PULSA Series®

DIAPHRAGM METERING PUMPS

Installation
Operation
Maintenance
Instruction

Bulletin No. IMP-90-CIP-LM

Pulsafeeder

Manufacturers of Quality Pumps,
Controls and Systems

A Unit of IDEX Corporation

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MAINTENANCE LOG

Pump Model____________________ Serial #____________________

Gear Ratio____________________ Maximum Flow____________________

Piston Diameter____________________ Maximum Pressure____________________

KOPkit____________________

All the above information can be obtained from the pump nameplate. Refer to the Pump Specification Data Sheet for additional information.

Date	Serviced By	Maintenance Performed

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HOW IT WORKS

A standard foot mounted motor drives a worm shaft at constant speed. Through worm gear reduction and eccentric, a reciprocating power stroke is transferred to a plunger. The length of plunger stroke determines pump capacity and can be adjusted manually to provide pumping range from 0-100% of rating. However, this plunger does not pump chemicals, but an exceptionally stable oil*, having excellent lubricating qualities. This makes a perfect pumping medium.

* A special property petroleum oil tradenamed "PULSAlube" is generally used as hydraulic fluid. Continual reference to "oil" as hydraulic medium implies its general use rather than its use of necessity. Check with your representative or the factory if substitute oil must be used.

Hydraulically Balanced HYDRATUBE Diaphragm Design

Using this oil, the plunger hydraulically moves a flat disc type elastomer diaphragm which in turn causes compression and decompression on a secondary sealed hydraulic reservoir, (Figure 2). This secondary reservoir surrounds a cylindrical diaphragm. The compression and decompression of this intermediate hydraulic fluid transmits a controlled squeeze and release on the cylindrical HYDRATUBE diaphragm, thereby displacing process liquid which is contained within it. Inlet and outlet check valves, operating in unison with the HYDRATUBE movement, precisely control liquid flow in one direction. Since they are gravity seating valves, flow is from bottom to top.

HYDRATUBE Housing Assembly

The HYDRATUBE confines the liquid pumped internally isolated from any contact with the hydraulic system. The HYDRATUBE housing assembly consists of

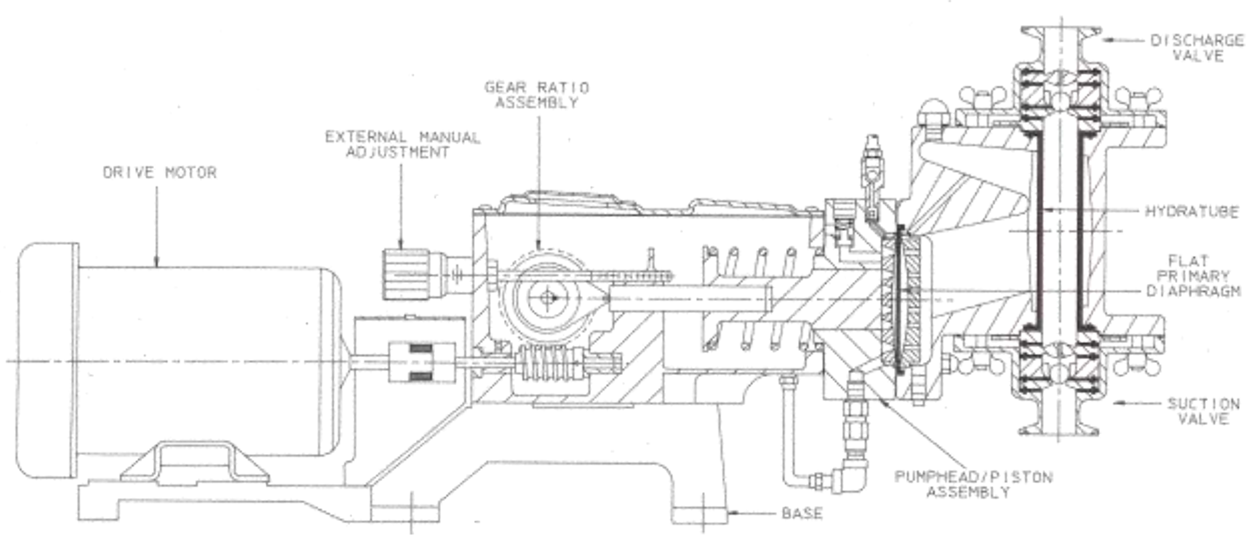


FIGURE 1.

a SS304 casting which positions the HYDRATUBE and contains the intermediate fluids, a support plate to protect the primary diaphragm from over travel and inlet and discharge check valve.

The HYDRATUBE responds exactly to the action of the primary flat diaphragm through the medium of an intermediate fluid selected for compatibility with the casting and other material.

Pump Head Assemblies

The hydraulic pump head assembly contains the plunger, cylinder and various hydraulic components to protect and maintain a precise hydraulic balance between the plunger and diaphragm. Figure 2.

Make-up, Bypass and Bleeder Valves within the Hydraulic System

Make-up Valve (Vacuum Compensator)

Any leakage past the plunger, however slight, is replaced by the make-up valve which permits flow of replacement oil from the oil reservoir. This is an automatic function. The oil loss allows the diaphragm to get out of phase with the plunger thus creating a vacuum ahead of the plunger during the suction stroke of the pump. The make-up valves are factory set.

Hydraulic Bypass Valve

The hydraulic bypass valve protects the pumping mechanism from excess pressure due to accidental valve closure or restricted flow in the suction or discharge piping. It will bypass oil, ahead of the plunger, back to the reservoir. It is an adjustable valve preset by the factory at 10% above the rated pump pressure unless specified differently by the purchaser.

