

PRINCIPLE OF PUMP OPERATION

This flap valve pump is powered by compressed air and is a 1:1 pressure ratio design. It alternately pressurizes the inner side of one diaphragm chamber, while simultaneously exhausting the other inner chamber. This causes the diaphragms, which are connected by a common rod, to move endwise. Air pressure is applied over the entire surface of the diaphragm, while liquid is discharged from the opposite side. The diaphragm operates under a balanced condition during the discharge stroke, which allows the unit to be operated at discharge heads over 200 feet (61 meters) of water head.

Since the diaphragms are connected by a common rod, secured by plates to the center of the diaphragms, one diaphragm performs the discharge stroke, while the other is pulled to perform the suction stroke in the opposite chamber.

For maximum diaphragm life, keep the pump as close to the liquid being pumped as possible. Positive suction head in excess of 10 feet of liquid (3.048 meters) may require a back pressure regulating device. This will maximize diaphragm life.

Alternate pressuring and exhausting of the diaphragm chamber is performed by means of an externally mounted, pilot operated, four-way spool type air distribution valve. When the spool shifts to one end of the valve body, inlet air pressure is applied to one diaphragm chamber and the other diaphragm chamber exhausts. When the spool shifts to the opposite end of the valve body, the porting of chambers is reversed. The air distribution valve spool is moved by an internal pilot valve which alternately pressurizes one side of the air distribution valve spool, while exhausting the other side. The pilot valve is shifted at each end of the diaphragm stroke by the diaphragm plate coming in contact with the end of the pilot valve spool. This pushes it into position for shifting of the air distribution valve.

The chambers are manifolded together with a suction and discharge check valve for each chamber, maintaining flow in one direction through the pump.

INSTALLATION & START-UP

Locate the pump as close to the product being pumped as possible, keeping suction line length and number of fittings to a minimum. Do not reduce line size.

For installations of rigid piping, short flexible sections of hose should be installed between pump and piping. This reduces vibration and strain to the piping system. A Warren Rupp Tranquilizer® surge suppressor is recommended to further reduce pulsation in flow.

This pump was tested at the factory prior to shipment and is ready for operation. It is completely self-priming from a dry start for suction lifts of 10-15 feet (3-4.5 meters) or less. For suction lifts exceeding 15 feet of liquid, fill the chambers with liquid prior to priming.

AIR SUPPLY

Air supply pressures cannot exceed 125 psi (8.61 bar). Connect the pump air inlet to an air supply of sufficient capacity and pressure required for desired performance. When the air line is solid piping, use a short length of flexible hose (not less than 3/4" (19mm) in diameter) between pump and piping to eliminate strain to pipes (Fig. 1).



IMPORTANT

Read these safety warnings and instructions in this manual completely, before installation and start-up of the pump. It is the responsibility of the purchaser to retain this manual for reference. Failure to comply with the recommendations stated in this manual will damage the pump, and void factory warranty.



CAUTION

Before pump operation, inspect all gasketed fasteners for looseness caused by gasket creep. Retorque loose fasteners to prevent leakage. Follow recommended torques stated in this manual.



WARNING

Before maintenance or repair, shut off the compressed air line, bleed the pressure, and disconnect the air line from the pump. The discharge line may be pressurized and must be bled of its pressure.



WARNING

In the event of diaphragm rupture, pumped material may enter the air end of the pump, and be discharged into the atmosphere. The air exhaust must be piped to an appropriate area for safe disposition.



WARNING

Take action to prevent static sparking. Fire or explosion can result, especially when handling flammable liquids. The pump, piping, valves, containers or other miscellaneous equipment must be grounded.

AIR INLET & PRIMING

For start-up, open an air valve approximately 1/2" to 3/4" turn. After the unit primes, an air valve can be opened to increase flow as desired. If opening the valve increases cycling rate, but does not increase flow rate, cavitation has occurred, and the valve should be closed slightly.

For the most efficient use of compressed air and the longest diaphragm life, throttle the air inlet to the lowest cycling rate that does not reduce flow.

AIR EXHAUST

If a diaphragm fails, the pumped liquid or fumes can enter the air end of the pump, and be exhausted into the atmosphere. When pumping hazardous or toxic materials, pipe the exhaust to an appropriate area for safe disposition.

