

## Installation, Operation & Maintenance Manual



Bulletin: IOM-PUL-1000

# PULSA<sup>®</sup> HYDRACONE<sup>®</sup> R1 METERING PUMP

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# 1. Introduction

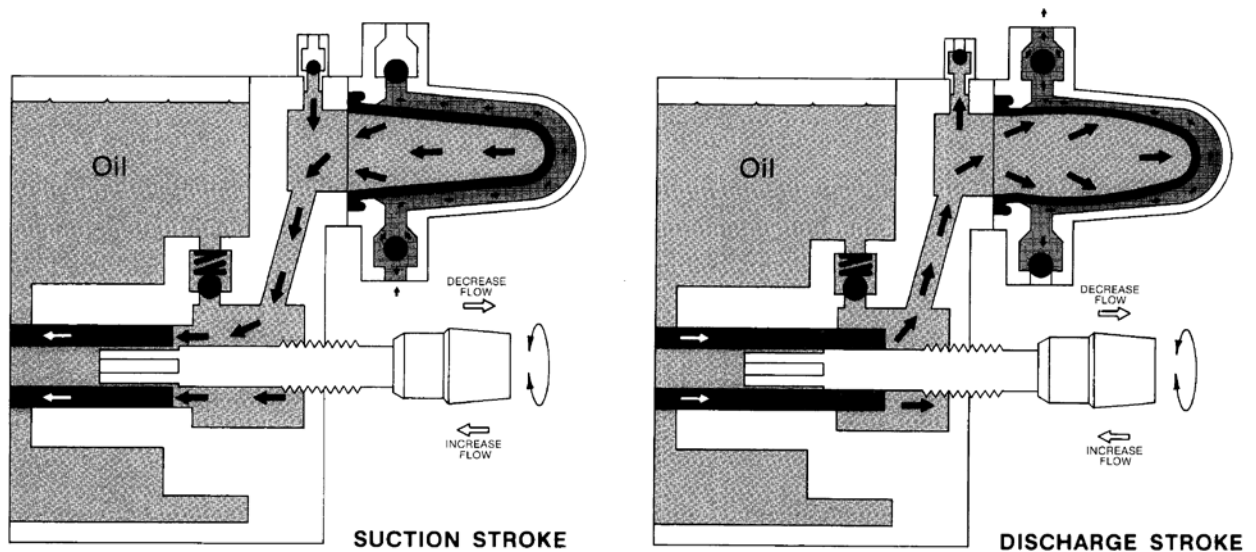
Pulsafeeder developed hydraulic diaphragm metering pumps more than 40 years ago and has led the technology ever since. Pulsafeeder pumps, including the HYDRACONE Series, are world-famous for reliability and durability. They have no stuffing boxes to leak and they're accurate to a +/-1% of maximum capacity. The HYDRACONE R1 gives you these advantages and many more at a very competitive price.

## 1.1 How it Works

The Hydracone R1 is a reciprocating, single acting combination piston, hydraulically actuated, diaphragm metering pump. The diaphragm has a conical shape. It is expanded by a controlled displacement of hydraulic oil on the discharge stroke. It retracts from its own elasticity during the suction stroke.

## 1.2 "Big Pump" Features

The R1 model provides many "big pump" Pulsafeeder features at remarkably low cost. This is made possible by standardizing on the most popular capacity and pressure ranges. It will pump up to 25 gph, pressure to 1200 psig. One of its key features is its high suction lift of 24 inches of mercury. It is self-priming, except in certain unusual cases. It is exceptionally easy and economical to run and maintain.



## 2. Metering Pump Description

A standard 56C face motor, mounted vertically, drives a worm shaft at a constant speed. This rotary motion is transferred through worm gear reduction to an eccentric and connecting rod to develop a fixed reciprocating piston travel. A stationary slotted control rod, inserted into the center of a tubular piston, allows for a portion of the fixed hydraulic piston displacement to be bypassed through the piston. The remainder of the piston displacement is directed towards an elastic HYDRACONE diaphragm which expands and contracts in response to the hydraulic displacement.

