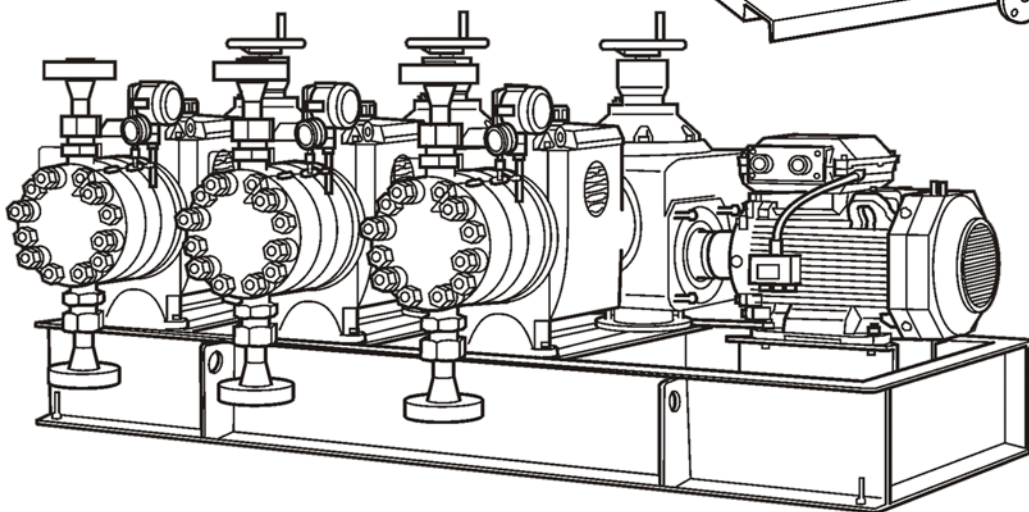
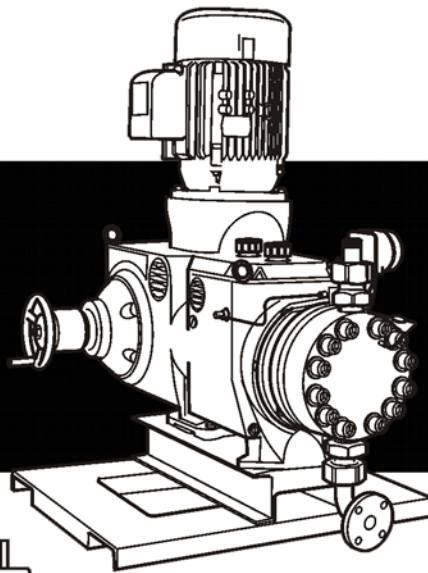




# MILTON ROY

## Primeroyal / Critical Service HPD Liquid End Instruction Manual

### INSTALLATION, OPERATION, AND MAINTENANCE MANUAL



Please record the following data for file reference

Tag Number(s): \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Installation Date: \_\_\_\_\_

Installation Location: \_\_\_\_\_

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## **SECTION 1 DESCRIPTION**

Milton Roy's High Performance Diaphragm (HPD) liquid end overcomes the Net Positive Suction Head (NPSH) restrictions associated with conventional disc diaphragm metering pumps. This is accomplished by a patented Mechanically Actuated Refill System (MARS) that eliminates the process side support plate.

The MARS also does away with the need for field adjustment of the refill mechanism by automatically compensating for process liquid modifications. This, combined with removable check valves, makes the HPD an ideal choice for any process in which downtime is critical. The HPD features a diaphragm that is compatible with a wide range of process liquids and chemicals.

The HPD liquid end is particularly suitable for pumping costly, aggressive or hazardous liquids without leakage.

