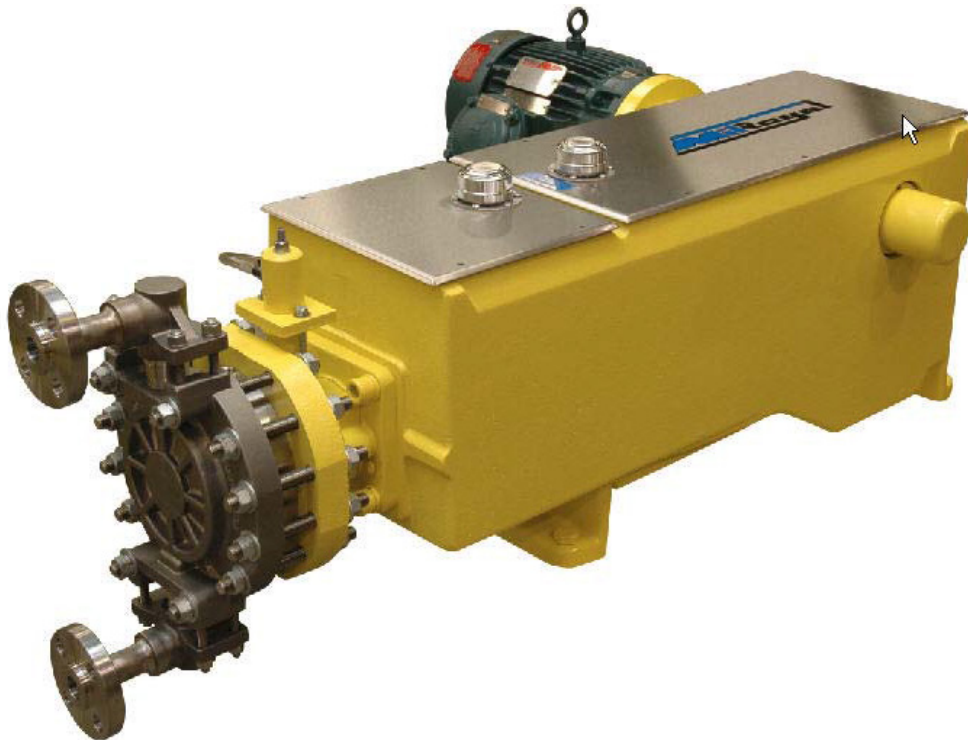




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MILROYAL[®] B and C Disc Diaphragm Liquid End Instruction Manual

Manual No : 54145

Rev. : 00

Rev. Date : 12/2015



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PRECAUTIONS

The following precautions should be taken when working with metering pumps.
Please read this section carefully prior to installation.

Protective Clothing



ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to **Safety Data Sheets** for the solution being pumped.

Hearing Protection



It is recommended that hearing protection be used if the pump is in an environment where the time - weighted average sound level (TWA) of 85 decibels is exceeded. (as measured on the A scale - slow response)

Electrical Safety



- Remove power and ensure that it remains OFF while maintaining pump.
- **DO NOT FORGET TO CONNECT THE PUMP TO EARTH / GROUND.**
- Electric protection of the motor (Thermal protection or by means of fuses) is to correspond to the rated current indicated on the motor data plate.

Liquid Compatibility



Verify if the materials of construction of the wetted components of your pump are recommended for the solution (chemical) to be pumped.

Pumps Water “Primed”



All pumps are tested with water at the factory. If your process solution is not compatible with water, flush the **Pump Head Assembly** with an appropriate solution before introducing the process solution.

Plumbing and Electrical Connections



Always adhere to your local plumbing and electrical codes.

Line Depressurization



To reduce the risk of chemical contact during disassembly or maintenance, the suction and discharge lines should be depressurized before servicing.

Over Pressure Protection



To ensure safe operation of the system it is recommended that some type of safety / pressure- relief valve be installed to protect the piping and other system components from damage due to over-pressure.

Lifting



This manual should be used as a guide only - Follow your company's recommended lifting procedures. It is not intended to replace or take precedence over recommendations, policies and procedures judged as safe due to the local environment than what is contained herein. Use lifting equipment that is rated for the weight of the equipment to be lifted.



