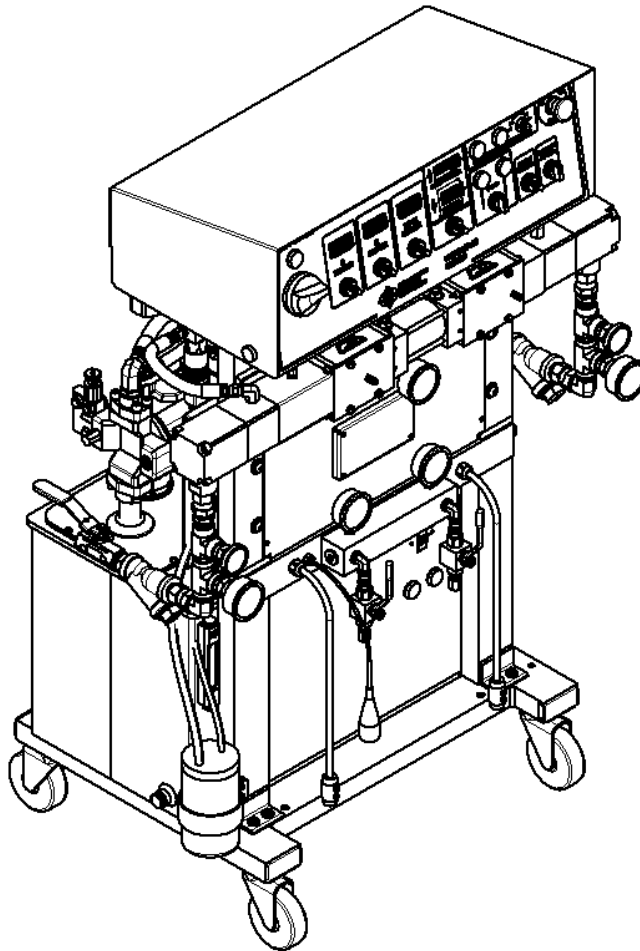




POLYURETHANE
MACHINERY CORPORATION

PH-2 Proportioner Service Manual

Ref. # 202197
Revision 1.5



FOR PROFESSIONAL USE ONLY
Not approved for use in European explosive atmosphere locations



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1 WARRANTY

Polyurethane Machinery Corporation (hereinafter “PMC”) provides this **LIMITED WARRANTY** (hereinafter “Warranty”) to the original purchaser (hereinafter “Customer”) covering this equipment and the original PMC manufactured accessories delivered with the equipment (hereinafter “Product”) against defects in material or workmanship of the Product (hereinafter “Defect” or “Defective”) for a period of one (1) year from the date of first purchase as shown on the original PMC invoice (hereinafter “Warranty Period”)

If during the Warranty Period under normal use, the Product is suspected by Customer to be Defective in material or workmanship, it is Customer’s responsibility to contact PMC and return the Product to PMC as directed by PMC, freight prepaid. If PMC determines that the Product is Defective and that such Defect is covered by this Warranty, PMC will credit Customer for the reasonable freight charges incurred by Customer in returning the Defective Product to PMC, and PMC (or its authorized agent) will, at PMC’s option, repair or replace the Product, subject to the following:


1. **Original Invoice:** The original invoice must be kept as proof of the date of first sale and the Product serial number. The Warranty does not cover any Product if the Original Invoice appears to have been modified or altered, or when the serial number on the Product appears to have been altered or defaced.
2. **Product Maintenance:** It is the Customer’s responsibility to maintain the Product properly. See your maintenance schedule and owner’s manual for details. The Warranty does not cover an improperly maintained Product.
3. **Non-PMC Components and Accessories:** Non-PMC manufactured components and accessories that are used in the operation of the Product are not covered by this Warranty. Such components and accessories shall be subject to the warranty offered to the Customer, if any, by the original manufacturer of such component or accessory.
4. **Other Warranty Exclusions:** The Warranty does not cover any Product that PMC determines has been damaged or fails to operate properly due to misuse, negligence, abuse, carelessness, neglect, or accident. By way of example only, this includes:
 - Normal wear and tear.
 - Improper or unauthorized installation, repair, alteration, adjustment, or modification of the product.
 - Use of heating devices, pumping equipment, dispensers, or other parts or accessories with the product that have not been approved or manufactured by PMC.
 - Failure to follow the operating instructions and recommendations provided by PMC.
 - Cosmetic damage.
 - Fire, flood, “acts of God”, or other contingencies beyond the control of PMC.

THE WARRANTY DESCRIBED HEREIN IS THE EXCLUSIVE REMEDY FOR THE CUSTOMER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, AND THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER WARRANTIES ARE HEREBY DISCLAIMED. TO THE FULLEST EXTENT PERMITTED BY LAW, PMC SHALL NOT BE RESPONSIBLE, WHETHER BASED IN CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), WARRANTY OR ANY OTHER LEGAL OR EQUITABLE GROUNDS, FOR ANY CONSEQUENTIAL, INDIRECT, INCIDENTAL, LOST PROFITS, SPECIAL, PUNITIVE OR EXEMPLARY DAMAGES, WHETHER TO PERSON OR PROPERTY, ARISING FROM OR RELATING TO THE PRODUCT, EVEN IF PMC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSSES OR DAMAGES.

- Non-Warranty Service by PMC: If PMC determines that the suspected Defect of the Product is not covered by this Warranty, disposition of the Product will be made pursuant to the terms and conditions of PMC's written estimate on a time and materials basis.
- Continuing Warranty for Products Repaired or Replaced under Warranty: Following the repair or replacement of a Product covered by this Warranty, such Product will continue to be subject to the original Warranty for the remainder of original Warranty Period or for three (3) months from the repair or replacement date, whichever is longer.
- No Rights Implied: Nothing in the sale, lease or rental of any Product by PMC shall be construed to grant any right, interest, or license in or under any patent, trademark, copyright, trade secret or other proprietary right or material owned by anyone; nor does PMC encourage the infringement of same.
- Exclusive Warranty: This writing is the final, complete, and exclusive expression of the Warranty covering the Product. Any statements made by PMC, its employees or agents that differ from the terms of this Warranty shall have no effect. It is expressly understood that Customer's acceptance of this Warranty, by performance or otherwise, is upon and subject solely to the terms and conditions hereof, and any additional or different terms and conditions proposed or expressed by Customer or anyone, whether in writing or otherwise, are null and void unless specifically agreed to in writing by an Officer of PMC.

2 SAFETY AND HANDLING

This chapter contains important information on the safety, handling, and use of your PH Series Proportioner.

	<p>Before installing the PH Series Proportioner and startup, carefully read all the technical and safety documentation included in this manual. Pay special attention to the information in order to know and understand the operation and the conditions of use of the PH Series Proportioner. All of the information is aimed at improving user safety and avoiding possible breakdowns from the incorrect use of the PH Series Proportioner.</p>
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WARNING! Symbol is presented in front of information to alert of a situation that might cause serious injuries if the instructions are not followed.

CAUTION! Symbol is presented in front of information that indicates how to avoid damage to the proportioner or how to avoid a situation that could cause issues.

NOTE! Symbol is presented in front of relevant information of a procedure being carried out.

Careful study of this manual will enable the operator to know the characteristics of the PH Series Proportioner and the operating procedures. By following the instructions and recommendations contained herein, you will reduce the potential risk of accidents in the installation, use, and maintenance of the PH Series Proportioner. You will provide a better opportunity for greater output, incident-free operation for a longer time, and the possibility of detecting and resolving problems quickly and simply.






Keep this Operations Manual for future consultation of useful information. If you lose this manual, ask for a new copy from your PMC Service Center or go online at our web site (www.polymacusa.com).

The PH Series Proportioner has been designed and built for the application of polyurea chemical systems, polyurethane foam chemical systems, and some two-component epoxy systems

WARNING! The design and configuration of the PH Series Proportioner does not allow its use in potentially explosive atmospheres, or the pressure and temperature limits described in the technical specifications of this manual to be exceeded.

Always use liquids and solvents that are compatible with the unit. If in doubt, consult your authorized PMC distributor.

When working with the PH Series Proportioner, it is recommended that the operator wear suitable clothing and elements of personal protection, including, without limitation, gloves, protective goggles, safety footwear and face masks. Use breathing equipment when working with the PH Series Proportioner in enclosed spaces or in areas with insufficient ventilation. The introduction and follow-up of safety measures must not be limited to those described in this manual. Before starting up the PH Series Proportioner, a comprehensive analysis must be made of the risks derived from the products to be dispensed, the type of application, and the working environment.

	<p><i>To prevent possible injury caused by incorrect handling of the raw materials and solvents used in the process, carefully read the Safety Data Sheet (SDS) provided by your supplier. Deal with the waste caused according to current regulations.</i></p>
	<p><i>To avoid damage caused by the impact of pressurized fluids, do not open any connection, or perform maintenance work on components subject to pressure until the pressure has been completely eliminated.</i></p>
	<p><i>Use suitable protection when operating, maintaining or being present in the area where the equipment is functioning. This includes, but is not limited to, the use of protective goggles, gloves, shoes, and safety clothing and breathing equipment.</i></p>
	<p><i>The equipment includes components that reach high temperatures and can cause burns. Hot parts of the equipment must not be handled or touched until they have cooled completely.</i></p>
	<p><i>To prevent serious injury through crushing or amputation, do not work with the equipment without the safety guards installed on the moving parts. Make sure that all the safety guards are correctly reinstalled at the end of the repair or maintenance work of the equipment.</i></p>

3 CHARACTERISTICS

The PH Series Proportioner has been designed and built for the application of polyurea chemical systems, polyurethane foam chemical systems, and some specific two-component epoxy systems.

3.1 PRINCIPAL HEATING SYSTEM

The Proportioner consists of one (1) Material Heater without internal seals. The Low-Pressure Heater has three (3) Heating Elements per fluid side rated at 1,250, 1,500, or 1750 watts, each giving the Proportioner a total heat output of 7,500, 9,000, or 10,500 watts. The High-Pressure Heater has four (4) Heating Elements per fluid side rated at 1750 watts, each giving the Proportioner's total heat output of 14,000 watts. Every heating system provides the necessary control and safety components for their precise operation. The Material Heater design allows for a controlled and precise temperature differential (ΔT) and material application temperatures of up to 190° F under ambient temperatures.

3.2 HOSE HEATING SYSTEM

The system is designed with a 3 KVA Isolation Transformer that enables effective heating of up to a total hose length of 310 feet (also available with a 2KVA transformer and a 5 KVA transformer for maximum hose lengths of 210 and 410, respectively). The system includes an innovative hose heating concept in which the continuous braid tinned-copper jacket is distributed evenly around the circumference of the hose providing a uniform heating watt density and precise control of the material application temperature. This hose heating element design is extremely resistant to fatigue failure.

100% circumferential coverage produces the most uniform distribution of heat available.



Figure 1: Hose Heating Diagram

3.3 DOUBLE ACTING OPPOSED PISTON METERING PUMPS

The opposed double acting Pump Line is driven by a double ended Hydraulic Cylinder. The in-line pump system with opposed piston pumps provides a constant volume and guarantees uniform pressures in both directions of pump movement.

3.4 PRESSURE BALANCE CONTROL SYSTEM

The Pressure Balance Control (PBC) system performs an automatic shutdown when a chemical imbalance occurs. When the system is turned off, the Proportioner will perform as if there is no PBC system and will continue pumping material. When the system is turned on, it will continually monitor the pressure between the two chemicals (known as the **pressure differential**). If the pressure differential becomes equal to or greater than the **maximum allowable pressure differential**, the pumps will be shut off.

The Pressure Balance Control system can be simplified into a logic box diagram with inputs and outputs. There are five inputs: the power supply from the main console, the pressure readings from each chemical, the maximum pressure, and the maximum allowable pressure differential. Inside the logic box, the actual pressure differential of the chemicals is compared to the maximum allowable pressure differential. Depending on the circumstances of all five inputs, there are only two possible outputs: either the pumps will continue to pressurize and move material, or the pumps will shut off and flow will be lost.

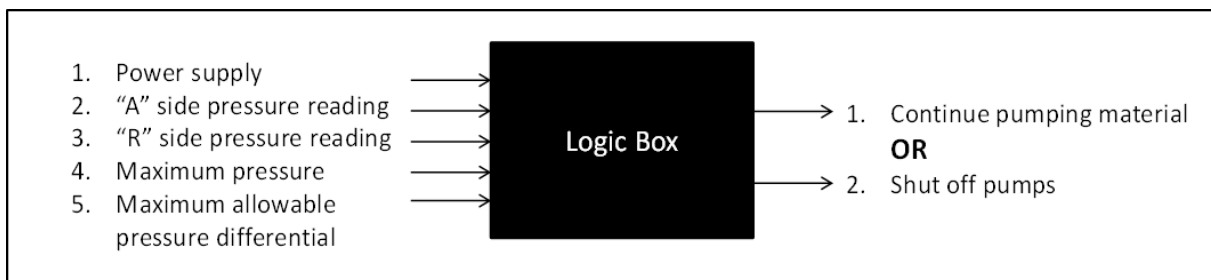


Figure 2: Pressure Balance Control Logic Diagram

4 TECHNICAL SPECIFICATIONS

4.1 ELECTRICAL

PH-2 Detailed Electrical Specifications

Pressure	Material Heater Power	Electrical Consumption (208-240VAC/1PH)	Electrical Consumption (208-240VAC /3PH)	Electrical Consumption (380VAC /3PH)	Power Consumption
2,000PSI	7.5kW (3.75kW [3x1250W]/side)	33A	19A	11A	7.5kW
	9.0kW (4.50kW [3x1500W]/side)	39A	23A	14A	9.0kW
	10.5kW (5.25kW [3x1750W]/side)	46A	26A	16A	10.5kW
	14kW (7kW [4x1750W]/side)	61A	35A	21A	14kW
Hose Transformer					
	70V	9A	5A	3A	2kVA
	90V	13A	8A	5A	3.15kVA
	120V	22A	13A	8A	5kVA
Electrical Motor					
	PH-2	21A	13A	9A	3HP
Console					
	All	2A	2A	2A	-



CAUTION! Inside the console is a Terminal Strip for connecting the main power (wire not supplied) to the PH Series Proportioner. This electrical connection must be made only by a qualified electrician.

PH-2 Total Electrical Consumption

Material Heater Power	Hose Transformer	Total Electrical Consumption (208-240VAC/1PH)	Total Electrical Consumption (208-240VAC /3PH)	Total Electrical Consumption (380VAC /3PH)
7.5kW	90V	69A	42A	27A
9.0kW		75A	46A	30A
10.5kW		82A	49A	32A
14kW		97A	58A	37A

NOTES: Calculations for 208-240VAC specifications based off a 230VAC input.

4.1 MECHANICAL

123 Pumps	
Maximum Working Pressure	2,000PSI (14MPa, 138bar)
Maximum Production	28lb/min (14kg/min)
Minimum Production	2lb/min (1kg/min)
Volume per Cycle (Single Pump)	0.01859gal/cycle (0.07220L)
Volume per Cycle (Both Pumps)	0.03788gal/cycle (0.14439L)
Cycles per 55gal (200L) Drum	2,904cycles
Maximum Hose Length	
2KVA Transformer	210ft (64m)
3KVA Transformer	310ft (95m)
5KVA Transformer	410ft (125m)
Approximate Weight	
Hydraulic Tank Empty	415lbs (166kg)
Hydraulic Tank Full (12gal)	450lbs (197kg)
Overall Dimensions (W x D x H)	
36in x 23in x 54in (92cm x 60cm x 138cm)	

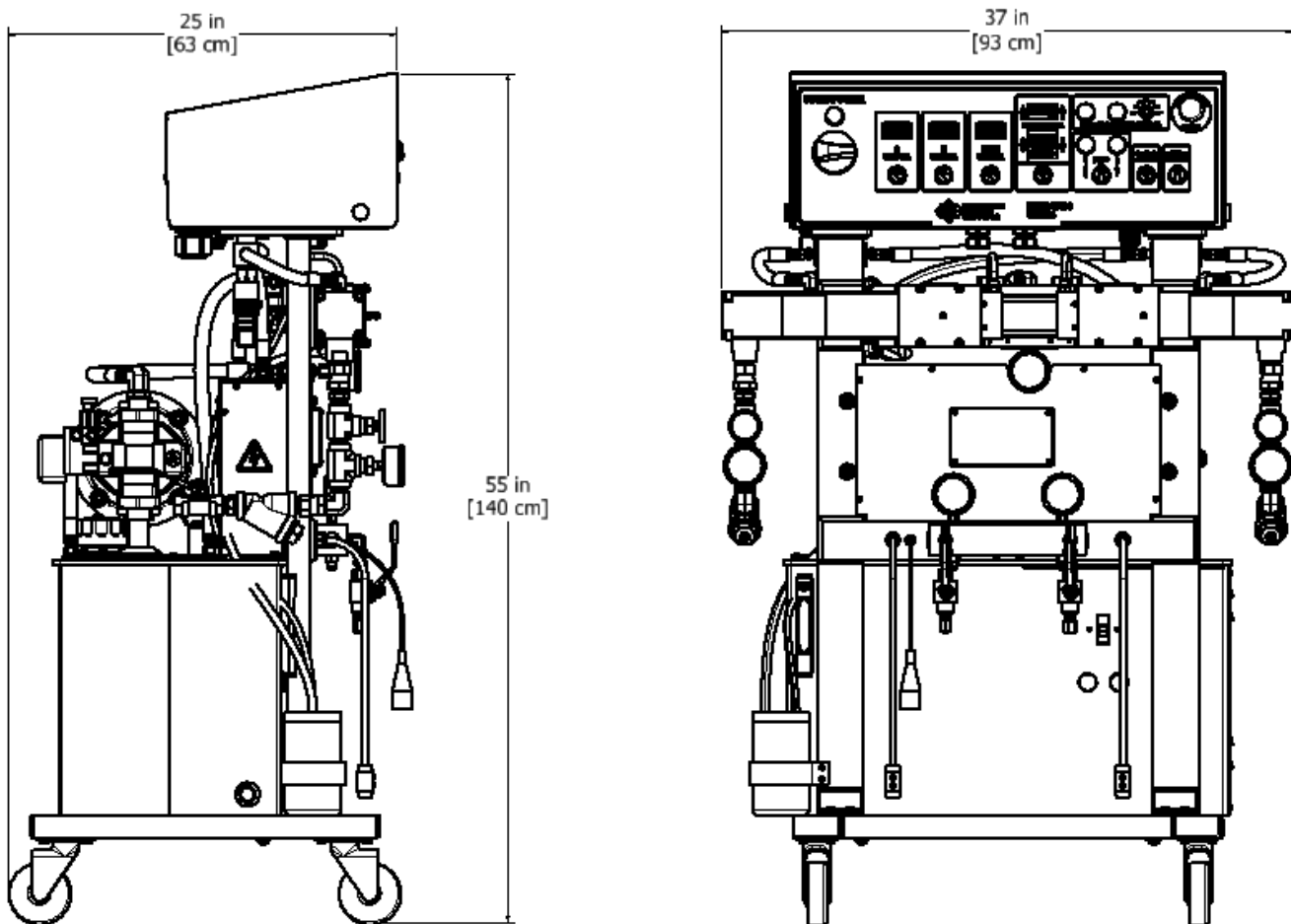


Figure 3: Proportioner Dimensions

5 DESCRIPTION

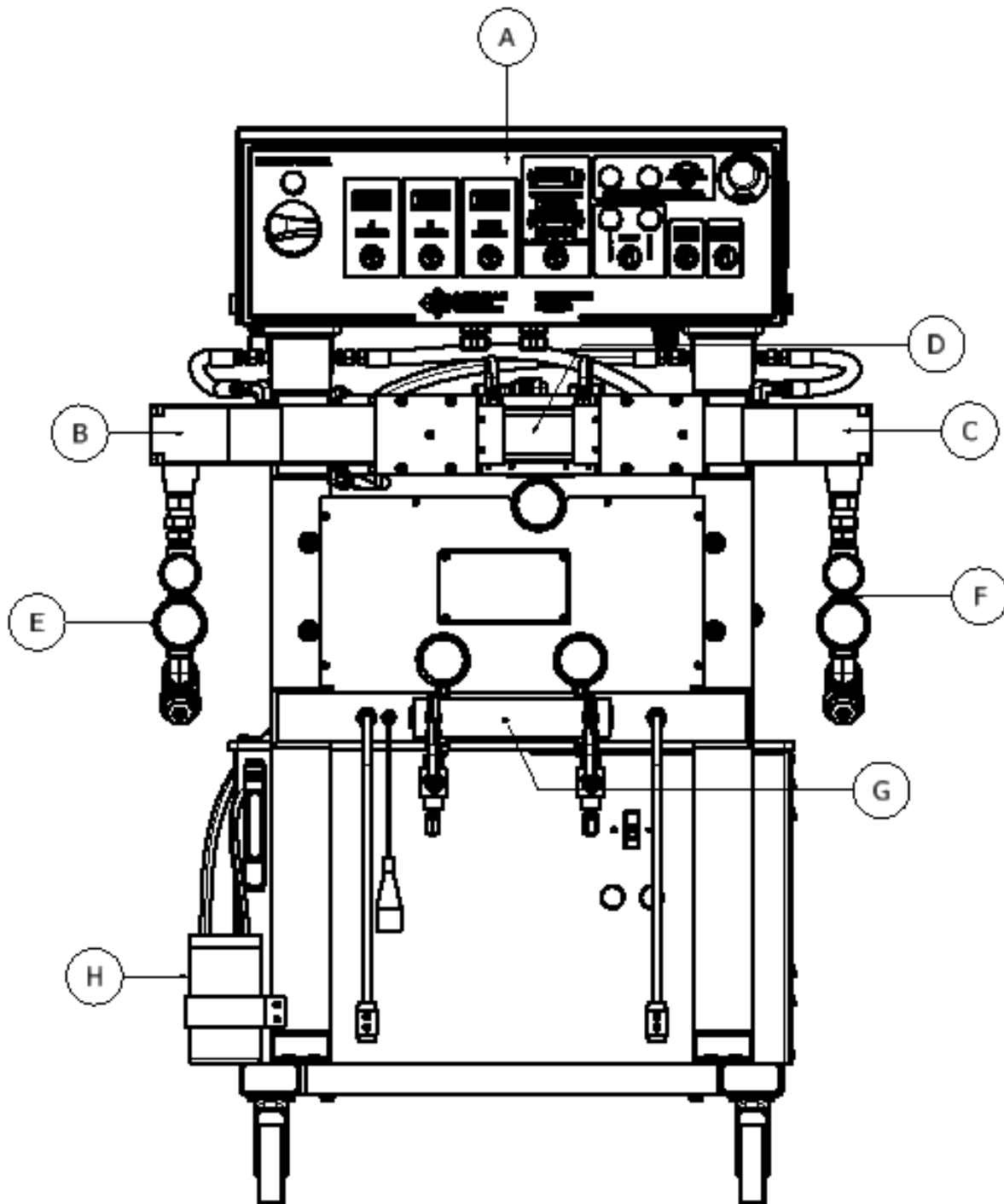


Figure 4: Component Identification - Front

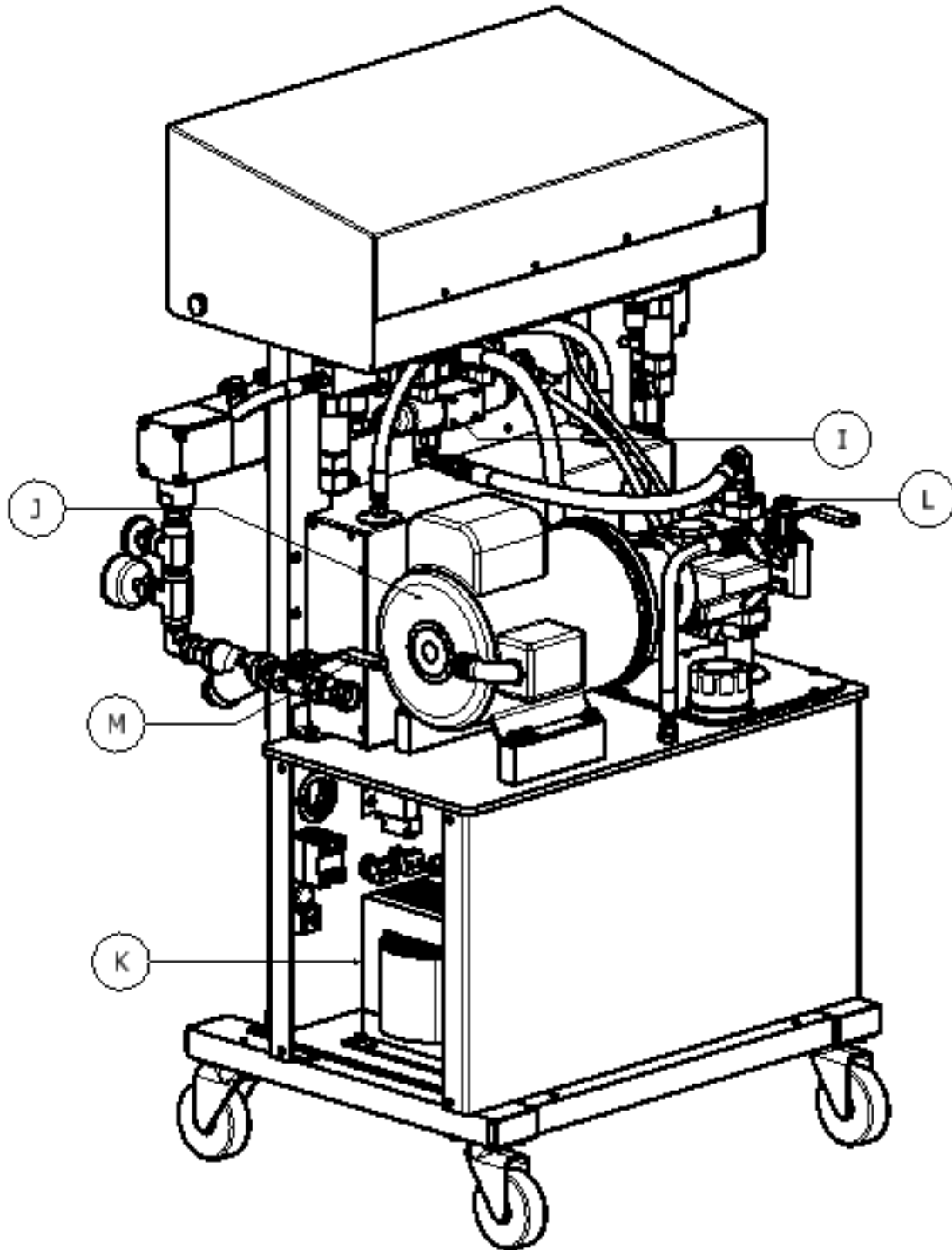


Figure 5: Component Identification - Back

A. Control Panel

Controls and regulates the operation of the PH Series Proportioner.

