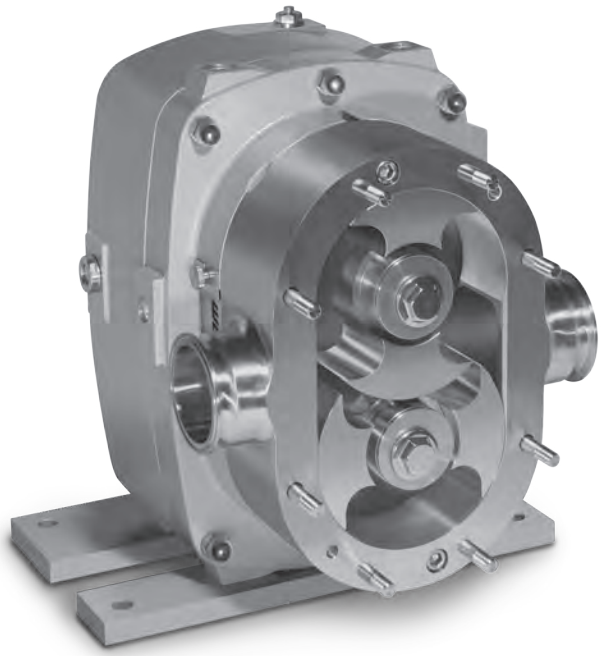
Fristam PUMPS®

Engineered For Lasting Performance®

Instruction and Maintenance Manual

FKL Positive Displacement Pump Models 15–400 (split-style gearbox)



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ANAB ACCREDITED

DESCRIPTION

This manual contains installation, operation and repair instructions for the Fristam FKL Series balanced circular piston pump.

The FKL pump is a positive displacement pump characterized by its balanced rotor design. The rotors travel through a precisely machined, close clearance channel in the housing and cover allowing the product to be pumped very efficiently.

The FKL series pump features a unique balanced rotor design with heavy-duty shafts allowing the pump to maintain its efficiency at differential pressures up to 500 psi. The pump also features rotors made from “non-galling” stainless steel, which allows the pump to continue to run even under extreme conditions.

The FKL series pump is ideal for pumping products that are shear sensitive, have a high viscosity and/or contain large particulate. The FKL series pump excels in applications with high differential pressure and/or low inlet pressures and its high efficiency, low slip performance makes it an excellent pump for metering applications for consistent flow control.

The FKL series pump is available with any connection type desired and may be mounted with the inlet/outlet connections in a horizontal or vertical orientation. The pump should be coupled to a motor/drive assembly properly specified to give the desired performance for the required application.

CAUTION: BEGIN ALL PUMP MAINTENANCE OPERATIONS BY DISCONNECTING THE ENERGY SOURCE TO THE PUMP. OBSERVE ALL LOCK OUT/TAG OUT PROCEDURES AS OUTLINED BY ANSI Z244.1-1982 AND OSHA 1910.147 TO PREVENT ACCIDENTAL START-UP AND INJURY.

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TECHNICAL INFORMATION

SPECIFICATIONS

Normal Differential Pressure Range ..... 0 to 200 PSI (models 15–20)
..... 0 to 300 PSI (model 25)
..... 0 to 500 PSI (models 50–400)
Normal Speed Range ..... 0 to 1000 RPM (model 15)
..... 0 to 800 RPM (model 20)
..... 0 to 600 RPM (models 25–400)
Normal Temperature Differential (Standard Rotors) ..... Δ140°F
Normal Temperature Differential (High Temperature Rotors) ..... Δ210°F

MATERIALS OF CONSTRUCTION

Major Product Contact Components ..... AISI 316L (CF3M)
Rotors ..... Non-galling Stainless Steel
Cover Gasket ..... BUNA (standard)
Also available in ..... Viton, EPDM and other options available
Surface Finish for Product Contact Surfaces ..... 32 Ra (standard)
Also available in ..... 25 Ra, 20 Ra, and 15 Ra
Cover Gasket and Other O-rings on Aseptic ..... EPDM

SHAFT SEALS & O-RINGS

Mechanical Seal Type ..... Single/Double
Stationary Seal Ring Material ..... Carbon (standard)
Also available in ..... Silicon Carbide & Chrome oxide/SS
Rotating Seal Ring Material ..... Chrome Oxide/SS
Also available in ..... Silicon Carbide
Other O-rings (mechanical seals) ..... Viton (standard)
Also available in ..... EPDM and other options available
O-ring Seal Type ..... Single/Double
O-ring Seal Material ..... Viton (standard)
Also available in ..... EPDM and other available upon request

LUBRICATION

Oil Grade* ..... SAE 15W40
..... **Note: food grade lubricants available*
Oil Capacity (horizontal or vertical mount)
FKL 15–20 ..... 0.5 liters (0.5 US quart)
FKL 25 ..... 0.7 liters (0.75 US quart)
FKL 50 ..... 0.9 liters (1 US quart)
FKL 75 ..... 3.8 liters (4 US quarts)
FKL 150 ..... 4.7 liters (5 US quarts)
FKL 205 ..... 4.7 liters (5 US quarts)
FKL 250 ..... 5.7 liters (6 US quarts)
FKL 400 ..... 8 liters (8.4 US quarts)

WOODS SURE-FLEX COUPLING ALIGNMENT

TABLE A1: Woods Sure-Flex Coupling Alignment						
Sleeve Size	Type E			Type H		
	Parallel A	Angular Y max. - Y min.	Y*	Parallel A	Angular Y max. - Y min.	Y*
5	.015	.056	1.938	-	-	-
6	.015	.070	2.375	.010	.016	2.375
7	.020	.081	2.563	.012	.020	2.563
8	.020	.094	2.938	.015	.025	2.938
9	.025	.109	3.500	.017	.028	3.500
10	.025	.128	4.063	.202	.032	4.063
11	.032	.151	4.875	.022	.037	4.875
12	.032	.175	5.688	.025	.042	5.688
13	.040	.195	6.688	.030	.050	6.688
14	.045	.242	7.750	.035	.060	7.750
Dimensions are in inches. *The “Y” dimension is shown for reference.						

RECOMMENDED TORQUE VALUES

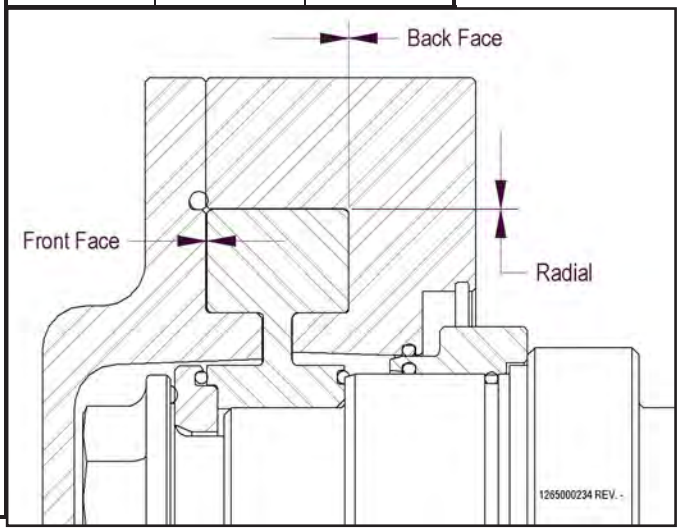
FKL Recommended Torque Values									
Part	**FKL 15**	**FKL 20**	**FKL 25**	**FKL 50**	**FKL 75**	**FKL 150**	**FKL 205**	**FKL 250**	**FKL 400**
Cover Nut	65 IN-LB (7.3 N-m)		15 ft-lb (20.3 N-m)	45 ft-lb (61 N-m)					
Rotor Bolt	25 ft-lb (34 N-m)					50 ft-lb (68 N-m)	65 ft-lb (88 N-m)		
Bearing Cap Screw	45 IN-LB (5 N-m)		5 ft-lb (6.8 N-m)	15 ft-lb (20.3 N-m)			25 ft-lb (34 N-m)		
Bearing Lock Nut	50 ft-lb (68 N-m)								
Mounting Strap Screw	10 ft-lb (13.5 N-m)				70 ft-lb (95 N-m)				80 ft-lb (108 N-m)
Seal Housing Screw	N/A		2.5 ft-lb (3.4 N-m)						10 ft-lb (13.6 N-m)
Housing Screw	45 IN-LB (5 N-m)		10 ft-lb (13.5 N-m)		45 ft-lb (61 N-m)				
Gearbox Nut	65 IN-LB (7.3 N-m)		15 ft-lb (20.3 N-m)	25 ft-lb (34 N-m)	45 ft-lb (61 N-m)		110 ft-lb (149 N-m)		

ROTOR CLEARANCES

Dimensions are in millimeters (inches).

Model	Rotor Material: Non-Galling Stainless Steel			Rotor Material: 316L & 17-4 Stainless Steel, Hastelloy, AL6XN		
	Rotor Clearances: Standard			Rotor Clearances: Standard		
	Back Face	Front Face	Radial	Back Face	Front Face	Radial
15	0.06 - 0.08 (0.0025" - 0.0030")	0.07 - 0.17 (0.0030" - 0.0065")	0.05 - 0.09 (0.0020" - 0.0035")	0.13 - 0.17 (0.0050" - 0.0065")	0.13 - 0.25 (0.0050" - 0.0100")	0.11 - 0.15 (0.0045" - 0.0060")
20	0.06 - 0.08 (0.0025" - 0.0030")	0.07 - 0.17 (0.0030" - 0.0065")	0.05 - 0.09 (0.0020" - 0.0035")	0.13 - 0.17 (0.0050" - 0.0065")	0.13 - 0.25 (0.0050" - 0.0100")	0.11 - 0.15 (0.0045" - 0.0060")
25	0.06 - 0.08 (0.0025" - 0.0030")	0.07 - 0.17 (0.0030" - 0.0065")	0.05 - 0.09 (0.0020" - 0.0035")	0.13 - 0.17 (0.0050" - 0.0065")	0.13 - 0.25 (0.0050" - 0.0100")	0.11 - 0.15 (0.0045" - 0.0060")
50	0.07 - 0.11 (0.0030" - 0.0045")	0.08 - 0.20 (0.0030" - 0.0080")	0.05 - 0.11 (0.0020" - 0.0045")	0.14 - 0.20 (0.0055" - 0.0080")	0.15 - 0.29 (0.0060" - 0.0115")	0.12 - 0.17 (0.0045" - 0.0065")
75	0.08 - 0.12 (0.0030" - 0.0045")	0.10 - 0.22 (0.0040" - 0.0085")	0.07 - 0.13 (0.0030" - 0.0050")	0.15 - 0.21 (0.0060" - 0.0085")	0.18 - 0.32 (0.0070" - 0.0125")	0.15 - 0.20 (0.0060" - 0.0080")
150	0.08 - 0.12 (0.0030" - 0.0045")	0.13 - 0.25 (0.0050" - 0.0100")	0.08 - 0.14 (0.0030" - 0.0055")	0.15 - 0.21 (0.0060" - 0.0085")	0.23 - 0.37 (0.0090" - 0.0145")	0.16 - 0.21 (0.0065" - 0.0085")
205	0.09 - 0.13 (0.0035" - 0.0050")	0.16 - 0.28 (0.0065" - 0.0110")	0.11 - 0.17 (0.0045" - 0.0065")	0.16 - 0.22 (0.0065" - 0.0085")	0.28 - 0.42 (0.0110" - 0.0165")	0.20 - 0.27 (0.0080" - 0.0105")
250	0.09 - 0.13 (0.0035" - 0.0050")	0.16 - 0.28 (0.0065" - 0.0110")	0.11 - 0.17 (0.0045" - 0.0065")	0.16 - 0.22 (0.0065" - 0.0085")	0.28 - 0.42 (0.0110" - 0.0165")	0.20 - 0.27 (0.0080" - 0.0105")
400	0.10 - 0.14 (0.0040" - 0.0055")	0.16 - 0.30 (0.0065" - 0.0120")	0.12 - 0.18 (0.0045" - 0.0070")	0.17 - 0.23 (0.0065" - 0.0090")	0.30 - 0.45 (0.0120" - 0.0175")	0.23 - 0.29 (0.0090" - 0.0115")
580/600	0.11 - 0.16 (0.0045" - 0.0065")	0.17 - 0.32 (0.0065" - 0.0125")	0.14 - 0.19 (0.0055" - 0.0075")	0.21 - 0.26 (0.0083" - 0.0102")	0.47 - 0.61 (0.0185" - 0.0240")	0.39 - 0.44 (0.0153" - 0.0173")
	Rotor Clearances: High Temperature			Rotor Clearances: High Temperature		
	Back Face	Front Face	Radial	Back Face	Front Face	Radial
15	0.11 - 0.14 (0.0045" - 0.0055")	0.11 - 0.23 (0.0045" - 0.0090")	0.08 - 0.12 (0.0030" - 0.0045")	0.18 - 0.22 (0.0070" - 0.0085")	0.18 - 0.30 (0.0070" - 0.0120")	0.15 - 0.19 (0.0060" - 0.0075")
20	0.11 - 0.14 (0.0045" - 0.0055")	0.11 - 0.23 (0.0045" - 0.0090")	0.08 - 0.12 (0.0030" - 0.0045")	0.18 - 0.22 (0.0070" - 0.0085")	0.18 - 0.30 (0.0070" - 0.0120")	0.15 - 0.19 (0.0060" - 0.0075")
25	0.11 - 0.14 (0.0045" - 0.0055")	0.11 - 0.23 (0.0045" - 0.0090")	0.08 - 0.12 (0.0030" - 0.0045")	0.18 - 0.22 (0.0070" - 0.0085")	0.18 - 0.30 (0.0070" - 0.0120")	0.15 - 0.19 (0.0060" - 0.0075")
50	0.12 - 0.17 (0.0045" - 0.0065")	0.13 - 0.27 (0.0050" - 0.0105")	0.09 - 0.15 (0.0035" - 0.0060")	0.19 - 0.25 (0.0075" - 0.0100")	0.21 - 0.34 (0.0085" - 0.0135")	0.15 - 0.20 (0.0060" - 0.0080")
75	0.13 - 0.18 (0.0050" - 0.0070")	0.16 - 0.30 (0.0065" - 0.0120")	0.12 - 0.18 (0.0045" - 0.0070")	0.20 - 0.26 (0.0080" - 0.0100")	0.25 - 0.39 (0.0100" - 0.0155")	0.20 - 0.25 (0.0080" - 0.0100")
150	0.13 - 0.18 (0.0050" - 0.0070")	0.21 - 0.35 (0.0085" - 0.0140")	0.13 - 0.19 (0.0050" - 0.0075")	0.20 - 0.26 (0.0080" - 0.0100")	0.32 - 0.46 (0.0125" - 0.0180")	0.21 - 0.26 (0.0085" - 0.0100")
205	0.14 - 0.19 (0.0055" - 0.0075")	0.26 - 0.40 (0.0100" - 0.0155")	0.18 - 0.24 (0.0070" - 0.0095")	0.21 - 0.27 (0.0085" - 0.0105")	0.38 - 0.51 (0.0150" - 0.0200")	0.25 - 0.31 (0.0100" - 0.0120")
250	0.14 - 0.19 (0.0055" - 0.0075")	0.26 - 0.40 (0.0100" - 0.0155")	0.18 - 0.24 (0.0070" - 0.0095")	0.21 - 0.27 (0.0085" - 0.0105")	0.38 - 0.51 (0.0150" - 0.0200")	0.25 - 0.31 (0.0100" - 0.0120")
400	0.15 - 0.20 (0.0060" - 0.0080")	0.27 - 0.43 (0.0105" - 0.0170")	0.20 - 0.26 (0.0080" - 0.0100")	0.22 - 0.28 (0.0085" - 0.0110")	0.40 - 0.55 (0.0155" - 0.0215")	0.27 - 0.33 (0.0105" - 0.0130")
580/600	0.17 - 0.23 (0.0065" - 0.0090")	0.30 - 0.44 (0.0120" - 0.0175")	0.22 - 0.28 (0.0085" - 0.0110")	TBD	TBD	TBD
	Rotor Clearances: Chocolate*					
	Back Face	Front Face	Radial			
15	0.26 - 0.38 (0.0100" - 0.0150")	0.21 - 0.49 (0.0085" - 0.0195")	0.22 - 0.30 (0.0085" - 0.0120")			
20	0.26 - 0.38 (0.0100" - 0.0150")	0.21 - 0.49 (0.0085" - 0.0195")	0.22 - 0.30 (0.0085" - 0.0120")			
25	0.26 - 0.38 (0.0100" - 0.0150")	0.21 - 0.49 (0.0085" - 0.0195")	0.22 - 0.30 (0.0085" - 0.0120")			
50	0.27 - 0.41 (0.0105" - 0.0160")	0.22 - 0.52 (0.0085" - 0.0205")	0.25 - 0.33 (0.0100" - 0.0130")			
75	0.28 - 0.42 (0.0110" - 0.0165")	0.23 - 0.53 (0.0090" - 0.0210")	0.28 - 0.36 (0.0110" - 0.0140")			
150	0.28 - 0.42 (0.0110" - 0.0165")	0.23 - 0.53 (0.0090" - 0.0210")	0.29 - 0.37 (0.0115" - 0.0145")			
205	0.29 - 0.43 (0.0115" - 0.0170")	0.27 - 0.57 (0.0105" - 0.0225")	0.37 - 0.46 (0.0145" - 0.0180")			
250	0.29 - 0.43 (0.0115" - 0.0170")	0.27 - 0.57 (0.0105" - 0.0225")	0.37 - 0.46 (0.0145" - 0.0180")			
400	0.30 - 0.44 (0.0120" - 0.0175")	0.30 - 0.62 (0.0120" - 0.0245")	0.44 - 0.53 (0.0175" - 0.0210")			
580/600	TBD	TBD	TBD			