Contraction of the diaphragm causes chemical reagent to be drawn through the suction check valve, which is the lower of the two ball check valves. Expansion of the diaphragm forces chemical reagent out of the upper ball check valve.

Pump capacity is determined by the position of the slotted control rod. A micrometer type adjustment knob provides precise manual positioning of the control rod. The output of the pump is thus varied from 0% to 100% of rated flow.

An externally adjustable, factory set, hydraulic bypass valve is built into the hydraulic system and protects the pump against excess pressure.

The gear box is filled with oil which gives continuous lubrication to all power elements and serves as the hydraulic medium between the piston and HYDRACONE diaphragm.

An automatic air bleed valve is positioned at the higher point in the hydraulic system and continuously purges air or vapor to maintain a sound, non-compressible transfer medium.

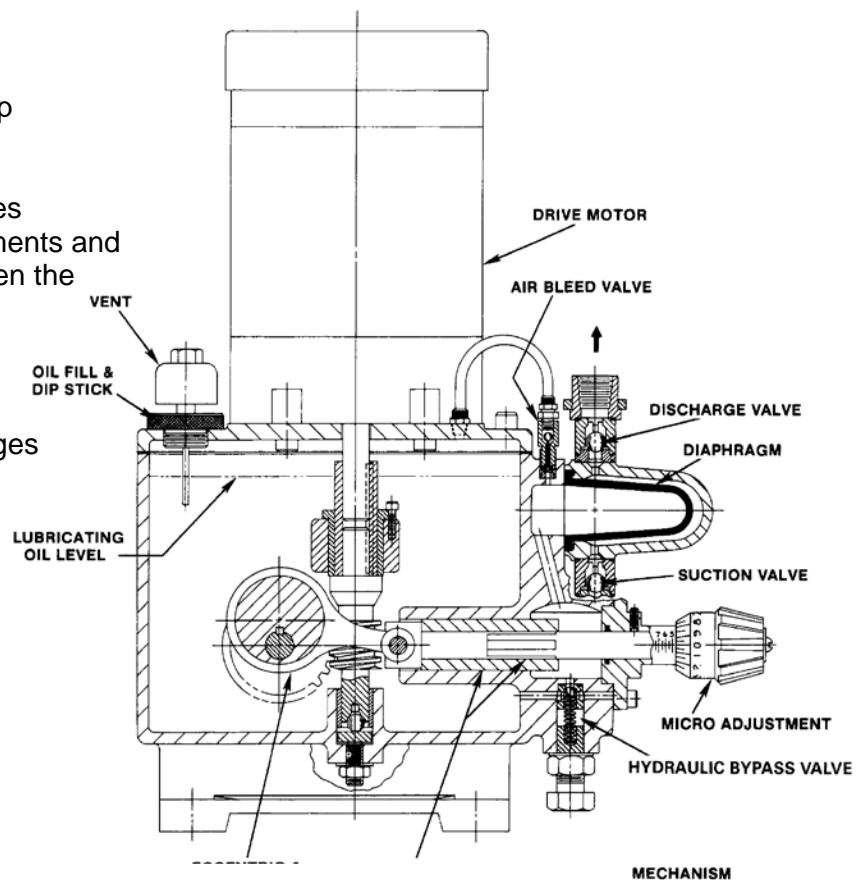


Figure 1- Model R1 Hydracone

## 3. Major Functional Groups

### 3.1 Motor

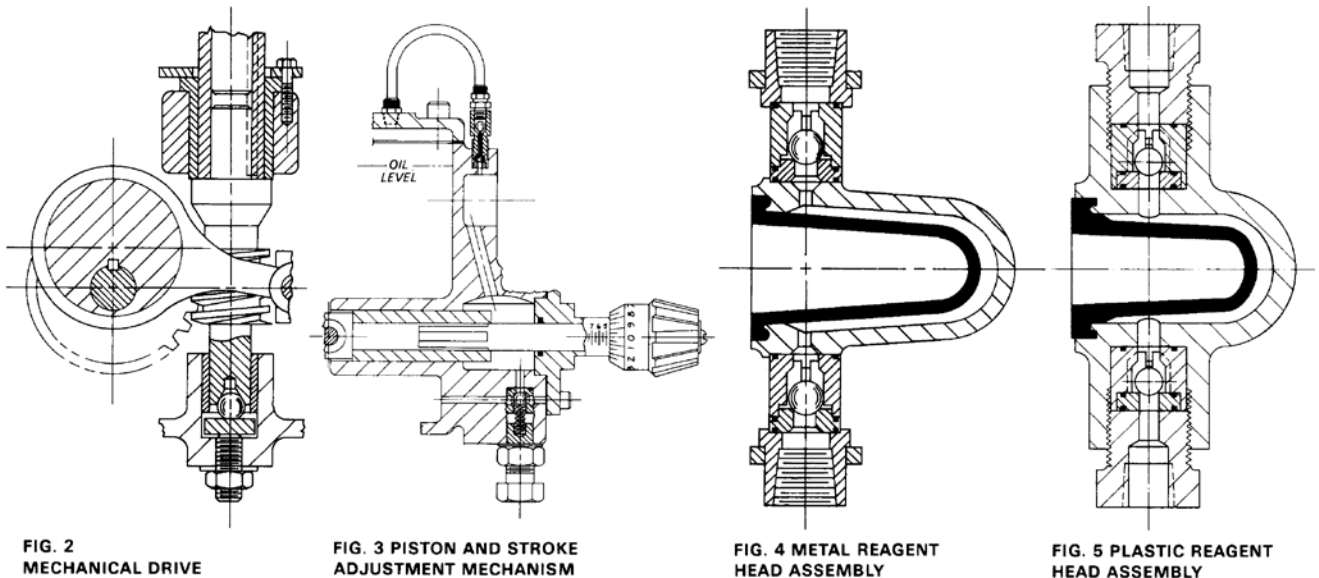
A drive motor with a standard NEMA 56C face has been supplied with your pump. The pump will accommodate either a NEMA 48 or 56 frame size.\* The motor drives the pump through a combination coupling-bearing.

### 3.2 Mechanical Drive

(Figure 2)

The combination coupling-bearing turns a worm shaft which bears on a hardened steel thrust assembly. The worm shaft meshes with and turns a worm wheel at a reduced speed. An eccentric rotates with the worm wheel and drives one end of the connecting rod. The other end of the connecting rod is confined to linear motion due to being connected to the piston.