### **1.1 SPECIFICATIONS**

**Steady State Accuracy/Turndown Ratio:**  
+ 1% over 10:1 turndown ratio.

**Liquid Temperature:**  
+20°F to 250°F

**Minimum Suction Pressure:**  
3 PSIA minimum (12 psi maximum vacuum).

**Minimum Discharge Back Pressure:**  
35 psi above suction pressure

**Hydraulic Fluid:**  
Mobile SHC-524 or Equivalent.

**Ball Checks:**  
Double ball checks in suction and discharge.

**Gear Lubricant**  
SHC-634 or Equivalent.

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## **SECTION 2 INSTALLATION**

### **2.1 UNPACKING**

Pumps are shipped f.o.b. from the factory and the title passes to the customer when the carrier signs for receipt of it. The customer, therefore, must file damage claims with the carrier.

The shipping crate should be carefully examined upon receipt from the carrier to be sure there is no obvious damage to the contents. Open the crate carefully, as there are sometimes accessory items fastened to the inside of the crate that may be lost or damaged. Examine all material inside crate and check against the packing list to be sure that all items are accounted for and undamaged.

### **2.2 SAFETY PRECAUTIONS**

When installing, operating, and maintaining an HPD pump, keep safety considerations foremost. Use proper tools, protective clothing, and eye protection when working on the equipment and install the equipment with a view toward ensuring safe operation. Follow the instructions in this manual and take additional safety measures appropriate to the liquid being pumped. Be extremely careful in the presence of hazardous substances, (e.g. corrosives, toxics, solvents, acids, caustics, flammables, etc.).

### **2.3 MOUNTING**

The HPD liquid end is shipped already mounted to the appropriate pump. Mounting, therefore, is simply a matter of securing the pump to a safe, level surface. For further information on proper pump mounting, see the appropriate pump instruction manual.

### **2.4 PIPING CONNECTIONS**

#### **General**

General piping instructions are given in the pump drive instruction manual. No reciprocating plunger pump can be expected to perform satisfactorily unless those recommendations are followed. Pay particular attention to plastic liquid ends, as these units are relatively fragile and can be damaged by the installation. For best results, avoid straining the liquid end by installing a very short section of flexible tubing between rigid, fixed piping and suction and discharge cartridges on plastic liquid ends.

**NOTE:** *Maximum safety and reliability may be ensured by protecting liquid ends and piping with an external relief valve installed in the system discharge line.*

### **2.5 NPSH CONSIDERATIONS**

The HPD liquid end is far superior to conventional diaphragm liquid ends for suction lift and many other NPSH critical applications. It's patented diaphragm and advanced design refill mechanism give this liquid end truly high performance in these applications.

For more NPSH information, refer to Milton Roy web site ([www.miltonroy.com](http://www.miltonroy.com)) for aid in evaluating applications for this liquid end.

### **2.6 TYPICAL PIPING**

In order to adjust the HPD relief valve, it is necessary to have a pressure gauge and a shut off valve installed in the discharge line. The pressure gauge must have a higher range than the desired pump relief pressure, and should be installed as close to the pump discharge connection as possible. The shut off valve should be installed downstream of the pressure gauge. These items are not required for normal operation, but for ease of pump maintenance and adjustment, it is suggested that they be permanently piped into the line.

Also see the instructions in the appropriate pump instruction manual for additional typical piping instructions.

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## SECTION 3 OPERATION

### 3.1 PUMP START-UP PROCEDURE (VARIABLE STROKE PUMPS)

#### CAUTION

**DO NOT RUN THE MOTOR UNTIL ALL START UP STEPS HAVE BEEN COMPLETED. YOU COULD DAMAGE THE PUMP IF YOU RUN THE MOTOR BEFORE ALL OF THE STEPS HAVE BEEN COMPLETED. IT MAY BE NECESSARY TO TEST THE MOTOR OFF THE PUMP TO INSURE PROPER DIRECTION AND OPERATION. THE MOTOR DIRECTION IS CRITICAL. WIRE THE MOTOR SO THAT IT ROTATES IN THE DIRECTION OF THE ARROW CAST ON THE MOTOR MOUNT FLANGE. CONSULT MANUFACTURER DOCUMENTATION FOR MOTOR START UP RECOMMENDATIONS.**

