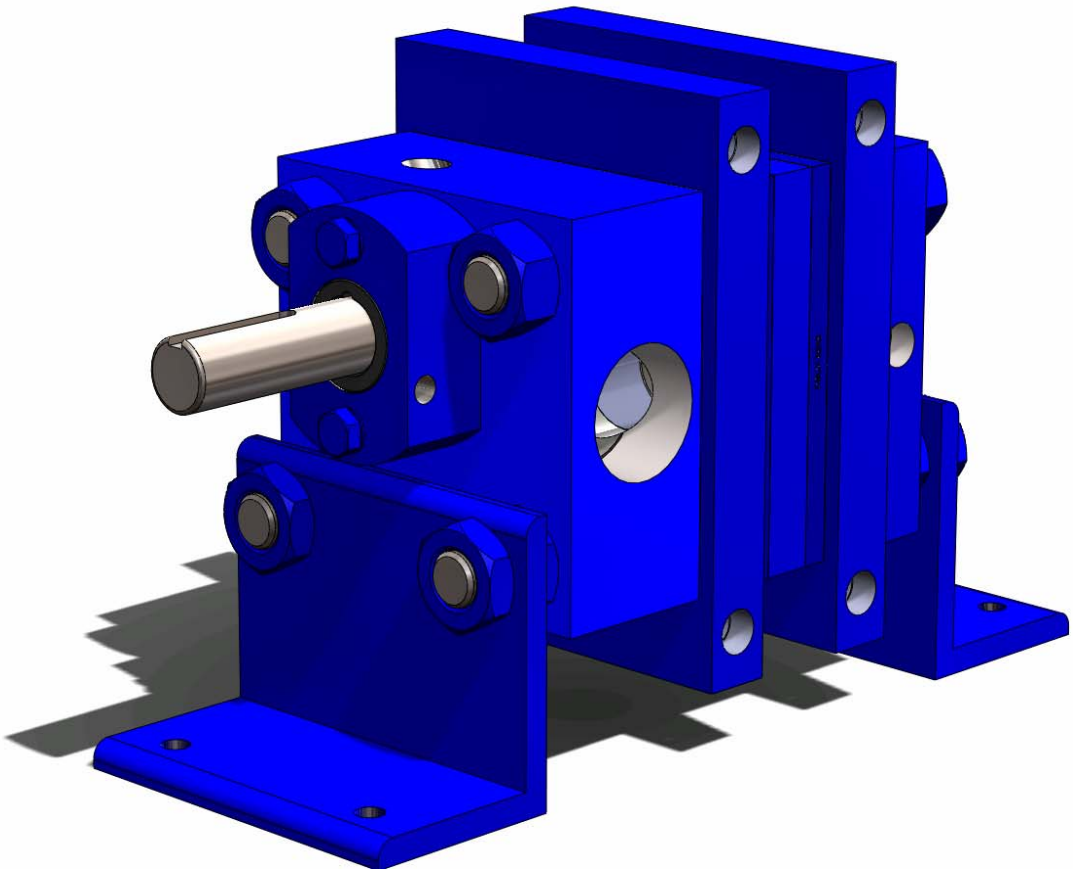
Operation & Maintenance Manual

Northern® 4000 Series Sulfur Pumps



340 West Benson Avenue
Grantsburg, WI 54840
1-800-366-1410
www.northern-pump.com

Table of Contents

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. Turn off and lock out the drive mechanism.

2. Fully depressurize both the suction and discharge lines to the pump, as well as hot water / steam heating connections.

3. Close the valve in the suction and discharge lines closest to the pump.

4. Close the hot water or steam heating connection valves.

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 disconnected from the pump.

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 sulfur residue from the drive shaft. Remove any burrs or upset metal from the surface of the drive shaft.

