

## PLEASE NOTE!

The photos shown in this manual are for general instruction only. Your specific model may not be shown. Always refer to the parts list and exploded view drawing for your specific model when installing, disassembling or servicing your pump.

## PRINCIPLE OF PUMP OPERATION

This ball check 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. 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. This pump was tested at the factory prior to shipment and is ready for operation. It is completely self-priming from a dry start.

## AIR SUPPLY

Air supply pressures cannot exceed 100 psi (6.89 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 ¼" (6.35 mm) in diameter) between pump and piping to eliminate strain to pipes. Lubrication of air supply is not required.

## AIR INLET & PRIMING

For start-up, open an air valve approximately ½ to ¾ 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 disposal.

## ⚠ IMPORTANT ⚠

*Read these instructions completely, before installation and start-up. 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 ⚠

*Operating temperature limitations are as follows:*

Polypro 150°F(65°C) Max. to  
40°F (5°C) Min.

## ⚠ BEFORE OPERATION ⚠

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

## MAX. SUCTION LIFT

Dry	5.83 ft.	1.78 m
Wet	25.5 ft.	7.77 m

## MAX. VISCOSITY

10,000 SSU  
2,200 CPS

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  $\frac{3}{8}$ " (.9525 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. Use exhaust kit 475-145-000 to pipe out exhaust.

Freezing or icing 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 to pump 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.

## CHECK VALVE SERVICING

Need for inspection or service is usually indicated by poor priming, unstable cycling, reduced performance or the pump's cycling but not pumping.

Remove the sixteen machine screws securing the manifold assemblies to the outer chambers. Inspect the surfaces of both check valve and seat for wear or damage that could prevent proper sealing. If pump is to prime properly, valves must seat air tight.

## DIAPHRAGM SERVICING

Remove the two V-Band clamps securing the outer chambers to the intermediate housing. Remove the diaphragm assembly (outer plate, diaphragm, inner plate) by turning the assembly counterclockwise using a  $\frac{1}{2}$ " (1.27 cm) wrench on the outer plate lugs. (If a socket is used, it must be a six point socket.) The interior components consisting of the shaft seal and pilot valve assembly are now accessible for service.

Procedures for reassembling the diaphragms are the reverse of the above. Install the diaphragm with the natural bulge outward.

Install the outer diaphragm plate on the outside of the diaphragm and make certain that the large radius side of the inner plate is toward the diaphragm. Tighten the outer diaphragm plate to approximately 30 in./lbs. (3.39 Newton meters).

Torque while allowing the diaphragm to turn freely with plates. Use a wrench on the outer diaphragm plate of the opposite side to keep rod from rotating. If the opposite chamber is assembled, the rod need not be held.

## EXTERNALLY SERVICEABLE MAIN AIR DISTRIBUTION VALVE

To service the main air distribution, first shut-off and disconnect the air supply to the pump. Remove the four long hex capscrews and hex nuts (on opposite side of pump) which fasten the main air valve body (item 1), gaskets (items 8 and 11), muffler (item 14), and caps (items 6 and 15) to the pump.

Once the main air valve body is off the pump remove the retaining rings (items 7) that hold the end caps in place. Remove the end caps (items 6) to inspect the spool and sleeve. Remove the main air spool (item 4) and inspect for damage or wear. Replace o-rings and backups if needed. Inspect the inside diameter of the main air valve sleeve (item 2) for dirt, scratches, or other contaminants. Remove and replace the sleeve if needed. When re-installing the sleeve, apply a light coating of grease to the six o-rings (items 3) before inserting the sleeve into the main air valve body. Align the holes in the sleeve with the slots in main valve body, making sure the sleeve is centered in the bore. Clean the main air valve spool, lightly grease the o-rings, and insert into the sleeve flush to one end. Re-install the end caps and retaining rings. The main air valve body is now ready to put back on the pump.

Assemble the air inlet cap (item 9), valve body gasket (item 8), to the main air valve body (making sure the five rectangular slots face the air inlet cap), and the intermediate gasket onto the four hex capscrews and install onto the pump. Slide the muffler (item 14) and the air exhaust cap (item 15) over the capscrews. Re-install the washers (items 10) and hex nuts (items 16) onto the four hex capscrews and torque to 30 in./lbs. (3.39 Newton meters).

