male threads only.

#### **Warning:**

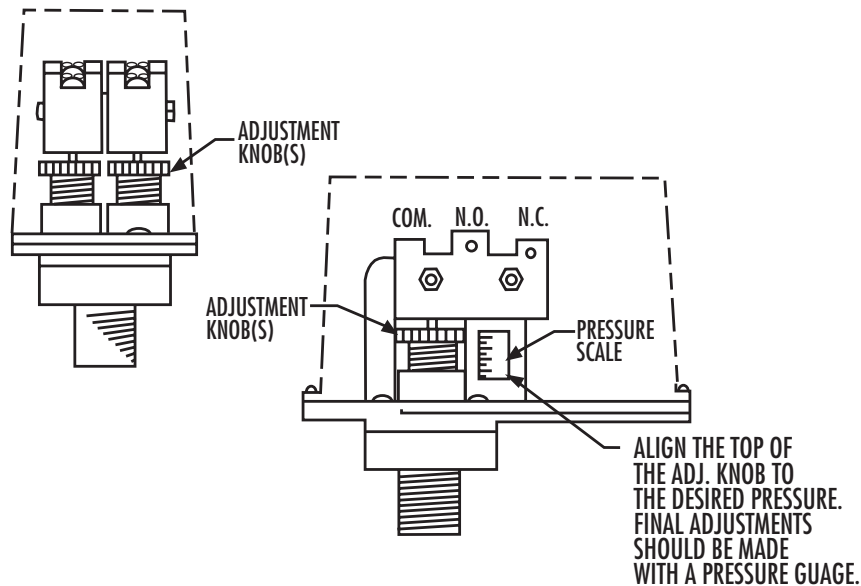
Use of pipe joint cement may result in obstruction of aperture and loss of signal.

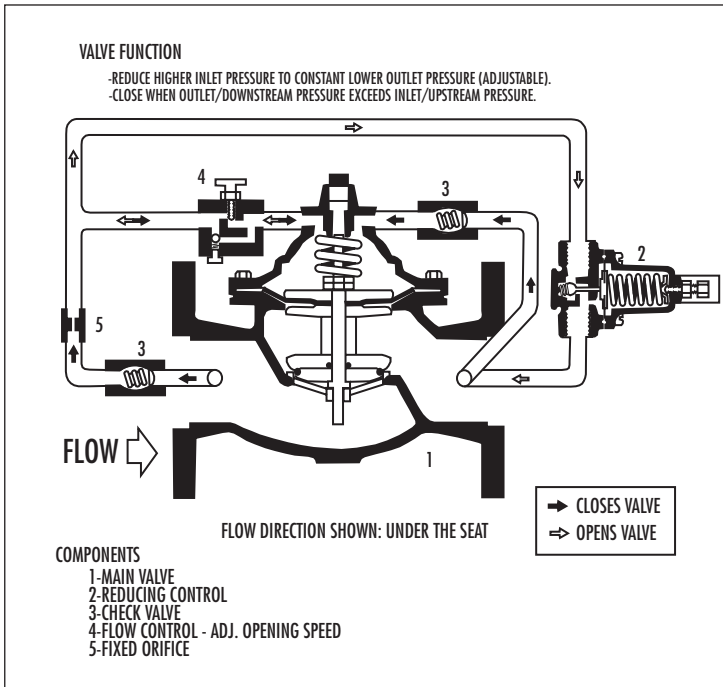
#### **MOUNTING:**

Device should be mounted in upright position. (Threaded connection down.)

#### **FIELD ADJUSTMENTS:**

The operating point of the switch or switches can be adjusted to any point within their adjustable range. (10-175 PSI). To adjust the device, turn the adjustment knob(s) clockwise to raise the actuation point and counterclockwise to lower the actuation point. On the two switch models the two switches operate independently of each other and each switch may be adjusted to actuate at any point within their adjustable range. The pressure scales on the devices are approximate. Final adjustment should be made with a pressure gauge.





**FUNCTIONAL DESCRIPTION**

**Pressure Reducing Function**

The pressure reducing function is controlled by the 263AP or 263SS control. The 263 is normally open, adjustable control set to respond to outlet/downstream pressure changes. An increase in pressure above the set point of the control throttles the control towards closed. The main valve modulates towards a closed position. When pressure drops, the control throttles towards open, modulating the main valve towards an open position. A constant outlet/downstream pressure is maintained.

Turning the adjustment screw clockwise (IN) increases the outlet/downstream pressure, counterclockwise (OUT) decreases the outlet/downstream pressure.

**Opening Speed Control – F.C.**

An adjustable flow control adjacent the valve cover port, determines the opening speed of the main valve. It allows free flow into the cover and restricted flow out of the cover. Counterclockwise adjustment for faster opening, clockwise for slower opening. Complete closure prevents the main valve from opening.