The bypass valve is not designed to protect the process system and piping

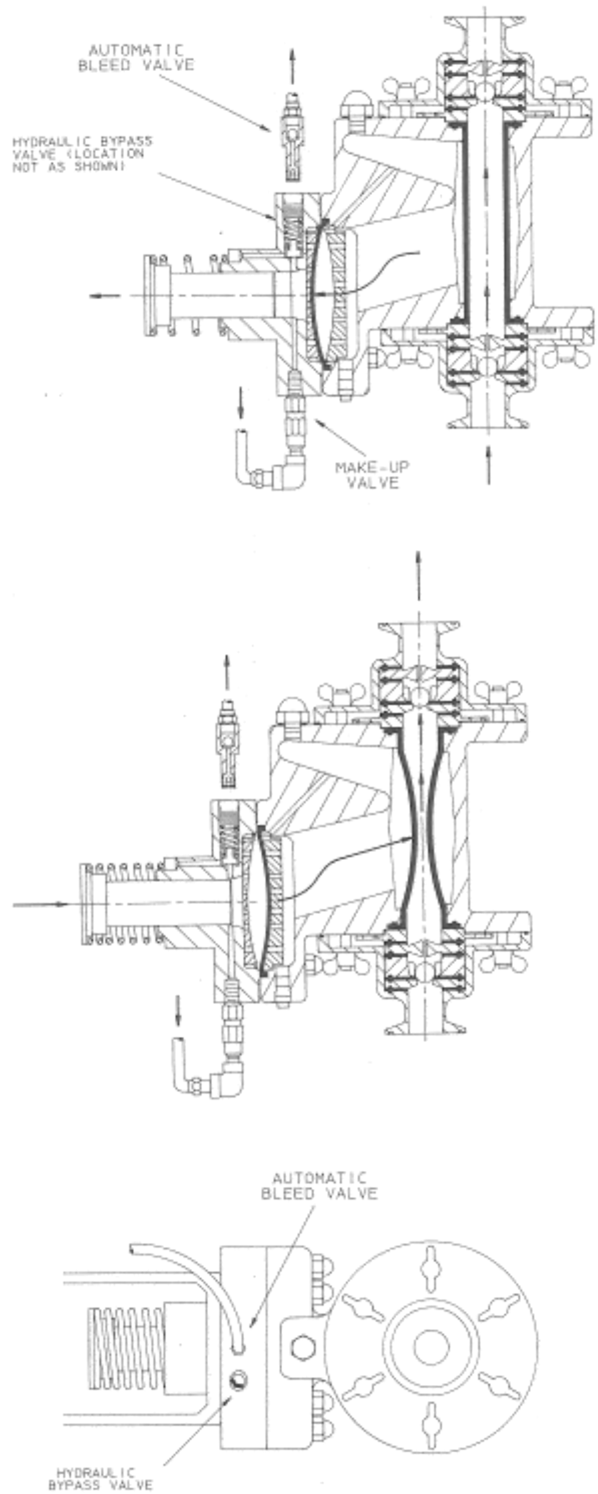


FIGURE 2.

from pressure damage. Careless installation practices or careless field adjustment of the bypass valve negate its application as a safety valve. A process relief valve should be considered where pressure sensitive equipment or safety is involved.

Bleeder Valve

The function of this valve is to release any air or oil vapors from ahead of the piston and maintain a solid hydraulic medium to transmit infinite movements of the piston to the diaphragm. In large piston models where adequate oil movement exists the bleed valve functions automatically weeping a minute quantity of oil plus any air or vapor out of the hydraulic system.

Additional detail on the function of these valves will be given as applicable in the Operation, Maintenance and Trouble Shooting Sections.

INSTALLATION TIPS

Check The Shipment

A standard Pulsafeeder shipment includes the pump, PULSAlube oil, wrenches, instruction and parts list packet and replacement parts if ordered. Unpack carefully, check packing list and make sure all parts are received. Check voltage of electric motor against the service to be used.

Locating The Pumps:

Pulsafeeder pumps are designed to operate under indoor atmospheric conditions. It is desirable to provide a hood or covering for outdoor service. Gear box heaters are suggested or external heating should be arranged if ambient temperature will be below 40°F.

1. Check level of pump. Shim where necessary.

2. Securely bolt to foundation. Do not distort base.

3. Check motor alignment and reagent head and valve bolt tightness before operation. Follow bolt torque readings carefully.

Flooded Suction Desirable:

Installation will be simpler to operate if the liquid will flow to the pump by gravity. Wherever possible the pump should be located below the level of storage vessel.

Discharge Pressure:

All models are designed for continuous service at the rated discharge pressure. To prevent liquid flow thru, it is necessary that discharge pressure be at least 5 psi above suction pressure. When pumping downhill a back pressure valve should be placed in the discharge line.

Piping:

Pipe size and length are critical to proper operation of any metering pump. A restricted discharge or stared suction condition spell immediate failure to any metering pump installation. A separate brochure "Designing a Successful Metering Pump Installation" is provided to assist engineers responsible for piping system design. Copies are available upon request (Bulletin 304). Inlet piping must be at least equal in size to pump inlet connection.

Figure A shows the preferred piping configuration for a good metering pump installation. A good piping installation addresses present and future requirements of the metering system. Plan for shut off valves and unions or flanges installed on both the suction and discharge lines. This allows inspection of the check valves without draining long runs of pipe. Install a tee in the suction and discharge piping between the pump and the shut off valves. This permits easy installation of a calibration tube for calibration of the pump at start up or any future date. A tee in the

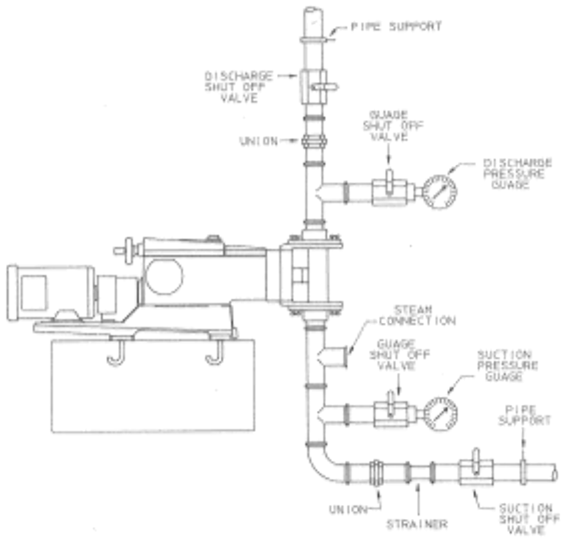


FIGURE A.

up or any future date. A tee in the discharge piping is a must on a good installation because it permits ease of mounting a pressure gauge to check discharge pressure at the pump and setting the hydraulic bypass valve during start up and future maintenance functions. To prevent strain on the valve housings use pipe straps and braces. Do not allow the weight of the piping to be supported by a pipe union, the valve housing or other portion of the pump head or leaks will occur. An air leak at a union or other fitting in the suction piping can severely affect metering accuracy and is extremely difficult to detect. If rigid piping is used, we suggest bolting the pump to its foundation.

Use Strainers:

Pump check valves are susceptible to dirt and other contaminants and any accumulation can cause malfunction. Be sure to use a pipeline strainer in the suction line between suction shut off valve and pump suction valve. 100 mesh screen is preferred.

Flush Piping System:

Whether new or old piping is used, all lines should be flushed with a clean liquid or air before starting pump to carry out pipe scale or other foreign material. Make sure flushing liquid is compatible with the chemical to be pumped.

Metal Reagent Head Models:

The metal reagent head assembly is provided in several alloys. Piping of similar alloy should be selected. Dissimilar materials can cause galvanic corrosion.

Do not backweld piping to valve housings without first removing valve housings from pump as excessive heat can damage the reagent head and other parts.

START-UP INSPECTION

Every metering pump is tested for correct capacity at maximum pressure capability of the hydraulic bypass valve before shipment. The diaphragm cavity is fully primed and remains so for shipment. For shipment purposes the gear and hydraulic reservoir oil have been removed. Sufficient fresh PULSAlube oil is included with the shipment for refilling the gear and hydraulic reservoirs.

WARNING

1. Do not run pump without oil.
2. Do not remove main gear box cover while pump is running.
3. Do not run pump with coupling guard removed.
4. Do not put hands or fingers in gear box or reservoir when pump is running.

Filling Gear And Oil Reservoirs:

Remove the pump cover and fill both reservoirs with PULSAlube oil to the top of the gear box partition. Do not overfill. PULSAlube oil is compounded to serve both gear lubricant and hydraulic transfer fluid. Check with factory if substitute oils must be used.

The cover assembly incorporates a free acting diaphragm to allow breathing of the reservoir and at the same time seal the reservoir from the atmosphere. Be sure the diaphragm is properly positioned when replacing the cover so that it will seal on the gear box.