B. Isocyanate (Iso, A) Metering Pump

Meters the Isocyanate material.

C. Polyol (Poly, R) Metering Pump

Meters the Polyol material.

D. Hydraulic Cylinder Assembly

Transfers power from hydraulic pump to material pumps.

E. Isocyanate (Iso, A) Inlet Manifold Assembly

Provides Isocyanate temperature and pressure readings prior to heating and pressurizing.

F. Polyol (Poly, R) Inlet Manifold Assembly

Provides Polyol temperature and pressure readings prior to heating and pressurizing.

G. Exit Manifold Assembly

Provides pressure reading of material after heating and pressurizing.

H. Isocyanate (Iso, A) Lube Reservoir

Provides lube to the Isocyanate pump shaft.

I. Hydraulic Manifold Assembly

Provides pressure reading of hydraulic fluid and controls direction of flow.

J. Motor

Provides power for hydraulic pump.

K. Hose Heating Transformer - Right side (inside of hydraulic tank)

Supplies the required voltage for material Heated Hoses.

L. Hydraulic Pressure Control

Allows the pressure of the hydraulic system to be increased or decreased. Turn clockwise to increase the pressure and counterclockwise to decrease. To regulate the pressure of the hydraulic system, the NORMAL or RETRACT Pump Switch position must be selected.

M. Inlet Material Strainer

Screens (60 mesh) material from bulk supply.

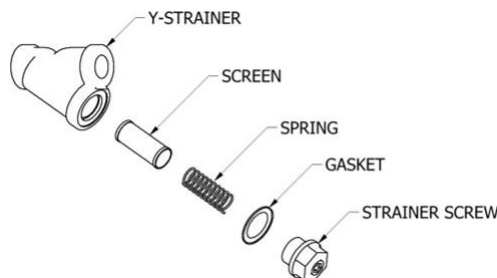


Figure 6: Inlet Strainer Components

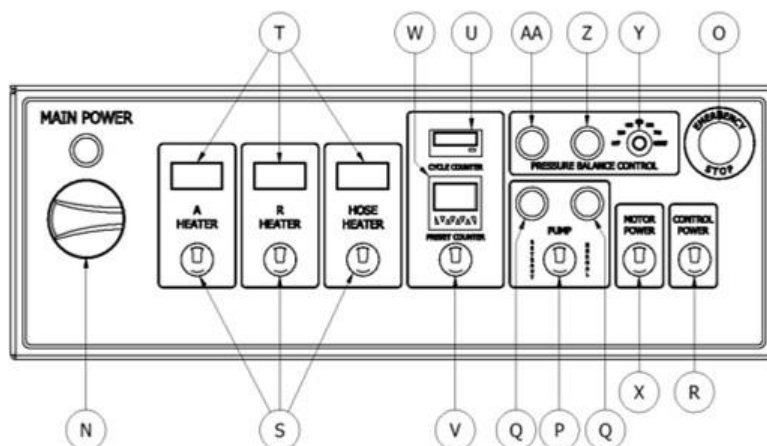


Figure 7: Front Panel Description

N. Main Power

Turns ON and OFF main power to the control panel. It must be turned ON for any operation to be performed with the unit. When turned ON, the red pilot will light.

O. Emergency Stop

Interrupts the PH- Series control power circuit to stop all motion and heating.

P. Pump Switch

Off - Removes power from the pump circuit. The directional indicator lights will not be lit.

Normal - Activates the normal operation of the machine. When the switch is ON, the directional light corresponding to the stroke direction will light.

Retract - Sets the Piston Rod of the Iso (A) metering pump into the pump to prevent crystallization of Iso (A) on the Piston Rod. Set the Pump Switch to RETRACT every time the unit is stopped by the operator (See Section 11 on page 32).

Q. Direction Indicator Lights

Indicates the movement direction of the Metering Pumps. If excessive pressure is caused in the system, the pump circuit will be disabled, and the directional lights will be OFF.

R. Control Power

Turns ON and OFF the control power to the complete electrical circuit including Heaters and Hose Heater.

S. Heater Temperature Switch (A(Iso)/R(Poly)/Hose)

Turns ON and OFF power to the specific Heaters and Hose.

T. Temperature Controllers

Displays the temperature of the chemicals. See Section 9 on page 27 for detailed Temperature Controller instructions.

U. Totalizer

Indicates the number of pump cycles to calculate material usage for both A and R side combined:

Model	Pressure	Pump Size	Cycles per Gal (3.79L)
PH-2	2,000PSI	123	27

V. Auto Shut Down Switch

Turns ON and OFF power to the Auto Shut Down unit.

W. Auto Shut Down Counter

Used to set the number of cycles required to prevent the chemical drums from running dry, the machine will shut down when the preset cycles expire. There is an on/off switch to activate this feature or deactivate and not use it.

X. Motor Switch

Turns ON and OFF the Electric/Hydraulic Motor. When turned ON, the pilot will light. In the event of an overload of the Motor, pilot light will turn OFF and Motor will stop.

Y. Pressure Balance Control Knob

Used to set the maximum allowable pressure differential (in PSI) between the A (Iso) and R (Poly) pumps. See page 26 or more information.

Z. Pressure Balance Control "ON" Light

Indicates that the Pressure Balance Control system is on and functioning.

AA. Pressure Balance Control "FAULT" Light

Indicates that the pressure differential is equal to or greater than the maximum allowable pressure differential.

6 INSTALLATION

WARNING! Use suitable protection and follow the recommendations in the Safety Information enclosed and provided by material suppliers when installing or working with the Proportioner.

CAUTION! Make sure the power cable is disconnected from the main power source before connecting to the Terminal Strip in the Console.

NOTE! To ensure the PH Series Proportioner works correctly, the electrical supply must meet the specifications indicated on the Serial Number Placard affixed to the Electrical Console.

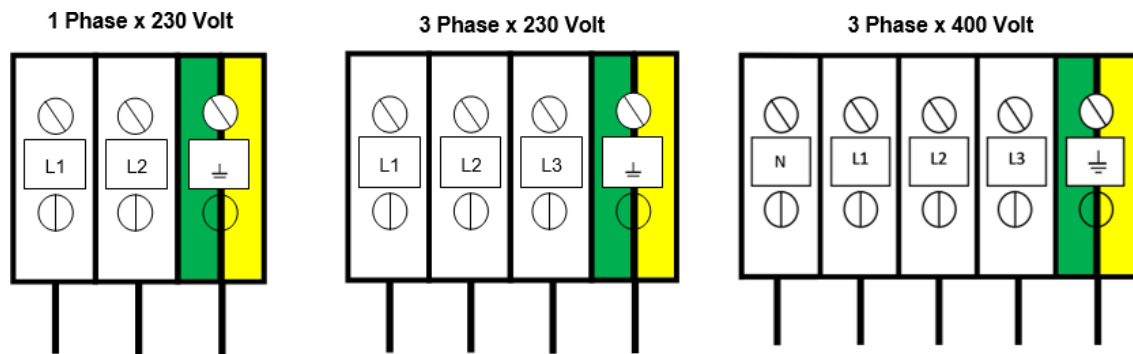


Figure 8: Incoming Electrical Power Connections

1. Insert the main power cable by passing it through the wire stop at the bottom of the electrical console and connect as shown in the diagram above.
2. Fill the Hydraulic Reservoir with 10 gallons (37 Liters) of approved hydraulic fluid. See page 54 for hydraulic oil specifications.

NOTE! Do not fill the tank to maximum capacity; use the Visual Level Indicator on the tank to make sure the amount of hydraulic fluid is not more than 10 gal (37 L) or 80% of the tank's maximum capacity.

3. To check the level of the hydraulic fluid in the Hydraulic Pump Case, disconnect the Hydraulic Hose from the 90-degree fitting and remove Fitting from Hydraulic Case. Add fluid as required. Reattach Fitting and Hydraulic Hose. Turn the hydraulic pressure control knob counterclockwise until it stops, that is the lowest hydraulic pressure setting.

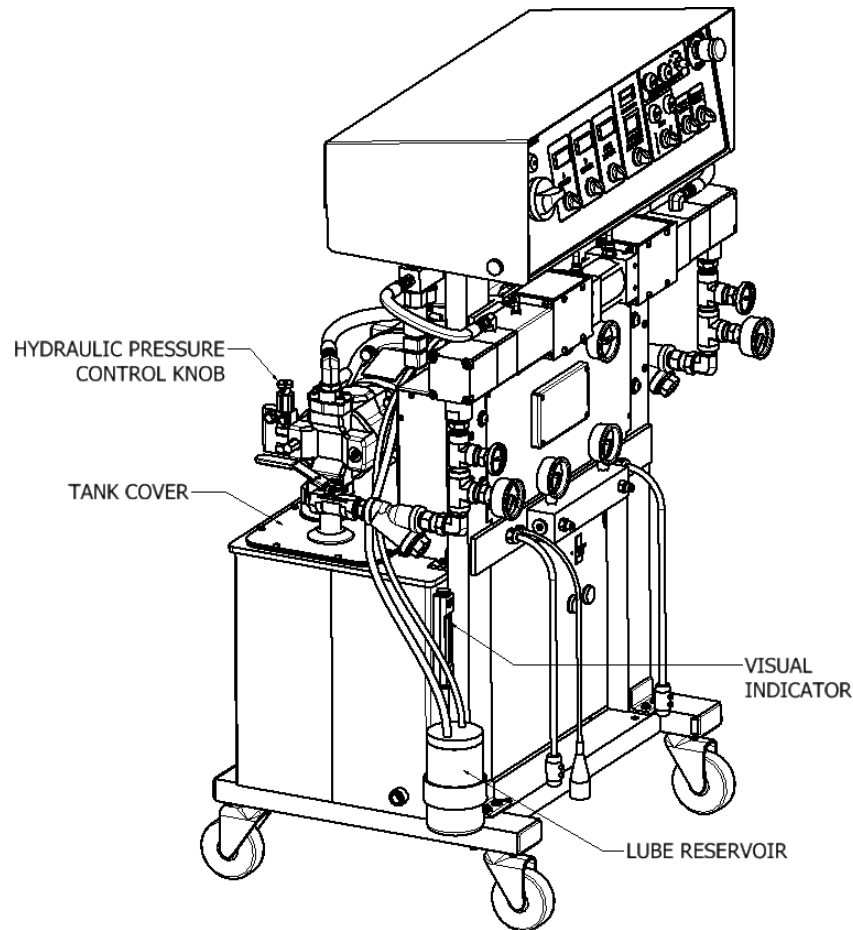


Figure 9: Installation

CAUTION! Ensure that the emergency stop is not engaged.

4. **Three Phase Proportioner Only:** Check the Electric Motor to ensure rotation is clockwise when viewing the end of the Electric Motor. A counterclockwise rotation indicates two of the incoming power leads need to be reversed.

CAUTION! Ensure Main Power Switch is OFF and incoming power is locked OFF before reversing power leads.

Recheck rotation before proceeding with Installation.

5. Fill the Lube Reservoir with PMC Pump Lube or suitable dilutants. It is not necessary to prime the system.

6.1 HEATED HOSE INSTALLATION

CAUTION! The material delivery Heated Hoses are color coded Red and Blue, allowing the user to recognize them. The Red corresponds to the Isocyanate (Iso, A) and the Blue to the Polyol (Poly, R). To avoid connection errors, the Coupling Connections of the Iso (A) and Poly (R) Heated Hoses are different sizes to ensure correct orientation.

NOTE! The material delivery Heated Hoses are capped at the ends to prevent absorbing moisture. Do not remove caps until the Heated Hoses are going to be installed on the Proportioner.

1. Lay out all the Heated Hose assemblies end to end aligning the Iso “A” (red) and Poly “R” (blue) and connect the respective Coupling Connections using the appropriately sized open-end wrench after ensuring Heated Hose assemblies lay flat.

CAUTION! Take care to not cross-thread or over-tighten the Coupling Connections. Thread seal tape or compound is not recommended for this tapered seat Coupling Connections.

2. Connect the material Heated Hoses to the outlets of the respective Heaters i.e., Iso (A) Heated Hose to the Iso (A) Heater and the Poly (R) Heated Hose to the Poly (R) Heater ensuring Heated Hose assemblies lay flat.
3. Connect Air Hose Coupling Connections.
4. Connect the Heated Hose power wires to the “Fast-Lock” Connector (Part# KT-00029A) coming from the Hose Heat Transformer as follows:
 - (a) Loosen the Socket Head Set Screw to allow insertion of the Heated Hose electrical wire Terminal.
 - (b) Insert the Terminal into the “Fast-Lock” Connector Body.
 - (c) Securely tighten the Socket Head Set Screw.
 - (d) Install electrical tape around Connector Body.

NOTE! A good practice is to add some dielectric grease (Permatex 67VR or equivalent) to the outside of the Terminal, where the electrical connection is made, prior to insertion.

5. Repeat the above steps to connect the “Fast-Lock” Connectors that you will find on all Heated Hose power wire.
-

CAUTION! Ensure the proper mechanical and electrical connections of the Heated Hoses are made to avoid possible material leakage and Hose heat problems.

6. It is recommended the TSU (Temperature Sensing Unit) be installed between the last section of Heated Hose and the Gun Whip. Carefully straighten the sensing wire, inserting it in the Iso (A) Heated Hose and tighten fluid fittings with appropriately sized open-end wrenches.

CAUTION! To protect the TSU sensor, you must pay special attention not to kink or excessively bend the Heated Hoses. Do not coil the Heated Hoses with a diameter of less than 4 feet (1.22 Meters). (TSU)

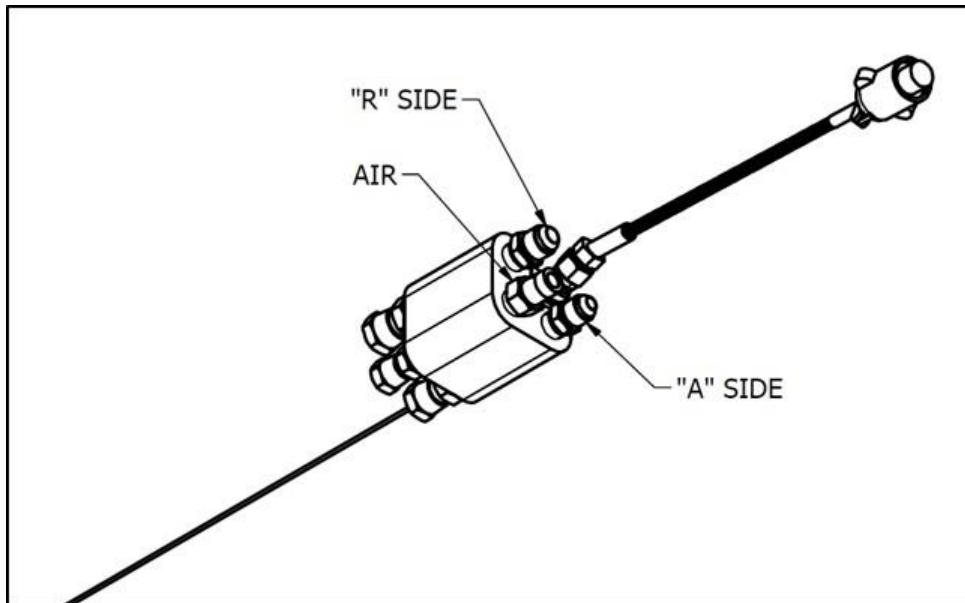


Figure 10: Temperature Sensing Unit

Part# EL-51A-4
Replacement Sensor Part# EL-51A-2

CAUTION! Connecting the TSU between the first and second section of Heated Hose results in the TSU sensing the material temperature exiting the Heater and not the inside of the Heated Hose near the Spray Gun.

6.2 HOSE HEAT TRANSFORMER

The Hose Heat Transformer offers the ability of connecting to different output voltages depending on the total length of the Heated Hose in use, maximizing the heating ability of the Heated Hose. The factory setting is 18 volts for use with 60 feet of Heated Hose. Before starting the Proportioner, ensure the setting matches the Heated Hose length installed. If Heated Hose sections are added or removed, the Tap setting should be changed to a setting which will limit the maximum amperage in the Heated Hose to 52 amps. The suggested settings are listed in the table below.

RECOMMENDED TAP SETTINGS		
Tap	Feet	Meters
120V	410	125.0
105V	360	109.7
90V	310	94.5
75V	260	79.5
60V	210	64.0
45V	160	48.8
30V	110	33.5
18V	60	18.3

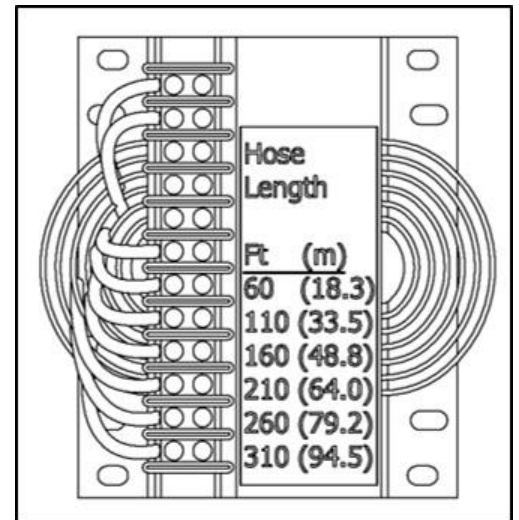
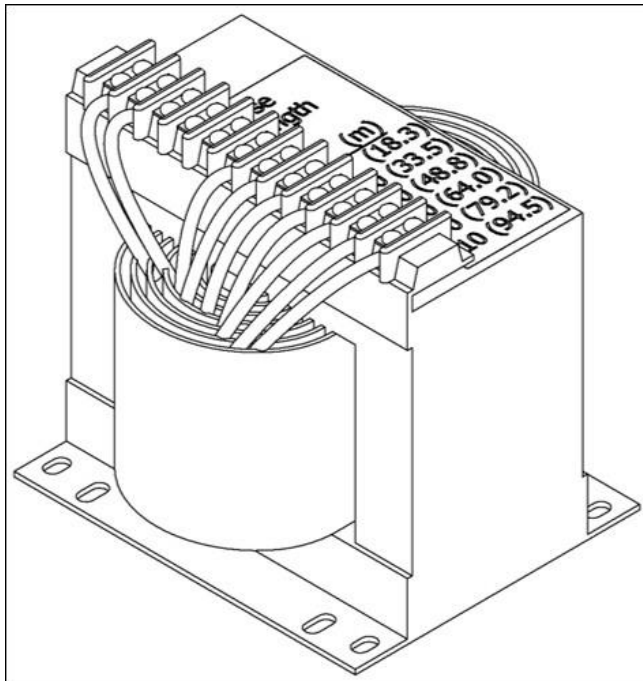


Figure 11: Transformer Tap Settings

*90V transformers (shown above) allow for a maximum hose length of 310 ft (94.5 m). 120V transformers allow for a maximum hose length of 410 ft (125 m).

7. Ensure the Manual Valves are CLOSED and connect the Coupling Block to the Heated Gun Whip.

CAUTION! Excessive force closing or opening the Manual Valves may result in damage to the Manual Valves and/or Coupling Block.

8. Connect the Transfer Pump/ Heated Hose Assemblies/Air Supply and Air Dryer systems as required. Review the Installation Instructions for each to ensure proper set-up and operation.
9. Install the Material Transfer Pumps as follows:

WARNING! If Transfer Pumps have been previously used, pay special attention to connect each Pump to its specific material. Inadvertently changing the Transfer Pumps will cause a chemical reaction rendering them useless.

NOTE! Placing a tape of the same color as of the Material Delivery Hoses (red for the Iso (A), blue for the Poly (R)) on each Transfer Pump would be a good method for minimizing errors in connection.

- a. Make sure that the Inlet Valves on the Proportioner are closed.
- b. Connect one end of the Polyol (R) Material Delivery Hose (3/4" thread) to the Proportioner Polyol (R) Inlet Valve and the other end to the Polyol (R) Transfer Pump.
- c. Connect one end of the Iso (A) Material Delivery Hose (1/2" thread) to the Proportioner Iso (A) Inlet Valve and the other end to the Iso Transfer Pump.
- d. Connect the air hose to the Transfer Pumps after ensuring each Transfer Pump Shut-Off Valve is CLOSED.

NOTE! To avoid errors in connection, the Coupling connections of the Iso (A) and Poly (R) Material Delivery Hoses are different sizes, making it difficult to swap connections.

10. Ground the Transfer Pump as recommend by the material supplier. The movement of product inside the Hoses can cause static electricity and produce electrical discharges.
11. Connect air to the airline coming off the first section of hose (90-110 psi, 6-8 bar)

7 PROPORTIONER PURGING

WARNING! Use suitable Personal Protection Equipment (PPE) and follow the recommendations in the Safety Information provided by product suppliers when installing or working with the unit.

WARNING! Do not turn the Temperature Controllers ON until the Proportioner purging procedure is complete and the Primary Heaters and Heated Hoses are filled with material.

NOTE! Before using the Proportioner it is necessary to purge the entire system, including Heated Hoses of mineral oil left over from Quality Control testing and air. The following procedure is also followed to purge air entrapped by running out of material in the supply Drum/Reservoirs resulting in a significant indicated material pressure imbalance as indicated by the Pressure Gauges and sprayed material.

1. Ensure the following before proceeding:
 - a. Air supply to Transfer Pumps is 90 - 110 psi (6 - 8 bar).
 - b. Proportioner inlet ball valves are CLOSED.
 - c. All connections are tight.
 - d. Material should be stored to the material suppliers recommended temperatures.
 - e. Spray gun coupling block is installed and manual valves are closed.
2. Slowly OPEN the Poly (R) Transfer Pump Air Shut-Off Valve allowing Pump to cycle slowly as it fills the Material Delivery Hose to the Proportioner. Check for leaks.
3. OPEN Poly (R) Coupling Block Manual Valve over a waste container.
4. Slowly OPEN Proportioner Poly (R) Inlet Valve allowing Transfer Pump to move material through the system. When all spitting of air stops and all traces of mineral oil have disappeared, CLOSE Poly (R) Coupling Block Manual Valve. Clean Coupling Block.
5. Repeat steps 2 to 4 for Iso (A) side.

CAUTION! Properly dispose of all waste chemicals in accordance with all applicable local, state, and federal codes. DO NOT turn on the Auto Countdown Switch or the Pressure Balance Control Switch.

1. Turn Hydraulic Pressure Control (See Figure 5 on page 14) fully COUNTERCLOCKWISE.
2. Turn ON Main Power (See Figure 7 on page 16). Green pilot will light.
3. Turn ON Control Power (See Figure 7 on page 16). Switch will light.
4. Turn ON Motor Power (See Figure 7 on page 16). Switch will light.
5. Set Pump Switch (See Figure 7 on page 16) to NORMAL. Turn Hydraulic Pressure Control CLOCKWISE increasing material pressure to 400 psi (28 bar). Both Material Pressure Gauges (See Figure 4 on page 13) should approximately read the same. Check all Heated Hose Coupling connections for leakage.
6. Check all TSU and “Fast-Lock” connections for leaks.
7. Bundle all Heated Hose Connections ensuring that there are NO kinks in the TSU Cable or Air Hose. Wrap with Electrical Tape to securely hold all components in place and minimize places for bundle to snag onto job site protrusions.

8 PRESSURE BALANCE CONTROL

The PH Series Proportioner has been designed with a pressure balance control system. This system will give the operator of this machine the ability to control a pressure imbalance within certain predetermined parameters.

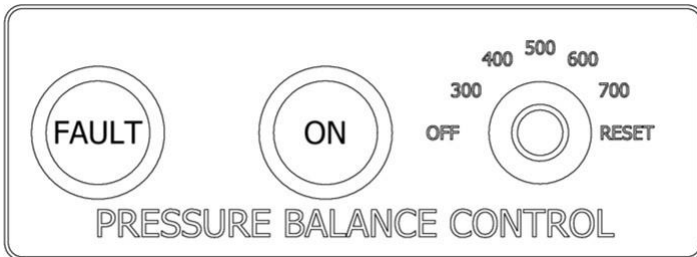


Figure 12: Pressure Balance Control Interface

The system consists of:

- Selector Switch
- Fault Light
- On Light
- Control Unit
- Pressure Transducers
- Relay

8.1 OPERATION

Position the selector switch on one of the three options:

- **Pressure Differential Number** - these consist of 300, 400, 500, 600, and 700 PSI. Selecting any of these numbers with the switch will activate the green ON light. While the pressure differential numbers are selected, the control box will continually monitor pressure on both sides of the Proportioner. In the event that the pressure differential between both sides of the Proportioner is equal to or larger than the selected number, a fault is given (the red fault light is turned on and the active green light is turned off) and shuts down.
- **Off** - if the selector switch is placed in this position, the Proportioner will operate as though there is NO PRESSURE BALANCE CONTROL SYSTEM (neither the red fault light nor the active green light will be lit). The over pressure system will remain active for the machine and personnel protection.
- **Reset** - in the event of a pressure imbalance, resolve the Proportioner imbalance, position the selector switch on reset to clear the fault light and restore power to the Proportioner. After the fault has been cleared, position the switch in either a Pressure Differential number or in the OFF Position to continue operations.

9 DIGITAL TEMPERATURE CONTROLLER

The PH Series has three Digital Temperature Controllers to manage the temperatures for the Primary Heaters (Iso (A), Poly (R)) and the Heated Hose. The Hose Heater Controller is programmed different from the Iso (A) and Poly (R) Controllers and therefore not interchangeable with them.