**Hydraulic Check Feature**

When main valve outlet pressure exceeds inlet pressure, fluid is directed from the outlet to the main valve cover. This causes the main valve to close until inlet pressure / flow is again greater than outlet.

**Main Valve – Description**

CP-Boss automatic control valves are hydraulically operated, diaphragm actuated, pilot controlled, angle valves of packless design. The stem assembly is the only moving part in the main valve and is guided top and bottom. Positive, drip-tight, closure is accomplished by a quad seal and non-edged seat.

**Start-Up and Adjustment**

Close upstream and downstream isolation valves.  
 Open any ball valves or isolation cocks in the control tubing.  
 Failure to open these will prevent the valve from functioning properly.

**Step 1**

Pre-set pilots as noted:  
**Pressure Reducing** – Adjust OUT, counterclockwise, backing pressure off the spring, preventing possible overpressuring of the system.  
**Opening Speed** – Turn the adjustment screw on the Opening Speed Control OUT, counterclockwise, 1-1/2 to 2-1/2 turns from full closed position.

**Step 2**

Loosen a tube fitting or cover plug at the main valve to allow air to vent during start-up.

**Step 3**

Pressurize the line, opening the upstream isolation valve slowly. Air is vented through the loosened fitting. Tighten the fitting when a steady stream of liquid begins to vent.

**SETTING THE PRESSURE REDUCING CONTROL**

**Step 4**

Slowly open the downstream isolation valve to establish flow through the system.

**Step 5**

Fine tune the Pressure Reducing Control to the desired pressure set point by turning the adjustment screw IN, clockwise to increase or OUT, counterclockwise to decrease downstream pressure.

**Step 6**

Opening Speed Flow Control Adjustment: The opening speed flow control allows free flow into the cover and restricted flow out of the cover of the main valve.

If recovery of pressure is slow upon increased downstream demand, turn the adjustment screw OUT, counterclockwise, increasing the rate of opening.

If the recovery of downstream pressure is too quick, as indicated in a rapid increase in pressure, possibly higher than the desired set-point, turn the adjustment screw IN, clockwise, decreasing the rate of opening.

**CONTROL VALVE FUNDAMENTALS**

**Main Valve**

- Diaphragm : Seat Ratio  
 -1 1/2 diaphragm area to 1 seat area

**Flow Directions**

- Under the seat  
 -Waterworks and all general applications  
 -If diaphragm wears/leaks, valve still flows

**Golden Rules**

- Fluid into cover – valve closes
- Fluid out of cover – valve opens
- What the control does, the valve does  
 -Pilot on outlet  
 \*If it opens, valve opens  
 \*If it closes, valve closes

## APPENDIX C (continued) MODELS 770-790

### Piping Schemes

- 2-way (T to cover)
  - Supply Line
    - \*Restriction in line
    - \*Location of Speed Control
- Control/Discharge Line
  - 2-way pilot control in line
    - \*On/Off
    - \*Variable restriction
  - Valve position varies or modulates
- Supply to Discharge relationship
  - Supply restriction is required for valve to regulate

### 3-Way Piping

- Operation
  - #1 – Routes fluid into cover-valve closed
  - #2 – Blocks supply – routes fluid out of cover-valve opens
  - Control typically used with low capacity pilots or valves smaller than 4"
    - \*Solenoids
    - \*Altitude
    - \*Float
    - \*Accelerator control
  - Used to increase capacity of 3-port controls

### GUIDE TO TROUBLE SHOOTING PRESSURE REDUCING VALVES

#### PROPER START-UP

1. Valves should be started in a manner that allows for controlled pressurizing of the valve and the system.
  - a. The valve should be pressurized and vented.
    - i. Bleed the air off of the main valve cover
    - ii. Bleed the air off of the valve controls
      1. Trapped air will give a false reading unless it is eliminated.
  - b. Bring pilots into service with a pressure setting lower than that required.
    - i. Adjust to higher pressures as the system and valve stabilizes.
  - c. Pilot Adjustments.
    - i. Make all adjustments slowly, allowing for the control, valve and system to read the change
    - ii. Clockwise adjustments always increase the pressure setting.
      1. Turning the reducing control IN will INCREASE outlet pressure.
      2. Turning the relief/sustaining control IN will INCREASE the inlet or relief set-point.
    - iii. Counterclockwise adjustments always LOWER/DECREASE the pressure setting
      1. Turning the reducing control OUT will LOWER outlet pressure.
      2. Turning the relief/sustaining control OUT will LOWER the inlet or relief set-point.