## SERVICING THE PILOT VALVE

To remove the pilot valve spool (item 23) first remove the end o-ring (item 24) from one end of spool. Slide the spool out of the sleeve and inspect the five remaining o-rings (items 24) for damage or wear. If necessary, replace damaged o-rings. Inspect the inner diameter of the pilot valve sleeve (item 20) for scratches, dirt, or other

## ⚠ CAUTION ⚠

*In the event of diaphragm rupture, pumped material may enter the air end of the pump, and be discharged into the atmosphere. If pumping a product which is hazardous or toxic, the air exhaust must be piped to an appropriate area for safe disposal.*

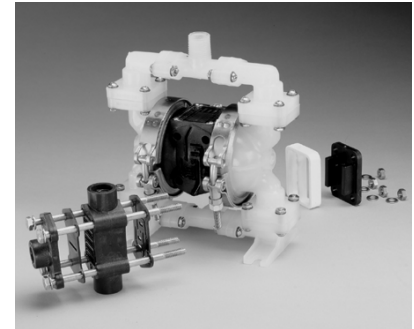


Figure 1

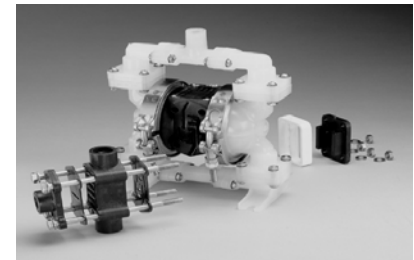


Figure 2



Figure 3

contaminants. Replace the sleeve if necessary. To remove the sleeve first remove the retaining ring from one end. When installing a pilot valve sleeve first lightly grease the six o-rings (items 21). Insert the sleeve into the chamfered end of bore on the intermediate bracket (item 13). Push the sleeve in until the shoulder is flush to intermediate bracket surface and install the retaining ring (item 22). To install the pilot valve spool first lightly grease the four interior o-rings and insert into the pilot valve sleeve. After inserting the spool into the sleeve install the remaining loose o-ring onto spool.

## SERVICING THE DIAPHRAGM ROD SEALS

To service the rod seals (items 18) first remove pilot valve, then remove the inserts on each of the intermediate brackets (items 17) by prying them out with a small flat screwdriver. After removing the inserts take the K-R rod seals out of the inserts and replace. When reinstalling the seals, make sure the open side of the seals face into the counterbore in the inserts. To install the inserts into intermediate bracket, simply press the insert into the counterbore in each end of the intermediate bracket, making sure that the closed side of insert faces out. The inserts should be flush to the surface of the intermediate bracket or slightly below the surface when fully installed.

## TROUBLESHOOTING

### 1. Pump will not cycle

- Check to make sure the unit has enough pressure to operate and that the air inlet valve is open.
- Check the discharge line to insure that the discharge line is neither closed nor blocked.
- If the spool in the air distribution valve is not shifting, check the main spool. It must slide freely.
- 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.
- Blockage in the liquid chamber can impede movement of diaphragm.

### 2. Pump cycles but will not pump

- 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.
- 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.
- 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.
- 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

- 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.
- 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. Viscosity is limited to a maximum of 10,000 SSU (2,200 CPS). 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.
- 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.
- 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 anti-freeze lubricant in an air line lubricator should solve this problem.

## 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.

## ⚠ CAUTION ⚠

*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. When used for toxic or aggressive fluids, the pump should always be flushed clean prior to disassembly.*



Figure 4



ITEM NO.	PART NUMBER	DESCRIPTION	TOTAL RQD.
1	095-077-551	Body, Main Air Valve	1
2	<b>031-106-000</b>	<b>Sleeve &amp; Spool Set</b>	<b>1</b>
3	<b>560-101-360</b>	<b>O-Rings</b>	<b>8</b>
6	165-074-551	Cap, End with O-Ring	2
7	<b>675-051-115</b>	<b>Ring, Retaining</b>	<b>2</b>
8	<b>360-085-360</b>	<b>Gasket, Valve Body</b>	<b>1</b>
9	165-072-551	Cap, Air Inlet	1
10	901-037-115	Washer, Flat 1/4"	8
11	170-103-115	Capscrew, Hex Head 1/4-20 x 5" Long	4
12	<b>360-084-360</b>	<b>Gasket, Intermediate Bracket</b>	<b>1</b>
13	114-019-551	Bracket, Intermediate	1
14	530-022-550	Muffler	1
15	165-073-551	Cap, Air Exhaust	1
16	545-003-115	Nut, Hex 1/4-20UNC	4
17	449-021-551	Insert, Gland	2
18	<b>720-031-359</b>	<b>Seal, K-R</b>	<b>2</b>
19	685-046-120	Rod, Diaphragm	1
20	<b>755-038-000</b>	<b>Sleeve, Pilot Valve with O-rings</b>	<b>1</b>
21	<b>560-066-360</b>	<b>O-rings</b>	<b>6</b>
22	<b>675-047-115</b>	<b>Ring, Retaining - Pilot Valve Sleeve</b>	<b>1</b>
23	<b>775-038-000</b>	<b>Spool, Pilot Valve with O-rings</b>	<b>1</b>
24	<b>560-029-374</b>	<b>O-rings</b>	<b>6</b>
25	612-147-150	Plate, Inner Diaphragm	2
26	<b>286-069-354</b>	<b>Diaphragm</b>	<b>2</b>
	<b>286-070-600</b>	<b>Diaphragm</b>	<b>2</b>
27	612-146-552	Plate, Outer Diaphragm	2
28	200-057-115	Clamp, V-Band	2
29	100-002-115	T-Bolt	2
30	545-027-337	Nut, Hex 1/4-28UNF	2
31	196-145-552	Chamber, Outer	2
32	<b>720-032-600</b>	<b>Seal, Check Valve</b>	<b>8</b>
33	722-073-552	Seat, Check Valve	4
34	<b>050-033-354</b>	<b>Ball, Check</b>	<b>4</b>
	<b>050-034-600</b>	<b>Ball, Check</b>	<b>4</b>
35	312-095-552	Elbow, Suction	2
37	706-023-115	Screw, Machine 10-32UNF x 1" Long	24
38	544-004-115	Nut, Hex Flange 10-32UNF	24
39	312-096-552	Elbow, Discharge	2
40	<b>720-033-600</b>	<b>Seal, Manifold</b>	<b>4</b>
41	518-127-552	Manifold, Horizontal (Optional Discharge)	1/2
42	518-128-552	Manifold, Vertical	1
43	<b>360-086-360</b>	<b>Gasket, Sealing</b>	<b>2</b>