This pump can be submerged if materials of construction are compatible with the liquid. The air exhaust must be piped above the liquid level. Piping used for the air exhaust must not be smaller than 1" (2.54 cm). Reducing the pipe size will restrict air flow and reduce pump performance. When the product source is at a higher level than the pump (flooded suction), pipe the exhaust higher than the product source to prevent siphoning spills.

Freezing or icing-up of the air exhaust can occur under certain temperature and humidity conditions. Use of an air dryer should eliminate most icing problems.

BETWEEN USES

When used for materials that tend to settle out or transform to solid form, the pump should be completely flushed after each use, to prevent damage. Product remaining in the pump between uses could dry out or settle out. This could cause problems with valves and diaphragms at re-start. In freezing temperatures, the pump must be drained between uses in all cases.

When priming at high suction lifts or with long suction lines operate the pump at maximum cycle rate.

CHECK VALVE SERVICING:

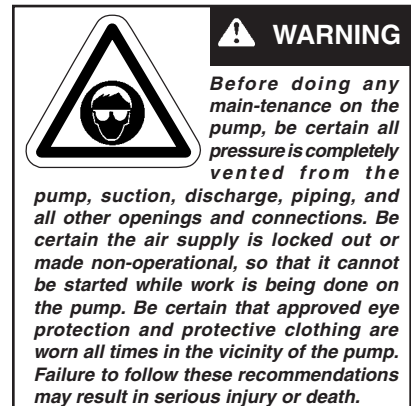
For flap valve inspection or replacement, remove the flange bolts securing the suction and discharge elbows and loosen Dresser-type couplings. The flap valves are exposed for inspection or servicing upon removal of elbows.

DIAPHRAGM SERVICING:

Remove the twelve bolts (six each side) securing the manifolds to the elbows. Remove the eight bolts securing the outer chamber to the inner chamber. Remove the diaphragm assembly (outer plate, diaphragm, inner plate) by turning the assembly counterclockwise using a 1 1/8" (3.17 cm) wrench on the outer plate lugs. To disassemble the diaphragm assemblies, screw into the inner plates two threaded pins, place the pins in a vise and turn the outer plate counterclockwise using the 1 1/8" wrench. The interior components consisting of shaft seals, sleeve bearings and bearing retainers are now accessible for service.

Procedures for reassembling the diaphragms are the reverse of the above. The diaphragms must be installed with their natural bulge to the outside, toward the outer diaphragm plate. Install the inner plate with the flat face against the diaphragm.

After all components are in position in a vise and hand tight, tighten with a wrench to approximately 50 ft. lbs.. (69.14 Newton meters) torque. After both diaphragm assemblies have been assembled, thread one assembly into the shaft (hold the shaft near the middle in a vise with soft jaws, to protect the finish). Install this sub assembly into the pump and secure by placing the outer chamber on the end with the diaphragm. This holds the assembly in place while the opposite side is installed. Torque the last diaphragm assembly to 50 ft. lbs. (69.14 Newton meters). This final torquing will lock the diaphragm assemblies together. Place the remaining outer chamber on the open end and tighten the bolts. Replace the manifold assemblies.



AIR DISTRIBUTION VALVE SERVICING:

The spool and sleeve are rust and corrosion resistant brass and hardened stainless steel. The spool is closely sized to the sleeve and should slide freely. Accumulation of dirt and oils may prevent the pump from cycling. Remove the valve body from the center pump housing, remove the end caps, and push the spool out of the sleeve. Wash the parts in cleaning solvent or kerosene, and check the spool and sleeve for possible roughness, nicks or scratches. Use a fine stone or crocus cloth to carefully remove any irregular marks on the surfaces. When the spool slides freely on the sleeve, coat the parts with light oil and reassemble.

PILOT VALVE SERVICING:

This assembly is reached by removing the air distribution valve body from the pump and lifting the pilot valve body out of the intermediate housing.

When reinserting an externally serviceable pilot valve, push both plungers out of the path of the pilot valve so that they and the pilot valve are not damaged.

Service Note: If a problem arises with the pilot valve, it is usually corrected by replacing only o-rings. Always grease the spool prior to inserting into the sleeve. If the sleeve is removed from the body, reinsertion must be from the same side it was removed from, the chamfered side. Again, grease the o-rings so that it slides into the body. Make sure the retaining ring has securely been inserted around the sleeve.