6. If you intend to disassemble the pump, remove the 2 Jam nuts *(10)* (4 total) that hold the Mounting brackets *(23)*.

7. Proceed to pump disassembly instructions.

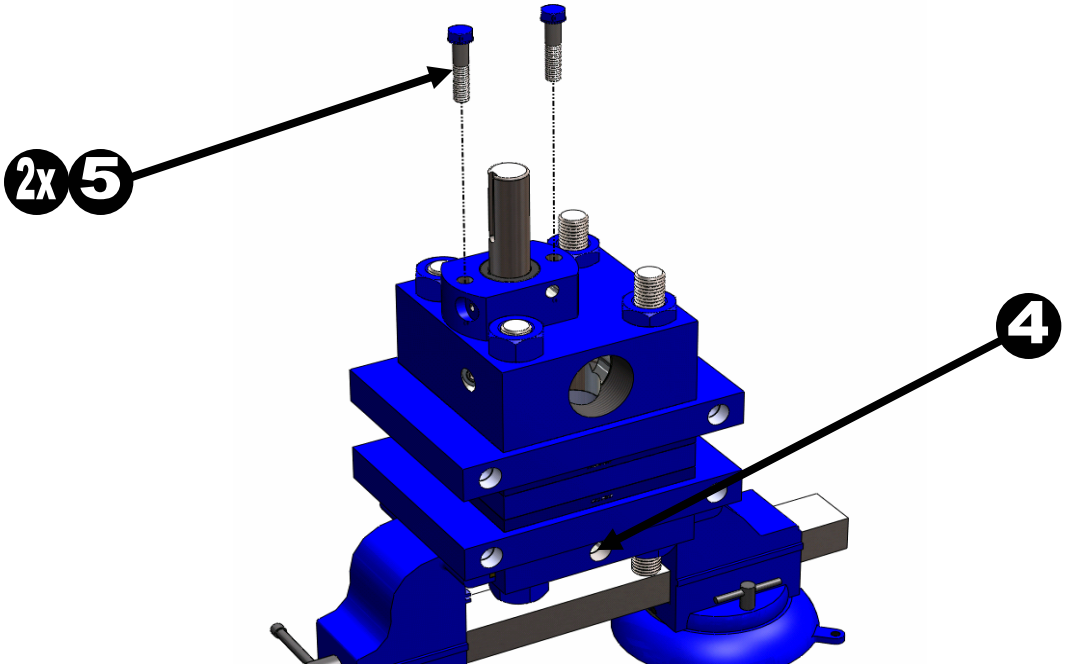
Disassembly

The pump body is a series of plates held together with four (4) studs which are a dowel fit in the plates. These studs provide the alignment of the pump body and are precision parts. The faying surfaces of the plates are ground flat and sealed with O-ring. The solidified sulfur in the pump will make the pump difficult to disassemble. 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.

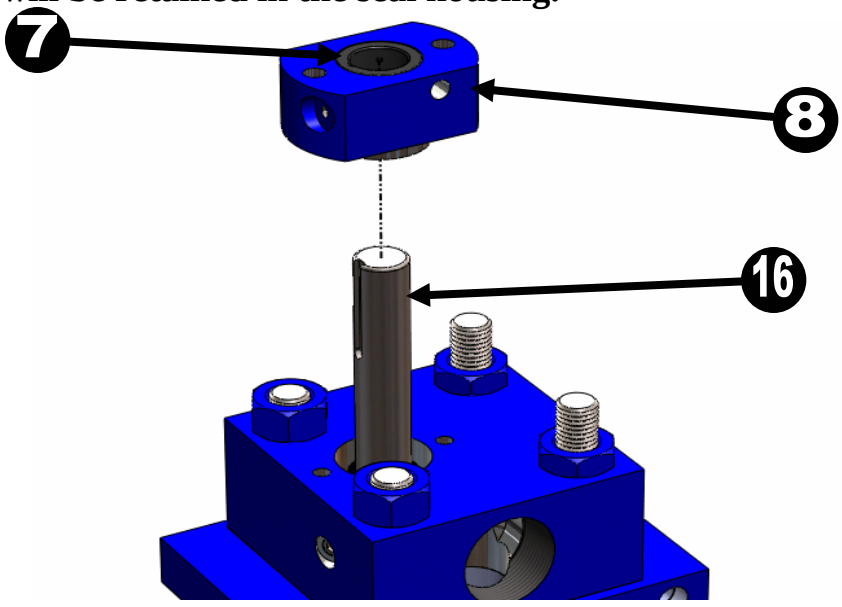
Before disassembly, mark the pump housing so that you will know how the parts were arranged before the pump was taken apart. A scribe line or permanent marker line along one edge and a diagonal form corner to corner works quite will.