Final Inspection:

Because of the pump's small size and light weight, it sometimes receives severe handling during shipment. Though physical damage may not occur, it is always possible for parts to move slightly in adjustment. This situation might occur with motor or pneumatic control alignment. A quick visual check should be made to assure that the motor and control shafts have not shifted severely out of alignment or damage could occur from starting the motor. If unusual vibration should occur after start up, realign the motor and coupling.

Start-up:

Since the hydraulic oil system is primed at the factory, priming the process system is all that should be necessary to produce flow. If the hydraulic system has inadvertently been dumped due to starting up with restricted suction or discharge conditions or improper adjustments to compensator or bleed valves, repriming procedures under the maintenance section may have to be followed before pump calibration can begin.

Priming Process Head:

1. Open the suction line and discharge line shut off valves.
2. If the piping system design and the storage tank are such that the product flows by gravity to the pump, no priming is required. If however, the discharge line is under pressure, air will be trapped in the process head and it will be necessary to remove the discharge pressure to enable the pump to prime itself.
3. If the pump must handle a suction lift, it may be necessary to manually prime the reagent head. Remove the discharge valve by unscrewing the valve cap bolts and then lifting the valve out. Fill the head with process fluid, or a compatible liquid, then replace the valve in the same position and retighten the bolts.
4. The pump is now ready for start-up.
5. Start the pump and increase the control setting to full stroke.
6. Make a brief check to assure that the pump is producing the approximate flow desired at the full stroke setting. Calibration should not be attempted on any model until it has run at least one hour to assure the pump hydraulic and reagent head systems have stabilized. Due to agitation of the PULSAlube oil when filling the reservoirs, minute air bubbles will have formed. It takes at least one hour running time to dissipate the bubbles and develop a sound hydraulic system. In some very low displacement models it may take up to eight hours running time to stabilize the system and permit accurate calibration. This is generally limited to models 680 with 1/4" diameter and 3/8" diameter plungers.

If the pump does not produce the approximate flow desired at the full stroke setting refer to the Trouble Shooting Section for possible causes and refer to Priming Procedure under the Operation and Maintenance Section.

To Adjust Flow Rate:
Figure B

A micrometer knob adjustment for changing length of stroke while in operation or idle. Turn adjustment knob clockwise to increase flow and counterclockwise to decrease flow. The adjustment knob is read directly in

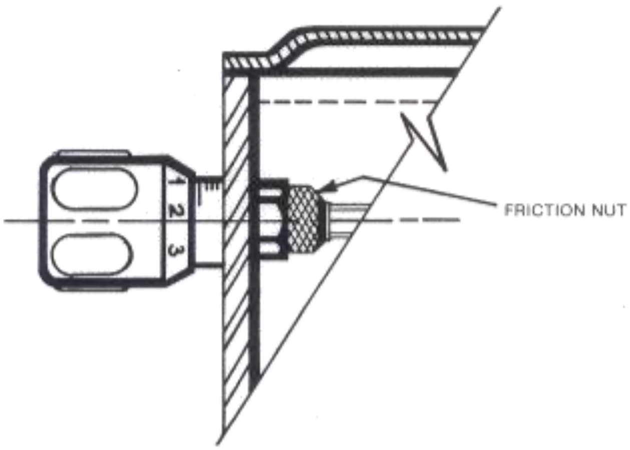


FIGURE B.

percent of flow. These indications can be converted to volumetric or weight units by calibration conversion charts. You may increase the friction on the adjustment or completely lock up the adjustment knob by removing the gear box cover and tightening the friction nut on the adjustment shaft. If a more expensive external friction lock is desired parts may be purchased to convert to a micrometer knob with external locking lever.

Calibration:

All pumps are tested on water at room temperature with 7 foot flooded head at full bypass valve pressure setting. Any curves supplied by Pulsafeeder would be representative of this test and can only be used as a guideline.

All pumps must be calibrated under actual operating conditions for the operator to know the proper adjustment for particular outputs. A typical displacement chart is shown in Figure C. Note that output is linear in respect to micrometer settings but that increase in discharge pressure decreased output slightly and describes the line parallel to that at atmospheric pressure. This is caused by compression of hydraulic oil and valve inefficiencies. Capacity at atmospheric pressure will be nearly that of calculated displacement. As the discharge pressure increases there will be a corresponding decrease in capacity at a rate of approximately 1% per 100 psi increase.

Check the capacity several times at three different stroke length settings and record them on linear graph paper. For all stable conditions, these points should describe a straight line. Pulsafeeder pumps supplied with automatic controls, either pneumatic or electronic, are accompanied by separate instructions on output adjustment and calibration.

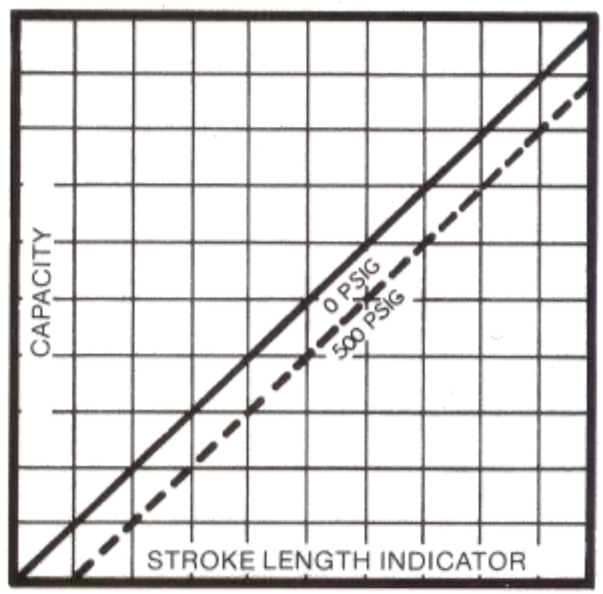


FIGURE C.

CIP/SIP

Steam in place for 30 minutes with saturated steam at 130°C (266°F) at 25 PSIG.

Caution: When removing valving for manual cleaning, do not remove the tube clamps or the hydraulic prime of the intermediate chamber will be lost.

MAINTENANCE

CAUTION

Before performing any maintenance requiring reagent head (wet-end) disassembly be sure to remove pressure from the piping system and flush pump thoroughly with a neutralizing liquid. Wear protective clothing and handle equipment with proper care.

Accurate records in the early stages of pump operation will reveal the type and amount of maintenance that will be required. A preventative maintenance program based on these records will insure troublefree operation. It is not possible in these instructions to forecast the life of such parts as the diaphragm, check valves and other parts in contact with the product you are handling. Corrosion rates and conditions of operation affect the useful life of these materials so an individual metering pump must be gauged according to particular service conditions.

PULSA Series Kopkits contain all replacement parts normally used in a preventative maintenance program. It is recommended that Kopkits and PULSAlube oil be kept available at all times.

All PULSA Series pumps are shipped with an individual specification data sheet supplied in the parts list package. This data sheet contains important information relating to both the application and the pump specifications (materials, piston size, stroking rate etc.). Please refer to this sheet during maintenance operations and when ordering spare parts.