*Chocolate rotor clearances apply to all rotor materials.



INSTALLATION

UNPACKING

Check the contents and all wrapping when unpacking the pump. Inspect the pump carefully for any damage that may have occurred during shipping. Immediately report any damage to the carrier. Keep the protective caps over the pump inlet and outlet in place until you are ready to install the pump.

INSTALLING

Prior to actually installing the pump, ensure that:

- The pump will be readily accessible for maintenance, inspection and cleaning.
- Adequate ventilation is provided for motor cooling.
- The drive and motor type is suitable for the environment where it is to be operated. Pumps intended for use in hazardous environments e.g., explosive, corrosive, etc., must use a motor and drive with the appropriate enclosure characteristics. Failure to use an appropriate motor type may result in serious damage and/or injury.
- When switching the pump mounting to vertical, the sight glass and vent cap will need to be switched.

PIPING

CAUTION: Because the FKL pump is a highly efficient positive displacement pump, the user needs to ensure that the pump will not be over-pressurized during operation as this can cause severe damage to the pump. (Over-pressurization can occur if a valve is closed on the discharge of the pump and the pump continues to run beyond its maximum pressure rating.) The pump warranty is void for damage caused by over-pressurization. The pressure can be determined by putting a pressure gauge at the discharge side of the pump.

Follow good piping practices when installing your FKL series pump:

- Slope inlet piping up to pump to avoid air pockets (support all piping independently to minimize the forces exerted on the pump) (figure 1).
- Ensure that the piping can accommodate thermal expansion without stressing the pump.
- Slope inlet piping up to pump to avoid air pockets (figure 2).

FIGURE 1

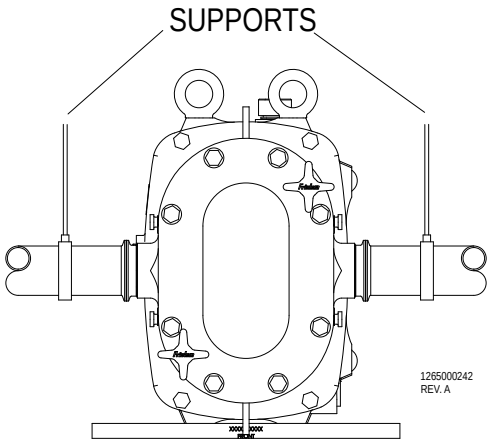
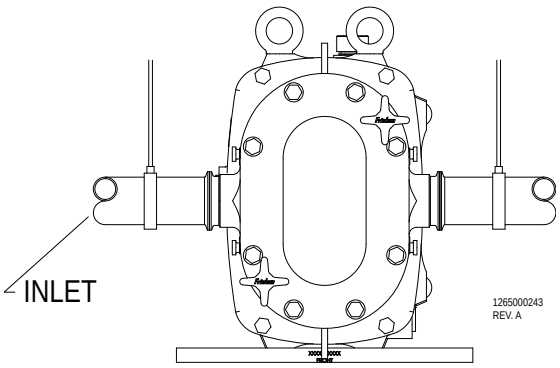


FIGURE 2



- Avoid sump areas where sediment may collect (figure 3).
- Use a check or “foot” valve on the inlet side of the pump in lift applications to keep the suction piping flooded.
- Avoid throttling valves in the suction piping.
- Keep suction lines as short and direct as possible.
- Avoid abrupt transitions in the piping systems (figure 4).
- Avoid the formation of air pockets in the piping (figure 5).
- Ensure that the NPSH available in the system is greater than NPSH required by the pump.
- Avoid abrupt closure of shut-off valves, this may cause hydraulic shock which can cause severe damage to the pump and system.
- Avoid elbows in the suction line if possible. When necessary they should be located 5 pipe diameters away from the pump inlet and have a bend radius greater then 2 pipe diameters (figure 6).
- Install a relief valve on the discharge side of the pump with a bypass loop back to the suction side to ensure that the pump cannot be over-pressurized.

FIGURE 3

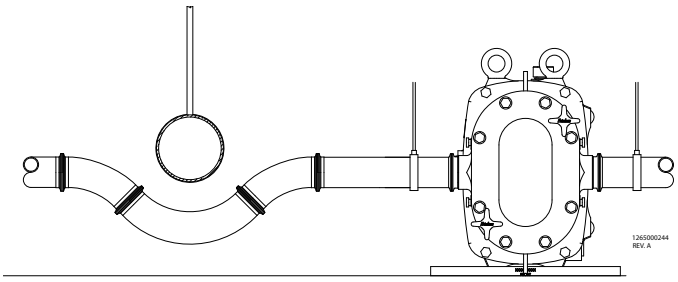


FIGURE 4

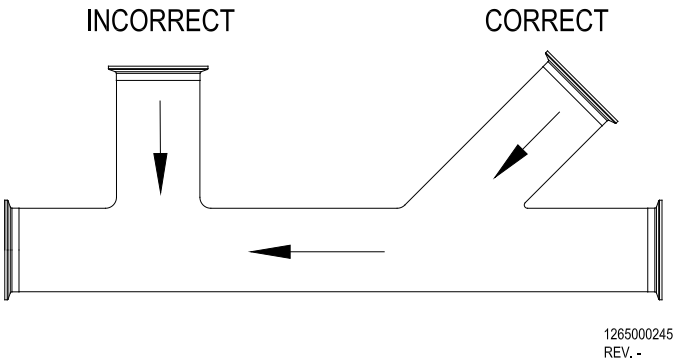


FIGURE 5

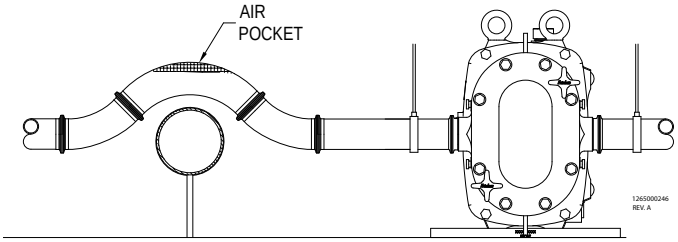
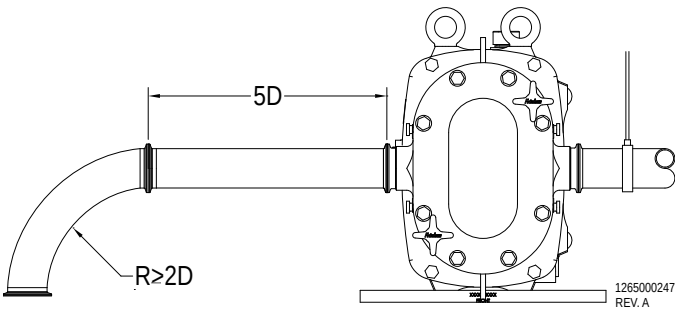


FIGURE 6



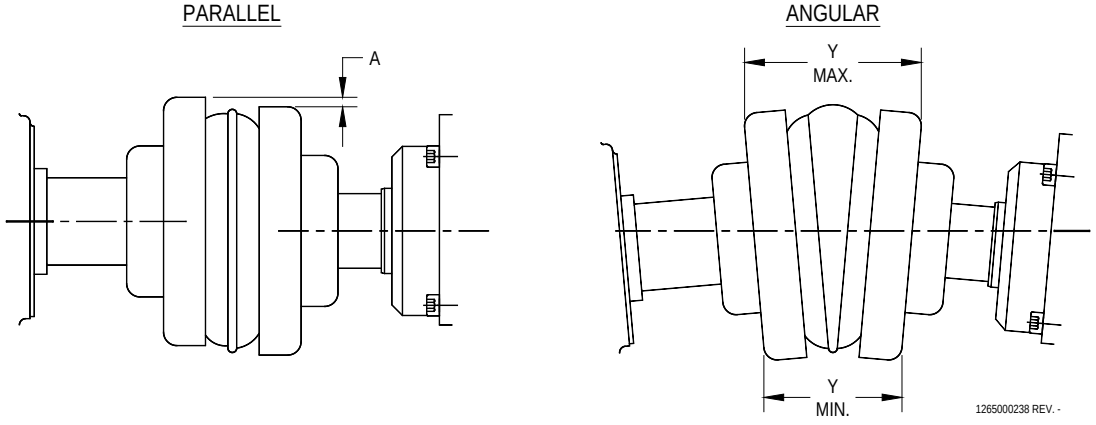
ALIGNMENT

In most cases, the pump will be shipped with a drive unit mounted on a baseplate. The drive and pump are aligned at the factory; however, this alignment should be checked after installation (Figure 7). Misalignment between the pump and drive can result in premature bearing failure or other damage. If the pump is not shipped with a drive unit, use a flexible coupling between the pump and drive unit. Align the pump and drive unit according to the coupling requirements.

To check the alignment:

- Remove the wire ring from the coupling sleeve and let it hang between the sleeve and one of the flanges.
- To check the parallel alignment place a straight edge across the two coupling flanges and measure the maximum offset at various points around the periphery of the coupling without rotating the coupling. If the maximum offset ("A") exceeds the figure shown under "Parallel" in the table below, realign the shafts.
- Check the angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other ("Y") at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions without rotating the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in the table below. If a correction is necessary, be sure to recheck the parallel alignment.
- Reinstall the wire ring on the O.D. of the coupling sleeve.

FIGURE 7



WOODS SURE-FLEX COUPLING ALIGNMENT

See Table A1 (page 5).

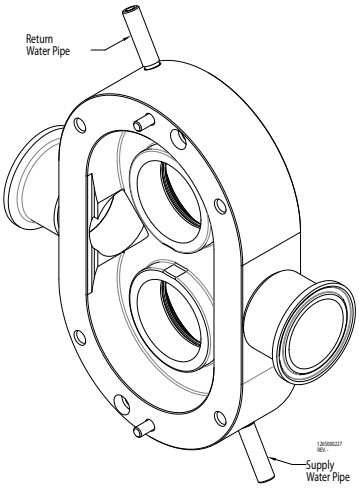
ELECTRICAL CONNECTIONS

Have an electrician connect the drive motor using sound electrical practices. Ensure that proper motor overload protection is provided. The size of the drive selected should meet the requirements of the operating conditions. A change in conditions (for example, higher viscosity product, higher product specific gravity) can overload the motor. For technical assistance regarding operating condition changes, please contact Fristam Pumps. Make sure that the pump is rotating in the correct direction.