WARNING! Do not turn the Temperature Controllers ON until the Proportioner Purging procedure is complete and the Primary Heaters and Heated Hoses are filled with material.

EATON CONTROLLER

1. Ensure Main Power (See Figure 7 on page 16) is ON, Control Power (See Figure 7 on page 16) is ON and **01** Display light is lit.
2. Press and release X button. The display will read **SP1**.
3. Press and release up or down button to display the **current material temperature set-point**.
4. Press and hold the up or down button to **increase** or **decrease** the material temperature set-point to the desired value as determined by the material supplier or application conditions.
5. Press and release up and down together to return to the **actual material temperature** in the Primary Heater/Hose Heater.

NOTE! The Temperature Controller normally displays the actual material temperature. When lit, the “01” display in the upper left indicates power is sent to the designated heating system. The “01” display goes out when the material temperature has reached its set-point. The “01” display will continue to cycle on and off indicating the Controller is maintaining the material temperature set-point.

OMRON CONTROLLER

1. Press and hold the UP or DOWN keys to **increase** or **decrease**, respectively, the material temperature set-point to the desired value as determined by the material supplier or application conditions.
2. The smaller **green** numbers in the bottom right side of the controller display the set point. The larger **white** numbers in the center of the controller display the actual temperature of the material as read by the thermocouples in the Pre-Heater and TSU assembly. See the image below for the OMRON Heater Controller display.
3. Turn the Heater Temperature Switch (See Figure 7 on page 16) to the **right** to turn ON each heater.



Figure 13: OMRON Temperature Controller

NOTE! The Temperature Controller displays the actual material temperature and the set point. The **YELLOW** box with the word **OUT** indicates that the heaters are being powered.

WARNING! The Controllers are factory programmed and are not field re-programmable. If a problem is encountered, contact your PMC Distributor. Do not attempt to change any of the programmed parameters. Do not substitute a Controller from an alternate supplier as its use may result in equipment damage and/or bodily injury.

10 START-UP

NOTE! Follow the recommended procedure in the order shown.

CAUTION! The Start-up procedures assume that all steps in Proportioner purging have been performed and no problems were found.

1. Check the hydraulic fluid level and service as required.
2. Make sure the materials have been stored at the manufacturer's recommended temperature. Ask your material supplier for information (Safety Data Sheet) on the minimum storage temperature.
3. Y-Strainer screens should be checked routinely.
4. Connect air supply to the two Transfer Pumps and ensure Air Valves are in the fully OPEN position. OPEN both Proportioner Material Inlet Ball Valves.

CAUTION! Remove all Heated Hose sections from coiled storage and lay flat to eliminate heat build-up and possible Heated Hose failure.

5. Turn ON Main Power (See Figure 7 on page 16).
6. Turn ON Control Power (See Figure 7 on page 16).
7. Turn ON Hose Heater (See Figure 7 on page 16) and confirm material set-point temperature as recommended by the material supplier or application conditions.

CAUTION! To avoid excessive pressure in the Proportioner, wait for the Hose Heater to reach its set-point temperature before continuing.

8. Turn ON each Primary Heater and confirm material set-point temperature as required by the material supplier or application conditions has been reached.
9. Turn ON Motor Power (see Figure 7 on page 16).
10. Set Pump Switch (See Figure 7 on page 16) to NORMAL. One of the Directional Indicator Lights (See Figure 7 on page 16) will illuminate, indicating the Metering Pump direction, and the Metering Pump Shafts will begin to move.

NOTE! The Material Pressure Gauges should be approximately equal and remain constant throughout the Metering Pump cycle. If not, refer to Trouble Shooting section.

NOTE! Directional Indicator Lights must indicate Metering Pump direction when Pump Switch is in the NORMAL position. If not, refer to Trouble Shooting section.

- 11a. Using the Hydraulic Pressure Control, adjust to the required **stall pressure** and check each Material Pressure Gauge.
- 12a. Auto Shut Down Counter - **If this function is not needed, leave it in the off position.**
To set the Auto Shut Down Counter:
 - a. Turn the switch to the on position, the green light will illuminate.
 - b. Insert the number of cycles desired to disable the PH machine by pushing in on the white triangles to set the cycle count. Push in on the red button until the data is replicated on the top row, the top row will count down.

Model	Pump Size	Cycles per Gallon
PH-2 (2,000PSI)	123	27 Cycles

- c. When the counter counts down to zero the machine will stop and the pump directional light will be off, push in on the red button to reset.

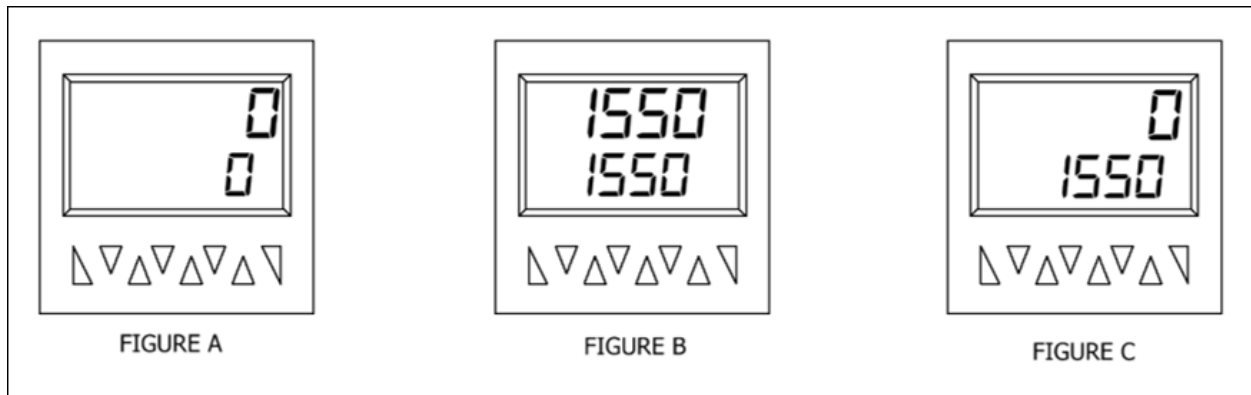


Figure 14: EATON Countdown Counter

- 13a. Proceed with Installation and Start-up of the Spray Gun as per the Gun manual.

Stall pressure: When materials are at recommended application temperature and Metering Pumps are pressurized but not moving. This pressure is normally 100–200 psi (7-14 Bar) greater than the developed spray pressure as recommended by the material supplier.

NOTE! Directional Indicator Lights must indicate Metering Pump direction when Pump Switch is in the NORMAL position. If not, refer to Trouble Shooting section.

12b. (See Figure 7 on page 16) - **If this function is not needed, leave it in the off position.**

To set the Auto Shut Down Counter:

- a. Input the number of cycles desired to disable the PF machine onto the Auto Shut Down Counter by pushing in on the gray buttons to set the Countdown Value. The bottom row of **green** numbers identifies the set point. The top row of numbers identifies the number of cycles left to count down and will initially be colored **red** before the Countdown Value is set. Each button corresponds to a specific digit. For example, in order to set the Auto-Shut Down Counter to a value of 136 as seen in the images below, press Button 1 (6) times, Button 2 (3) times and Button 3 (1) time. See table on page 29 for approximate cycles required per gallon or liter.
- b. Press the gray “RST” button on the bottom left of the display to set the countdown value. The top row of numbers will now become **green**. Turn the Pump Switch (See Figure 7 on page 16) to **Normal**. The top row of numbers will count down by 1 after each cycle of the Pump Line is completed.
- c. After the Pump Line has completed the set number of cycles, the Countdown Value will read “0” and change color to **red**, the Pump Line will stop in the Retract position, and the Pump Switch/Indicator Light will no longer illuminate.
- d. To make the machine operational again, reset the Countdown Value by pressing the “RST” button with the next desired Countdown Value or by shutting off the Auto Shut Down Counter.

13b. Proceed with Installation and Start-up of the Spray Gun as per the Gun manual.



Figure 15: OMRON Countdown Counter

11 SHUT DOWN

11.1 SHORT-TERM

Follow the procedure below for temporary shutdowns, such as **lunch breaks**:

1. Set Pump Switch (See Figure 7 on page 16) to the OFF position.
2. Turn both “A” and “R” Heaters OFF. Hose Heater should remain ON. Never leave Proportioner ON if unattended.
3. CLOSE Spray Gun Manual Valves.

CAUTION! Excessive force opening or closing the Manual Valves may result in damage to the Manual Valves and/or Coupling Block.

11.2 LONG-TERM

Follow the procedure below for shutdowns when work is **stopped for the day**:

1. Set Pump Switch (See Figure 7 on page 16) to the RETRACT position.
2. Spray off the application surface until Material Pressure Gauges (See Figure 4 on page 13) readings begin to fall.

CAUTION! To avoid possible Proportioning Pump Seal weepage, and moisture vapor drive into the Heated Hoses, the system pressure should not be reduced to zero. It is recommended to lower the system pressure to a minimum of 400 psi (28 bar).






3. CLOSE the Spray Gun Coupling Block Manual Valves.
4. Turn OFF Motor Power (See Figure 7 on page 16).
5. Turn OFF the A and R Heaters and Hose Heater (See Figure 7 on page 16).
6. Turn OFF the Control Power (See Figure 7 on page 16).
7. Turn OFF the Auto Shut Down Switch (See Figure 7 on page 16).
8. Turn OFF the Main Power (See Figure 7 on page 16).
9. Disconnect the air supply to the two Transfer Pumps and CLOSE the Proportioner Material Inlet Valves.

CAUTION! Excessive force opening or closing the Manual Valves may result in damage to the Manual Valves and/or Coupling Block.

12 TROUBLESHOOTING

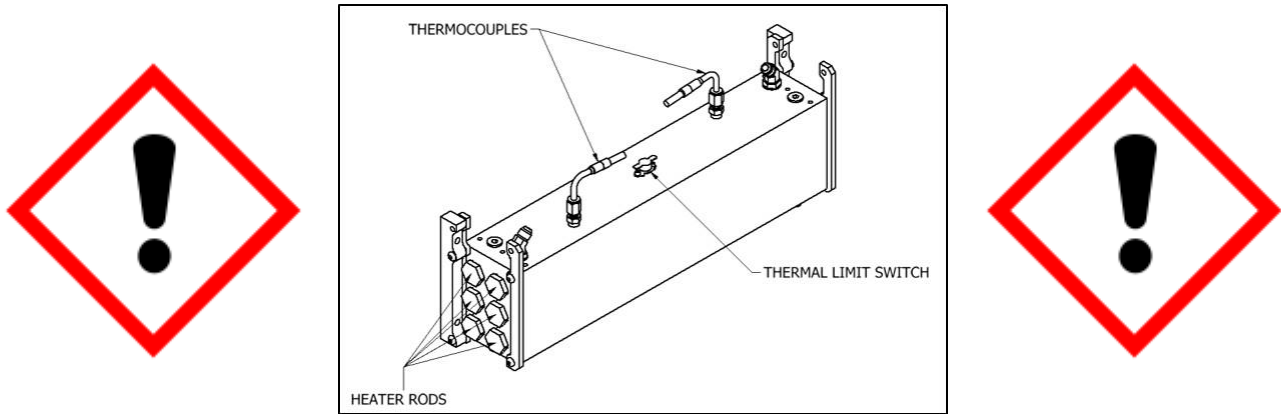
This PH Series Proportioner has been designed and built to withstand severe working conditions with a high degree of reliability, provided that it is used in a suitable application by a properly trained operator. This chapter contains information on possible faults that may interrupt the operation of the PH Series Proportioner. The information provided will serve as a guideline to detect and resolve problems. In any case, feel free to contact your authorized PMC distributor, where a qualified technician will advise you.

WARNING! Only qualified personnel should perform troubleshooting; unqualified personnel may cause damage to the unit and put the operator at risk.

	<p>To prevent possible injury caused by incorrect handling of the raw materials and solvents used in the process, carefully read the Safety Data Sheet (SDS) provided by your supplier. Deal with the waste caused according to current regulations.</p>
	<p>To avoid damage caused by the impact of pressurized fluids, do not open any connection, or perform maintenance work on components subject to pressure until the pressure has been completely eliminated.</p>
	<p>Use suitable protection when operating, maintaining or being present in the area where the equipment is functioning. This includes, but is not limited to, the use of protective goggles, gloves, shoes, and safety clothing and breathing equipment.</p>
	<p>The equipment includes components that reach high temperatures and can cause burns. Hot parts of the equipment must not be handled or touched until they have cooled completely.</p>
	<p>To prevent serious injury through crushing or amputation, do not work with the equipment without the safety guards installed on the moving parts. Make sure that all the safety guards are correctly reinstalled at the end of the repair or maintenance work of the equipment.</p>

12.1 HEATERS

WARNING! Only qualified personnel should perform troubleshooting; unqualified personnel may cause damage to the unit, personnel, or property and put the operator at risk. The Heaters are components that reach high temperatures; you must wait until they cool before handling.



NOTE! The Thermal Limit Switch is a safety switch in contact with the Heater Body. If the surface temperature exceeds 220°F (109°C) the Limit Switch will shut off the Heater power. The Limit Switch will not reset until the temperature in the Heater is below 190°F (88°C). The system is designed that in case of an over temperature, a contactor located in the console will open and disable power to both Heaters and the Hose.

Frequent Heater Problems

Primary heater does not heat and the display on the controller shows ambient temperature.	Page 35
Primary heater does not heat and the display on the controller shows an error message (SbEr, EEPE, CjEr, AdEr).	Page 36
Primary heater controller shows excessive temperature, and the circuit has turned off.	Page 36
Primary heater Temperature drops excessively while spraying.	Page 36

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all Switches are in the correct position and Indicator Lights ON before determining the existence of a fault.

-
- **Problem:** Primary heater does not heat and the display on the controller shows ambient temperature.

Solutions:

1. Check that the light on the on/off switch is lit when the heater is turned on, if not replace the switch.

If the light is on, move to the next step.

2. Check the heater breaker in the main console and reset the breaker. If it continues to trip, wrap an Amp Clamp around one of the wires coming off the breaker. If the Amperage reading does not exceed the rating of the breaker, the breaker needs to be replaced. If the breaker draws more than it is rating the most likely cause is that one or more of the fire rods located in the heater are shorted.

If the breaker is not tripped, move on to the next step.

3. Open the console top and locate the solid-state relays for the heaters, looking over the console top from the front of the machine. There are two relays to the left bottom of the console, the one to the far left is for the "A" heater and the one to the right is for the "R" heater. With the heater on, look to see if an LED light is lit on the relay.

If there is no LED light on the solid-state relay, move to the next step.

4. With a DC voltmeter read across position A1 and A2 on the solid-state relay (smaller wires) if you have a reading of 4-6 volts DC and the AC reading across L1 and L2 (Heavy wires) reads 208-230 volts AC replace the solid-state relay. With 4-6 volts DC at A1 and A2 the proper reading should be 1 volt AC across L1 and L2. A defective over temperature switch will open a contactor disabling both Heaters and the Hose.

If there is no DC voltage to the relay, move to the next step.

5. Check the M1 contactor to ensure it is activated. If not, inspect the contactor for failure.

If the M1 contactor is activated, move to the next step.

6. Using a DC voltmeter, on an Eaton Controller measure across position 5 and 9 on the back of the heater controller. On an Omron Controller measure across position 5 and 6 on the back of the heater controller. This is the output of the controller and sends power to the solid-state relay. On an Eaton Controller, your reading will be 4-6 volts DC. On an Omron Controller, your reading will be 12 volts DC. If there is no reading check to make sure that the set temperature of the controller is above the actual temperature reading on the controller. Before replacing the controller read across position 1 and 2 to make sure that the controller is powered up, your reading will be 208 to 230 volts AC. If there is no voltage detected, check for loose wires or a malfunction of the heater circuit breaker.

- **Problem:** Primary heater does not heat and the display on the controller shows an error message (SbEr, EEPE, CjEr, AdEr).

Solutions:

1. Check position 6 and 7 on the heater controller for loose wires.
If the wires are tight, move to the next step.
2. Remove the heater cover and check that the thermocouple wires are secure to the harness going up to the controller.
If there are no loose connections replace the heater thermocouple.

- **Problem:** Primary heater controller shows excessive temperature, and the circuit has turned off.

CAUTION! The heater must be allowed to cool down before continuing.

Solutions:

1. Set the controller set point at least 20 degrees lower than the temperature shown on the controller. Briefly turn on the heater and look for the LED light on the solid-state relay to be on.
If the light is on, replace the controller.
If the light is off, replace the solid-state relay.

- **Problem:** Primary heater Temperature drops excessively while spraying.

Solutions:

1. Temperature of the chemical in the containers is too cold.
2. Exceeding the flow rate specification of the machine. Use a smaller mixing chamber to reduce flow.
3. Disconnect power to the machine. One or more of the fire rods in the heater have malfunctioned. Remove the heater cover and disconnect the wires to measure the resistance across each rod. Installing a smaller mixing chamber in the gun may allow you to spray until a new rod(s) is installed.

CAUTION! If the rod that is used in conjunction with the thermocouple is defective, do not operate the heater until the rod is replaced.

Individual Ohm Measurement

1250 WATT	37 OHMS
1500WATT	31 OHMS
1750 WATT	27 OHMS

12.2 HYDRAULIC DRIVE SYSTEM

Frequent Hydraulic Drive System Problems

Hydraulic Pump does not develop pressure and the electric motor is not running.	Page 37
Hydraulic Pump does not develop pressure.	Page 38
Low or zero hydraulic pressure with unusual Hydraulic Pump noises.	Page 38

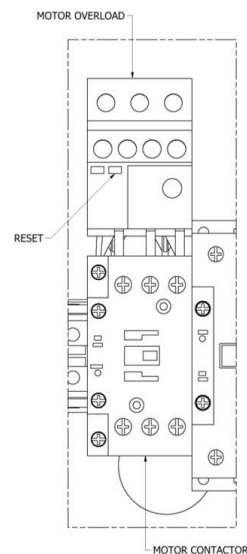
Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all Switches are in the correct position and Indicator Lights ON before determining the existence of a fault.

WARNING! Only qualified personnel should perform troubleshooting; unqualified personnel may cause damage to the unit, personnel, or property and put the operator at risk. The Heaters are components that reach high temperatures; you must wait until they cool before handling.

CAUTION! Excessive force opening or closing the Manual Valves may result in damage to the Manual Valves and/or Coupling Block.

- **Problem:** Hydraulic Pump does not develop pressure and the electric motor is not running.
Solutions:

Motor Contactor Safety or Motor Breaker - The Electric Motor is protected from excessive current by an Overload Safety Switch. After allowing the Motor to cool, open the Control Panel and reset Motor Contactor Safety.



- **Problem:** Hydraulic Pump does not develop pressure.

Solutions:

NOTE! Hydraulic pressure is not generated if the Motor Power Switch (See Figure 7 on page 16) is OFF or the Pump Switch (See Figure 7 on page 16) is in the OFF position.

Hydraulic Power Package - With the Pump Switch in the NORMAL position, the failure of the Hydraulic Pump to develop pressure is loss of pump suction (prime). To ensure positive prime, check the following:

- a. Motor Rotation.
- b. Hydraulic Reservoir is filled to the correct level.
- c. Hydraulic Pump Case is filled with the proper hydraulic fluid.
- d. Loose Inlet Plumbing: Check that all inlet plumbing to Hydraulic Pump is tight ensuring no air leakage into the hydraulic system.

-
- **Problem:** Low or zero hydraulic pressure with unusual Hydraulic Pump noises.

Solutions:

1. The use of an incorrect hydraulic fluid can result in unusual noises from the pump, excessive wear, and moisture absorption. Ensure the hydraulic oil used is from the list on page 53. In addition, continuous excessive hydraulic oil temperature as well as failure to change the hydraulic oil on a yearly basis will cause the oil to fail and result in excessive Hydraulic Pump wear and unusual noises.
2. Loose Inlet Plumbing: Check that all inlet plumbing to Hydraulic Pump is tight, ensuring no air leakage into the hydraulic system.

12.3 METERING PUMP-LINE

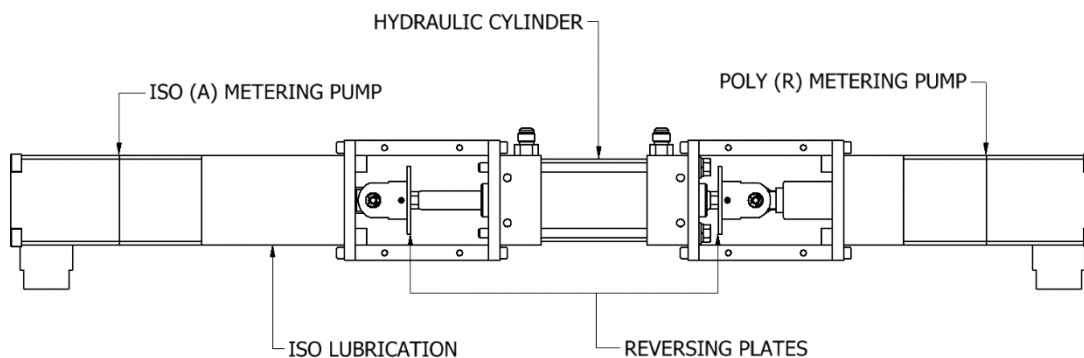


Figure 16: Metering Pump-Line

Frequent Pump-Line Problems

Metering pumps do not change direction and the pressures on both of chemical gauges are lower than normal.	Page 38
Cavitation.	Page 41
Pressure Loss: Discharge/Inlet Ball.	Page 41

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all Switches are in the correct position and Indicator Lights ON before determining the existence of a fault.

- **Problem:** Metering pumps do not change direction and the pressures on both of chemical gauges are lower than normal.

Solutions:

1. The Metering Pump Line has Reversing Plates which actuates two Proximity Switches (EL-153), one at each end of the stroke. The Prox. Switches in turn actuate the appropriate Directional Valve Solenoid (HI-05003). Failure to make contact with either Prox. Switch may be caused by:
 - a. Deformation of the Reversing Plate.
 - b. Foreign material preventing the Reversing Plate from contacting the Prox. Switches.
2. Passing of the Reversing Plate beyond the Prox. Switch may be caused by:
 - a. Failure of the Prox. Switch and related components on the side of the over-run.
 - b. Failure of a component of the Directional Valve.
 - c. Mounting Plate (PU-07006) and/or Prox. Switch is out of adjustment.

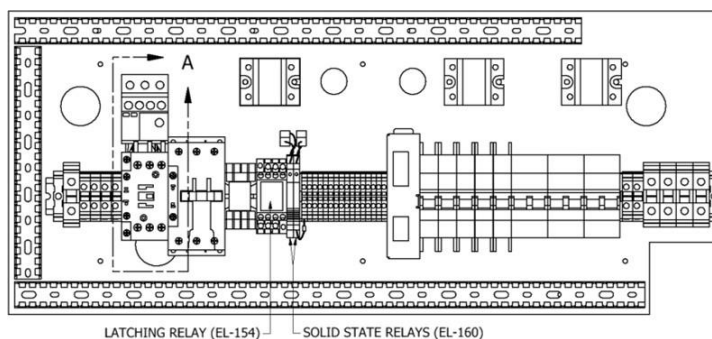
NOTE! IF THE DIRECTIONAL INDICATOR LIGHT (Q, Page 16) IS ON CHECK THE REVERSING VALVE COIL ON THE SIDE THAT THE LIGHT IS ON. IF YOU HAVE 24 VOLTS DC AT THE PLUG, CHECK THE OHM'S RESISTANCE OF THE COIL, IT SHOULD READ APPROXIMATELY 19 OHMS, IF NOT REPLACE THE COIL OR REVERSING VALVE. IF THE DIRECTIONAL LIGHT IS OFF PROCEED BELOW.

NOTE! BEFORE TROUBLESHOOTING, THE REVERSING PLATE MUST BE MOVED AWAY FROM THE SWITCH.











- d. Bleed down the chemical pressures.
- e. Ensure Pump Switch (P, section 5) is **OFF**.
- f. Turn on the motor (X, section 5).
- g. Go to the Directional Valve and locate the Actuation Coils. Located in the middle of each coil is a small round tab that can be pushed in to manually shift the spool to move the pumps. If the Reversing plate is all the way to the left push in on the right-side coil. If it is all the way to the right side, push in on the left side coil.

WARNING! THE MOTOR MUST BE OFF AND THE PUMP SWITCH IN THE NORMAL POSITION.

- h. Take a small screwdriver or a thin piece of metal and move it across the front of each Prox. switch. A red light on the back of the switch should illuminate. If not, replace the switch that does not light.
- i. If the Prox. switches light up, turn off all power and check for continuity on both over pressure switches, pin 1 and 2. If the pressure switches are good, go to the two solid state relays inside the console and interchange them, they can be pulled from their housing. Power up the unit with the pump switch in the normal position and the motor **OFF**. If the directional light comes on replace the defective solid-state relay. If not replace the Latching relay.



3. Safety Pressure Switch - Each Metering Pump has a Safety Pressure Switch set to 2,200 psi. for # 123 pumps, 3,200 psi for #61 pumps. When the material system reaches this pressure, the Safety Pressure Switch will remove power from the Directional Valve and Direction Indicator Lights (Q, section 5). Lack of Direction Indicator Lights along with high pressure indicated on one or both of the material Pressure Gauges (E, F, section 5) is an indication of an over-pressure condition. The Safety Pressure Switches are a momentary design; when the pressure bleeds off the Metering Pump Line will resume normal operation. However, the cause of the over-pressure should be determined and corrected. The most common causes are:
 - a. Cavitations of the Metering Pump on the **low**-pressure side causing high pressure on the opposite side.
 - b. A restriction in the Spray Gun on the **high**-pressure side.
4. Pressure/Material Imbalance - Troubleshooting this problem requires the applicator to:
 - c. Know what the NORMAL spray pressures are for the application in progress.
 - d. Determine what material is NOT exiting the Mixing Chamber.
 - e. Read the Pressure Gauge on the problem side and interpret the reading.