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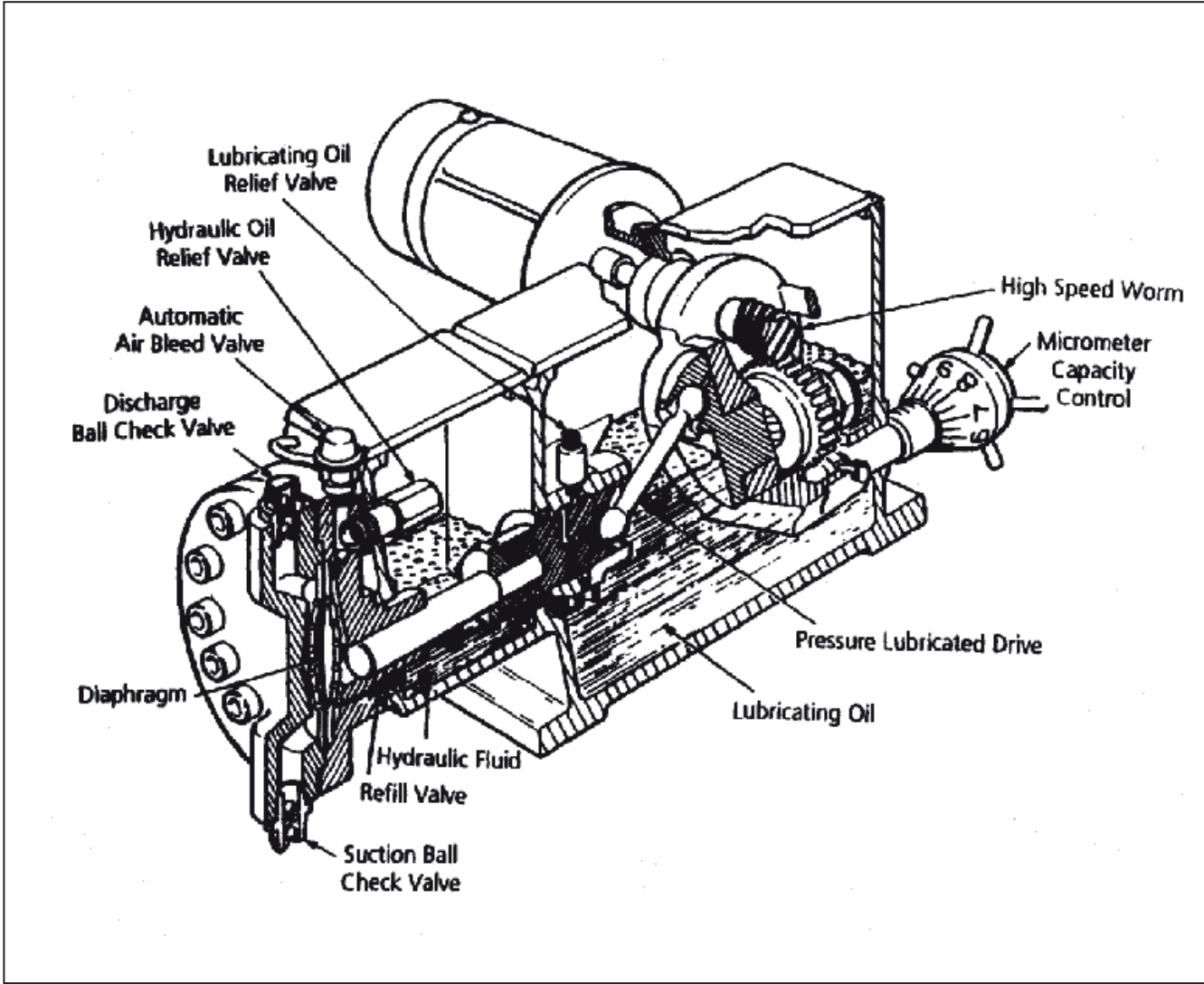


Figure 1. MILROYAL® B and C Disc Diaphragm

This Instruction Manual is designed to serve as a supplement to Instruction Manuals 53943 and 53939, which provide both general information and specific instructions for installing, operating, and maintaining MILROYAL® pumps. This manual covers only the optional Disc Diaphragm Liquids Ends which may be fitted to these pumps in place of the standard Packed Plunger Liquid Ends. Do not rely on this manual alone in installing, maintaining, and operating MILROYAL® pumps.

1.1 GENERAL

The Disc Diaphragm Liquid End is particularly suitable for pumping costly, aggressive, or hazardous liquids without leaking. The diaphragm is hydraulically balanced between the process liquid on one side and the hydraulic oil on the other side. The hydraulic oil takes the place of a mechanical connection between pump plunger and diaphragm.

1.2 PRINCIPLE OF OPERATION

In a Disc Diaphragm Liquid End, the reciprocating pump plunger alternately forces hydraulic oil against the diaphragm and then draws the oil back into the plunger bore. This action causes the diaphragm to flex between the limiting contour plates.

Each suction stroke of the plunger pulls the diaphragm towards the oil side contour plate so that process liquid flows into the displacement chamber through the suction ball-check valve. Each discharge stroke of the plunger pushes the diaphragm towards the process side contour plate to expel the process liquid from the displacement chamber through the discharge ball-check valve. On each suction stroke, the discharge ball-checks are seated, and on each discharge stroke, the suction ball-checks are seated (pressure in pump head is greater than suction line pressure). This mode of operation prevents back flow and ensures liquid movement from the suction port, through the displacement chamber, and out the discharge port. Precise hydraulic oil volume is maintained by an automatic air-bleed valve and a refill valve.

1.3 SAFETY PRECAUTIONS

When installing, operating, and maintaining the Disc Diaphragm Liquid End, 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 liquid being pumped. Be extremely careful in the presence of hazardous substances (e.g. corrosives, toxins, solvents, acids, caustics, flammables etc.).

SECTION 2 - INSTALLATION

2.1 UNPACKING

Units are shipped Free on Board (FOB) factory and title passes to customer when carrier signs for receipt of pump. The customer, therefore, must file any damage claims with the carrier.

Carefully examine the shipping crate upon receipt from the carrier to be sure there is no obvious damage to contents. Open the crate carefully, so that accessory items fastened to the inside of the crate will not be lost or damaged. Examine all materials inside the crate and check against packing list to be sure that all items are accounted for and undamaged.

2.2 CONVERSION PROCEDURES

To convert a pump from standard Packed Plunger Liquid End to Disc Diaphragm Liquid End, study drawings at the back of this manual and then mount the liquid end to the pump as follows (numbers in parentheses are part numbers).