WATER FLUSH CONNECTIONS

If your pump is equipped with a double mechanical or double o-ring product seal, water must be supplied to provide cooling and lubrication (Figure 8). Connect supply and return lines to the water pipes supplied with the product seal on your pump.

FIGURE 8

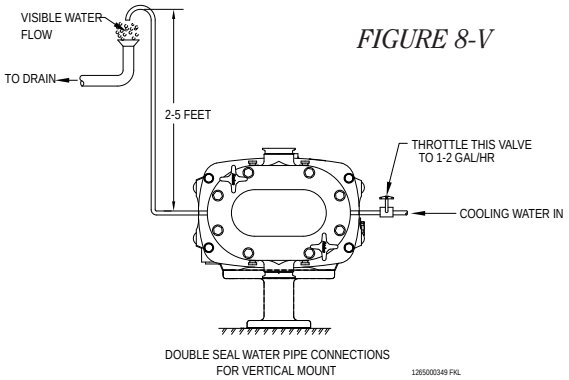


Note: Water should flow from bottom to top and steam should travel top to bottom. Use about 3-12 gallons per hour of water at 1-2 psi. Excessive seal pressure and/or flow rate through the product seal cavity may cause increased seal wear and shorten seal life.

Vertical Mount (Figure 8-V): Pipe the exit side of the water flush with 2-5 feet physical height of tubing. This ensures that some water is always in the center seal and the seal never runs dry.

It is desirable to have the flush water on the outlet side visible. This allows an easy check to see that the flush water is on and also if the seal is functioning properly. In a malfunctioning seal the flush water will disappear, become discolored, or show an unusual increase in flow. If these conditions exist, check the seal and replace if necessary.

FIGURE 8-V



START-UP CHECK-LIST

- Make sure that the pump and piping system are clear of any foreign matter. Do not use the pump to flush the system.
- Make sure that the pump and drive are properly lubricated (page 4). See instructions from the manufacturer for the drive.
- Check to make sure that all guards are in place and secure.
- Check for proper pump and drive rotation (Figures 9 & 10). Make sure that the pump is flooded with product when checking the rotation. Running the pump dry even momentarily can cause seal damage.
- Check that all valves on the discharge side are open to prevent over-pressurizing the pump.
- Place an in-line screen before the pump inlet to ensure no foreign objects run through the pump and alter critical clearances.

FIGURE 9

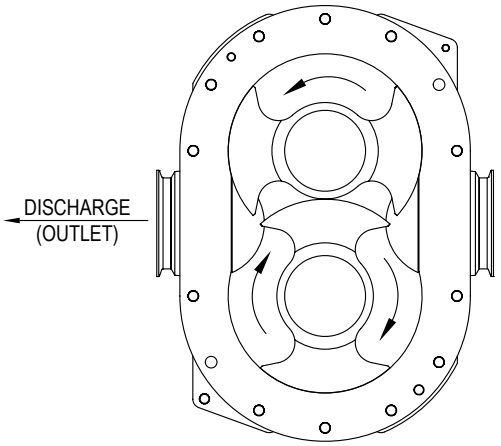
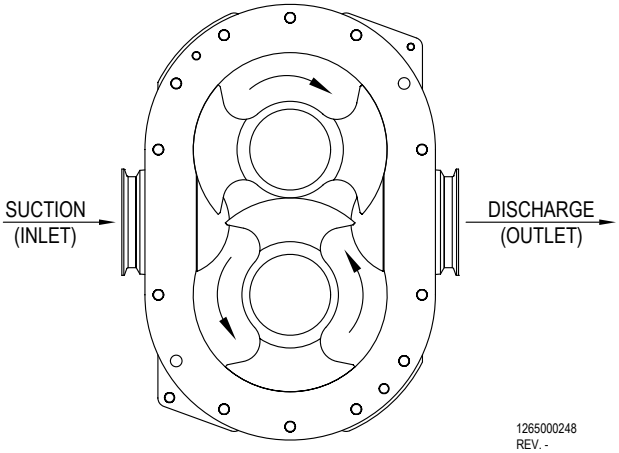


FIGURE 10



RECOMMENDED PREVENTIVE MAINTENANCE

RECOMMENDED SEAL MAINTENANCE

Visually inspect mechanical seal daily for leakage.
Replace mechanical seal annually under normal duty.
Replace mechanical seal as often as required under heavy duty.
When replacing ANY seal part, it is important to replace ALL seal wear parts.

ELASTOMER INSPECTION

Inspect all elastomers (o-rings and gaskets) when performing pump maintenance. We recommend replacing elastomers during seal, pump shaft and/or motor replacement or sooner depending on the application.

If the rotor bolt o-ring, rotor washer o-ring, or rotor o-ring fails, the threaded hole on the end of the shaft and the rotor bolt threads will need to be cleaned. We recommend removing the rotors and rotor bolts/washers while the pump is being CIP'd. This will ensure that the internal threads are cleaned before production resumes. We recommend cleaning the external threads on the rotor bolt with a wire brush.

LUBRICATION

The bearings and gears are lubricated with 15W40 oil. *Note: food grade lubricants are available.* The oil level should be maintained in the center of the sight glass on the side of the gearbox housing. The oil should be changed every 4,000 hours under normal conditions and every 2,000 hours under severe conditions such as washdown applications.
See the oil capacity listing on page 4.

PERIODIC MAINTENANCE

Periodically inspect the pump housing, cover and rotors for any signs of wear or damage. If wear is present this could be a sign of over-pressurization, incorrect rotor gap or bearing wear.

TEMPERATURE DIFFERENTIALS

Positive pump efficiency depends on internal clearances between the rotors and the pump housing. The pump can withstand certain temperature changes based on the rotors. For example, if you are running CIP solution at 180°F and your product is 50°F, that is a 130°F temperature differential. This differential is in the standard rotor range.

The temperature differential is a concern, because if there is a severe temperature change in the pump, the shaft and rotors may expand inside the pump housing. This expansion can result in rotor to cover or rotor to housing damage.

The clearances inside the FKL pump are extremely small, below are the recommended temperature differentials. Fristam recommends high temperature rotors for pumps that will be cleaned or steamed at elevated temperatures.

FKL Temperature Differential	Correct Rotor
Δ 140°F	standard rotors
Δ 210°F	high temperature rotors

CLEANING RECOMMENDATIONS

The FKL pump is designed for CIP (clean-in place) cleaning. It is not necessary to disassemble the pump for cleaning in most applications.

Temperature

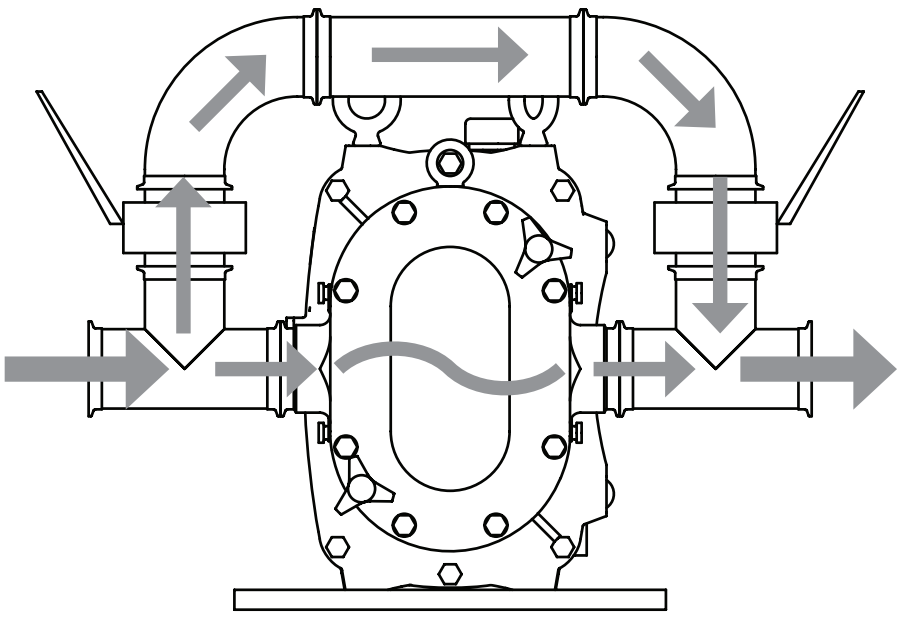
Note that the FKL pump has tight clearances between the rotors and the housing which attributes to its high efficiency. When you are running products or cleaning solutions with different temperatures, allow enough time for all of the wetted components inside the pump to reach a steady-state temperature before running the pump.

If your process does not allow you to stop the pump during this transition, you should install rotors that provide larger clearances.

Flow Rate

To ensure that you have the proper flow rate to clean the entire circuit and adequate turbulence inside the FKL pump, Fristam strongly recommends using a separate CIP supply pump and a bypass loop around the FKL (see illustration).

PARTIAL BYPASS LOOP



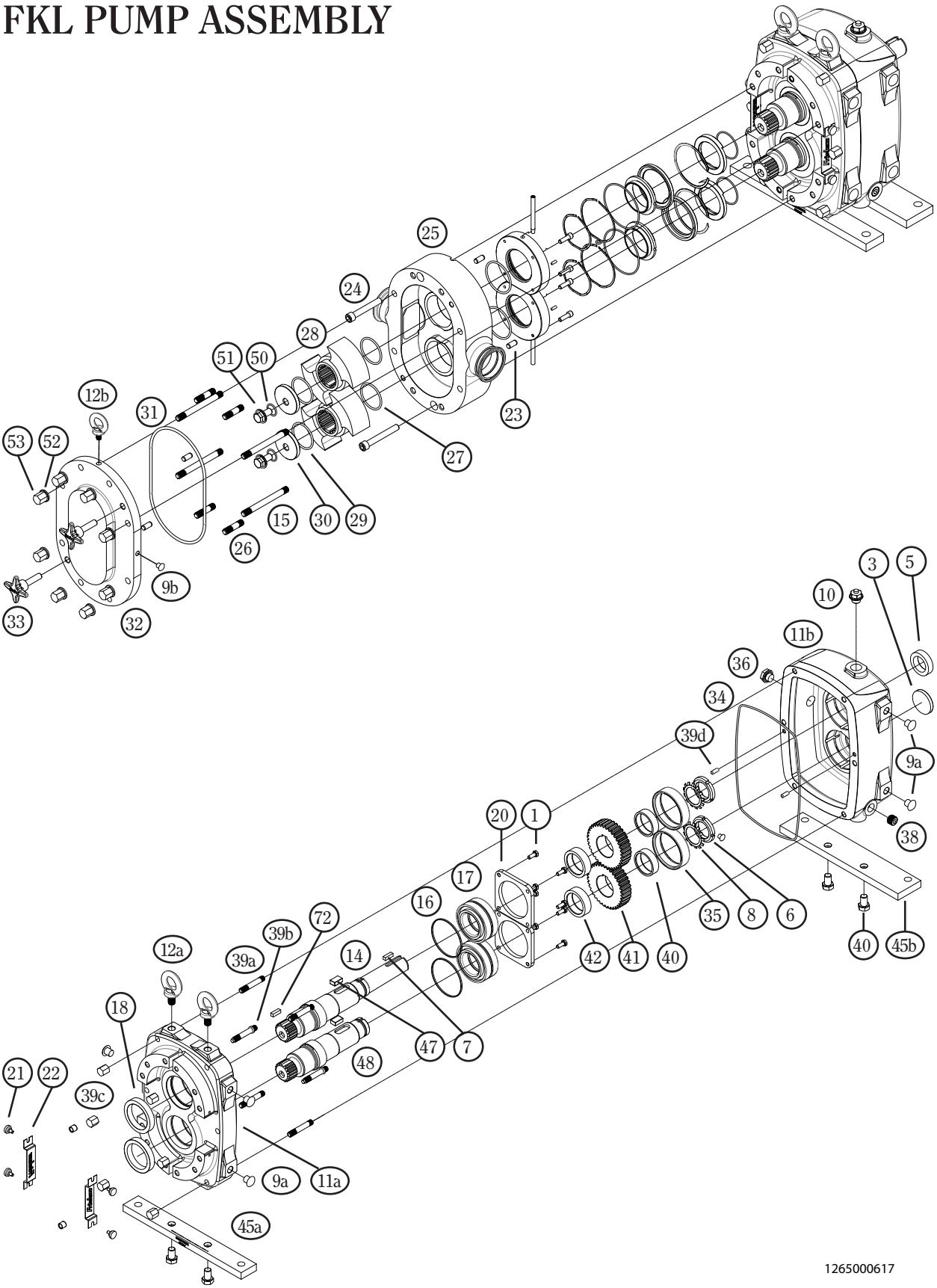
Pump Speed

During CIP, the FKL should operate at approximately 100 RPM. A slower rotation promotes turbulence and cleaning.

Differential Pressure

For less viscous products, differential pressure within the pump (inlet to outlet) should be at least 10 PSI to promote the resonance time of CIP solution in the pump. For higher product viscosity, the required differential pressure may need to be increased to 30-50 PSI.