PILOT VALVE ACTUATOR SERVICING:

The bushings for the pilot valve actuators are threaded into the intermediate bracket from the outside. The plunger may be removed for inspection or replacement from the inside by removing the air distribution valve body and the pilot valve body from the pump. The plungers should be visible as you look into the intermediate from the top. Depending on their position, you may find it necessary to use a fine piece of wire to pull them out.

Under rare circumstances, it may become necessary to replace the o-ring seal. The bushing can be removed from the inner chamber by removing the outer chamber assembly and diaphragm.

SERVICE INSTRUCTIONS: TROUBLE SHOOTING

1. Pump will not cycle

- A. Check to make sure the unit has enough pressure to operate and that the air inlet valve is open.
- B. Check the discharge line to insure that the discharge line is neither closed nor blocked.
- C. If the spool in the air distribution valve is not shifting, check the main spool. It must slide freely.
- D. Excessive air leakage in the pump can prevent cycling. This condition will be evident. Air leakage into the discharge line indicates a ruptured diaphragm. Air leakage from the exhaust port indicates leakage in the air distribution valve. See further service instructions.
- E. Blockage in the liquid chamber can impede movement of diaphragm.

2. Pump cycles but will not pump

- A. Suction side of pump pulling in air. Check the suction line for air leaks and be sure that the end of the suction line is submerged. Check flange bolting. Check valve flanges and manifold to chamber flange joints.
- B. Make certain the suction line or strainer is not plugged. Restriction at the suction is indicated by a high vacuum reading when a vacuum gauge is installed in the suction line.
- C. Check valves may not be seating properly. To check, remove the suction line and cover the suction port with your hand. If the unit does not pull a good suction (vacuum), the check valves should be inspected for proper seating.
- D. Static suction lift may be too high. Priming can be improved by elevating the suction and discharge lines higher than the check valves and pouring liquid into the unit through the suction inlet. When priming at high suction lifts or with long suction lines operate the pump at maximum cycle rate.

3. Low performance

- A. Capacity is reduced as the discharge pressure increases, as indicated on the performance curve. Performance capability varies with available inlet air supply. Check air pressure at the pump inlet when the pump is operating to make certain that adequate air supply is maintained.
- B. Check vacuum at the pump suction. Capacity is reduced as vacuum increases. Reduced flow rate due to starved suction will be evident when cycle rate can be varied without change in capacity. This condition will be more prevalent when pumping viscous liquids. When pumping thick, heavy materials the suction line must be kept as large in diameter and as short as possible, to keep suction loss minimal.
- C. Low flow rate and slow cycling rate indicate restricted flow through the discharge line. Low flow rate and fast cycling rate indicate restriction in the suction line or air leakage into suction.
- D. Unstable cycling indicates improper check valve seating on one chamber. This condition is confirmed when unstable cycling repeats consistently on alternate exhausts. Cycling that is not consistently unstable may indicate partial exhaust restriction due to freezing and thawing of exhaust air. Use of an air dryer should solve this problem.

For additional information, see the Warren Rupp Troubleshooting Guide.

WARRANTY

This pump is warranted for a period of five years against defective material and workmanship. Failure to comply with the recommendations stated in this manual voids all factory warranty.

RECOMMENDED WARREN RUPP® ACCESSORIES TO MAXIMIZE PUMP PERFORMANCE:

- **Tranquilizer® Surge Suppressor.** For nearly pulse-free flow.
- **WarrenRupp Filter/Regulator.** For modular installation and service convenience.
- **Warren Rupp Speed Control.** For manual or programmable process control. Manual adjustment or 4-20mA reception.