2.2.1 MILROYAL® A & B (See Figure 4)

1. Remove Packed Plunger Liquid End assembly from pump (see pump drive disassembly instructions in Instruction Manual 53943). Remove plunger adapter, gland cap, gland studs or bolts, and funnel.
2. Place lip-type seal over crosshead and position seal flush with original seal in crosshead bore. Be careful not to damage seal lip during installation. Also, note that seal is installed with lip extending towards pump liquid end.
3. Place a length of 2 1/2" (64 mm) o.d. schedule 40 pipe over crosshead and against seal. Using a soft mallet, strike the pipe to drive seal into crosshead bore until new seal is flush with casing face.
4. Drill a 1/4" (6 mm) diameter hole OFF the vertical center line 2 1/2" (64 mm) below the top machined edge of the pump casing wall in which seals are installed. (Lay a cloth in casing to catch chips from drilling.)
5. Flush out all dirt, chips, and debris from pump casing. Clean liquid end mounting face on pump casing.
6. Loosely install plunger adapter in crosshead.
7. Place liquid end gasket on mounting face of displacement chamber. Position relief valve gasket between pump casing and displacement chamber. This is best done by threading a pipe nipple into the relief valve port and pushing the gasket onto the pipe. Insert plunger assembly in bore of displacement chamber. Carefully fit liquid end assembly to casing bore while guiding plunger assembly into hole in plunger adapter.
8. Thread bolts into displacement chamber from inside pump catchall and tighten securely. Remove gasket-positioning pipe and install relief valve in displacement chamber so valve port faces bottom of pump casing. Bottom plunger firmly in plunger adapter against crosshead and then tighten adapter securely.
9. Install air-bleed valve in top of displacement chamber. Install hose connection and tubing for oil return from valve to pump casing.
10. Install relief valve assembly and adapter to displacement chamber from inside pump catchall.
11. Install and tighten drain plug in bottom of pump catchall.
12. Proceed to start-up instructions in *Section 3*.

2.2.2 MILROYAL® C (See Figure 5)

1. Remove Packed Plunger Liquid End assembly from pump (see *pump drive disassembly instructions in Instruction Manuals 53939*). Remove plunger adapter, cap, gland studs, and funnel.
2. Place lip-type seal over crosshead and position seal flush with original seal in crosshead bore. Be careful not to damage seal lip during installation. Also, note that seal is installed with lip extended towards pump liquid end.
3. Place a length of 4" (102 mm) o.d. Schedule 40 pipe over the crosshead and against seal. Using a soft mallet, strike the pipe to drive seal into crosshead bore until new seal is flush with casing face.
4. Drill a 1/4" (6 mm) diameter hole OFF the vertical center line 4 3/8" (111 mm) below the top machined edge of the pump casing wall in which seals are installed. (Lay a cloth in casing to catch chips from drilling).
5. Flush out all dirt, chips, and debris from pump casing. Clean liquid end mounting face on pump casing.
6. Loosely install plunger adapter in crosshead.
7. Place liquid end gasket against mounting face of displacement chamber. Insert plunger assembly in bore of displacement chamber. Carefully fit liquid end assembly to casing bore while guiding plunger assembly into hole in plunger adapter.
8. Thread bolts into displacement chamber from inside pump catchall. Tighten securely. Bottom plunger firmly in plunger adapter against crosshead. Tighten securely.
9. Install air-bleed valve in top of displacement chamber. Install hose connection (402-10 and tubing for on return from valve to pump casing).
10. Install refill valve and adapter to displacement chamber from inside pump catchall. Note the two different locations of refill valve shown on *Figure 5* for different size plunger pumps.
11. Install relief valve in top of displacement chamber. On 2 1/2" and 3 1/2" diameter plunger pumps, install relief valve between side port of displacement chamber and pump catchall chamber drain hole with pipe fittings as shown on *Figure 5*.
12. If relief valve has been installed, install and tighten drain plug in bottom of pump catchall.

2.3 PIPING

General piping instructions are given in pump drive Instruction Manuals 53943 and 53939. 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 careless installation. For best results, install a very short section of flexible tubing between rigid, fixed piping and suction and discharge cartridges on plastic liquid ends.

NOTE:

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

SECTION 2 - INSTALLATION

2.3.1 Piping Concentrated Sulfuric Acid

The liquid ends of pumps with plungers less than 5/6" in diameter, designed for 20 gph delivery or less, are too small to tolerate the sludge in commercial concentrated sulfuric acid. However, even these pumps will serve in such applications if the piping system is modified as follows:

1. Install a sulfuric acid tank, fitted with a heel (unused portion below the tank outlet), in the suction line to collect sludge from the system. (Maximum pressure / sludge trap is 20 psig.)
2. Ensure pump suction is flooded.
3. Use piping material identical to liquid end material: install steel pipe to steel liquid end. Never connect iron to steel or serious galvanic corrosion will occur.
4. Filter sludge by installing a glass wool filter or Milton Roy Sludge Trap in the suction line.

The first and last of these precautions will benefit any size pump by removing the high proportion of sludge in this acid, which can foul or clog pump check valves. *Figures 2 and 3 illustrate sludge trap and installation.*

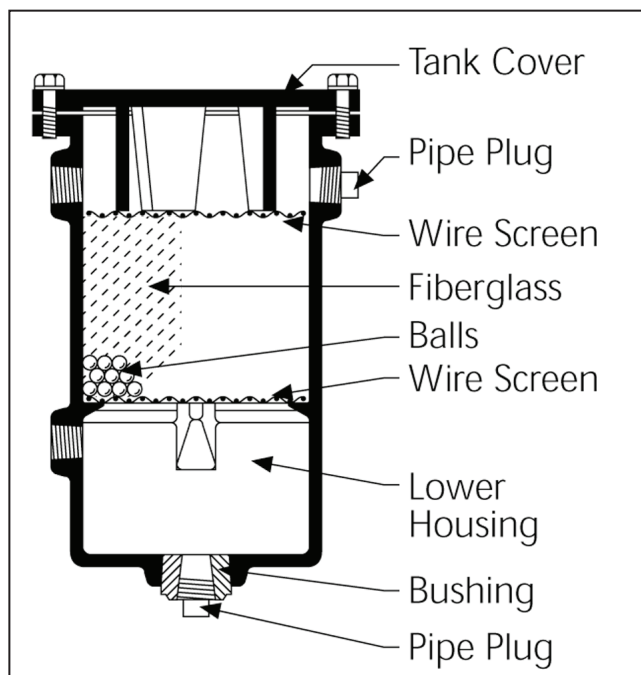


Figure 2. Milton Roy Sludge Trap.