Pump Disassembly Steps

Step 1 **Place Pump in vise so that the vise clamps on the end plate only. The drive shaft should point upward. Then remove the two cap screws *(5)*.**

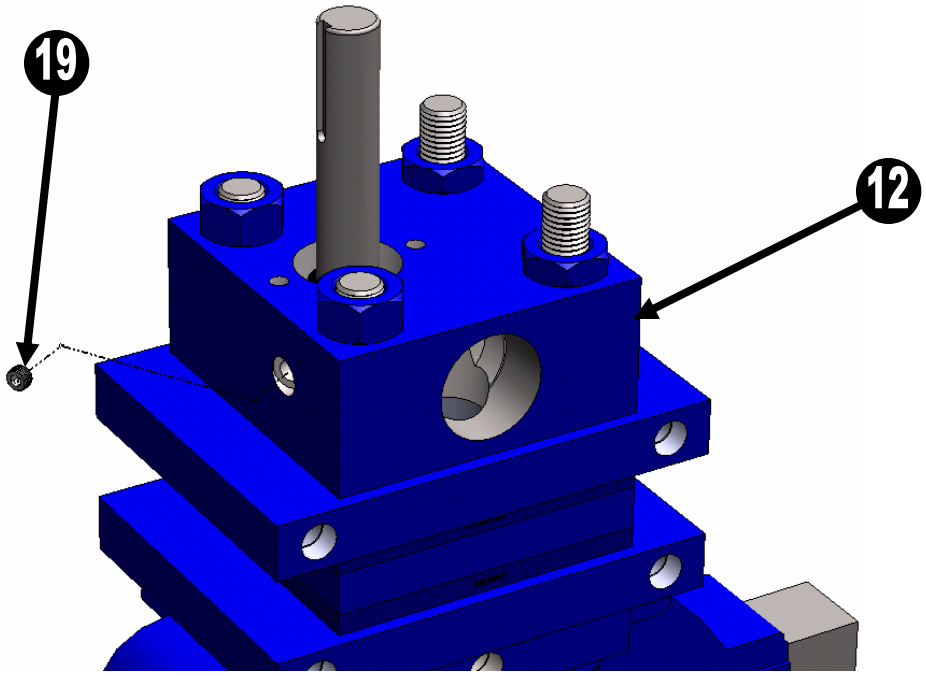


Step 2 **Remove the Bearing & Seat housing *(8)* by sliding it up and over the drive shaft *(16)*. The sleeve bearing *(7)* and mating ring of the mechanical seal *(20B)* will be retained in the seal housing.**