Repair Parts shown in **bold face (darker)** type are more likely to need replacement after extended periods of normal use. 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
- 015... Ductile Iron
- 025... Music Wire
- 080... Carbon Steel 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... 301/302/304 Stainless Steel
- 120... 416 Stainless Steel (Wrought Martensitic)
- 148... Hardcoat Anodized Aluminum
- 150... 6061-T6 Aluminum
- 151... 6063-T6 Aluminum
- 154... Almag 35 Aluminum
- 155 or 156... 356-T6 Aluminum
- 157... Die Cast Aluminum Alloy #380
- 159... Anodized Aluminum
- 162... Brass Yellow Screw Machine Stock
- 170... Bronze Bearing Type Oil Impregnated
- 180... Copper Alloy
- 330... Plated Steel
- 331... Chrome Plated Steel
- 332... Electroless Nickel Plated
- 335... Galvanized Steel
- 354... Santoprene
- 355... Thermoplastic Elastomer
- 356... Hytrel
- 357... Ruppilon (Urethane Rubber)
- 358... Ruppilon (Urethane Rubber) Color coded: PURPLE (Some Applications, Compression Mold)
- 360... Buna-N Rubber Color coded: RED
- 363... Viton (Fluorel) Color coded: YELLOW
- 364... E.P.D.M Rubber Color coded: BLUE
- 365... Neoprene Rubber Color coded: GREEN
- 366... Food Grade Nitrile Color coded: WHITE
- 368... Food Grade EPDM
- 374... Carboxylated Nitrile
- 375... Fluorinated Nitrile
- 405... Cellulose Fibre
- 408... Cork and Neoprene

**AVAILABLE SERVICE KITS:**

<b>031-107-551</b>	<b>Main Air Valve Body Assembly (Polypropylene &amp; Kynar Units) (Includes Items 1, 2, 3 (two), 6, and 7)</b>	<b>1</b>
<b>031-101-000</b>	<b>Pilot Valve Assembly (Includes Items 20, 22, and 23)</b>	<b>1</b>
475-145-000	Air Exhaust Conversion Kit	
476-117-354	Wetted End Kit (Santoprene Diaph. & Balls)	
476-117-644	Wetted End Kit (Santoprene Diaph. & Virgin PTFE Balls)	
476-117-600	Wetted End Kit (Virgin PTFE Diaphragm and Balls)	
476-129-000	Air End Kit (Sleeves, Spools, O-rings, Retaining Rings, K-R Seals, and Gaskets)	

**MATERIAL CODES****The Last 3 Digits of Part Number**


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425...Compressed Fibre  
426...Blue Gard  
440...Vegetable Fibre  
500...Delrin 500  
501...Delrin 570  
502...Conductive Acetal  
503...Conductive Acetal (Glass Filled)  
506...Acetal  
520...Injection Molded PVDF Natural Color  
541...Nylon, glass filled  
542...Nylon, unfilled  
544...Nylon Injection Molded  
550...Polypropylene  
551...Polypropylene, glass filled  
552...Polypropylene, unfilled  
555...PVC (Polyvinyl Chloride)  
580...Ryton  
600...Virgin PTFE, Tetrafluoroethylene (TFE)  
603...Blue Gylon  
604...Virgin PTFE - Diaphragm  
606...Virgin PTFE  
610...Virgin PTFE Encapsulated Silicon  
611...Virgin PTFE Encapsulated Viton

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

Gylon and Envelon are registered tradenames of Garlock, Inc.