2.3.2 Suction Lift Conditions

Disc Diaphragm Liquid End pumps are designed to operate with process liquid supplied at or above atmospheric pressure. Although these pumps can move liquids supplied at less than atmospheric pressure, the resulting suction lift must remain constant and the hydraulic & refill valve must be adjusted to compensate for the specific conditions. Refer to Bulletin 220, the practical Handbook of NPSH for metering pumps before start-up to determine the minimum operating suction pressure for the application.

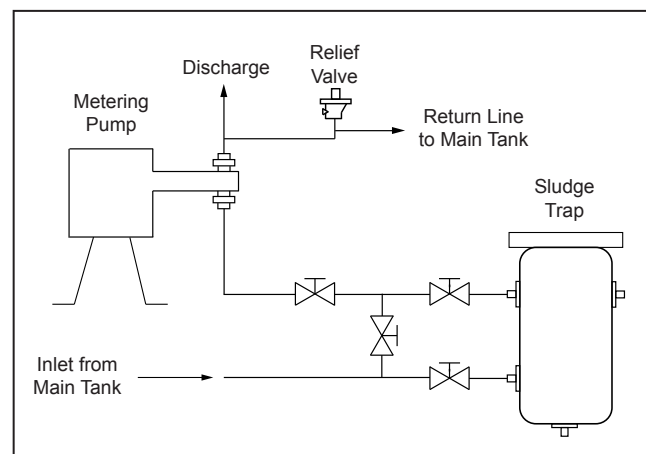


Figure 3. Typical Sludge Trap Installation.

3.1 INITIAL START-UP

After installing the pump and the Disc Diaphragm Liquid End, perform the following operations before placing the pump in routine service. (Numbers in parentheses are part numbers-see *Figures 4 & 5*.)

1. Disconnect tubing from air-bleed valve and remove air-bleed valve from top of liquid end.
2. Fill displacement chamber through air-bleed valve port with hydraulic oil furnished with pump or conversion liquid end (or fill with good quality anti-foaming Type A automatic transmission fluid). Allow air bubbles to surface and add oil as required to maintain level at top of liquid end until all air has escaped.
3. Fill pump catchall chamber to top of crosshead oil seal with the same type of oil as used in *step 2*.
4. Install air-bleed valve and tubing.
5. Prepare pump drive for initial start-up as outlined in Instruction Manuals 53943 and 35939.

3.2 INITIAL ADJUSTMENT (*Figure 4 & 5*)

MILROYAL® refill and relief valves must be adjusted to operating conditions by the following procedures. Adjust these valves after first installing pump and after any corrective maintenance.

3.2.1 Refill Valve

1. Start pump and run at normal operating pressures of suction and discharge and at normal operating capacity; e.g., if a pump rated for 20 gph will be operated at 12 gph, set capacity adjustment at 60% (12/20) capacity.

▲ WARNING KEEP HANDS AWAY FROM RECIPROCATING PLUNGER AND CROSSHEAD.

2. Turn refill valve adjusting nuts clock wise to reduce loading on spring until valve stem, and nut move very slightly with each suction stroke of the pump plunger. Now each stroke will replenish the hydraulic system through the refill valve and discharge the excess through the relief valve.
3. Gradually turn adjusting nuts counter clock wise to increase spring loading against stem nut until stem and nut stop moving.
4. Back OFF adjusting nut 1/4 turn. When properly adjusted, refill valve stem nut will move very slightly with each stroke to allow just enough hydraulic oil into the displacement chamber to replace any lost through plunger bore and air-bleed valve. Movement can be detected with a light fingertip on the bottom of relief valve.

3.2.2 Refill Valve

▲ CAUTION 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.

1. To adjust relief valve, first operate pump against a system operating pressure.
2. Stop pump.
3. Install a pressure gauge, with a range higher than desired relief pressure, at the pump discharge connection.
4. Install a shut OFF valve downstream from the pressure gauge.
5. Open shut OFF valve. Start pump; pump process liquid to drain or other safe point to establish proper pumping action.
6. Set capacity control at 30%.
7. Close shut OFF valve (“dead head” the pump) and closely watch pressure increase on pressure gauge. If pressure exceeds desired value, quickly open shut OFF valve to relieve pressure in line.

SECTION 3 - OPERATION

⚠ WARNING KEEP HANDS AWAY FROM RECIPROCATING PLUNGER AND CROSSHEAD.

8. Loosen relief valve adjusting screw and repeat *step 7* until the maximum pressure gauge reading equals the relief valve pressure setting desired.
9. After setting relief valve, ensure shut OFF valve is fully open. Remove pressure gauge from line or leave in place, as desired, and place pump in routine service.

3.3 MAINTENANCE

3.3.1 Hydraulic Oil

Inspect and replace hydraulic oil on the schedule as gear drive lubricants.

3.3.2 Check Valves

Except for plastic construction, check valve assemblies are of identical design with those described in MILROYAL® Instruction Manuals 53943 and 53939. Maintain and service metallic ball-check valves according to those instructions.

3.3.3 Plastic Check Valves

Plastic ball check cartridges for MILROYAL® A and B pumps are serviced in the same manner as the metallic cartridges; however, plastic components are more fragile than metallic parts. Handle plastic parts with care and do not overtighten during assembly.

Plastic ball check valves furnished on 2 1/2" and 3 1/2" diameter plunger MILROYAL® C pumps should be serviced as described below.

⚠ CAUTION PLASTIC COMPONENTS ARE MORE FRAGILE THAN METALLIC PARTS. HANDLE PLASTIC PARTS WITH CARE AND DO NOT OVERTIGHTEN DURING ASSEMBLY.