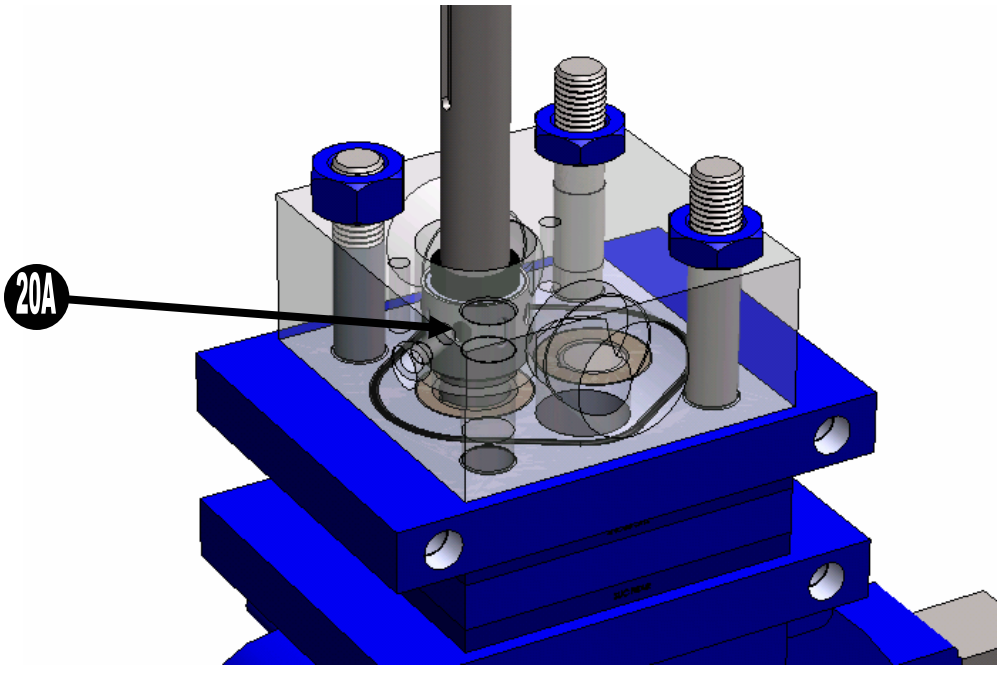
Step 3

Remove the Pipe plug *(19)* that is located in the Seal Adapter plate *(12)*.



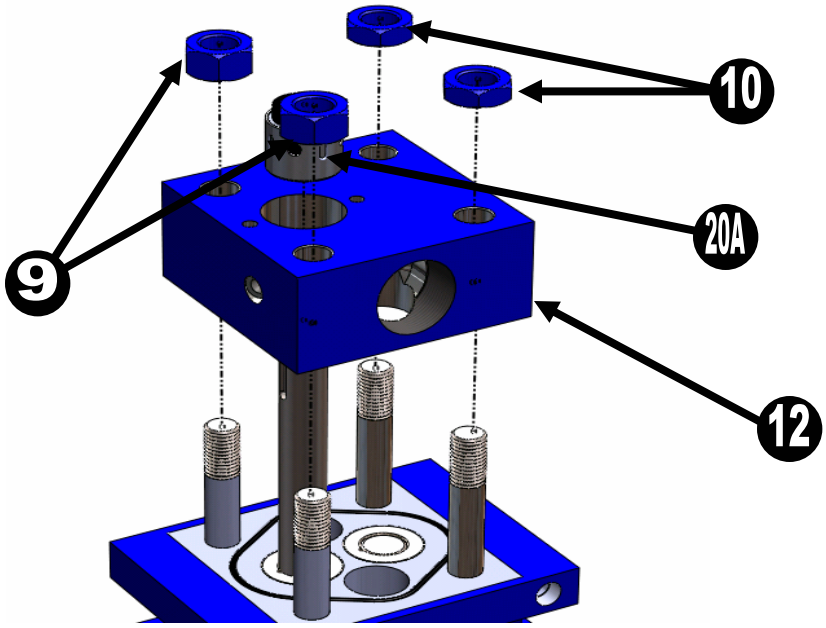
Step 4

Using an Allen wrench, loosen the 4 set screws which retain the Mechanical seal *(20A)*. To access the set screws, rotate the shaft until a set screw is visible through the hole from which you removed the pipe plug *(19)*.



