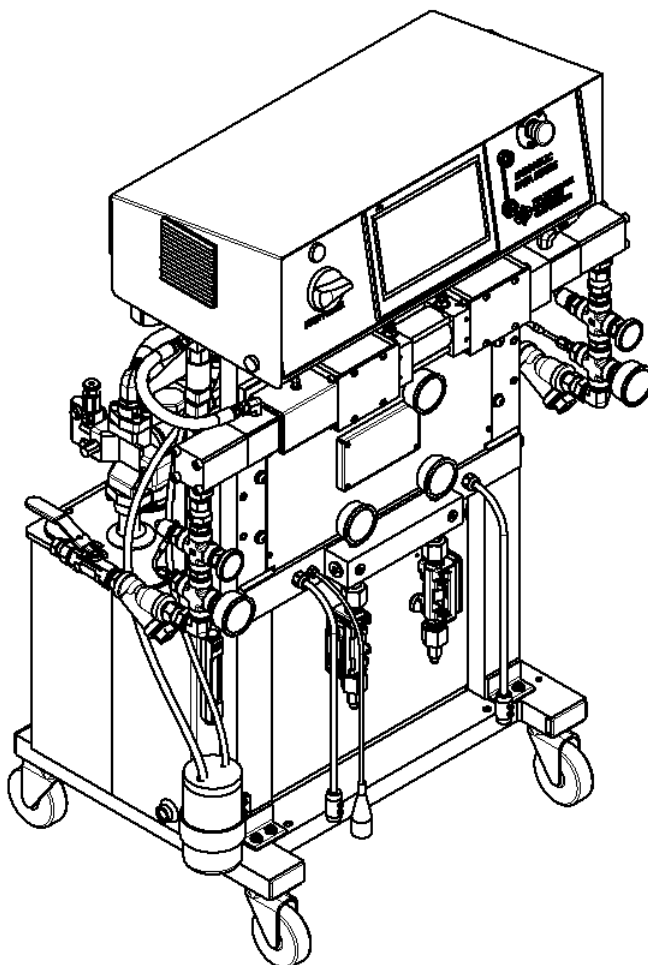

PHDX-2 Proportioner

Service Manual

Ref. # 202266
Revision 1.7



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 PHD Series Proportioner.



Before installing the PHD Series Proportioner and start-up, 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 PHD Series Proportioner. All of the information is aimed at improving user safety and avoiding possible breakdowns from the incorrect use of the PHD Series Proportioner.

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 PHD 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 PHD 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 at all times. If you lose this manual, ask for a new copy from your PMC Service Center or go on line at our web site (www.polymacusa.com).

The PHD 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 PHD 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 PHD 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 PHD 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 PHD 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.

	<i>To prevent possible injury caused by incorrect handling of the raw materials and solvents used in the process, carefully read the Material Safety Data Sheet (SDS) provided by your supplier. Deal with the waste caused according to current regulations.</i>
	<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>
	<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>
	<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>
	<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>

3 CHARACTERISTICS

The PHD 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.

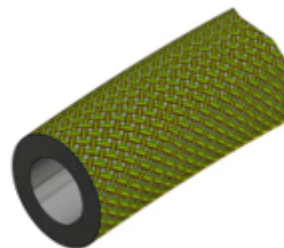
3.1 PRINCIPAL HEATING SYSTEM

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 a 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^o 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.



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.

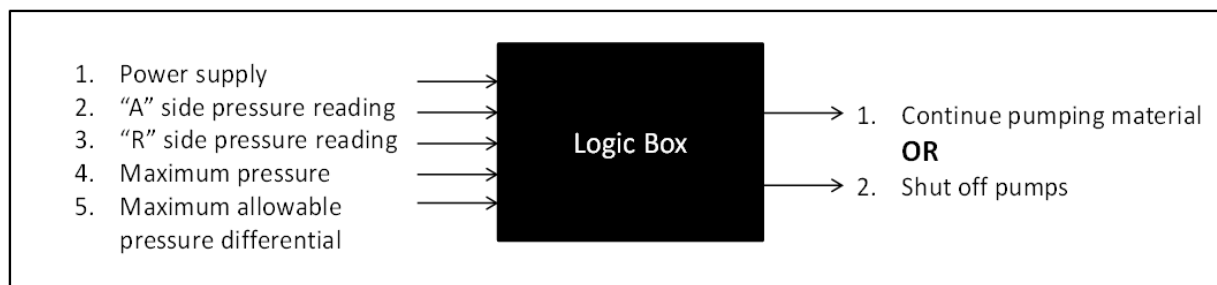


Figure 1: Pressure Balance Control Logic Diagram

4 TECHNICAL SPECIFICATIONS

4.1 ELECTRICAL

PHDX-2, Single Phase, 208-240V

Pressure	Heater Size	Electrical Consumption
3,000PSI	9.0kW(4.5kW/side)	83A
	10.5kW(5.25kW/side)	90A
	14.0kW(7.0kW/side)	105A

PHDX-2, Three Phase, 208-240V

Pressure	Heater Size	Electrical Consumption
3,000PSI	9.0kW(4.5kW/side)	50A
	10.5kW(5.25kW/side)	53A
	14.0kW(7.0kW/side)	62A

PHDX-2, Three Phase, 400V

Pressure	Heater Size	Electrical Consumption
3,000PSI	9.0kW(4.5kW/side)	34A
	10.5kW(5.25kW/side)	36A
	14.0kW(7.0kW/side)	41A

Material Heater Power	Power Consumption
4.50kW/side(3x1500W/side)	9.0kW
5.25kW/side(3x1750W/side)	10.5kW
7.0kW/side(4x1750W/side)	14.0kW
Hose Transformer	Power Consumption
70V	2kVA
90V	3kVA
120V	5kVA
Electrical Motor	Power Consumption
PHDX-2	5hp

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

4.2 MECHANICAL

123 Pumps	
Maximum Working Pressure	3,000PSI(21MPa, 207bar)
Maximum Production	2.3gal/min(10.5L/min)
Minimum Production	2lb/min(1kg/min)
Gallons per Cycle	0.00911gal/cycle(0.03449L)
Cycles per 55gal(200L) Drum	6,037cycles
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)	
37in x 25in x 54in (95cm x 63cm x 138cm)	

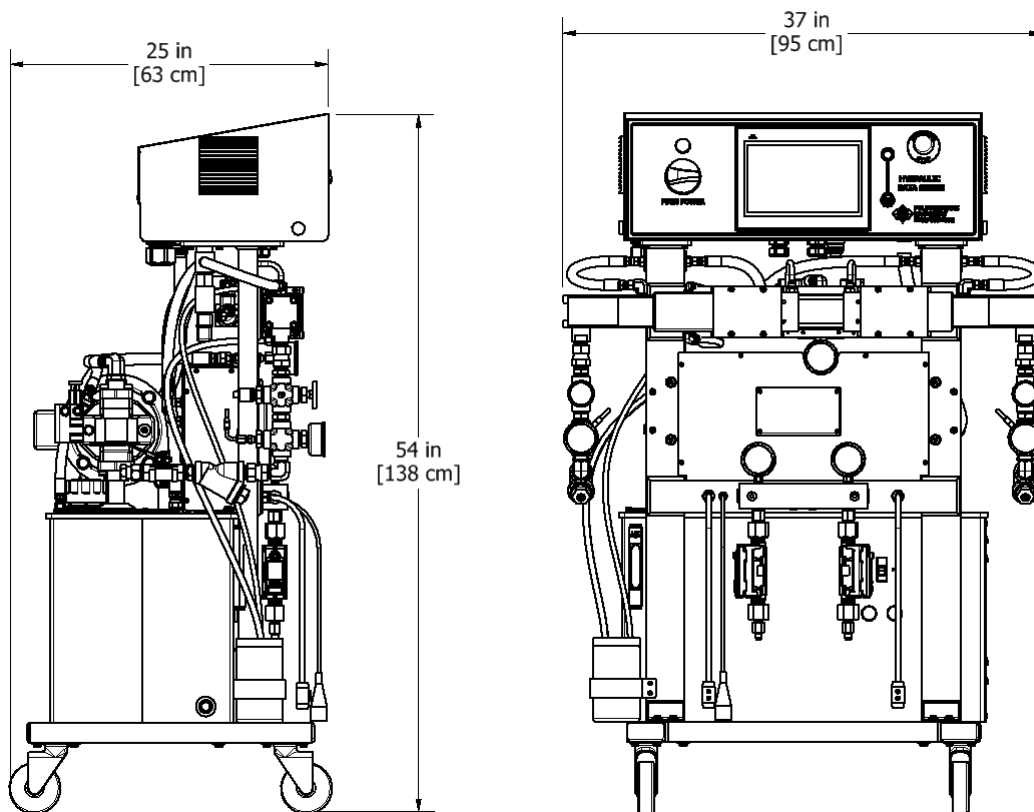


Figure 2: Proportioner Dimensions

5 DESCRIPTION

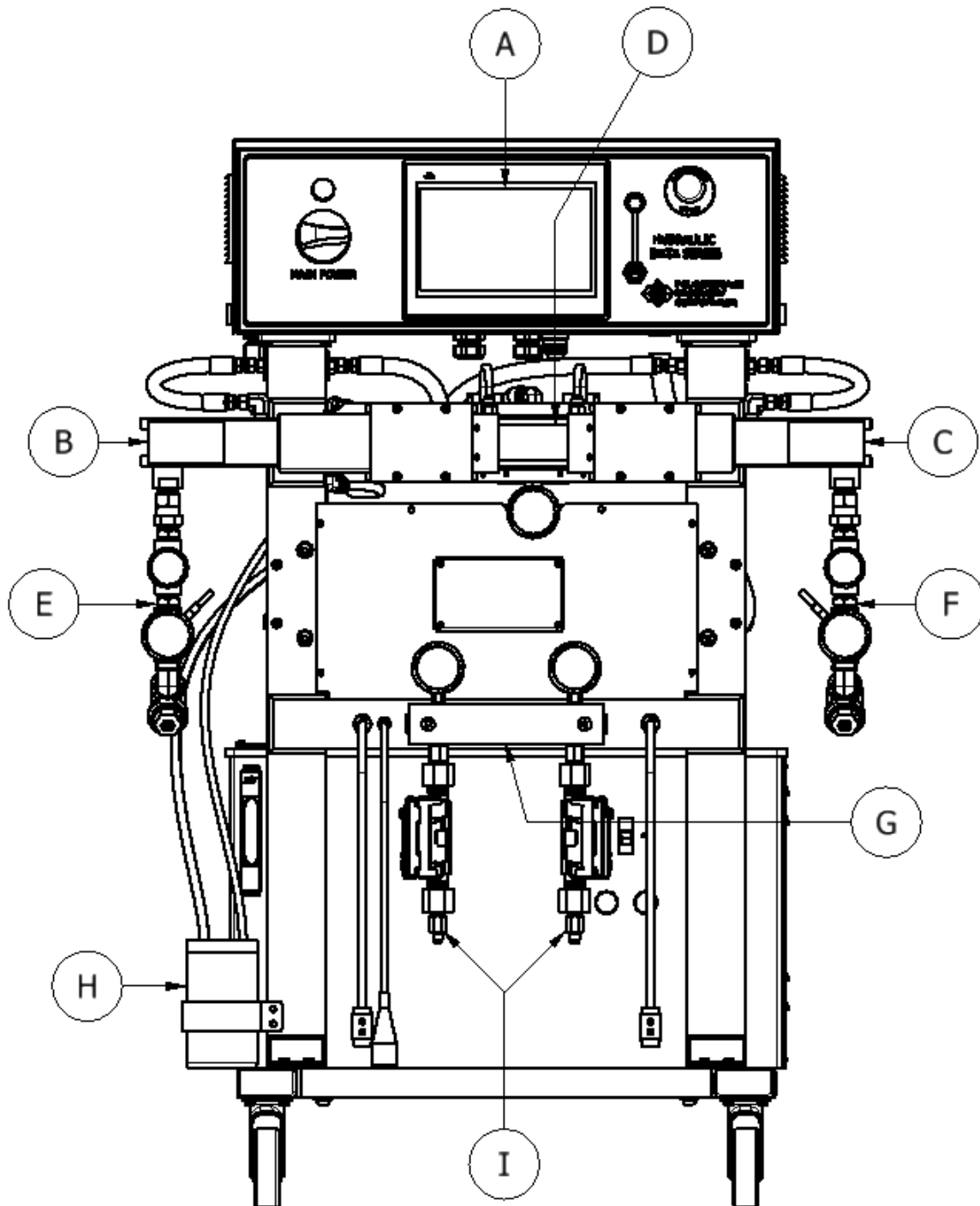


Figure 3: Component Identification - Front

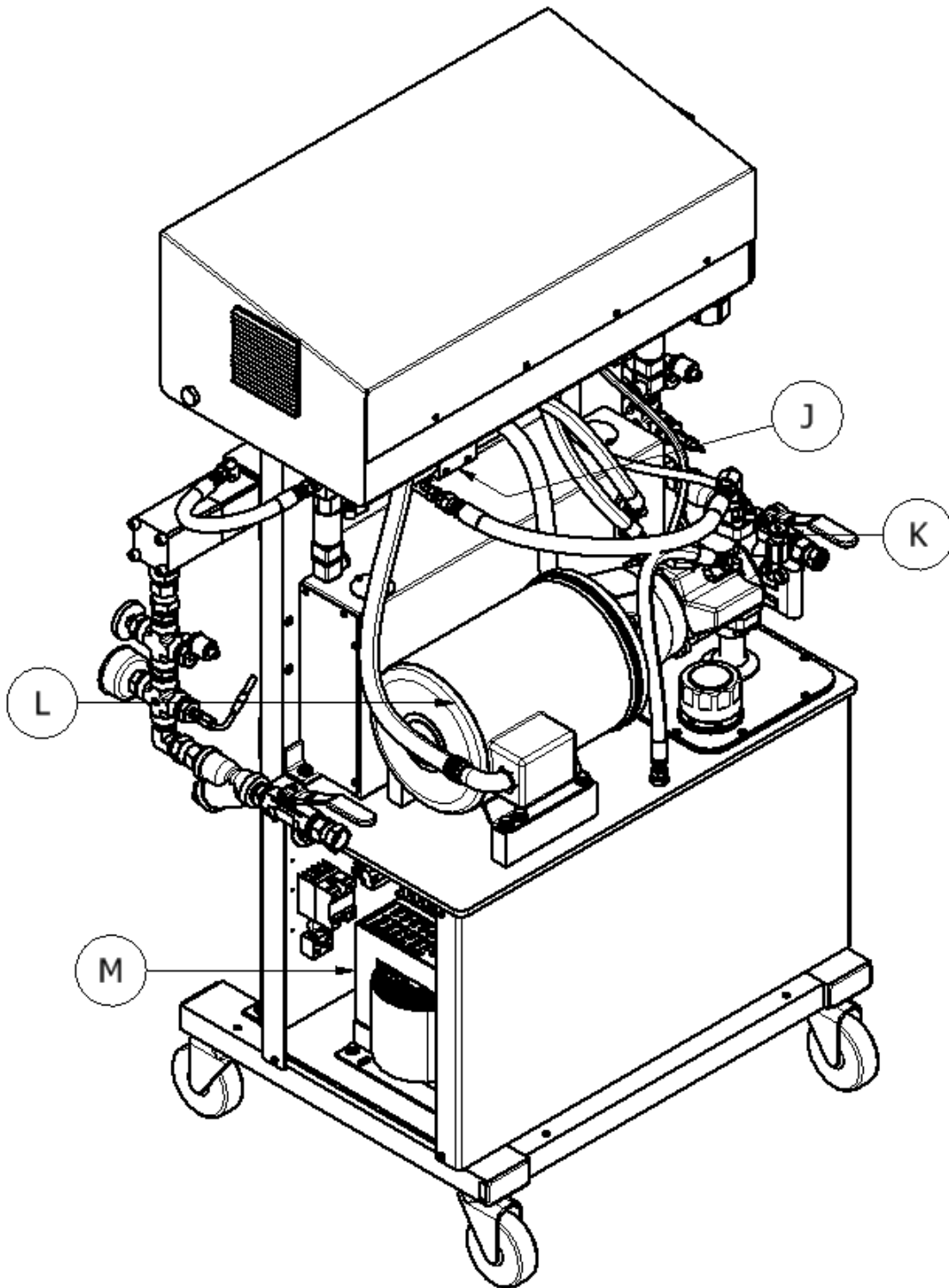


Figure 4: Component Identification - Back

- A. Control Panel** - Controls and regulates the operation of the PHD 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. Flow Meters (Optional)** - Monitor the flow rate of both materials exiting the Proportioner.
- J. Hydraulic Manifold Assembly** - Provides pressure reading of hydraulic fluid and controls direction of flow.
- K. 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.
- L. Motor** - Provides power for hydraulic pump.
- M. Hose Heating Transformer - Right side (inside of hydraulic tank)** - Supplies the required voltage for material Heated Hoses.

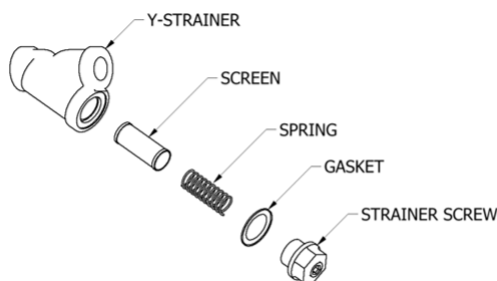


Figure 5: Y-Strainer Components

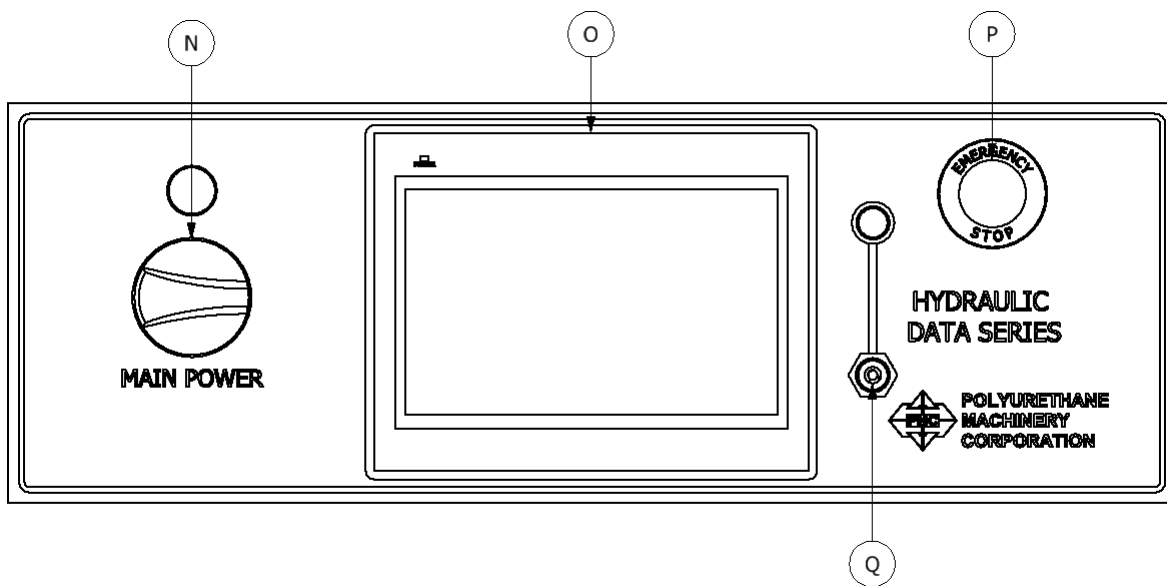


Figure 6: Front Panel Description

- 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. Human-Machine Interface (HMI)** - The HMI unit on this PHD Series Proportioner is a 10.1" touch screen. This screen is used to operate the PHD Series Proportioner and allows users to enable/disable optional functions of the Proportioner.
- P. Emergency Stop** - Interrupts the PHD Series control power circuit to stop all motion and heating.
- Q. USB Port** - The USB Port is used to update the software of the PHD Series Proportioner as well as to retrieve data collected during usage.