FKL PUMP ASSEMBLY

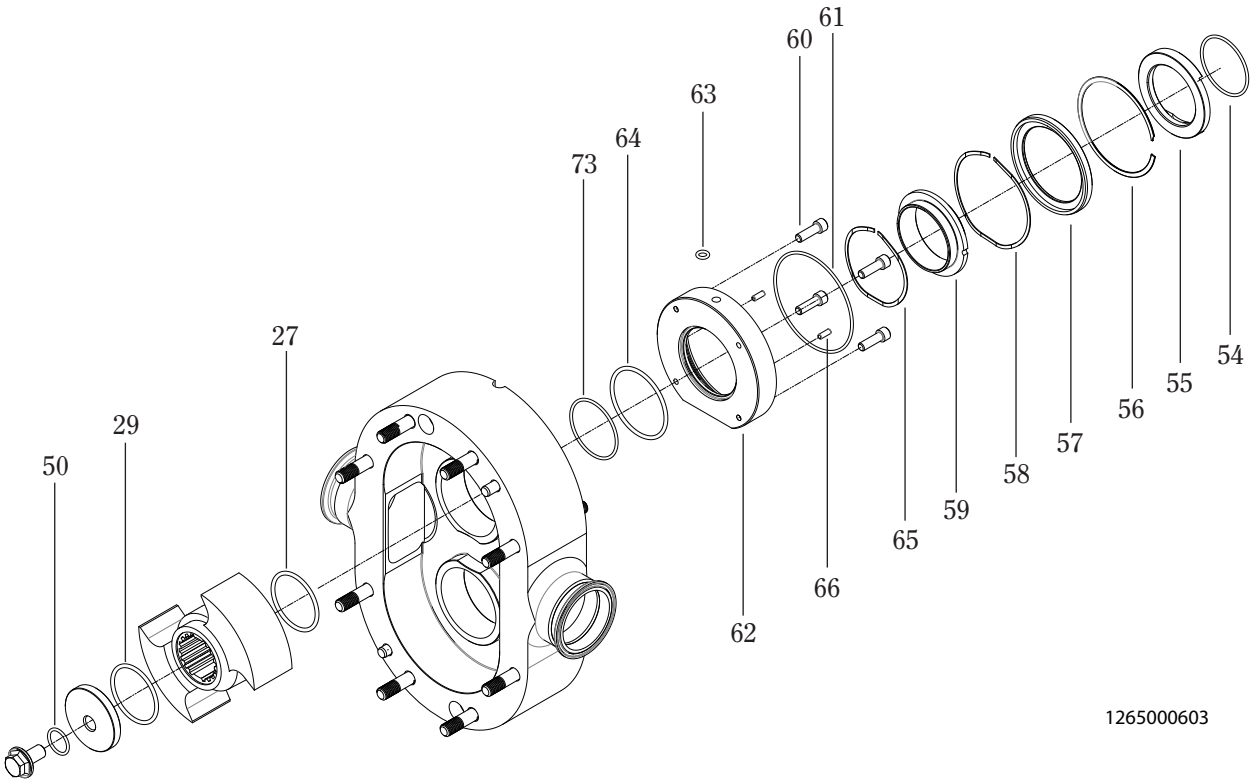


PARTS LIST

Item	Description	Qty	15	20	25	50	75	150	205	250	400
1	Bearing cover bolt	8*	1101000208	1101000208	1101000255	1101000239	1101000239	1101000239	1101000256 (*10)	1101000256 (*10)	1101000256 (*12)
3	Shaft hole plug	1	1812000063	1812000063	1812000065	1812000062	1812000064	1812000061	1812000067	1812000066	1812000068
5	Rear oil seal	1	1812000059	1812000059	1812000055	1812000058	1812000051	1812000048	1812000056	1812000046	1812000047
6	Bearing lock nut	2	1306000083	1306000083	1306000006	1306000112	1306000002	1306000005	1306000004	1306000004	1306000007
7	Coupling key	1	1315000039	1315000039	1315000013	1315000011	1315000026	1315000026	1315000042	1315000025	1315000028
8	Bearing lock nut washer	2	1104000069	1104000069	1104000019	1104001051	1104000021	1104000018	1104000017	1104000017	1104000020
9a	Gearbox hole plug (mild steel)	5*	1101000250 (*6)	1101000250 (*6)	1101000251	1101000251	1101000253	1101000253	1101000253	1101000253	1101000254
	Gearbox hole plug (stainless steel)		1101000131 (*6)	1101000131 (*6)	1101000252	1101000252	1101000206	1101000206	1101000206	1101000206	1101000266
9b	Cover hole plug	1	N/A	N/A	N/A	N/A	N/A	N/A	1101000252	1101000252	1101000252
10	Vent plug	1	1248000023	1248000023	1248000023	1248000013	1248000013	1248000013	1248000013	1248000013	1248000013
11a	Front gearbox (cast iron)	1	1310600200	1310600200	1310600204	1310600189	1310600197	1310600185	1310600220	1310600213	1310600252
	Front gearbox (stainless steel)		1310600194	1310600194	1310600203	1310600188	1310600196	1310600183	1310600219	1310600212	1310600251
11b	Rear gearbox (cast iron)	1	1310600201	1310600201	1310600206	1310600191	1310600199	1310600186	1310600222	1310600215	1310600254
	Rear gearbox (stainless steel)		1310600193	1310600193	1310600205	1310600190	1310600198	1310600184	1310600221	1310600214	1310600253
12a	Gearbox Eyebolt (mild steel)	2	N/A	N/A	1101000072	1101000073	1101000164	1101000164	1101000164	1101000164	1101000152
	Gearbox Eyebolt (stainless steel)		N/A	N/A	1101000248	1101000244	1101000242	1101000242	1101000242	1101000242	1101000267
12b	Cover Eyebolt	1	N/A	N/A	N/A	N/A	N/A	N/A	1101000244	1101000244	1101000244
14	Drive shaft	1	1372600028	1372600026	1372600086	1372600080	1372600082	1372600078	1372600112	1372600098	1372600163
15	Housing stud (long)	4*	1103000115	1103000079	1103000146 (*2)	1103000123 (*2)	1103000130	1103000102	1103000157	1103000105	1103000169
16	Gapping shim kit	1	1080000106	1080000106	1080000054	1080000099	1080000056	1080000056	1080000057	1080000057	1080000058
17	Front bearing assembly	2	1173000041	1173000041	1173000013	1173000048	1173000014	1173000016	1173000018	1173000017	1173000019
18	Front oil seal	2	1812000060	1812000060	1812000054	1812000046	1812000053	1812000047	1812000057	1812000045	1812000049
20	Front bearing cover	2	1304000017	1304000017	1304000040	1304000035	1304000036	1304000034	1304000042	1304000041	1304000043
21	Guard screw	4	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000
22	Gearbox guard	2	1936000160	1936000160	1936000165	1936000159	1936000161	1936000158	1936000172	1936000169	1936000187
23	Housing/Cover pin	4*	1891000080 (*6)	1891000080 (*6)	1891000069	1891000069	1891000073	1891000073	1891000076	1891000076	1891000076
24	Housing screw	2	1101000209	1101000210	1101000249	1101000245	1101000246	1101000243	1101000257	1101000257	1101000265
25	Pump housing	1	1652610000	1654610000	1656610052	1658610091	1660610053	1668610060	1664610012	1670610046	1670610024
26	Housing stud (short)	4*	N/A	N/A	1103000147	1103000101 (*2)	1103000099	1103000091	1103000095 (*10)	1103000097 (*10)	1103000103 (*12)
27	Rotor o-ring (viton)	2	1180000700	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234
28	Rotor (standard)	2	1653630000	1655630000	1657630000	1659630000	1661630000	1669630000	1665630000	1671630000	1673600000
29	Rotor bolt washer o-ring (viton)	2	1180000700	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234
30	Rotor bolt washer	2	1104000068	1104000068	1104000027	1104000024	1104000028	1080000042	1104000093	1080000043	1080000044
31	Cover gasket (buna - standard)	1	1180000000	1180000716	1180000165	1180000595	1180000593	1180000590	1180000817	1180000586	1180000757
32	Pump cover	1	1652620000	1654620000	1656620012	1658620018	1660620018	1668620020	1664620002	1670620011	1670620006
33	Forcing screw	2	1018000074	1018000074	1018000074	1018000074	1018000075	1018000075	1018000089	1018000089	1018000089
34	Gearbox gasket	1	1181000152	1181000152	1180000983	1180000948	1180000951	1180000952	1180000847	1180000991	1180001164
35	Rear bearing assembly	2	1173000039	1173000039	1173000050	1173000045	1173000049	1173000044	1173000051	1173000051	1173000053
36	Oil sight glass	1	1248000029	1248000029	1248000029	1248000028	1248000028	1248000028	1248000028	1248000028	1248000028
38	Oil drain plug	2	1248000030	1248000030	1248000030	1248000031	1248000031	1248000031	1248000031	1248000031	1248000031
39a	Gearbox stud	4*	1103000127 (*2)	1103000127 (*2)	1103000148	1103000124	1103000142	1103000142 (*6)	1103000154 (*6)	1103000154 (*6)	1103000168 (*6)
39b	Gearbox forcing stud	2	1103000131	1103000131	1103000149	1103000126	1103000125	1103000125	1103000158	1103000155	1103000155
39c	Gearbox nut	6*	1103004836 (*4)	1103004836 (*4)	1103000032	1101000137	1103004835	1103004835	1103000012 (*8)	1103000012 (*8)	1103000012 (*8)
39d	Gearbox pin	2	1891000080	1891000080	1891000067	1891000069	1891000069	1891000069	1891000076	1891000076	1891000076
40	Gear spacer (rear)	2	1224000103	1224000103	1224000021	1224000113	1224000115	1224000112	1224000117	1224000016	1224000020
41	Gear	2	1365000012	1365000012	1365000003	1365000005	1365000004	1365000014	1365000013	1365000001	1365000002
42	Gear spacer (front)	2	1224000103	1224000103	1224000021	1224000114	1224000023	1224000017	1224000117	1224000016	1224000019
45a	Front mounting strap (mild steel)	1	1925000024	1925000024	1925000031	1925000026	1925000027	1925000029	1925000044	1925000035	1925000045
	Front mounting strap (stainless steel)		1925000018	1925000018	1925000032	1925000022	1925000020	1925000016	1925000043	1925000034	1925000046
45b	Rear mounting strap (mild steel)	1	1925000025	1925000025	1925000031	1925000026	1925000028	1925000030	1925000044	1925000035	1925000045
	Rear mounting strap (stainless steel)		1925000019	1925000019	1925000032	1925000022	1925000021	1925000017	1925000043	1925000034	1925000046
46	Mounting strap screw (mild steel)	4	N/A	N/A	N/A	N/A	1101000033	1101000033	1101000033	1101000033	1101000270
	Mounting strap screw (stainless steel)		1101000210	1101000210	1101018615	1101018615	1101000206	1101000206	1101000206	1101000206	1101000039
47	Gear key	2	1315000037	1315000037	1315000014	1315000030	1315000029	1315000012	1315000043	1315000024	1315000027
48	Idle shaft	1	1372600029	1372600027	1372600087	1372600081	1372600083	1372600079	1372600113	1372600099	1372600164
50	Rotor bolt o-ring (viton)	2	1180000085	1180000085	1180000085	1180000085	1180000085	1180000095	1180000398	1180000398	1180000398
51	Rotor bolt	2	1102000001	1102000001	1102000001	1102000001	1102000001	1102000002	1102000010	1102000010	1102000010
52	Cover nut washer	8*	N/A	N/A	1104000000 (*6)	1104000002 (*4)	1104000002	1104000002	1104000002 (*14)	1104000002 (*14)	1104000002 (*16)
53	Cover nut	8*	1103004836 (*4)	1103004836 (*4)	1103000032 (*6)	1103000018 (*4)	1103000018	1103000018	1103000018 (*14)	1103000018 (*14)	1103000018 (*16)
72	Rotor Key	2	131500040	131500038	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* Quantities may vary

