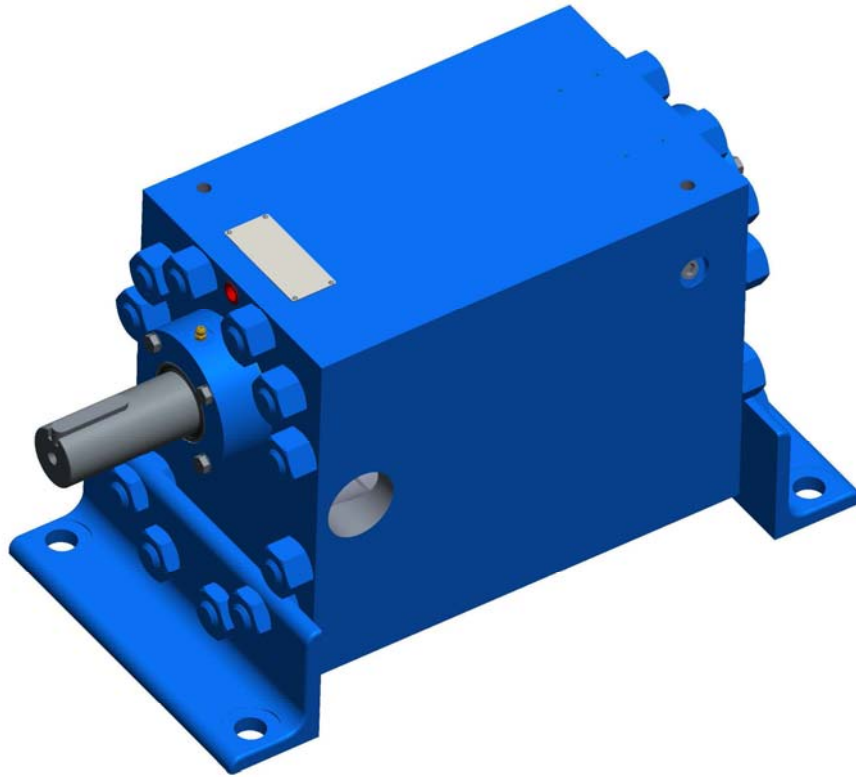


Operation & Maintenance Manual

4900 Series Pipeline Injection Pumps

Bulletin 150



NORTHERN[®] PUMP

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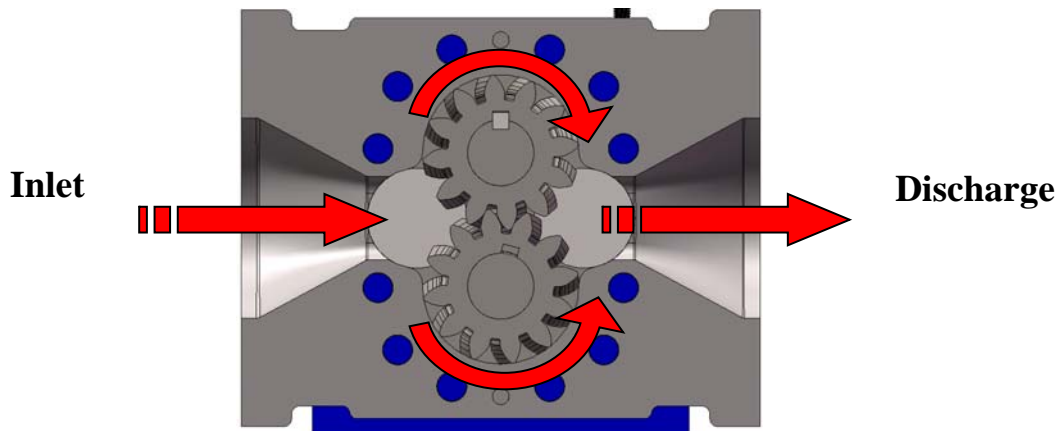


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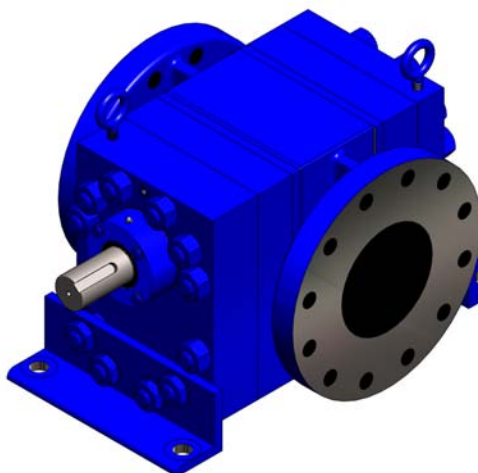
Introduction

The 4900 Series Pipeline Injection gear pump is a positive displacement, rotary pump with two gears of equal size. The pump has a constant discharge at constant rotational speed. The inlet port of the pump is on the side where the gears are coming out of mesh. The discharge port is on the side of the pump where the gears are coming in to mesh. The pump transfers fluid trapped in the spaces between adjacent gear teeth and the cylinder from the inlet to the discharge side of the pump.

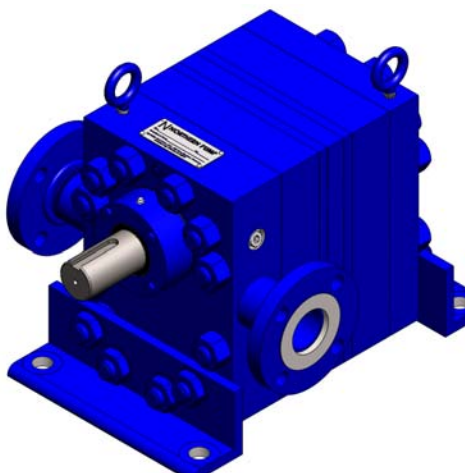


There are virtually unlimited variations of the pump assembly possible depending on the application. The combination of the width of the gear and the speed of the pump determine the flow rate. Generally, with narrower gears, the inlet and discharge ports are NPT connections and located on the seal adapter plate. With wider gears, the inlet and discharge ports are cast flanges and located on the cylinder. Welded flanges on the Seal Adapter Plate or Cylinder may also be used should the application require them. The shaft is typically sealed with a John Crane Type 8-1, mechanical seal; however, the pump assembly may use Type 21, Type 9 or Type 8B1 seals.