5.1 OPERATION MENU

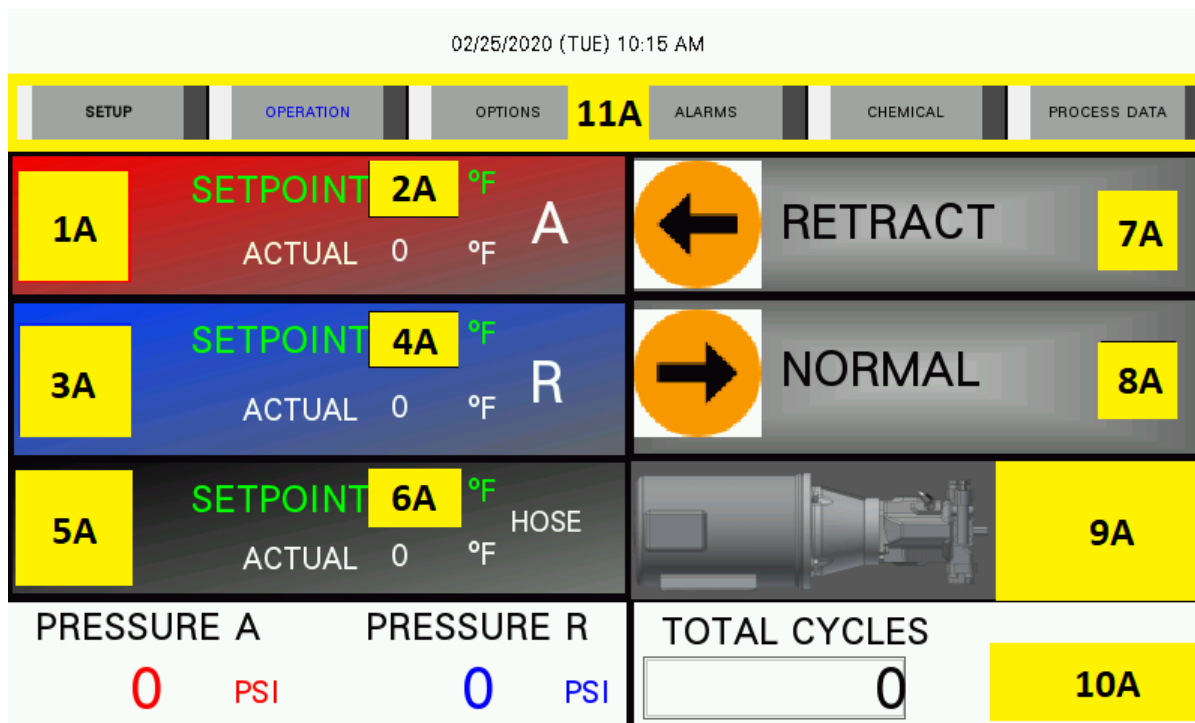


Figure 7: HMI Operation Menu

- 1A - A SIDE HEATER ON/OFF
- 2A - INPUT A SIDE HEATER TEMPERATURE
- 3A - R SIDE HEATER ON/OFF
- 4A - INPUT R SIDE HEATER TEMPERATURE
- 5A - HOSE HEAT ON/OFF
- 6A - INPUT HOSE HEAT TEMPERATURE
- 7A - PUMP TO RETRACT POSITION ON/OFF
- 8A - PUMP POWER ON/OFF
- 9A - MOTOR POWER ON/OFF
- 10A - CYCLE COUNTER RESET
- 11A - SCREEN NAVIGATION

5.2 OPTIONS MENU

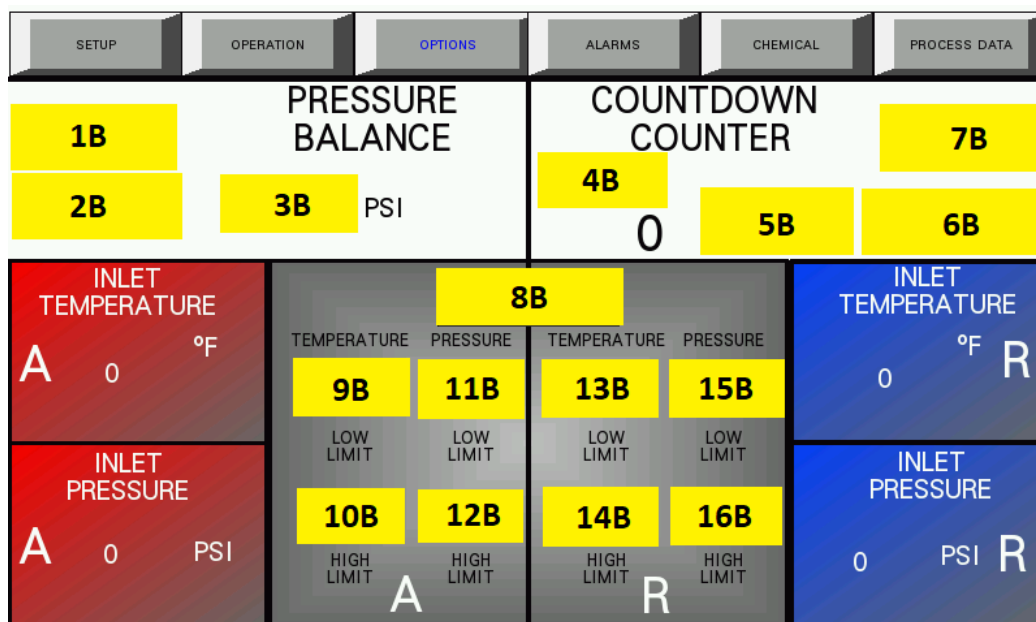


Figure 8: HMI Options Menu

- 1B - PRESSURE BALANCE CONTROL ON/OFF
- 2B - PRESSURE BALANCE ALARM RESET
- 3B - INPUT PRESSURE BALANCE CONTROL VALUE
- 4B - INPUT COUNTDOWN COUNTER
- 5B - SET COUNTDOWN COUNTER
- 6B - COUNTDOWN COUNTER RESET
- 7B - COUNTDOWN COUNTER ON/OFF
- 8B - INLET MONITORING PARAMETERS ON/OFF
- 9B - INPUT A SIDE TEMPERATURE LOW LIMIT
- 10B - INPUT A SIDE TEMPERATURE HIGH LIMIT
- 11B - INPUT A SIDE PRESSURE LOW LIMIT
- 12B - INPUT A SIDE PRESSURE HIGH LIMIT
- 13B - INPUT R SIDE TEMPERATURE LOW LIMIT
- 14B - INPUT R SIDE TEMPERATURE HIGH LIMIT
- 15B - INPUT R SIDE PRESSURE LOW LIMIT
- 16B - INPUT R SIDE PRESSURE HIGH LIMIT

5.3 ALARMS MENU

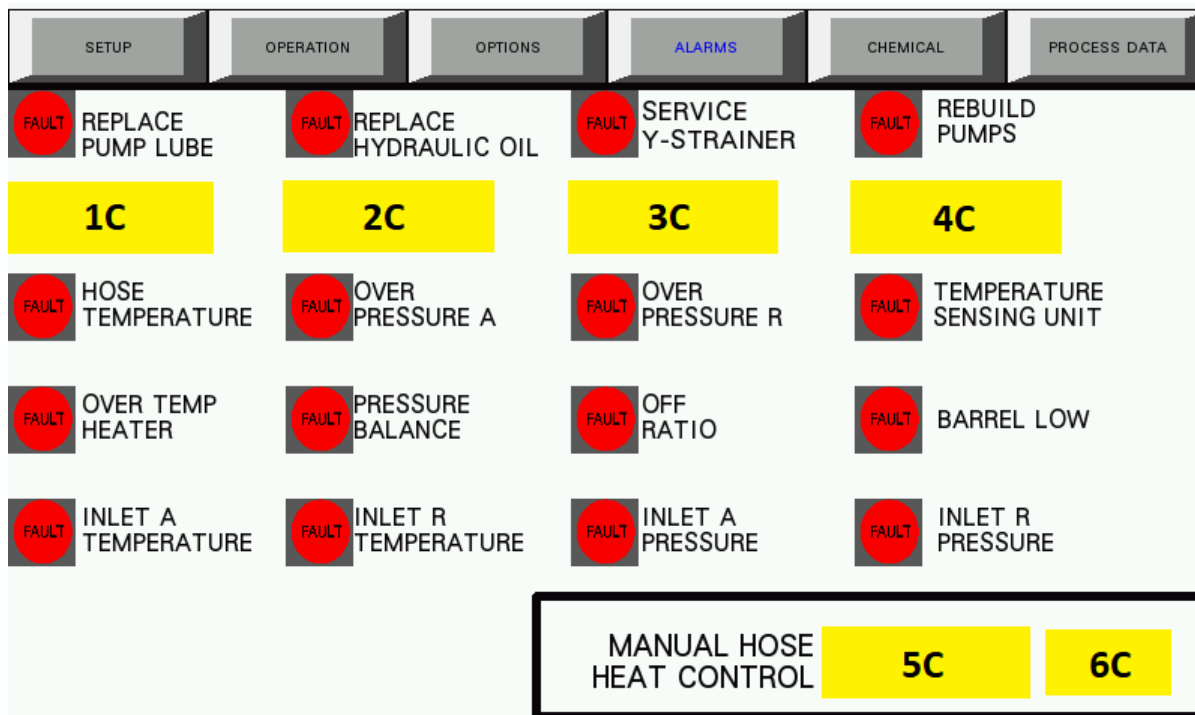


Figure 9: HMI Alarms Menu

1C - REPLACE PUMP LUBE ALARM RESET

2C - REPLACE HYDRAULIC OIL ALARM RESET

3C - SERVICE Y-STRAINER ALARM RESET

4C - PUMP REBUILD ALARM RESET

5C - MANUAL HOSE HEAT ON/OFF

6C - INPUT HOSE HEAT

5.4 CHEMICAL MENU

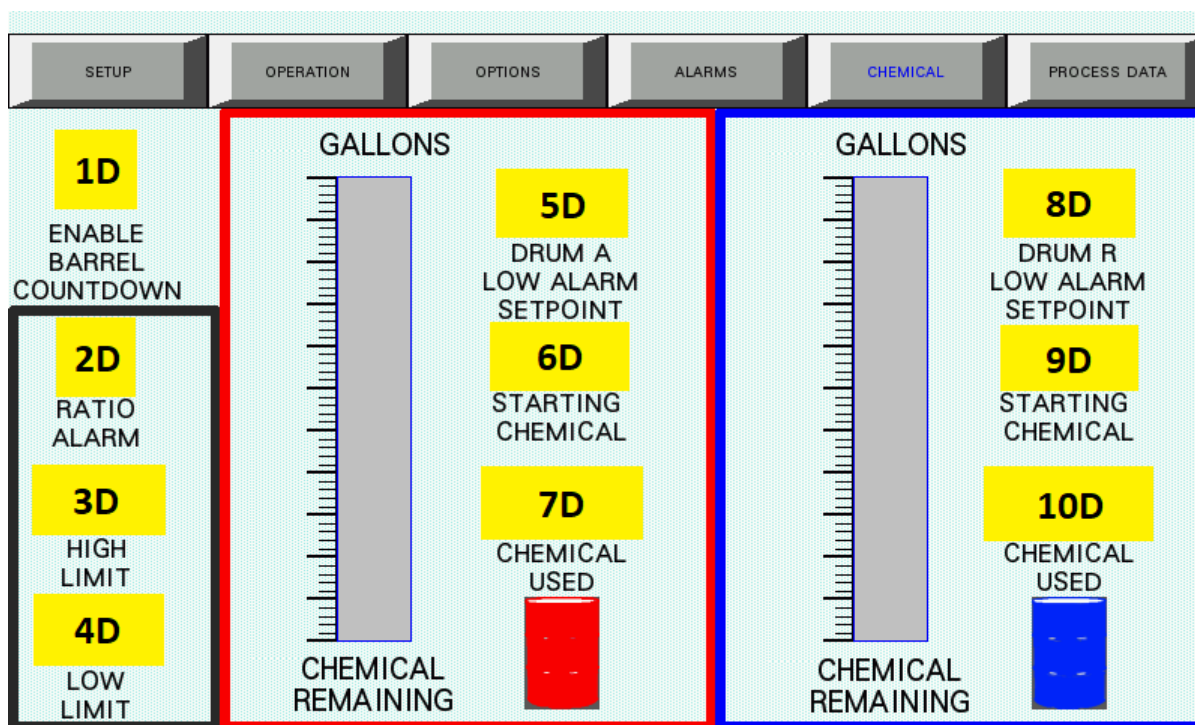


Figure 10: HMI Chemical Menu

- 1D - CHEMICAL COUNTDOWN COUNTER ON/OFF
- 2D - RATIO ALARM ON/OFF
- 3D - INPUT CHEMICAL RATIO HIGH LIMIT
- 4D - INPUT CHEMICAL RATIO LOW LIMIT
- 5D - INPUT LOW LIMIT FOR CHEMICAL A ALARM
- 6D - INPUT STARTING AMOUNT OF CHEMICAL A
- 7D - DISPLAYS AMOUNT OF CHEMICAL A USED
- 8D - INPUT LOW LIMIT FOR CHEMICAL R ALARM
- 9D - INPUT STARTING AMOUNT OF CHEMICAL R
- 10D - DISPLAYS AMOUNT OF CHEMICAL R USED

5.5 PROCESS DATA MENU

2020/02/25 (TUE) 10:17:34 AM

JOB NUMBER **1E** HISTORY DATA QUERY BY DATE (YYYYMMDD) **2E**

PROCESS DATA **3E**

ALARM DATA **4E**

5E

Figure 11: HMI Process Menu

1E - INPUT JOB NUMBER

2E - INPUT DATE OF JOB

3E - DATA DISPLAY

4E - ALARM DISPLAY

5E - USB EJECT

5.6 SETUP MENU LOGIN

The diagram illustrates the 'Setup Menu Login' screen, which is divided into two main sections. The top section, titled 'USER ACCESS LOGIN' in a blue header bar, contains three input fields: 'USER NAME' (labeled 1F), 'ACCESS PASSWORD' (labeled 2F), and two buttons labeled 3F and 4F. The bottom section, titled 'USER LEVEL LOGIN' in a blue header bar, contains one input field labeled 'LEVEL PASSWORD' (labeled 5F). A red 'X' icon is located in the top right corner of the 'USER ACCESS LOGIN' section.

USER ACCESS LOGIN	
USER NAME	1F
ACCESS PASSWORD	2F
3F	4F

USER LEVEL LOGIN	
LEVEL PASSWORD	5F

Figure 12: Setup Menu Login

1F - INPUT USER NAME

2F - INPUT PASSWORD

3F - LOGIN

4F - LOGOUT

5F - INPUT LEVEL PASSWORD

5.7 SETUP MENU

FACTORY SETUP		SETUP		OPERATION		LOGOUT	
LANGUAGE		°F PSI GALLONS		CHANGE LEVEL 1 PASSWORD			
1G		2G		3G			
2020/02/25 (TUE) 10:14:29 AM				10G			
				0/ 0/0 0: 0:0			
MONTH	DAY	YEAR	MONTH	DAY	YEAR		
4G	5G	6G	11G	12G	13G		
HOUR	MINUTE	SECOND	HOUR	MINUTE	SECOND		
7G	8G	9G	14G	15G	16G		

Figure 13: Setup Menu

1G - TOGGLE AVAILABLE LANGUAGES

2G - TOGGLE AVAILABLE UNITS

3G - CHANGE PASSWORD

4G - INPUT DISPLAYED MONTH VALUE

5G - INPUT DISPLAYED DAY VALUE

6G - INPUT DISPLAYED YEAR VALUE

7G - INPUT DISPLAYED HOUR VALUE

8G - INPUT DISPLAYED MINUTE VALUE

9G - INPUT DISPLAYED SECOND VALUE

10G - SET DISPLAY AND INTERNAL TIME AND DATE

11G - INPUT INTERNAL MONTH VALUE

12G - INPUT INTERNAL DAY VALUE

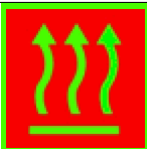
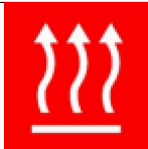
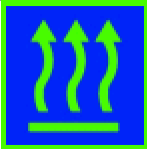







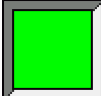
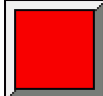
13G - INPUT INTERNAL YEAR VALUE

14G - INPUT INTERNAL HOUR VALUE

15G - INPUT INTERNAL MINUTE VALUE

16G - INPUT INTERNAL SECOND VALUE

5.8 BUTTON APPEARANCE

CONTROL	ON	OFF
Heater A (Figure 7, Item 1)		
Heater R (Figure 7, Item 3)		
Hose Heat (Figure 7, Item 5)		
Motor (Figure 7, Item 9)		
Standard Button #1		
Standard Button #2		

5.9 DATA COLLECTION

The PHD series proportioner has the ability to collect and store data. The data is set, by default, to be saved onto an SD card located in the PLC within the console. A USB memory stick can be inserted on the front panel and the data will automatically be stored on the USB as well as the SD card, **HOWEVER**, the USB must be inserted **DURING** machine usage for the data to be stored. For example, if someone wanted to record 24 hours of data using a USB stick, the USB must be plugged into the machine for the full 24 hours of usage. It is important to note that the PHD series proportioner has **NO BUILT IN MEMORY**. Meaning if there is no USB in at the time of usage and the SD card has been removed, the proportioner **WILL NOT** record any data. Follow the instructions detailed below to retrieve data off of the USB or SD card.

ACCESSING USB DATA

1. Push the "USB EJECT" button (Item 33, Figure 11) in the PROCESS DATA menu so it reads "REMOVE USB".
2. Remove the USB stick from the front of the machine and insert it into a laptop or desktop computer.
3. Open the USB file.
4. Open the "trend" folder.
5. Open the "HistoryData" folder.
6. The data files are named automatically using the template "YYYYMMDD" where "YYYY" is the year, "MM" is the month and "DD" is the day that the data was recorded on.

ACCESSING SD CARD DATA

1. Turn the main power (Item Q, Figure 6) to the machine OFF.
2. Remove the thumbscrews on either side of the console and open the cover.
3. Open the latch to the PLC (Figure 14) to access the SD card.
4. Gently push down on the SD card (Figure 15) and it will pop up. Then remove the SD card.
5. Insert the SD card into the appropriate port of a laptop or desktop computer.
6. Open the SD card file.
7. The data files are named automatically using the template "YYYY-MM-DD" where "YYYY" is the year, "MM" is the month and "DD" is the day that the data was recorded on.

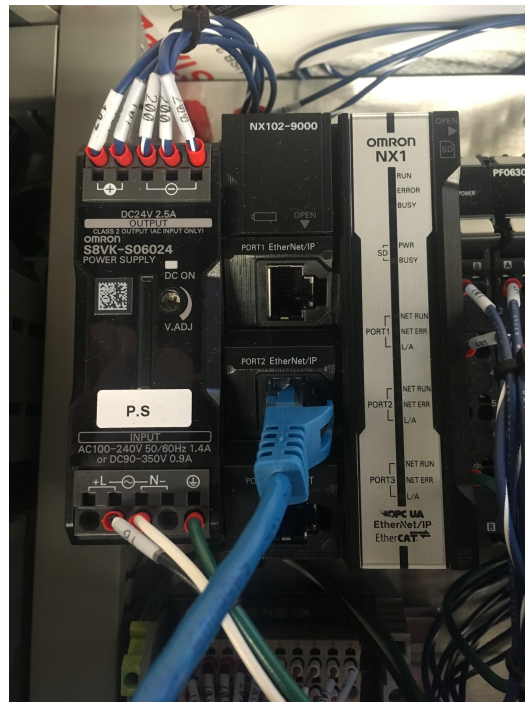


Figure 14: PLC Location - Closed

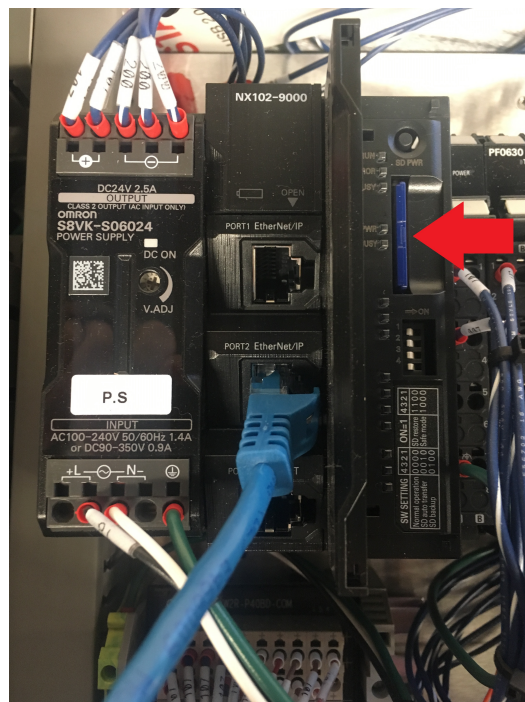


Figure 15: PLC Location - Open

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 PHD Series Proportioner works correctly, the electrical supply must meet the specifications indicated on the Serial Number Placard affixed to the Electrical Console.