\*Some early production models are limited to a NEMA 48 motor frame size. These units are identified by the absence of a motor rotation arrow cast into the gear box cover.



### 3.3 Piston and Stroke Adjustment

(Figure 3)

A hollow piston and slotted control rod provide the basic pumping and metering functions. An externally adjustable pressure relief valve will terminate all pumping action by relieving excess oil pressure in the event of a line stoppage or accidental valve closure.

Positioned at the highest point in the hydraulic system, the automatic air bleed valve continuously purges air or vapor to maintaining a sound non-compressible hydraulic medium.

### 3.4 Metal Reagent Head Assembly

(Figure 4)

The metal reagent head is a precision, non-porous investment casting of either 316 or Carpenter 20 stainless steel. The valves are of the free acting ball type seating on sharp edged metal seats. Check valve balls are not normally spring loaded, but are free to revolve and make a new contact on each pump stroke, insuring a long trouble free life.

## 3.5 Plastic Reagent Head Assembly

*(Figure 5, previous page)*

A plastic glass filled polypropylene (FPP) injection molded reagent head assembly is supplied when chemical or physical compatibilities dictate. The function remains the same except the valve seats may be FPP or molded elastomer.

# 4. Installation

## 4.1 Check the Shipment

A standard Hydracone shipment includes the Hydracone pump, the proper Pulsalube oil, instructional manual, spare parts list and replacement parts, if ordered. Unpack carefully, check packing list and make sure all parts are received. Check voltage of electric motor with intended service.