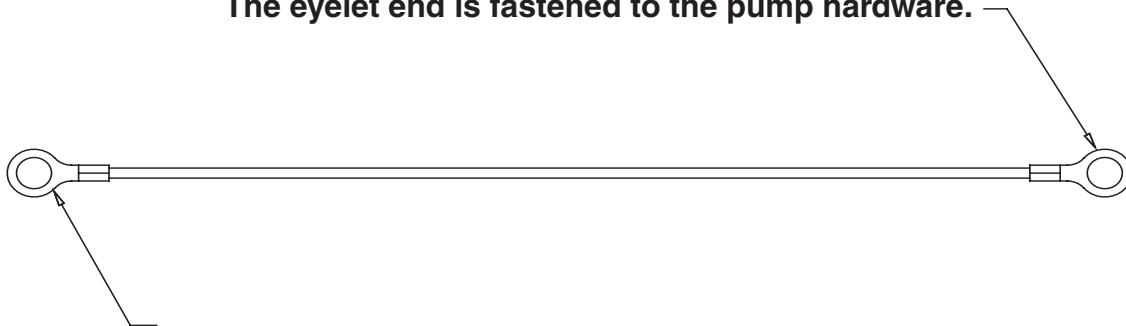
For more detailed information on these accessories, contact your local Warren Rupp Factory-Authorized Distributor, or Warren Rupp corporate headquarters.

Grounding The Pump

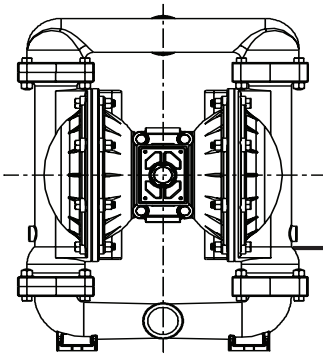
⚠ WARNING ⚠

Take action to prevent static sparking. Fire or explosion can result, especially when handling flammable liquids. The pump, piping, valves, containers or other miscellaneous equipment must be grounded.

The eyelet end is fastened to the pump hardware.



The clamp end is installed to a true earth ground.



This 8 foot long (244 centimeters) Ground Strap, part number 920-025-000 can be ordered as a service item.



To reduce the risk of static electrical sparking, this pump must be grounded. Check the local electrical code for detailed grounding instruction and the type of equipment required, or in the absence of local codes, an industry or nationally recognized code having jurisdiction over specific installations.



SERVICE AND OPERATING MANUAL

Models HDF3-M Type 2

HDF4-M Type 2

| ITEM NO. | PART NUMBER | DESCRIPTION | TOTAL RQD. |
|----------|---------------------|---------------------------------------|------------|
| 1 | 070.006.170. | Bearing, Sleeve | 2 |
| 2 | 114.002.010. | Bracket, Intermediate | 1 |
| 3 | 132.022.360. | Bumper | 2 |
| 4 | 135.016.162. | Bushing, Threaded, with O-Ring | 2 |
| 5 | 620.011.114. | Plunger, Actuator | 2 |
| 7 | 360.041.379. | Gasket, Valve Body | 1 |
| 8 | 560.001.360. | O-Ring | 2 |
| 9 | 132.014.358. | Bumper, Valve Spool | 2 |
| 10 | 095.073.000. | Pilot Valve Assembly | 1 |
| 10-A | 095.070.551. | Pilot Valve Body | 1 |
| 10-B | 755.025.000. | Sleeve, with O-Ring | 1 |
| 10-C | 560.033.360. | O-Ring (Sleeve) | 4 |
| 10-D | 775.026.000. | Spool, with O-Ring | 1 |
| 10-E | 560.023.360. | O-Ring (Spool) | 2 |
| 10-F | 675.037.080. | Retaining Ring | 1 |
| 11 | 165.011.010. | Cap, End | 2 |
| 12 | 360.048.425. | Gasket, Valve Body | 1 |
| 13 | 360.010.425. | Gasket, End Cap | 2 |
| 14 | 560.020.360. | O-Ring | 6 |
| 15 | 031.018.000. | Sleeve & Spool Set | 1 |
| 16 | 170.032.330. | Capscrew, Hex Head | 8 |
| 17 | 095.043.010. | Body, Valve | 1 |
| 18 | 196.100.015. | Chamber, Inner | 2 |
| 19 | 560.022.360. | O-Ring | 2 |
| 20 | 170.045.330. | Capscrew, Hex Head | 4 |
| 21 | 530.036.000. | Muffler, Exhaust | 1 |
| 22 | 685.041.120. | Rod, Diaphragm | 1 |
| 23 | 115.068.080. | Bracket, Support | 1 |
| 24 | 170.024.330. | Capscrew, Hex Head | 8 |
| 25 | 900.006.330. | Washer, Lock | 8 |
| 26 | 720.004.360. | Seal, U-Cup | 2 |
| 27 | 722.007.010. | Seat, Flap Valve-Angle | 4 |
| 28 | 326.004.080. | Mounting Foot | 2 |
| 29 | 132.002.360. | Bumper | 2 |
| 30 | 612.090.010. | Plate, Outer Diaphragm Assy. | 2 |
| 31 | 807.046.330. | Stud | 2 |
| 32 | 612.124.010. | Plate, Inner Diaphragm | 2 |
| 33 | 286.098.365. | Diaphragm | 2 |
| | 286.098.360. | Diaphragm | 2 |
| | 286.098.354. | Diaphragm | 2 |
| 34 | 900.003.330. | Washer, Lock | 22 |
| 35 | 545.008.330. | Nut, Hex | 16 |
| 39 | 807.017.330. | Stud | 8 |
| 40 | 618.003.330. | Pipe Plug | 4 |
| 41 | 900.006.330. | Washer, Lock | 4 |
| 42 | 170.012.330. | Capscrew, Hex Head | 6 |
| 43 | 360.013.379. | Gasket, Seat | 4 |
| | 360.013.384. | Gasket, Seat | 4 |