3.3.3.1 Disassembly

Remove and disassemble plastic check valves as follows (*See Figure 5*).

1. Unscrew check valve assembly from diaphragm head.
2. Remove O-ring from assembly.
3. Remove cartridge assembly nuts from cartridge assembly bolts to release compression plates, straight flange adapter, guide stop, seat, pipe flange adapter, gaskets, and ball-checks.

3.3.3.2 Reassembly

Reassemble check valves in reverse order from disassembly. During reassembly, tighten cartridge assembly nuts carefully to avoid deforming plastic components.

⚠ CAUTION TURN CHECK VALVE ASSEMBLIES INTO PLASTIC LIQUID END BY HAND. DO NOT USE A WRENCH. SEAL THREADS WITH PIPE DOPE; DO NOT USE THREAD TAPE.

3.3.4 Diaphragm

3.3.4.1 Disassembly

Remove diaphragm head as follows (*see Figures 4 and 5*).

1. Flush process liquid from liquid end.
2. Disconnect piping from suction and discharge ball-check cartridges.
3. Remove bolts from diaphragm head and remove head from displacement chamber.

⚠ CAUTION PROCESS SIDE CONTOUR PLATE OR BOTH CONTOUR PLATES MAY COME AWAY WITH DIAPHRAGM HEAD.

4. Remove process side contour plate and diaphragm from displacement chamber, nothing any indication of a top side on the plate (i.e., either closer hole spacing or a stamped arrow).

3.3.4.2 Reassembly

Clean all parts for reassembly, then proceed as follows.

1. Set oil side contour plate in displacement chamber, oriented as in step 4 above. Set Process side contour plate in diaphragm head rabbet (oriented as in step 4 above). Set new diaphragm in head over contour plate. Mount diaphragm head assembly to displacement chamber with bolts. If necessary, hold diaphragm and contour plate in place in head with a thin, flat, smooth strip of metal (e.g., a knife blade) until head, diaphragm and contour plate are positioned on displacement chamber; then withdraw metal strip and install bolts. Tighten bolts evenly and securely to ensure proper seating of diaphragm and contour plates.
2. Reconnect suction and discharge lines.
3. Test pump for leaks and then return to normal service.

Plastic diaphragm heads are serviced as for the metallic construction except that the mounting bolts secure the head with a reinforcement plate (back-up plate) and the process side contour plate manufactured integral with the diaphragm head, rather than as a separate part.

⚠ CAUTION HAND-TIGHTEN PLASTIC COMPONENTS DURING ASSEMBLY AS THESE PARTS ARE MORE FRAGILE THAN METALLIC PARTS AND MAY DISTORT UNDER EXCESSIVE TORQUE.

3.4 SPARE PARTS

A minimal stock of spares should generally include the parts listed in the appropriate charts below. For parts ordering information and factory repair procedures, see the appropriate pump drive Instruction Manual.

The parts below are needed for all sizes & material Disc Diaphragm liquid ends.

Drawing Location Reference	Description	Qty
2090	Air Bleed Valve Assy	1
2070	Refill Valve Assembly	1
2080	Relief Valve Assembly	1
2030	Plunger Assembly	1
2430	Ring Insert	2
30	Air Bleed Valve Ball Chk	1
330	Crosshead Oil Seal	2
80	Air Bleed Valve Plug	6
70	Air Bleed Valve O-Ring	2

The parts below are needed in addition to the parts above for all sizes & material Disc Diaphragm liquid ends except 2 1/2" & 3 1/2" plastic.

Drawing Location Reference	Description	Qty
2242	Check Valve Seat	4
2250	O-Ring	4
2920	Limit Pin	2
1920	Diaphragm	2
1992	Ball Check	4

The parts below are needed in addition to the parts listed in the first chart for 2 1/2" & 3 1/2" Disc Diaphragm liquid ends only.

Drawing Location Reference	Description	Qty
1995	Check Valve Seat	2
2040	Check Valve Gasket	6
1920	Diaphragm	2
4074	Ball Check	6
70	O-Ring	6

SECTION 4 - TROUBLESHOOTING

Pump drive Instruction Manuals list most possible malfunctions, their causes and cures. The following problems peculiar to Disc Diaphragm Liquid Ends may be remedied as indicated below.

Excessive delivery	<ul style="list-style-type: none">• Low discharge line pressure. Increase line pressure (e.g., install a back pressure valve).
Insufficient delivery	<ul style="list-style-type: none">• Incorrect refill valve setting. Adjust valve to operating conditions.
	<ul style="list-style-type: none">• Blocked discharge line. Clear line.
	<ul style="list-style-type: none">• Relief Valve set too low. Adjust valve to operating conditions.
	<ul style="list-style-type: none">• Air in hydraulic system. Stop pump at end of suction stroke. Remove air bleed valve and allow air to escape. Fill displacement chamber with hydraulic oil and reinstall valve.
Erratic delivery	<ul style="list-style-type: none">• Leaky relief valve. Repair or replace valve.

PARTS LIST FOR FIGURE 4.