## 4.2 Motor Rotation

Correct pump rotation is obtained when the motor is turning clockwise when viewed from the top. Some models are supplied with motors that can be wired to run in either direction. If the nameplate or the underside of the terminal cover indicates that the motor is wired for bi-directional operation, check for correct rotation after wiring motor. The pump will function when operated in either direction but improper rotation will create a higher than normal motor current and may eventually cause internal damage to the pump mechanism.

## 4.3 Preferred Location

The Hydracone R1 metering pump is designed to withstand outdoor service. Check to see that the motor supplied with your pup is weatherproof before installing in a severe outdoor environment. Gear box heaters are suggested or external heating should be arranged if ambient temperatures will be below 40°F (4°C). Check with factory if in doubt.

1. Check level of pump and shim where necessary.
2. Bolt securely to foundation. Do not distort base.
3. Check valve bolt tightness before operation.

## 4.4 Flooded Suction Desirable

Although Hydracone metering pumps have the capability of substantial suction lift, an installation will be simpler to operate if the chemical media will flow to the pump by gravity. The Hydracone diaphragm may be damaged by suction pressures in excess of 15 psig. Consult factor if higher suction pressures are anticipated.

## 4.5 Discharge Pressure

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

## 4.6 Piping Suggestions

It is recommended that shut-off valves and unions be installed on both suction and discharge lines. This allows inspection of check valves and cleaning of the reagent head assembly without draining long runs of pipe.

To prevent strain on valve housings, it is desirable to use pipe straps and braces. Do not allow weight of piping to be supported by the valve housing, or leaks will occur. A short flexible section near the pump on both the suction and discharge piping is a good way of insuring no strain is transferred to the reagent head. This is particularly critical if the pump has a plastic reagent head. In the assembly of piping, use pipe thread compound compatible with the product handled.

Pump check valves are highly susceptible to dirt and other contaminants and any accumulation can cause malfunction. Be sure to use a pipe line strainer in the suction line between suction shut-off valve and pump suction valve. Regular cleaning of the suction strainer will prevent the pump capacity from falling off with use. The reagent head check valves should be cleaned after plumbing has been installed and before start-up.

In addition, a separate process relief valve should be installed in the process piping to protect piping and sensitive process equipment.

## **4.7 Metal Reagent Head Assembly**

The cast metal reagent head assembly is provided in 316 or Carpenter 20 stainless steel. Piping of similar alloy should be selected. Dissimilar metallic materials can cause galvanic corrosion.

DO NOT back weld piping to valve housing without first removing valve housing from pump, as excessive heat can damage the reagent head and other parts. The tie bars must be positioned on the valve housing before welding.

## **4.8 Plastic FPP Reagent Head Assembly**

The injection molded plastic reagent head is provided in glass filled polypropylene (FPP). To prevent fatigue from high temperature or ultraviolet radiation, do not continually expose the FPP to strong sunlight. Piping should be of the same material or some other material compatible with the chemical to be pumped. Valve seats are either FPP or molded elastomer to match the diaphragm material. Check valve balls are normal alumina ceramic.

When assembling suction and discharge piping to the reagent head assembly, use an open end wrench on the valve caps to prevent breakage of the reagent head. DO NOT OVERTIGHTEN.

## **4.9 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.

## 5. Equipment Start Up

### 5.1 Filling the Gear Box

Sufficient PULSAube is provided to fill the gear box to the level as marked on the dipstick under the oil fill cap. PULSAube oil is compounded to serve as both worm gear lubricant and hydraulic transfer duty. Do not use substitute oil or mix with other oil without consulting the factory.