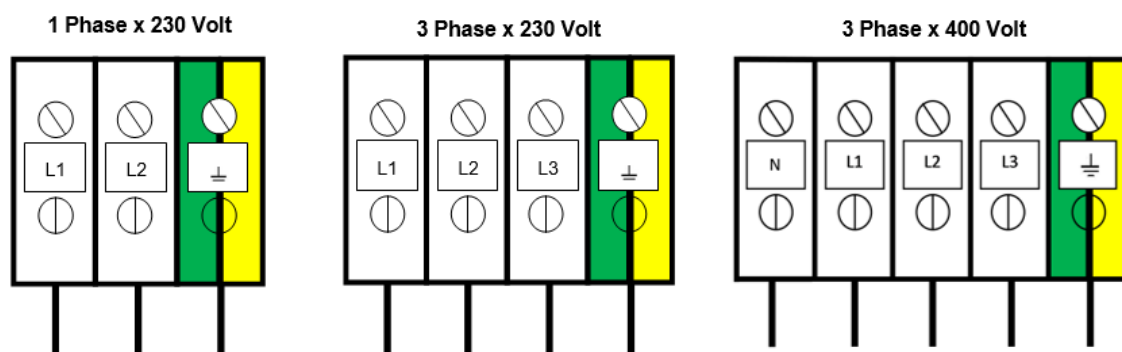


Figure 16: Electrical Installation

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 62 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 tanks 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 counter clockwise until it stops, that is the lowest hydraulic pressure setting.

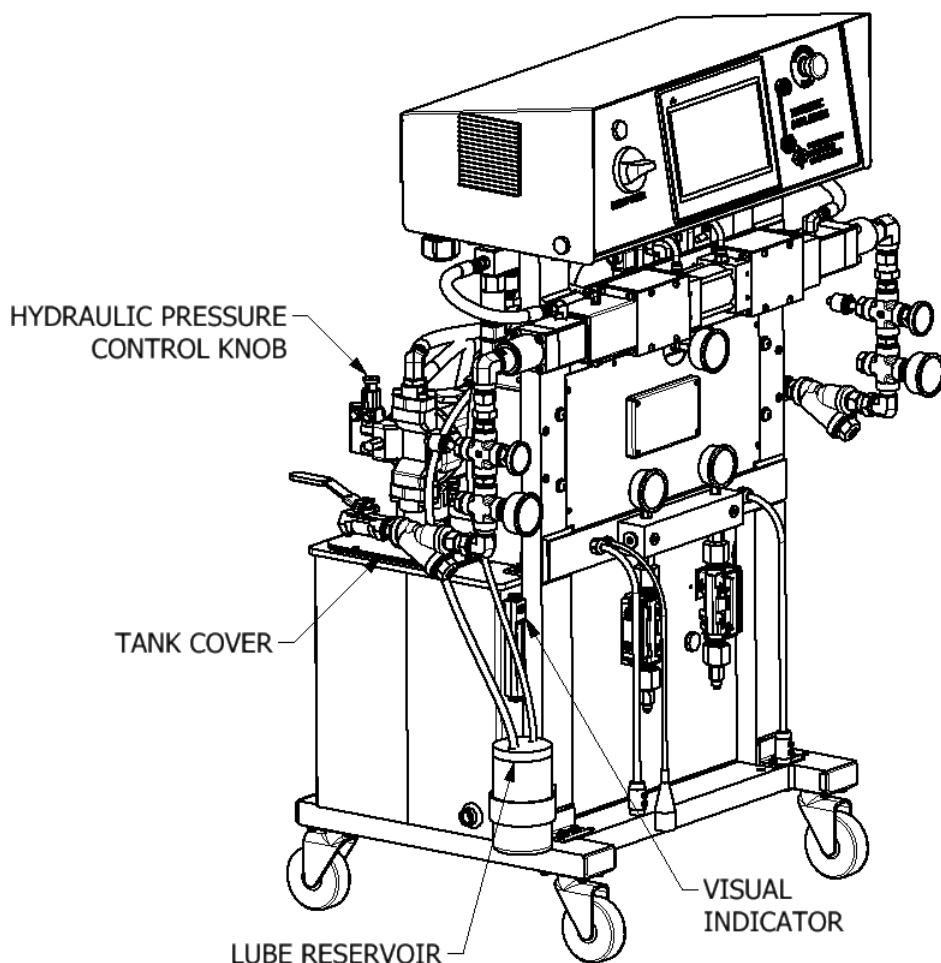


Figure 17: Component Identification - Misc

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 counter clockwise 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 diluents. 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 appropriate 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 these tapered seat Coupling Connections.

2. Connect the material Heated Hoses to the outlets of the respective Exit Manifold Assembly. Iso (A) Heated Hose to the JIC fitting on the left side of the Exit Manifold Assembly and the Poly (R) Heated Hose to the JIC fitting on the left side of the Exit Manifold Assembly. Ensure the 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 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 appropriate 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).

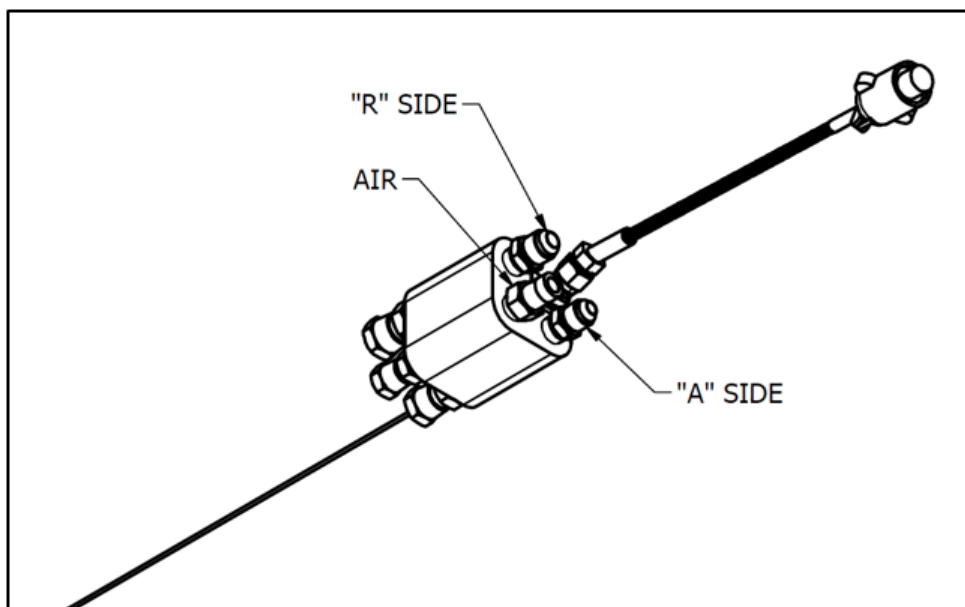


Figure 18: Temperature Sensing Unit

(TSU) 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.

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 air line coming off the first section of hose (90-110 psi, 6-8 bar)

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	Hose Length (Feet)	Hose Length (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

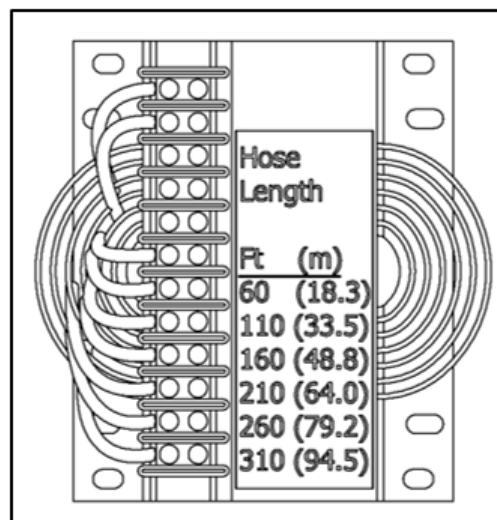
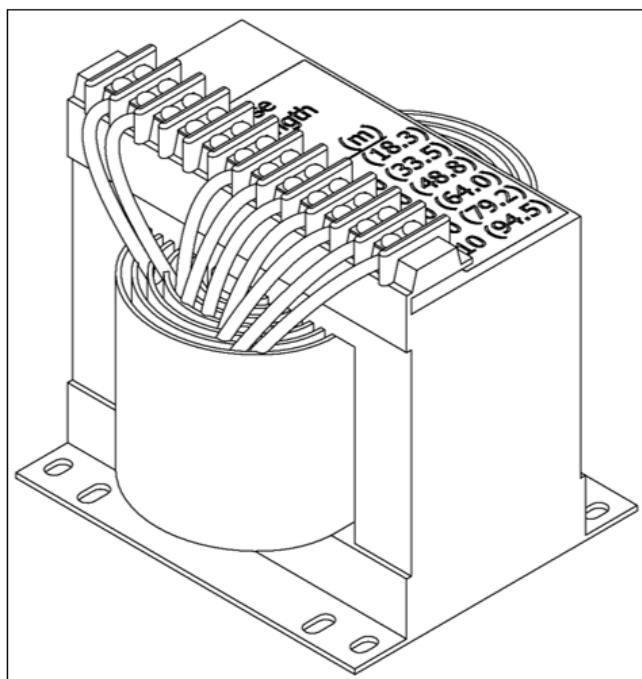


Figure 19: Transformers

*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 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.

6. Turn Hydraulic Pressure Control (Item K, Figure 4) fully COUNTERCLOCKWISE.
7. Turn ON Main Power (Item N, Figure 6).
8. Turn ON Motor Power (Item 9, Figure 7). Button will turn green when activated.
9. Activate Pump Power (Item 8, Figure 7). The button will turn green and the pump will activate. Turn Hydraulic Pressure Control CLOCKWISE increasing material pressure to 400 psi (28 bar). Both Material Pressure Gauges on the Exit Manifold Assembly (Item G, Figure 3) should approximately read the same. Check all Heated Hose Coupling connections for leakage.
10. Check all TSU and "Fast-Lock" connections for leaks.
11. 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 PHD 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.



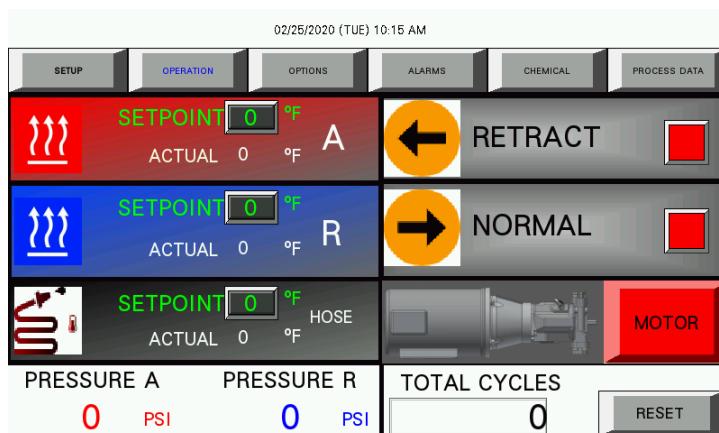
8.1 OPERATION

The Pressure Balance Control menu is located in the Options tab. This screen is detailed in Section 5.2 on page 18.

- **Input Pressure (Item 14, Figure 8)** - Press and a pop up will appear containing a standard number pad. This is where the desired value for the Pressure Balance Control is input.
- **Pressure Balance Control ON/OFF (Item 12, Figure 8)** - Press to activate the Pressure Balance Control option. Once activated the button will turn GREEN and read ON. Press to deactivate the Pressure Balance Control option.
- **Pressure Balance Control Alarm Reset (Item 13, Figure 8)** - Once a value is input and the option is activated, the PLC 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, an alarm will trigger and the Proportioner will stop pumping. Once the issue is resolved and is pushed, the alarm will reset and allow the Proportioner to pump again.










9 TEMPERATURE CONTROLS

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.



9.1 OPERATION

The Temperature Controller menu is located in the "Operation" tab. This screen is detailed in Section 5.1 on page 17.

- **Input Heater A Temperature (Item 2, Figure 7)** - Press  and a pop up will appear containing a standard number pad. This is where the desired value for the A side Heater is input.
- **A side Heater ON/OFF (Item 1, Figure 7)** - Press  to activate the A side Heater. While the A side Heater is active the button will appear as .
- **Input Heater R Temperature (Item 4, Figure 7)** - Press  and a pop up will appear containing a standard number pad. This is where the desired value for the R side Heater is input.
- **R side Heater ON/OFF (Item 3, Figure 7)** - Press  to activate the R side Heater. While the R side Heater is active the button will appear as .
- **Input Hose Heat Temperature (Item 6, Figure 7)** - Press  and a pop up will appear containing a standard number pad. This is where the desired value for the Hose Heater is input.
- **Hose Heat ON/OFF (Item 5, Figure 7)** - Press  to activate the Hose Heater. While the Hose Heater is active the button will appear as .

10 START-UP

NOTE! Follow the recommended procedure in the order shown.

CAUTION! The Start-up procedures assume that all steps in Proportioner purging (Section 7) 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 full 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.

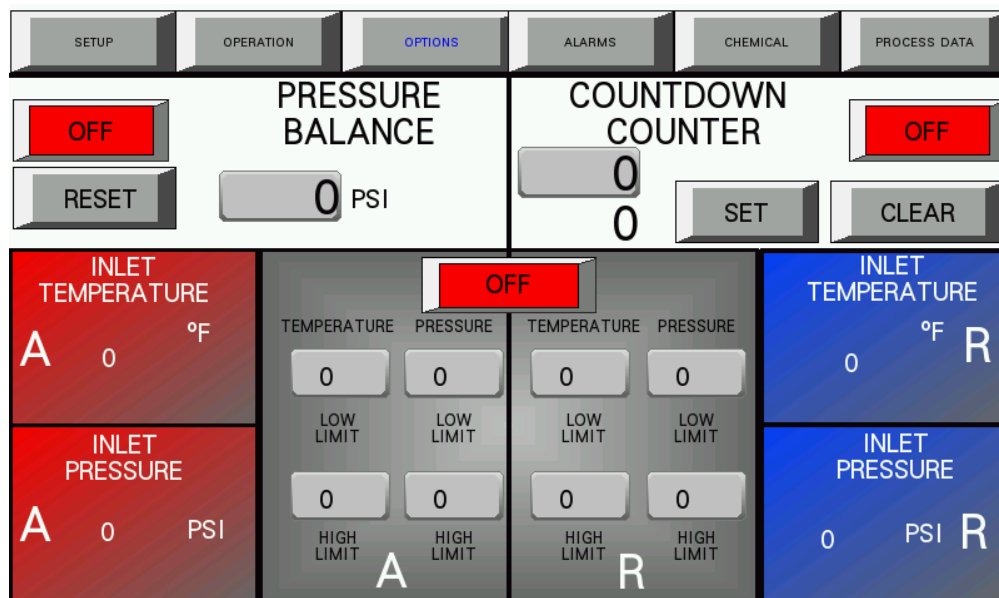
5. Turn ON Main Power (Item N, Figure 6).
6. Turn ON Hose Heater (Item 5, Figure 7) and confirm material set-point temperature as recommended by the material supplier or application conditions.

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

7. Turn ON each Primary Heater and confirm material set-point temperature as required by the material supplier or application conditions has been reached.
8. Turn ON Motor Power (Item 9, Figure 7).
9. Turn ON Pump to NORMAL (Item 8, Figure 7).

NOTE! The Material Pressure Gauges should be approximately equal and remain constant throughout the Metering Pump cycle. If not, refer to the Troubleshooting section (Section 12).

10. Using the Hydraulic Pressure Control (Item K, Figure 4), adjust to the required **stall pressure** and check each Material Pressure Gauge.
11. Countdown Counter - Follow the steps below to set the Auto Shut Down Counter:



- a. Press and input desired number of cycles.
 - b. Press to submit the value to the counter.
 - c. When the counter counts down to zero the machine will stop and the pump directional light will be off.
 - d. To reset the counter press and the Proportioner will continue to pump.
12. Proceed with Installation and Start-up of the Spray Gun as per the Gun manual.






Model	Pump Size	Cycles per Gallon	Cycles per Liter
PHDX-2 (3,000PSI)	61	55 Cycles	14.5 Cycles

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.

11 SHUT-DOWN


11.1 SHORT-TERM

Follow the procedure below for temporary shut-downs, such as **lunch breaks**:




1. Turn OFF pump RETRACT. The button should appear as  when inactive.
2. Turn OFF pump NORMAL. The button should appear as  when inactive.
3. Turn OFF MOTOR POWER. The button should appear as  when inactive.
4. Turn OFF both “A” and “R” Heaters. The buttons should appear as  and  when inactive.
Hose Heater should remain ON. Never leave Proportioner ON if unattended.
5. CLOSE Spray Gun Manual Valves.

11.2 LONG-TERM

Follow the procedure below for shut-downs when work is **stopped for the day**:

1. Turn ON the pump NORMAL and RETRACT. The buttons should appear as  when active.
2. Spray off the application surface until Material Pressure Gauge (Item G, Figure 3) 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. The button should appear as  when inactive.
5. Turn OFF both “A” and “R” Heaters. The buttons should appear as  and  when inactive.
6. Turn OFF the Main Power (Item N, Figure 6).
7. 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.

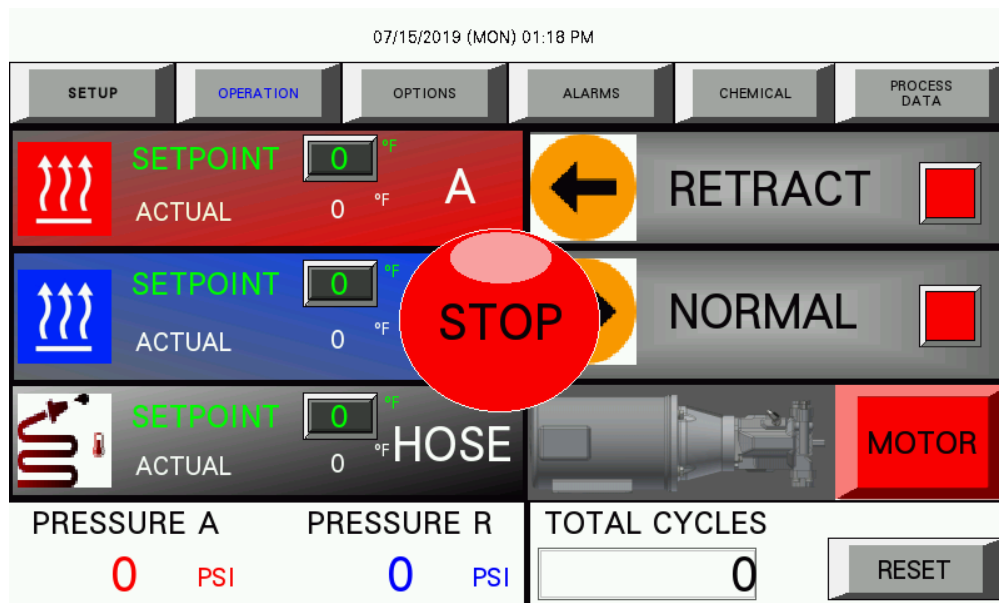
12 TROUBLESHOOTING

This PHD 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 PHD 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.

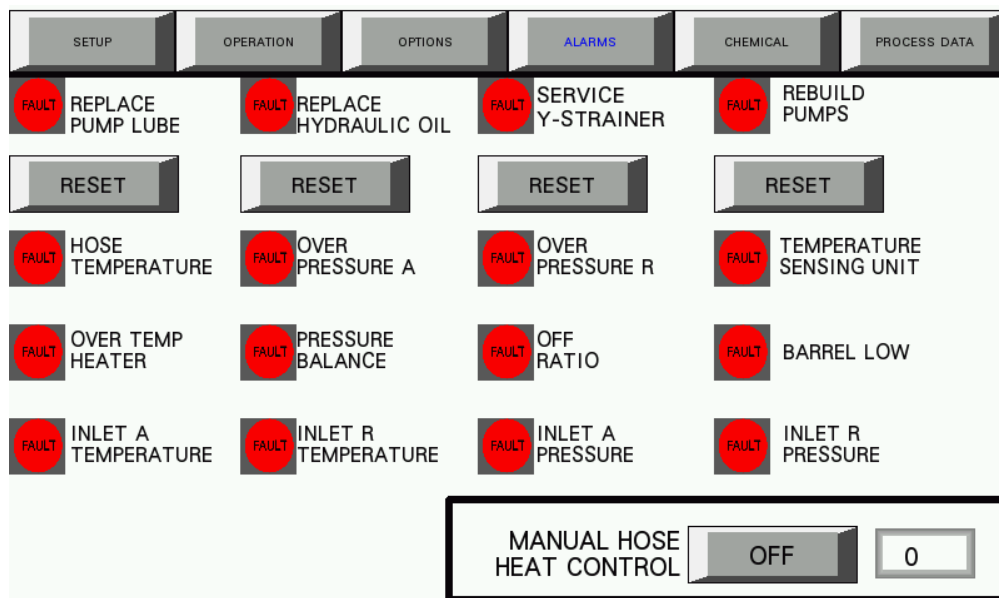
WARNING! Only qualified personnel should perform troubleshooting; unqualified personnel may cause damage to the unit and put the operator at risk.