1. Follow the motor mounting procedure before attempting to start your pumps. On some pumps, the motor is mounted at the factory.
2. Make the proper electrical connections to the motor per the manufacturer's recommendations. Make sure the motor is properly grounded.
3. Make sure that all of the mounting holes for the pump base are used to securely tighten the base to the mounting area.
4. Do not run the motor until **ALL** start up steps have been completed.
5. Remove the gear drive fill cap (the chamber closest to the motor).
6. Fill the gear drive chamber with appropriate gear lubricant (SHC-634). This oil was shipped with the pump. Fill this chamber so that the oil level is even with the midpoint of the sight glass. Do not overfill.

7. Remove the hydraulic fluid fill cap (closest to the process liquid end of the pump) revealing the plunger and bleed valve. Fill this chamber with hydraulic oil, ISO -32 (SHC-524). This oil was shipped with your pump, and is a lower viscosity compared to the gear oil. The hydraulic fluid must fill the catchall chamber so that the oil level is even with the 90°-tubing elbow, connected to the rabbled valve. It may be necessary to remove the catchall cover to check the fluid level. Do not overfill.

**NOTE:** *Two types of oils have been provided. They must be added at the proper location.*

8. Replace catchall chamber cover.
9. Now fill the entire diaphragm displacement chamber in the liquid end with ISO -32 (SHC-524).
10. Remove all of the tubing connecting the air bleed valve (at the top of the displacement chamber behind the discharge check valve). There is a compression fitting at the point where the tubing enters the front catchall reservoir. Loosen the nut and remove the tubing from this fitting. There is a fitting connected to the air bleed valve that needs to be removed. Remove all air bleed valves from the top of the displacement chamber.
11. The displacement chamber must be filled with, ISO -32 (SHC-524).

#### CAUTION

**IF THE DISPLACEMENT CHAMBER IS FILLED WITH THE PLUNGER FULLY REARWARD, THE DIAPHRAGM COULD RUPTURE AT START-UP. TO PROPERLY FILL THE DISPLACEMENT CHAMBER, THE PLUNGER MUST BE POSITIONED SO THAT IT IS TOP DEAD CENTER IN THE DISPLACEMENT CHAMBER.**

12. With the plunger fully engaged in the displacement chamber (pump at TDC, Top Dead Center) adjust the stroke adjustment mechanism until the indicating needle reads 100%. Either turn the hand wheel on a micrometer, apply a 15-PSI supply signal for a Pneumatic, or apply a 20-mA signal for an Electronic actuator. In order to fill each displacement chamber, rotate the motor either by hand (by removing the fan cover and spinning the fan by hand), or by rotating the motor electrically. The motor may be jogged by turning the power on and off very quickly.

## CAUTION

**IT IS VERY IMPORTANT NOT TO ROTATE THE MOTOR AT HIGH SPEED, BECAUSE HYDRAULIC FLUID WILL BE FORCED FROM THE AIR BLEED PORT AT A VERY HIGH VELOCITY.**

13. Rotate the motor shaft so that the pump is at TDC (fully extended plunger into the displacement chamber). Fill this chamber with ISO-32 oil.

14. Replace the air bleed valve and tighten. Use a pipe thread sealant to seal the threads. Be very careful not to get any sealant into the displacement chamber air bleed port. Place the end of the tubing into the compression fitting and tighten the lock nut to secure the tubing.

15. On multiplex units, repeat these two steps for each pump to insure proper hydraulic fill in each displacement chamber.

16. Recheck the oil level in the catchall reservoir and install the cover, screws and lock washers. The gaskets have an adhesive backing that should be removed and the gaskets should be firmly attached to the covers using this adhesive.

17. Make sure that all oil fill caps are securely tightened to prevent oil leakage.

## CAUTION

**ALWAYS WEAR THE PROPER PROTECTIVE GEAR WHEN WORKING ON THE PUMP LIQUID END.**

18. Connect suction and discharge piping manifolds. Use the proper gaskets and tighten each flange per specification. Check that all connections are tight including the check valves, flanges, air bleed valves and the motor mount bolts.