All PULSAube oils are available in:

- 1 Quart Containers
- 1 Gallon containers
- 5 Gallon containers
- 55 Gallon Drums

### 5.2 Test Prime and Pump Head

As part of the final factory test of your new Hydracone R1 metering pump, the pump head was primed with oil. Checking the prime or repriming the oil side of the diaphragm is easily accomplished. It is unnecessary to connect piping to and from the pump to completely prime the oil passages and Hydracone diaphragm. Proceed as follows:

1. Set the adjustment knob to 90% capacity.
2. Start the pump motor and check for proper rotation (clockwise when viewed from the top).
3. Observe the transparent tube connecting the top of the air bleed valve to the gear box cover. No oil at all indicates that the pump does not have a hydraulic prime. Let the pump run. No oil movement may indicate a vapor locked air bleed valve which should be lightly tapped to unlock. Small vapor bubbles moving toward the gear box cover indicates an almost fully primed condition. A full and normal prime exists when the vapor bubbles migrating in the air bleed tube are very small and barely visible.
4. Operate the pump at 90% stroke from about 5 minutes. Some traces of air may remain, but will be relieved through the air bleed valve after the pump is operating against normal pressure.
5. Calibration of the pump is not recommended for at least eight hours of operation, as minute air bubbles in the hydraulic oil can cause compressive losses.

### 5.3 Priming Reagent Heads

With flooded suction and low discharge pressures, Hydracone R1 pumps will readily self prime. All that is necessary to start pumping is to turn on the motor. In some extreme cases, the pump will not prime. If this happens, shut off the motor and proceed as follows:

1. Be sure that the shut-off valves in both suction and discharge lines are open.
2. Set capacity from 90% to 100%.
3. Relieve pressure from discharge line. Arrange a bypass for discharge to drain or return to product storage tank.
4. If liquid does not flow, turn on motor and allow to run until pumping is evident. (Under high suction lift conditions, the pump *may* have to be manually primed by filling the reagent head and suction line prior to starting.)
5. The Hydracone can now be operated. Reconnect discharge piping.



## 5.4 Adjusting Flow Rate

The Hydracone stroke adjustment can be adjusted while the pump is idle or while operating. Turn the adjustment thimble clockwise to increase flow. Calibration of flow registers on the barrel and thimble in 1/2% increments to 100% of rated capacity.

## 5.5 Calibrating

(Figure 6)

A typical displacement chart is shown on the next page. Note that output is linear in respect to micrometer settings but that increases in discharge pressure decreases output slightly and describes a line parallel to that at 5psi. This is caused by compression of the hydraulic oil and valve inefficiencies.