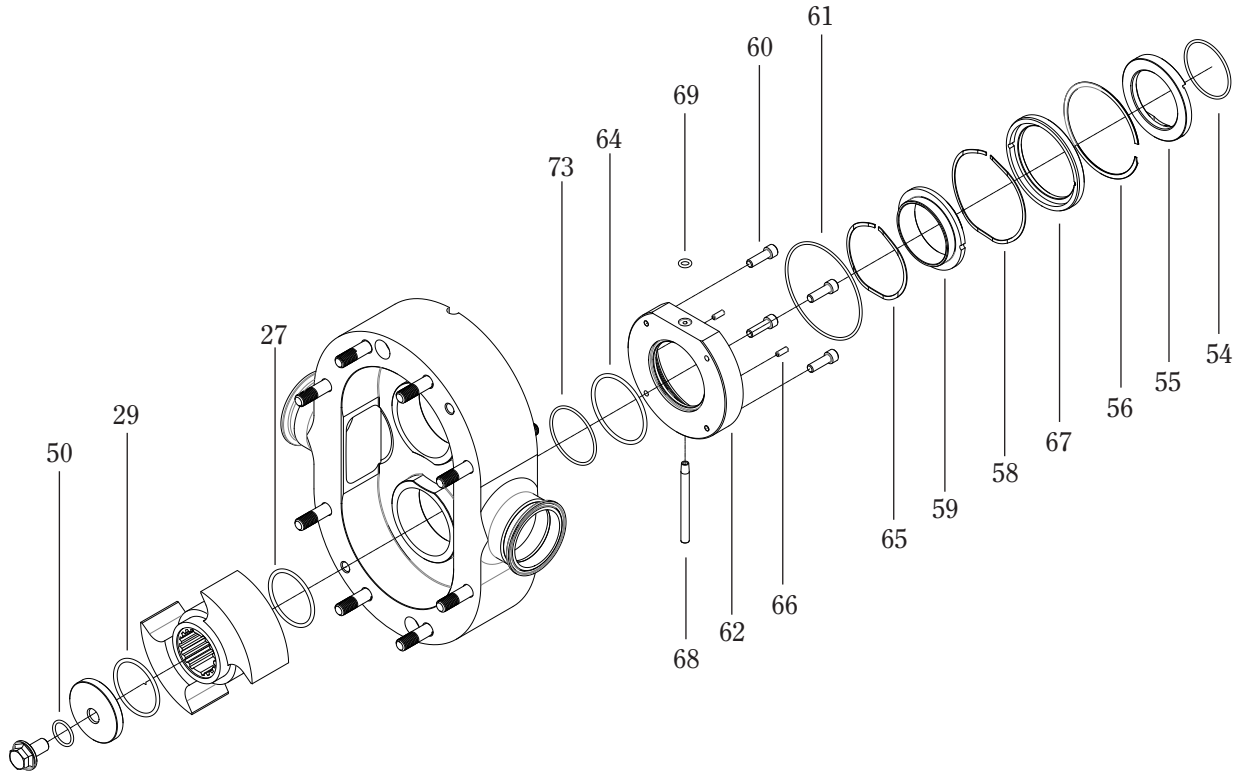
SINGLE MECHANICAL SEAL ASSEMBLY



FKL SINGLE MECHANICAL SEAL												
Item	Description	Qty	15/20	25	50	75	150	205	250	400	580	600
27	Rotor o-ring (viton)	2	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234	1180000919	
29	Rotor bolt washer o-ring (viton)	2	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234	1180000919	
50	Rotor bolt o-ring (viton)	2*	1180000085				1180000095		1180000398		1180000398 (4)	N/A
54	Rotating seal o-ring (viton)	2*	1180000700	1180000243	1180000032	1180000275	1180000112	1180000256	1180000217	1180000216	1180000919	1180000012
55	Rotating seal (Chrome oxide/SS)	2	1810600112	1810600075	1810600057	1810600076	1810600066	1810600124	1810600042	1810600074	1810600130	1810600087
	Rotating seal (Silicon carbide)		1810600113	1810600085	1810600036	1810600077	1810600067	1810600123	1810600062	1810600086	1810600141	1810600157
56	Seal retaining ring	2	N/A**	1148000018	1148000014	1148000019	1148000016	1148000032	1148000015	1148000017	1148000035	1148000020
57	Single seal insert	2	N/A**	1815600019	1815600020	1815600021	1815600022	1815600144	1815600023	1815600024	1815600151	1815600099
58	Outer seal spring	2	N/A**	1820000037	1820000018	1820000040	1820000022	1820000069	1820000020	1820000024	1820000071	1820000055
59	Stationary seal (carbon)	2	1815600115	1815600058	1815600049	1815600060	1815600051	1815600142	1815600052	1815600055	1815600157	TBD
	Stationary seal (Silicon carbide)		1815600182	1815600183	1815600184	1815600185	1815600186	1815600199	1815600187	1815600200	TBD	1815600201
	Stationary seal (Chrome oxide/SS)		1815600128	1815600086	1815600066	1815600112	1815600108	1815600141	1815600106	1815600097	1810600172	1815600070
60	Seal housing screw	8	N/A**	1101000220		1101000221	1101000220(12)	1101000221(12)	1101000221(12)	1101000227(12)	1101000010 (16)	1101000002 (16)
61	Outer seal o-ring (viton)	2	N/A**	1180000256	1180000186	1180000148	1180000225	1180000215		1180000240	1180000922	1180000019
62	Seal housing	2	N/A**	1845000010	1845000000	1845000015	1845000006	1845000045	1845000005	1845000004	1845000048	1845000028
63	Plastic cover plug	2*	N/A**				1248000006				1248000002	1248000002(4)
64	Inner seal o-ring (viton)	2	1180000261	1180000030	1180000014	1180000253	1180000231	1180000234	1180000052	1180000239	1180000634	1180000455
65	Inner seal spring	2	1820000041	1820000038	1820000017	1820000039	1820000021	1820000068	1820000019	1820000023	1820000070	1820000054
66	Seal pin	4	1891000051	1891000011	1891000009	1891000013	1891000009	1891000013	1891000009	1891000010	1891000088	1891000043
73	Cartridge seal o-ring (viton)	2	N/A**	(models 250–600 only)					1180000148	1180000225	1180000920	1180000686

* Quantities may vary ** N/A - models 15-20 (no cartridge)

DOUBLE MECHANICAL SEAL ASSEMBLY



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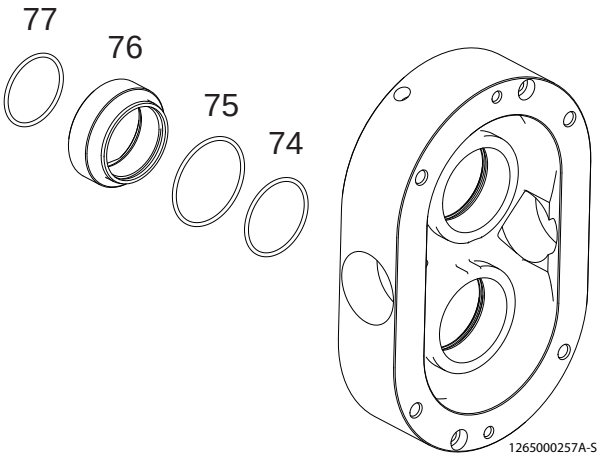
FKL DOUBLE MECHANICAL SEAL												
Item	**Description**	**Qty**	**15/20**	**25**	**50**	**75**	**150**	**205**	**250**	**400**	**580**	**600**
27	Rotor o-ring (viton)	2	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234	1180000919	
29	Rotor bolt washer o-ring (viton)	2	1180000700	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234	1180000919	
50	Rotor bolt o-ring (viton)	2*	1180000085				1180000095	1180000398			1180000398 (4)	N/A
54	Rotating seal o-ring (viton)	2	1180000700	1180000243	1180000032	1180000275	1180000112	1180000256	1180000217	1180000216	1180000919	1180000012
55	Rotating seal (Chrome oxide/SS)	2	1810600112	1810600075	1810600057	1810600076	1810600066	1810600124	1810600042	1810600074	1810600130	1810600087
	Rotating seal (Silicon carbide)		1810600113	1810600085	1810600036	1810600077	1810600067	1810600123	1810600062	1810600086	1810600141	1810600157
56	Seal retaining ring	2	N/A**	1148000018	1148000014	1148000019	1148000016	1148000032	1148000015	1148000017	1148000035	1148000020
58	Outer seal spring	2	N/A**	1820000037	1820000018	1820000040	1820000022	1820000069	1820000020	1820000024	1820000071	1820000055
59	Stationary seal (carbon)	2	1815600115	1815600058	1815600049	1815600060	1815600051	1815600142	1815600052	1815600055	1815600157	TBD
	Stationary seal (Silicon carbide)		1815600182	1815600183	1815600184	1815600185	1815600186	1815600199	1815600187	1815600200	TBD	1815600201
	Stationary seal (Chrome oxide/SS)		1815600128	1815600086	1815600066	1815600112	1815600108	1815600141	1815600106	1815600097	1810600172	1815600070
60	Seal housing screw	8*	N/A**	1101000220		1101000221	1101000220(12)	1101000221(12)	1101000221(12)	1101000227(12)	1101000010 (16)	1101000002 (16)
61	Outer seal o-ring (viton)	2	1180000701	1180000256	1180000186	1180000148	1180000225	1180000215		1180000240	1180000922	1180000019
62	Seal housing	2	N/A**	1845000010	1845000000	1845000015	1845000006	1845000045	1845000005	1845000004	1845000048	1845000028
64	Inner seal o-ring (viton)	2	1180000261	1180000030	1180000014	1180000253	1180000231	1180000234	1180000052	1180000239	1180000634	1180000455
65	Inner seal spring	2	1820000041	1820000038	1820000017	1820000039	1820000021	1820000068	1820000019	1820000023	1820000070	1820000054
66	Seal pin	4	1891000051	1891000011	1891000009	1891000013	1891000009	1891000013	1891000009	1891000010	1891000088	1891000043
67	Flush seal (carbon)	2	1815600117	1815600059	1815600071	1815600062	1815600073	1815600143	1815600072	1815600160	1815600158	1815600173
68	Water pipe	2*	1910000002	1910000010		1910000019	1910000001				1910000003	1910000003(4)
69	Flush seal housing o-ring (viton)	1	N/A**	1180000293								N/A
73	Cartridge seal o-ring (viton)	2	N/A**	(models 250–600 only)					1180000148	1180000225	1180000920	1180000686

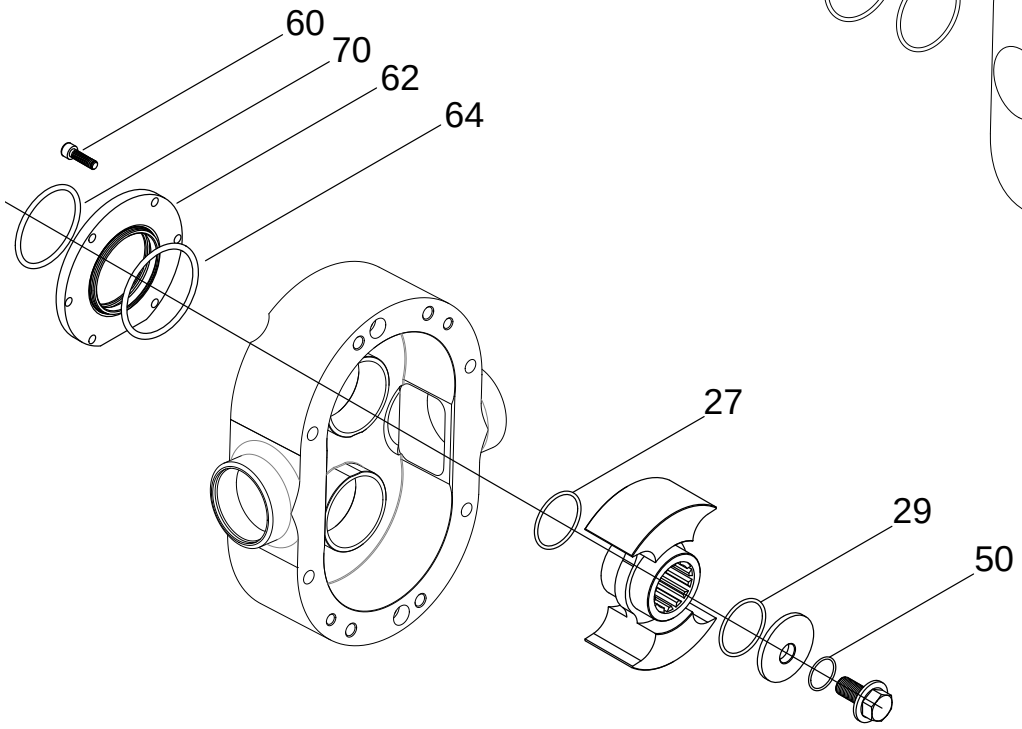
* Quantities may vary ** N/A - models 15-20 (no cartridge)

SINGLE O-RING SEAL ASSEMBLY

MODELS 15–20



MODELS 25–250



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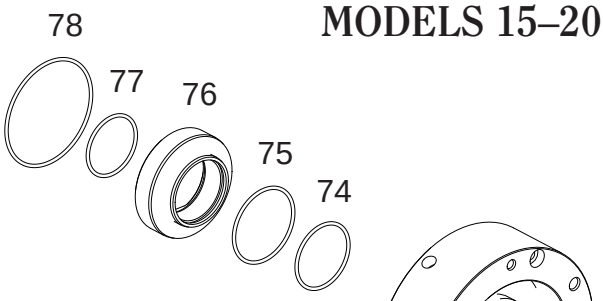
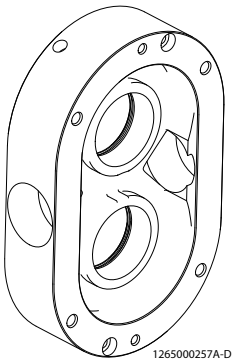
SINGLE O-RING SEAL (Models 25–250)								
Item	**Description**	**Qty**	**25**	**50**	**75**	**150**	**205**	**250**
27	**Rotor o-ring (viton)**	2	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212
29	**Rotor bolt washer o-ring (viton)**	2	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212
50	**Rotor bolt o-ring (viton)**	2	1180000085			1180000095	1180000398	
60	**Seal housing screw**	8*	1101000219			1101000219(12)		
62	**Seal housing**	2	1845000012	1845000001	1845000017	1845000008	TBD	1845000003
64	**Inner stationary seal o-ring (viton)**	2	1180000030	1180000014	1180000253	1180000231	1180000234	1180000052
70	**Seal o-ring (viton)**	2	1180000206	1180000044	1180000233	1180000280	1180000234	1180000234
* Quantities may vary								

SINGLE O-RING SEAL (Models 15–20)			
Item	**Description**	**Qty**	**15/20**
27	**Rotor o-ring (viton)**	2	1180000700
29	**Rotor bolt washer o-ring (viton)**	2	1180000700
50	**Rotor bolt o-ring (viton)**	2	1180000085
74	**Inner seal o-ring (viton)**	2	1180000350
75	**Outer seal o-ring (viton)**	2	1180000261
76	**O-ring seal: single**	2	1224000104
77	**Shaft o-ring (viton)**	2	1180000700