19. Make sure the process bleeder barb, if so equipped, is tight. It is located on the front face of the pump directly under the discharge check valve. This fitting is used to purge any air that is trapped in the process liquid end. If this fitting is loose when you fill the pump, a stream of process fluid will come out and create a hazardous condition.

20. It is advisable to test the pump for proper operation by testing it with water before you use a process fluid. Now fill the process liquid ends with process fluid.

## WARNING

**TAKE ADDITIONAL SAFETY MEASURES APPROPRIATE TO THE LIQUID BEING PUMPED. BE EXTREMELY CAREFUL IN THE PRESENCE OF HAZARDOUS SUBSTANCES (CORROSIVES, TOXINS, SOLVENTS, ACIDS, CAUSTICS, AND FLAMMABLES).**

21. Loosen each process bleeder barb, if so equipped, on each pump to bleed any air from the liquid end. Connect a hose to this barb and use caution if you are pumping a hazardous chemical. After all process liquid ends have been purged of air, you can tighten all bleeder barbs to prevent leakage.

22. Now the motor can be started if and only if all steps have been followed.

- For constant speed motors, adjust the stroke adjustment mechanism so that the indication needle reads 25-30%. Gradually increase the capacity adjustment mechanism and increase back-pressure to insure that the pump has time to purge all air from the system.

- For a variable speed drive, the motor should be run at a very slow speed between 75-100 revolutions per minute, and the pump should have minimal process back pressure for initial start up. Gradually increase the motor speed and increase back-pressure to insure that the pump time to purge all air from the system.

**NOTE:** *This concludes the start-up procedure. Please follow these steps to insure start-up success and reduce any risk of damage to the pump.*

### 3.2 RELIEF VALVE ADJUSTMENT

#### **WARNING**

**THE PRESSURE RELIEF VALVE IS FACTORY SET TO OPEN AT A PRESSURE SLIGHTLY ABOVE THE PUMP MAXIMUM OPERATING DISCHARGE PRESSURE; NEVER SET THE VALVE AT ANY GREATER PRESSURE.**

All HPD liquid ends have a built in relief valve that allows hydraulic fluid to return to the hydraulic fluid reservoir if excessive pressure builds up in the discharge line. This effectively stops the pump from pumping, since the forward stroke of the piston will not displace the hydraulic fluid and force the diaphragm to flex.

The HPD liquid end relief valve may be adjusted to operating conditions by the following procedure. Adjust the relief valve after first installing the pump and after any maintenance procedures.

1. A pressure gauge and shut off valve must be installed in the discharge line to complete this procedure. If the necessary equipment is not installed, refer to the "Typical Piping" instructions in Section 2.
2. Make sure shut off valve is open. Start pump and pump process liquid to drain or other safe point to establish proper pumping action.
3. Set capacity control at 30%.

#### **WARNING**

**KEEP HANDS AWAY FROM RECIPROCATING PLUNGER AND CROSSHEAD.**

**DO NOT LEAVE PUMP OPERATING UNATTENDED WITH SHUT OFF VALVE CLOSED! EXCESSIVE PRESSURE CAN BUILD QUICKLY, POSSIBLY CAUSING SEVERE DAMAGE TO PUMP AND/OR PIPING. SINCE THE RELIEF VALVE IS NOT YET PROPERLY ADJUSTED, IT CAN NOT BE RELIED ON TO LIMIT EXCESSIVE PRESSURE BUILD-UP. BE SURE TO WATCH PRESSURE GAUGE VERY CAREFULLY AND OPEN SHUT OFF VALVE IMMEDIATELY IF EXCESSIVE PRESSURE DEVELOPS.**

4. Close shut off valve slowly ("dead head" the pump) and closely watch the pressure increase on the pressure gauge. If pressure exceeds desired value, quickly open shut off valve to relieve pressure in line.
5. With shut off valve still closed, loosen relief valve adjusting screw located on top of valve until the maximum pressure gauge reading reaches and maintains the relief valve pressure setting desired.
6. After setting relief valve, make sure shut off valve is fully open. Remove pressure gauge from line or leave in place, as desired, and place pump in routine service.