Nylatron is a registered tradename of Polymer Corporation.

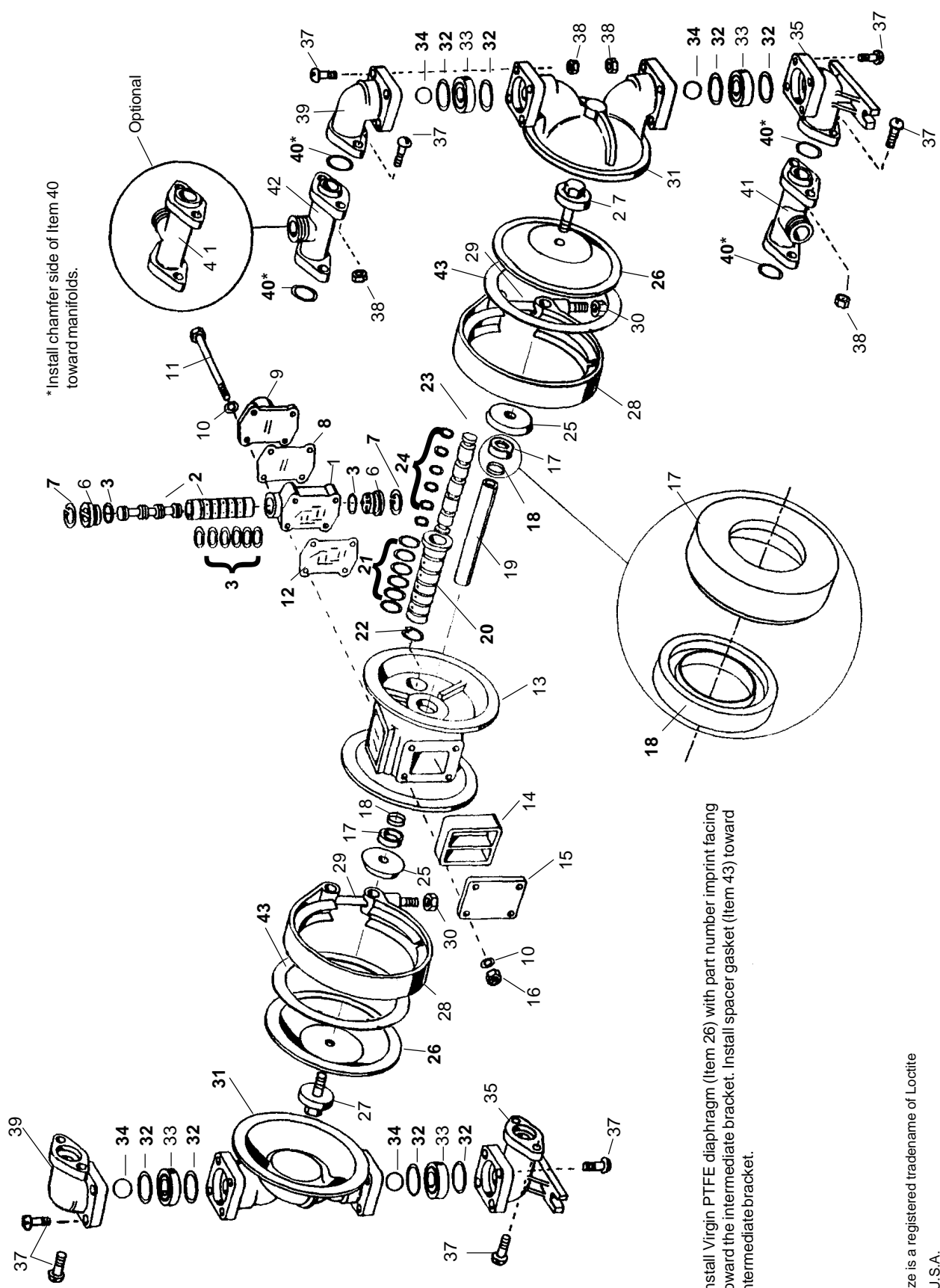
Rulon II is a registered tradename of Dixion Industries Corp.

Hastelloy-C is a registered tradename of Cabot Corporation.

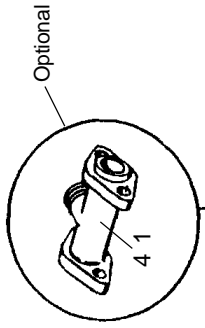
Ryton is a registered tradename of Phillips Chemical Company.

Santoprene is a registered tradename of Monsanto Corp.

Valox is a registered tradename of General Electric Company.



\*Install chamfer side of Item 40 toward manifolds.



NOTE: Install Virgin PTFE diaphragm (Item 26) with part number imprint facing toward the intermediate bracket. Install spacer gasket (Item 43) toward intermediate bracket.

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