Material Condition	"A" GAUGE	"R" GAUGE
NORMAL		
LACK OF ISO (A)		
LACK OF POLY (R)		
RESTRICTION OF ISO (A)		
RESTRICTION OF POLY (R)		

- **Problem:** Cavitation.

Solutions:

1. Cavitations occur when the Metering Pump (B or C, section 5) requires a larger volume of material than the supply system (Transfer Pump) can furnish. This creates a “void” of material in the Metering Pump. The most common causes of cavitations are:
 - a. Material temperature too low causing increased material viscosity resulting in the inability of the Transfer Pump to maintain sufficient supply to the Metering Pump. This is most common with today’s blowing agents. Ensure the material temperature in the drums is no lower than the material suppliers’ recommendation.
 - b. Failure to vent the material drum while drawing material out with the Transfer Pump causes a vacuum and cavitations in the Transfer Pump. Ensure the drum is vented to the atmosphere or a Desiccated Air Dyer Kit is installed as recommended by the material supplier.
 - c. Insufficient air volume for Transfer Pump or a partially closed Transfer Pump Air Valve will limit the ability of the Transfer Pump to operate at its maximum capability.
 - d. Inlet Material Screen (M, section 5) obstructed (See MAINTENANCE section, page 47).
 - e. Metering Pump Inlet Ball does not seat properly allowing material to flow back into the Material Delivery Hose when the Metering Pump is on the “Discharge” stroke. This causes the volume of material on that Metering Pump to be less on the discharge stroke resulting in intermittent off-ratio material and Pressure Gauge fluctuation.

- **Problem:** Pressure Loss: Discharge/Inlet Ball.

Solutions:

1. Simultaneous observation of the material Pressure Gauge (E, F, section 5) and Direction Indicator Light (Q, section 5) is necessary to determine which direction the Metering Pump fails to maintain pressure. Refer to the chart to determine problem:

	Left Arrow Directional Indicator Light ON	Right Arrow Directional Indicator Light ON
Iso Pressure Gauge FALLS	Iso Inlet Ball does not seat properly	Iso Discharge Ball does not seat properly
Poly Pressure Gauge FALLS	Poly Discharge Ball does not seat properly	Poly Inlet Ball does not seat properly

In most cases the cause of a leaking Inlet/Discharge Ball is foreign material preventing the Ball from seating properly. If the above steps do not resolve the problem, replace the appropriate Ball. For service see MAINTENANCE: METERING PUMP-LINE (page 51).

12.4 HOSE HEATING

WARNING! Before correcting any kind of defect, make sure the Main Power Switch is OFF and incoming power is locked OFF. NEVER access the inside of the Control Panel with the Proportioner power supply ON. The Heated Hose are components which reach high temperatures; you must wait until they have cooled before handling.

CAUTION! Excessive force opening or closing the Manual Valves may result in damage to the Manual Valves and/or Coupling Block.

Hose Heating Problems

Heated Hose does not heat and the display on the controller shows ambient temperature.	Page 43
Hose does not heat and the display on the controller shows an error message (SbEr).	Page 44
Heated hose controller shows excessive temperature.	Page 45
Hose will heat but does not come up to set temperature.	Page 45
Hose does not heat and the display on the controller shows an error message.	Page 45

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all Switches are in the correct position and Indicator Lights ON before determining the existence of a fault.

- **Problem:** Heated Hose does not heat and the display on the controller shows ambient temperature.

Solutions:

1. Check that the light on the on/off switch is lit when the heater is turned on, if not replace the switch.
If the light is on, move on to the next step.
2. Check the Hose Heat breaker in the main console and reset the breaker. If it continues to trip, wrap an Amp Clamp around one of the wires coming off the breaker. If it does not draw more than the rated value of the breaker, the breaker needs to be replaced.
If the breaker is not tripped, move on to the next step.
3. Check the circuit breaker mounted on the transformer and reset the breaker. If it continues to trip, wrap an Amp Clamp around one of the wires from the transformer going to the heated hose. If it does not draw more than the rated value of the breaker, the breaker needs to be replaced.
If the Amp Draw is less than the rated value, move on to the next step.
4. Check that the tap setting on the transformer is set for the proper hose length.
If it is set correctly, move to the next step.

5. To check the secondary side of the transformer, you must take an AC volt reading across the two leads coming out of the transformer that are connected to the "A" and "R" hose leads. If you are reading voltage (your volt reading will vary depending on what tap setting is used), most likely the problem is in the heated hose. Either a connector has come loose or there is a broken wire.
6. Because the gun whip takes the most abuse, it is most likely the whip that has failed. Disconnect the crossover wires on the machine end of the whip hose and connect the two wires together coming off the 50' section. Turn on the hose heat and see if the hose heat circuit is operating; if so, replace the whip. To take a continuity reading through the heated hose, one of the leads from the transformer to the "A" or "R" heated hose must be disconnected.

If no voltage is coming out of the transformer to the heated hose, move on to the next step.

7. Open the right side of the tank (where the transformer is located) and locate the solid-state relay for the hose circuit (EL-35). With the hose turned on and the LED light illuminated on the relay, take a voltmeter (set on DC) and measure across position A1 and A2; your reading should be 24 volts. Then take an AC volts measurement across position L1 and L2 (heavy wires). With the relay functioning properly you should have a 1-volt Reading. If the Reading is 18 to 90 volts AC, the relay has malfunctioned and needs to be replaced. If the AC Reading across L1 and L2 is .025 volts check the over temperature switches in the heaters. A defective over temperature switch will open a contactor disabling both Heaters and the Hose.

If there is no light on the solid-state relay, move to the next step.

8. Using a DC voltmeter, measure across position 5 and 6 on the back of the hose controller. This is the output of the controller and sends power to the solid-state relay. Your reading will be **4-6 volts DC**. If there is no voltage, check to make sure that the set temperature of the controller is above ambient temperature. Before replacing the controller, read across position 1 and 2 to make sure that the controller is powered up; your reading will be 208 to 230 volts AC.

If there is no DC voltage to the relay, move to the next step.

-
- **Problem:** Hose does not heat and the display on the controller shows an error message (SbEr).

Solutions:

1. Check position 6 and 7 on the heater controller for loose wires.
If the wires are tight, move to the next step.
2. Remove the transformer cover and check that the thermocouple wires are secure to the harness going up to the controller. If there are no loose connections, disconnect the wire from the TSU and connect it directly to the thermocouple harness coming out of the hose transformer.

If the controller still shows the error code, replace the hose thermocouple. If the error code goes away and temperature is now shown on the display of the controller, then all the TSU harnesses from the TSU to the transformer need to be checked for loose connectors or one or more of the harnesses defective.

- **Problem:** Heated hose controller shows excessive temperature.

Solutions:

1. Set the controller set point at least 20 degrees lower than the temperature shown on the controller. Briefly turn on the hose and look for the LED light on the solid-state relay to be on.

If the light is on, replace the controller.

If the light is off, replace the solid-state relay.

- **Problem:** Hose will heat but does not come up to set temperature.

Solutions:

1. Check the tap setting on the transformer to ensure that the correct position has been selected for the length of hose being used. Depending on the machines incoming voltage, you may have to move the tap setting higher (up one).

CAUTION! Do not exceed the trip value of the transformer hose breaker.

WARNING! Before correcting any kind of defect, make sure the Main Power Switch is OFF and incoming power is locked OFF. NEVER access the inside of the Control Panel with the Proportioner power supply ON.

- **Problem:** Hose does not heat and the display on the controller shows an error message.

Solutions:

1. Check position 9 and 10 on the heater controller for loose wires.

If the wires are tight, move to the next step.

2. Remove the transformer cover and check that the thermocouple wires are secure to the harness going up to the controller. If there are no loose connections disconnect the wire from the TSU and connect it directly to the thermocouple harness coming out of the hose transformer.

If the controller still shows the error code, replace the hose thermocouple. If the error code goes away and temperature is now shown on the display of the controller, then all the TSU harnesses from the TSU to the transformer need to be checked for loose connectors or one or more of the harnesses are defective.

12.5 PRESSURE BALANCE CONTROL

If the Pressure Balance Control box is not working properly, follow these steps to resolve the potential issue:

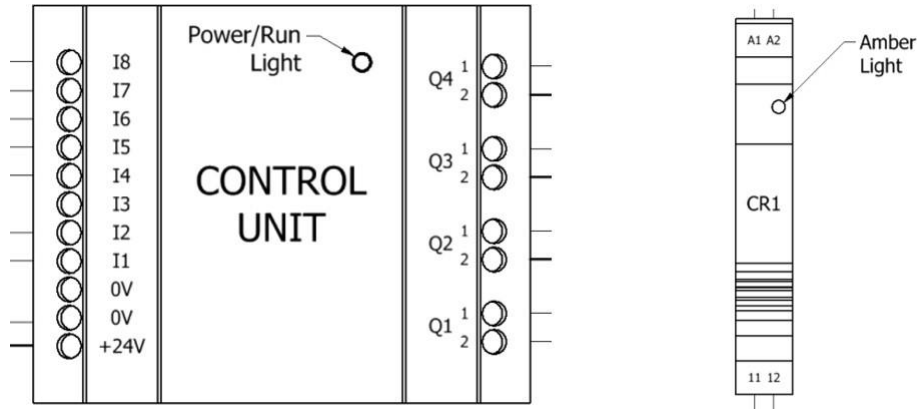







Figure 17: Pressure Balance Control Unit

1. With the Main Power **ON**, check the Power/Run light on the Control Unit:
 - a. If **OFF**, the Control Unit is not getting power. Check for loose or poor wire connections. If the Power/Run light still does not turn on, contact your authorized PMC distributor.
 - b. If **SOLID**, the Control Unit has power but no program. Contact your authorized PMC distributor.
 - c. If **BLINKING**, the Control Unit has power and is programmed properly. Proceed to the next step.
2. With Main Power **ON**, turn the Rotary Switch to a Pressure Differential Number and check the Amber light on CR1:
 - a. If **OFF**, CR1 is not activating properly. Check for loose or poor wire connections between the Control Unit and CR1.
 - b. If **ON**, CR1 is activating, but the mechanical switch inside the relay may not be functioning properly. If the system has faulted (i.e., a pressure imbalance exists, the ON light turns off, and the FAULT light turns on), but the pumps do not shut off, check for continuity between contacts 11 and 12 on CR1. If there is continuity, contact your authorized PMC distributor. If there is discontinuity, proceed to the next step.
3. Contact your authorized PMC distributor for further assistance.

13 MAINTENANCE

To achieve maximum output from the PH Series Proportioner, a daily or regular maintenance schedule is required.

	<p><i>To prevent possible injury caused by incorrect handling of the raw materials and solvents used in the process, carefully read the Safety Data Sheet (SDS) provided by your supplier. Deal with the waste caused according to current regulations.</i></p>
	<p><i>To avoid damage caused by the impact of pressurized fluids, do not open any connection, or perform maintenance work on components subject to pressure until the pressure has been completely eliminated.</i></p>
	<p><i>Use suitable protection when operating, maintaining or being present in the area where the equipment is functioning. This includes, but is not limited to, the use of protective goggles, gloves, shoes, and safety clothing and breathing equipment.</i></p>
	<p><i>The equipment includes components that reach high temperatures and can cause burns. Hot parts of the equipment must not be handled or touched until they have cooled completely.</i></p>
	<p><i>To prevent serious injury through crushing or amputation, do not work with the equipment without the safety guards installed on the moving parts. Make sure that all the safety guards are correctly reinstalled at the end of the repair or maintenance work of the equipment.</i></p>

CAUTION! All repairs performed by unqualified personnel or the use of parts other than supplied by PMC may cause damage to the unit and put the operator at risk.

13.1 INLET MATERIAL SCREENS

Inspection of the Inlet Material Screens on a daily basis is no longer necessary as long as the following conditions are met.

1. Material drums are stored within the recommended material storage temperature range and drums are not opened prior to installing the Proportioner Material Transfer Pumps.
2. Desiccant air dryers are used to dry replacement air as material is removed from the drum to the Proportioner.
3. Consolidation of old material into a common drum for use is minimized, especially the Iso (A).

If the above conditions are met, inspection of the Inlet Material Screens may be done on a **bi-weekly** basis.

NOTE! Inspect and clean Inlet Material Screens before Proportioner start-up. They should not be cleaned after the days' operation as the Proportioner should be purged (see page 24) immediately after inspection and cleaning. This is to reduce the risk of moisture contamination, contamination through the reaction with the solvent used in the cleaning operation, and cross-over at the Spray Gun due to air entrapment.

CAUTION! Make sure the Main Power Switch is OFF and incoming power is locked OFF.

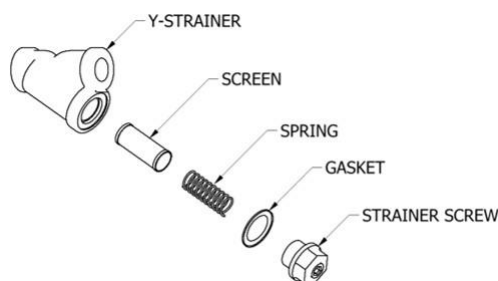


Figure 18: Inlet Strainer Components

1. CLOSE the Poly (R) Proportioner Inlet Valve.
2. Place a suitable container under the Material Inlet Strainer to collect the residual material. Carefully loosen the Strainer Plug to drain material into the container.
3. Completely unscrew the Strainer Plug.
4. Remove the Seal, Spring and Screen and clean them with a suitable solvent. Dry the parts and ensure the Screen is not obstructed. Replace the Screen if more than 20% of the Screen surface is obstructed by residue.
5. Reinstall the Screen, Spring and Seal. Screw on the Strainer Screw and screw in Plug.

6. OPEN the Poly (R) Proportioner Inlet Valve, pressurize the Material Transfer Pump, check for leaks, and wipe Y-strainer clean.
7. Repeat above for the Iso (A) side.
8. Proceed with Proportioner Purging operation (See page 24).

13.2 ISO LUBRICATION SYSTEM

DAILY: Check the condition of the PMC Lube Oil in the Iso Lube Reservoir. Replace the PMC Lube Oil if you see significant changes in the color or signs of solidification. Ensure inside of Reservoir is wiped clean.

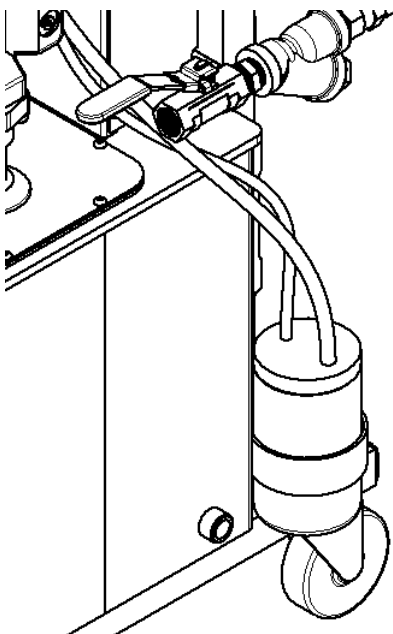


Figure 19: ISO Lubrication System

To replace the Lube Oil, proceed as follows:

1. Remove the Lube Reservoir from its support, unscrew the Lid and remove the Check Valve from the Suction Hose.
2. Empty the contaminated Lube Oil in a waste container and refit the Check Valve in the Suction Hose.

NOTE! Valve is directional.

3. Clean the Reservoir, refill with Lube Oil, and screw on the Lid and place the Reservoir in its support.

The system is auto-suction and does not need priming.

13.3 HYDRAULIC DRIVE SYSTEM

WARNING! Before performing any maintenance, make sure the Main Power Switch is OFF and incoming power is locked OFF. The Hydraulic Unit is a component that works under pressure. Do not open any connection or carry out maintenance on components subject to pressure until all pressure has been bled to zero.

The hydraulic unit should be serviced yearly:

1. Completely drain the Tank of hydraulic fluid.
2. Clean the Tank Top to prevent foreign material from falling into the Tank when the Cover is removed.
3. Unscrew the Suction Pipe from its connection with the Hydraulic Pump.
4. Remove the Cover and Suction Pipe from the Hydraulic Tank. Take care not to damage Tank Cover Gasket.
5. Inspect the bottom of the Tank for sediment and clean as required. Clean the Suction Pipe and its connections.
6. Fill the Tank with 10 gal (37 L) of approved hydraulic fluid (See page 54 for recommendations).
7. Insert the Suction Pipe into the Tank Cover and install the Cover. Again, take care not to damage Tank Cover Gasket. Connect the Suction Pipe securely to the Hydraulic Pump.
8. Ensure the Hydraulic Pump Case is full of fluid and proceed with the normal operation.

13.4 METERING PUMP-LINE

WARNING! Before performing any maintenance, make sure the Main Power Switch is OFF and incoming power is locked OFF. Allow material temperature to cool below 80°F and bleed all material pressure to zero.

Weekly: When the Proportioning Pumps are functioning properly it is not unusual for a small amount of Poly (R) material to appear on the Pump Shaft. This material should be wiped away, so dirt does not accumulate on the Pump Shaft and the Pump Shaft Packings are not damaged.

Yearly or as required: It is not unusual for those who use the PH Series Proportioner on a regular basis to rebuild the Proportioning Pumps on a yearly basis and service the Hydraulic Drive System (See page 50) at the same time, while the Proportioner is out of service.

13.5 PUMP SEAL REPLACEMENT

The pump rebuild kit part number for low pressure pumps is KT-PA and for high pressure pumps is KT-PAX.

NOTE!

- When Iso (A) Proportioning Pump Cylinder is disassembled for service, all parts included in the Seal Kit (KT-PA) should be replaced.
- When the Poly (R) Proportioning Pump Cylinder is disassembled for service, all parts included in the Seal Kit (KT-PA) should be replaced.
- When assembling Proportioning Pump, lubricate all Seals, Piston Rod, and Pump Cylinder with # 1 Lithium Grease to assist in assembly and minimize Seal damage during re-assembly.

CAUTION! Use wooden or plastic tools or a brass brush for cleaning. Do not use metal or abrasive tools that can scratch the contact surfaces.

13.6 MATERIAL HEATER

WARNING! Before performing any maintenance, make sure the Main Power Switch is OFF and incoming power is locked OFF. NEVER access the inside of the Control Panel with the Proportioner power supply ON. The Heaters are components that reach high temperatures; you must wait until they have cooled before handling and bleed all material pressure to zero.

13.7 THERMOCOUPLE REPLACEMENT

NOTE! The Thermocouple is assembled into the Connector Body with a Ferrule and Nut. Once inserted into the Body and the Nut is tightened, the Ferrule locks to the Thermocouple and does not allow it to be relocated or moved. The location of the Thermocouple is very important and must be done correctly before tightening the Nut.

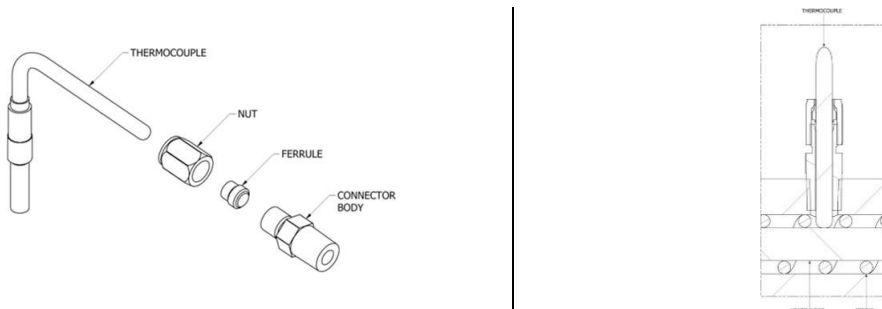


Figure 20: Thermocouple Identification

1. Unscrew the Nut that holds the defective Thermocouple and remove from the Body. Disconnect Thermocouple wiring located under the Top Cover of the Heater. Remove Body and discard.
2. Install Heating Element and Spring if also removed.
3. Install Connector Body into Heater using an open-end wrench and tighten to prevent leakage. Teflon Tape or appropriate Thread Sealant should be used.
4. Slide the Nut and the Ferrule over the Thermocouple and insert this assembly into the Connector Body until it comes into **positive physical contact** with the Heating Rod. Make sure the Spring does not prevent the Thermocouple from making contact with the Heating Rod.
5. Slowly tighten the Nut using an open-end wrench, ensuring the Thermocouple maintains positive physical contact with the Heating Rod.
6. Reinstall the Thermocouple wires.

WARNING! Before performing any maintenance, make sure the Main Power Switch is OFF and incoming power is locked OFF. NEVER access the inside of the Control Panel with the Proportioner power supply ON. The Heaters are components that reach high temperatures; you must wait until they have cooled before handling and bleed all material pressure to zero.

To replace a defect Heating Rod, proceed as follows:

1. Ensure Main Power Switch is OFF and incoming power is locked OFF. Depressurize proportioner and remove the Cover on Heater.

WARNING! If the Heating Rod to be replaced is the one in contact with the Thermocouple, it is necessary to remove the Thermocouple first. Do not loosen or tighten Thermocouple Body.

2. Disconnect the suspect Heating Rod from the wire connections and test the Heating Rod again for proper electrical resistance.

Heating Rod	Ohm Measurement per Rod	Total Ohm Measurement per Fluid Side
1250 WATT	39.0 Ω	13.0 Ω
1500 WATT	32.4 Ω	10.8 Ω
1750 WATT	27.5 Ω	9.2 Ω

3. Unscrew the Heating Rod and remove from the Heater Block along with its Spring and inspect; it must be smooth and shiny in appearance. If it is blackened or has material adhered to it replace the Heating Rod, even if ohm reading is acceptable.
4. Apply Teflon Tape or appropriate Thread Sealant to the Heating Rod thread and assemble Heating Rod and Spring into the Heater Block. Tighten securely to 110 ft/lbs (150 Nm)
5. If necessary, carefully re-install Thermocouple ensuring positive physical contact with the Heating Rod. Make sure the Spring does not prevent the Thermocouple from making contact with the Heating Rod. Tighten Nut with open-end wrench.
6. Reconnect wire connections and replace Cover.
7. Ensure Heater is full of material prior to electrical testing.

14 HYDRAULIC OIL SPECIFICATIONS

Recommended Hydraulic Oil Specification:

ISO/ASTM Viscosity Grade 32

Viscosity:

28.8 – 35.2 SSU at 104°F Rust and Oxidation Inhibited

14.1 MANUFACTURERS

- Mobil DTE24 (Recommended)
- Cook's Albavis 8
- Ashland - Valvoline AW15
- Shell - Tellus 32(25)
- Sun Oil - Sunvis 706
- Chevron ISO32
- American Oil & Supply - PQ Iso 32
- Gulf Oil - Harmony 32AW (43AW)
- Atlantic Richfield - Duro AWS-150
- BP Oil - Energol HLP-C32
- Exxon - Nuto H-32(44)
- Margolis - T.I.P.100-15-7
- Fiske Bros. - Lubriplate Hyd. #0
- SW - Alemite Hydraulic HD #0
- Texaco - Rando HD32 (HD A0)
- White & Bagley - EP Hyd. 150

15 PARTS IDENTIFICATION

15.1 FRAME ASSEMBLY

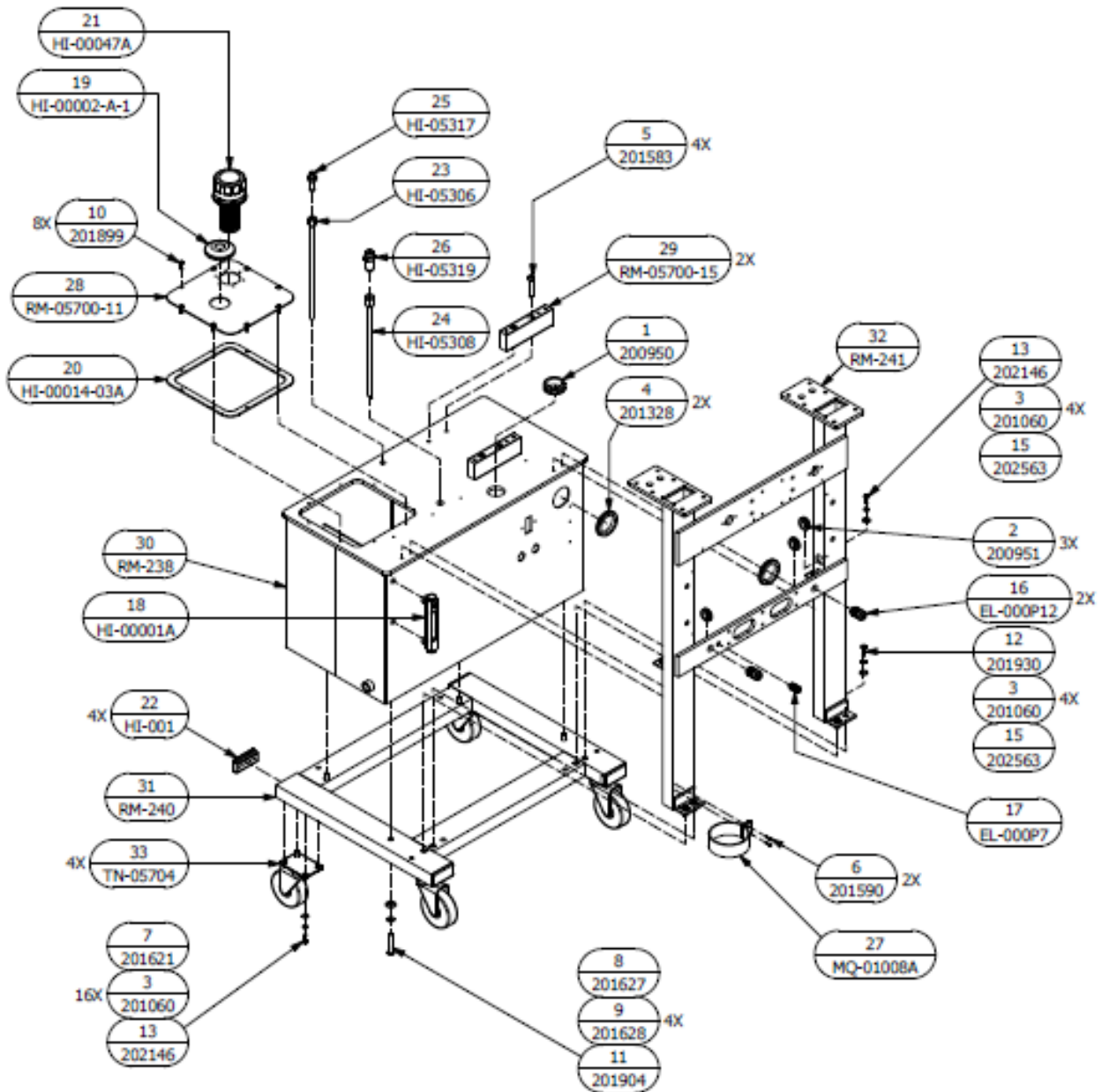


Figure 21: Frame Assembly (FR-10)