Repair Parts shown in **bold face (darker)** type are more likely to need replacement after extended periods of normal use. They are readily available from most Warren Rupp distributors. The pump owner may prefer to maintain a limited inventory of these parts in his own stock to reduce repair downtime to a minimum.

IMPORTANT: When ordering repair parts always furnish pump model number, serial number and type number.

MATERIAL CODES The Last 3 Digits of Part Number

- 000...Assembly, sub-assembly; and some purchased Items
- 010...Cast Iron
- 012...Powered Metal
- 015...Ductile Iron
- 020...Ferritic Malleable Iron
- 025...Music Wire
- 080...CarbonSteel AISI B-1112
- 100...Alloy 20
- 110...Alloy Type 316 Stainless Steel
- 111...Alloy Type 316 Stainless Steel (Electro Polished)
- 112...Alloy "C"
- 113...Alloy Type 316 Stainless Steel (Hand Polished)
- 114...303 Stainless Steel
- 115...302/304 Stainless Steel
- 117...440-C Stainless Steel (Martensitic)
- 120...416 Stainless Steel (Wrought Martensitic)
- 123...410 Stainless Steel (Wrought Martensitic)
- 148...Hardcoat Anodized Aluminum
- 149...2024-T4 Aluminum
- 150...6061-T6 Aluminum
- 151...6063-T6 Aluminum
- 152...2024-T4 Aluminum (2023-T351)
- 154...Almag 35 Aluminum
- 155 or 156...356-T6 Aluminum
- 157...Die Cast Aluminum Alloy #380
- 158...Aluminum Alloy SR-319
- 159...Anodized Aluminum
- 162...Brass, Yellow, Screw Machine Stock
- 165...Cast Bronze, 85-5-5-5
- 166...Bronze SAE 660
- 170...Bronze, Bearing Type, Oil Impregnated
- 180...Copper Alloy
- 310...Kynar Coated
- 330...Zinc Plated Steel
- 331...Chrome Plated Steel
- 332...Electroless Nickel Plated
- 335...Galvanized Steel
- 336...Zinc Plated Yellow Brass
- 337...Silver Plated Steel
- 340...Nickel Plated
- 342...Filled Nylon
- 354...Injection Molded #203-40 Santoprene - Duro 40D ± 5; Color: RED
- 355...Thermoplastic Elastomer
- 356...Hytre
- 357...Rupplon (Urethane Rubber) Color coded: PURPLE
- 358...Rupplon (Urethane Rubber) Color coded: PURPLE (Some Applications, Compression Mold)
- 359...Urethane Rubber
- 360...Buna-N Rubber Color coded: RED
- 361...Buna-N
- 363...Viton (Fluorel) Color coded: YELLOW
- 364...E.P.D.M. Rubber Color coded: BLUE
- 365...Neoprene Rubber Color coded: GREEN
- 370...Butyl Rubber Color coded: BROWN
- 371...Philtane (Tuftane)
- 375...Fluorinated Nitrile
- 378...High density Polypropylene