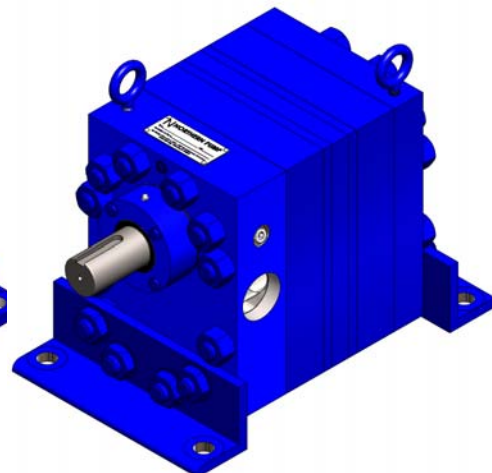
Cylinder with Flanged Connections



Seal Adapter plate with welded flange assembly

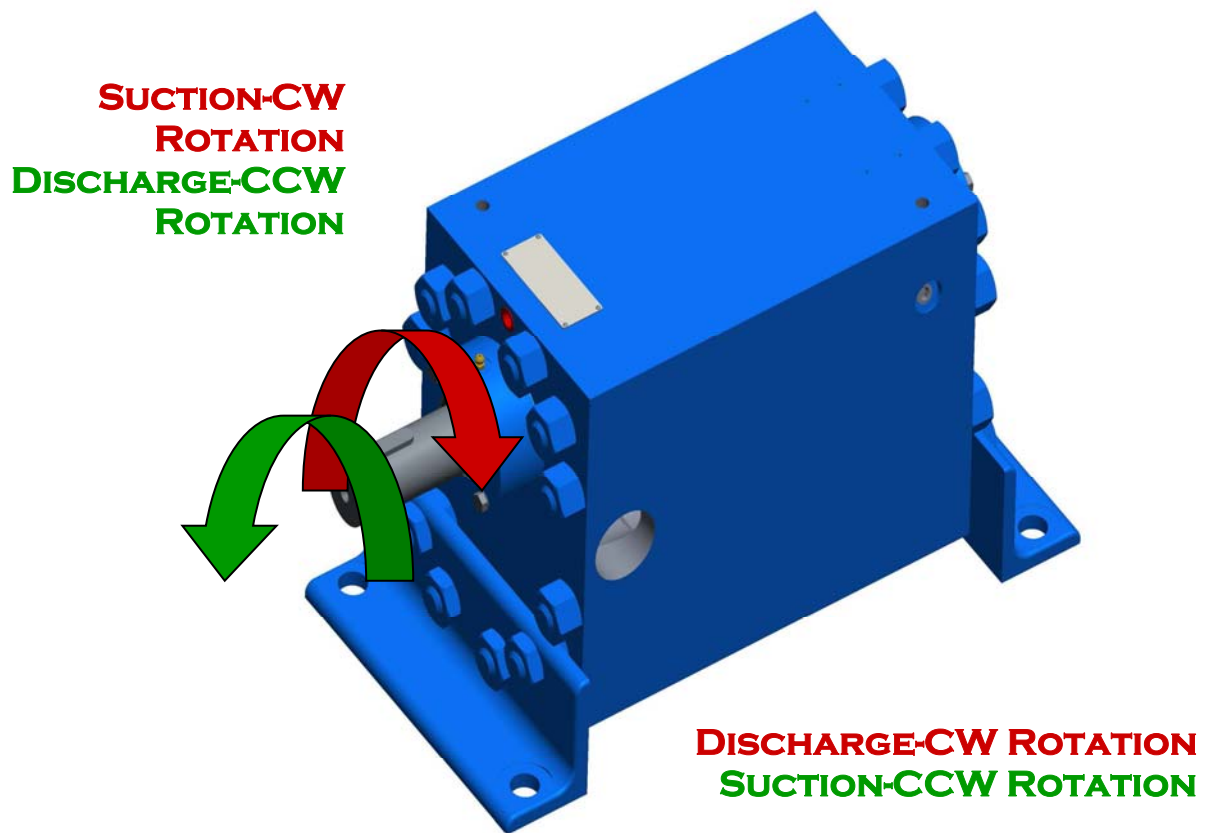


Seal adapter plate with NPT Connections



Rotation

Rotation of the pump is determined by facing the end of the pump with the drive shaft protruding from it. (looking at the pump with the drive shaft pointed at you) If the discharge of the fluid comes out of the right side of the pump, it is clockwise rotation orientated. If the discharge of the fluid come out of the left side of the pump, it is counter-clockwise orientated. Both of the orientations are depicted below. The designed rotational orientation of the pump is printed on the ID Tag.

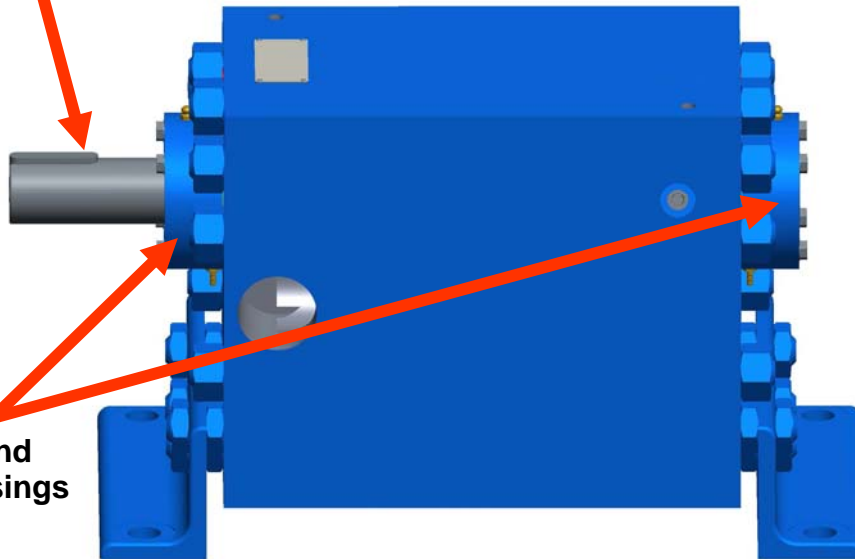


Hydraulic Balance

The 4900 Series Pipeline Injection Pumps are hydraulically balanced. Hydraulically balanced pumps can be identified by their through shaft design, having bearing and seat housings on both ends, two mechanical seals and two outer support bearings. This design eliminates wear on the pump components caused by the axial thrust load generated by high inlet pressures.

**Drive shaft
through pump**

**Bearing and
Seat Housings**



Cautionary Statements

Failure to heed these cautionary statements may result in personal injury and/or damage to equipment.

1. Disable and lock-out the drive system before any work is done to install, maintain, or remove the pump.
2. Fully depressurize the entire system.
3. Close the valves closest to the pump in both the suction and discharge pipe.
4. Wear protective eyewear, and any other required face protection.
5. When handling corrosive, caustic, toxic, or hazardous liquids, wear protective clothing to prevent contact with skin.
6. Wear protective footwear such as safety shoes.
7. When handling liquids with toxic vapors, wear a properly rated breathing mask.
8. Work area must be properly ventilated.
9. Work area must be properly grounded.
10. Do not work alone.
11. Clean up any spilled liquid immediately.

Pump Installation

1. 4900 Series Pipeline Injection Pumps are heavy. Use appropriate lifting and transportation methods and means (hoist, forklift, pallet jack, etc) when moving a pump.
2. Turn off and lock out the drive mechanism.
3. Fully depressurize both the suction and discharge lines to the pump.
4. Close the valve in the suction and discharge lines closest to the pump.
5. Place a pan or other liquid collecting device under the pump to collect the liquid that may drain from the pump and the suction and discharge lines when connected to the pump.
6. Level and properly align pump.
7. Line pipes up naturally. Forcing pipes into place with flange bolts can draw pump out of alignment. Support pipes independently to eliminate strain on pump casing. Check alignment again and correct if necessary.
8. Test inlet pipe lines with pressure for leaks to ensure that they are completely airtight. The inlet piping must have a diameter equal to, or larger than, the pump inlet port.
9. Test rotation of the motor to ensure that the pump rotates in the direction indicated by arrow on pump casing.
10. Do not subject pumps to thermal shock by exposing a cold pump to a hot liquid supply or vice versa.

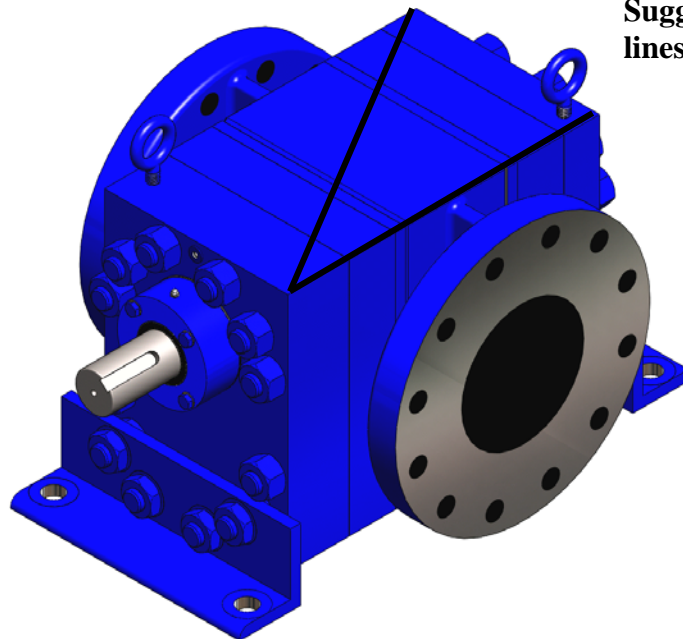
Removal from Installation

1. Turn off and lock out the drive mechanism.
2. Fully depressurize both the suction and discharge lines to the pump.
3. Close the valve in the suction and discharge lines closest to the pump.
4. Place a pan or other liquid collecting device under the pump to collect the liquid that may drain from the pump or the suction and base plate when assembly is disconnected.
5. Remove the coupling hub and key from the drive shaft. Clean any residue from the drive shaft. Remove any burrs or upset metal from the surface of the drive shaft.