FRAME ASSEMBLY (FR-10)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	200950	GROMMET, 1.750" GD, 0.375" GW, 1.500" ID
2	2	200951	GROMMET, 1.000" GD, 0.125" GW, 0.813" ID
3	24	201060	WASHER, LOCK, 1/4, 18-8 SS
4	2	201328	GROMMET, 2.250" GD, 0.125" GW, 2.000" ID
5	4	201583	SHCS, 3/8-16 X 2.0, 18-8 SS
6	2	201590	BHCS, #8-32 X 0.5, 18-8 SS
7	16	201621	WASHER, FLAT, 1/4, 18-8 SS
8	4	201627	WASHER, FLAT, 3/8, 18-8 SS
9	4	201628	WASHER, LOCK, 0.375, 18-8 SS
10	8	201899	BHCS, 1/4-20 X 0.75, 18-8 SS
11	4	201904	BHCS, 3/8-16 X 2.25, 18-8 SS
12	4	201930	HHCS, 1/4-20 X 1.0, ZP GRD8
13	20	202146	HHCS, 1/4-20 X 0.750, ZP GRD8
14	1	202552	PLUG, LOCKING, ϕ 1.125, NYLON
15	8	202563	WASHER, FLAT, 1/4, 18-8 SS USS
16	2	EL-000P12	HAYCO #6 AWG SR
17	1	EL-000P7	HAYCO SR THERMOCOUPLE
18	1	HI-00001A	SIGHT GAUGE
19	1	HI-00002-A-1	GROMMET MODIFIED 1"
20	1	HI-00014-03A	TANK TOP GASKET
21	1	HI-00047A	HYDRAULIC FILL STRAINER
22	4	HI-001	PLASTIC TUBE CAPS
23	1	HI-05306	TANK PUMP DRAIN TUBE
24	1	HI-05308	TANK DISCHARGE TUBE
25	1	HI-05317	3/8 JIC BULKHEAD UNION
26	1	HI-05319	1/2 JIC BULKHEAD UNION
27	1	MQ-01008A	LUBE BOTTLE BRACKET
28	1	RM-05700-11	TANK LID
29	2	RM-05700-15	MOTOR MOUNT BARS
30	1	RM-238	TANK
31	1	RM-240	FRAME BASE ASSY
32	1	RM-241	FRAME UPRIGHT
33	4	TN-05704	4" CASTER

15.2 PROX SENSOR ASSEMBLY

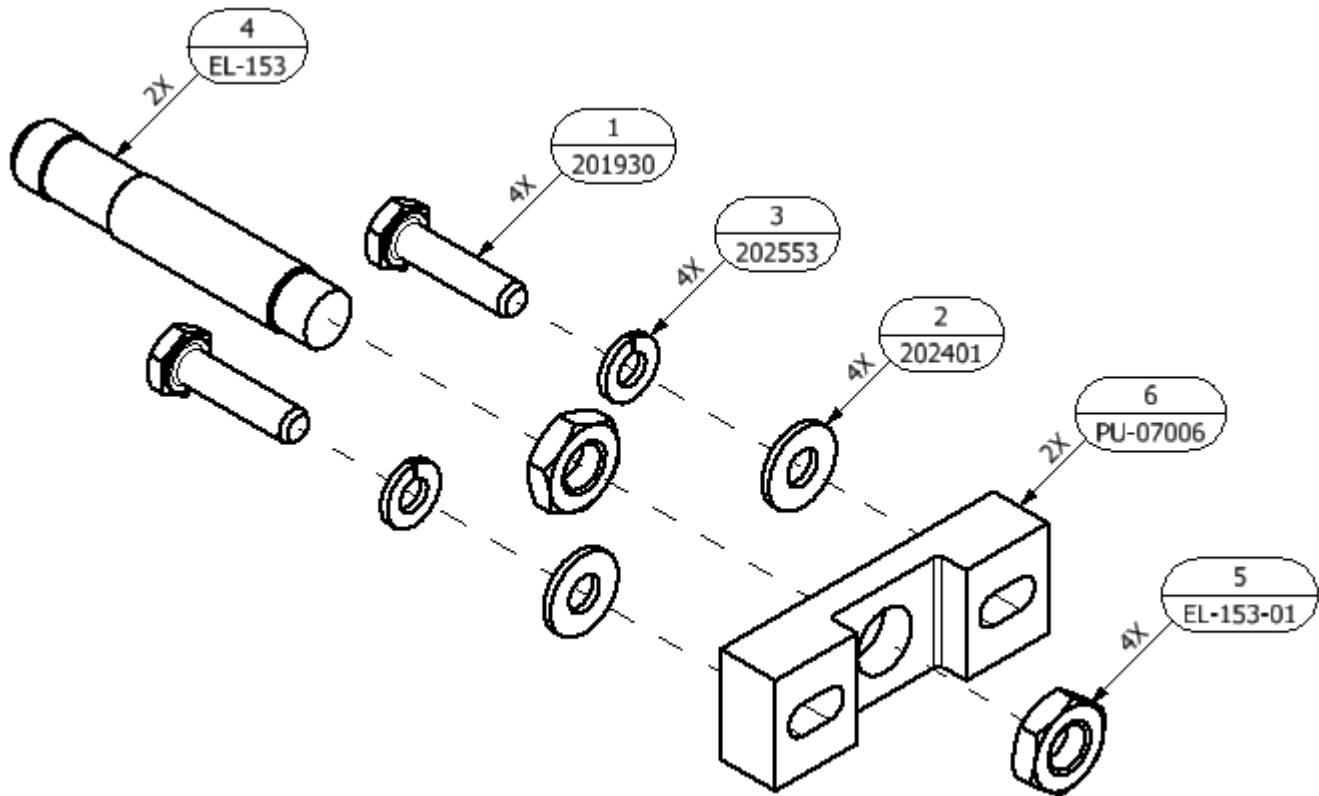


Figure 22: Prox. Sensor Assembly (RM-243)

PROX SENSOR ASSEMBLY (RM-243)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1*	2	201930	HHCS, 1/4-20 X 1.0, ZP GRD8
2*	2	202401	WASHER, FLAT, 1/4, ZP SAE
3*	2	202553	WASHER, LOCK, 1/4, ZP
4	1	EL-153	12MM PROX SWITCH
5	2	EL-153-01	HEX JAM NUT, M10
6	1	PU-07006	PROX SWITCH MOUNT

* Indicates parts not included in RM-243 assembly, hardware located in final assembly.

Note: There is a quantity (2) of RM-243 in the final assembly.

15.3 HYDRAULIC MANIFOLD ASSEMBLY

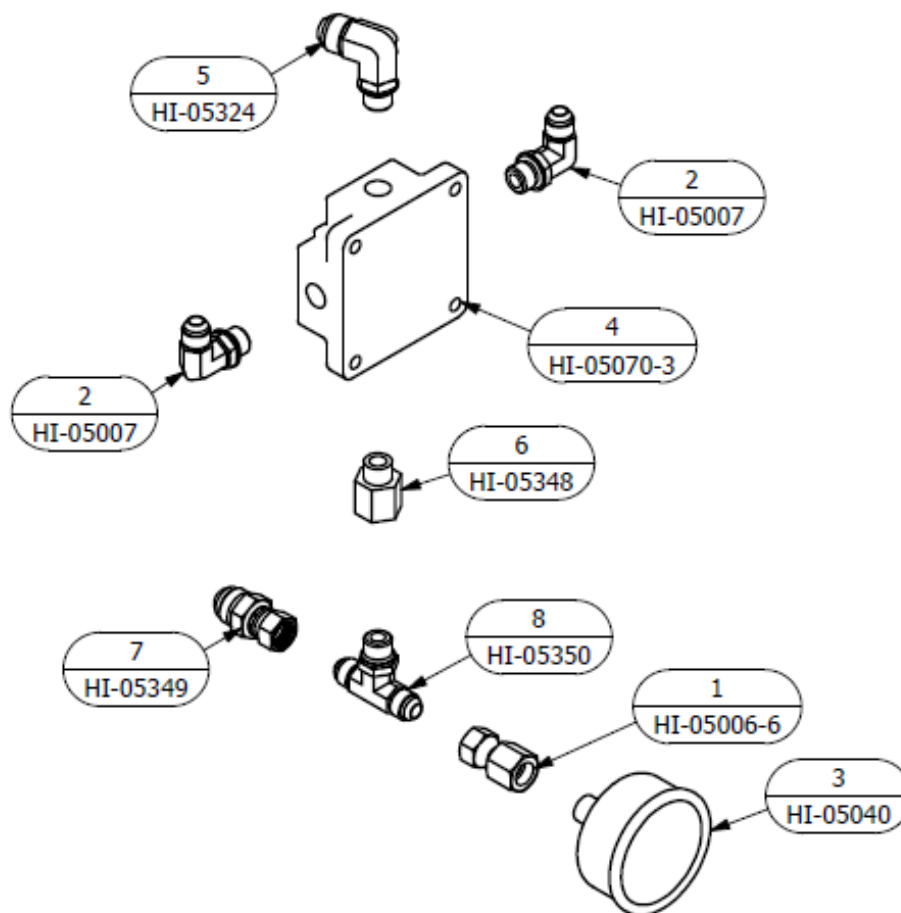


Figure 23: Hydraulic Manifold Assembly (HI-05335)

HYDRAULIC MANIFOLD ASSEMBLY (HI-05335)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05006-6	1/4 NPT X 6 JIC GAUGE FITTING
2	2	HI-05007	6 ORB X 6 JIC
3	1	HI-05040	PRESSURE GAUGE 0-2000 PSI
4	1	HI-05070-3	HYDRAULIC MANIFOLD
5	1	HI-05324	6 ORB X 1/2 JIC; 90 DEG
6	1	HI-05348	6 ORB EXTENTION
7	1	HI-05349	6 JIC X 8 JIC
8	1	HI-05350	6 JIC 6 ORB "T"

15.4 EXIT MANIFOLD ASSEMBLY

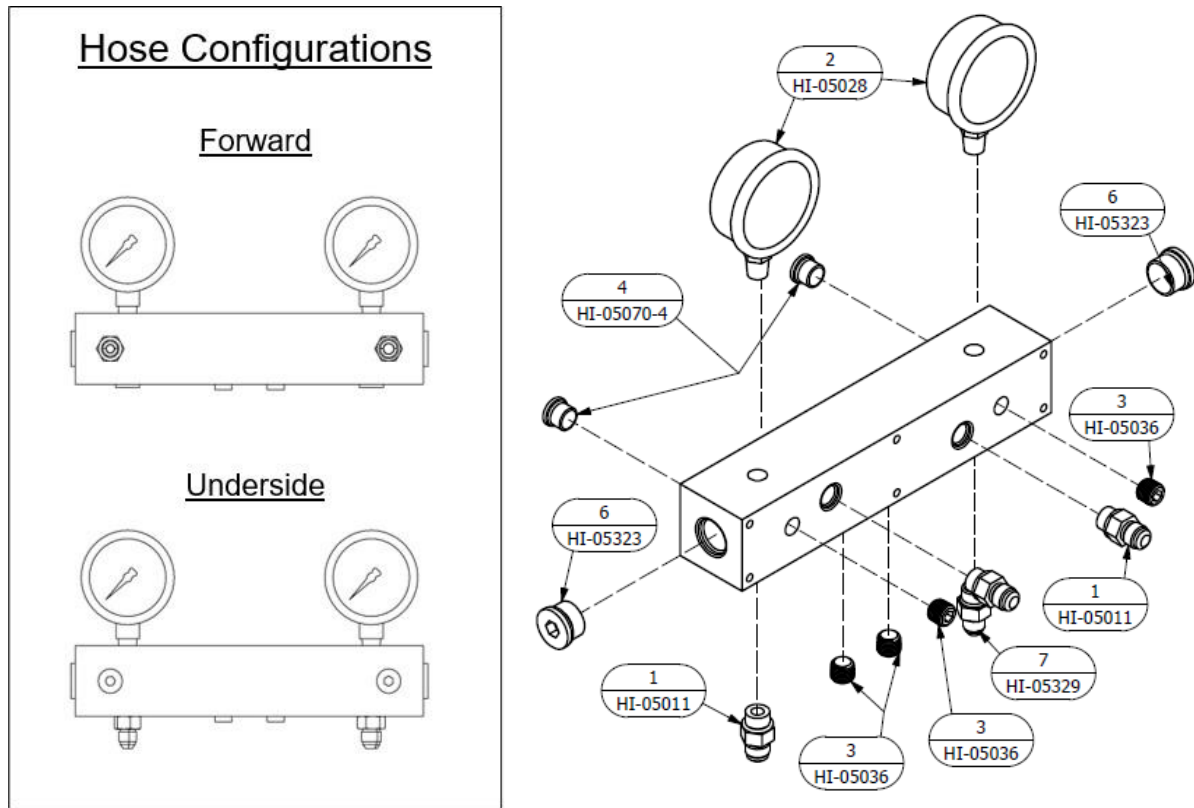


Figure 24: Exit Manifold Assembly (HI-05343)

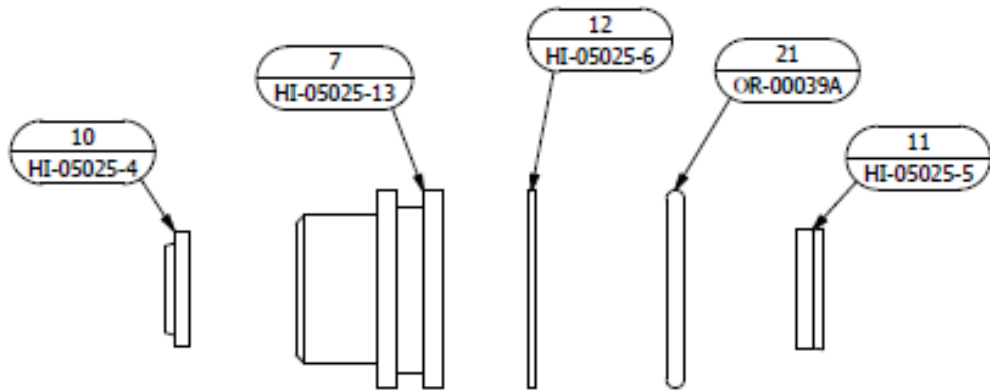
EXIT MANIFOLD ASSEMBLY (HI-05343)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	3	HI-05011	9/16-18 O-RING X #6 JIC
2*	2	HI-05028	PRESSURE GAUGE 0-3000 PSI (HI-05331)
	2	HI-00035	PRESSURE GAUGE 0-5000 PSI (HI-05343)
3	4	HI-05036	1/4 NPT FLUSH SEAL PIPE PLUG
4	2	HI-05070-4	HEX SOCKET O-RING BOSS
5	1	HI-05307	OUTLET MANIFOLD
6	2	HI-05323	10 ORB PLUG
7	1	HI-05329	6 ORB X 5 JIC

* Indicates parts not included in HI-05343.

HYDRAULIC CYLINDER ASSEMBLY (HI-05336)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	201580	WASHER, FLAT, 5/16, 18-8 SS
2	4	201591	FHCS, #8-32 X 0375, 18-8 SS
3	4	202145	WASHER, LOCK, 5/16, 18-8 SS
4	4	202212	HHCS, 5/16-18 X 7.500, ZP GRD5
5	2	HI-05011	9/16-18 O-RING X #6 JIC NIPPLE
6	2	HI-05025-1	U CUP. HYDRAULIC PISTON
7	2	HI-05025-13	BUSHING, HYDRAULIC CYLINDER
8	2	HI-05025-2	BACK-UP RING, HYDRAULIC PISTON
9	1	HI-05025-3	WEAR RING, HYDRAULIC PISTON
10	2	HI-05025-4	ROD WIPER, BUSHING, HYDRAULIC CYLINDER
11	2	HI-05025-5	SHAFT SEAL, BUSHING, HYDRAULIC CYLINDER
12	2	HI-05025-6	BACK-UP RING, BUSHING, HYDRAULIC CYLINDER
13	2	HI-05200-3	PORT BLOCK, HYDRAULIC
14	1	HI-05300	HYDRAULIC PISTON
15	1	HI-05301	HYDRAULIC CYLINDER
16	2	HI-05302	FEMALE CLEVIS
17	2	HI-05303	SWITCH PLATE
18	1	HI-05332	FLANGE RETAINER, "A" SIDE
19	1	HI-05333	FLANGE RETAINER, "R" SIDE
20	2	HI-05337	SPRING PIN, SLOTTED 1/8" DIA
21	2	OR-00039A	O-RING #218 HYD CYLINDER
22	2	OR-00040A	O-RING #036 HYD CYLINDER

15.5.1 HYDRAULIC CYLINDER REBUILD KIT

HYDRAULIC CYLINDER REBUILD KIT (KT-05200)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	HI-05025-1	U CUP
2	2	HI-05025-2	BACK-UP RING, PISTON
3	1	HI-05025-3	WEAR RING
4	2	HI-05025-4	WIPER, ROD
5	2	HI-05025-5	SHAFT SEAL
6	2	HI-05025-6	BACK-UP RING, BUSHING
7	2	OR-00039A	O-RING -218 HYD CYLINDER ROD
8	2	OR-00040A	O-RING -036 HYD CYLINDER



BUSHING SEAL DETAIL

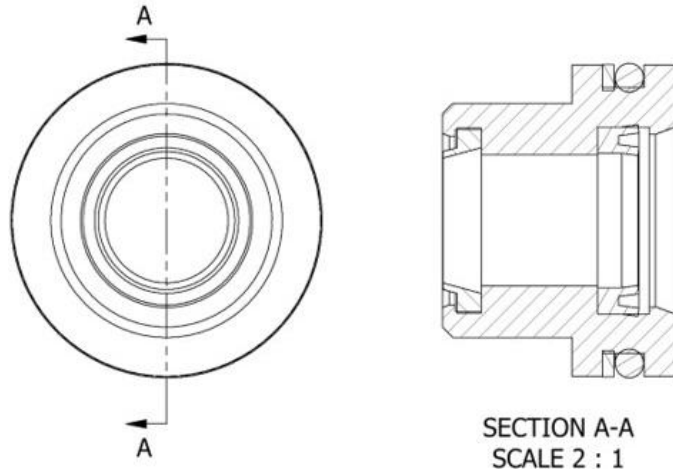
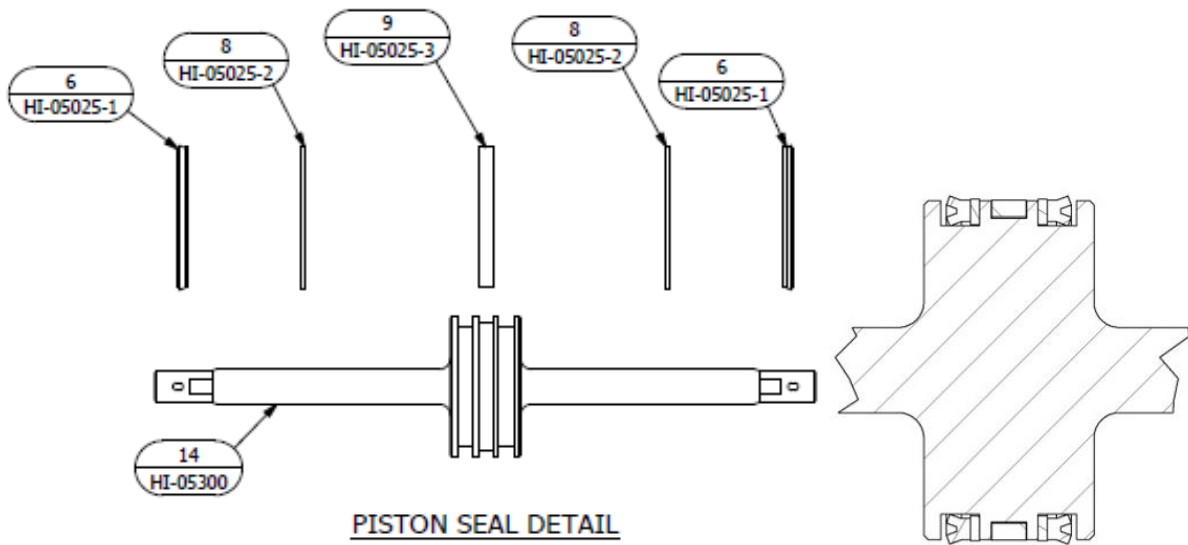


Figure 26: Hydraulic Seal Detail View



PISTON SEAL DETAIL

Figure 27: Hydraulic Piston Detail View

15.6 A & R SINGLE PUMP ASSEMBLY

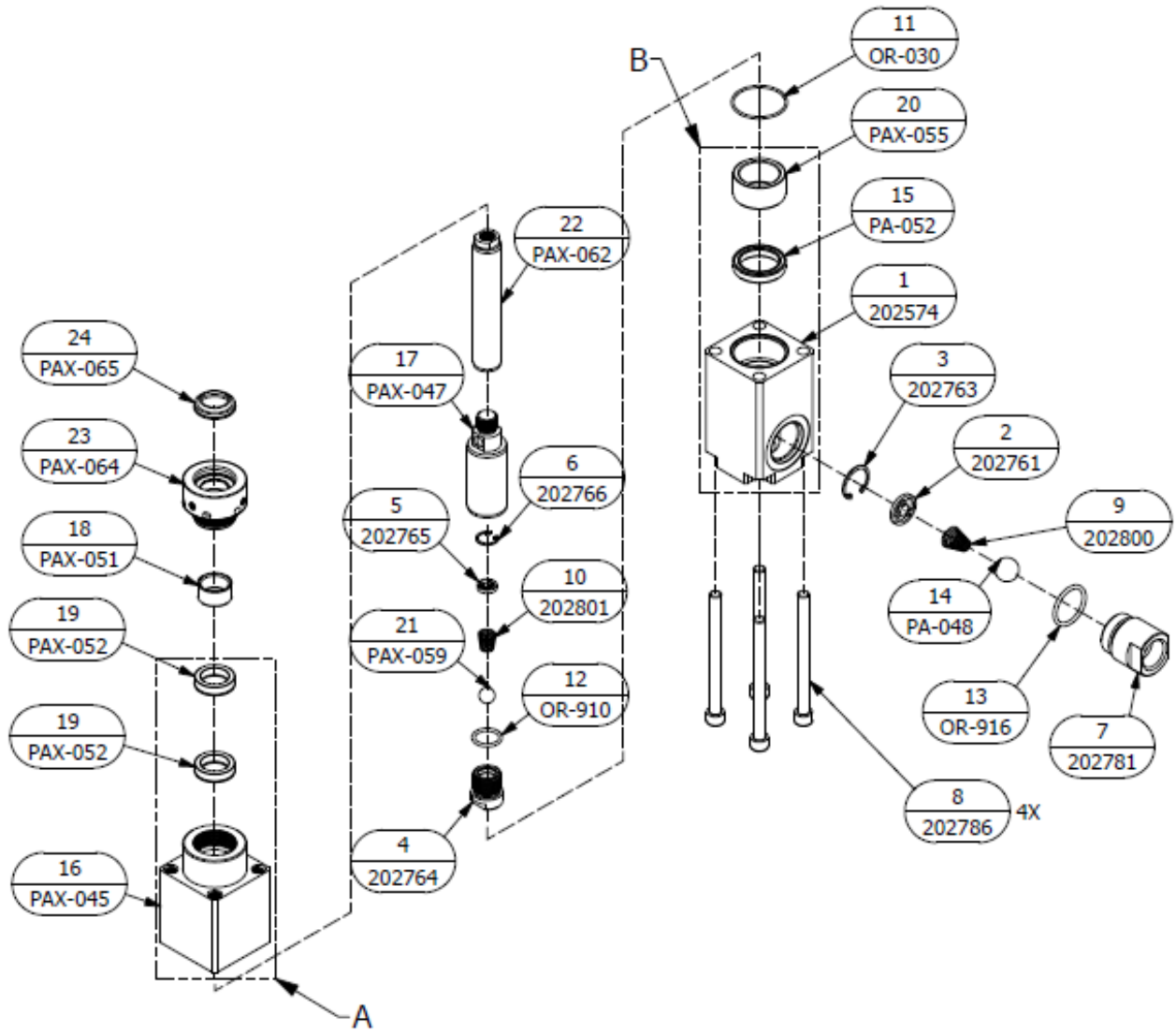


Figure 28: A & R Single Pump Assembly (202192)

A & R SINGLE PUMP ASSEMBLY (202587)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	202574	INLET BODY, BTM FEED, HP
2	1	202761	INLET BODY, BOTTOM FEED
3	1	202763	RETAINING RING, INTERNAL, HP
4	1	202764	PISTON VALVE, HP
5	1	202765	SPRING RETAINER, PISTON VALVE, HP
6	1	202766	RETAINING RING, INTERNAL 5/8 ID
7	1	202781	INLET VALVE, BOTTOM FEED, FP
8	4	202786	SHCS, 3/8-16 X 4.500, ZP ALLOY
9	1	202800	SPRING, INLET VALVE, HP
10	1	202801	SPRING, PISTON VALVE, HP
11	1	OR-030	O-RING, -030, BRN VITON
12	1	OR-910	O-RING, -910, BRN VITON
13	1	OR-916	O-RING, -916, BRN VITON
14	1	PA-048	3/4" CHROME BALL
15	1	PA-052	ROD SEAL ASSEMBLY
16	1	PAX-045	OUTLET BODY
17	1	PAX-047	PISTON
18	1	PAX-051	ROD BUSHING
19	2	PAX-052	ROD SEAL ASSEMBLY
20	1	PAX-055	PISTON BUSHING
21	1	PAX-059	1/2" CHROME BALL
22	1	PAX-062	FLUID ROD
23	1	PAX-064	PACKING NUT
24	1	PAX-065	SCRAPER SEAL