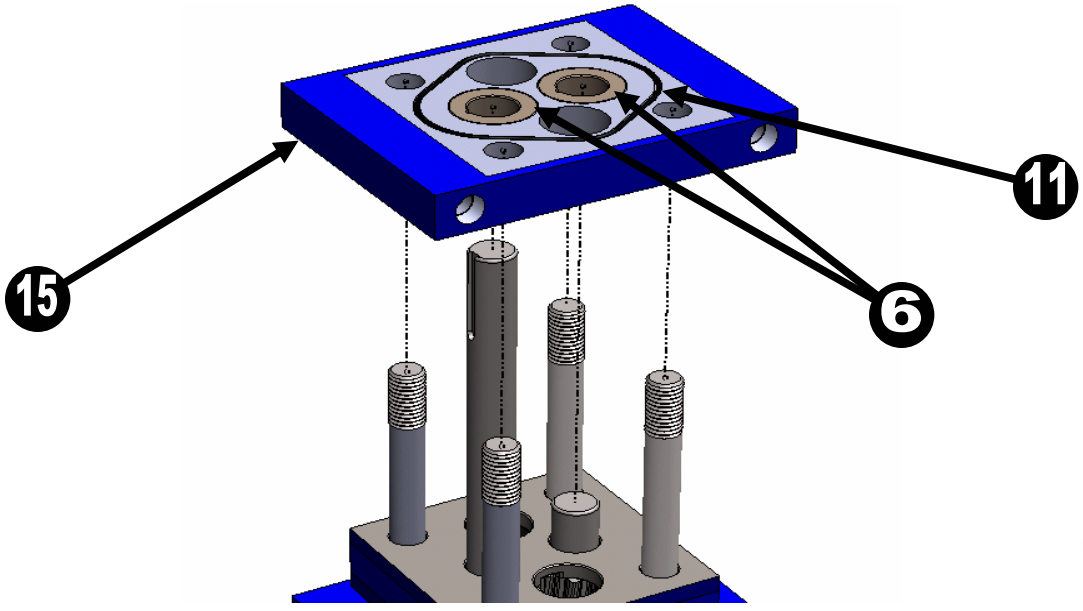
Step 5

Loosen and remove the 2 Whole nuts *(9)* and 2 Jam nuts *(10)*. Then remove the Seal Adapter plate *(12)* and Mechanical seal *(20A)* by lifting them up and over the drive shaft *(16)*.



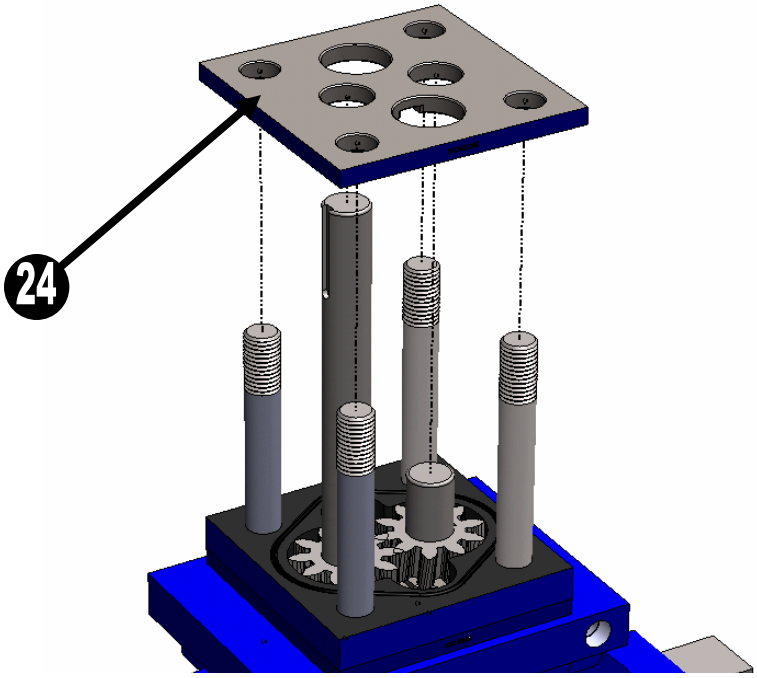
Step 6

Remove the front Bearing plate *(15)*, bearings *(6)* and two O-rings *(11)* from the assembly by lifting them up and over the drive shaft. The O-Ring on the underside of the Bearing plate may or may nor remain in the O-Ring Groove. If it is not retained, remove it at this point.