Disassembly

The 4900 Series Pipeline Injection Pump assembly is a series of plates held together with Pump Studs (27) and two Dowel Pins (13). The dowels provide the alignment of the pump plates and are precision parts. The faying surfaces of the plates are ground flat and sealed with an O-ring. Be prepared to use some force to take the pump apart. However, you are also trying to reuse as much of the pump as possible, so be careful not to damage parts unnecessarily.

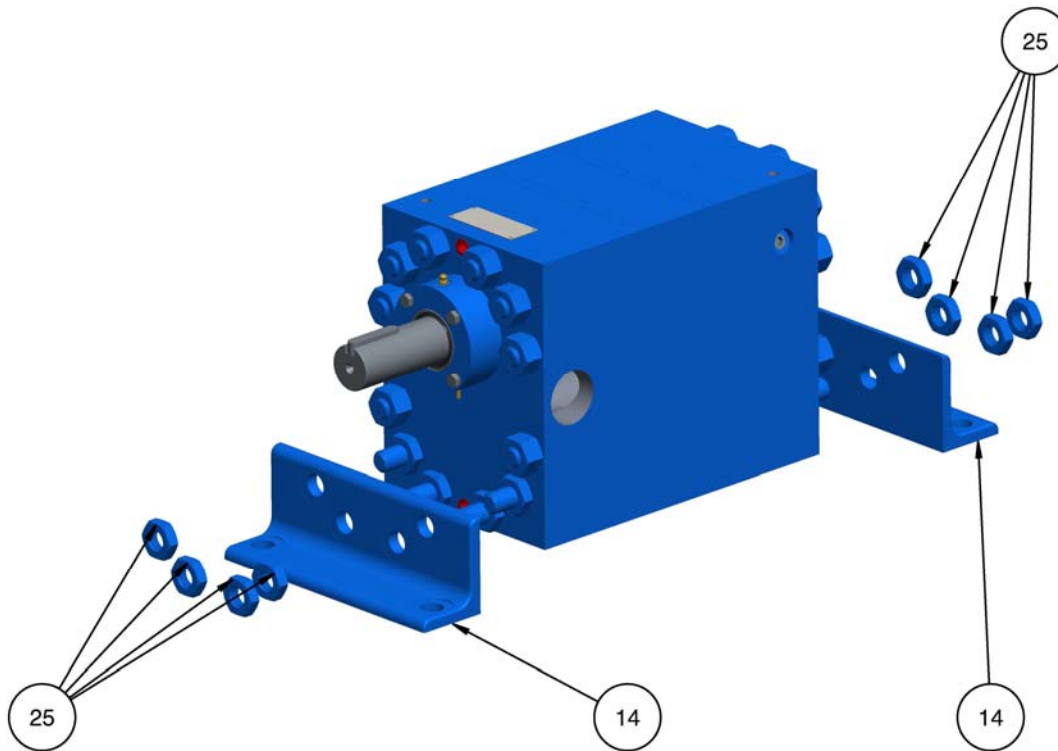
It is important to re-assemble the plates in the same order and orientation as they were when shipped from our factory. The plates are marked and numbered when shipped, but it is advisable before disassembly to mark the pump housing as shown to ensure that you will know how the parts were arranged before the pump was taken apart. A scribe line or permanent marker line along one edge and a diagonal from corner to corner works quite well.



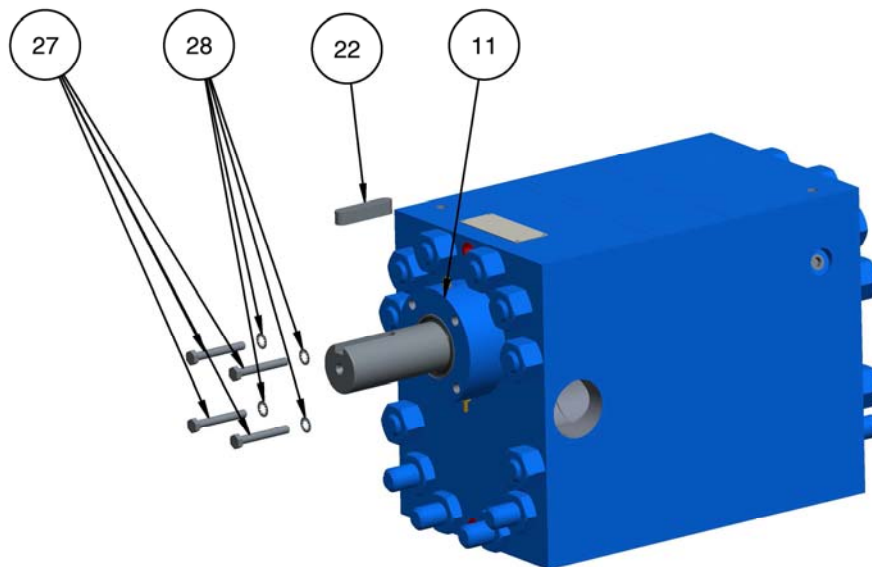
Suggested marker or scribed lines across plates.

Pump Disassembly Steps

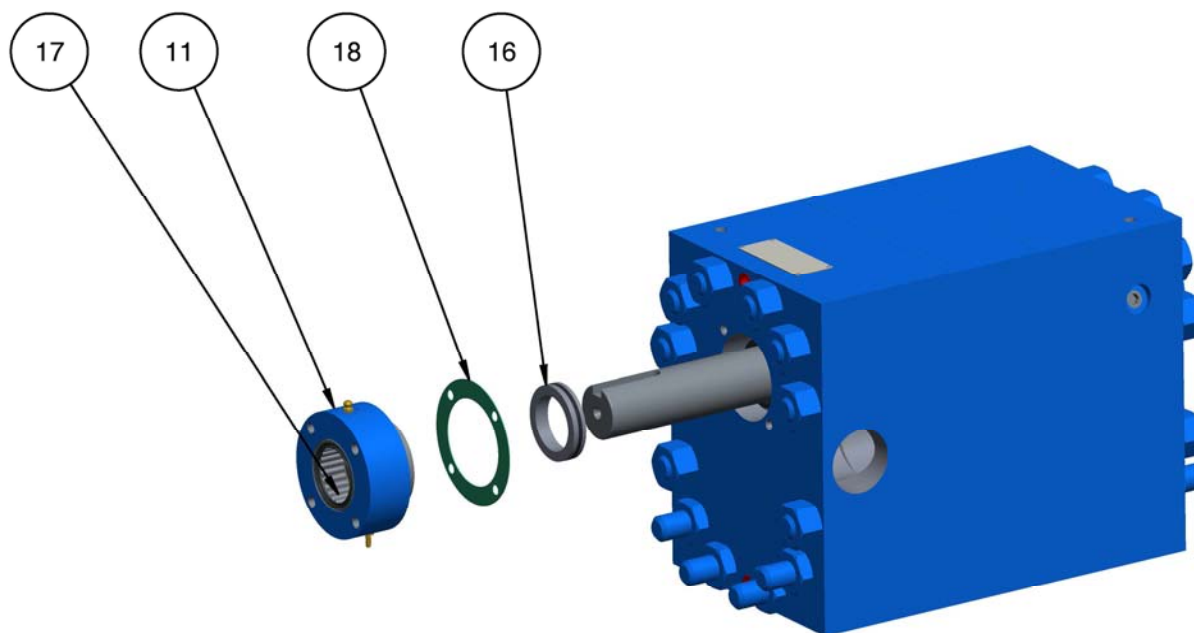
1. Remove the Outer Jam Nuts (25) and the Mounting Brackets (14) from the front and rear of the pump.