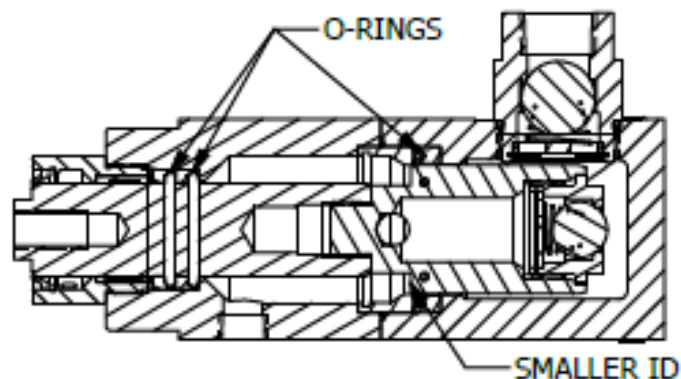


Figure 29: A & R Single Pump Cross Section

15.7 PUMP-LINE SEAL ORIENTATION

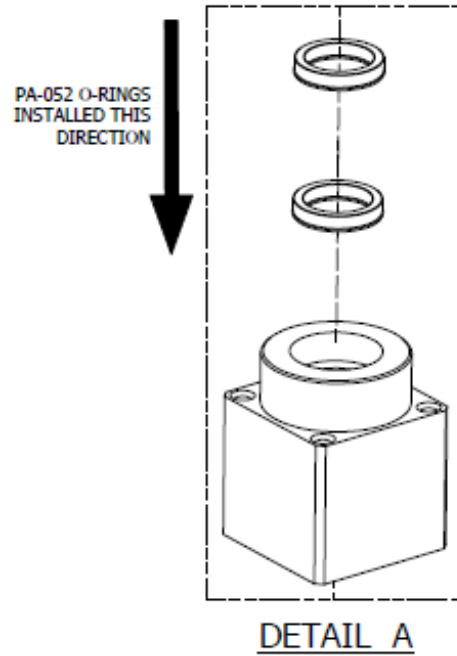


Figure 30: A & R Single Pump Assembly Detail A

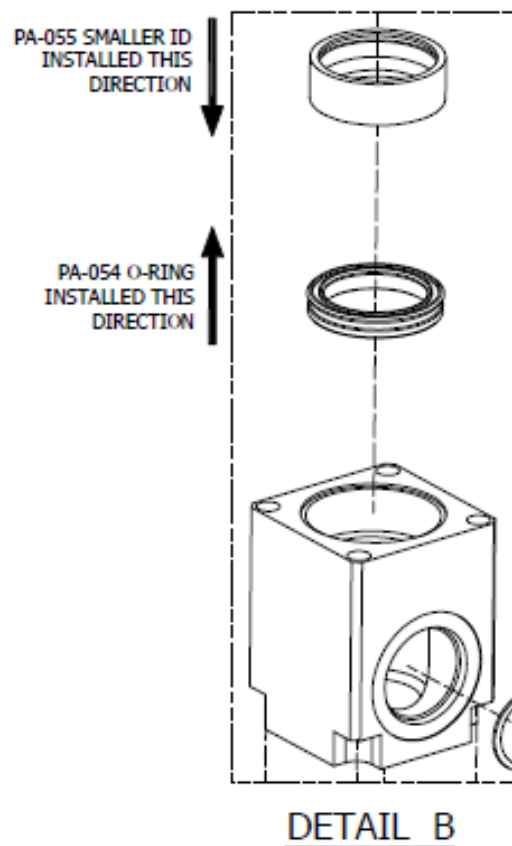


Figure 31: A & R Single Pump Assembly Detail B

15.8 PUMP-LINE ASSEMBLY

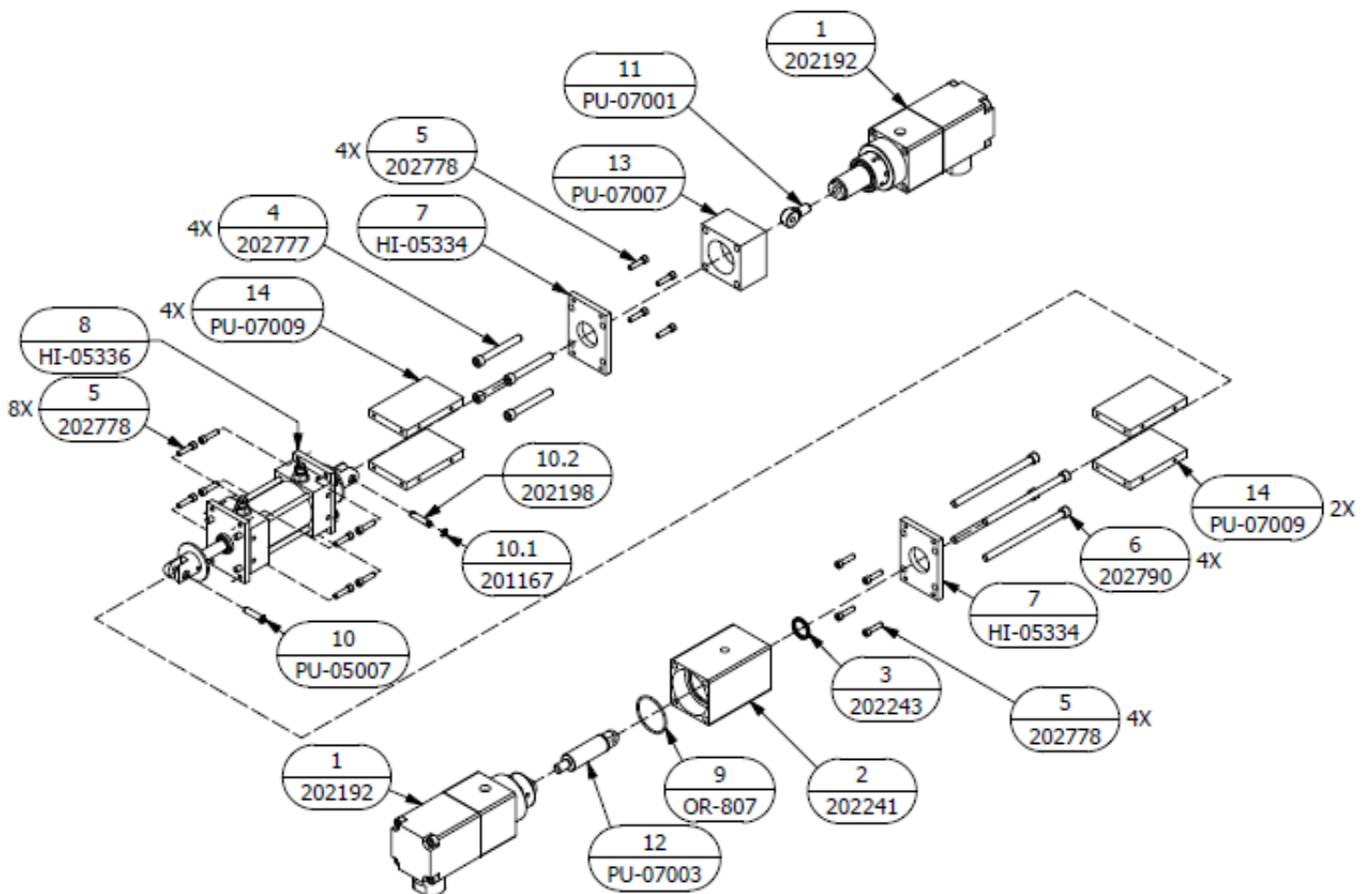


Figure 32: Pump-Line Assembly (PL-9)

PUMP LINE ASSEMBLY - LOW PRESSURE (PL-9)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	202192	PUMP, LP, BOTTOM FEED, PH-2
2	1	202241	LUBE SECTION
3	1	202243	ROD SEAL 1.00 DIA
4	4	202777	SHCS, 3/8-16 X 3.000, ZP ALLOY
5	16	202778	SHCS, 1/4-20 X 1.000, ZP ALLOY
6	4	202790	SHCS, 3/8-16 X 6.000, ZP ALLOY
7	2	HI-05334	FLANGE
8	1	HI-05336	HYDRAULIC CYLINDER ASSY, PH(X)-2
9	1	OR-807	O-RING -137, VITON
10	2	PU-05007	PIN, CLEVIS W/ CLIP
10.1	1	201167	E-CLIP, 7/32"
10.2	1	202198	PIN, CLEVIS
11	1	PU-07001	MALE CLEVIS
12	1	PU-07003	LUBE SHAFT
13	1	PU-07007	BRACKET
14	4	PU-07009	STAND OFF

Note: Items 10.1 & 10.2 can be ordered separately but are all included in purchase of Item 10 (PU-05007).

15.8.1 PUMP REBUILD KIT

PUMP REBUILD KIT - LOW PRESSURE (KT-PA)		
QTY	PART NUMBER	DESCRIPTION
1	OR-035	O-RING, -035, BM VITON
1	OR-916	O-RING, -916, BM VITON
1	OR-920	O-RING, -920, BM VITON
1	PA-051	ROD BUSHING
2	PA-052	ROD SEAL ASSEMBLY
1	PA-054	PISTON SEAL ASSEMBLY
1	PA-055	PISTON BUSHING
1	PA-065	SCRAPER SEAL

15.9 INLET MONITORING ASSEMBLY

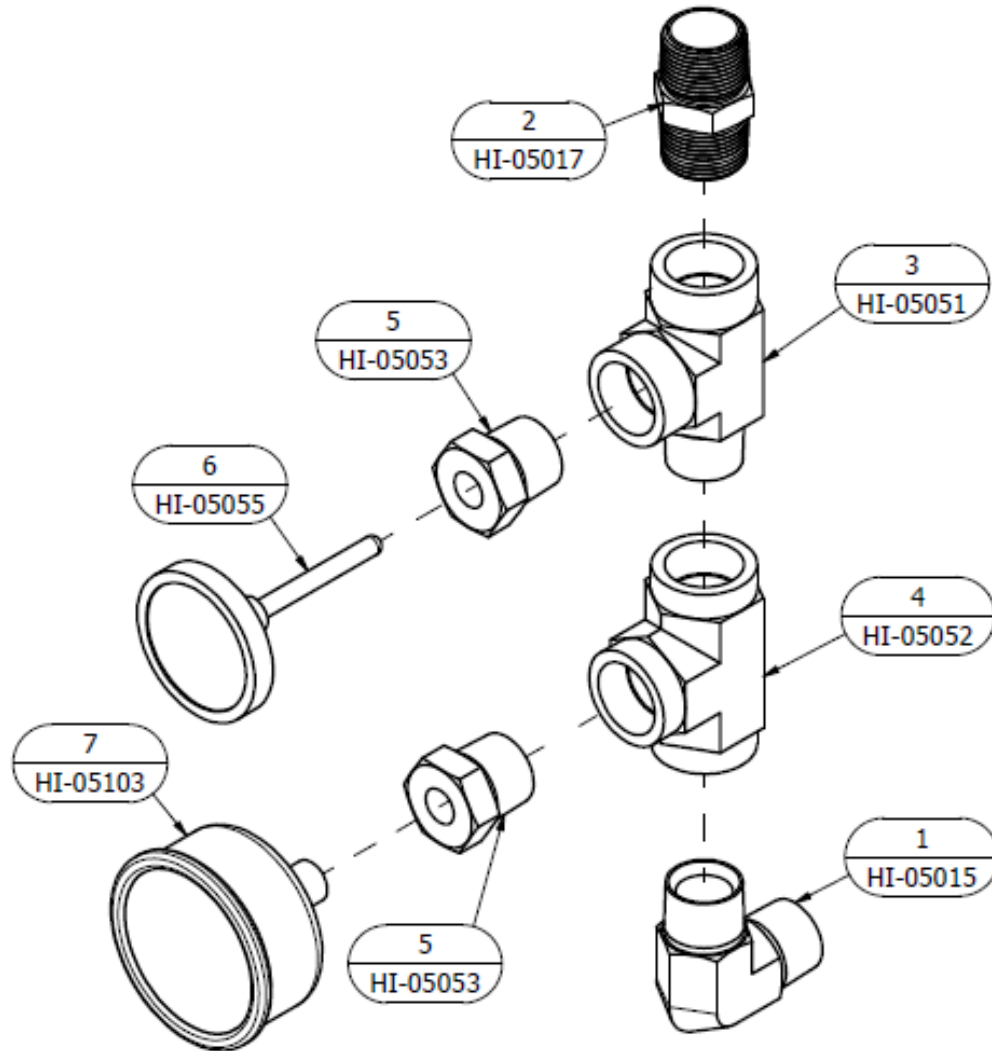


Figure 33: Inlet Monitoring Assembly

INLET MONITORING ASSEMBLY (KT-05005)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	HI-05015	3/4 FTG, 90 DEG ELBOW, 3/4 MNPTF, STL
2	2	HI-05017	FTG, UNION, 3/4 MNPTF, STL
3	2	HI-05051	FTG, RUN TEE, 3/4 NPTF, STL
4	2	HI-05052	PARKER PIPE FIT FEMALE PIPE TEE
5	4	HI-05053	FTG, RDCR, 3/4 MNPTF, 1/4 FNPTF, STL
6	2	HI-05055	GAUGE, TEMP, 0-200 F
7	2	HI-05103	PRESS GAUGE 0-600 PSI

15.10 Y-STRAINER ASSEMBLY "A" SIDE

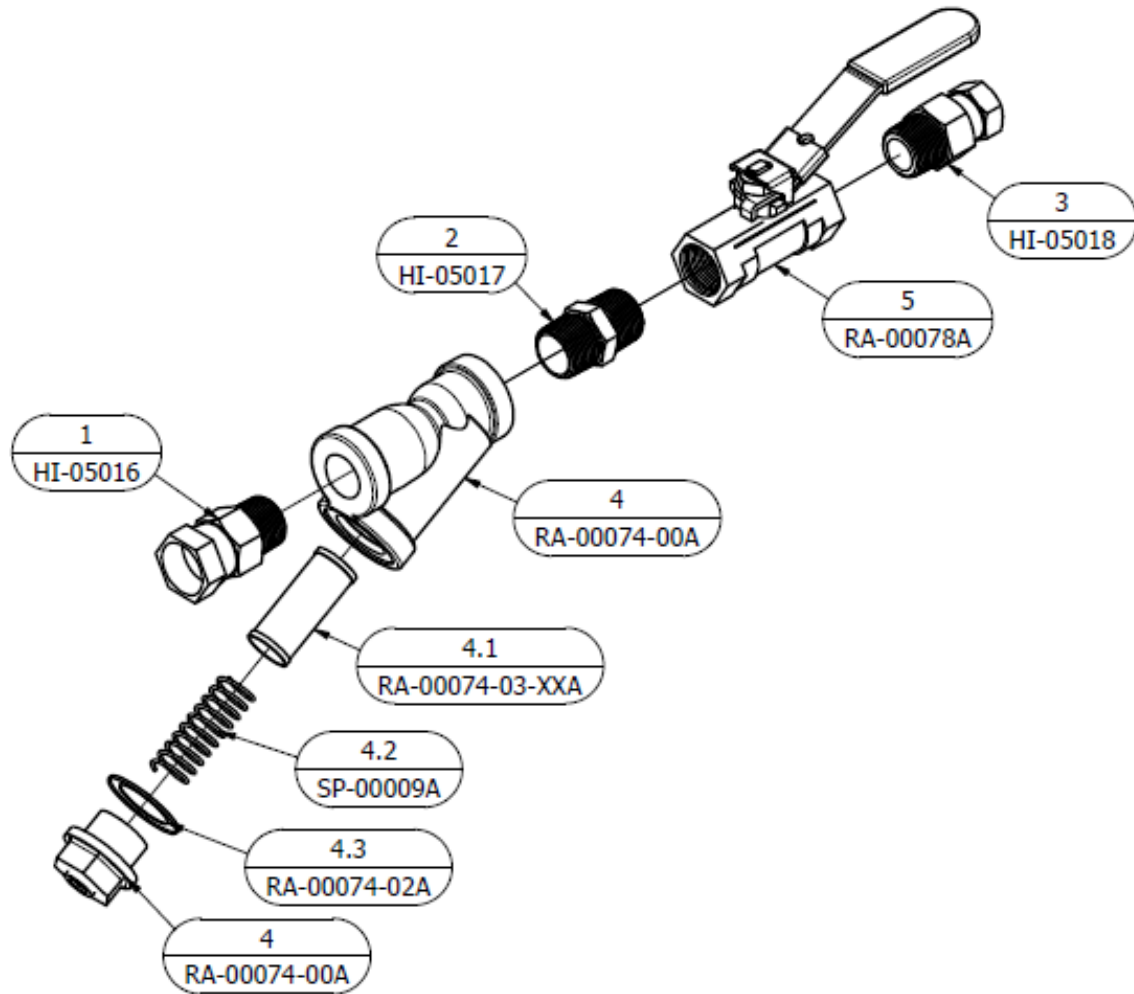


Figure 34: Y-Strainer Assembly "A" Side (YS-1)

Y-STRAINER ASSEMBLY "A" SIDE (YS-1)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05016	3/4 NPTM X 3/4 NPTF SW
2	1	HI-05017	3/4 MNPT UNION
3	1	HI-05018	3/4 NPT X 1/2 NPT SW
4	1	RA-00074-00A	Y-STRAINER ASSY
4.1	1	RA-00074-03-XXA	FILTER SCREEN 30/60/80
4.2	1	SP-00009A	FILTER SCREEN SPRING
4.3	1	RA-00074-02A	GASKET, Y-STRAINER
5	1	RA-00078A	3/4 BALL VALVE SS

Note: Items 4.1-4.3 can be order separately but are all included in purchase of Item 4 (RA-00074-00A).

15.11 Y-STRAINER ASSEMBLY "R" SIDE

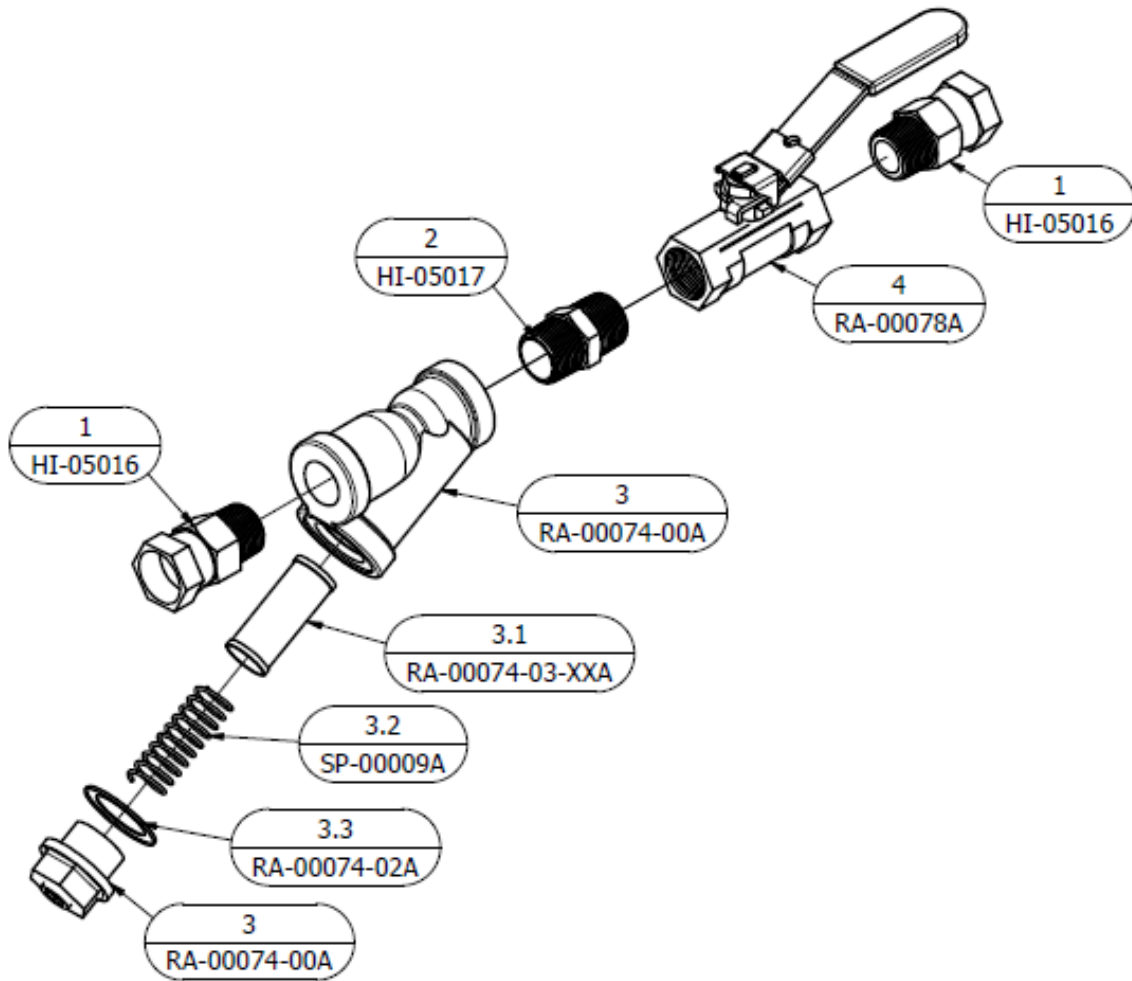


Figure 35: Y-Strainer Assembly "R" Side (YS-2)

Y-Strainer Assembly "R" Side (YS-2)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	HI-05016	3/4 NPTM X 3/4 NPTF SW
2	1	HI-05017	3/4 MNPT UNION
3	1	RA-00074-00A	Y-STRAINER ASSY
3.1	1	RA-00074-03-XXA	FILTER SCREEN 30/60/80
3.2	1	SP-00009A	FILTER SCREEN SPRING
3.3	1	RA-00074-02A	GASKET, Y-STRAINER
4	1	RA-00078A	3/4 BALL VALVE SS

Note: Items 3.1-3.3 can be order separately but are all included in purchase of item 3 (RA-00074-00A).

15.12 HEATER ASSEMBLY

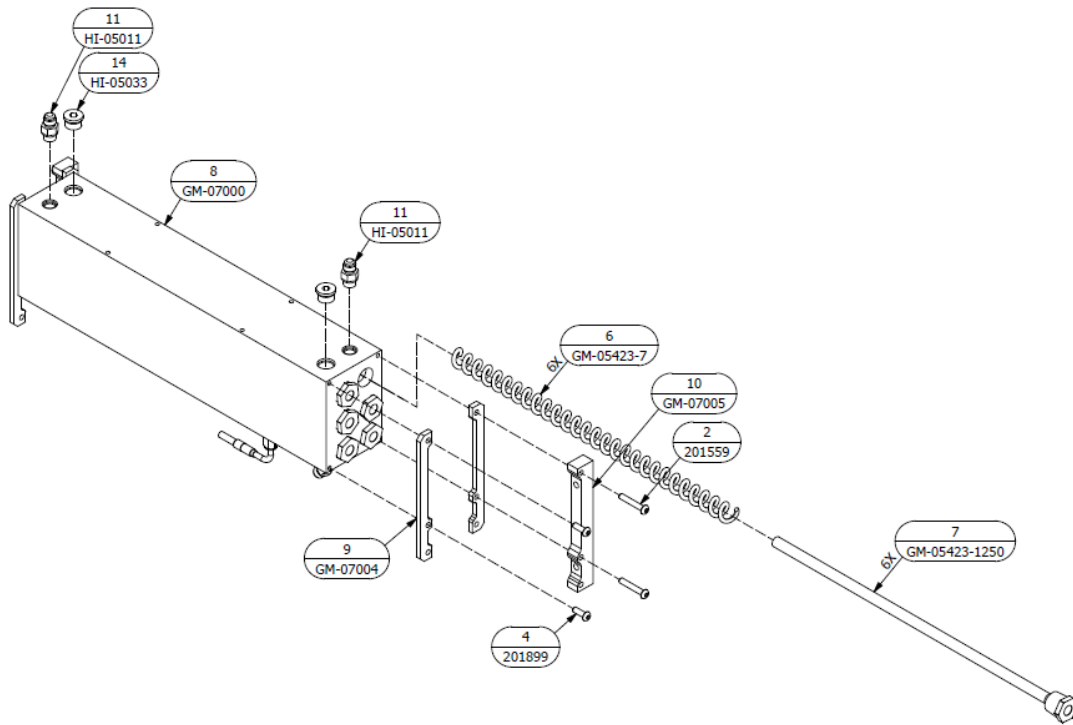


Figure 36: Heater Assembly, 6 Rod - A

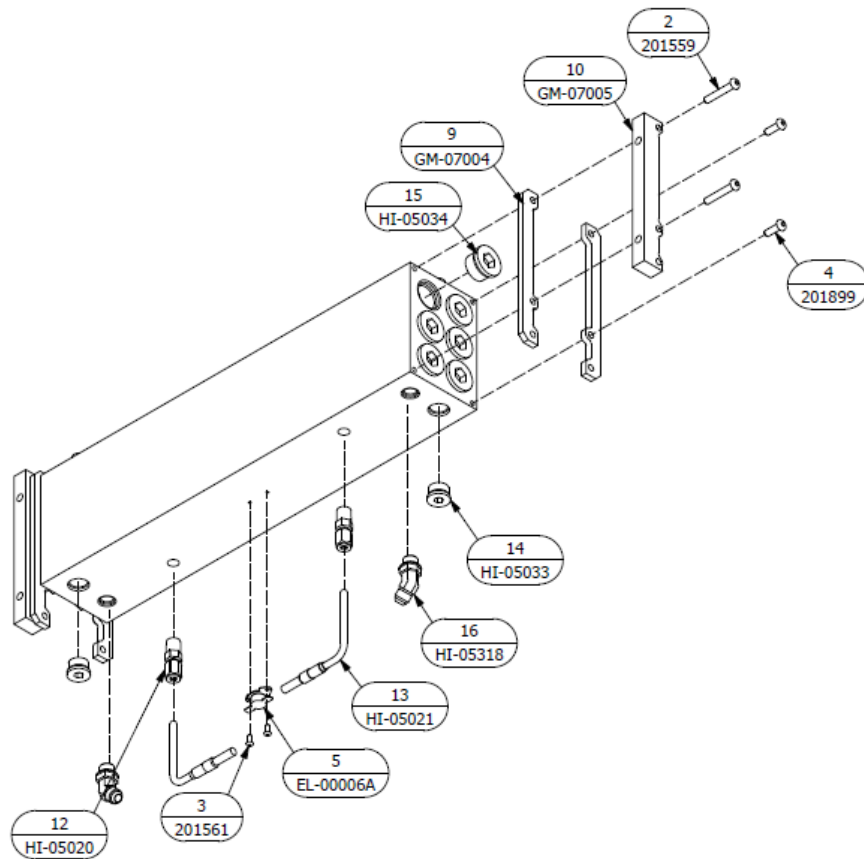


Figure 37: Heater Assembly, 6 Rod - B

PREHEATER ASSEMBLY, 6-ROD			
PH-21 (7.5kW)			
PH-22 (9kW)			
PH-23 (10.5kW)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	200939	FERRULE, 10 AWG, YELLOW
2	4	201559	BHCS, 1/4-20 X 1.500, 18-8 SS
3	2	201561	BHCS, #6-32 X 0.375, 18-8 SS
4	4	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
5	1	EL-00006A	OVERTEMP SWITCH
6	6	GM-05423-1250	FIRE ROD, 1250W, 3/4 NPT, 17.5"
	6	GM-05423-1500	FIRE ROD, 1500W, 3/4 NPT, 17.5"
	6	GM-05423-1750	FIRE ROD, 1750W, 3/4 NPT, 17.5"
7	6	GM-05423-7	SPRING 18"
8	1	GM-07000	HEATER BLOCK
9	4	GM-07004	HEATER SPACER
10	2	GM-07005	HEATER MOUNT
11	2	HI-05011	9/16-18 O-RING X #6 JIC
12*	2	HI-05020	THERMOCOUPLE NUT
13*	2	HI-05021	E TYPE THERMOCOUPLE
14	4	HI-05033	8 ORB PLUG
15	6	HI-05034	12 ORB PLUG
16	2	HI-05318	6 ORB X 6 JIC 45 DEGREE

* Indicates part included in KT-05021: Heater Thermocouple Kit.