Drawing Location Reference	Description	Qty
2090	Air Bleed Valve Assy	1
2070	Refill Valve Assy	1
2080	Relief Valve Assy	1
590	Base	2
2074	Refill Valve Stem Nut	1
2071	Refill Valve Adjusting Nut	2
2030	Plunger Assy	1
1900	Displacement Chamber	1
2076	Refill Valve Body	1
2000	Check Valve Assy	2
2212	Check Valve Body	2
1950	Diaphragm Head	1
1990	Check Valve Body	2
10	Relief Valve Body	1
2242	Check Valve Seat	4
1995	Check Valve Seat	2
1991	Check Valve Seat	2
2430	Ring Insert	2
2250	O-Ring	4
2040	Relief Valve Gasket	1
2010	Liquid End Gasket	1
1970	Caution Sticker	1
50	Relief Valve Adjusting Screw	1
2073	Refill Valve Stem	1
40	Air Bleed Valve Stem	1
2020	Plunger Adapter	1
2060	Refill Valve Adapter	1
2072	Refill Valve Spring	1
2920	Check Valve Limit Pin	4
1920	Diaphragm	1
1930	Contour Plate (Oil)	1
1930	Contour Plate (Process)	1
50	Retainer (Air Bleed Valve)	1

Drawing Location Reference	Description	Qty
340	Pipe Plug	1
60	Hose Connection	1
2050	Mounting Bolt	4
1990	Diaphragm Head Bolt	Var.
1960	Dia Head Bolt	Var.
1992	Ball Check	4
30	Air Bleed Valve Ball Check	1
20	Relief Valve Ball Check	1
3000	Tubing	1
330	Shaft Seal	1
80	Air Bleed Valve Plug	1
70	Air Bleed Valve O-Ring Seal	1

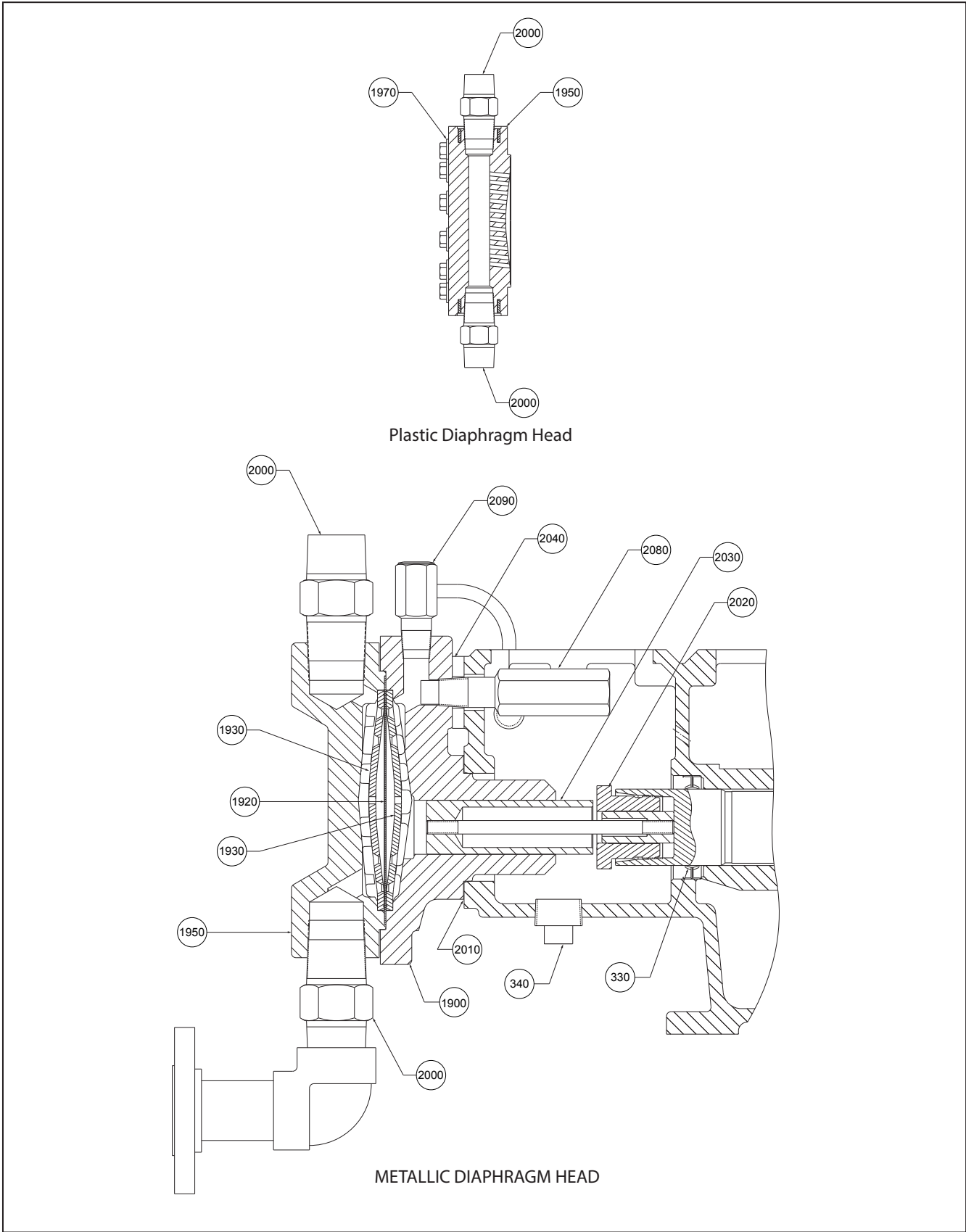
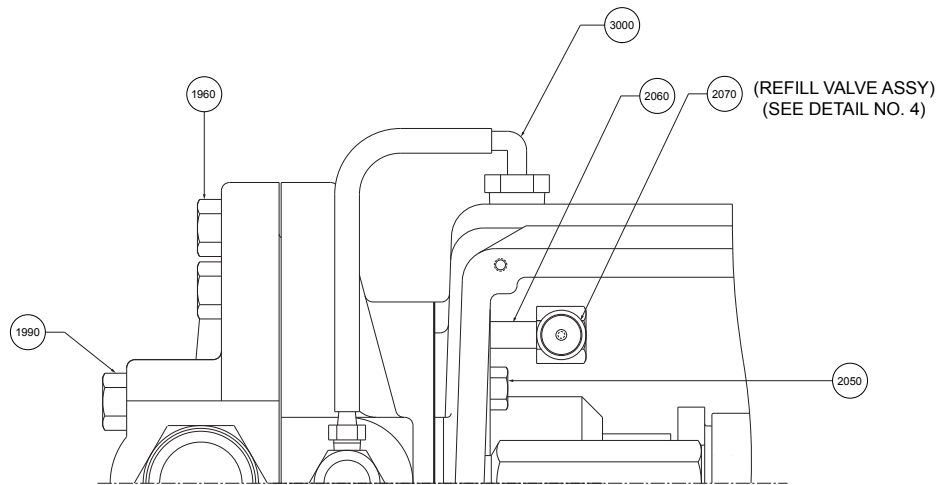
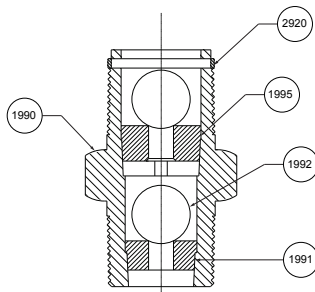