I. WET END REMOVAL, INSPECTION AND REINSTALLATION

A. Primary Diaphragm

PULSA Series flat elastomer, and TFE diaphragms are not subject to stress fatigue and will not fail from repeated flexure in normal use. However, long-time accumulation of foreign material or entrapment of hard sharp particles between the diaphragm and dish cavity can eventually cause failure. Failure may also occur as a result of overpressurization or chemical attack. Periodic inspection of all flat diaphragms is desirable. (Figure 3).

To remove the diaphragm the first six steps are the same for TFE or elastomer diaphragms, custom head assemblies included.

1. Remove all pressure from the piping system.
2. Disconnect the power source to the drive motor.
3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous liquid.

FIGURE 3.

4. Close the inlet and outlet shut-off valves.

5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if liquid is hazardous.**

6. Place a pan under the pump head to catch oil or intermediate liquid leakage.

   CAUTION: If the diaphragm has failed, product may have contaminated the pump oil. Handle with proper care.

7. Remove all but one top reagent head bolt. Oil (or intermediate liquid depending on the model), will leak out between the heads as the bolts are loosened.

8. Rotate the head and pour any residual product/neutralizing agent trapped by the check valves into a suitable receptacle. **Use extreme caution if hazardous.** Custom head assemblies utilizing remote valves may require disassembly of the pipe between the reagent head and valves.

9. Remove the last bolt and rinse the head in water or a compatible liquid.

10. If there is no evidence of damage on the pumphead side, the diaphragm can be removed for complete inspection by forcing compressed air into the suction port while plugging the discharge port.

    Note: This is done only after the hydratube has been removed to avoid damage.

    Inspect the diaphragm for damage. It may appear convex or concave as a result of conforming to the dishplates. This is a normal condition and does not require replacement. If the diaphragm appears warped, deformed or excessively dimpled replace it.

11. PULSA Series TFE and elastomer diaphragms incorporate an integral "o" ring design which seats into the reagent head. If the diaphragm has been damaged, insert a knife along the diaphragm's periphery and pry it out. If plastic head construction, use extreme caution so as not to mar, gouge, or damage the head or sealing area during diaphragm removal.

12. On diaphragm reinstallation, it is not necessary to follow the original orientation to the reagent head or pump head hole pattern. Set the diaphragm in place on the reagent head and work the integral o-ring into place by pressing around the periphery. Insure that the diaphragm sealing area is clean and free of debris.

13. Before mounting the reagent head make sure the pump head dish plate is seated in the head with the concave cavity facing the diaphragm, and one of the four holes closest to the edge of the dish plate is at the top of the pump head (Figure 4). This assures that any gases are vented out of the dish cavity.

14. Reinstall the reagent head bolts and tighten in an alternating pattern to ensure an even seating force. Refer to Appendix III for recommended torque values.

15. For repriming follow procedures in MAINTENANCE, Section II.

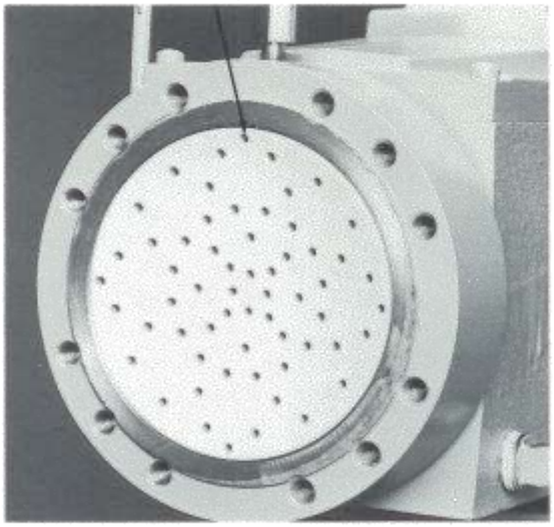


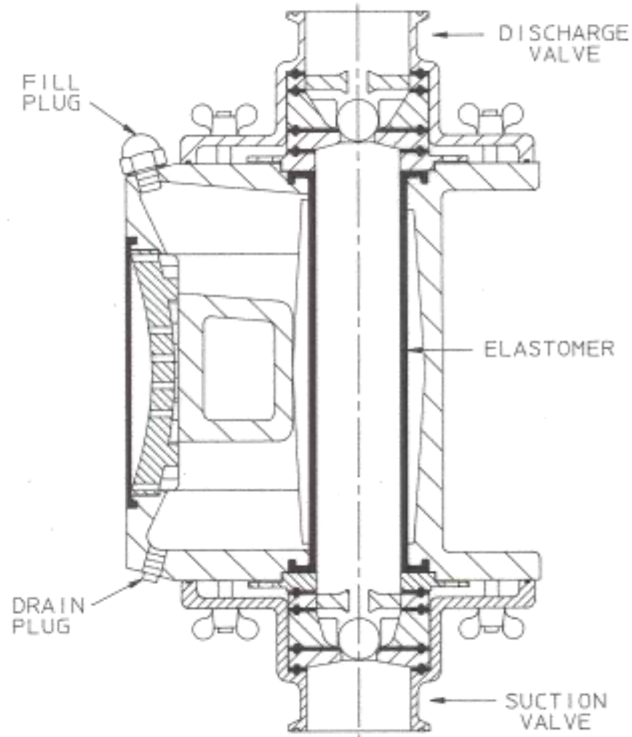
FIGURE 4.

B. HYDRATUBE Diaphragm

The HYDRATUBE is not subject to stress fatigue and will not fail from repeated flexure. Failure may occur however as a result of improper prime, overpressurization or chemical attack.

To remove and reinstall the HYDRATUBE, see Figures 5a and 5b through Figure 15.

1. Remove all pressure from the piping system.
2. Disconnect the power source to the drive motor.
3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.
4. Close the suction and discharge shut off valves.
5. Disconnect the unions or flanges on the piping and drain off any liquid. **Use extreme caution if the product is hazardous.**



ELASTOMER HYDRATUBE ASSEMBLY

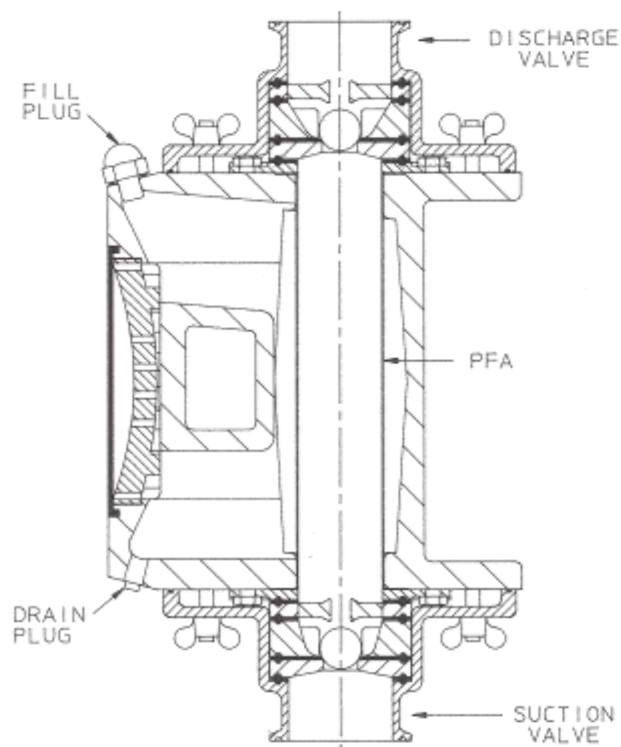


FIGURE 5 A, B. PFA HYDRATUBE ASSEMBLY

6. Remove the top fill plug from the HYDRATUBE housing. Next place a pan under the housing and remove the bottom pipe plug to drain the intermediate liquid. Note: On models equipped with a CHEMALARM the bottom pipe plug is replaced with a conduction probe. Refer to separate instructions for removal and reinstallation of the probe.