#### **WARNING**

**NEVER OPEN THE AIR PURGE VALVE (IF EQUIPPED 0261) DURING PRESSURIZED PUMP OPERATION!**

7. The diaphragm head is equipped with an air bleed purge valve built in just below the discharge port. (Item 0350). The purpose of this device is to vent entrapped air from the diaphragm head during priming and start-up. This end of this fitting will accept flexible tubing in order to pipe off the solution to a non-hazardous location. Immediately after priming, the fitting should be tightened.

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## SECTION 4 MAINTENANCE

### 4.1 DIAPHRAGM REPLACEMENT

The HPD diaphragm is extremely durable and often lasts for many years of service. As a preventive measure, however, Milton Roy Company recommends that the diaphragms be replaced yearly to coincide with annual check valve replacement. The liquid end must be removed from the pump to replace the diaphragm. The following is the diaphragm replacement procedure:

1. Stop pump and relieve all pressure from system. Isolate the liquid end from all sources of process liquid with appropriate valving and purge liquid end of all process fluid.

2. Disconnect both the suction inlet and discharge outlet from the piping system.

**NOTE:** *Approximately one pint of oil will still be present in the contour plate area which will be released when the diaphragm is removed. Prepare your work area accordingly.*

3. Remove the catchall cover and drain catchall of hydraulic oil by removing pipe plug at bottom of casing.

4. Completely loosen the piston rod retention nut (960) located inside the catchall.

5. Disconnect all tubing that connects the liquid end to the pump body.

**NOTE:** *The liquid end is very heavy (150 lbs. or more). A hoist is required to move it.*

6. Support liquid end with a hoist and unscrew nuts (980) that hold the displacement chamber (630) to the pump body. Pull liquid end and plunger (2030) off, being careful to protect the plunger from damage. Carefully raise liquid end and plunger over catchall and pull plunger from liquid end, allowing hydraulic fluid to drain back into catchall. Pull plunger firmly but carefully, being careful not to bend or otherwise damage the plunger.

7. Remove relieve valve (1040) and refill valve (400) from displacement chamber.

8. Place liquid end, diaphragm head up, on a bench or other clean, flat, and convenient working area.

9. Once the diaphragm head is adequately supported, the diaphragm head bolts (735) can be removed. Carefully pull the diaphragm head (700) away from the displacement chamber. The diaphragm (670) may pull off with the diaphragm head or remain with the displacement chamber. Remove diaphragm (670). (When equipped with leak detection remove two diaphragms, leak detection ring A (8081), leak detection ring B (8080), and leak detection ring spacer (8082). Leak detection ring A, leak detection ring B, and leak detection ring spacer can be reused).

10. Clean all sealing surfaces and install new diaphragm (670). (When equipped with leak detection install two diaphragms, leak detection ring A (8081), leak detection ring B (8080), and leak detection ring spacer (8082) removed previously. Apply a small amount of mineral oil between the diaphragms. Stacked diaphragms and rings may be aligned using the three small holes as a guide).

**NOTE:** *Apply anti-seize thread lubricant to the bolts.*

11. Reinstall liquid end on catchall, using the bolts as a guide.

**NOTE:** *The bolt torque value stamped on the head only applies to the material grade supplied with the pump.*

12. Torque bolts in sequence to one half of the final torque value stamped on the head. Follow the bolt torque pattern as stamped on the head. Repeat the torque sequence until bolts are tightened to final torque value.