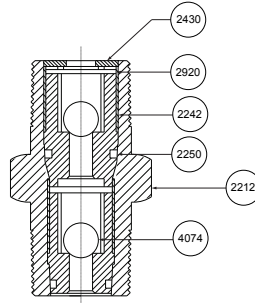
Figure 4. MILROYAL® B Disc Diaphragm Liquid End Assembly Drawing (C-102-2095-0006)



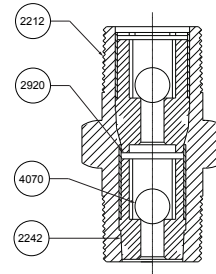
Top View



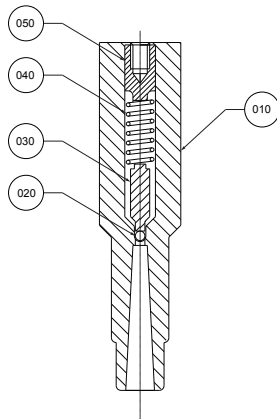
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2 1/2" Dia. Metallic Plgr.
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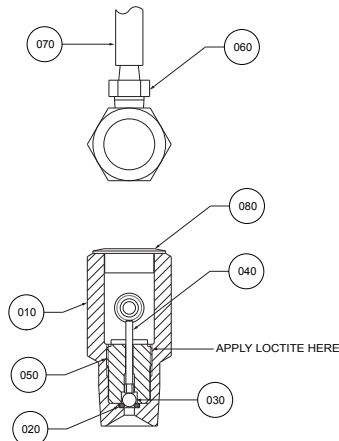
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Check Valve
All Plgr. Dia. Except 2 1/2"
2210264102



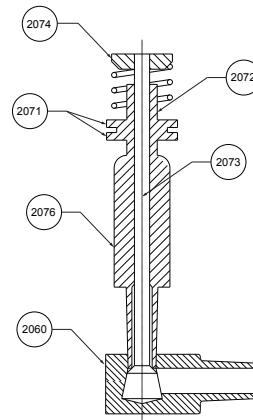
Detail No. 6
Check Valve
2 1/2" Dia. Plastic Plgr.



Detail No. 3*
Relief Valve Assy.
101001300X



Detail No. 5*
Air Bleed Valve Assy.
1010018000



Detail No. 4*
Refill Valve Assy.
1010017100

Figure 4. MILROYAL® B Disc Diaphragm Liquid End Assembly Drawing Continued (C-102-2095-0006)

PARTS LIST FOR FIGURE 5.

Drawing Location Reference	Description	Qty
2090	Air Bleed Valve Assembly	1
2070	Refill Valve Assembly	1
2040	Relief Valve Assembly	1
590	Base	2
1996	Ball Guide	1
2074	Refill Valve Stem Nut	1
2171	Relief Valve Adjusting Nut	2
2025	Plunger Assembly	1
1900	Displacement Chamber	1
10	Air Bleed Valve Body	1
	Check Valve Body	2
2076	Refill Valve Body	1
1990	Check Valve Body	2
20	Check Valve Seat	4
	Air Bleed Valve O-Ring	1
1995	Check Valve Seat	2
1991	Check Valve Seat	2
2010	Displacement Chamber Gasket	1
30	Check Valve O-Ring Seal	4
40	Ring Insert	1
	Air Bleed Valve Stem	1
2073	Refill Valve Stem	1
2020	Plunger Adapter	1
2072	Refill Valve Spring	1
1998	Check Valve Limit Pin	4
50	Air Bleed Valve Retainer	1
60	Hose Connection	1
1992	Check Valve Ball Check	4
30	Air Bleed Valve Ball Check	1
480	Shaft Seal	1
80	Air Bleed Valve Plug	1
70	Dekoron Tubing	1
1920	Diaphragm	1