CAUTION: If the diaphragm has failed, intermediate liquid could have process liquid mixed into it. If the primary diaphragm has also failed, product may have contaminated the pump oil. Handle with proper care.

7. Remove the valve caps, valves and tube clamps from both the suction and discharge.

   Note: Any product or neutralizing fluid trapped between valves will be released.

For elastomer HYDRATUBES follow Steps 8 through 20. For PFA HYDRATUBES follow Steps 21 through 36.

8. Pick up on edge of the HYDRATUBE flange (Figure 6) and push that same edge down the throat of the HYDRATUBE. The balance of the flange will fold and follow.

9. Pull the HYDRATUBE out from the bottom of the housing by a combination of twisting and bending sideways.

10. Inspect the HYDRATUBE for any damage, i.e. cuts, cracks, chemical attack or excessive deformation. Replace if necessary.

11. When installing a HYDRATUBE do not use tools which may cut or damage the tube.

12. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

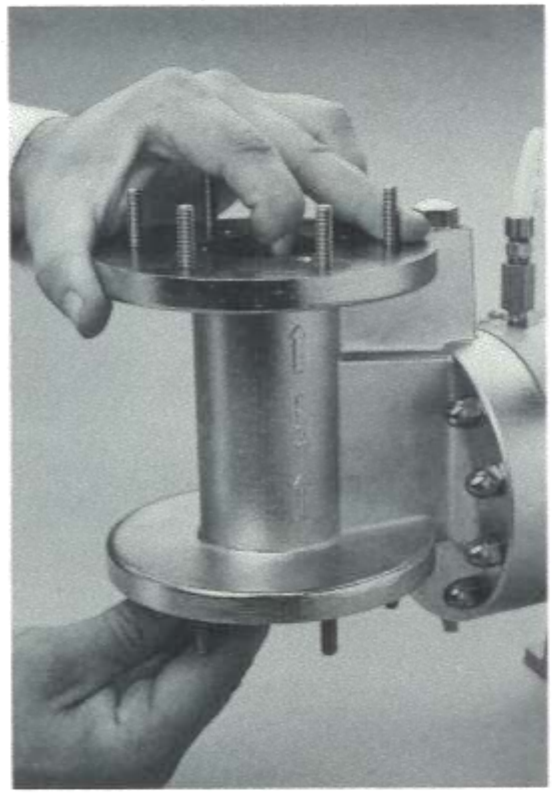


FIGURE 6.

13. Fold a point on the edge of the flange upward (Figure 7). Push the edge down the throat of the HYDRATUBE (Figure 8). Fold the sides of the flange inward to form a compact 45° "nose" and wrap tightly with a rubber band (Figure 9). This wrapped nose should be reasonably compact and secure.

14. Work the wrapped nose of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the tube upward to the top of the housing.

15. At this stage, with a slight push at the bottom flange of the HYDRATUBE guide the nose of the HYDRATUBE to the center and out the top hole in the housing (Figure 10).

16. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring

the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded, reinstall the bottom valve adaptor and drain plug and then partially fill the housing with the appropriate liquid.

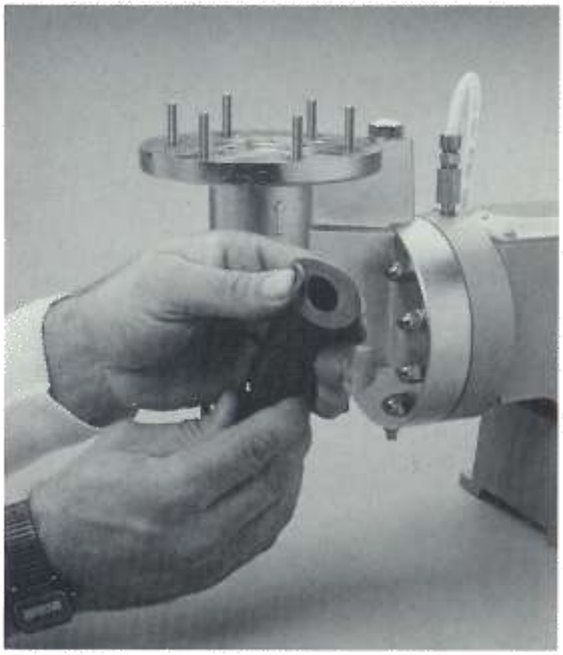


FIGURE 7.

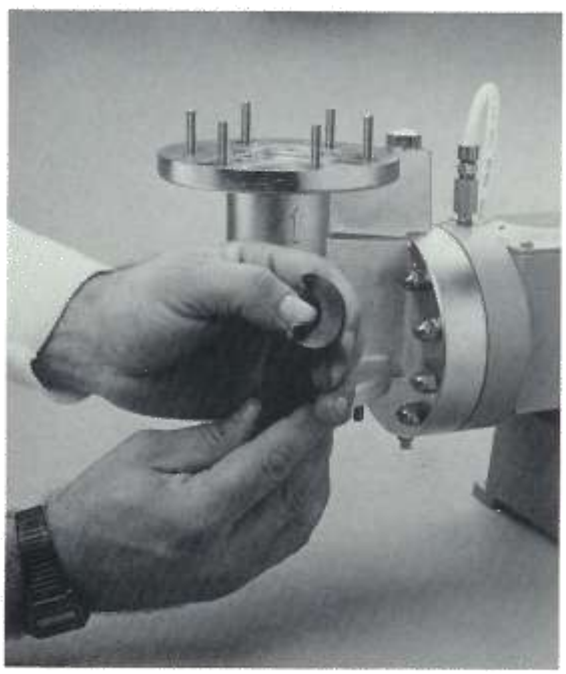


FIGURE 8.

FIGURE 9.

FIGURE 10.

17. Remove the rubber band.

18. Unfold the top flange (Figure 11) and center both the top and bottom of the HYDRATUBE.

FIGURE 11.

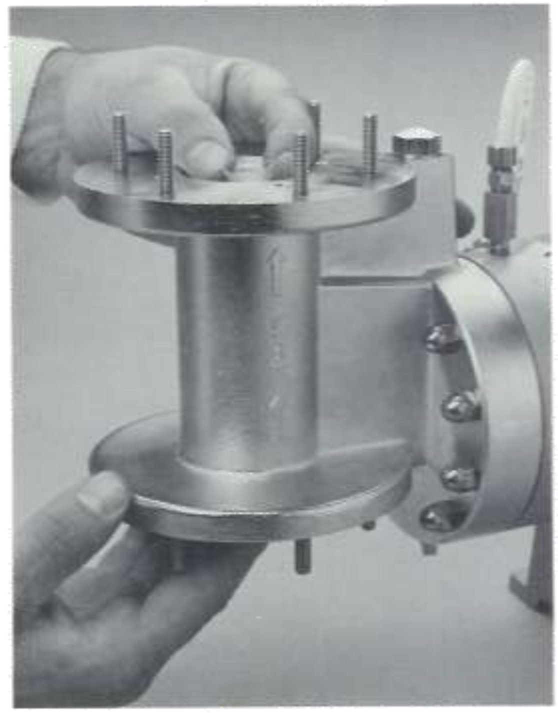


FIGURE 12.