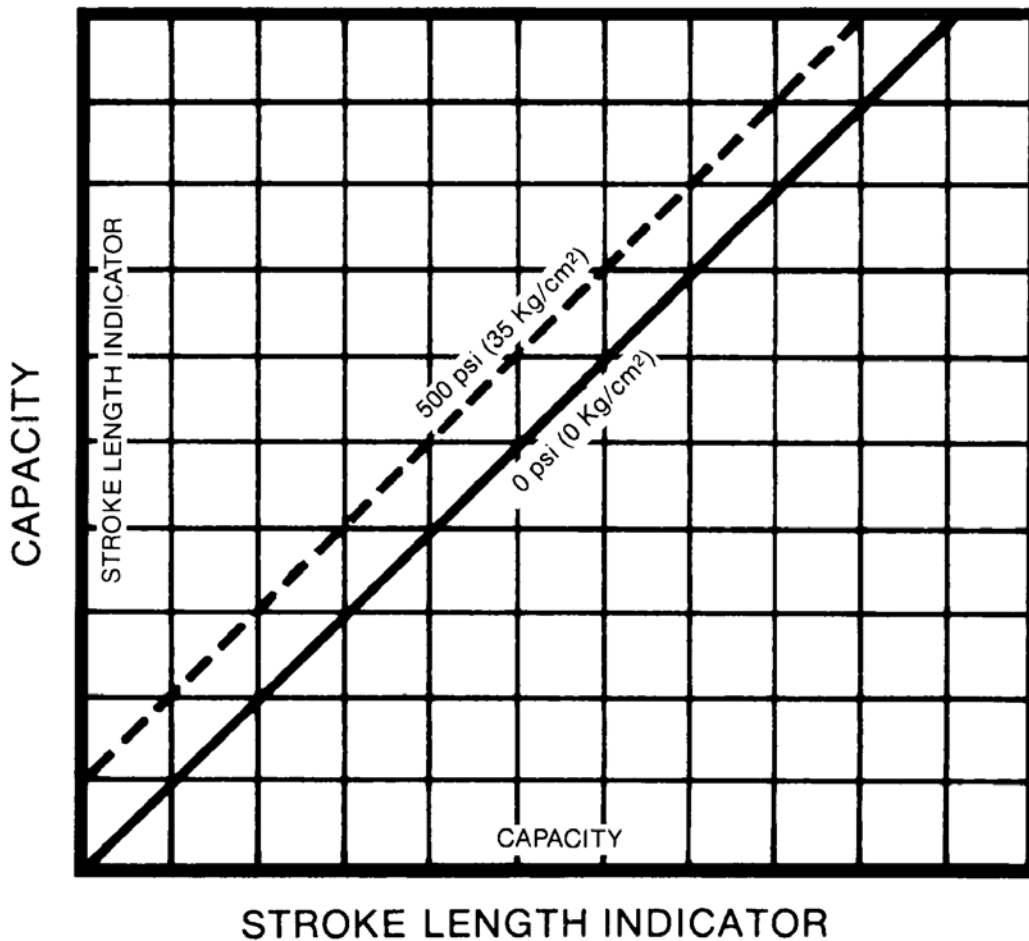


FIG. 6

## 6. Maintenance

The Hydracone has been designed to require minimal maintenance. It is recommended, however, that a preventative maintenance program be established to assure continuous, reliable performance.

Pulsafeeder KOPkits® are available to aid in establishing such a program. A KOPkit contains recommended spare parts which will provide normal maintenance needs. Contact your local Pulsafeeder representative for further information.

### 6.1 Corrosion

Under corrosive chemical service, a program of periodic takedown and inspection of all liquid handling parts is desirable to insure uninterrupted service. Corrosion may eventually damage such parts as diaphragms, valves and valve seats. Check these parts as often as indicated and replace when service shows damage.

### 6.2 Check Valves

Efficient check valve performance determines almost entirely the overall efficiency of the Hydracone pump. Check valves are of the ball type for both suction and discharge. Valves and seats can be replaced as indicated.

### 6.3 Metal Valve Assemblies

(Figure 7)

The metal valve assembly has a guide, ball and valve seat made of either stainless steel, Alloy-C, or Montel. Three TFE O-rings are used as seals for the assembly. When reassembling after cleaning or replacement, be sure to use new O-rings. Assemble in the order shown in Figure 7.