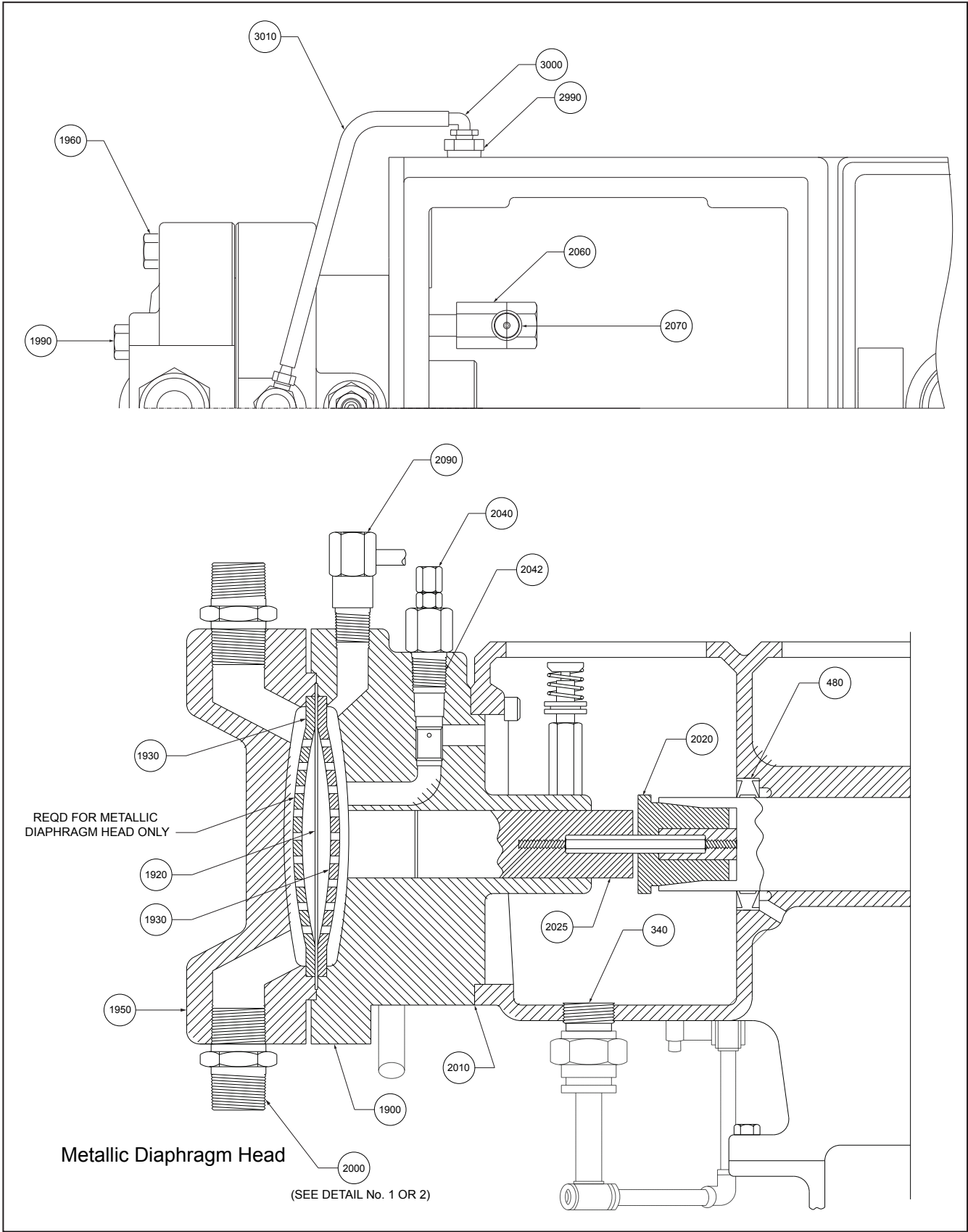
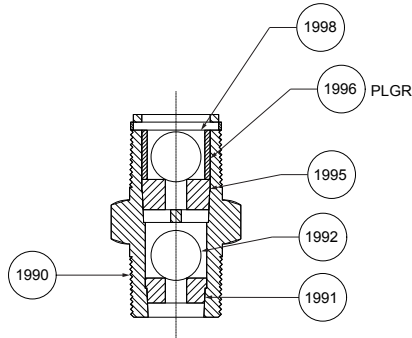
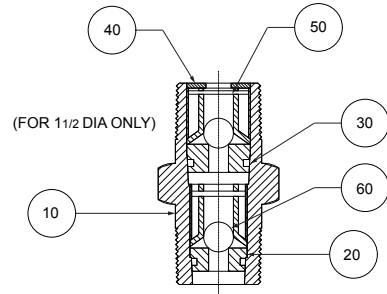


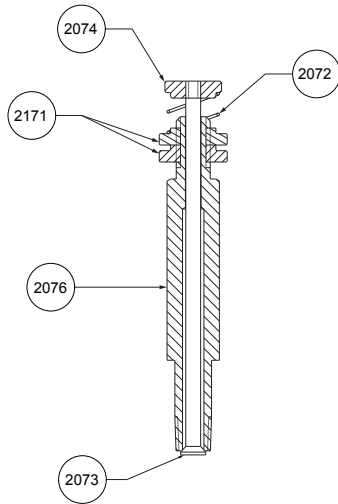
Figure 5. MILROYAL® C Disc Diaphragm Liquid End Assembly Drawing (C-102-2285-0006)



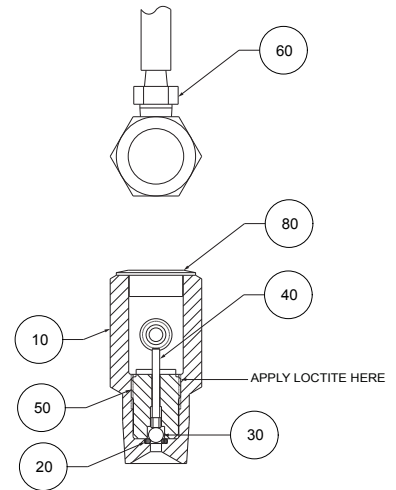
Detail No. 1
Check Valve
1 1/2", 2", 2 1/2" and 3 1/2" Dia. Plgr.



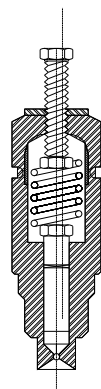
Detail No. 2
Check Valve
5/8", 7/8" and 1/8" Dia. Plgr.
2210263XXY



Detail No. 3
Refill Valve
1010017X00



Detail No. 4
Air Bleed Valve Assy.
1010018000



Detail No. 5
Relief Valve
4070177XXY
Purchased and No Spare Parts

Figure 5. MILROYAL® C Disc Diaphragm Liquid End Assembly Drawing Continued
(C-102-2285-0006)

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