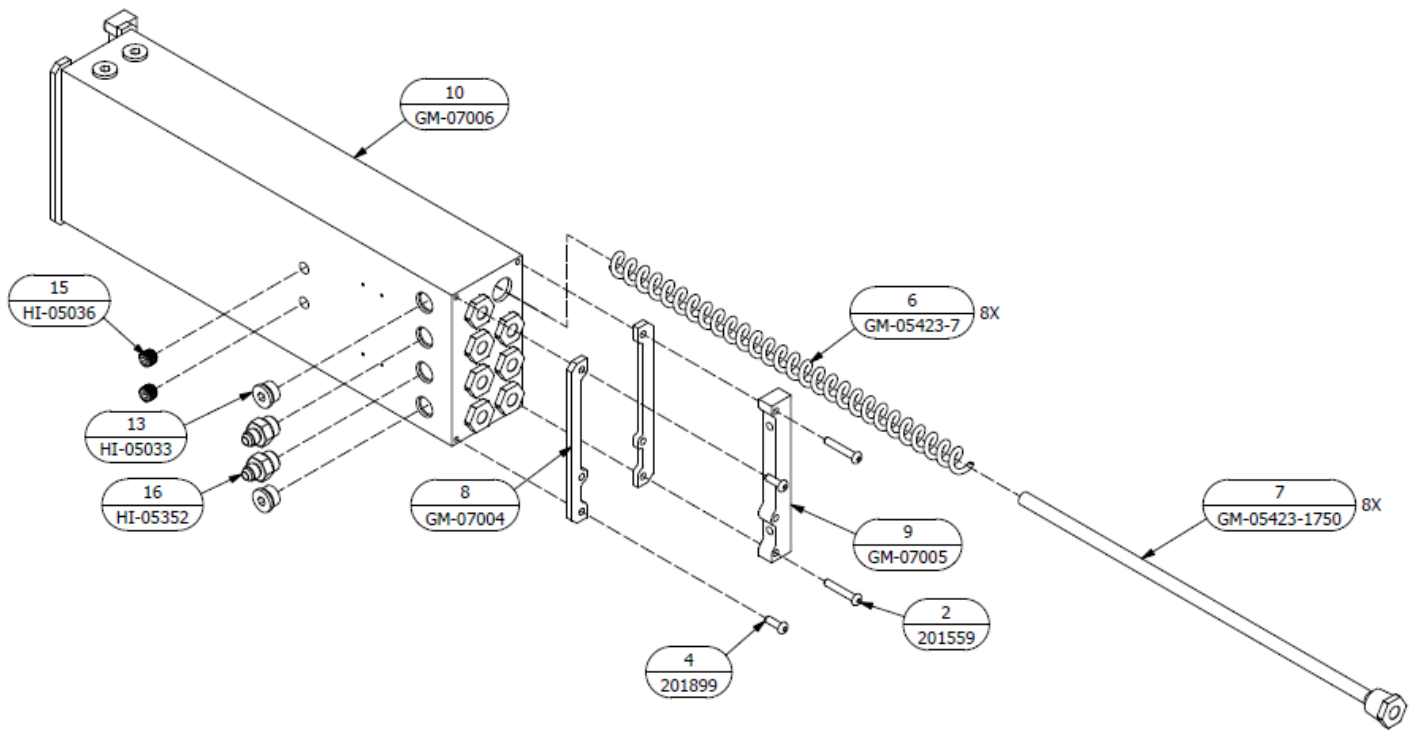


Figure 38: Heater Assembly, 8 Rod - A

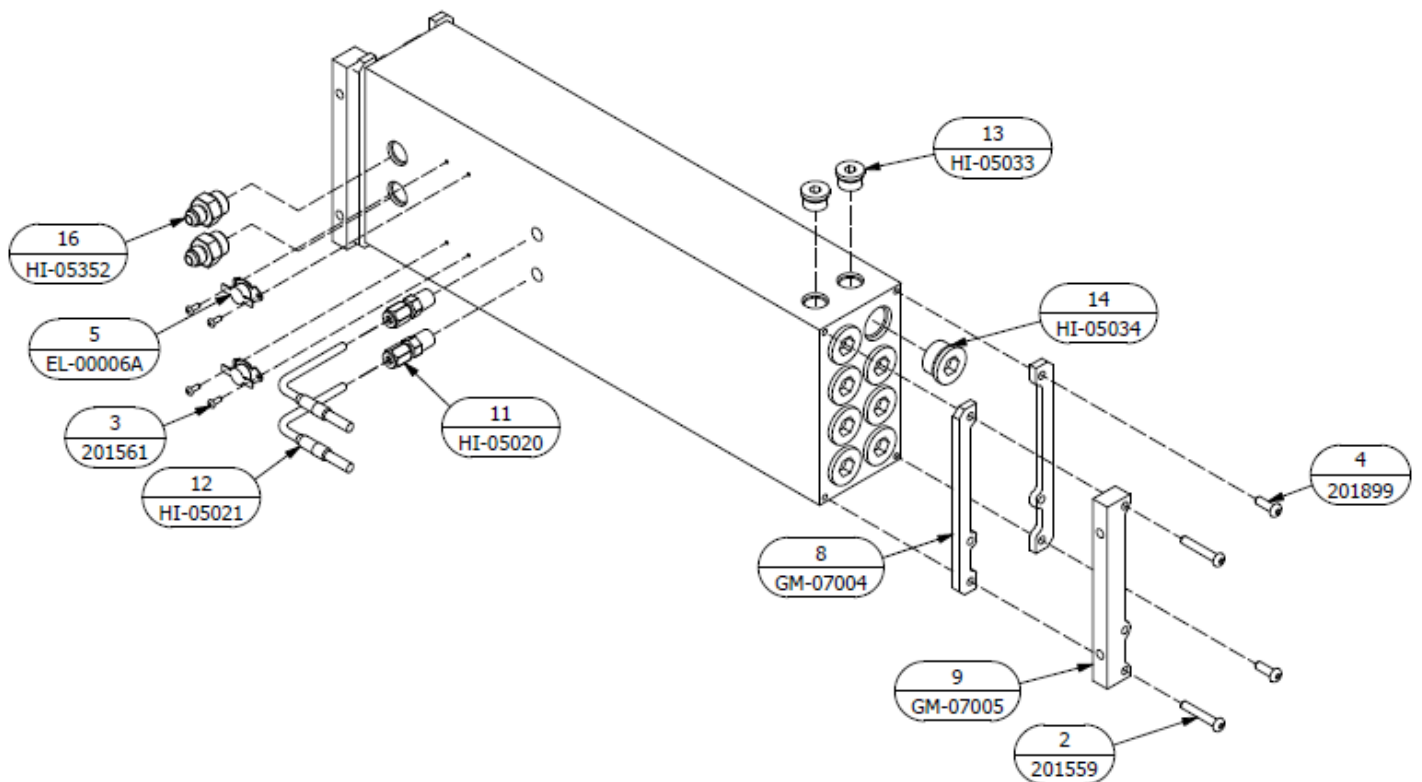


Figure 39: Heater Assembly, 8 Rod - B

PREHEATER ASSEMBLY, 8-ROD PH-33 (14kW)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	200939	FERRULE, 10 AWG, YELLOW
2	4	201559	BHCS, 1/4-20 X 1.500, 18-8 SS
3	4	201561	BHCS, #6-32 X 0.375, 18-8 SS
4	4	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
5	2	EL-00006A	OVERTEMP SWITCH
6	8	GM-05423-7	HEATER SPRING, 18"
7	8	GM-05423-1750	FIRE ROD, 1750W, 3/4 NPT, 17.5"
8	4	GM-07004	HEATER SPACER
9	2	GM-07005	HEATER MOUNT
10	1	GM-07006	8 ROD HEATER BODY
11*	2	HI-05020	THERMOCOUPLE NUT
12*	2	HI-05021	E TYPE THERMOCOUPLE
13	6	HI-05033	8 ORB PLUG
14	8	HI-05034	12 ORB PLUG
15	2	HI-05036	1/4 NPT FLUSH SEAL PIPE PLUG
16	4	HI-05352	8 ORB X 6 JIC

* Indicates part included in KT-05021: Heater Thermocouple Kit.

15.13 MOTOR-LINE ASSEMBLY

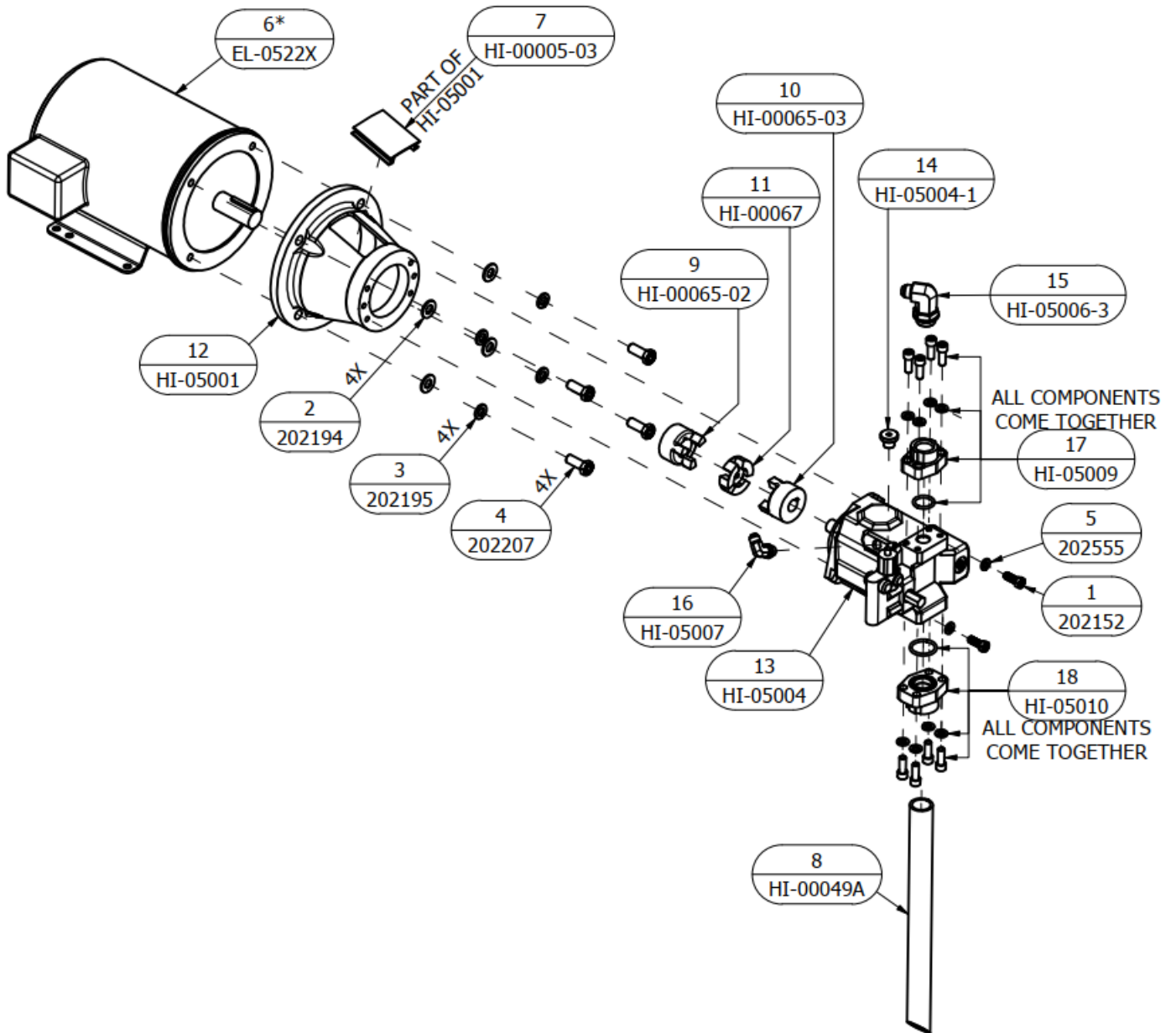


Figure 40: Motor-Line Assembly

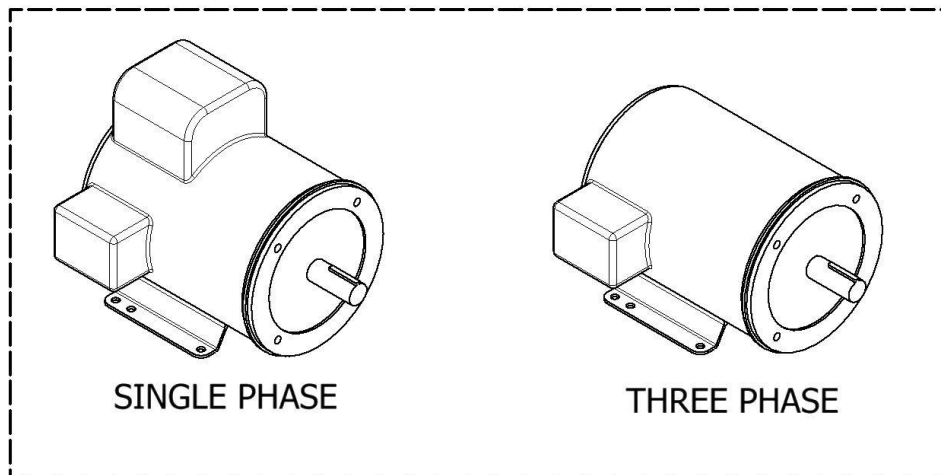


Figure 41: Motor Comparison

MOTOR-LINE ASSEMBLY (ML-1)/(ML-2)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	202152	HHCS, 3/8-16 X 1.000, ZP GRD8
2	4	202194	WASHER, FLAT, 1/2, ZP SAE
3	4	202195	WASHER, LOCK, 1/2, ZP
4	4	202207	HHCS, 1/2-13 X 1.25, ZP GRD8
5	2	202555	WASHER, LOCK, 3/8, ZP
6	1	EL-05221	ELECTRIC MOTOR, 5HP, 1PH, 60HZ (ML-2)
	1	EL-05224	ELECTRIC MOTOR, 5HP, 3PH, 60HZ (ML-1)
7	1	HI-00005-03	ACCESS COVER
8	1	HI-00049A	1X16 BLACK PIPE FOR HYDRAULIC
9	1	HI-00065-02	COUPLER HUB, 1 1/8
10	1	HI-00065-03	COUPLER HUB, 3/4
11	1	HI-00067	MAGNALOY INDERT, 9.45HP
12	1	HI-05001	BELL HOUSING
13	1	HI-05004	HYDRAULIC PUMP
14	1	HI-05004-1	CONTROL KNOB, HYD PUMP
15	1	HI-05006-3	90 DEGREE 1/2 JIC X #12 ORB
16	1	HI-05007	6 ORB X 6 JIC 90 DEGREE
17	1	HI-05009	1-1/16-12 OUTLET FLANGE
18	1	HI-05010	1" NPT INLET FLANGE