	<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>
	<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>
	<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>
	<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>
	<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>

When the proportioner experiences an error an alarm will flash on the current menu in use. This alarm is shown below. Upon activation of this alarm the machine will cease to function. The proportioner will only allow further usage once the parameter that is causing the fault has been fixed. To troubleshoot the fault go into the alarms menu.

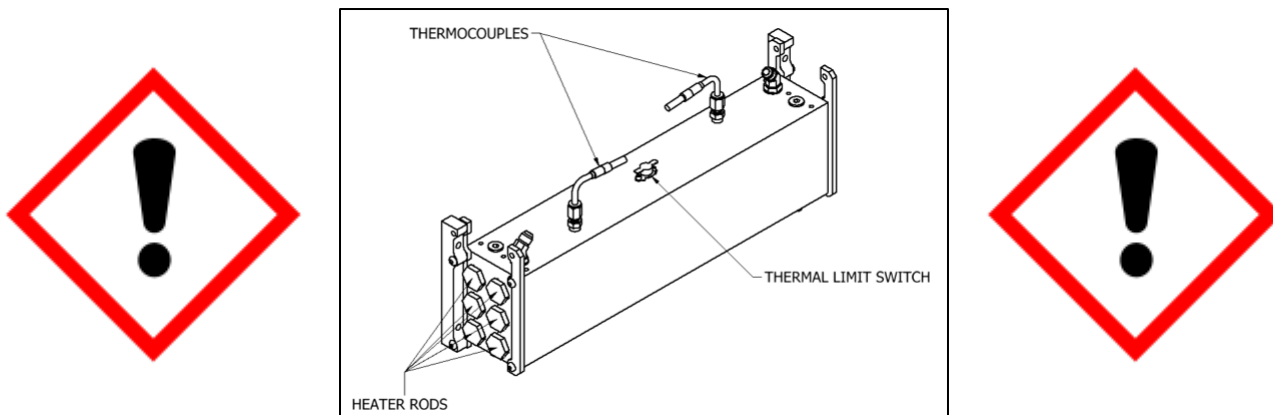


The alarms menu below shows the current alarms triggered with a description of the components affected. When an alarm is triggered the red circle that says **FAULT** will be flashing.



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 HMI shows ambient temperature.	Page 43
Primary heater does not heat and the display on the HMI shows an error.	Page 44
Primary heater shows excessive temperature and the circuit has turned off.	Page 44
Primary heater temperature drops excessively while spraying.	Page 44

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all features are in the correct setting before determining the existence of a fault.

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

Solutions:

1. 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 its 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.

2. 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.

3. Using a DC volt meter, 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.

4. Check the M1 contactor to ensure it is activated. If not, inspect the contactor for possible causes of failure.

If the M1 contactor is activated, call your distributor for further assistance.

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

Solutions:

1. Open the console and check PLC slice TS3101. Make sure that the wires in spots 5A, 5B, 7A, and 7B are securely fastened.

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
1500 WATT	31 OHMS
1750 WATT	27 OHMS

12.2 HYDRAULIC DRIVE SYSTEM

Frequent Hydraulic Drive System Problems

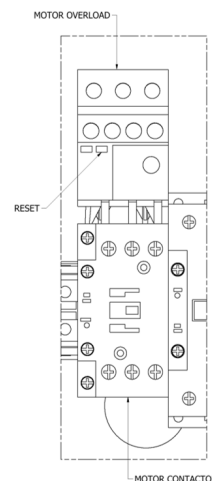
Hydraulic Pump does not develop pressure and the electric motor is not running.	Page 46
Low or zero hydraulic pressure with unusual Hydraulic Pump noises.	Page 46

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all features are in the correct setting 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.

NOTE! Hydraulic pressure is not generated if the Motor Power (Item 9, Figure 7) is OFF.

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 and the electric motor is not running.

Solutions:

Hydraulic Power Package - With the Pump in the NORMAL position, the failure of the Hydraulic Pump to develop pressure is loss of pump suction (this is called "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 62. 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.

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

12.3 METERING PUMP-LINE

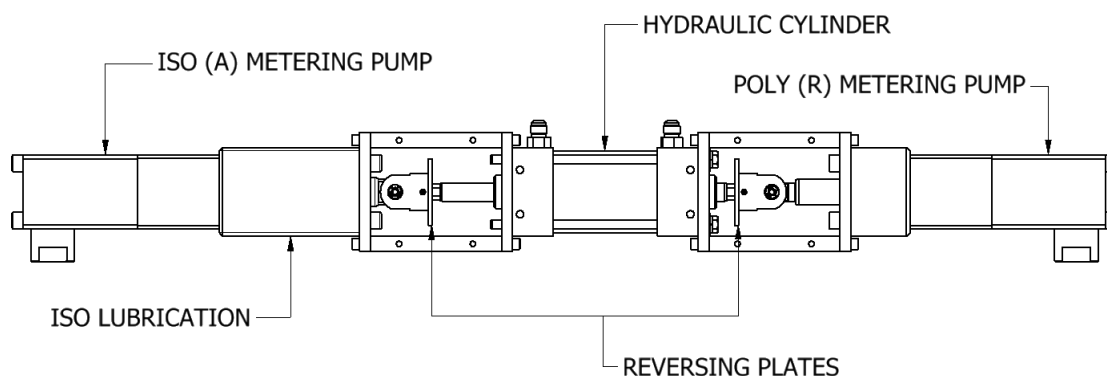


Figure 20: Metering Pump-Line (202588)

Frequent Pump-Line Problems

Metering pumps do not change direction and the pressures on both of chemical gauges are lower than normal.	Page 47
Pump Cavitation.	Page 50
Pressure Loss: Discharge/Inlet Ball.	Page 50

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all features are in the correct setting 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 (arrows for RETRACT and NORMAL, Page 17) 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 ohm's, 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 (Item 8, Figure 7) is **OFF**.
- f. Turn on the Motor (Item 9, Figure 7).
- 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's 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 screw driver 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 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.

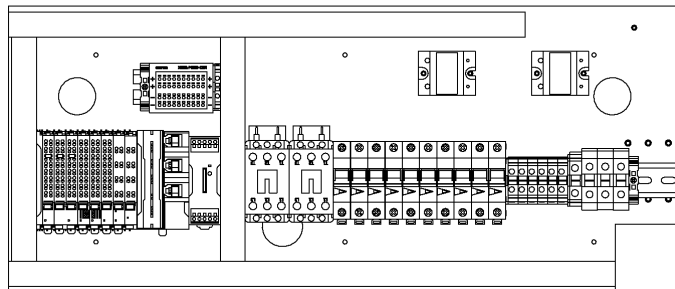












Figure 21: PHDX-2 Console - Bottom Plate

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 (arrows for RETRACT and NORMAL, Figure 7). Lack of Direction Indicator Lights along with high pressure indicated on one or both of the material Pressure Gauges (Items 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:
- a. Know what the NORMAL spray pressures are for the application in progress.
 - b. Determine what material is NOT exiting the Mixing Chamber.
 - c. 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. Cavitation occurs when the Metering Pump 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 obstructed (See Section 13.1 on page 56).
 - 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 (Items E & F, Section 5) and Direction Indicator Light (arrows for RETRACT and NORMAL, Figure 7) 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 Section 13.4 on page 59.

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

Hose heater does not heat and the HMI displays ambient temperature.	Page 51
Hose heater does not heat and the HMI shows an error.	Page 52
Hose heater shows excessive temperature.	Page 53
Hose will heat but not up to set temperature.	Page 53
Hose does not heat and the HMI shows an error message.	Page 53

Follow the recommended procedure in the indicated order to solve the problem and avoid unnecessary repairs. Make sure all features are in the correct setting before determining the existence of a fault.

- **Problem:** Hose heater does not heat and the HMI displays 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 volt meter (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 volt meter, measure across position C7 and D7 on the back of the TS3101. This is the output that 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 HMI is above ambient temperature. **If there is no DC voltage to the relay, contact your local distributor for further assistance.**

- **Problem:** Hose does not heat and the HMI shows an error.

Solutions:

1. Check position C7 and D7 on the PLC slice TS3101 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, 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.

- **Problem:** Hose heater shows excessive temperature.

Solutions:

1. Set the temperature 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 off, replace the solid state relay.

If the light is on, contact your local distributor for further assistance.

- **Problem:** Hose will heat but not 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 Proprietor power supply ON.

- **Problem:** Hose does not heat and the HMI shows an error message.

Solutions:

1. Check position 5 and 7 on the PLC slice TS3101 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.

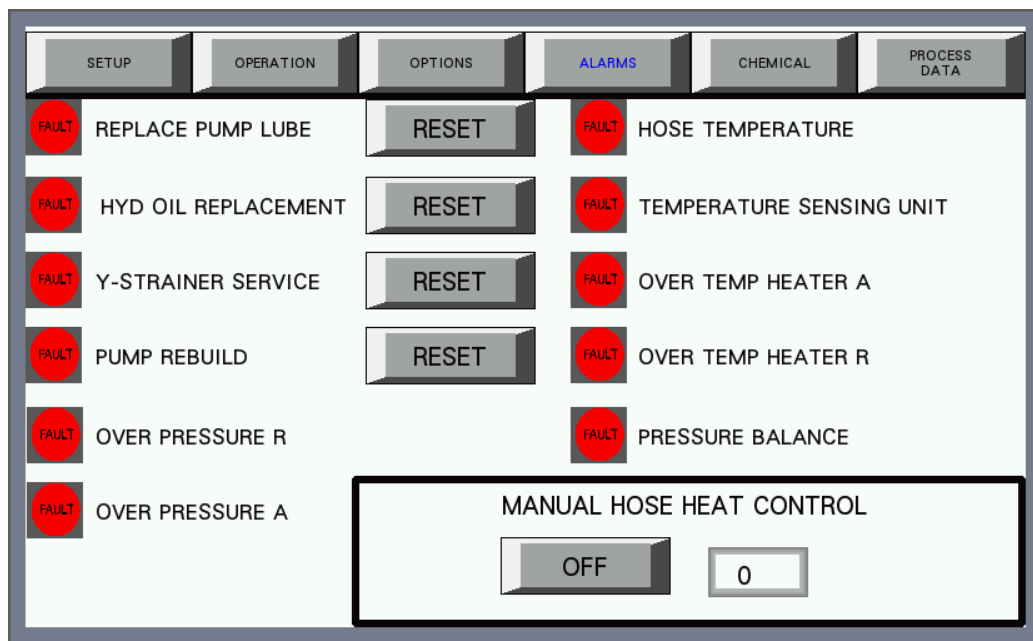
13 MAINTENANCE

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

	<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>
	<i>Disconnect the unit from the power supply before carrying out any operation inside the electrical console. The electrical maintenance of the machine must only be performed by a qualified electrician.</i>
	<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>
	<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>
	<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>
	<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>

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.

The first four alarms in the alarms menu are simple maintenance warnings. These alarms will not automatically stop the proportioner from functioning. They are, however, critical features that require maintenance and, if neglected, could compromise the integrity of the proportioner. Once serviced, press  and the alarm will deactivate.



The components that these warnings affect are as follows:

- **REPLACE PUMP LUBE (ISO LUBRICATION SYSTEM, Section 13.2)**
- This alarm is triggered after a certain amount of pump strokes. The pump lube acquires dirt over time and should be monitored regularly. Dirty lube could affect pump performance and compromise certain seals.
- **HYD OIL REPLACEMENT (HYDRAULIC DRIVE SYSTEM, Section 13.3)** - Failure to change the hydraulic oil on a yearly basis will result in unusual noises from the pump as well as excessive wear and unwanted moisture absorption.
- **Y-STRAINER SERVICE (INLET MATERIAL SCREENS, Section 13.1)** - This is the main filter for chemicals entering the Proportioner. Failure to clean out the filter in the Y-strainer could cause a blockage of material, resulting in the Proportioner not functioning correctly.
- **PUMP REBUILD (METERING PUMP-LINE, Section 13.4)** - This alarm is triggered after a certain amount of pump strokes. When this alarm is active it is best to inspect the Pump-Line for any visible leaks or damage.

13.1 INLET MATERIAL SCREENS

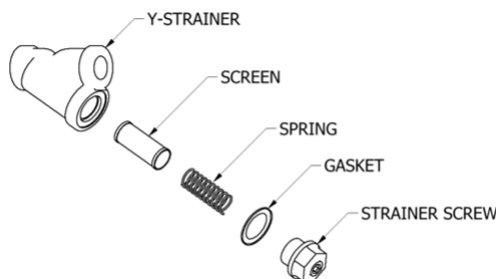
CAUTION! Make sure the Main Power Switch is OFF and incoming power is locked OFF.

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 33) immediately after inspection and cleaning. This is to reduce the risk of moisture contamination, chemical reaction with the solvent used in the cleaning operation, and cross-over in the Spray Gun due to air entrapment.

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 drums 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. Instructions for a proper inspection are listed below.

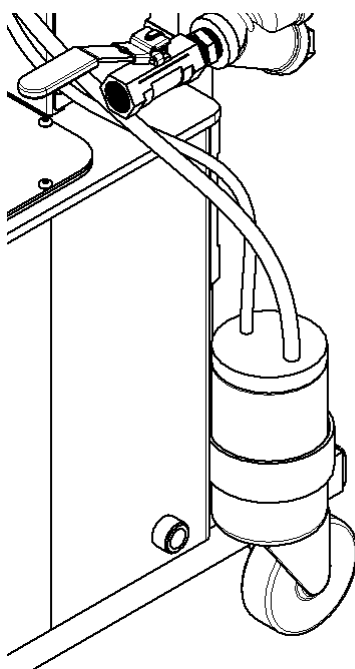


1. CLOSE the Poly (R) Proportioner Inlet Valve.
2. Place a suitable container under the Material Inlet Strainer to collect the residual material. Carefully loosen the Strainer Plug to drain material into the container.
3. Completely unscrew the Strainer Plug.
4. Remove the Seal, Spring and Screen and 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 Section 7 on page 33).

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.



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 Section 14 on page 62 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 PHD Series Proportioner on a regular basis to rebuild the Proportioning Pumps on a yearly basis and service the Hydraulic Drive System 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.

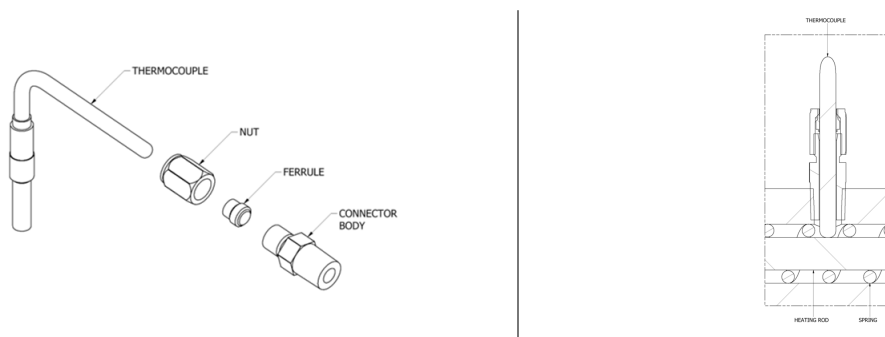
CAUTION! Use wooden or plastic tools or a brass brush for cleaning. Do not use metal or abrasive tools that can scratch the contact surfaces.

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.

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.



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

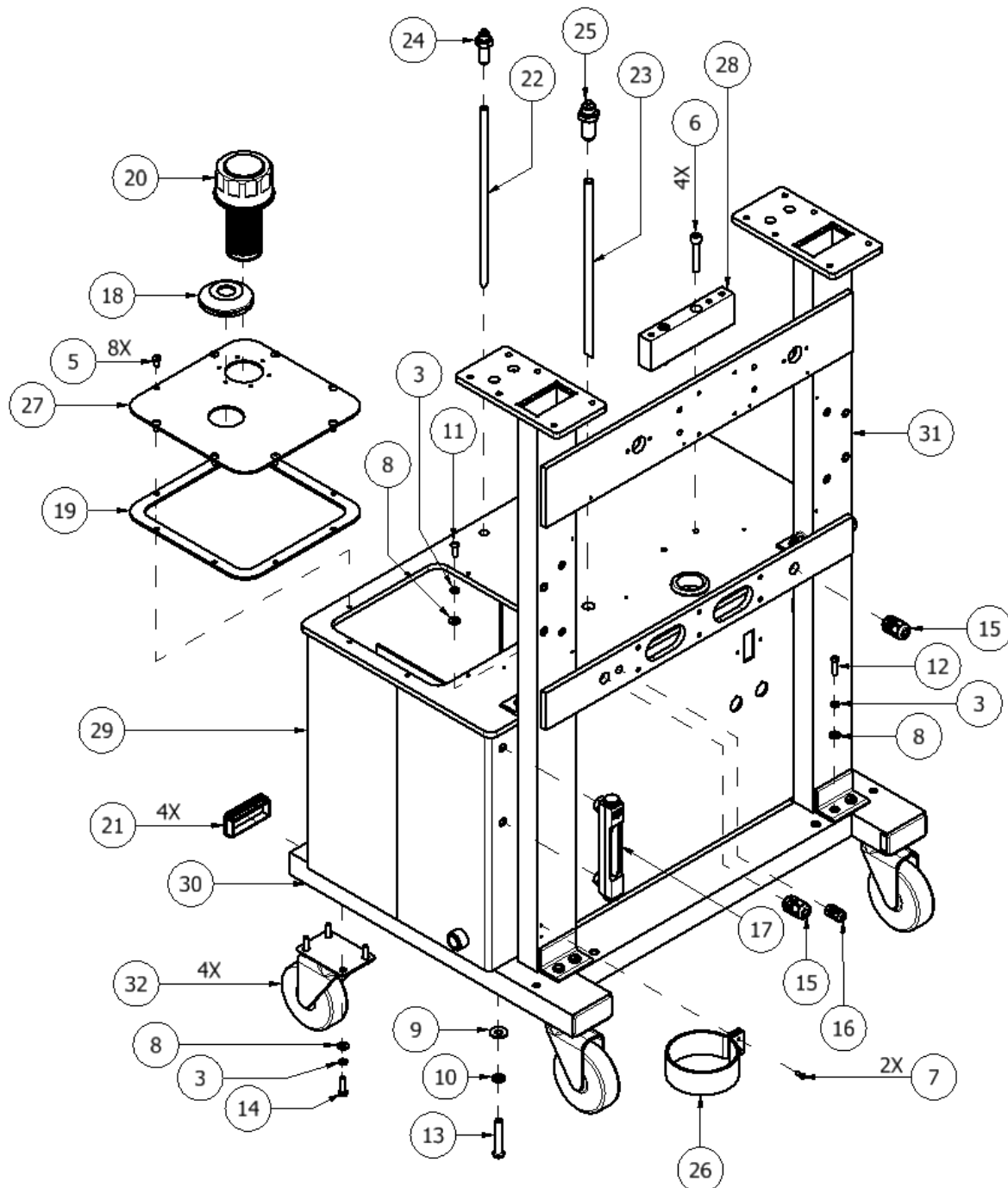


Figure 22: Frame Assembly (FR-10)