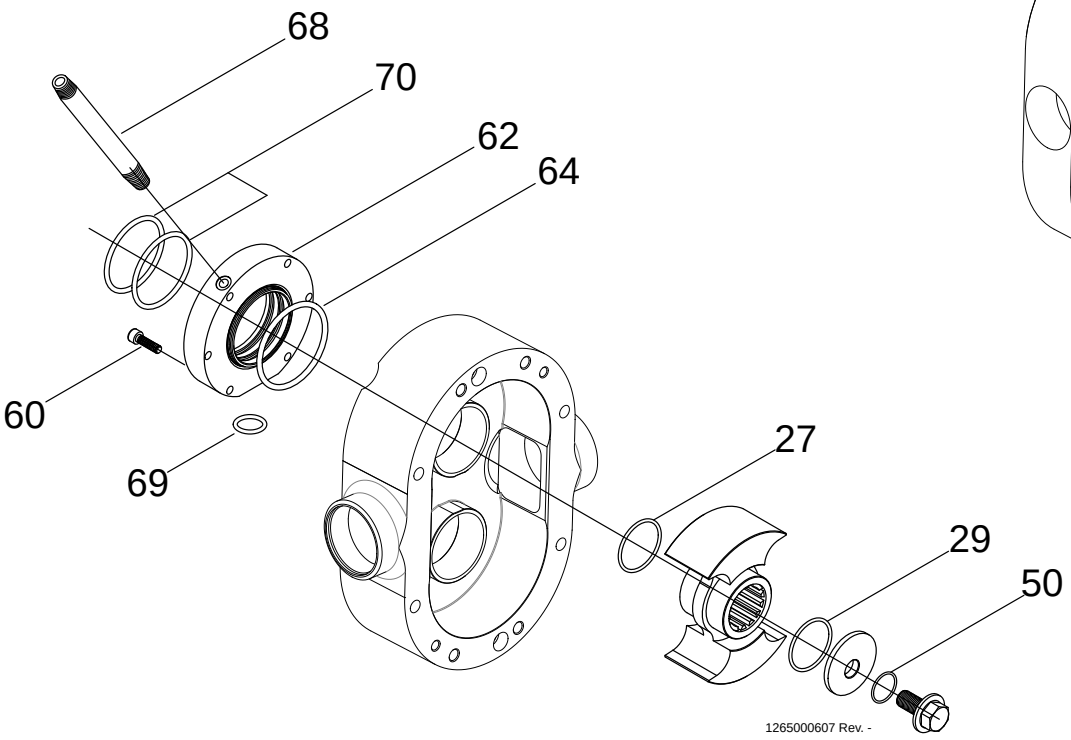
DOUBLE O-RING SEAL ASSEMBLY

MODELS 15–20





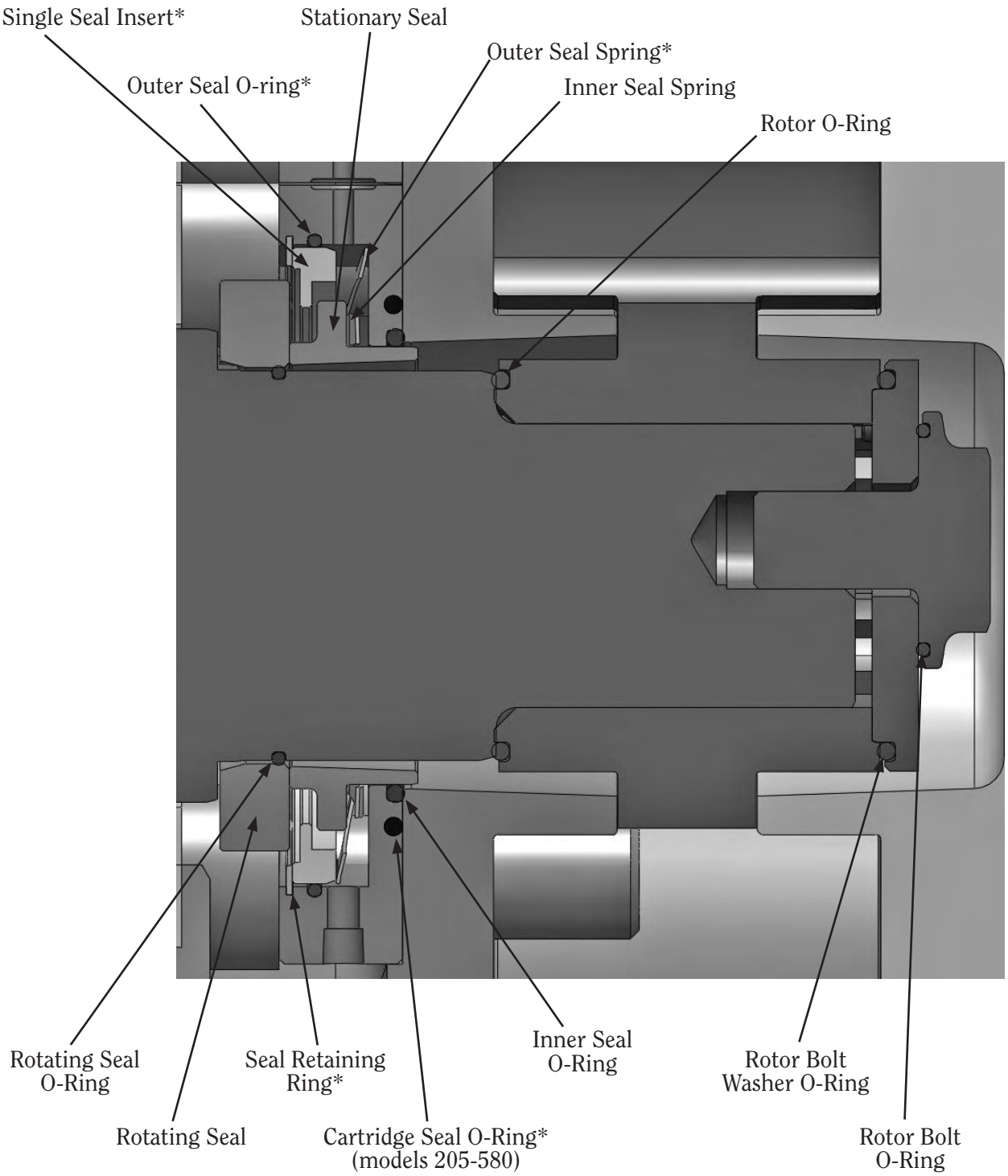
MODELS 25–250



DOUBLE O-RING SEAL (Models 25–250)								
Item	**Description**	**Qty**	**25**	**50**	**75**	**150**	**205**	**250**
27	Rotor o-ring (viton)	2	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212
29	Rotor bolt washer o-ring (viton)	2	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212
50	Rotor bolt o-ring (viton)	2	1180000085			1180000095	1180000398	
60	Seal housing screw	8*	1101000220			1101000220(12)		1101000221(12)
62	Seal housing	2	1845000011	1845000002	1845000016	1845000007	TBD	1845000009
64	Inner seal o-ring (viton)	2	1180000030	1180000014	1180000253	1180000231	1180000234	1180000052
68	Water pipe	2	1910000010			1910000001		
69	Flush seal housing o-ring (viton)	1	1180000293					
70	Seal o-ring (viton)	2	1180000206	1180000044	1180000233	1180000280	1180000234	1180000234
* Quantities may vary								

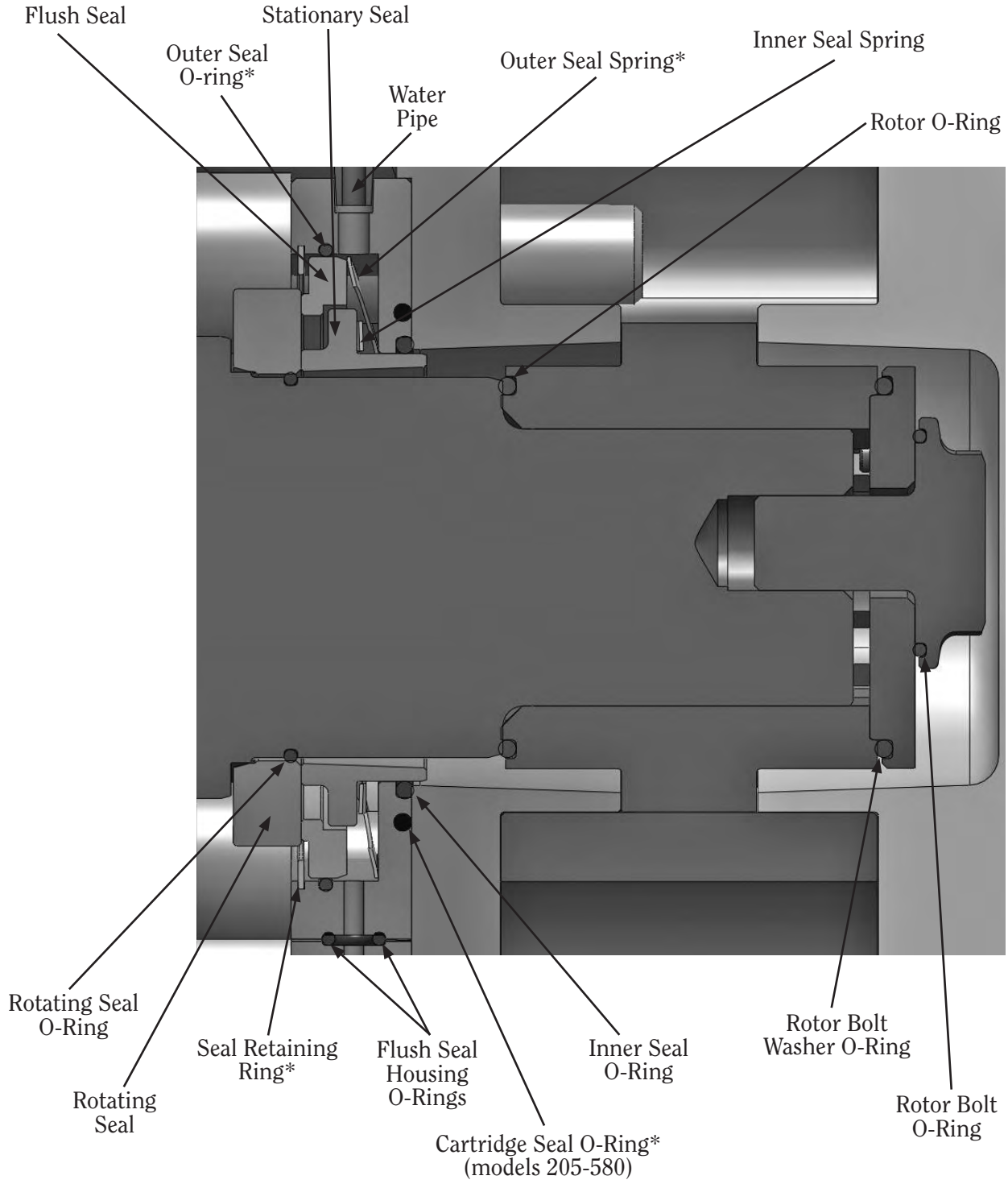
DOUBLE O-RING SEAL (Models 15–20)			
Item	**Description**	**Qty**	**15/20**
27	Rotor o-ring (viton)	2	1180000700
29	Rotor bolt washer o-ring (viton)	2	1180000700
50	Rotor bolt o-ring (viton)	2	1180000085
74	Inner seal o-ring (viton)	2	1180000350
75	Outer seal o-ring (viton)	2	1180000261
76	O-ring seal: double	2	1224000105
77	Shaft o-ring (viton)	2	1180000700
78	Flush o-ring (viton)	2	1180000701

SINGLE MECHANICAL SEAL CROSS-SECTION



**** N/A, Models 15-20 (no cartridge)***

DOUBLE MECHANICAL SEAL CROSS-SECTION



**** N/A, Models 15-20 (no cartridge)***

PUMP HEAD DISASSEMBLY

REMOVE THE COVER

- Remove the cover nuts (Figure 11).
- Remove the cover by turning the forcing screws clockwise.
- Remove the cover and discard the cover o-ring.
- Jacket Cover Only: Remove cover nuts, then remove jacketed cover and jacketed cover o-ring. Remove cover and discard cover o-ring.

FIGURE 11

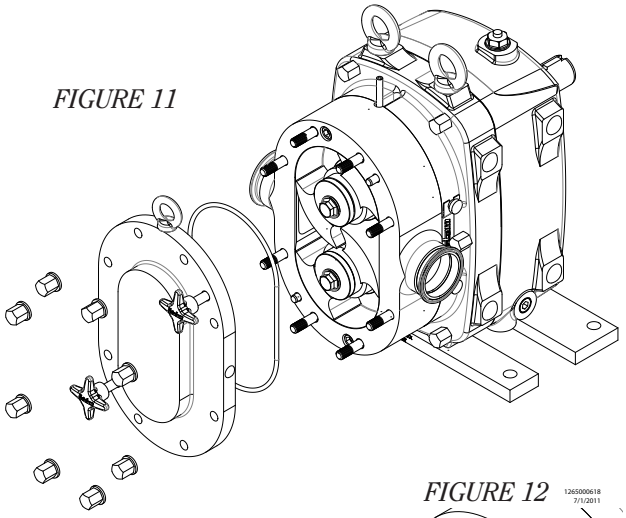
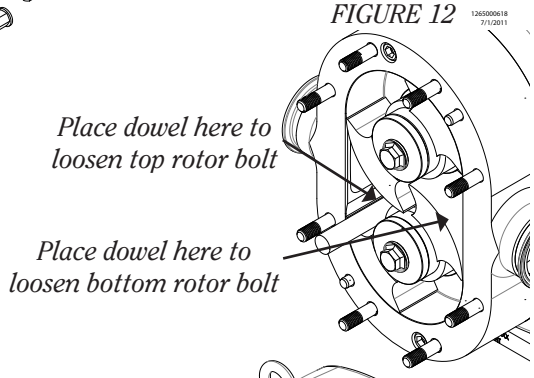


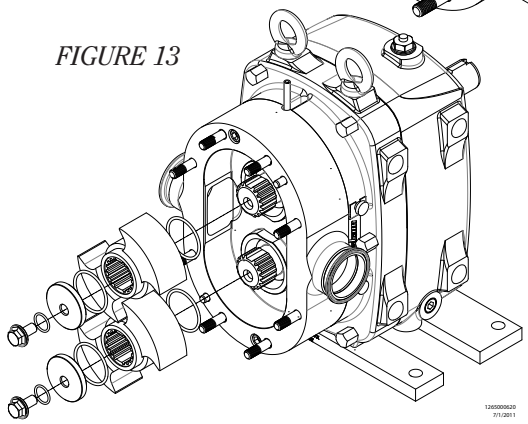
FIGURE 12



REMOVE THE ROTORS

- Place a 1/2" diameter wooden dowel between the rotors (Figure 12).
- Remove the rotor bolts (Figure 13).
- Discard the rotor bolt o-rings.
- Remove the rotor bolt washers and discard the rotor bolt washer o-rings.
- Remove the rotors. Note: Keep rotors free from damage (i.e. nicks, dings) to ensure high efficiency the pump was designed for.
- Discard the rotor o-rings.
- Remove the rotor keys (models 15–20 only).