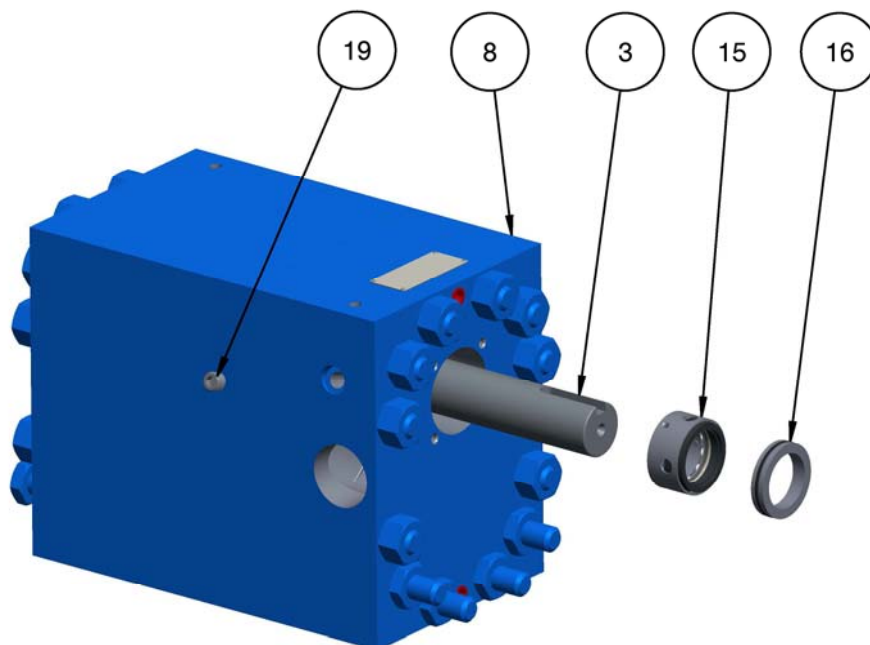
2. Loosen and remove the Cap Screws (27) and Lock Washers (28) from the front Bearing & Seat Housing (11) and remove the End Key (22)



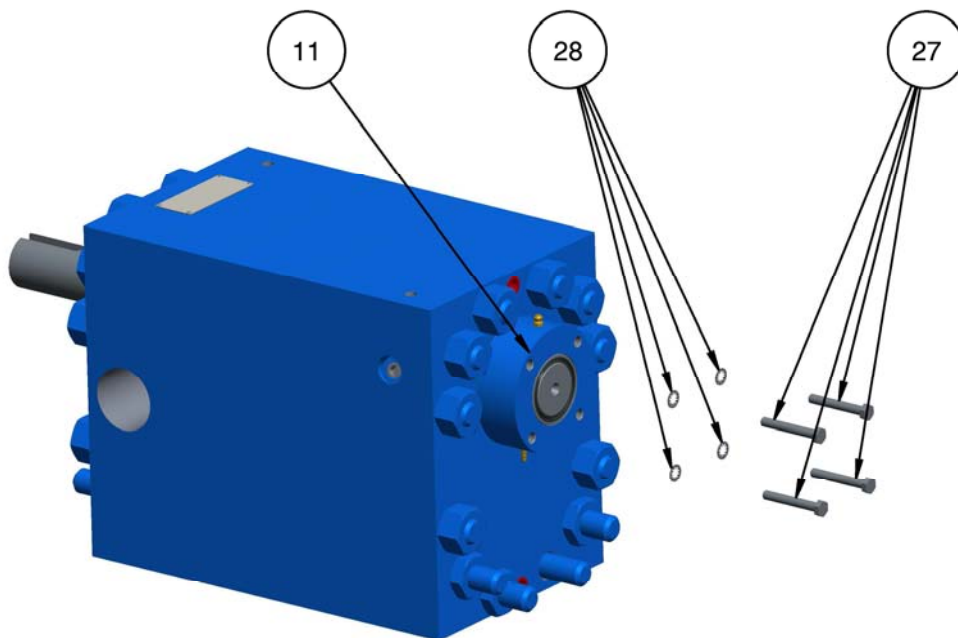
3. Remove the Bearing & Seat Housing (11), the Support Bearing (17) and the Gasket (18). The Mechanical Seal Seat (16) may remain installed in the Bearing & Seat Housing.



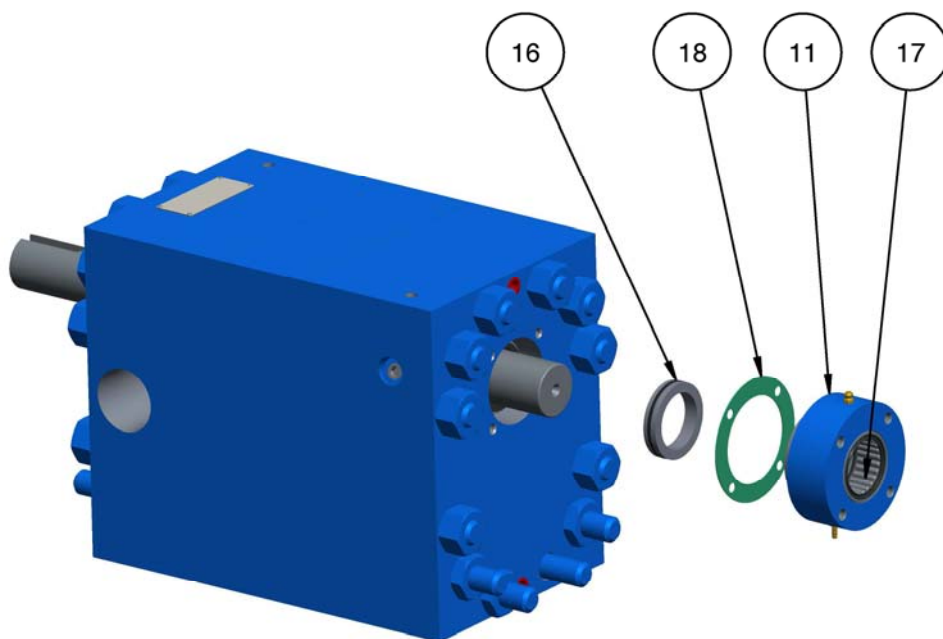
4. Remove the Pipe Plug (19) from the Suction & Discharge Seal Adapter Plate (8) and loosen the set screws from the Mechanical Seal (15) using a 1/8" hex end wrench at least 6 inches long. The drive shaft (3) will need to be rotated to align the set screws with the opening. Slide the Mechanical Seal and, if not already removed, the Mechanical Seal Seat (16) off of the Drive Shaft (3).



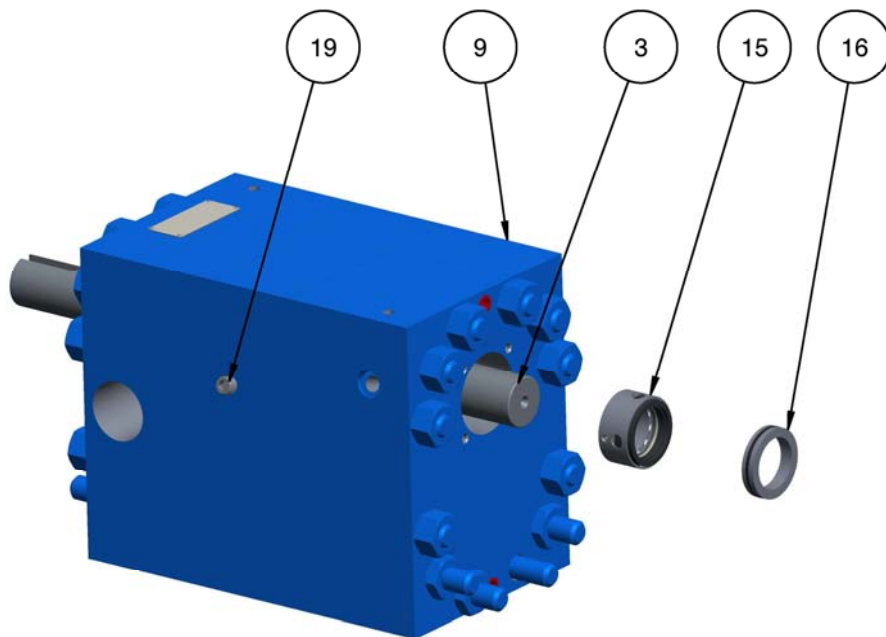
5. Loosen and remove the Cap Screws (27) and Lock Washers (28) from the rear Bearing & Seat Housing (11).