| ITEM NO. | PART NUMBER | DESCRIPTION | TOTAL RQD. |
|---------------------|--------------|---|------------|
| 44 | 360.014.379. | Gasket, Flange | 4 |
| | 360.014.384. | Gasket, Flange | 4 |
| 45 | 670.006.115. | Retainer, Flap Valve | 4 |
| | 670.043.115. | Retainer, Flap Valve (Santoprene only) | 4 |
| 46 | 807.016.330. | Stud | 12 |
| 47 | 170.023.330. | Capscrew, Hex Head | 4 |
| 48 | 545.007.330. | Nut, Hex | 20 |
| 49 | 807.018.110. | Stud | 8 |
| 50 | 547.002.115. | Nut, Stop | 8 |
| 51 | 334.020.000. | Flange, Follower | 4 |
| 52 | 360.021.000. | Gasket | 4 |
| 53 | 170.055.330. | Capscrew, Hex Head | 12 |
| 54 | 901.006.330. | Flat Washer | 14 |
| 55 | 170.095.330. | Capscrew, Hex Head | 2 |
| 56 | 196.060.010. | Chamber, Outer | 2 |
| 57 | 312.015.010. | Elbow, Suction | 2 |
| 58 | 312.016.010. | Elbow, Discharge | 2 |
| 59 | 518.045.010. | Manifold | 2 |
| 60 | 338.011.354. | Flap Valve | 4 |
| | 338.011.356. | Flap Valve | 4 |
| | 338.011.357. | Flap Valve | 4 |
| | 338.008.360. | Flap Valve | 4 |
| | 338.008.365. | Flap Valve | 4 |
| 61 | 570.002.360. | Pad, Hinge, Not used with Santoprene | 4 |
| | 570.002.365. | Pad, Hinge, Not used with Santoprene | 4 |
| 62 | 170.082.330. | Capscrew, Hex Head | 14 |
| 63 | 570.010.360. | Pad, Wear | 2 |
| | 570.010.365. | Pad, Wear | 2 |
| Not Shown: | | | |
| | 031.021.010. | Valve Body Assembly (consists of Items 9, 11, 13, 14, 15, 16, 17) | 1 |
| | 901.035.115. | Washer, Flat (use w/Santoprene flaps only) | 8 |
| SA4-M Type 2 | | | |
| 63 | 334.037.010. | Flange, Adapter | 2 |
| 64 | 807.005.330. | Stud | 8 |
| 65 | 900.007.330. | Washer, Lock | 8 |
| 66 | 545.009.330. | Nut, Hex | 8 |
| 67 | 360.036.426. | Gasket, Flange | 2 |

*Available in Kit form. Order P/N 031.055.000.
which also includes items 3, 5, 7, 12.

Repair Parts shown in **bold face (darker)** type are more likely to need replacement after extended periods of normal use. They are readily available from most Warren Rupp distributors. The pump owner may prefer to maintain a limited inventory of these parts in his own stock to reduce repair downtime to a minimum.

IMPORTANT: When ordering repair parts always furnish pump model number, serial number and type number.

MATERIAL CODES

The Last 3 Digits of Part Number

List continued next page

Continued from previous page

379... Conductive Nitrile
384... Conductive Neoprene
405... Cellulose Fibre
408... Cork and Neoprene
425... Compressed Fibre
426... Blue Gard
440... Vegetable Fibre
465... Fibre
500... Delrin 500
501... Delrin 570
505... Acrylic Resin Plastic
520... Injection Molded PVDF Natural Color
540... Nylon
541... Nylon
542... Nylon
544... Nylon Injection Molded
550... Polyethylene
551... Polypropylene
552... Unfilled Polypropylene
553... Unfilled Polypropylene
555... Polyvinyl Chloride
570... Rulon II
580... Ryton
590... Valox
591... Nylatron G-S
592... Nylatron NSB
600... Virgin PTFE (virgin material) Tetrafluoroethylene (TFE)
601... Virgin PTFE (Bronze and moly filled)
602... Filled Virgin PTFE
603... Blue Gylon
604... Virgin PTFE
606... Virgin PTFE
608... Conductive PTFE
610... Virgin PTFE Encapsulated Silicon
611... Virgin PTFE Encapsulated Viton

Delrin, Virgin PTFE, Viton and Hytrel are registered tradenames of E.I. DuPont.