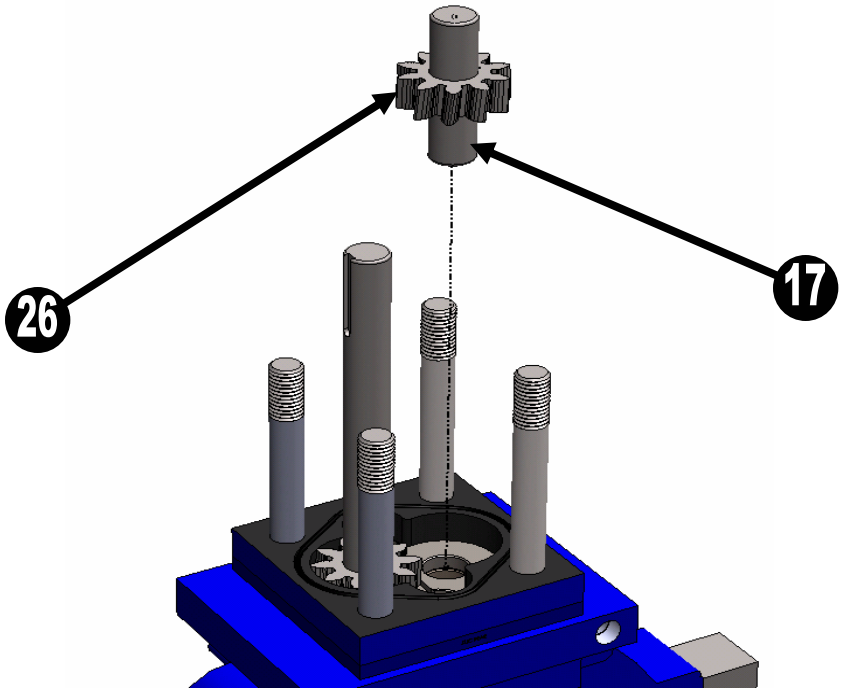
Step 7

Remove the front Liner plate *(24)* from the assembly by lifting it up and over the drive shaft. Note the orientation



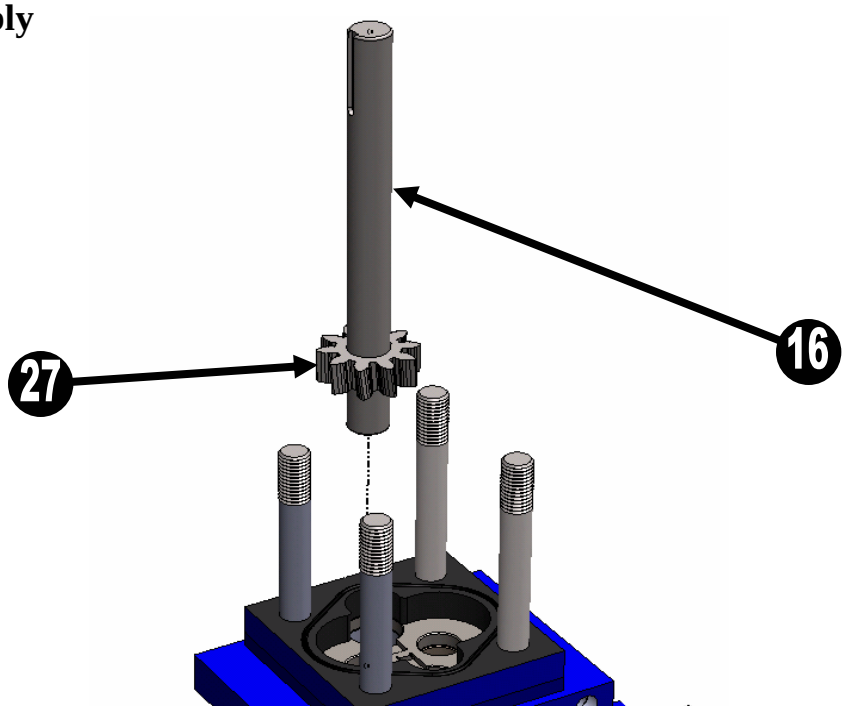
Step 8

Remove the driven gear *(26)* and driven shaft *(17)*. They are pressed together as one assembly