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	8	201560	BHCS, 1/4-20 X 0.5, 18-8 SS
6	4	201583	SHCS, 3/8-16 X 2.0, 18-8 SS
7	2	201590	BHCS, #8-32 X 0.5, 18-8 SS
8	24	201621	WASHER, FLAT, 1/4, 18-8 SS
9	4	201627	WASHER, FLAT, 3/8, 18-8 SS
10	4	201628	WASHER, LOCK, 0.375, 18-8 SS
11	4	201899	BHCS, 1/4-20 X 0.75, 18-8 SS
12	4	201902	BHCS, 1/4-20 X 1.0, 18-8 SS
13	4	201904	BHCS, 3/8-16 X 2.25, 18-8 SS
14	16	201930	HHCS, 1/4-20 X 1.0, ZP GRD8
15	2	EL-000P12	HAYCO #6 AWG SR
16	1	EL-000P7	HAYCO SR THERMOCOUPLE
17	1	HI-00001A	SIGHT GAUGE
18	1	HI-00002-A-1	GROMMET MODIFIED 1"
19	1	HI-00014-03A	TANK TOP GASKET
20	1	HI-00047A	HYDRAULIC FILL STRAINER
21	4	HI-001	PLASTIC TUBE CAPS
22	1	HI-05306	TANK PUMP DRAIN TUBE
23	1	HI-05308	TANK DISCHARGE TUBE
24	1	HI-05317	3/8 JIC BULKHEAD UNION
25	1	HI-05319	1/2 JIC BULKHEAD UNION
26	1	MQ-01008A	LUBE BOTTLE BRACKET
27	1	RM-05700-11	TANK LID
28	2	RM-05700-15	MOTOR MOUNT BARS
29	1	RM-238	TANK
30	1	RM-240	FRAME BASE ASSY
31	1	RM-241	FRAME UPRIGHT
32	4	TN-05704	4" CASTER

15.2 PROX SENSOR ASSEMBLY

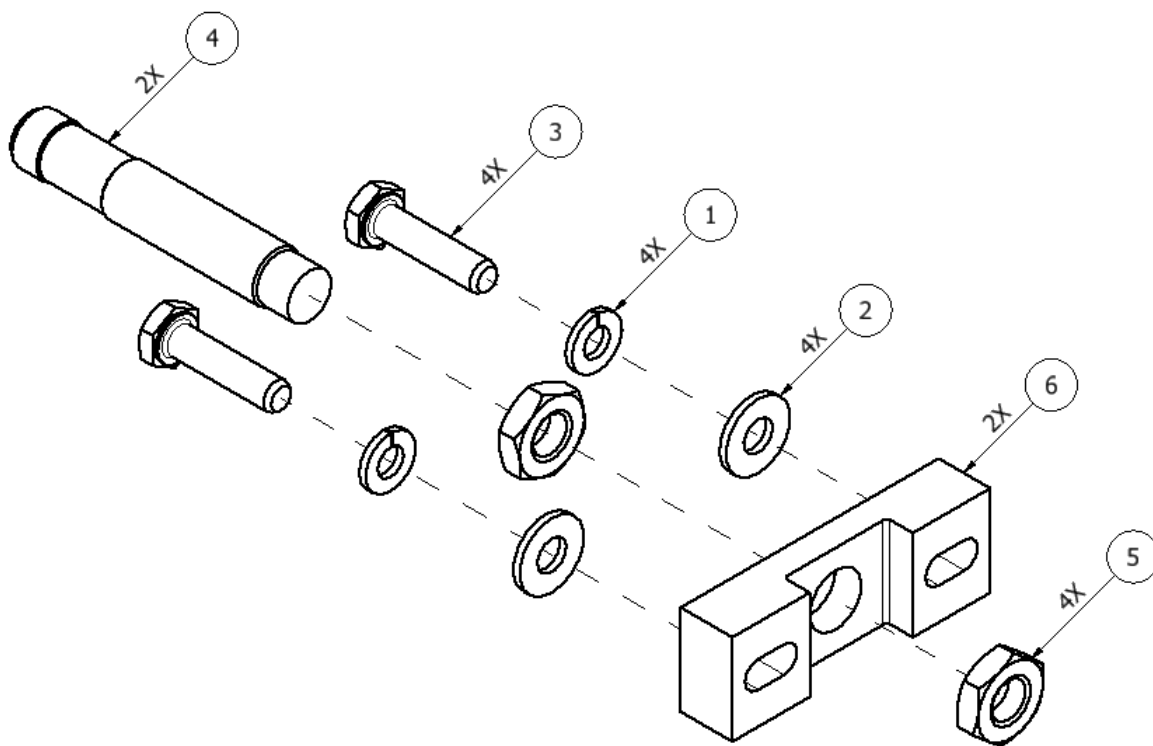


Figure 23: Prox Sensor Assembly (RM-243)

PROX SENSOR ASSEMBLY (RM-243)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	201060	WASHER, LOCK, 1/4, 18-8 SS
2	2	201621	WASHER, FLAT, 1/4, 18-8 SS
3	2	201930	HHCS, 1/4-20 X 1.0, ZP GRD8
4	1	EL-153	12MM PROX SWITCH
5	2	EL-153-01	HEX JAM NUT, M10
6	1	PU-07006	PROX SWITCH MOUNT

15.3 HYDRAULIC MANIFOLD ASSEMBLY

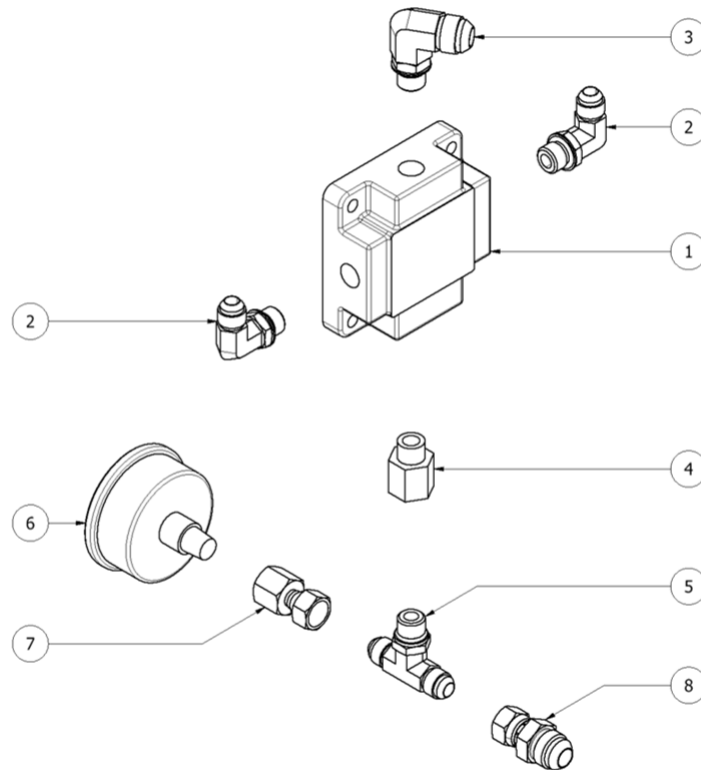


Figure 24: Hydraulic Manifold Assembly (HI-05335)

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

15.4 EXIT MANIFOLD ASSEMBLY

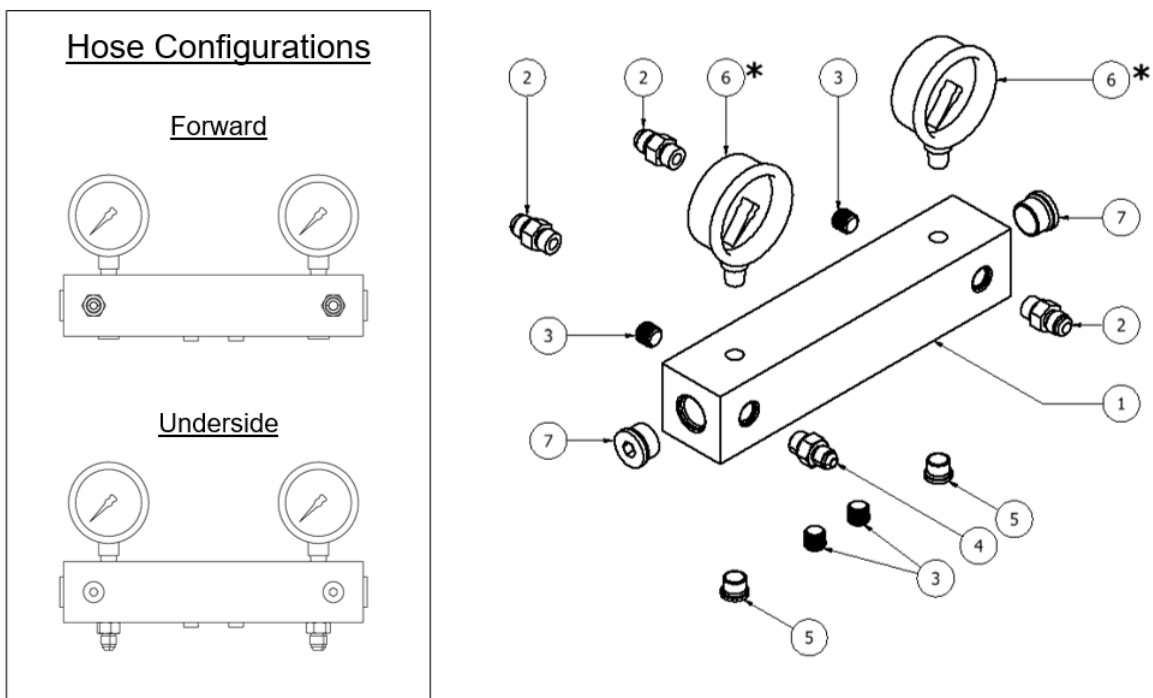


Figure 25: Exit Manifold Assembly (HI-05343)

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

* Indicates parts not included in HI-05343

15.5 HYDRAULIC SEAL ASSEMBLY

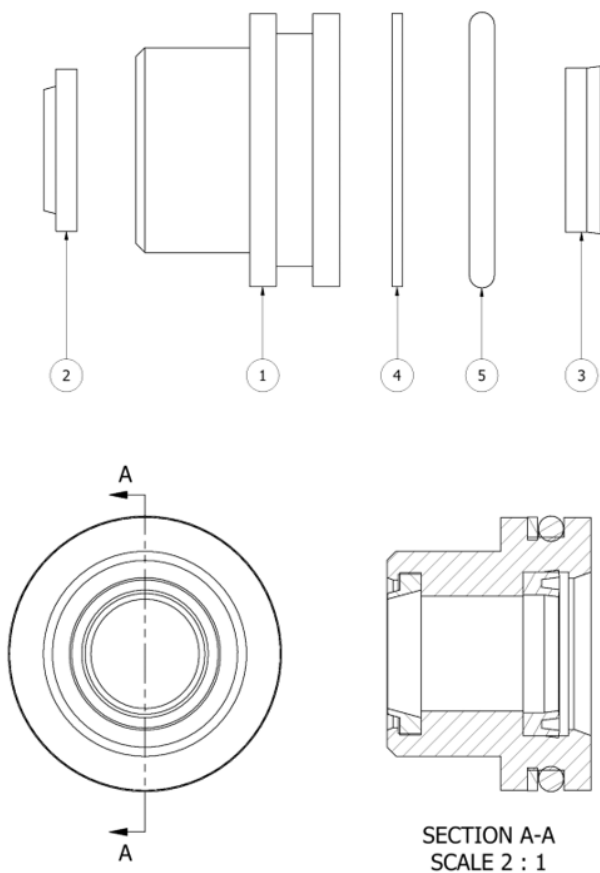


Figure 26: Hydraulic Seal Assembly

HYDRAULIC SEAL ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05025-13	BUSHING, ROD
2	1	HI-05025-4	WIPER, ROD
3	1	HI-05025-5	SHAFT SEAL
4	1	HI-05025-6	BACK UP RING, BUSHING
5	1	OR-00039A	O-RING #218 HYD CYLINDER ROD

Hydraulic Cylinder Rebuild Kit is on page 71

15.6 HYDRAULIC PISTON ASSEMBLY

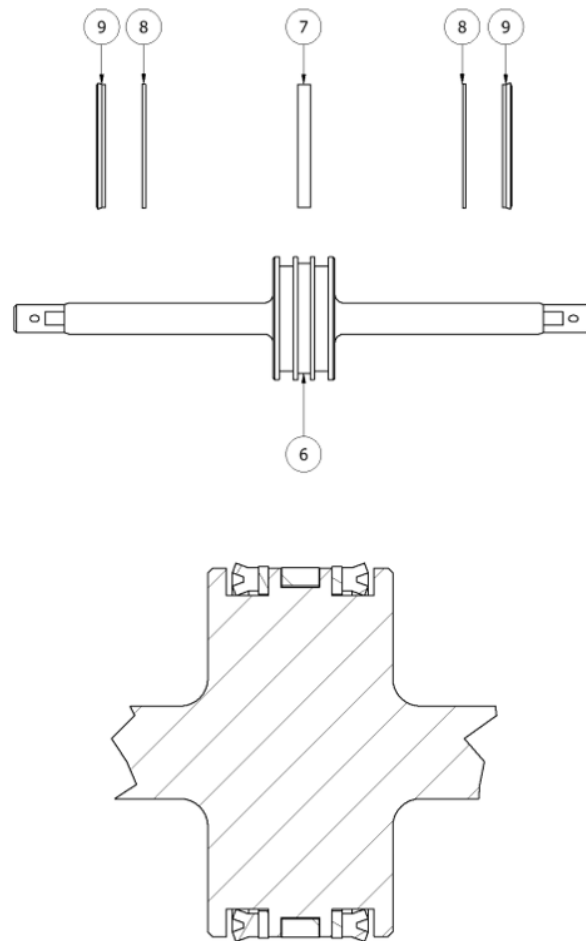


Figure 27: Hydraulic Piston Assembly

HYDRAULIC PISTON ASSEMBLY			
ITEM	QTY	PART NUMBER	DESCRIPTION
6	1	HI-05300	HYDRAULIC PISTON
7	1	HI-05025-3	WEAR RING
8	2	HI-05025-2	BACK-UP RING, PISTON
9	2	HI-05025-1	U-CUP

15.7 HYDRAULIC CYLINDER ASSEMBLY

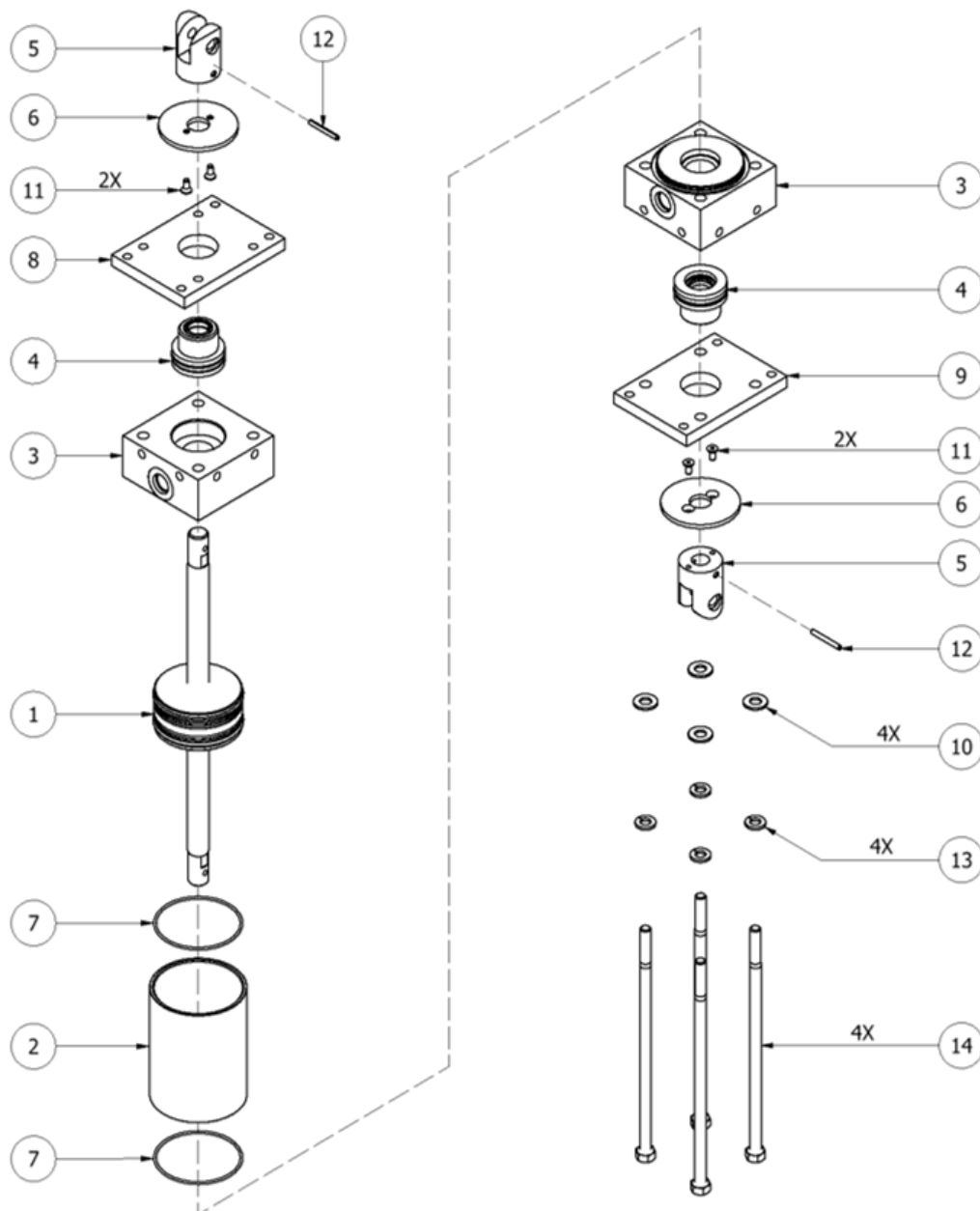


Figure 28: Hydraulic Cylinder Assembly (HI-05336)

HYDRAULIC CYLINDER ASSEMBLY (HI-05336)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	-	HYDRAULIC PISTON ASSEMBLY (SEE PAGE 69)
2	1	HI-05301	HYDRAULIC CYLINDER
3	2	HI-05200-3	PORT BLOCK, HYDRAULIC
4	2	-	HYDRAULIC SEAL ASSEMBLY (SEE PAGE 68)
5	2	HI-05302	FEMALE CLEVIS
6	2	HI-05303	SWITCH PLATE
7	2	OR-00040A	O-RING -036 HYD CYLINDER
8	1	HI-05322	FLANGE RTAINER, "A" SIDE
9	1	HI-05333	FLANGE RETAINER, "R" SIDE
10	4	201580	WASHER, FLAT, 5/16, 18-8 SS
11	4	201591	FHCS, #8-32 X 0.375, 18-8 SS
12	2	HI-05337	SPRING PIN, SLOTTED 1/8" DIA
13	4	202145	WASHER, LOCK, 5/16, 18-8 SS
14	4	202212	HHCS, 5/16-18 X 7.00, GRD5

15.7.1 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

15.8 A&R SINGLE PUMP ASSEMBLY

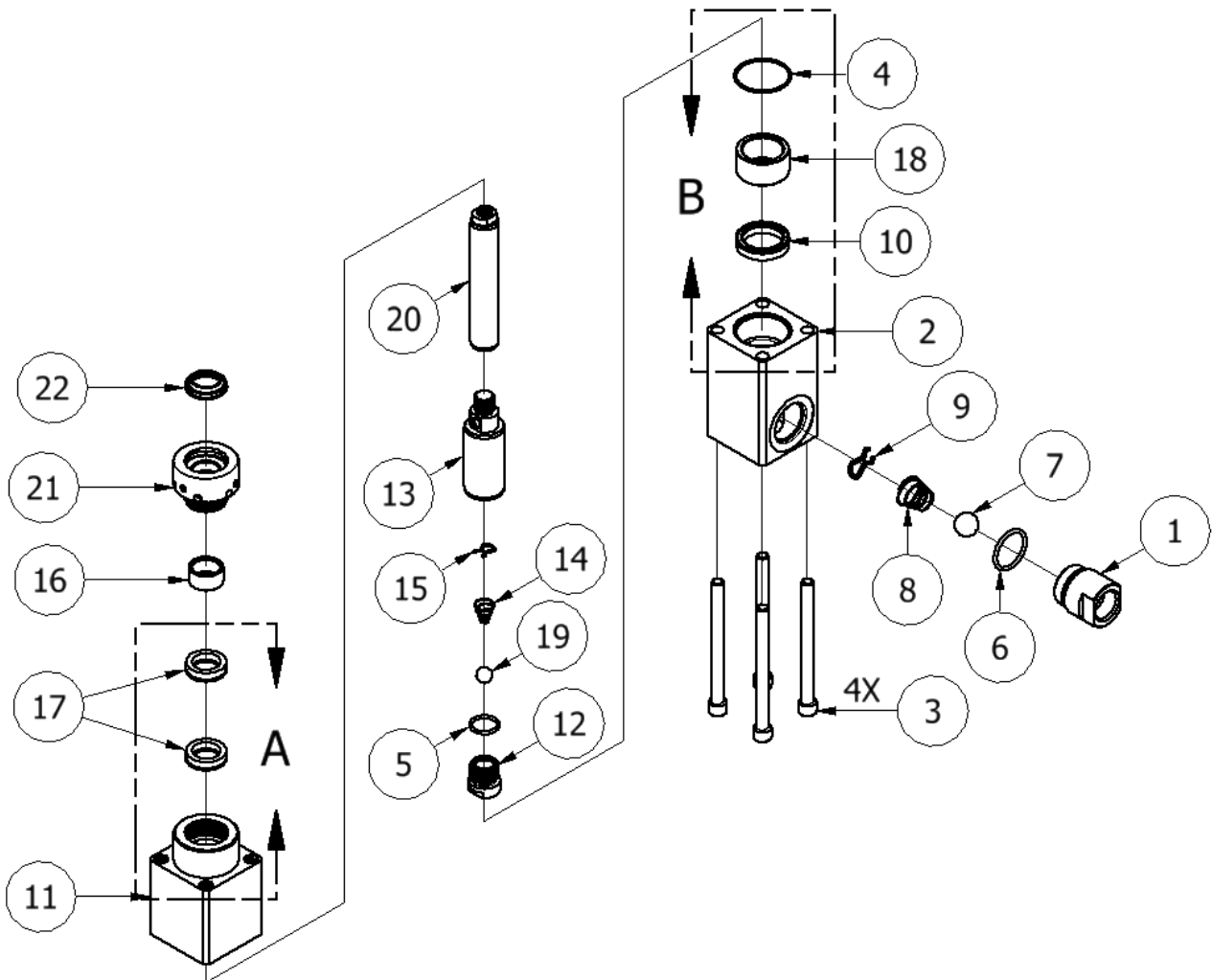


Figure 29: A & R Single Pump Assembly (202587)