Gylon is a registered tradename of Garlock, Inc.

Nylatron is a registered tradename of Polymer Corp.

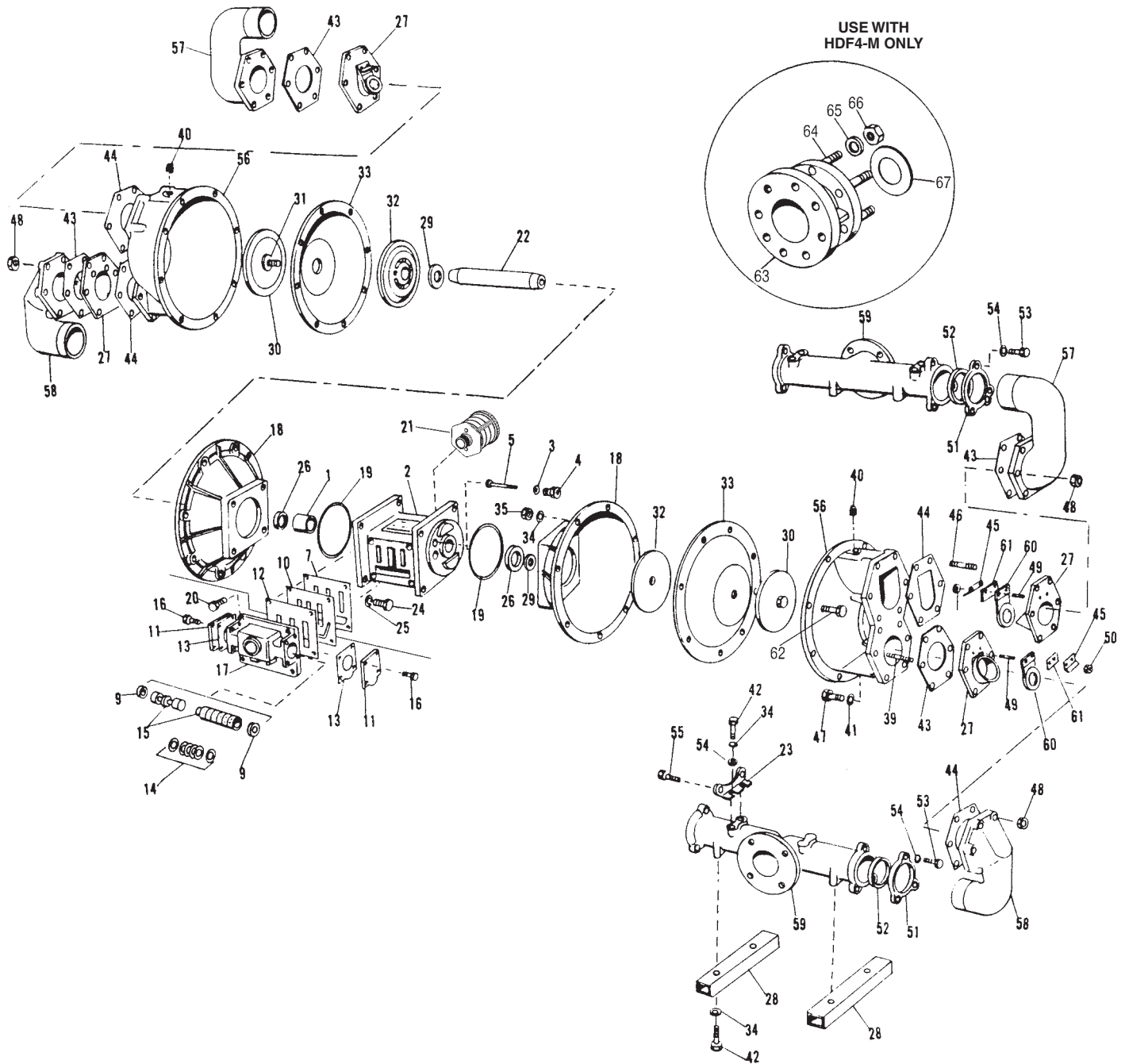
Rulon II is a registered tradename of Dixon Industries Corporation.

Hastelloy-C is a registered tradename of Cabot Corp.

Ryton is a registered tradename of Phillips Chemical Company.

Valox is a registered tradename of General Electric Co.

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