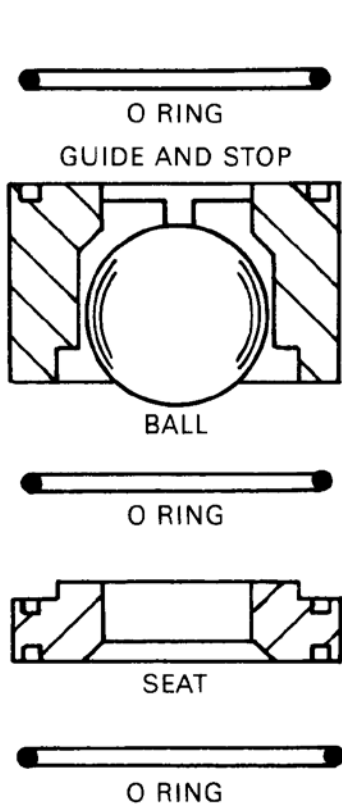


FIG. 7 METAL VALVE ASSEMBLIES

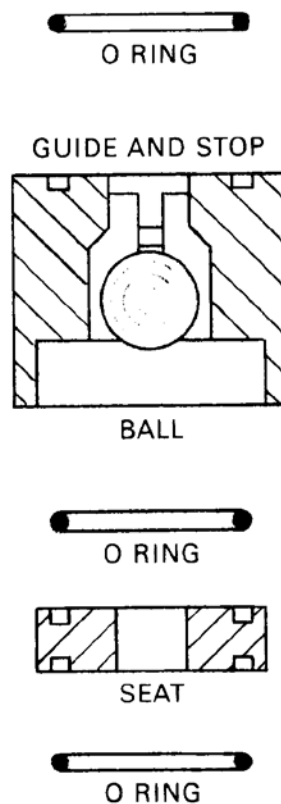


FIG. 8 PLASTIC VALVE ASSEMBLIES

## 6.4 Plastic Valve Assemblies

(Figure 8)

The plastic valve assembly has a guide made of glass filled polypropylene (FPP), a ball made of alumina ceramic, and a valve seat made of FPP or molded Viton<sup>®</sup> or Hypalon<sup>®</sup> elastomer. Three O-rings of the same material as the Hydracone are used as seals for the assembly. When reassembling after cleaning or replacement, be sure to use O-rings. Assemble in the order show in Figure 8.

## 6.5 Cleaning Pipe Lines

Some liquids tend to deposit a coating which in time can impair liquid flow and reduce pump accuracy. Other liquids carrying solids can settle out when the pump is idle and plug lines or cause the check valves to malfunction.

## 6.6 Lubrication Instructions

PULSAube is hydraulic oil expressly for lubrication and hydraulic transfer. Do not use substitute oils. A periodic check should be made on contamination and level. Depending on atmospheric conditions and duration of runs, it is desirable to replace oil every three months, or as contamination is noted. A suction pump similar to a grease gun is useful for removing oil from chambers, or, it may be drained from the plug on the bottom of the gear case.

# 7. Troubleshooting

## 7.1 Check Valves

Experience has shown that most metering pump troubles occur at the suction and discharge valves. To check possible trouble at these points, proceed as follows:

1. Remove suction and discharge check valves.
2. Examine valve seat contacts under magnifying glass. Test with back pressure if possible. If erosion or corrosion is apparent, replace valves, seats and gaskets.
3. In replacing valves, make sure O-rings are in place.
4. Check suction piping and all fittings for leakage.
5. Check both suction and discharge piping for stoppage.

## 7.2 Other Routine Checking

1. Check hydraulic bypass valve seat. Drain gear box and mark location of adjustment screw before dismantling. If scored or damaged, replace.
2. Make sure a slight back and forth motion exists in the air bleed valve line while the pump is operating. If not, remove air bleed valve, soak in mineral spirits and clean well.
3. Remove reagent head and check Hydracone for puncture or tearing at the sealing edge. Replace if the elastomer has hardened so as to be non-flexible. When replacing reagent head, tighten bolts evenly and securely.

## 7.3 Factory Repairs

Pulsafeeder maintains facilities in Rochester, NY for repair or complete reconditioning and even conversion of existing pumps for different service.

## 7.4 Other Problems and Possible Causes

DIFFICULTY	PROBABLE CAUSE
Loss of Reagent Head Prime	Leaky suction pipe or joints. Hydracone distorted. O-ring leaks. Vapor pressure of product too high.
Loss of Pump Head Prime	Reservoir oil level too low. Damaged piston or control rod. Hydracone leakage at seal. Hydraulic bypass valve leaks. Starved suction.
Delivery Low	Check valve leakage. Check valves clogged. Check suction and discharge piping for solids. Worn piston or control rod. Product viscosity too high. Product cavitating.
Delivery Erratic	Check valves need cleaning or replacing. Air in pump head Air in reagent head. Motor speed erratic. Sticky check valves.
Gradual Loss in Delivery with Pressure Constant	Check to see if valve contamination is developing. Vaporization of reagent.
Low Delivery with Hydraulic Bypass Valve Continually Blowing Off	Hydraulic bypass valve not set high enough for discharge pressure. Clogged suction line. Clogged discharge line. Viscosity of liquid handled too high Too high suction lift Hydracone distorted.





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