15.14 FINAL ASSEMBLY

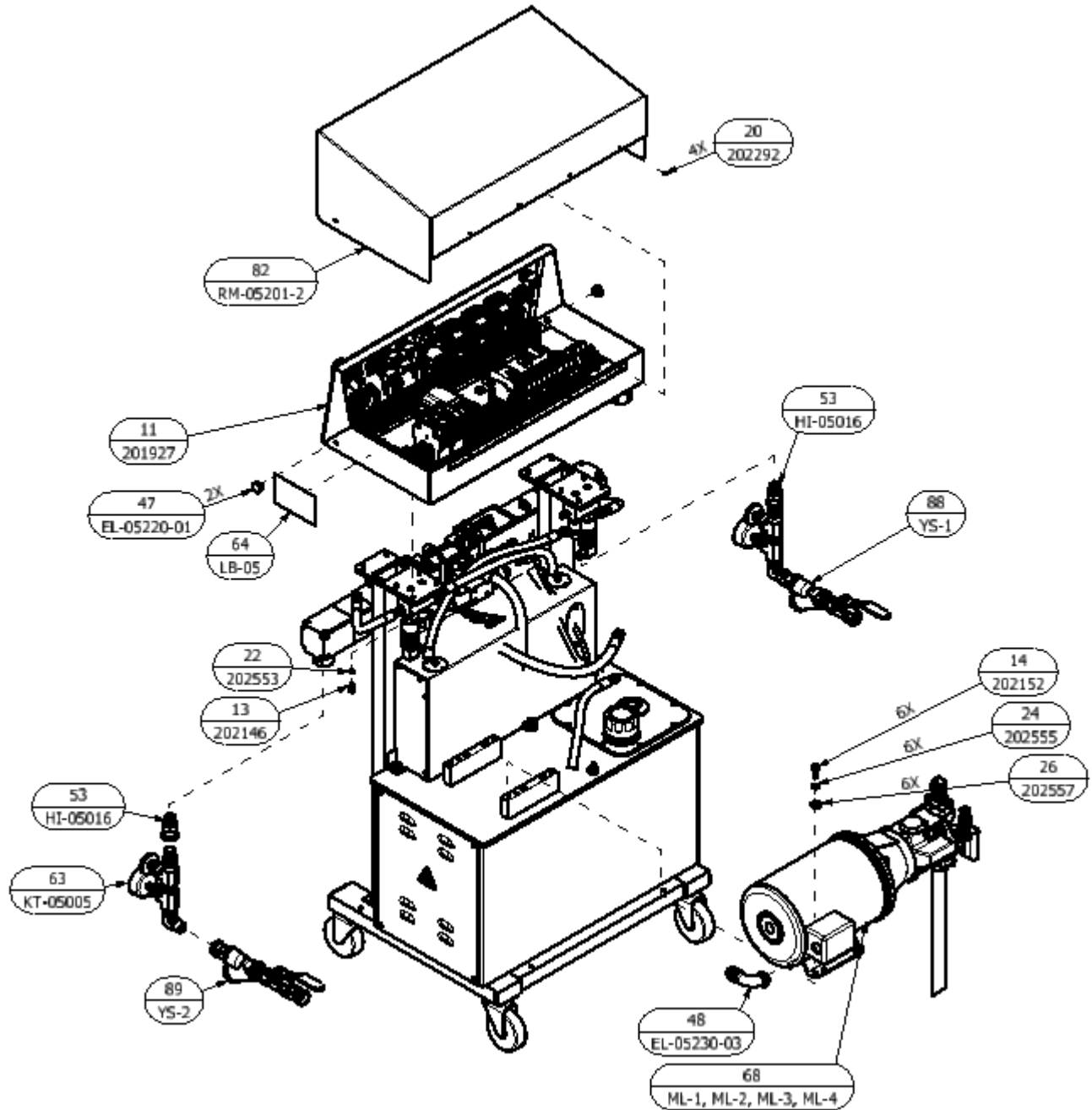


Figure 42: PH-2 Final Assembly

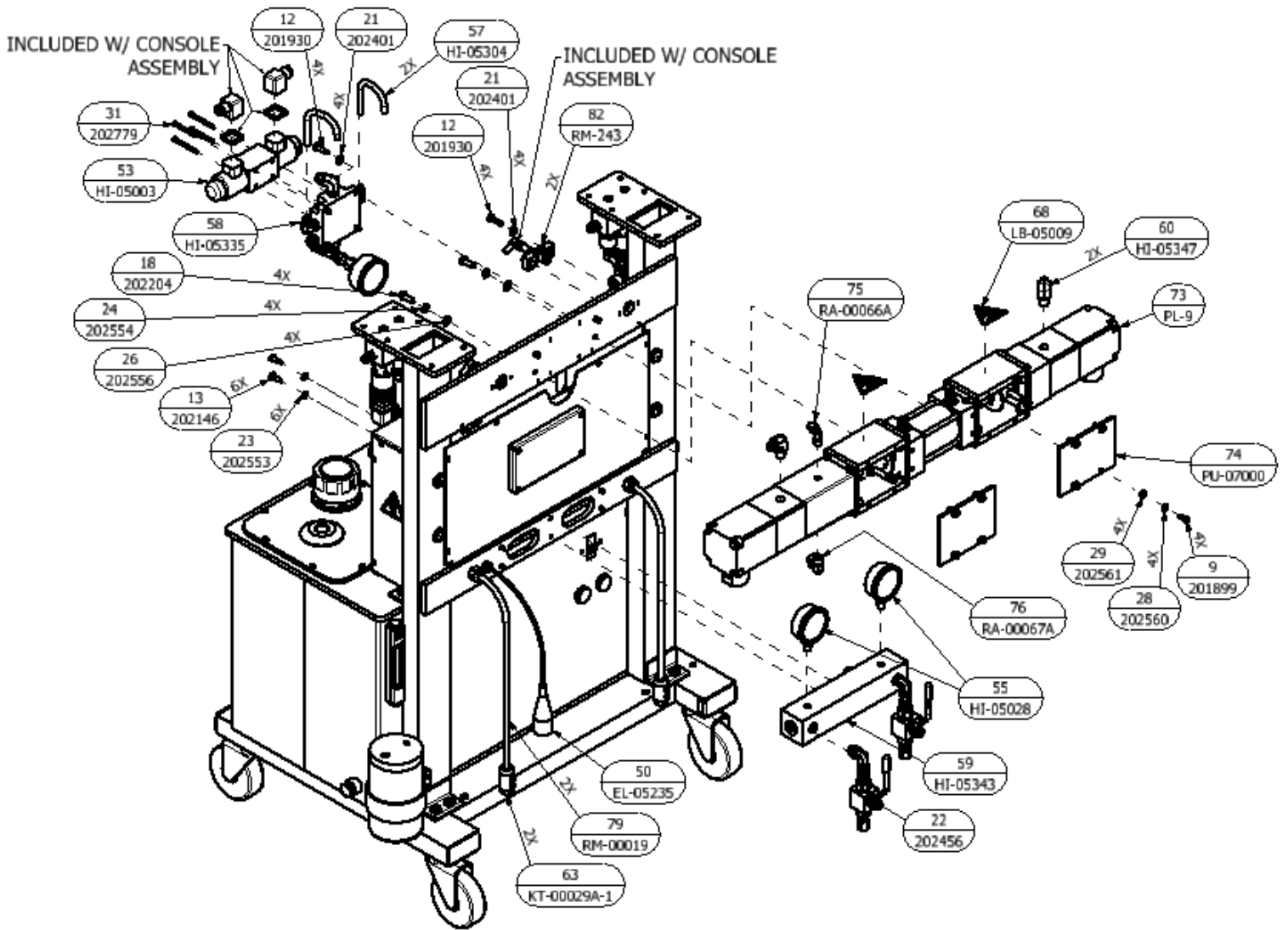


Figure 43: PH-2 Final Assembly - B

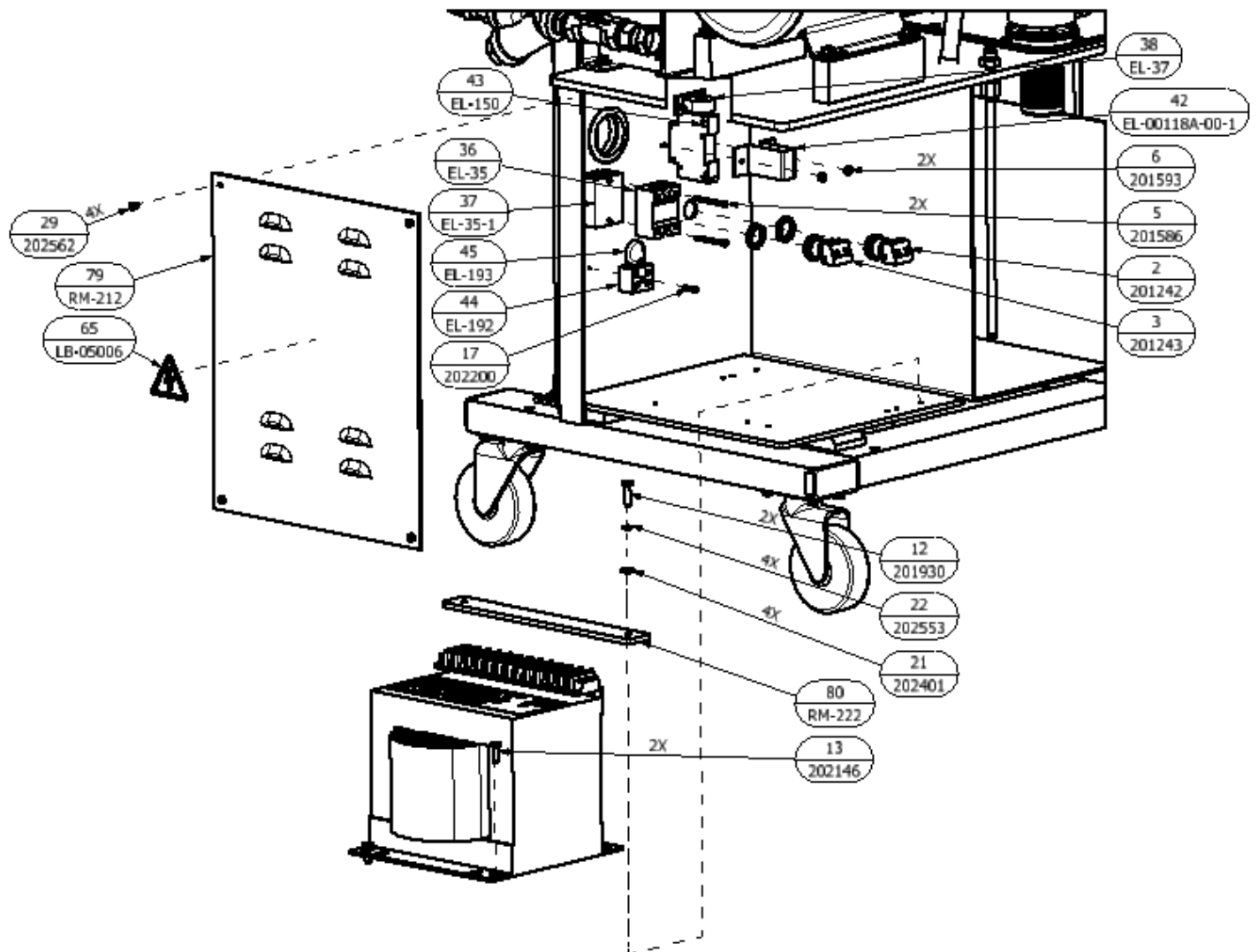


Figure 44: PH-2 Final Assembly - C

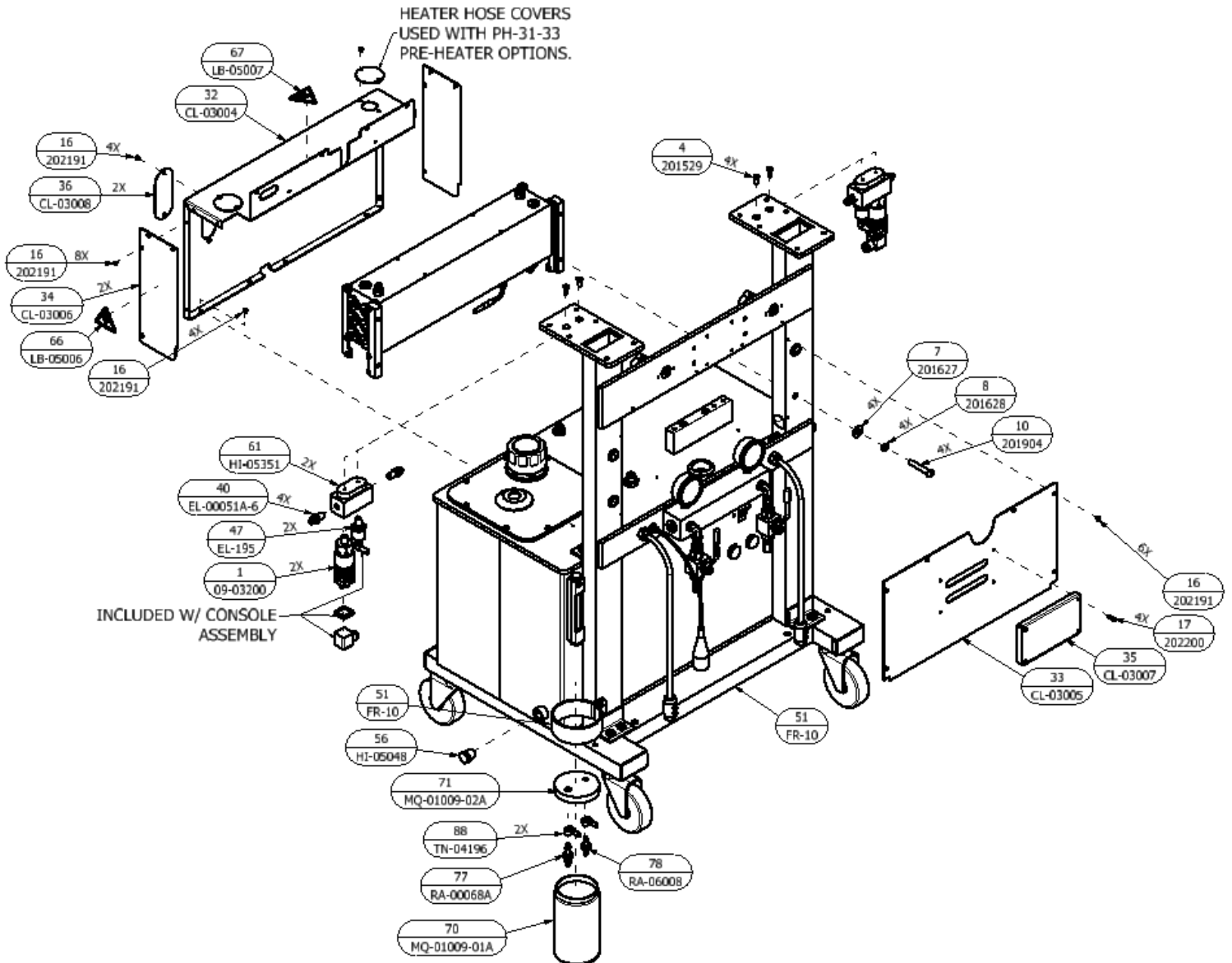


Figure 45: PH-2 Final Assembly - D

PH-2 (LOW PRESSURE)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	09-03200	PRESSURE SWITCH
2	1	201242	LIGHT UNIT, RED, 120VAC
3	1	201243	LIGHT UNIT, WHITE, 120VAC
4	4	201529	FHCS, 1/4-20 X 0.750, 18-8 SS
5	2	201586	SHCS, #8-32 X 1.75, 18-8 SS
6	2	201593	NUT, K-LOCK, #8-32, 18-8 SS
7	4	201627	WASHER, FLAT, USS, 3/8, 18-8 SS
8	4	201628	WASHER, LOCK, 1/8, 18-8 SS
9	8	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
10	4	201904	BHCS, 3/8-16 X 2.250, 18-8 SS
11	1	201927	CONSOLE ASSY, 3HP, 1PH, 220V
	1	201928	CONSOLE ASSY, 3HP, 3PH, 220V
	1	201929	CONSOLE ASSY, 3HP, 3PH, 380V
12	10	201930	HHCS, 1/4-20 X 1.000, ZP GRD 8
13	20	202146	HHCS, 1/4-20 X 0.750, ZP GRD 8
14	4	202152	HHCS, 3/8-16 X 1.000, ZP GRD 8
15	6	202174	WIRE NUT, #A8-14AWG, PORCELAIN
16	24	202191	BHCS, #8-32 X 0.250, 18-8 SS
17	5	202200	BHCS, #8-32 X 0.750, 18-8 SS
18	4	202204	HHCS, 5/16-18 X 0.875, ZP GRD 8
19	1	202262	HARNESS, XMFR-CT-LIGHTS
20	4	202292	BHCS, PATCH, #8-32 X 0.250, BO
21	12	202401	WASHER, FLAT, 1/4, ZP SAE
22	1	202456	BLEED VALVE KIT, PH(X)-2
23	30	202553	WASHER, LOCK, 1/4, ZP
24	4	202554	WASHER, LOCK, 5/16, ZP
25	4	202555	WASHER, LOCK, 3/8, ZP
26	4	202556	WASHER, FLAT, 5/16, ZP SAE
27	4	202557	WASHER, FLAT, 3/8, ZP USS
28	8	202560	WASHER, 0.500 OD X .230 ID, NE
39	8	202561	WASHER, SLEEVE, 1/4 X 0.188
30	4	202562	PHCS, #10-32 X 0.3125, ZP
31	4	202779	SHCS, #10-24 X 2.000, ZP ALLOY
32	1	CL-03004	HEATER COVER TOP
33	1	CL-03005	HEATER COVER FRONT
34	2	CL-03006	HEATER COVER ENDS
35	1	CL-03007	THERMOCOUPLE COVER
36	1	CL-03008	HEATER HOLE COVER 1
37	1	EL-35	HOSE HEAT RELAY
38	1	EL-35-1	HEAT SINK
39	1	EL-37	TRANSFORMER; SIGNAL
40	4	EL-00051A-6	1/4 X #6 JIC MALE FTG
41	1	EL-51A-4	TSU WITH FITTINGS
42	2	EL-63	PREHEATER ELECTRICAL CONNECTOR

ITEM	QTY	PART NUMBER	DESCRIPTION
43	1	EL-00118A-00-1	HOSE BREAKER MOUNTING PLATE
44	1	EL-150	CIRCUIT BREAKER 63AMP
45	1	EL-192	TERMINAL BLOCK
46	1	EL-193	INRUSH CURRENT LIMITER
47	2	EL-195	0-5000 PRESS TRANSDUCER
48	2	EL-05220-01	CONSOLE KNOBS
49	1	EL-05230-03	RT ANGLE CONDUIT CONNECTOR
50	1	EL-05235	THERMOCOUPLE HARNESS, 24"
51	1	FR-10	FRAME ASSY, PH-2
52	1	GP-00960-1 QRT	PUMP LUBE, 1 QRT
53	1	HI-05003	DIRECTIONAL VALVE
54	2	HI-05016	3/4 MPT X 3/4 FPT SW
55	2	HI-05028	PRESSURE GAUGE 0-3000 PSI
56	1	HI-05048	DRAIN PLUG
57	2	HI-05304	HYD CYLINDER TUBE
58	1	HI-05335	HYDRAULIC MANIFOLD ASSY
59	1	HI-05343	EXIT MANIFOLD ASSY, PH(X)-2
60	2	HI-05347	3/8 NPT X 6 JIC 90 DEGREE
61	2	HI-05351	PRESSURE MANIFOLD
62	2	KT-00029-4	FERRUEL, 6 AWG, GREEN
63	2	KT-00029A-1	HOSE HEAT, CONNECTOR BODY
64	1	KT-05005	INLET MONITORING KIT
65	1	LB-05	BLACK S/N BLANK
66	2	LB-05006	LABEL, HIGH VOLTAGE
67	1	LB-05007	LABEL, HOT SURFACE
68	2	LB-05009	LABEL, PINCH POINT
69	1	ML-1	MOTORLINE ASSY 18CC, 3HP, 3PH
	1	ML-2	MOTORLINE ASSY 18CC, 3HP, 1PH
70	1	MQ-01009-01A	LUBE BOTTLE
71	1	MQ-01009-02A	LUBE BOTTLE LID
72	1	PH-21	6 ROD PREHEATER ASSY, 7.5KW
	1	PH-22	6 ROD PREHEATER ASSY, 9KW
	1	PH-23	6 ROD PREHEATER ASSY, 10.5KW
	1	PH-33	8 ROD PREHEATER ASSY, 14KW
73	1	PL-9	PUMP-LINE, PH-2
74	2	PU-07000	CLEAR PUMP COVER
75	1	RA-00066A	CBMB 90 DEG MALE ELBOW NPT
76	1	RA-00067A	CBMB 90 DEG MALE ELBOW NPT
77	1	RA-00068A	CHECK VALVE
78	1	RA-06008	CHECK VALVE
79	11	RM-00019	#6 HOSE HEAT WIRE
80	1	RM-212	TRANSFORMER DOOR
81	1	RM-222	TRANSFORMER BRACKET

ITEM	QTY	PART NUMBER	DESCRIPTION
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82	2	RM-243	PROX SENSOR MOUNTING ASSY
83	1	RM-05201-2	CONSOLE ENCLOSURE, TOP
84	3.6	RM-E-64-0100	POLYFLO TUBING, 3/8"
85	3.6	RM-E-86-0100	POLYFLO TUBING, 1/2"
86	1.5	RM-RL-05230-01	3/4 X 1/4 X 100' FLEX CONDUIT
87	1	TL-01	TOOL, CLEVIS EXTRACTOR
88	2	TN-04196	HOSE CLAMP
89	1	YS-1	Y-STRAINER ASSY "A" SIDE
90	1	YS-2	Y-STRAINER ASSY "R" SIDE

15.15 PH-2 HOSES

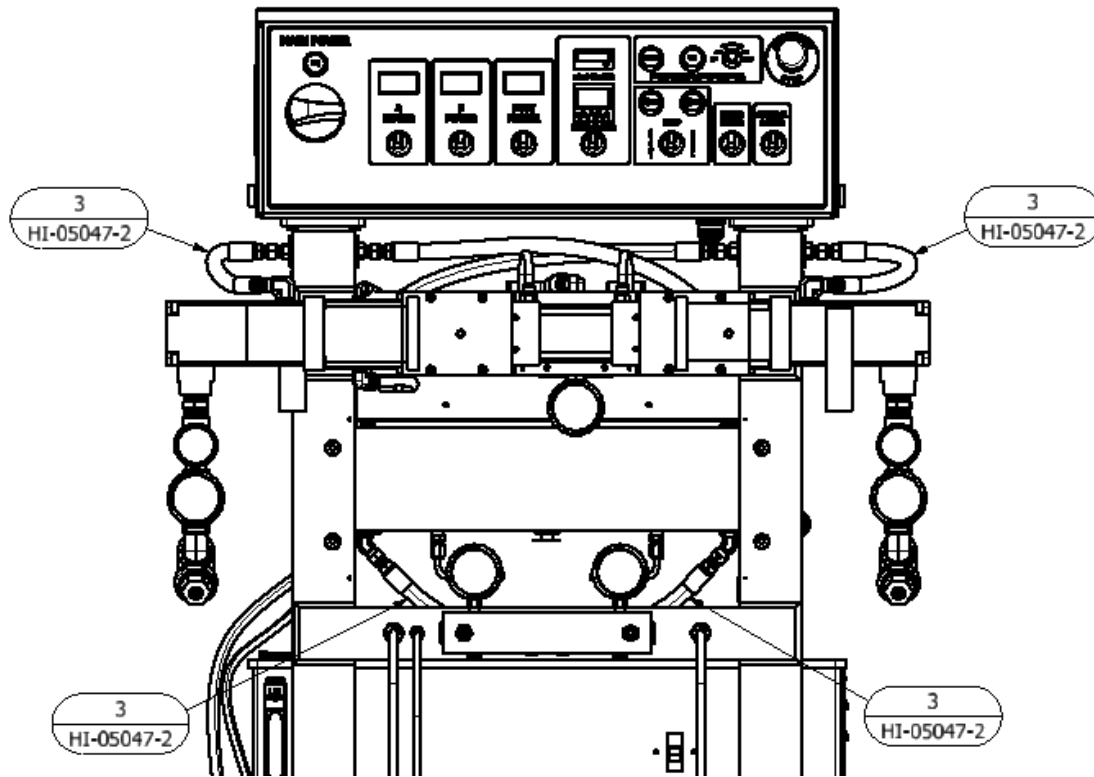


Figure 46: Proportioner Hoses - Front

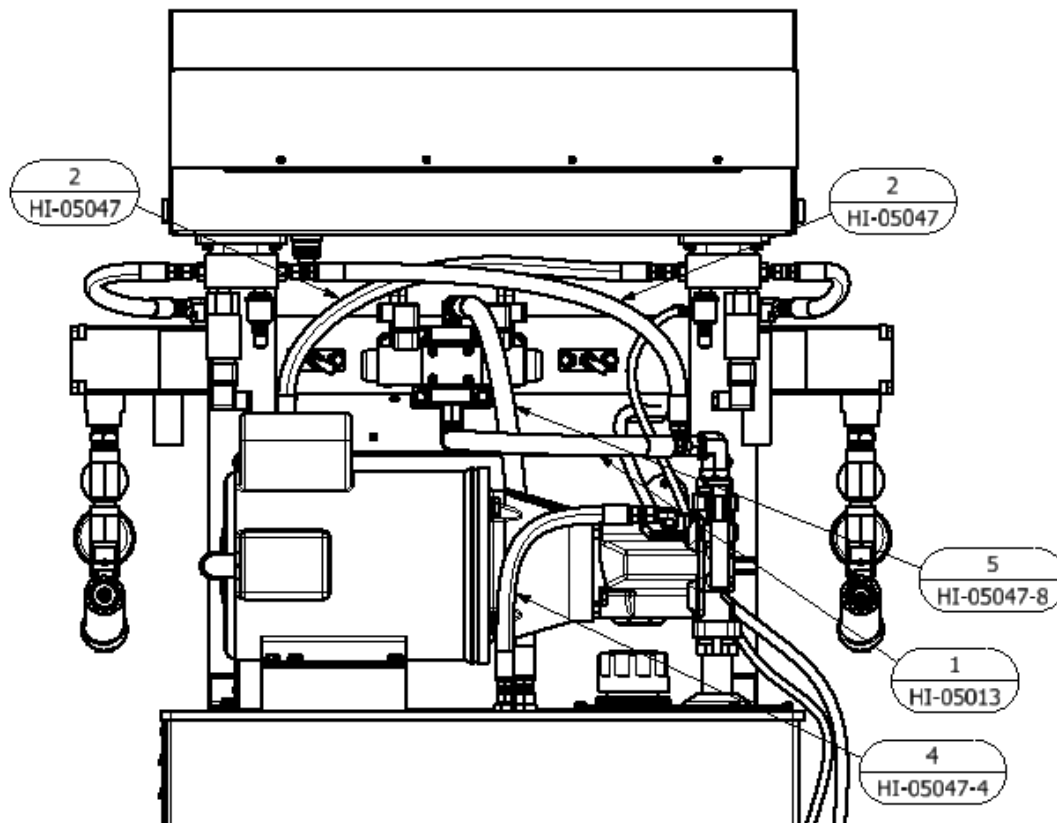


Figure 47: Proportioner Hoses - Back

PROPORTIONER HOSES			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05013	HOSE 1/2 X 2 HYD TANK RETURN
2	2	HI-05047	HOSE, PUMP TO HEATER
3	4	HI-05047-2	HOSE 9" HYD PUMP TO TANK
4	1	HI-05047-4	HOSE 13" TOP PUMP CYL
5	1	HI-05047-8	HOSE ASSY

15.15.1 HALF INCH HOSE KIT

HALF INCH HOSE KIT (200599)		
PART NUMBER	DESCRIPTION	QTY
200600	6 ORB X 8 JIC	1
200601	6 ORB X 10 JIC	1
200602	6 ORB X 8 JIC 90 DEG	1
200603	6 ORB X 10 JIC 90 DEG	1
RA-00019	JIC REDUCER 7/8-14 X 9/16-18	1
RA-00020	JIC REDUCER 3/4-16 X 1/2-20	1

15.16 LUBE BOTTLE COMPONENTS

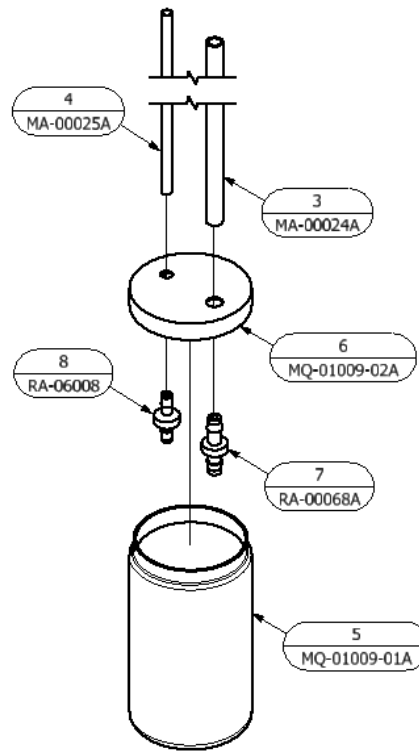


Figure 48: Lube Bottle Components

LUBE BOTTLE COMPONENTS			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	GP-00960-1-GAL	PUMP LUBE GALLON
2	1	GP-00960-1-QRT	PUMP LUBE QUART
3	1	MA-00024A	1/2" X 43' PLASTIC TUBING, RETURN
4	1	MA-00025A	3/8" X 43' PLASTIC TUBING
5	1	MQ-01009-01A	LUBE BOTTLE
6	1	MQ-01009-02A	LUBE BOTTLE LID
7	1	RA-00068A	CHECK VALVE
8	1	RA-06008	CHECK VALVE, POLYTUBE, 3/8

LUBE ASSY KIT, PH(X)-2 (202640)		
QTY	PART NUMBER	DESCRIPTION
1	MA-00024A-1	1/2" X 43' PLASTIC TUBING, RETURN
1	MA-00025A-1	3/8" X 43' PLASTIC TUBING
1	MQ-01009-01A	LUBE BOTTLE
1	MQ-01009-02A	LUBE BOTTLE LID
1	RA-00066A	MALE ELBOW, 3/8 TUBE X 1/4 NPT
1	RA-00067A	MALE ELBOW, 1/2 TUBE X 3/8 NPT
1	RA-00068A	CHECK VALVE
1	RA-06008	CHECK VALVE, POLYTUBE, 3/8

15.17 BLEED VALVE KIT

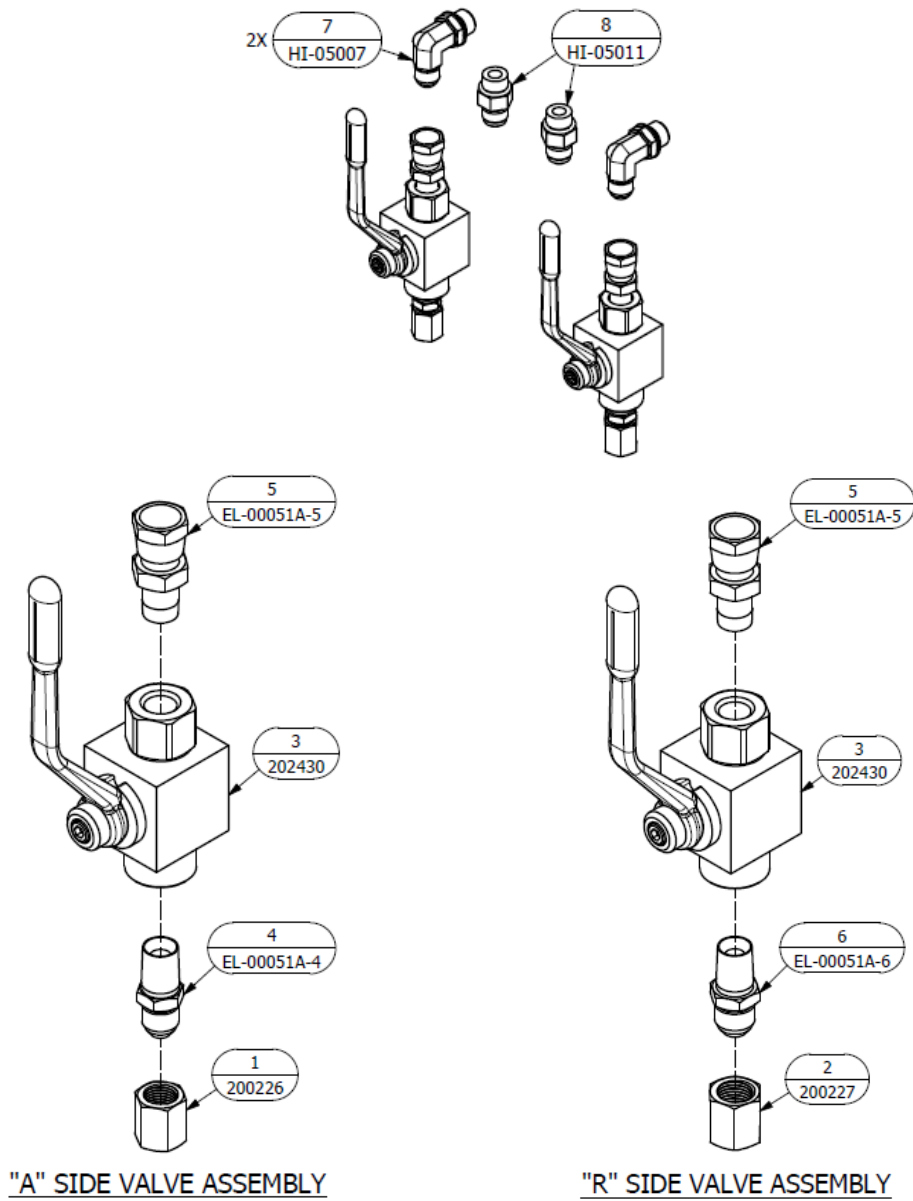


Figure 49: Bleed Valve Kit (202456)

BLEED VALVE KIT (202456)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	200226	5 JIC CAP
2	1	200227	6 JIC CAP
3	2	202430	BALL VALVE, 1/4 NPT, 5000 PSI
4	1	EL-00051A-4	1/4 NPT X 5 JIC
5	2	EL-00051A-5	1/4 NPT X 6 SWIVEL
6	1	EL-00051A-6	1/4 NPT X 6 JIC
7	2	HI-05007	6 ORB X 6 JIC 90 DEG
8	2	HI-05011	9/16-18 O-RING X #6 JIC