19. Reassemble the top and bottom adaptor parts, torquing the tie bar bolts to the recommended value, see Appendix III. Replace the bottom drain plug.

20. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat diaphragm repriming procedure before repriming the intermediate or housing chamber. See MAINTENANCE, Section II.

The following steps apply to PFA HYDRATUBES.

21. Pick up the edge of the HYDRATUBE flange and bend it upwards so that it is even with the body of the tube (Figure 12). Avoid creasing the tube material.

22. Pull the HYDRATUBE out from the bottom by a combination of twisting and bending sideways.

23. Inspect the tube for any damage, i.e. cuts, cracks, chemical attack. Replace if necessary.

24. When installing a HYDRATUBE d not use tools which may cut or damage the tube.

25. Obtain a rubber band of 1/16" to 1/8" (1.5 to 3mm) section.

26. Carefully straighten the flange on one end of the HYDRATUBE and tightly wrap the straightened end of the HYDRATUBE with a rubber band. (Figure 13).

27. Work the wrapped end of the HYDRATUBE up through the bottom hole of the housing, rotating gently to work the HYDRATUBE upward to the top of the housing.

28. At this stage, with a slight push at the bottom flange of the HYDRATUBE, guide the nose of the HYDRATUBE, to the center and out the top hole in the housing (Figure 14), reinstall the

FIGURE 13.

FIGURE 14.

bottom clamp and drain plug and then partially fill the housing with the appropriate liquid.

29. If the HYDRATUBE is one of the larger models (inside tube diameter is greater than 1.5 in or 38.1 mm) the time required to fill the housing can be reduced by pouring the intermediate liquid past the top of the HYDRATUBE. To do this leave the top flange folded.

30. Unfold the top flange (Figure 15).

31. Reassemble the top clamp, torquing the bolts to the recommended value.

32. If the HYDRATUBE housing has been removed from the pumphead and the hydraulic prime lost, follow the flat

FIGURE 15.

diaphragm repriming procedure before repriming the intermediate or housing chamber. Refer to MAINTENANCE, Section II.

II. REPRIMING THE PUMP

A. Priming the Pumphead
Figure 16

(Standard heads only, refer to separate instructions for custom heads).

1. Adjust the stroke length (capacity) to maximum. (See "Output Adjustment" Page 12).

2. Disconnect the power source to the drive motor.

3. Remove the coupling guard.

4. Remove the cover assembly.

5. Manually rotate the motor coupling until the pump piston is withdrawn to full suction stroke (toward the drive motor end).

6. Unscrew the tube fitting nut at the top of the automatic bleed valve and remove the plastic tube. Do not remove the actual tube fitting from the bleeder body. Now use a wrench on the body of the valve to remove it from the pumphead.

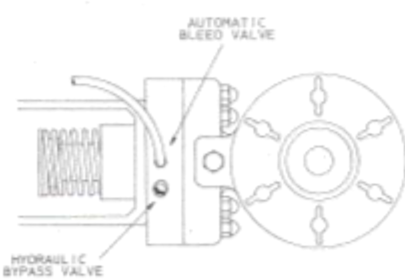


FIGURE 16.

7. Use an Allen wrench on the hydraulic bypass valve and remove the valve from the pumphead. Fill both the gearbox and hydraulic reservoir with PULSAlube.

8. Manually rotate the motor coupling to move the pump piston forward. At the same time watch for oil to appear at the automatic bleed valve port. When oil appears, reinstall the automatic bleed valve assembly and the hydraulic bypass valve screwing it into the pumphead to its original position.

9. Continue to rotate the coupling by hand until the piston is at the end of its discharge stroke. If, at some point, it becomes difficult to turn the coupling it indicates the hydraulic system is overprimed and some oil must be released. This can be done by loosening the hydraulic bypass valve and advance the piston to the end of its stroke, then tighten the valve back to its original position. The primary hydraulic system is now fully primed.

B. Priming the HYDRATUBE Housing (Intermediate Chamber)

Figure 17 A,B
In priming the intermediate chamber the flat diaphragm and HYDRATUBE must be properly synchronized. For any given piston/pumphead assembly the flat diaphragm utilizes only 40 to 70% of the combined dish volume. The HYDRATUBE, when properly

primed should be in its neutral position (fully round) when the diaphragm is in its rearmost position (as dictated by the piston, Figure 17a), and should begin to close as the diaphragm moves forward (Figure 17b). Primed in this way assures stable performance and protects the HYDRATUBE from damage during system upsets. The priming procedure is the same for elastomer and PFA HYDRATUBES. (See Figures 5a and 5b).

1. Disconnect the power source to the drive motor.

2. Adjust the stroke length (capacity) to maximum. (See "Output Adjustment" Page 12).

3. Remove the coupling guard.

4. Remove the front reservoir cover assembly.

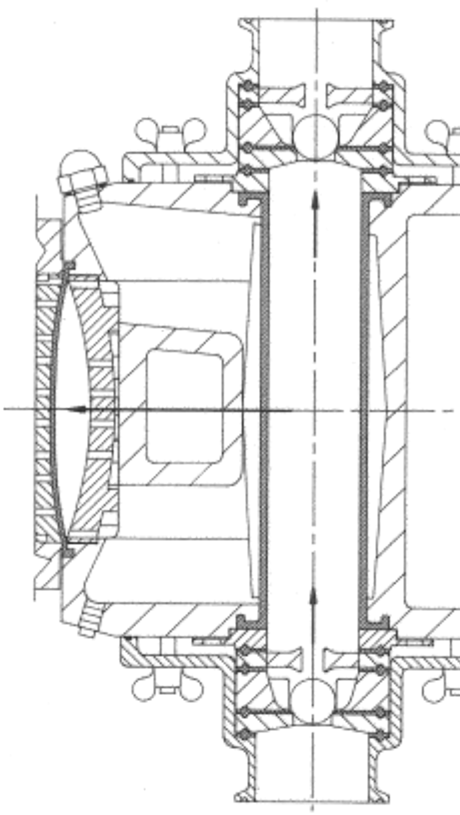
5. Insure that the bottom drain plug is installed in the intermediate chamber.

6. Remove the intermediate chamber fill plug. Clean the sealing surfaces and install a new gasket if required.

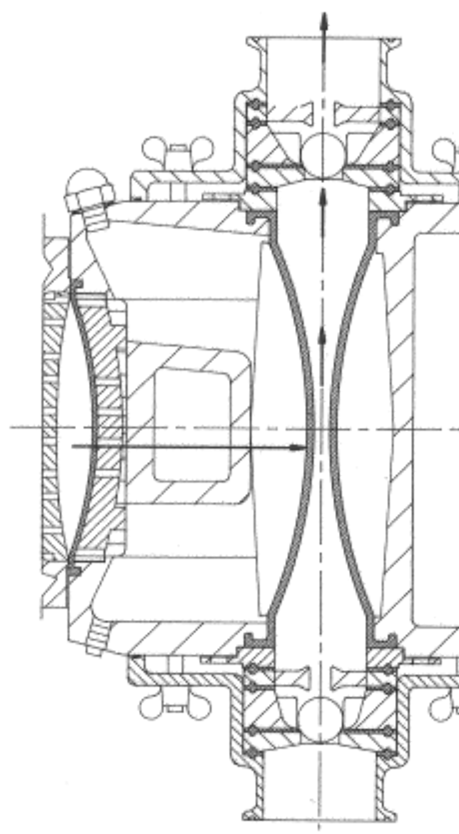
7. Remove the suction and discharge valve assemblies. **DO NOT** remove the **HYDRATUBE** clamps which seal the tube to the housing.