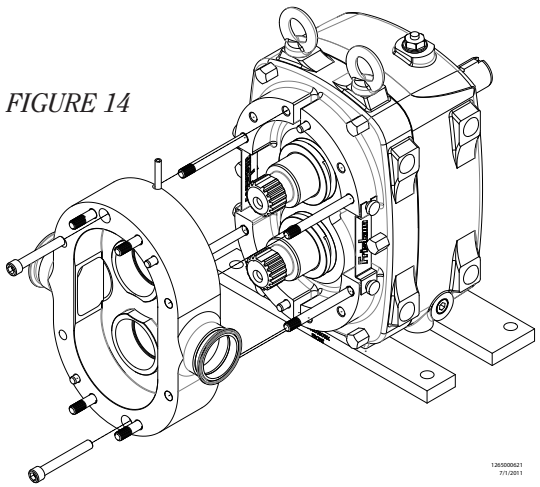
FIGURE 13



REMOVE THE HOUSING

- Remove the housing screws (Figure 14).
- Carefully slide the housing forward and remove.
- Note: Keep housing free from damage, e.g., nicks and dings, to ensure high efficiency the pump was designed for.

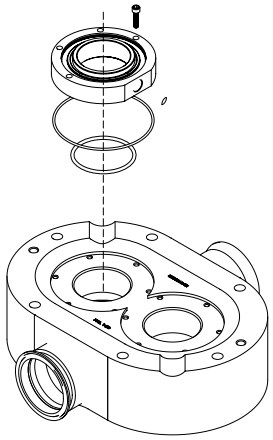
FIGURE 14



SEAL REPLACEMENT

MECHANICAL SEAL CARTRIDGE REMOVAL

FIGURE 15

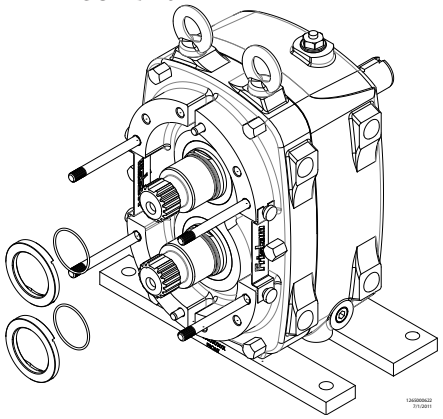


- Place the pump housing face down.
- Loosen the seal housing screws.
- Remove the seal housing screws, seal cartridges and seal housing o-rings (Figure 15).
- Remove the two rotating seals and rotating seal o-rings from the pump shaft (Figure 16).

If replacing the cartridge with a new cartridge proceed to the 'Seal Cartridge Installation' section.

MECHANICAL SEAL CARTRIDGE DISASSEMBLY

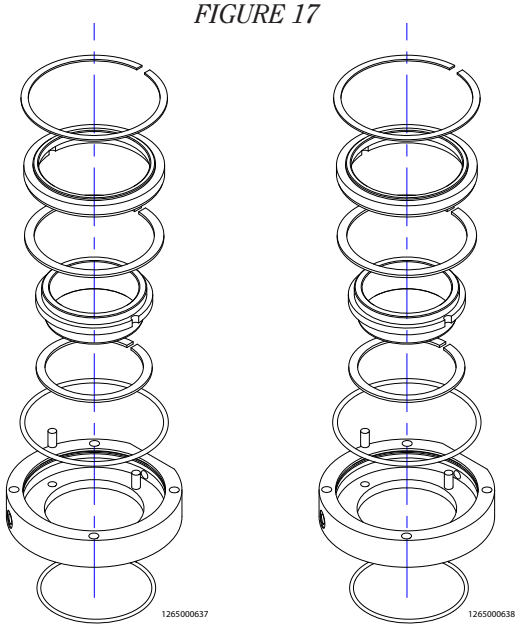
FIGURE 16



Place all of the seal parts on a clean work area and disassemble one cartridge at a time.

- Place the seal cartridge, with the seal face up, onto a flat surface (Figure 17).
- Compress the seal so that all of the pressure is off the seal retaining ring.
- Use the flat-faced screwdriver to pry the seal retaining ring out of the seal housing.
- Use your fingers to gently press the seal elements out of the seal housing.
- Remove the double and single seal springs and the flush seal o-ring.
- The seal housing should be cleaned to prepare it for reassembly.

FIGURE 17



SINGLE SEAL *DOUBLE SEAL*

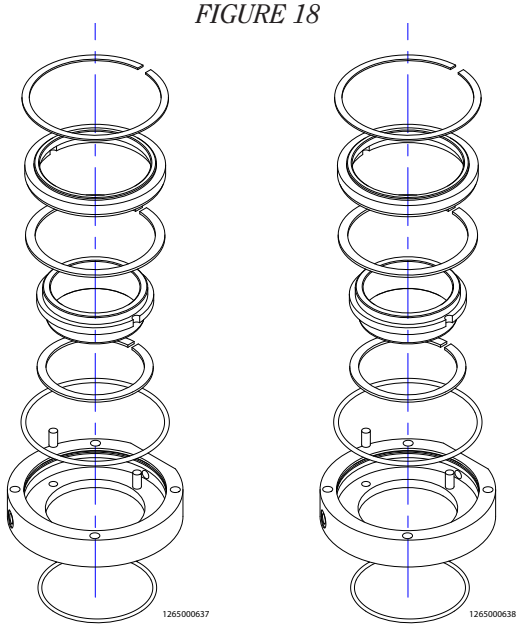
MECHANICAL SEAL CARTRIDGE ASSEMBLY

Assemble the cartridges one at a time.

- Lubricate the new flush seal o-ring and slightly stretch (Figure 18).
- Fit the flush seal o-ring into its groove inside the seal housing.
- Place the inner and outer seal springs into the seal housing.
- Set the seal housing on the seal assembly tool.
- Place the new inner stationary seal into the seal housing.
- Single mechanical seal: Lubricate the outer edge of the single seal insert and place into the seal housing. Be sure to fit the notches around the pins.

  Double mechanical seal: Lubricate the outer edge of the flush seal and place into the seal housing. Be sure to fit the notches around the pins.
- Set the seal retaining ring on top of the seal housing.
- Push down on the flush seal until it is past the seal retaining ring groove.
- Use your fingers to fit the seal retaining ring into place.

FIGURE 18



SINGLE SEAL *DOUBLE SEAL*

MECHANICAL SEAL CARTRIDGE INSTALLATION

- Place the pump housing face down (Figure 19).
- Install the stationary seal o-rings into the grooves in the seal housing.
- Install the seal housing o-rings into the new seal cartridges (models 205–400 only).
- Install one of the seal cartridges onto the pump housing with the flat side toward the middle as shown.
- Insert the seal housing screws through the holes in the seal cartridges and tighten.
- Double mechanical seal only: place the double seal housing o-ring into the groove on the secured seal cartridge.
- Install the other new seal cartridge onto the pump housing by repeating the procedure above.
- Next lubricate and install a new rotating seal o-ring into the groove on each shaft (Figure 20). Aseptic seal only: lubricate and install two rotating seal o-rings on each shaft.
- Install the rotating seals, making sure to align the flats on the seals with the flats on the shafts.

FIGURE 19

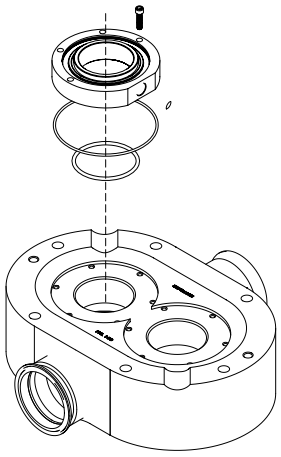
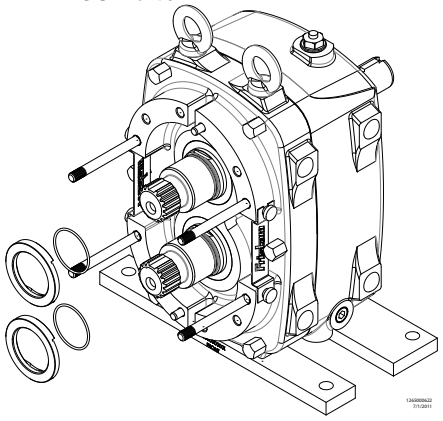
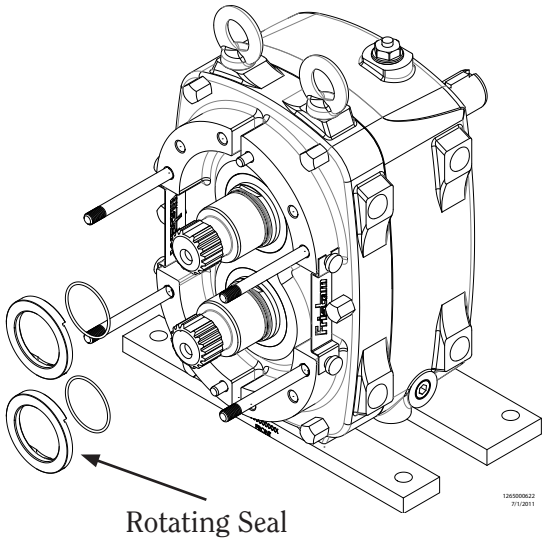


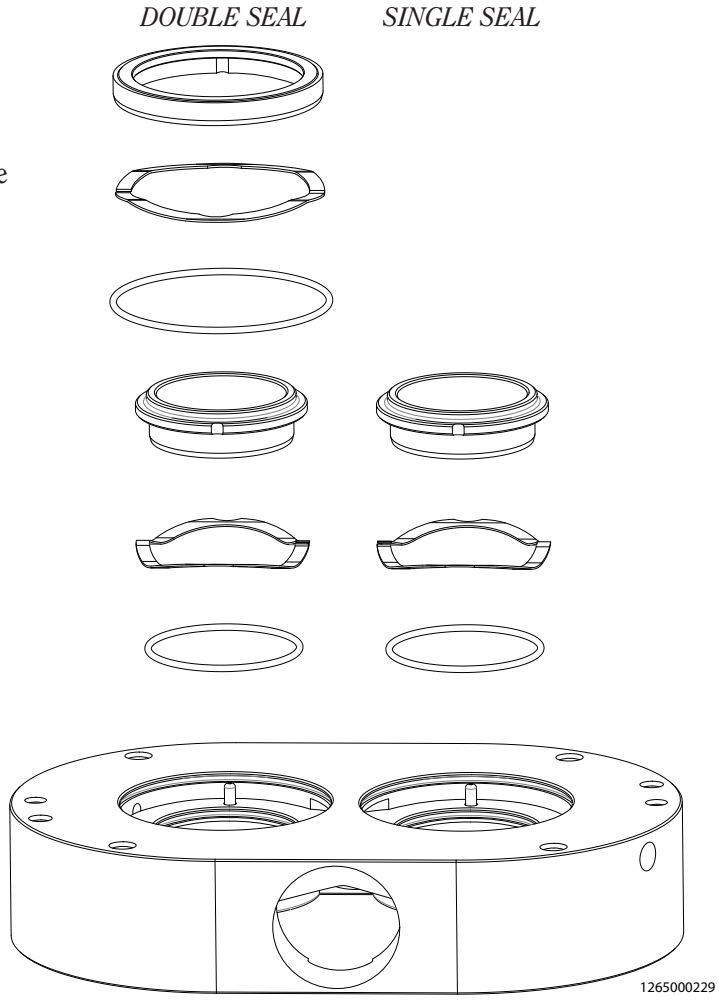
FIGURE 20



MECHANICAL SEAL DISASSEMBLY (MODELS 15-20 ONLY)

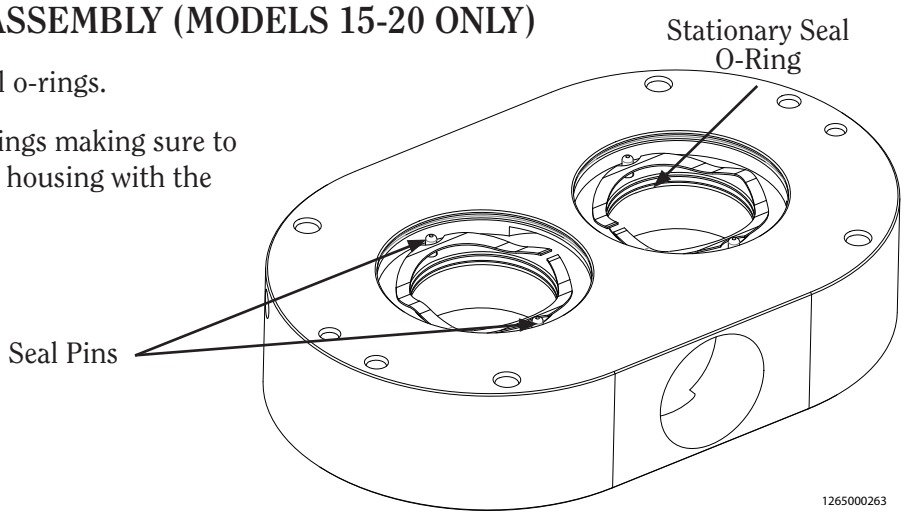
- Place the housing face down (right).
- Remove and discard the Stationary seals, o-rings and springs.
- Double Seal Only: Remove and discard the Flush seals, o-rings and springs.
- Remove and discard the rotating seals and o-rings (below).