#### ABOUT THE MAIN VALVE

1. Almost every function of control valve used in water applications call for a main valve flow of "under the seat".
  - a. If a diaphragm fails, the valve continues to allow flow.
    - i. Failure will be indicated by loss of pressure control or loss of positive shut-off

- b. Control circuit isolation ball valves can be used to isolate valve cover to allow for diaphragm condition check without removing the cover.
  - i. Close inlet ball valve
  - ii. Close cover ball valve
  - iii. Close outlet ball valve
  - iv. Bleed cover fluid
- c. Valve will open – fluid will continue to flow if diaphragm is damaged.

#### 2. VALVE WILL NOT OPEN-CHECK PILOT SYSTEM

- a. Check opening speed control – OPEN.
- b. Check on/off devices.
  - i. Solenoid
  - ii. Deadman control
  - iii. Hydraulic check function
- c. Check system
  - i. For flow demand
  - ii. Inlet pressure
  - iii. Closed isolation valves
- d. Check function of hydraulic controls.
  - i. See pilot trouble shooting guidelines
    1. Take corrective action.

#### 3. VALVE WILL NOT CLOSE

- a. Check pilot system.
  - i. Check closing speed control – OPEN
  - ii. Check on/of device for complete closing
    1. Solenoid
    2. Hydraulic check function.
  - iii. Check function of hydraulic controls
    1. See pilot trouble shooting guidelines.
      - a. Take corrective action.

#### 4. VALVE WILL NOT REGULATE

- a. This is normally a problem with the hydraulic controls.
  - i. Check response to adjustments
    1. Service pilots as required.
  - ii. Check and adjust speed controls
    1. Gauge swings to higher than acceptable pressures.
      - a. Adjust for slower opening speed.
      - b. Adjust for faster closing speed.
    2. Gauge swings to lower pressures than acceptable.
      - a. Adjust for faster opening speed.
      - b. Adjust for slower closing speed.

## APPENDIX D MODELS 770-790

ADJUSTABLE OPERATING RANGE	MINIMUM DEAD BAND.	PROOF PRESSURE	FACTORY SETTING
IPS40-1	9000104	1	10-175 PSI

**Listing/Approvals:** UL Standard 508 Guide (NKPZ) and CSA Standard C22.2 No. 14-M Class (321106) for Pressure Operated Industrial Control Equipment.

UL Standard 873 Guide (XAPX) and CSA Standard C22.2 No. 24 Class (481302) for Temperature Indicating and Regulating Equipment.

CE Marked

**Ambient/Media Temperature Range:**

-4°F to 180°F (-20°C to 82°C)

**Construction:**

- NEMA Type 4X Enclosure for indoor or outdoor use. (To maintain 4X rating, use appropriate Type 4 conduit hub.)
- Forged Brass or 316 S.S. Pressure Connections.
- Aluminum Diecast Base with Polymer Enclosure.
- Beryllium Copper Diaphragm (Stainless steel isolator diaphragm included for protection of beryllium copper diaphragm on models with stainless steel pressure connection.)
- Nitrile Pressure Sealing O-ring.

**Switch Contact:**

- Snap Action SPDT (Form C)
- 15 Amps at 125/250/480 VAC
- 1/8 HP at 125 VAC
- 1/4 HP at 250 VAC

### General Description

The pressure switch is an Adjustable Deadband Pressure Switch

with independent set and re-set points which are adjustable throughout the entire operating range of the switch. The minimum deadband (minimum span between set and reset points) may be obtained at any point in the operating range of the switch. A change in pressure greater than the high setting will reposition the switch mechanism to open or close a single snap-action electrical switch.

This control device is designed for use as an operating control in applications sensing air, water, or any fluid not harmful to the pressure connection, diaphragm or nitrile pressure sealing o-ring. Where an operating control would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) that protect against, or systems (alarm, supervisory systems) that warn of control failure.

This device is not intended for applications in explosive environments or use with hazardous fluids.