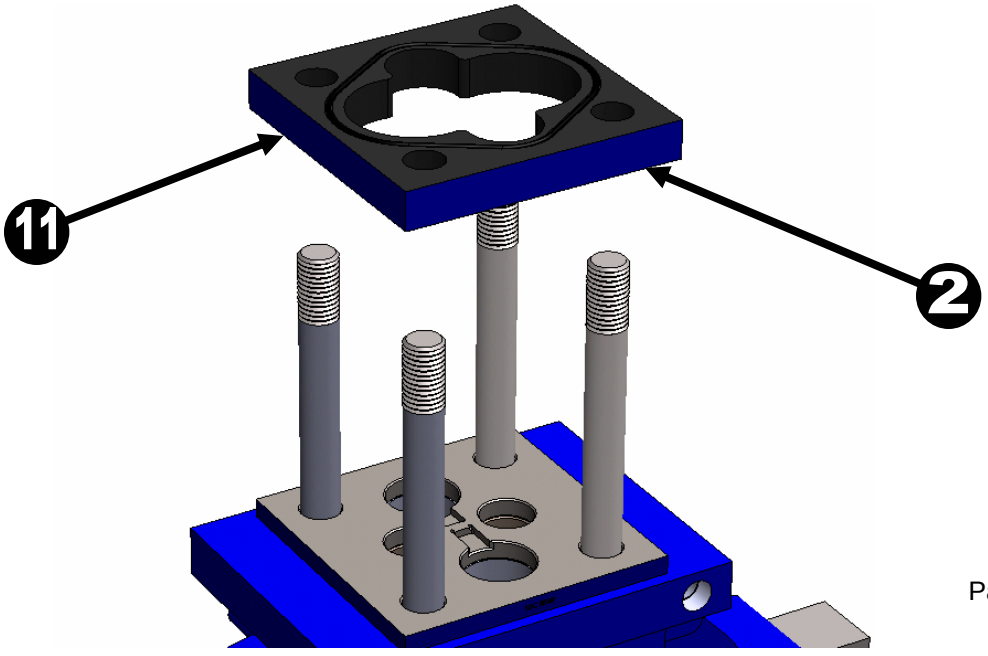
Step 9

Remove the drive gear and drive shaft. They are pressed together as one assembly



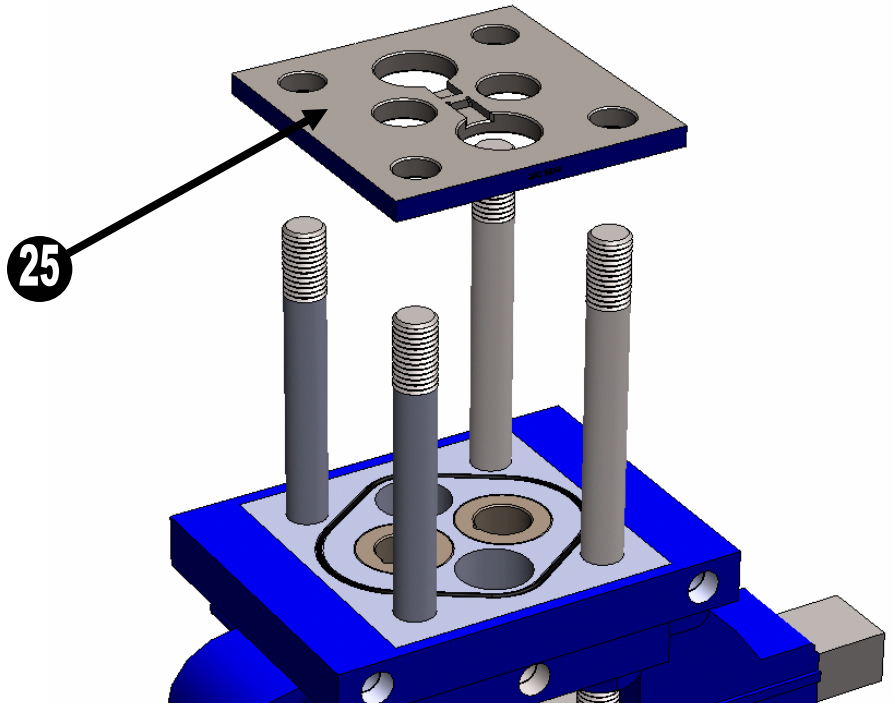
Step 10

Remove the Pump Cylinder *(2)* and O-Rings *(11)*. The O-Ring on the underside of the Cylinder may or may nor remain in the O-Ring Groove. If it is not retained, remove it at this point.



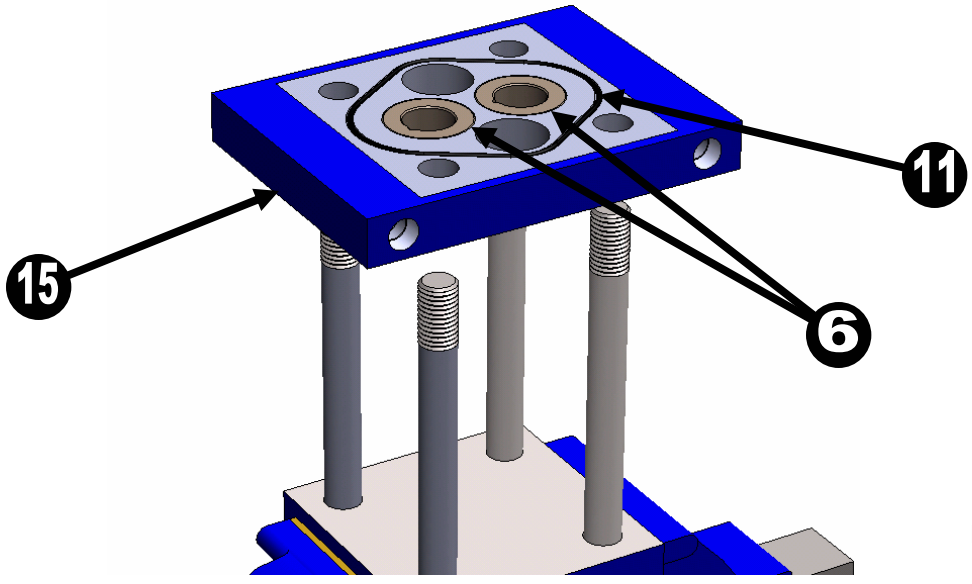
Step 11

Remove the rear liner plate *(25)* from the assembly. Note orientation.



Step 12

Remove the bearing plate *(15)*, bearings *(6)* and O-rings *(11)*. The O-Ring on the underside of the Bearing plate may or may nor remain in the O-Ring Groove. If it is not retained, remove it at this point. Remove the studs if you have not already. Disassembly is now complete.



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 160 ºC (320ºF).

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 bores and gear wear surfaces.

   2.1 The bearing bores must be free of major scratches and major scoring.

   2.2 The lubrication groove must be clean.

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 carbon graphite 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. Replace if necessary.

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. Complete disassembly procedures in reverse order.

3. 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	Check for air leaks in the suction line. Check for correct rotation of the pump shaft -- CW when facing the shaft end of the pump. "Wet" the internals of the pump with the liquid to be pumped to provide a liquid hydraulic seal in the pumping chamber. Make sure that all suction and discharge line valves are open. Make sure that the suction and discharge lines are free of obstructions.

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.

There is no preventative maintenance routine to follow for this pump as there are no manual adjustments or other actions required for normal operation.