A & R SINGLE PUMP ASSEMBLY (202587)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	202573	INLET VALVE
2	1	202574	INLET BODY, BOTTOM FEED
3	4	202590	SHCS, 3/8-16 X 4.500, 18-8 SS
4	1	OR-030	O-RING, -030, BRN VITON
5	1	OR-910	O-RING, -910, BRN VITON
6	1	OR-916	O-RING, -916, BRN VITON
7	1	PA-048	3/4" CHROME BALL
8	1	PA-049	SPRING
9	1	PA-050	SPRING RETAINER
10	1	PA-052	ROD SEAL ASSEMBLY
11	1	PAX-045	OUTLET BODY
12	1	PAX-046	PISTON VALVE
13	1	PAX-047	PISTON
14	1	PAX-049	PISTON VALVE TAPER SPRING
15	1	PAX-050	SPRING RETAINER
16	1	PAX-051	ROD BUSHING
17	2	PAX-052	ROD SEAL ASSEMBLY
18	1	PAX-055	PISTON BUSHING
19	1	PAX-059	1/2" CHROME BALL
20	1	PAX-062	FLUID ROD
21	1	PAX-064	PACKING NUT
22	1	PAX-065	SCRAPER SEAL

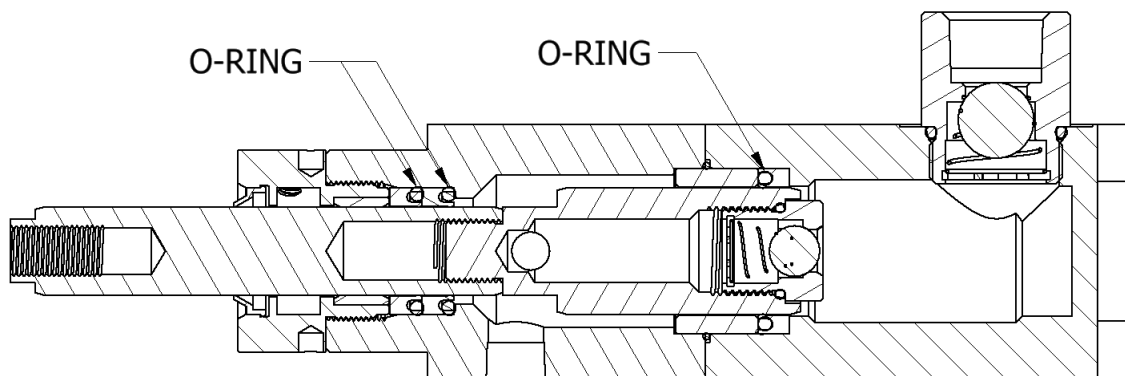


Figure 30: A & R Single Pump Cross Section

15.9 PUMP-LINE SEAL ORIENTATION

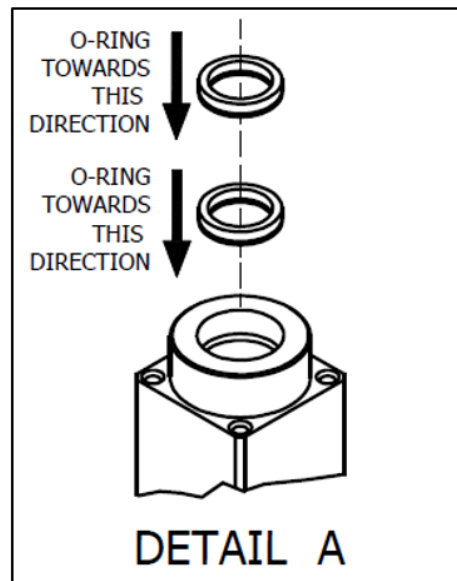


Figure 31: A&R Single Pump Assembly Detail A

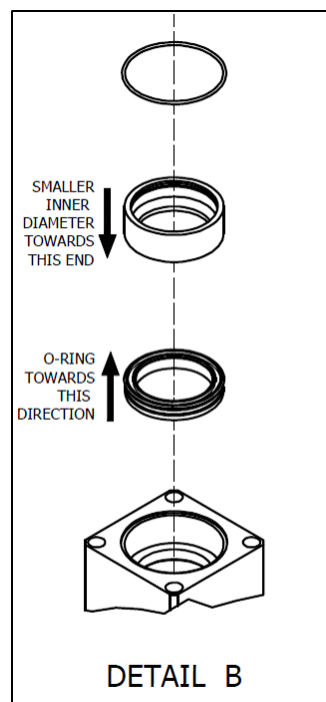


Figure 32: A&R Single Pump Assembly Detail B

15.10 PUMP-LINE ASSEMBLY

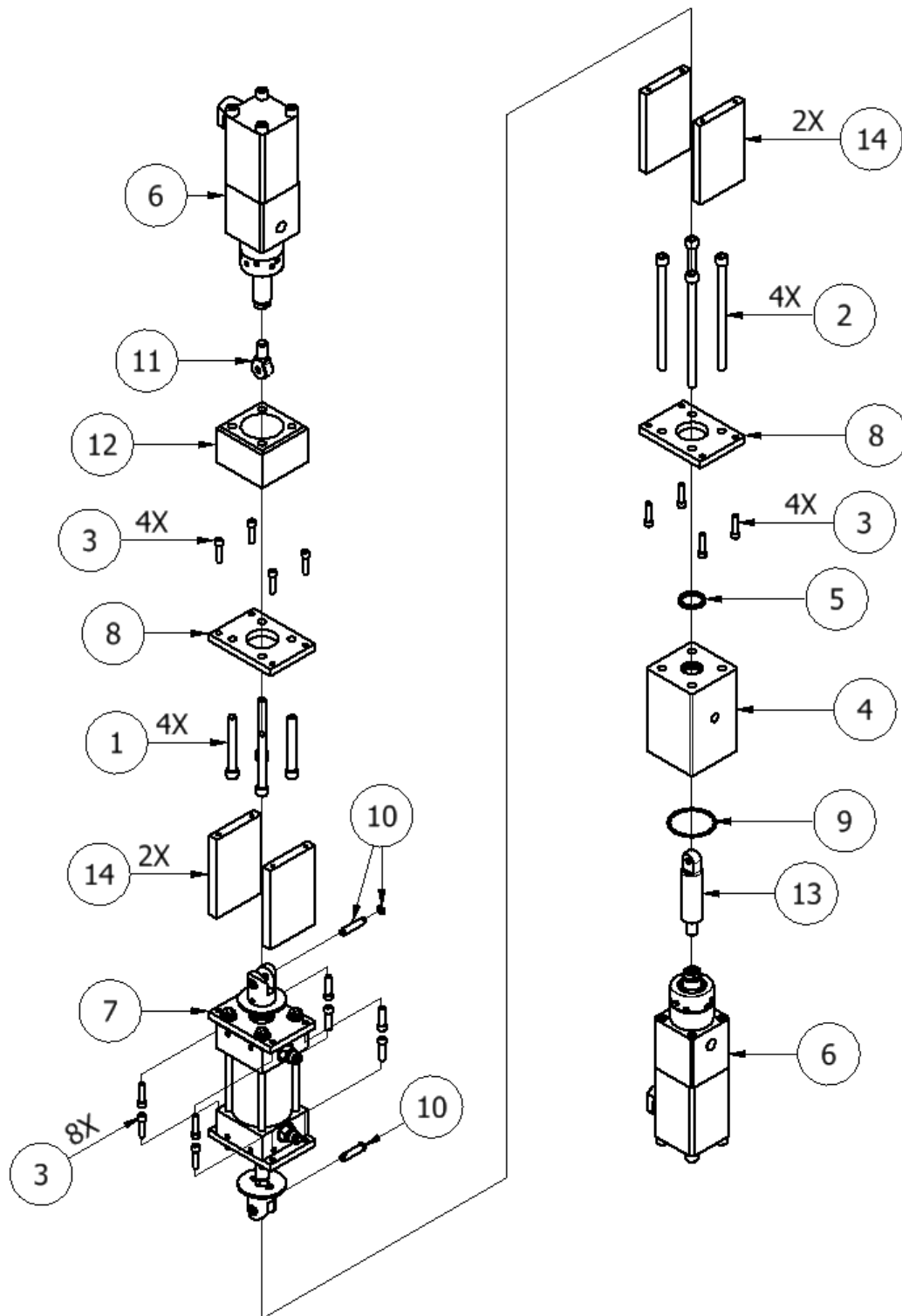


Figure 33: Pump-Line Assembly (202588)

PUMP LINE ASSEMBLY - HIGH PRESSURE (202588)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	201584	SHCS, 3/8-16 X 3.000, 18-8 SS
2	4	201585	SHCS, 3/8-16 X 6.000, 18-8 SS
3	16	201589	SHCS, 1/4-20 X 1.000, 18-8 SS
4	1	202242	LUBE SECTION, ROD SEAL, HP
5	1	202243	SEAL, ROD 1.00 DIA
6	2	202587	30:1 A/R BOTTOM FEED PUMP
7	1	HI-05336	HYDRAULIC CYLINDER ASSY, PH(X)-2
8	2	HI-05338	FLANGE
9	1	OR-807	O-RING -137, VITON
10	2	PU-05007	PIN, CLEVIS W/ CLIP
11	1	PU-07001	MALE CLEVIS
12	1	PU-07002	BRACKET
13	1	PU-07003	LUBE SHAFT
14	4	PU-07009	STAND OFF

15.10.1 PUMP REBUILD KIT

PUMP REBUILD KIT		
QTY	PART NUMBER	DESCRIPTION
1	KT-PAX	PHX PUMP REBUILD KIT (3,000PSI)

15.11 INLET MONITORING ASSEMBLY

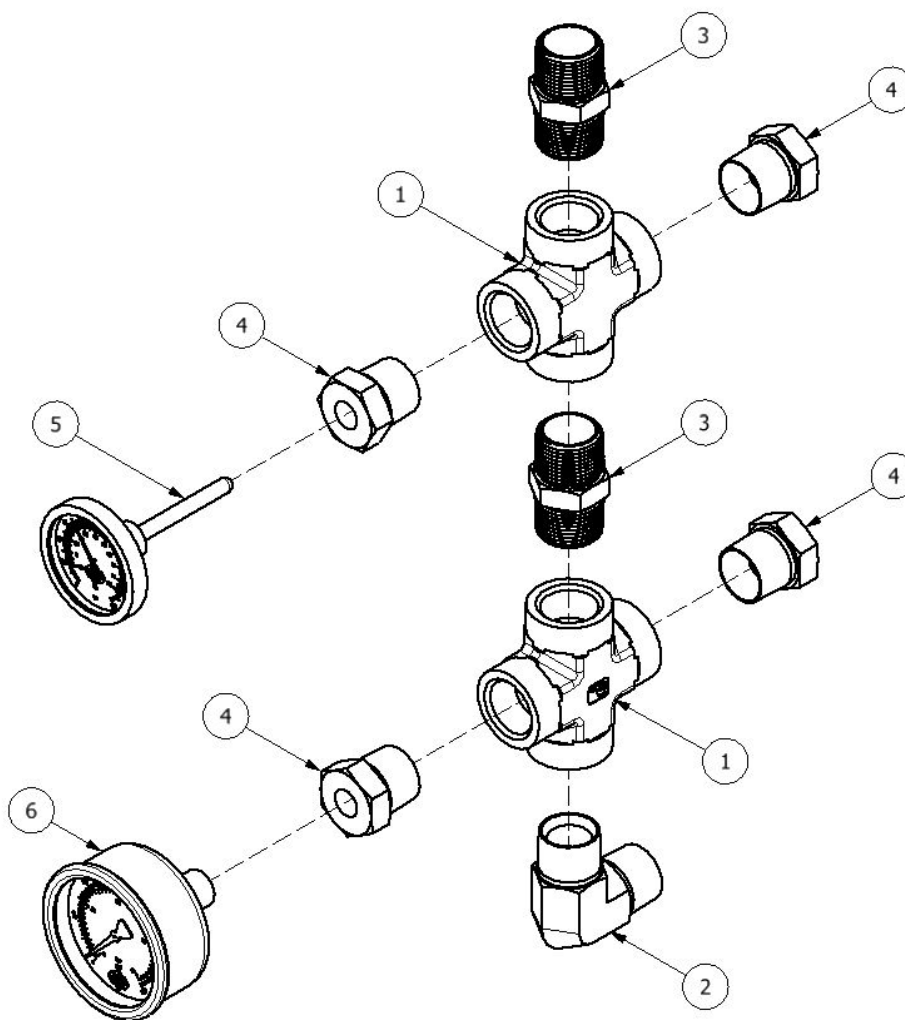


Figure 34: Inlet Monitoring Assembly (202237)

INLET MONITORING ASSEMBLY (202237)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	202236	FTG, CROSS, 3/4 NPTF, STEEL
2	1	HI-05015	3/4 FTG, 90 DEG ELBOW, 3/4 MNPTF, STL
3	2	HI-05017	FTG, UNION, 3/4 MNPTF, STL
4	4	HI-05053	FTG, RDCR, 3/4 MNPTF, 1/4 FNPTF, STL
5	1	HI-05055	GAUGE, TEMP, 0-200 F
6	1	HI-05103	PRESS GAUGE 0-600 PSI

15.12 Y-STRAINER ASSEMBLY "A" SIDE

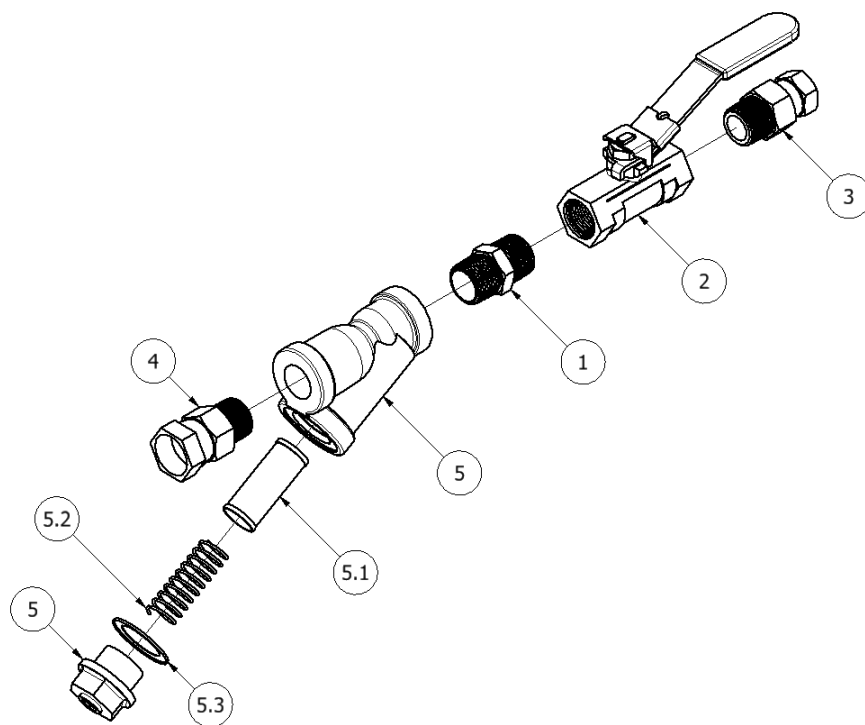


Figure 35: Y-Strainer Assembly "A" Side (YS-1)

Y-STRAINER ASSEMBLY "A" SIDE (YS-1)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05017	3/4 MNPT UNION
2	1	RA-00078A	3/4 BALL VALVE SS
3	1	HI-05018	3/4 NPT X 1/2 NPT SW
4	1	HI-05016	3/4 NPTM X 3/4 NPTF SW
5	1	RA-00074-00A	Y-STRAINER ASSY
5.1	1	RA-00074-03-XXA	FILTER SCREEN 30/60/80
5.2	1	SP-00009A	FILTER SCREEN SPRING
5.3	1	RA-00074-02A	GASKET, Y-STRAINER

Note: Items 5.1-5.3 can be order separately but are all included in purchase of Item 5 (RA-00074-00A)

15.13 Y-STRAINER ASSEMBLY "R" SIDE

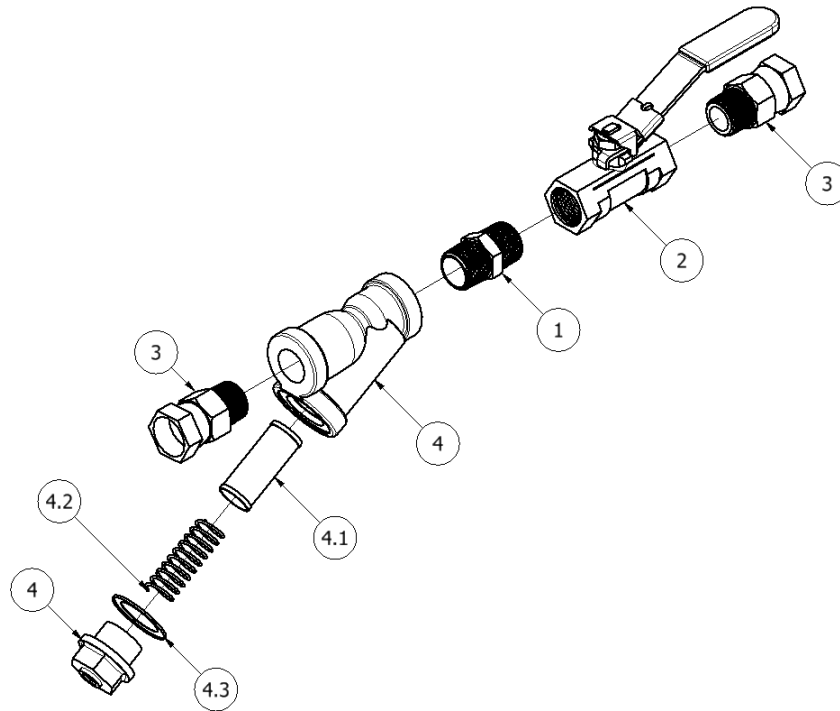


Figure 36: Y-Strainer Assembly "R" Side (YS-2)

Y-Strainer Assembly "R" Side (YS-2)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	HI-05017	3/4 MNPT UNION
2	1	RA-00078A	3/4 BALL VALVE SS
3	2	HI-05016	3/4 NPTM X 3/4 NPTF 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