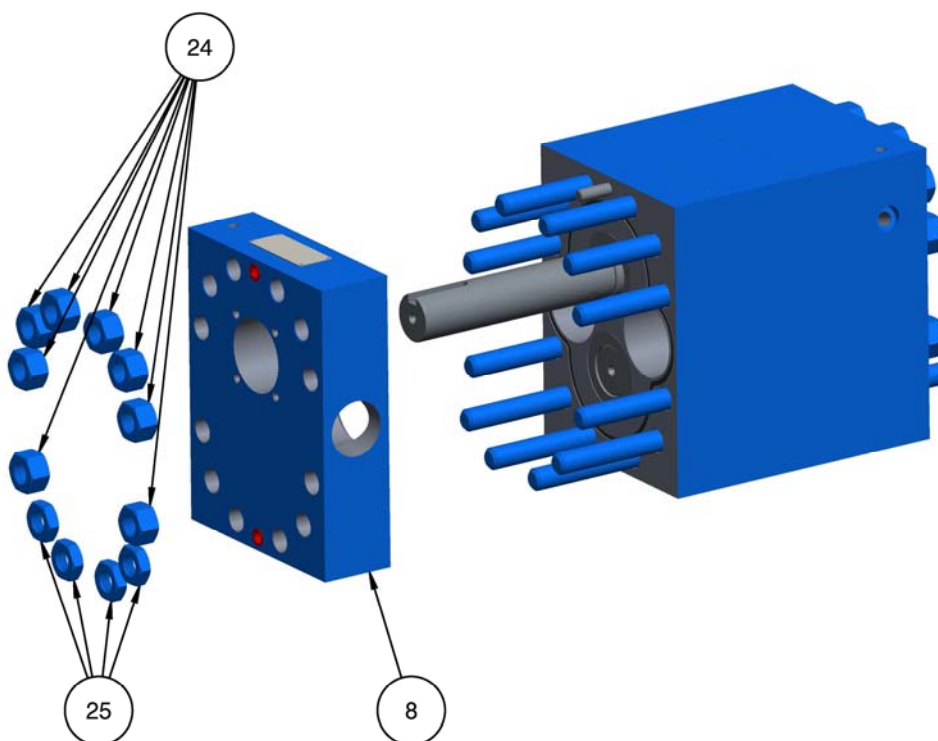
6. Remove the rear Bearing & Seat Housing (11), the Support Bearing (17) and the Gasket (18). The Mechanical Seal Seat (16) may remain installed in the Bearing & Seat Housing.



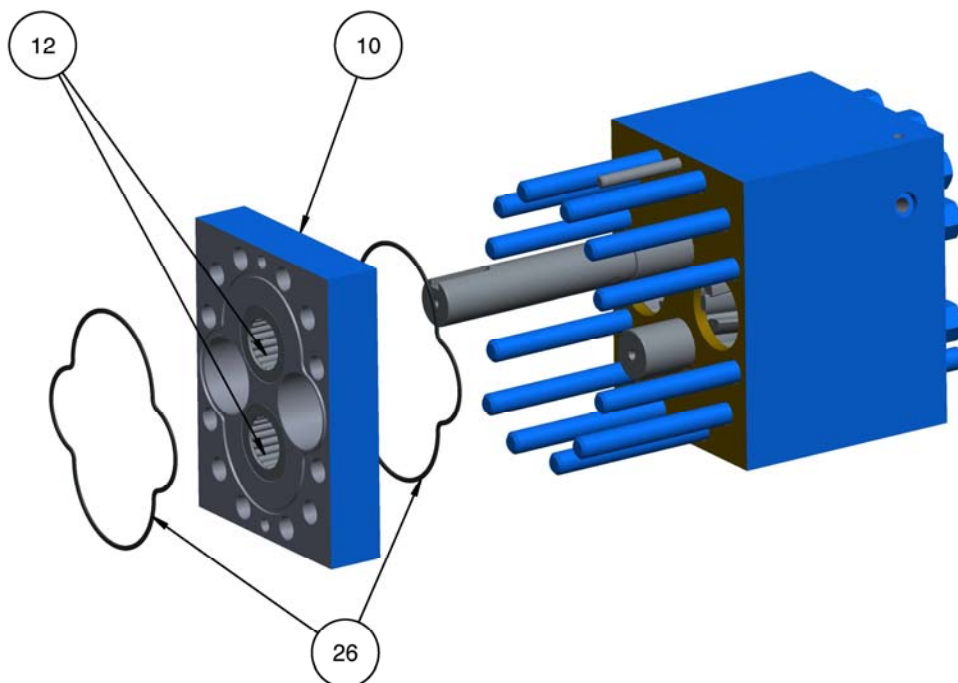
7. Remove the Pipe Plug (19) from the Seal Adapter Plate (9) and loosen the set screws from the Mechanical Seal (15) using a 1/8" hex end wrench at least 6 inches long. The drive shaft (3) will need to be rotated to align the set screws with the opening. Slide the Mechanical Seal and, if not already removed, the Mechanical Seal Seat (16) off of the Drive Shaft (3).



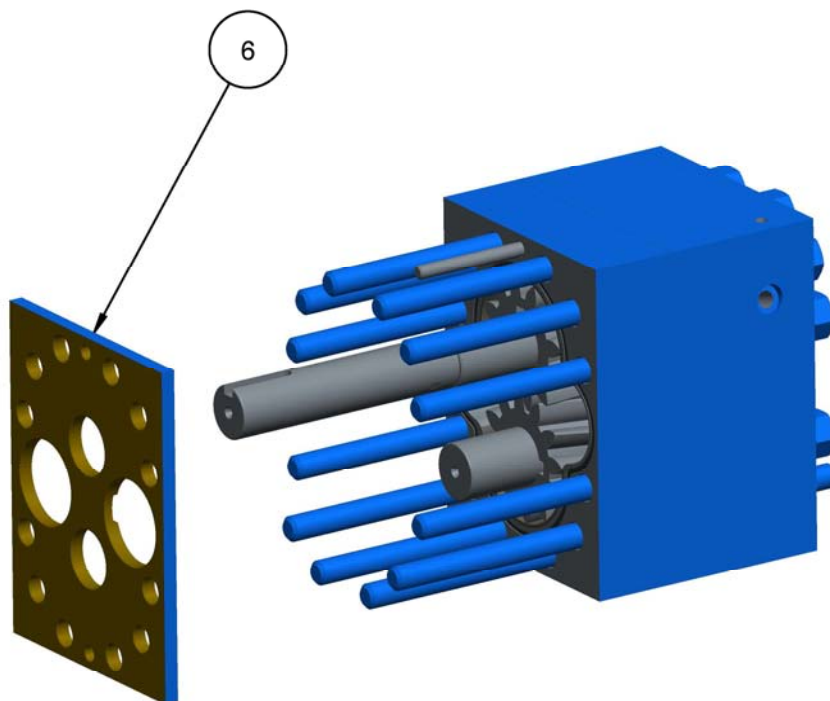
8. Remove the Heavy Hex Nuts (24) and the Heavy Hex Jam Nuts (25) from the Suction & Discharge Seal Adapter Plate (8) and slide the plate off of the front of the pump.



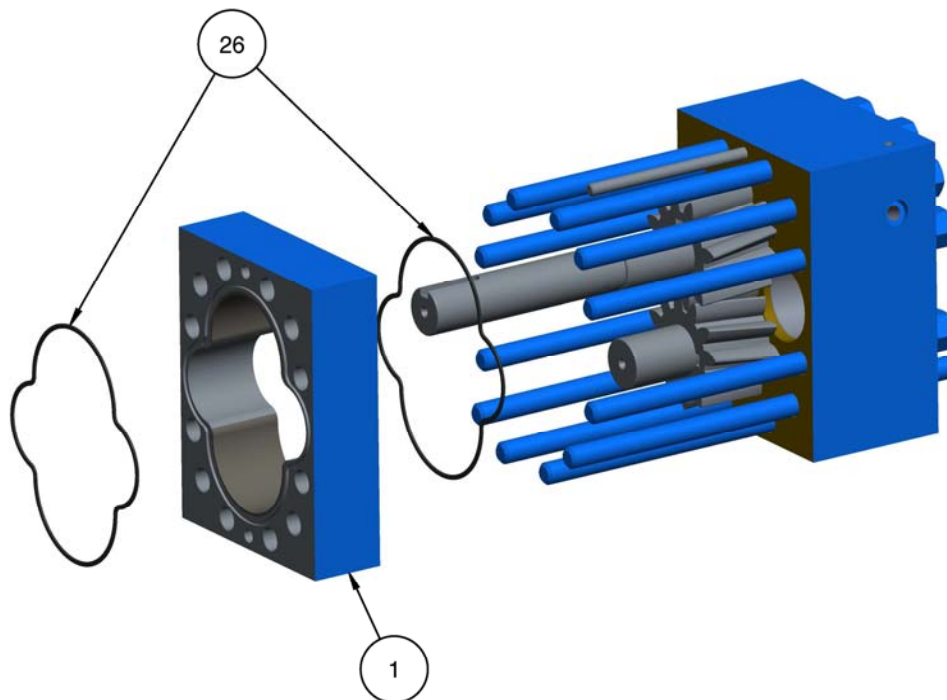
9. Remove the front Bearing Plate (10) with the Bearing Assemblies (12) from the front of the pump. Some of the bearing rollers may fall out of the Bearing Plate. This is normal. Remove the O'Rings (26) from the front and rear of the Bearing Plate.