8. Manually rotate the motor coupling until the pump piston is in the full suction position (toward the drive motor end).

9. Fill the intermediate chamber using a mixture of water and 1/3 ethylene glycol by volume, or other liquid selected for the particular application.



HYDRATUBE ON SUCTION STROKE



HYDRATUBE ON DISCHARGE STROKE

FIGURE 17 A, B.

10. Reinstall and tighten the fill plug.

11. Manually rotate the motor coupling and observe the tube through the discharge port. The tube should be completely round on the suction stroke and with approximately a 1/16" to 1/8" gap from touching in the center on the discharge stroke.

12. If tube walls touch on the discharge stroke, return piston to full suction stroke. Loosen fill plug and rotate coupling slightly to expel a small amount of intermediate liquid. Retighten fill plug and examine tube performance.

13. If tube is not closing enough, return piston to full suction and add a small amount of intermediate liquid. Retighten fill plug and examine tube for performance.

14. Repeat steps 11 through 17 as necessary.

15. Reinstall the coupling guard and cover. Allow the pump to run for 5 to 10 minutes. Observe the action of the HYDRATUBE through the discharge valve port. It may be helpful to shine a light up through the suction port. The pump now has a correct intermediate prime and is ready for service.

16. Reinstall the suction and discharge valve assemblies.

III. CHECK VALVES

A. General Description

Operating experience on thousands of installations has indicated that most metering pump troubles have to do with check valves. Problems usually stem from (a) an accumulation of solids between the valve and seat, (b) corrosion which damages seating surfaces, (c) erosion from high velocity flow, or (d) physical damage.

Although several valve designs are available, the basic valve incorporates a ball, guide, seat and stop (Figure 18ab). Flow in the unchecked direction lifts the ball off the seat allowing liquid to pass through the fluted areas of the guide. Gravity forces the ball down sealing it against the sharp edge of the valve seat. The guide allows the ball to rotate but limits its vertical and lateral movement thus minimizing slippage, or flow in the checked direction. By allowing the ball to rotate it seats on a different area each time thus prolonging its useful life. Because the ball returns to the seat by gravity the valve must be in the vertical direction to operate properly. Gaskets provide a seal between all the parts. All parts are available in a selection of materials best suited for resistance to chemical attack and physical damage.

B. Removal, Inspection and Reinstallation

1. Remove all pressure from the piping system.

2. Disconnect the power source to the drive motor.

3. Adequately flush the reagent head and associated piping with a neutralizing liquid to remove all toxic or hazardous product.

4. Close the suction and discharge shut off valves.

5. Disconnect and remove suction piping with caution as the suction check valve will trap liquid in the Hydratube. Loosen the suction valve cap wing nuts and catch any remaining liquid draining from the Hydratube.

6. Carefully remove the suction check valve assembly as a complete unit. (See Figures 18ab).

7. Loosen the valve cap wing nuts on the discharge valve. Again, spring the piping slightly to drain any liquid.

8. Carefully remove the discharge check valve assembly as a complete unit.

9. Separate the valve assembly and examine the components for wear, damage or accumulation of solids. A ball valve seat should have a sharp 90° edge, free of any nicks or dents. Hold the ball firmly on the seat and examine against a light. If light is visible between the two then replace the seat and/or ball.

10. Reassemble each assembly using new parts as required. (Figure 18 a and b)

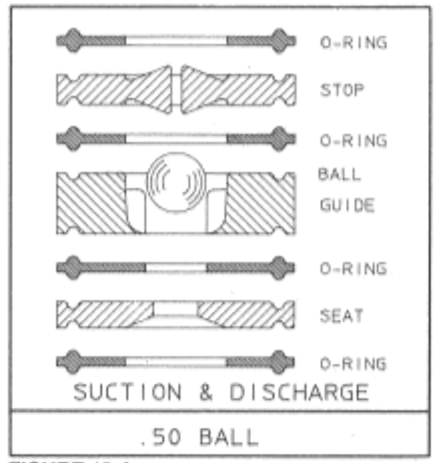


FIGURE 18 A.

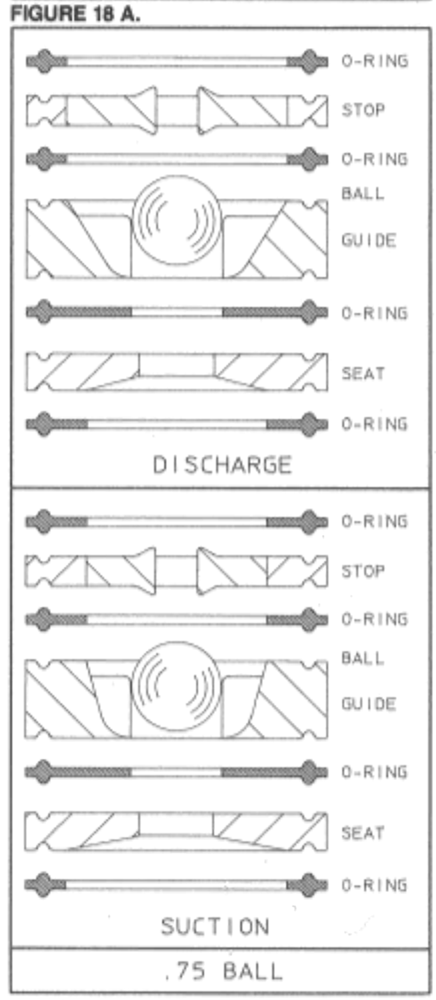


FIGURE 18 B.

11. Reinstall both valve assemblies. Make certain the valves are not upside down, refer to Figure 18ab for proper orientation.

12. Tighten the valve cap bolts evenly, making sure the valve assemblies are assembled squarely.

IV. HYDRAULIC MAKEUP VALVE

On each discharge stroke of the pump a very small amount of oil is lost through the automatic bleeder and past the piston seals. This causes the diaphragm to be drawn back further on each successive suction stroke until it contacts the rear dish plate. When this happens the pressure in the hydraulic system becomes negative and the hydraulic makeup valve allows oil to enter the system. All hydraulic makeup valves are factory set to open at a pressure of 7.2 psia (0.51 Kg/cm^2 or approximately 1/2 atmosphere). This setting allows the pump to produce suction at the inlet valve (9.5 psia maximum) and still maintain a sound hydraulic system. If the hydraulic makeup valve is set to a lower absolute pressure, dissolved air within the hydraulic system will come out of solution forming bubbles. These bubbles are subject to compression and can cause capacity loss and erratic operation.