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

15.14 HEATER ASSEMBLY

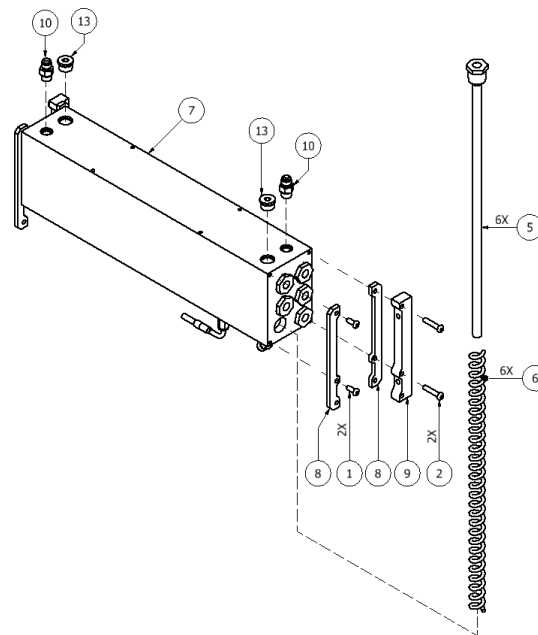


Figure 37: Heater Assembly, 6 Rod - A

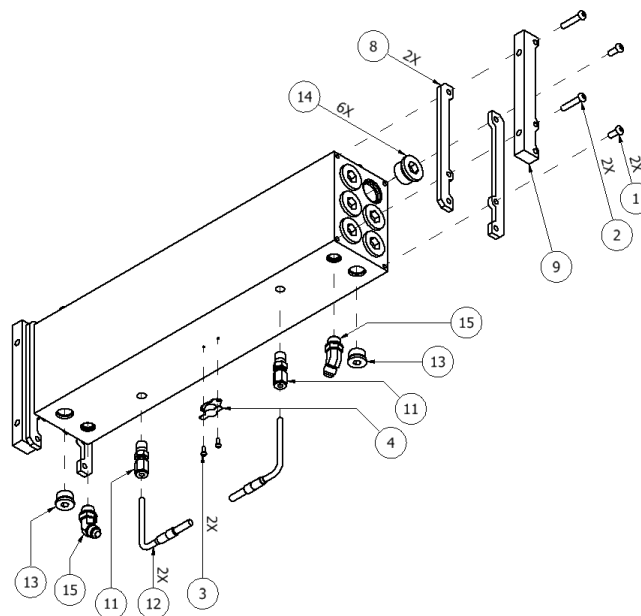


Figure 38: Heater Assembly, 6 Rod - B

PREHEATER ASSEMBLY PH-21 (3750W) PH-22 (4500W) PH-23 (5250W)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	201560	BHCS, 1/4-20 X 0.500, 18-8 SS
2	4	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
3	2	201561	BHCS, #6-32 X 0.375, 18-8 SS
4	1	EL-00006A	OVERTEMP SWITCH
5	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"
6	6	GM-05423-7	SPRING 18"
7	1	GM-07000	HEATER BLOCK
8	4	GM-07004	HEATER SPACER
9	2	GM-07005	HEATER MOUNT
10	2	HI-05011	6 ORB X 6 JIC
11*	2	HI-05020	THERMOCOUPLE NUT
12*	2	HI-05021	E TYPE THERMOCOUPLE
13	4	HI-05033	8 ORB PLUG
14	6	HI-05034	12 ORB PLUG
15	2	HI-05318	6 ORB X 6 JIC 45 DEGREE

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

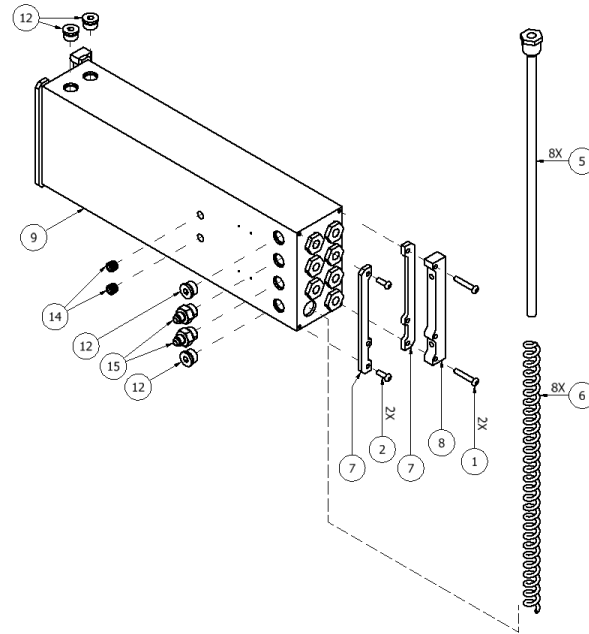


Figure 39: Heater Assembly, 8 Rod - A

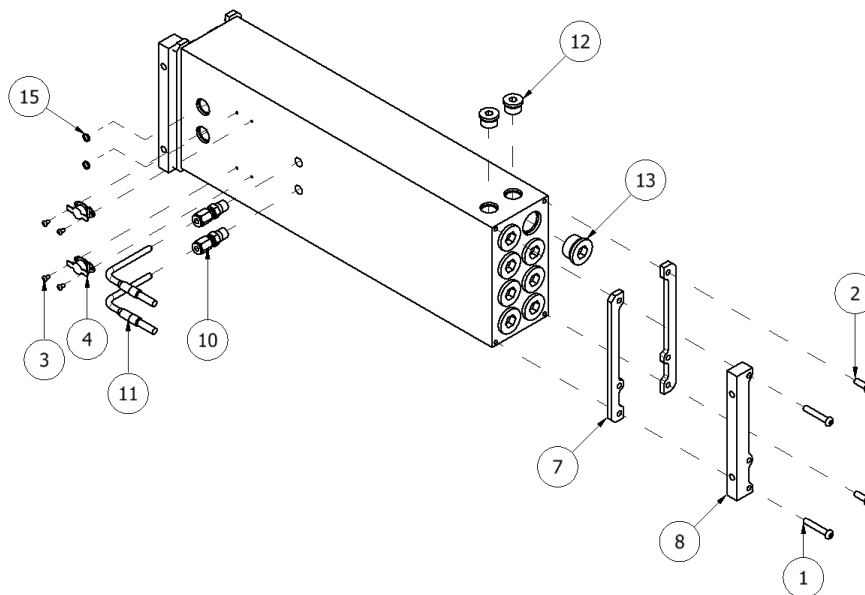


Figure 40: Heater Assembly, 8 Rod - B

PREHEATER ASSEMBLY PH-33 (7000W)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	201560	BHCS, 1/4-20 X 0.500, 18-8 SS
2	4	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
3	4	201561	BHCS, #6-32 X 0.375, 18-8 SS
4	2	EL-00006A	OVERTEMP SWITCH
5	8	GM-05423-1250	FIRE ROD, 1250W, 3/4 NPT, 17.5"
	8	GM-05423-1500	FIRE ROD, 1500W, 3/4 NPT, 17.5"
	8	GM-05423-1750	FIRE ROD, 1750W, 3/4 NPT, 17.5"
6	8	GM-05423-7	SPRING 18"
7	4	GM-07004	HEATER SPACER
8	2	GM-07005	HEATER MOUNT
9	1	GM-07006	8 ROD HEATER BODY
10*	2	HI-05020	THERMOCOUPLE NUT
11*	2	HI-05021	E TYPE THERMOCOUPLE
12	6	HI-05033	8 ORB PLUG
13	8	HI-05034	12 ORB PLUG
14	2	HI-05036	1/4 NPT FLUSH SEAL PIPE PLUG
15	4	HI-05352	8 ORB X 6 JIC

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

15.15 MOTOR-LINE ASSEMBLY

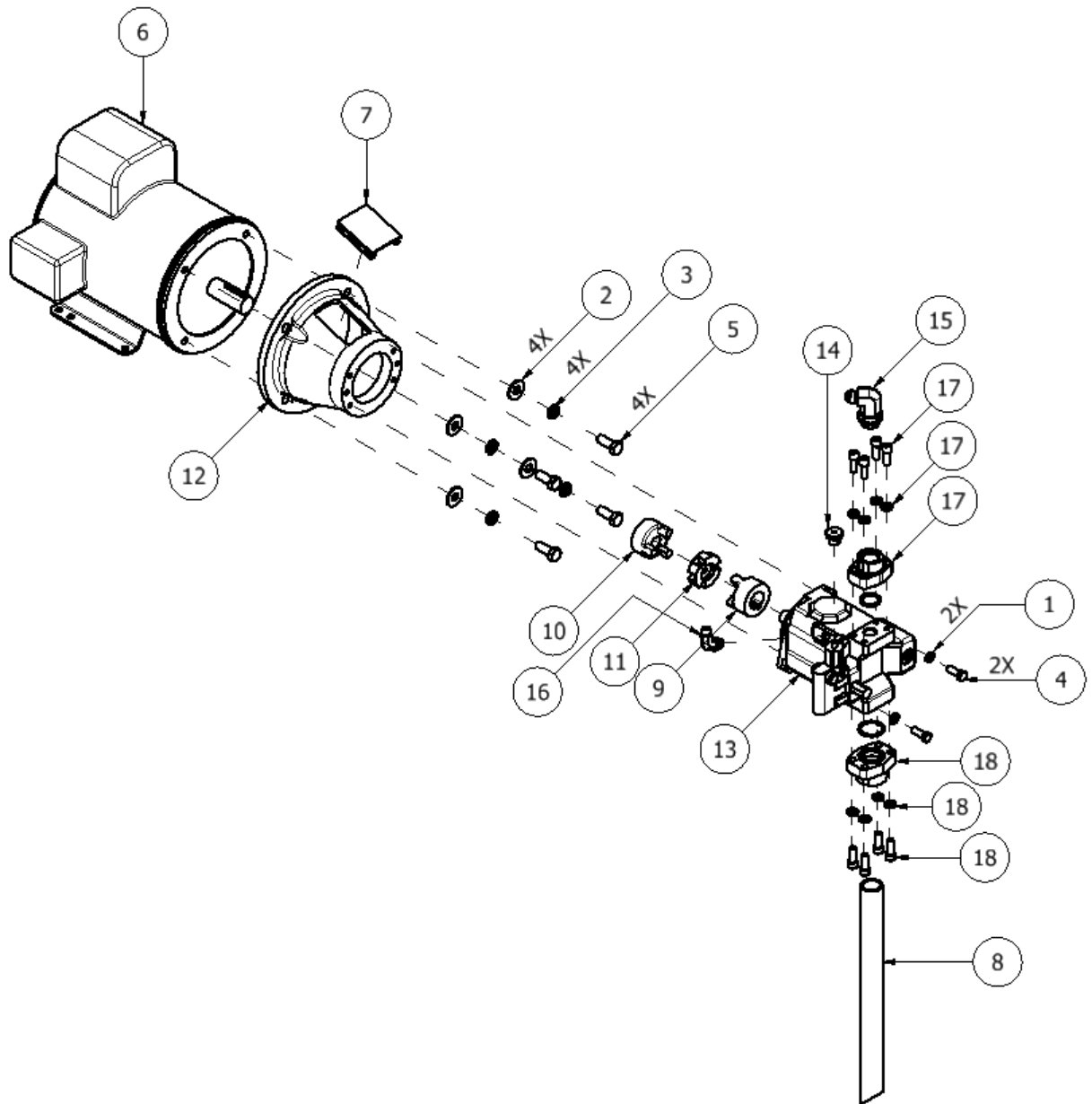


Figure 41: Motor-Line Assembly

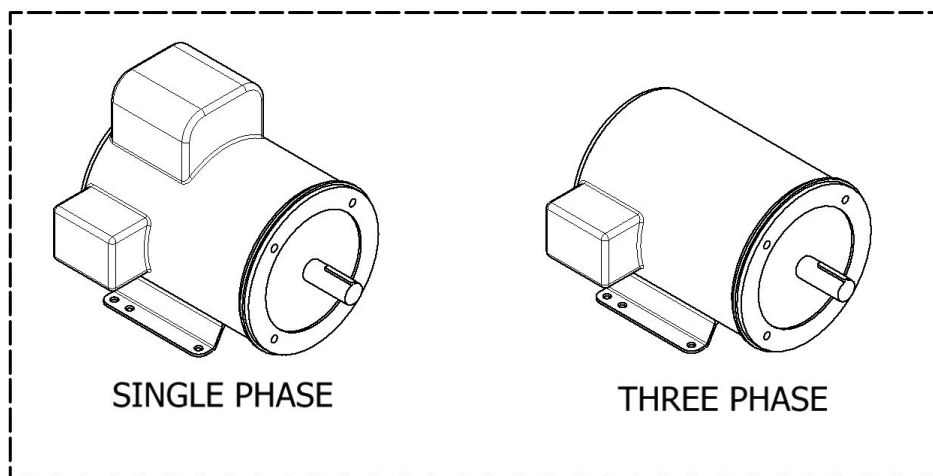


Figure 42: Motor Comparison

MOTOR-LINE ASSEMBLY (ML-3)/(ML-4)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	10	201628	WASHER, LOCK, 3/8, 18-8 SS
2	4	201629	WASHER, FLAT, 1/2, 18-8 SS
3	4	201630	WASHER, LOCK, 1/2, 18-8 SS
4	2	202152	HHCS, 3/8-16 X 1.000, ZP GRD8
5	4	202207	HHCS, 1/2-13 X 1.25, ZP GRD8
6	1	EL-05222	ELECTRIC MOTOR, 5HP, 1PH, 60HZ (ML-3)
	1	EL-05223	ELECTRIC MOTOR, 5HP, 3PH, 60HZ (ML-4)
7	1	HI-00005-03	ACCESS COVER
8	1	HI-00049A	1X16 BLACK PIPE FOR HYDRAULIC
9	1	HI-00065-03	COUPLER HUB, 3/4
10	1	HI-00065-02	COUPLER HUB, 1 1/8
11	1	HI-00065-01	COUPLER INSERT
12	1	HI-05001	BELL HOUSING
13	1	HI-05004	HYDRAULIC PUMP
14	1	HI-05004-1	CONTROL KNOB, HYD PUMP
15	1	HI-05008	1-1/16-12 O-RING X 3/4 JIC
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