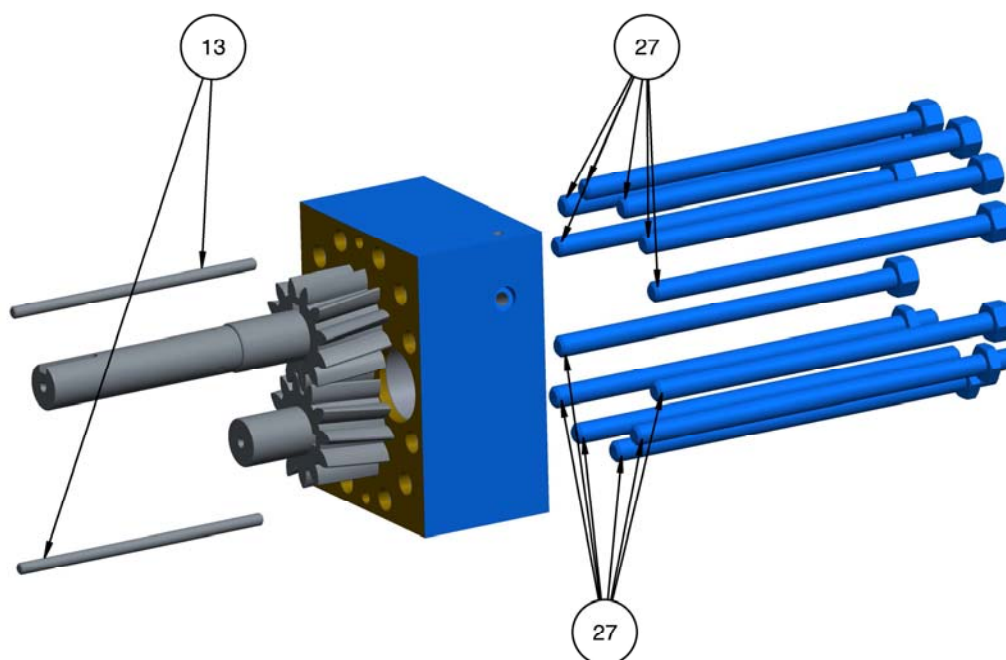
10. Slide the Front Liner Plate (6) off of the front of the pump.



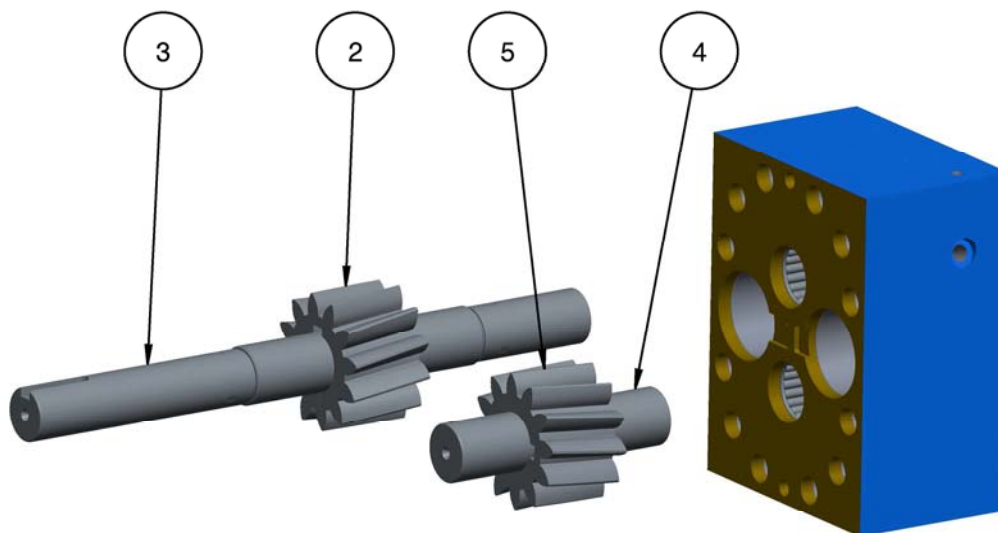
11. Remove the Cylinder (1) from the front of the pump and remove the O'Rings (26) from the front and rear of the Cylinder.



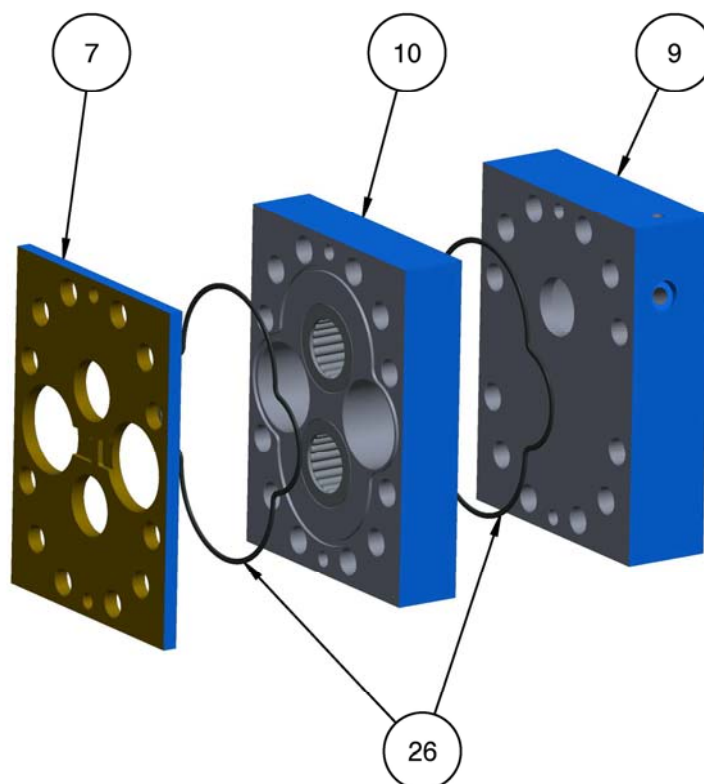
12. Remove the Pump Studs (27) from the rear of the pump, the four longer studs go in the bottom most holes. Remove the Dowel Pins (13) from the front of the pump.



13. Remove the Drive Shaft (3) with the Pump Gear (2) from the front of the pump, also remove the Driven Shaft (4) with the Pump Gear (5) from the front of the pump. The gears are press fit onto the shafts.



14. Separate the Rear Liner Plate (7) from the Bearing Plate (10) and the Seal Adapter Plate (9) removing the O'Rings (26) from between the plates. Some of the Bearing rollers may fall out of the Bearing Plate. This is normal.



Clean-up

1. Clean all parts of the pump in accordance with your specified cleaning procedures. Take all appropriate precautions to prevent damage to the parts of the pump during the cleaning process.
2. All pump parts should accept a wide variety of acceptable cleaning methods or chemicals.
3. All parts of the pump may be heated to 320°F (160 °C).
4. Clean the flat surfaces of the pump body parts by rubbing them lightly on a fine sand paper (240-320 grit) stretched or laid on a flat ground surface. Move the part in either a circular or figure eight pattern so that fine scratches are not produced across the part. Wetting the sand paper with solvent will improve the ability of the sandpaper to clean the parts.

Inspection

1. Visually inspect all parts for obvious problems- scratches on surfaces that mate with seals, cracks, upset metal that will affect how parts mate together, burrs, or other serious wear. Correct problem or replace part as necessary.
2. Inspect the shaft and bearing plates for excessive grooves or other signs of severe wear in bearing assembly and gear wear surfaces.
 - 2.1 The bearing bores must be free of major scratches and major scoring.
3. Inspect the drive shaft and gear for wear:
 - 3.1 No burrs or upset material is allowed on the surface of the drive shaft that mates with the coupling.
 - 3.2 Visually inspect the end surfaces of the gear. Major nicks, scratches, grooves, or other defects could be a sign of imminent gear failure.
 - 3.3 Visually inspect the Outside Diameter of the gear. No major nicks, scratches, grooves, or other defects are allowed.
 - 3.4 Visually inspect the gear teeth. The surfaces of the gear teeth must be smooth and free of obvious wear or damage.
4. Inspect the driven shaft and gear for wear:
 - 4.1 No burrs or upset material is allowed on the surface of the drive shaft that mates with the coupling.
 - 4.2 Visually inspect the end surfaces of the gear. Major nicks, scratches, grooves, or other defects could be a sign of imminent gear failure.