Pulsafeeder pumps utilize an external, non-adjustable valve located on the bottom of the pumphead (Figure 19).

All hydraulic make up valves are preset at the factory (parts orders included) and will typically require no maintenance provided the oil is clean and free of moisture.

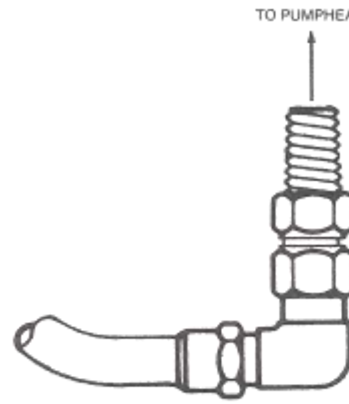


FIGURE 19.

Hydraulic Bypass Valve

The hydraulic bypass valve is an adjustable spring loaded valve. It is designed to protect the pump against excessive hydraulic pressure. The valve is factory set to the "Bypass Valve Setting" if specified on the specification data sheet or set to allow operation at the maximum pump pressure, indicated on the pump nameplate, without relieving.

To adjust the valve to a lower bypass pressure, turn counterclockwise.

To check the pressure setting it is necessary to install a gauge in the discharge line between the pump and a shut off valve. With the pump operating at maximum stroke a gradual closing of the shut off valve will cause the bypass valve to reach its cracking pressure which will be observed on the gauge.

When the bypass valve is set for maximum pump operating pressure (shown on nameplate), cracking pressure is slightly above maximum operating pressure so that it does not weep during normal pump operation. Dead head dumping pressure can be considerably higher than cracking pressure on some large piston, fast stroke rate models, so the internal bypass valve should not be considered a safety valve for protection of the process piping and instrumentation.

It is unusual for a hydraulic bypass valve to operate during normal pump operation. The following conditions will cause hydraulic bypass valve operation:

1. Excessive pressure buildup in the process which the pump is injecting into.

2. A plugged discharge line or someone shutting off a valve in the discharge line while the pump is operating.

3. Restricted flow to the pump causing the make-up valve to operate. If an inlet strainer is plugged, or someone closes an inlet valve thereby restricting flow of fluid to the pump, the diaphragm is then unable to follow movement of the plunger. The vacuums created between the diaphragm and the plunger upset the make-up valve allowing oil to replace the vacuum condition. This excess oil will be displaced through the pressure relief valve on the discharge stroke of the plunger. Undersized (restrictive) piping must be avoided.

   Any unusual condition in the system which prevents free movement of the diaphragm will cause a recirculating condition between the make-up valve and the hydraulic bypass valve. Continuous oil recirculation against the hydraulic bypass valve will eventually cavitate the hydraulic prime plus introduce unnecessary load conditions within the pump mechanism.

Automatic Bleed Valve
Figure 20

The automatic bleed valve is a gravity operated ball check valve designed to displace a small quantity of hydraulic oil or air on each pump stroke.

Any accumulation of solids can cause malfunction. Unscrew the valve and clean it with kerosene or solvent. If solids cannot be removed the valve must be replaced since there is no means of repair.

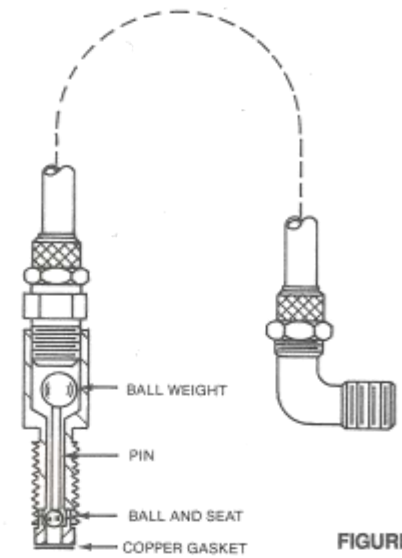


FIGURE 20.

Lubricating Instructions

PULSAlube is a custom blend oil with additives for lubrication and hydraulic transfer service. (For emergency requirements, a list of acceptable commercial oils is available). The diaphragm on the cover of the gear box assembly generally protects the oil from contamination for extended periods of time. A periodic six month check should be made for oil level and possible contamination.

Under sustained conditions of high humidity of if water is present, the oil can become emulsified and take on a yellowish color. Change the oil immediately if this occurs and examine the make-up valve and other parts for corrosion. A suction pump similar to a grease gun is useful for removing oil from chambers, or it may be drained from the ports at the side of each chamber.

To establish a maintenance record and routine procedure, check lubricant and drive mechanism at three and six month intervals. At the first six month interval check the condition of the inlet and outlet check valves. These items along with oil seal inspection should be part of a routine service procedure.

Oil Specifications

PULSAlube #1 is a custom blended lubricant which is suitable for most PULSA Series applications. It has an effective temperature range of 40°F to 280°F (4.4°C to 137.8°C). For adverse temperature conditions or optional lubricants, contact your representative.

Oil Capacities

All PULSAlube oils are available in:

* 1 quart containers (.95 liters)
* 1 gallon containers (3.8 liters)
* 5 gallon containers (18.9 liters)
* 55 gallon drums (207 liters)

It is recommended that an adequate supply of PULSAlube be on hand to handle periodic oil changes and emergency requirements.

The amount of oil required to fill PULSA Series gearboxes is as follows:

* 680 - 1.0 quarts (.95 liters)
* 880 - 1.5 quarts (1.90 liters)

Maintenance Parts Stock

Pulsafeeder offers a KOPkit which is a group of recommended spares carried in stock for replacement due to normal wear. The Kit covers such items as diaphragm, diaphragm gaskets if used, inlet and discharge valve parts, a complete set of valve gaskets and hydraulic pump head gasket. The KOPkit part number for your pump is indicated on the nameplate. A sufficient quantity of PULSAlube oil should be on hand for periodic oil changes.

Ordering Parts

When ordering parts always specify:

1. Pump model and serial number (stamped on nameplate).
2. Part number (from parts list), or KOPkit number.
3. Material of reagent head construction (liquid end parts).

Additional Pulsafeeder Services

FIELD SERVICE - Including pump repair or conversion to different services is available at nominal cost.

FACTORY REPAIR - Complete pump reconditioning.

OPERATOR TRAINING SEMINARS-Conducted by experienced factory trained service personnel at the factory in Rochester, New York or in the field. Field trips are available at nominal cost.

Trouble Shooting

Experience drawn from thousands of installations has shown that there are three outstanding areas which contribute to bulk of operating problems. First and foremost is installation conditions-improper location and supply; inadequate or restrictive piping to and from pump; unsupported piping; lack of strainer in suction piping.

The second major area is check valves. The check valve is the heart of any pump and sees more severe service than any other part of the pump. Opening and closing 40 to 140 times per minute the valve not only receives a mechanical hammering but receives it under high velocity, corrosive, erosive and sometimes extreme temperature conditions. Foreign particles, unlevel mounting, defective seals and improper torquing all too often aggravate even the simplest operation.

The third area is a simple lack of a routine service policy. Routine service will catch or avoid simple operating problems which can develop into a crisis if left unattended.

The following is a brief trouble shooting guide to help identify and cure any operating problems you might experience.

Pulsafeeder

Manufacturers of Quality Pumps,
Controls and Systems