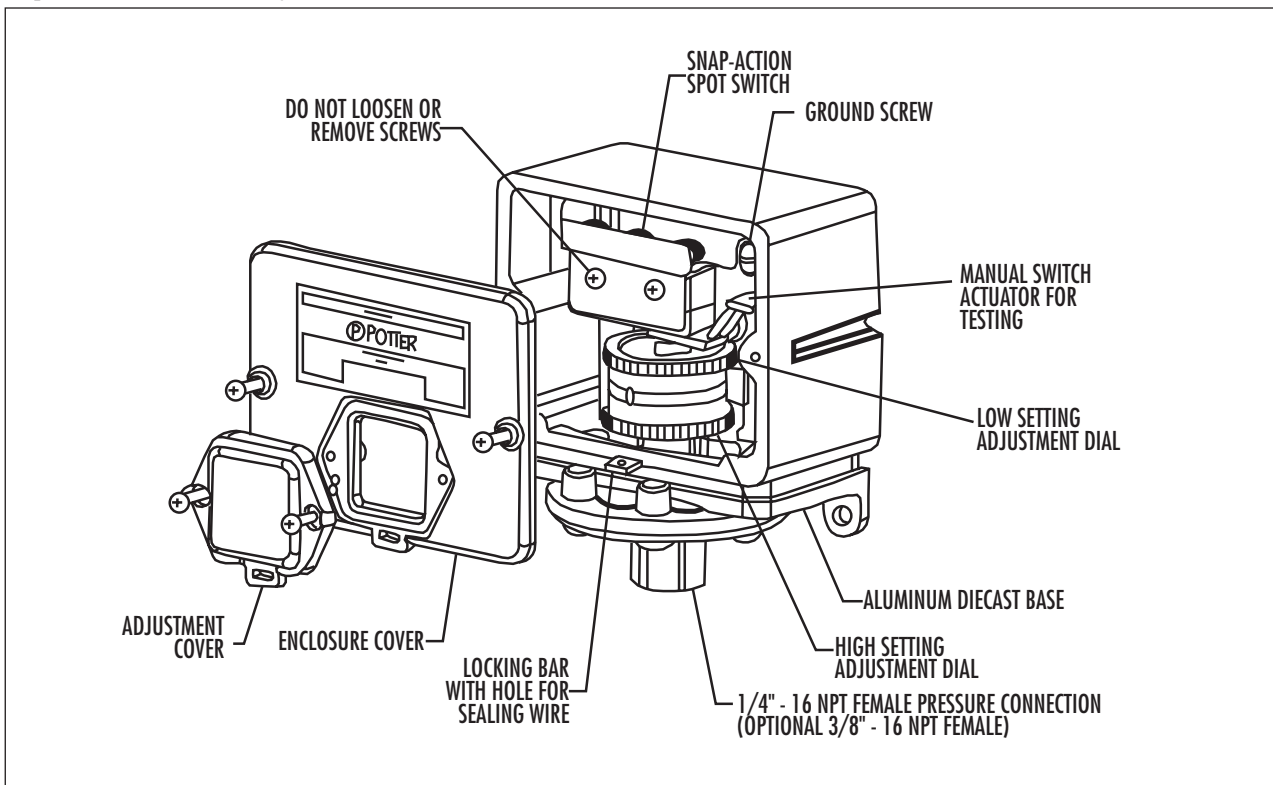
### ADJUSTMENTS

The two thumb adjustment dials, accessible through the enclosure cover, are used to adjust the set point and reset point of the switch. The dial scales and pointer may be used to give an indication of the low and high set points.

The high setting adjustment dial is calibrated for increasing pressure. The low setting adjustment dial is calibrated for decreasing pressure. For best accuracy, make the final adjustments with a pressure gauge at the actual working media pressure and temperature encountered in the application.

The minimum deadband (minimum span between set and reset points) may be obtained at any point in the operating range of the switch.

When the desired settings are obtained, replace the adjustment cover. The adjustment cover and enclosure cover can be made tamper resistant by a single sealing wire inserted through the hole





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## WARRANTY

Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller; however, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller. Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid. Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Seller assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated. If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller prior to any attempted repair, or sent to an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit, nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B., Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing. The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced, whichever is greater. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired. Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired. Seller may substitute new equipment or improve part(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated losses or damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment; (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

The above warranty shall not apply to any equipment which may be separately covered by any alternate or special warranties.

**PERFORMANCE:** In the absence of Certified Pump Performance Tests, equipment performance is not warranted or guaranteed. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy under Hydraulic Institute procedures.

**LIABILITY LIMITATIONS:** Under no circumstances shall the Seller have any liability under the Order or otherwise for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, regardless of the cause of such damages or losses. In any event, Seller's aggregate total liability under the Order or otherwise shall not exceed the contract price.

**ACTS OF GOD:** Seller shall in no event be liable for delays in delivery of the equipment or other failures to perform caused by fires, acts of God, strikes, labor difficulties, acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond Seller's control.

**COMPLIANCE WITH LAW:** Seller agrees to comply with all United States laws and regulations applicable to the manufacturing of the subject equipment. Such compliance shall include: The Fair Labor Standards Acts of 1938, as amended; Equal Employment Opportunity clauses of Executive Order 11246, as amended; Occupational Safety and Health Act of 1970 and the standards promulgated thereunder, if applicable. Since compliance with the various Federal, State, and Local laws and regulations concerning occupational health and safety, pollution or local codes are affected by the use, installation and operation of the equipment and other matters over which Seller has no control, Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty, or otherwise. It is incumbent upon the Buyer to specify equipment which complies with local codes and ordinances.



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