- 4.3 Visually inspect the Outside Diameter of the gear. No major nicks, scratches, grooves, or other defects are allowed.
- 4.4 Visually inspect the gear teeth. The surfaces of the gear teeth must be smooth and free of obvious wear or damage.
- 5. Inspect the cylinder for wear:
 - 5.1 Visually inspect the end surfaces of the cylinder. No nicks, burrs, or scratches are allowed on the ends of the cylinder.
 - 5.2 Visually inspect the gear bores for any sign that the gear has contacted the surface of the gear bore. No major nicks, scratches, grooves, or galling is allowed on the gear bore surface. If any of these conditions exist, check the gear outer diameter, shaft bearing diameter, and bearing bore diameter for wear and replace as necessary.
- 6. Inspect the seal adapter plate:
 - 6.1 Visually inspect the seal adapter plate for nicks, scratches, or burrs on the mating surfaces. No nicks, scratches, or burrs that will affect the mate-up of the parts at assembly or that will affect the ability of the O-ring to properly seal are allowed.
- 7. Inspect the Bearing & Seat housing:
 - 7.1 Inspect the bearing and bore. No scoring or other abnormal wear patterns are allowed. If necessary, the bearing may be pressed out of the Bearing housing and replaced by pressing in a new one.
- 8. Inspect the O-rings:
 - 8.1 Visually inspect the O-rings. No nicks, scratches, cuts, tears, or permanent deformation are allowed.
 - 8.2 Inspect the O-rings for aging. The O-rings must be firm and pliable. Replacement of O-rings is recommended whenever the pump is disassembled.

Assembly

1. Visually inspect all parts for obvious problems- scratches on surfaces that mate with seals, cracks, upset metal that will affect how parts mate together, burrs, or other serious wear. Correct problem or replace part as necessary.
2. Assembly of the pump must be done vertically starting with Seal Adapter Plate (9) clamped securely and level in a sturdy bench vise.
3. Complete disassembly procedures in reverse order.
4. Use a light coat of a stable, pure, synthetic oil on the shafts, gear, and studs to facilitate assembly.
5. Avoid touching the polished faying surfaces of the Mechanical Seal Head (16) and Seat (15).
6. Torque the Whole nuts (24) and Jam nuts (25) to not more than 180 foot-pounds.
7. Drive shaft & gear should turn freely after completion of assembly.

Trouble Shooting Guide (Standard for all 4000 series pumps)

Problem	Solution
Key will not fit into keyway in drive shaft	Check for burrs and nicks in the keyway and on the key. Remove as required. Measure width of key and keyway, if an interference fit is found, reduce the width of the key.
Motor shaft turns but pump shaft does not	Verify that the coupling has been properly installed with the correct key in each hub. Verify that the set screws are properly tightened in each coupling hub.
Pump will not prime	<p>Check for air leaks in the suction line.</p> <p>Check for correct rotation of the pump shaft -- CW when facing the shaft end of the pump.</p> <p>“Wet” the internals of the pump with the liquid to be pumped to provide a liquid hydraulic seal in the pumping chamber.</p> <p>Make sure that all suction and discharge line valves are open.</p> <p>Make sure that the suction and discharge lines are free of obstructions.</p>

Problem	Solution
Pump requires too much torque	Make sure that the viscosity of the liquid being pumped is not abnormally high. Check alignment of pump.
Pumped liquid has entrained air	Check for air leaks in suction line.
Flow rate is too low	Make sure that the viscosity of the liquid being pumped is not abnormally low. Make sure that the discharge pressure is not abnormally high. Make sure that there are no air leaks in the suction line. Verify that the rotational speed is correct. Disassemble pump and verify that the internal clearances are within specification.

Lubrication and Preventative Maintenance

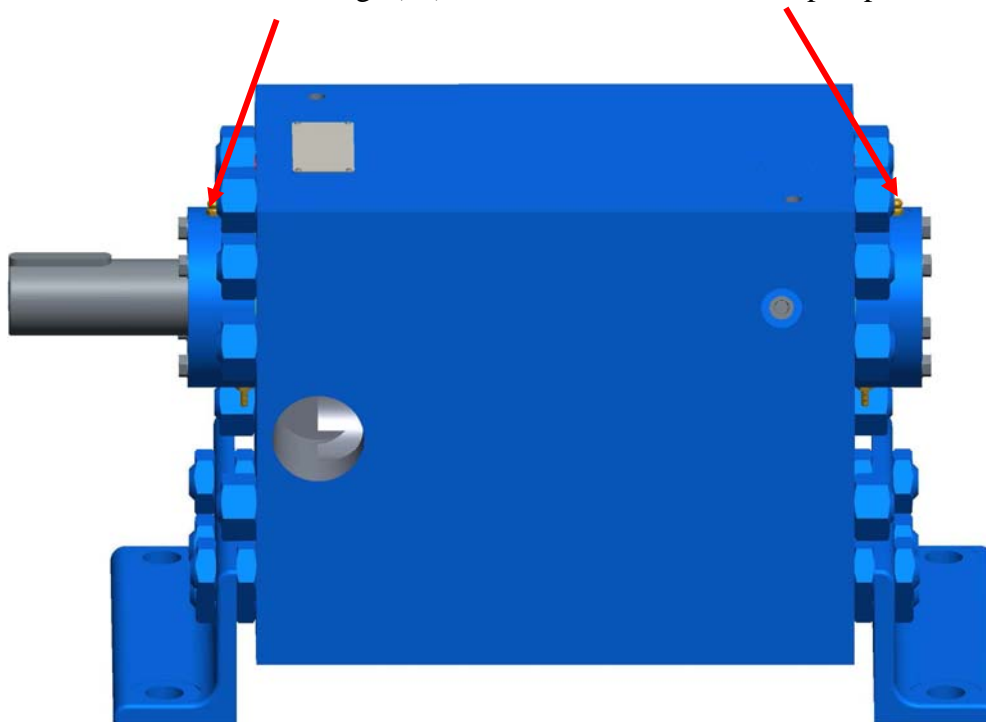
The pump is fully lubricated by the pumped liquid. **Dry running must be avoided, as it will cause internal damage to the pump.**

It is recommended that a very small amount of a liquid compatible with the liquid to be pumped be put into the pump at startup. This will lubricate the pump during the startup period and make the pump much easier to prime.

Grease Outer Support Bearings (17) located in the Bearing & Seat Housings (11) on pumps with Mobilith SHC 1500 or equivalent every 6 months or every 500 hours of operation, whichever occurs first (see image below).

There are no other maintenance requirements.