15.16 FINAL ASSEMBLY

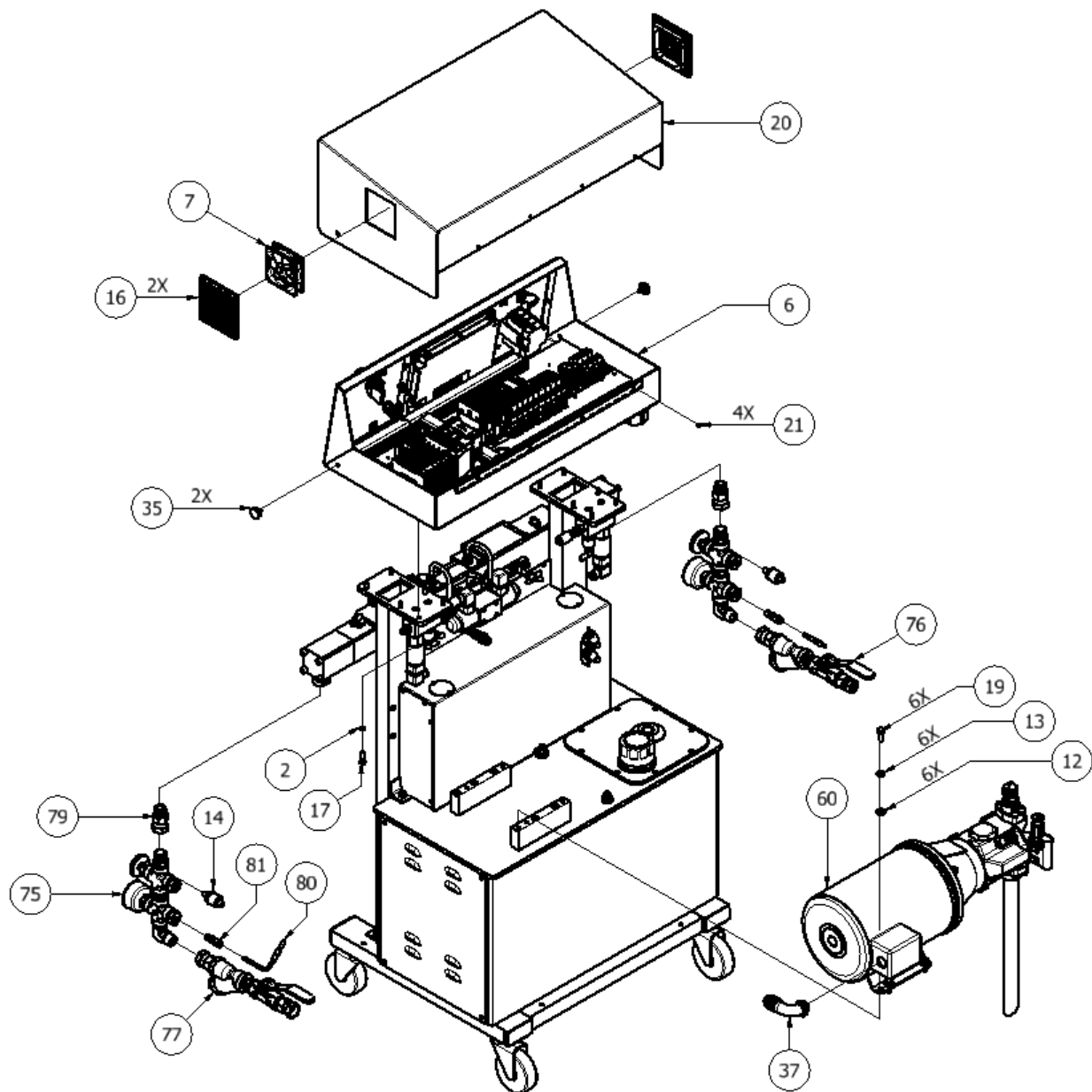


Figure 43: PHDX-2 Final Assembly - A

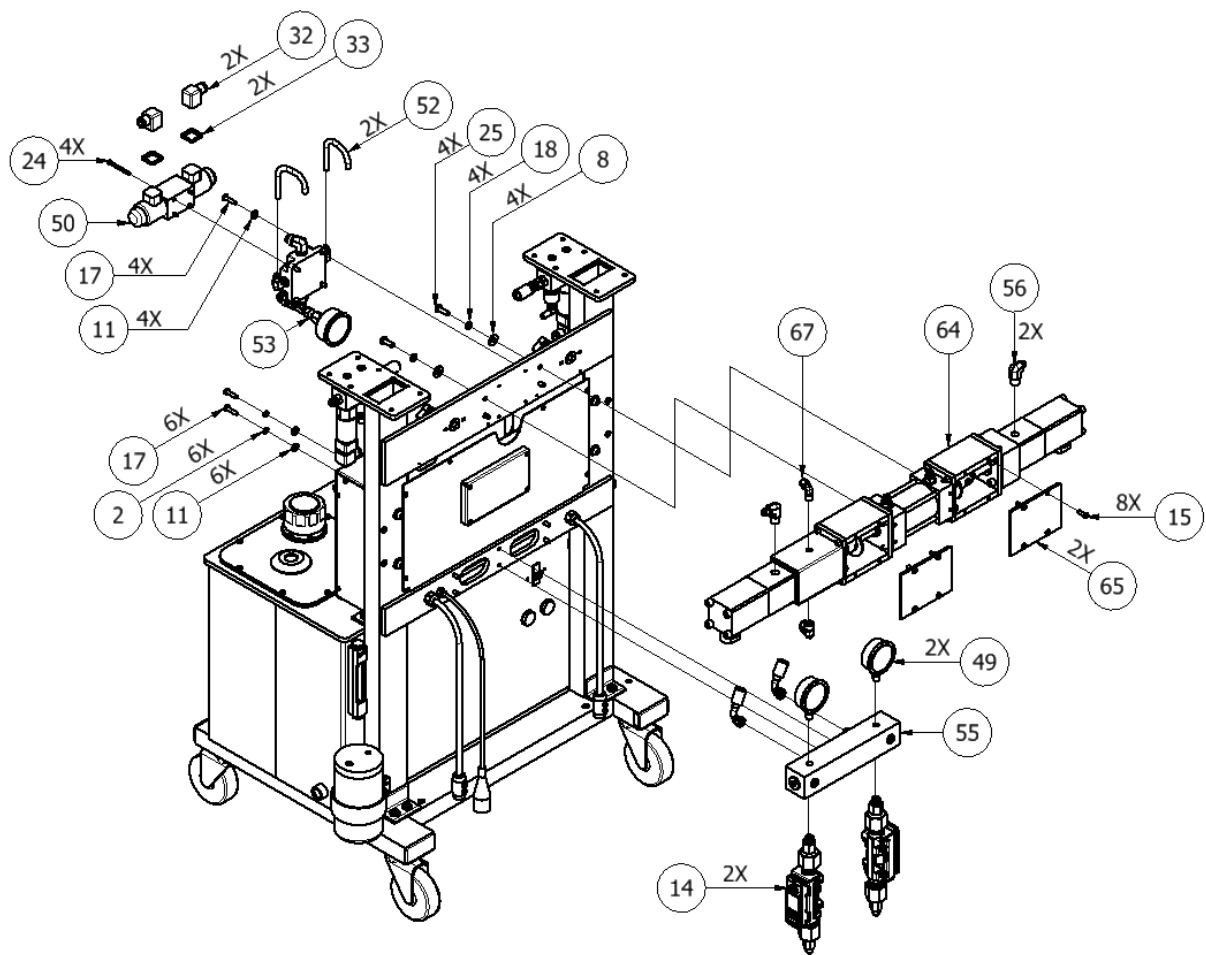


Figure 44: PHDX-2 Final Assembly - B

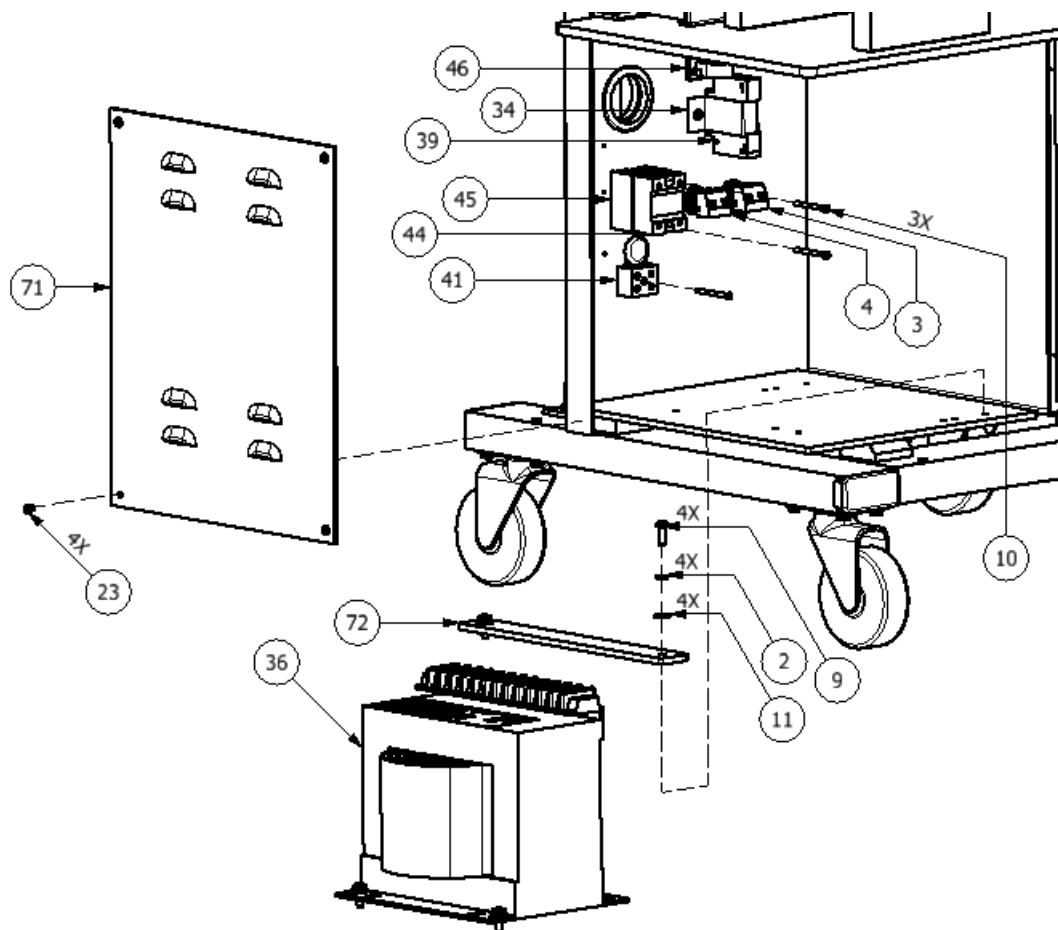


Figure 45: PHDX-2 Final Assembly - C

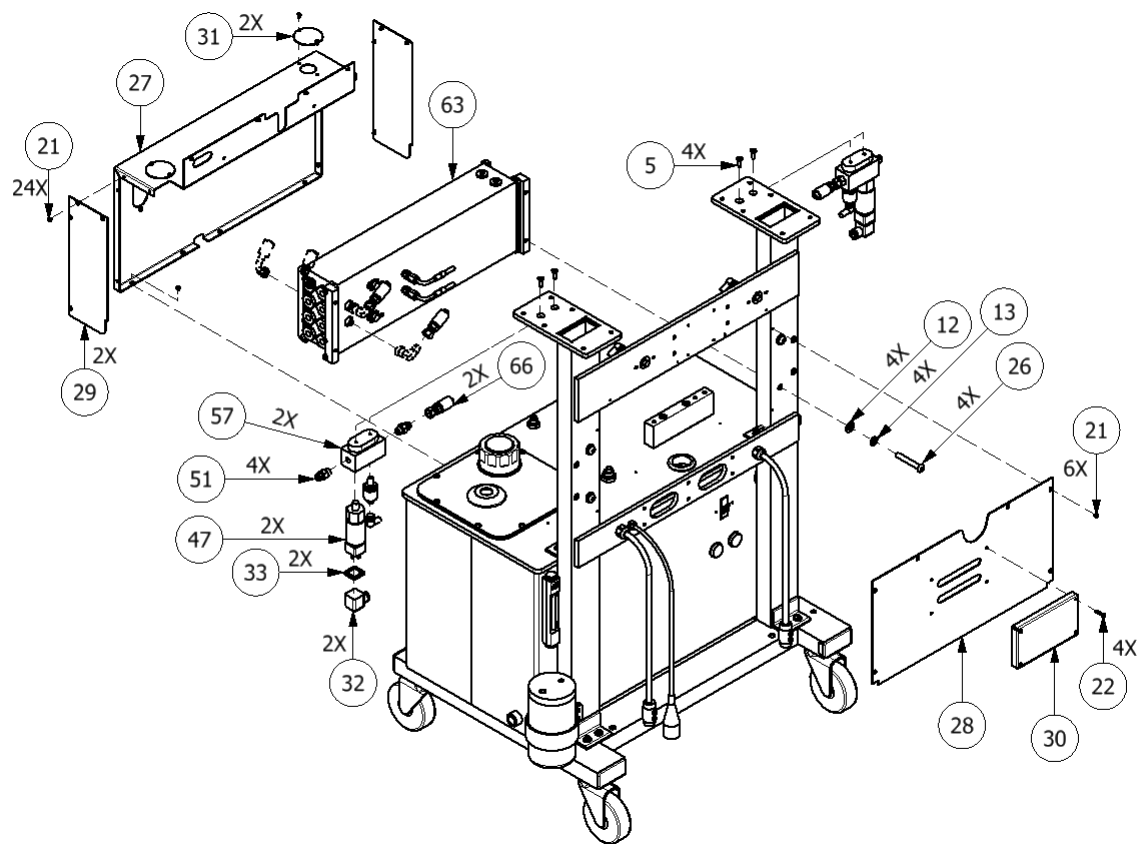


Figure 46: PHDX-2 Final Assembly - D

PHDX-2 FINAL ASSEMBLY (HIGH PRESSURE)			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	201057	NUT, HEX #8-32
2	30	201060	WASHER, LOCK, 1/4, 18-8 SS
3	1	201242	LIGHT UNIT, RED, 120VAC
4	2	201243	LIGHT UNIT, WHITE, 120VAC
5	4	201529	FHCS, 1/4-20 X 0.750, 18-8 SS
6	1	201546	CONSOLE ASSY, 3HP, 1PH, 220V
	1	201140	CONSOLE ASSY, 3HP, 3PH, 220V
	1	202363	CONSOLE ASSY, 3HP, 3PH, 380V
7	1	201567	FAN, DC BRUSHLESS, 24VDC
8	4	201580	WASHER, FLAT, 5/16, 18-8 SS
9	12	201581	HHCS, 1/4-20 X 0.750, 18-8 SS
10	2	201586	SHCS, #8-32 X 1.75, 18-8 SS
11	22	201621	WASHER, FLAT, 1/4, 18-8 SS
12	10	201627	WASHER, FLAT, 3/8, 18-8 SS
13	10	201628	WASHER, LOCK, 1/8, 18-8 SS
14	1	201883	INLET MONITORING KIT, FLOW METERS
15	8	201899	BHCS, 1/4-20 X 0.750, 18-8 SS
16	2	201920	COVER, FAN, 92MM
17	22	201930	HHCS, 1/4-20 X 1.000, ZP GRD8
18	4	202145	WASHER, LOCK, 5/16, 18-8 SS
19	6	202152	HHCS, 3/8-16 X 1.000, ZP GRD8
20	1	202173	CONSOLE ENCLOSURE, TOP, PHD(X)-2
21	30	202191	BHCS, #8-32 X 0.250, 18-8 SS
22	4	202201	BHCS, #8-32 X 0.875, 18-8 SS
23	4	202202	BHCS, #10-24 X 0.3125, 18-8 SS
24	4	202203	SHCS, #10-24 X 2.000, 18-8 SS
25	4	202204	HHCS, 5/16-18 X 0.875, 18-8 SS
26	4	202205	BHCS, 3/8-16 X 2.500, 18-8 SS
27	1	CL-03004	HEATER COVER TOP
28	1	CL-03005	HEATER COVER FRONT
29	2	CL-03006	HEATER COVER ENDS
30	1	CL-03007	THERMOCOUPLE COVER
31	2	CL-03009	HEATER HOLE COVER 2
32	4	EL-00052	SOLENOID VALVE CONNECTOR
33	4	EL-00053	SOLENOID VALVE GASKET
34	1	EL-00118A-00-1	HOSE BREAKER MOUNTING PLATE
35	2	EL-05220-01	CONSOLE KNOBS
36	1	EL-05225	90V TRANSFORMER
37	1	EL-05230-03	RT ANGLE CONDUIT CONNECTOR
38	1	EL-05237	THERMOCOUPLE HARNESS

PHDX-2 FINAL ASSEMBLY (HIGH PRESSURE)			
ITEM	QTY	PART NUMBER	DESCRIPTION
39	1	EL-150	CIRCUIT BREAKER 63AMP
40	4	EL-158	MICRO CORDSET 90 DEGREE
41	1	EL-192	TERMINAL BLOCK
42	1	EL-193	INRUSH CURRENT LIMITER
43	2	EL-195	0-5000 PRESS TRANSDUCER
44	1	EL-35	HOSE HEAT RELAY
45	1	EL-35-1	HEAT SINK
46	1	EL-37	TRANSFORMER, SIGNAL
47	2	EL-42-3200	PRESSURE SWITCH
48	1	FR-10	FRAME ASSY, PH-2
49	2	HI-00035	PRESSURE GAUGE 0-5000 PSI
50	1	HI-05003	DIRECTIONAL VALVE
51	4	HI-05011	6 ORB X 6 JIC
52	2	HI-05304	HYD CYLINDER TUBE
53	1	HI-05335	HYDRAULIC MANIFOLD ASSY
54	2	HI-05342	#12 JIC X 1/2 NPTM 90 DEG
55	1	HI-05343	EXIT MANIFOLD ASSY, PH2/PHX
56	2	HI-05347	3/8 NPT X 6 JIC 90 DEGREE
57	2	HI-05351	PRESSURE MANIFOLD
58	2	HOSE HEAT WIRE	HOSE HEAT WIRE
59	2	KT-00029A-1	HOSE HEAT, CONNECTOR BODY
60	1	ML-3	MOTORLINE ASSY, 5HP, 1PH, 60HZ
	1	ML-4	MOTORLINE ASSY, 5HP, 3PH, 60HZ
61	1	MQ-01009-01A	LUBE BOTTLE
62	1	MQ-01009-02A	LUBE BOTTLE LID
63	1	PH-33	8 ROD HEATER ASSY, PH(X)-2
64	1	202588	PUMP-LINE, HP BOTTOM FEED
65	2	PU-07000	CLEAR PUMP COVER
66	4	FEMALE SWIVEL FITTING	3/8 X 9/16-18 UNF
67	1	RA-00066A	CBMB 90 DEG MALE ELBOW NPT
68	1	RA-00067A	CBMB 90 DEG MALE ELBOW NPT
69	1	RA-00068A	CHECK VALVE
70	1	RA-06008	CHECK VALVE, POLYTUBE, 3/8
71	1	RM-212	TRANSFORMER DOOR
72	1	RM-222	TRANSFORMER BRACKET
73	2	RM-243	PROX SENSOR MOUNTING ASSY
74	1	TN-04196	HOSE CLAMP
75	1	202237	INLET MONITORING KIT, PHD

PHDX-2 FINAL ASSEMBLY (HIGH PRESSURE)			
ITEM	QTY	PART NUMBER	DESCRIPTION
76	1	YS-1	"A" INLET MANIFOLD ASSY
77	1	YS-2	"R" INLET MANIFOLD ASSY
78	2	201888	3/4 FNPT X 1/2 NPT, ELBOW, STEEL
79	2	HI-05016	3/4 NPTM X 3/4 NPTF, SW
80	2	HI-05021	E TYPE THERMOCOUPLE
81	2	HI-05020	NUT, THERMOCOUPLE

15.17 PHDX-2 HOSES

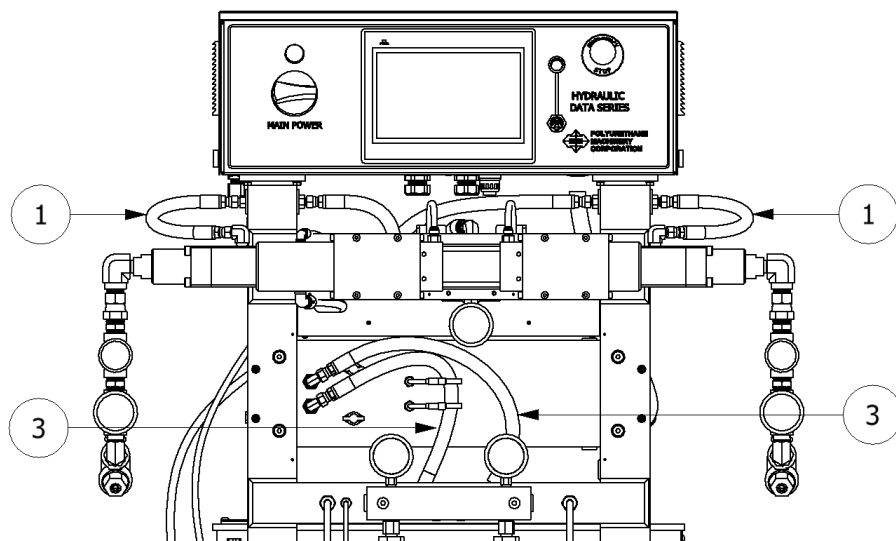


Figure 47: Proportioner Hoses - Front

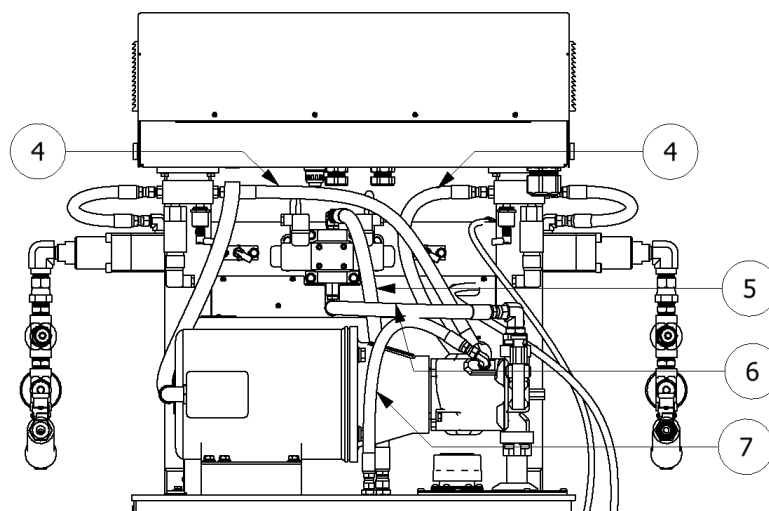


Figure 48: Proportioner Hoses - Back

PROPORTIONER HOSES			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	HI-05047-2	HOSE 9" HYD PUMP TO TANK
2	2	HI-05340-1	*OBSOLETE*
3	2	HI-05047-6	HOSE 13" TOP PUMP CYL TO LEFT M
4	2	HI-05047-7	HOSE ASSY HYDRAULIC PUMP TO TA
5	1	HI-05047-8	HOSE ASSY
6	1	HI-05013	HYD TANK RETURN HOSE 1/2 X 2
7	1	HI-05047-4	HOSE 13" TOP PUMP CYL TO LEFT

15.17.1 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

15.18 LUBE BOTTLE COMPONENTS

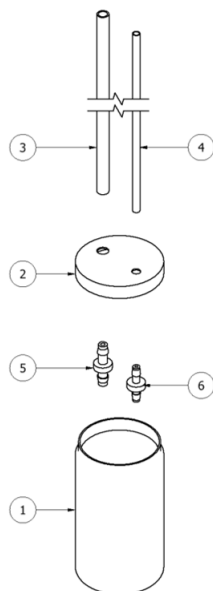


Figure 49: Lube Bottle Assembly

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

LUBE ASSY KIT, PHX2 (KT-05004)		
QTY	PART NUMBER	DESCRIPTION
1	RA-00068A	CHECK VALVE
1	RA-06008	CHECK VALVE
1	MQ-01009-01A	LUBE BOTTLE
1	MQ-01009-02A	LUBE BOTTLE LID
1	MA-00024A-1	1/2 X 43" PLASTIC TUBING, SUPPLY
1	MA-00025A-1	3/8" X 43" PLASTIC TUBING, RETURN

15.19 BLEED VALVE KIT

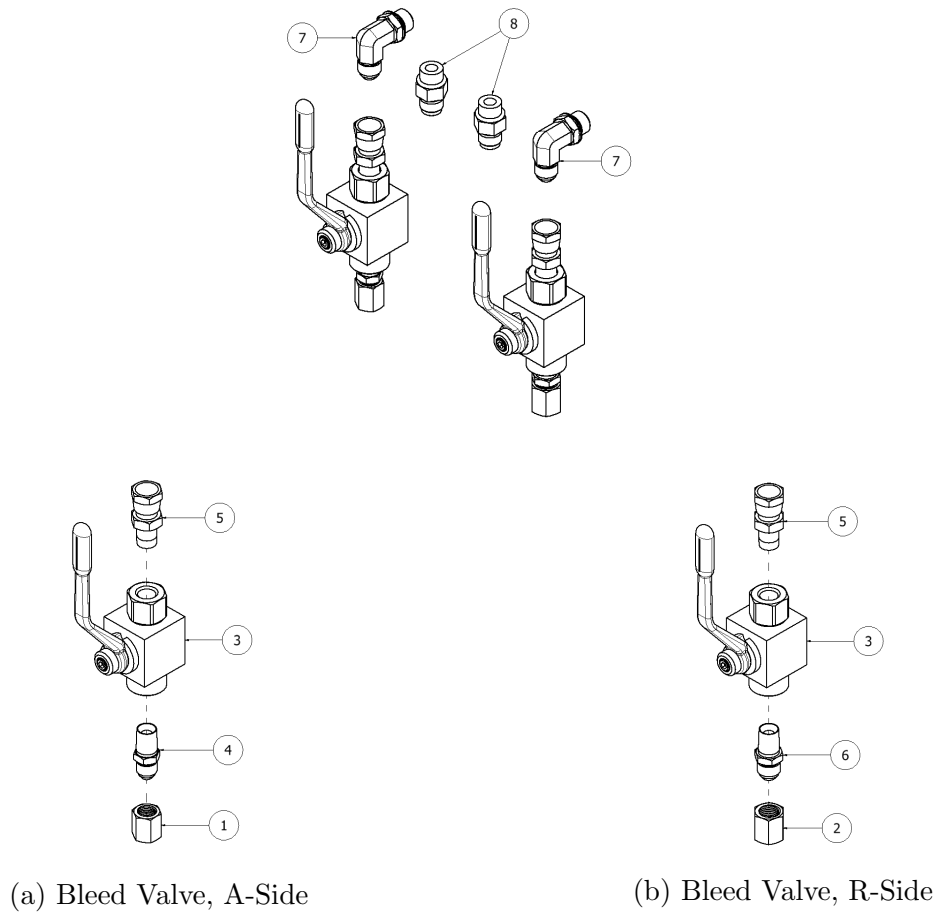


Figure 50: Bleed Valve Kit (202456)

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	6 ORB X 6 JIC