13. Reconnect suction inlet and discharge outlet to piping system.

14. Fill the liquid end with hydraulic oil (refer to above "INITIAL START-UP" procedure).

## 4.2 HYDRAULIC OIL REPLACEMENT

Inspect and replace hydraulic oil on same schedule as the pumps gear drive lubricant (or whenever diaphragm is replaced). Annual replacement is recommended.

## 4.3 MARS REFILL VALVE (400)

The MARS refill valve (400) requires no periodic maintenance. Clean hydraulic oil is critical for proper operation.

Strainer service: while replacing the hydraulic oil, it is also recommended that the hydraulic oil strainer be replaced. The strainer, (390) which screws into the displacement chamber can become fouled or clogged over time.

Screw the valve back into the chamber. If the valve is damaged or broken, replace the entire assembly.

## 4.4 RETURNING UNITS TO THE FACTORY

Pumps will not be accepted for repair without a Return Material Authorization, available from the factory or other authorized Customer Service Department. Pumps returned to the factory for repairs should be clearly labeled to indicate the liquid being pumped. Process liquid should be flushed from the pump liquid end before the pump is shipped.

**NOTE:** *Federal law prohibits handling of equipment that is not accompanied by an OSHA Material Safety Data Sheet (MSDS). A completed MSDS must be packed in the shipping crate with any pump returned to the factory. These safety precautions will aid the troubleshooting and repair procedure and preclude serious injury to repair personnel from hazardous residue in pump liquid end. A Material Safety Data Sheet must accompany all returns.*

## 4.5 RECOMMENDED SPARE PARTS

**Be Prepared.** To avoid delays in repairs, the following spare parts should be ordered for each pump:

One Routine Preventive Maintenance Kit, which contains replacements for those parts which are subject to wear; specifically the ball checks, check

valve seats, gaskets, and the hydraulic fluid strainer. Replacing these parts annually with an RPM kit can reduce the possibility of unexpected downtime and will help to extend pump life.

Parts orders must include the following information:

1. Serial number (found on nameplate)
2. Model number (found on nameplate)
3. Quantity required
4. Part number
5. Part description

Always include the serial and model numbers in all correspondence regarding the unit.

## 4.6 ROUTINE PREVENTIVE MAINTENANCE

### **WARNING**

**BEFORE ANY MAINTENANCE, RELIEVE ALL PRESSURE FROM SYSTEM, ISOLATE LIQUID END FROM ALL SOURCES OF PROCESS LIQUID WITH APPROPRIATE VALVING, AND PURGE LIQUID END OF ALL PROCESS LIQUID.**

All inquiries on part order should be addressed to your local Milton Roy sales representative or sent to:

Parts Department  
Milton Roy Company  
Flow Control Division  
201 Ivyland Road  
Ivyland, PA 18974-0577  
Phone: (215) 441-0800  
Fax: (215) 441-8620

## 4.7 HYDRAULIC OIL REPLACEMENT

Inspect and replace hydraulic oil on the same schedule as the pump's gear drive lubricant (see the appropriate pump drive instruction manual for this information). Semiannual replacement is recommended, and can be scheduled to coincide with season oil changes.

To replace the hydraulic oil:

1. Remove the catchall cover by unscrewing the four screws, which hold it on.

2. Place a container under the pump catchall to catch the oil and unscrew the catchall drain plug.
3. When oil has finished draining, make sure that the area around the drain hole is clean. Screw drain plug back in securely.
4. Fill the catchall to the top of the oil seal that surrounds the crosshead with new, clean oil. Use hydraulic oil or any good quality type A automobile transmission fluid.
5. Replace the catchall cover the screw firmly in place.

**NOTE:** *It is not necessary to purge the liquid end displacement chamber of oil during annual oil replacement.*

6. Dispose of oil according to federal, state, or local codes that may apply.

#### 4.8 CHECK VALVE MAINTENANCE

##### Disassembly

### WARNING

**BEFORE PERFORMING ANY MAINTENANCE ON THE CHECK VALVES, RELIEVE ALL PRESSURE FROM SYSTEM, ISOLATE LIQUID END FROM ALL SOURCES OF PROCESS LIQUID WITH APPROPRIATE VALVING, AND PURGE LIQUID END OF ALL PROCESS FLUID.**

After insuring that all system pressure has been relieved and that all hazardous process liquids have been flushed from the liquid end, disconnect both the suction inlet and discharge outlet from the system piping.