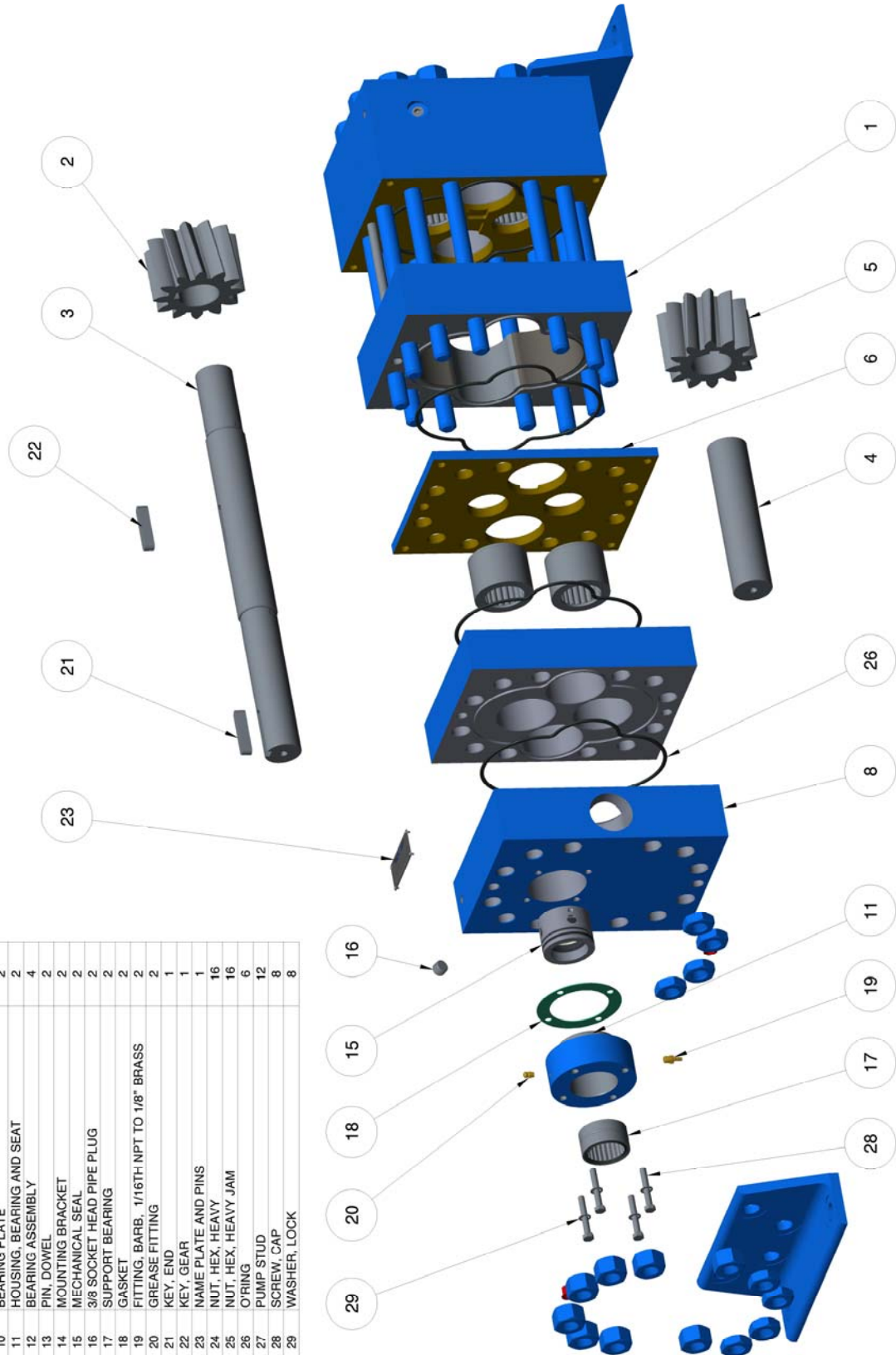
Grease Fittings (21) are located on both ends of pump

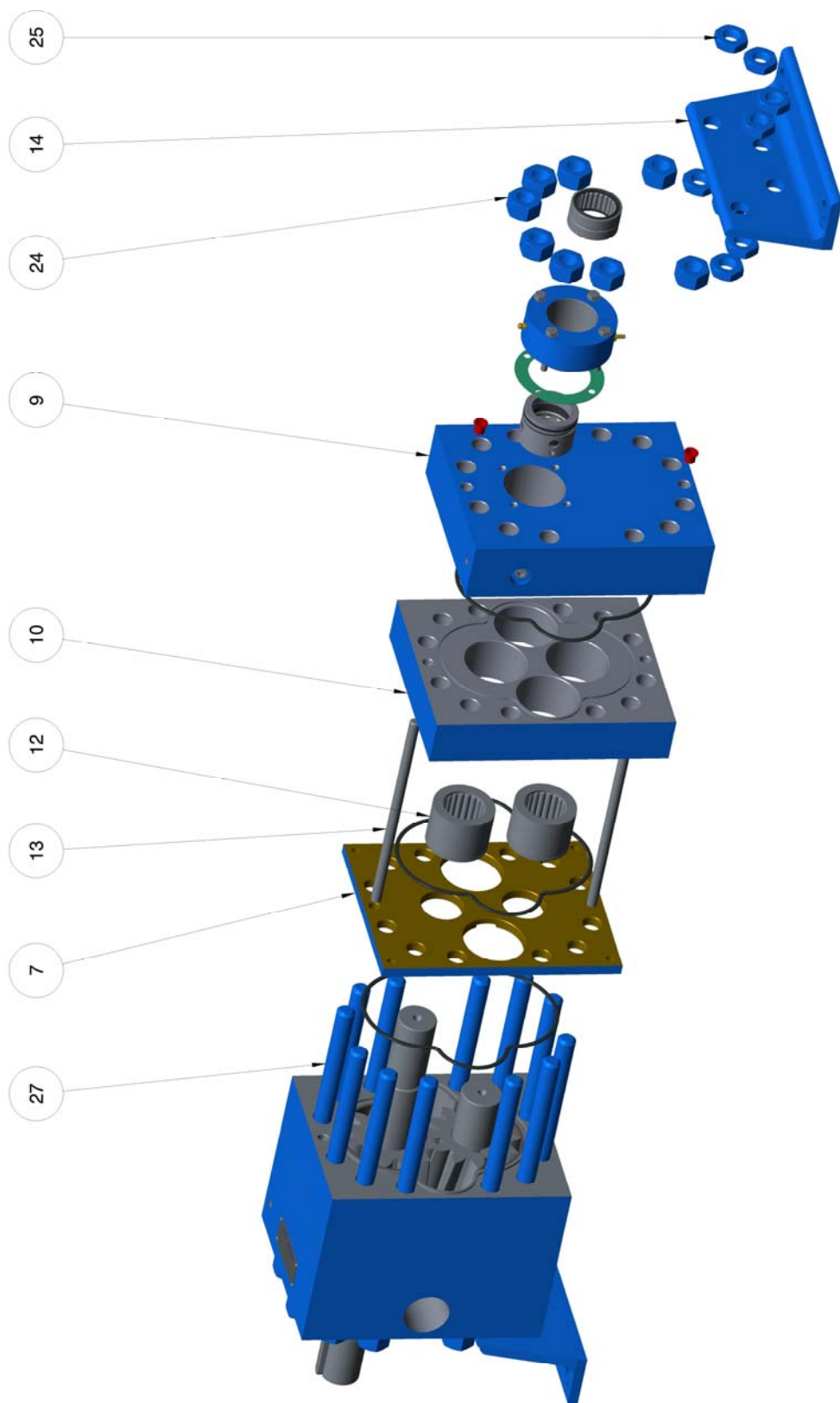


APPENDIX A

PUMP ASSEMBLY: FRONT HALF EXPLODED

PARTS LIST		
ITEM NO.	DESCRIPTION	QUANTITY
1	CYLINDER	1
2	GEAR, PUMP, HELICAL L.H.	1
3	DRIVE SHAFT	1
4	DRIVEN SHAFT	1
5	GEAR, PUMP, HELICAL R.H.	1
6	LINER PLATE, FRONT	1
7	LINER PLATE, REAR	1
8	SUCTION & DISCHARGE SEAL ADAPTER PLATE	1
9	SEAL ADAPTER PLATE	1
10	BEARING PLATE	2
11	HOUSING, BEARING AND SEAT	2
12	BEARING ASSEMBLY	4
13	PIN, DOWEL	2
14	MOUNTING BRACKET	2
15	MECHANICAL SEAL	2
16	3/8 SOCKET HEAD PIPE PLUG	2
17	SUPPORT BEARING	2
18	GASKET	2
19	FITTING, BARB, 1/16TH NPT TO 1/8" BRASS	2
20	GREASE FITTING	2
21	KEY, END	1
22	KEY, GEAR	1
23	NAME PLATE AND PINS	1
24	NUT, HEX, HEAVY	16
25	NUT, HEX, HEAVY JAM	16
26	O'RING	6
27	PUMP STUD	12
28	SCREW, CAP	8
29	WASHER, LOCK	8





PUMP ASSEMBLY: REAR HALF EXPLODED

APPENDIX B

PARTS LIST		
ITEM NO.	DESCRIPTION	QUANTITY
1	UNIT BASE	1
2	MOTOR, ELECTRIC	1
3	PUMP ASSEMBLY	1
4	GUARD, COUPLING	1
5	COUPLING COVER	1
6	COUPLING HUB	2
7	COUPLING INSERT	1
8	EYEBOLT	4