1. Loosen the retaining nut, then remove. Once disassembled, the O-rings should be discarded.

2. Check valves may be removed. A compressed O-ring provides the seal to the head. Inspect the balls carefully. If they are smooth, round and free of deposits or pits, then they are suitable for continued use. Examine the check valve seats. The area of the seat where it meets the ball (the un-chamfered side) must be in near perfect condition for continued use. Any imperfection visible on the seating surface (pits, erosion, cracks, or a ball shaped contour greater than 0.030 deep) makes the seat unusable. If both the balls and seats are in good condition, then the length of time between parts replacement may be lengthened. If the balls and seats are severely damaged, then the length of time between parts replacement should be shortened.

##### Re-assembly

1. Replace O-ring on the check valves. Lubricate the O-rings and check valve threads before assembly.
2. Attach port adapter and tighten retaining nut.

#### 4.9 CORRECTIVE MAINTENANCE

##### Relief Valve Assembly

The relief valve assembly operates in filtered hydraulic oil and should require maintenance only if unusual circumstances occur, such as if corrosive media contaminates the fluid. Assembly and disassembly is straightforward. Field servicing should be limited to inspection and cleaning only. Repairs of this critical component should only be carried out by an authorized Milton Roy repair facility.

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## **SECTION 5 PARTS**

- Please refer to the Bill of Material and assembly for spare parts.
- Use the drawing to identify the sequence for the part.
- The sequence number is used on the drawing and Bill of Material.
- Parts should be ordered by the “**Part Number**” listed in the Bill of Material.
- Also reference the sequence number of the part, since component upgrades occur.

**CONSULT FACTORY FOR BILL OF MATERIAL**

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## **SECTION 6 LIMITED WARRANTY**

The LMI/Milton Roy Company ("Company") warrants that its pumping products will be free from defects in title, and so far as of its own manufacture, will be free from defects in materials and workmanship for a period of thirty six months from shipment by the Company. The Company additionally warrants that all of its other products, including actuators, will be free from defects in title, and so far as of its own manufacture, will be free from defects in materials and workmanship for a period of twelve months from shipment by the Company. The Company will, as its option, repair or replace its products provided the Company's inspection reveals the products to have been defective or nonconforming within the terms of this warranty. This warranty is expressly conditioned upon the following: (a) proper installation, maintenance, and use under the Company specified service conditions, (b) prompt notice of nonconformance or defect, (c) the Company's prior written authorization for return, (d) the products being returned to the Company, or at the Company's discretion, to a Factory Authorized Service Center, all at no cost to the Company. The Company will deliver repaired or replacement products Ex Works its factory or Factory Authorized Service Center. Products not of the Company's manufacture are warranted only to the extent provided by the original manufacture. The company shall not be liable for damage of any kind resulting from erosive, corrosive or other harmful action of any liquids, gases, or any other substance handled by the Company's products.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS, OR LIABILITIES, WHETHER EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM THIS CONTRACT, ITS PERFORMANCE, OR IN CONNECTION WITH THE USE OF, OR INABILITY TO USE THE COMPANY'S PRODUCTS.

The liability of the Company in respect of all damages, losses, costs or expenses, whether suffered or incurred by the Purchaser or any third party arising in any manner or incident related to this contract of the performance hereunder, shall be limited in the aggregate to the actual price paid by the Purchaser to the Company.

**Milton Roy Company**  
201 Ivyland Road . Ivyland, PA 18974 USA . (215) 441-0800 . Fax: (215) 441-8620 . [www.miltonroy.com](http://www.miltonroy.com)  
E-mail: [info@miltonroy.com](mailto:info@miltonroy.com)