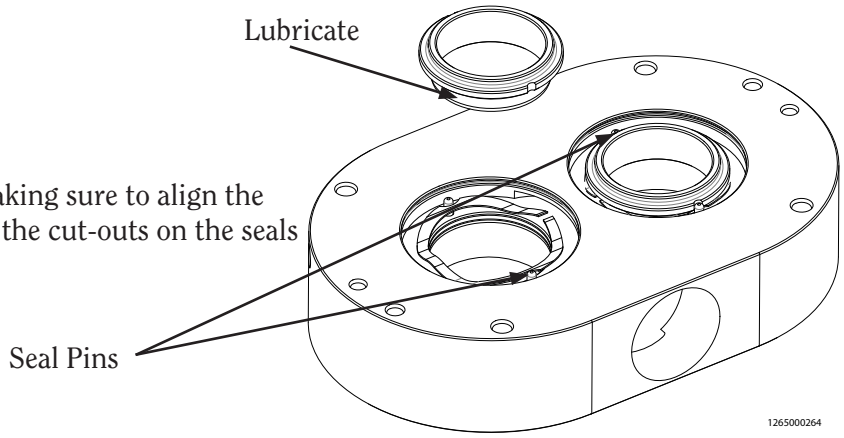




MECHANICAL SEAL ASSEMBLY (MODELS 15-20 ONLY)

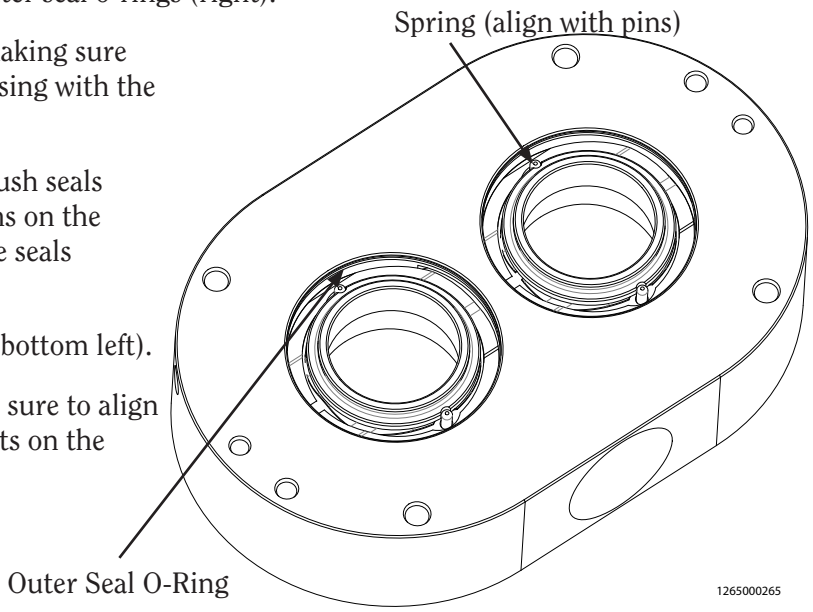
- Install the Stationary seal o-rings.
- Install the single seal springs making sure to align the seal pins on the housing with the cut-outs on the springs.

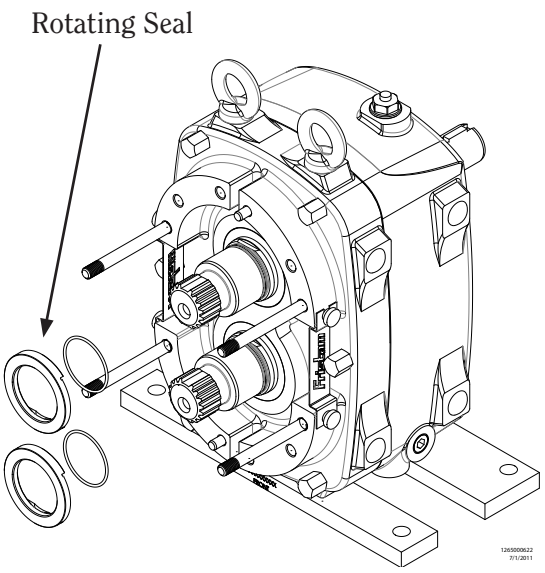


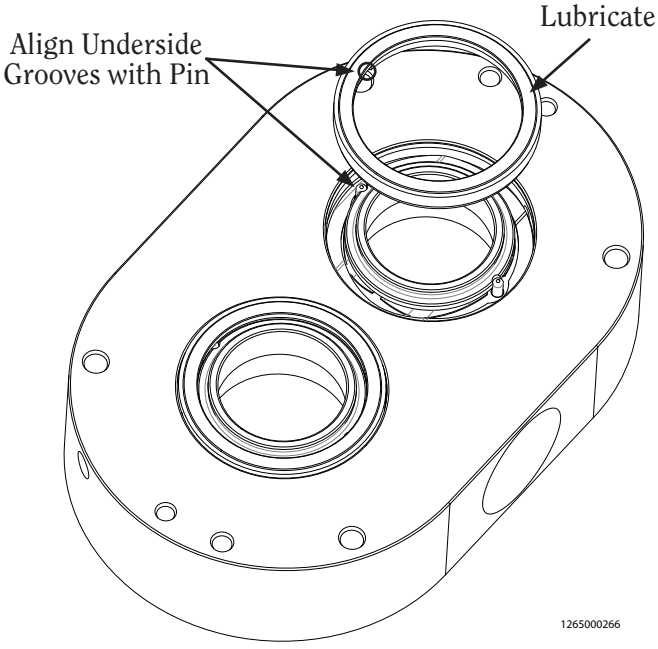


- Install the Stationary seals making sure to align the seal pins on the housing with the cut-outs on the seals (top).

- Double Seal Only: Install the outer seal o-rings (right).
- Install the double seal springs making sure to align the seal pins on the housing with the cut-outs on the springs.
- Double Seal Only: Install the Flush seals making sure to align the seal pins on the housing with the cut-outs on the seals (bottom right).
- Install the rotating seal o-rings (bottom left).
- Install the rotating seals making sure to align the flats on the seals with the flats on the shaft.



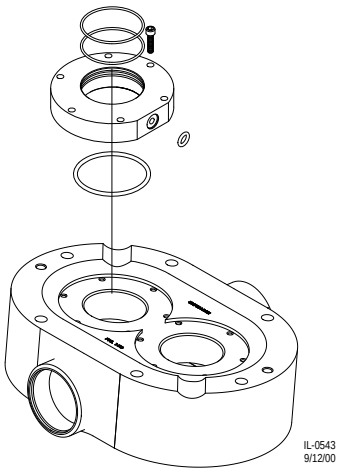




O-RING CARTRIDGE SEAL DISASSEMBLY

- Place the pump housing face down as shown.
- Remove the seal housing screws, o-ring seal cartridges and stationary seal o-rings (Figure 21).
- Remove the seal o-rings from the seal housings with the flat screwdriver.

FIGURE 21



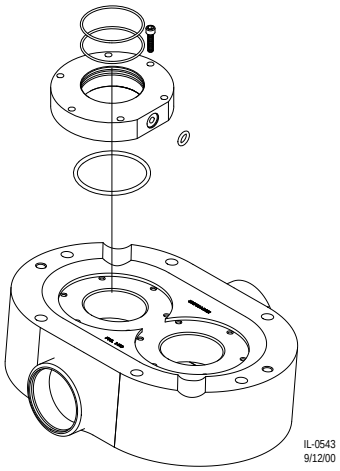
Inspect the pump shafts in the area in which the o-ring seals ride. Clean any o-ring or product residue off the pump shafts. If the shafts are worn excessively they must be replaced.

You are now ready to install the new seal components.

O-RING CARTRIDGE SEAL ASSEMBLY

- Place the pump housing face down (Figure 22).
- Install the new inner stationary seal o-rings into the grooves in the seal housing.
- Install the new seal o-rings into the o-ring seal housings. Do not lubricate the o-rings before installing.
- Install one of the seal housings onto the pump housing with the flat side toward the middle as shown.
- Insert the seal housing screws through the holes in the o-ring seal housing and tighten.
- Double o-ring seals only, place the new double seal housing o-ring into the groove on the secured o-ring seal housing.
- Install the other o-ring seal housing onto the pump housing by repeating instructions above.

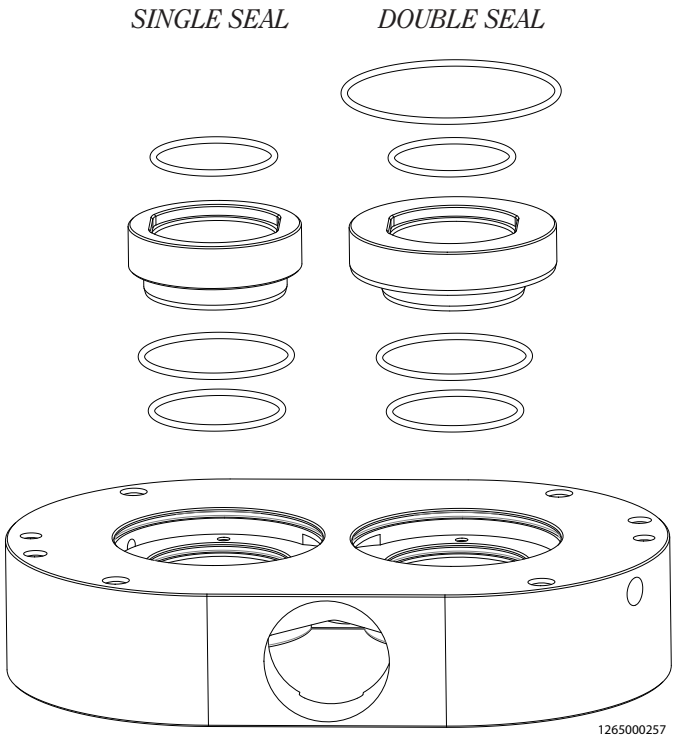
FIGURE 21

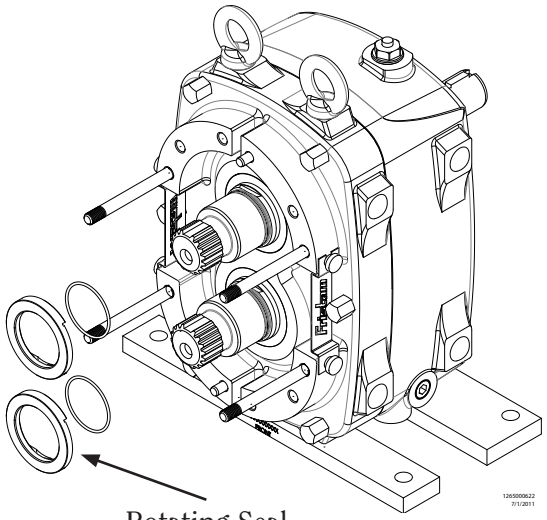


- Lubricate the pump shafts with a food grade lubricant compatible with the o-rings. Lubricate the shafts where the o-rings will slide.
- You are now ready to install the pump housing onto the gearbox. Install the pump housing while slowly rotating the shaft.

O-RING SEAL DISASSEMBLY (MODELS 15-20 ONLY)

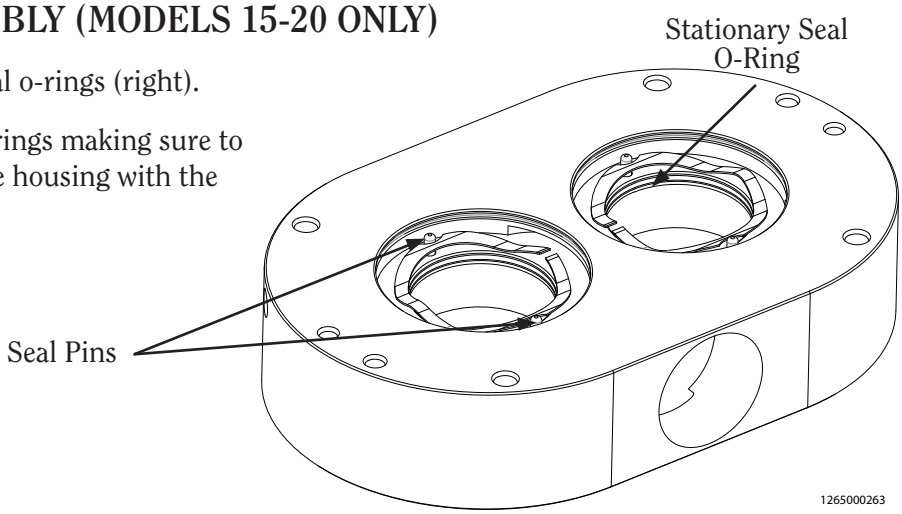
- Place the housing face down (right).
- Remove and discard the single o-ring seals and o-rings.
- Double Seal Only: Remove and discard the double o-ring seals and o-rings.
- Remove and discard the rotating seals and o-rings (below).





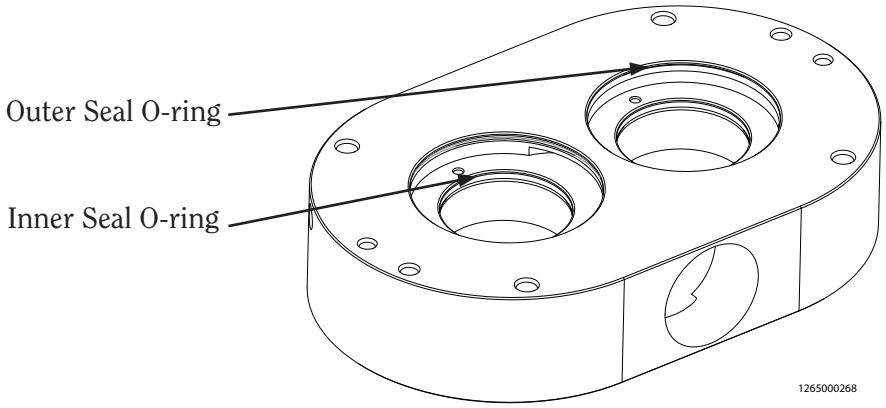
O-RING SEAL ASSEMBLY (MODELS 15-20 ONLY)

- Install the Stationary seal o-rings (right).
- Install the single seal springs making sure to align the seal pins on the housing with the cut-outs on the springs.

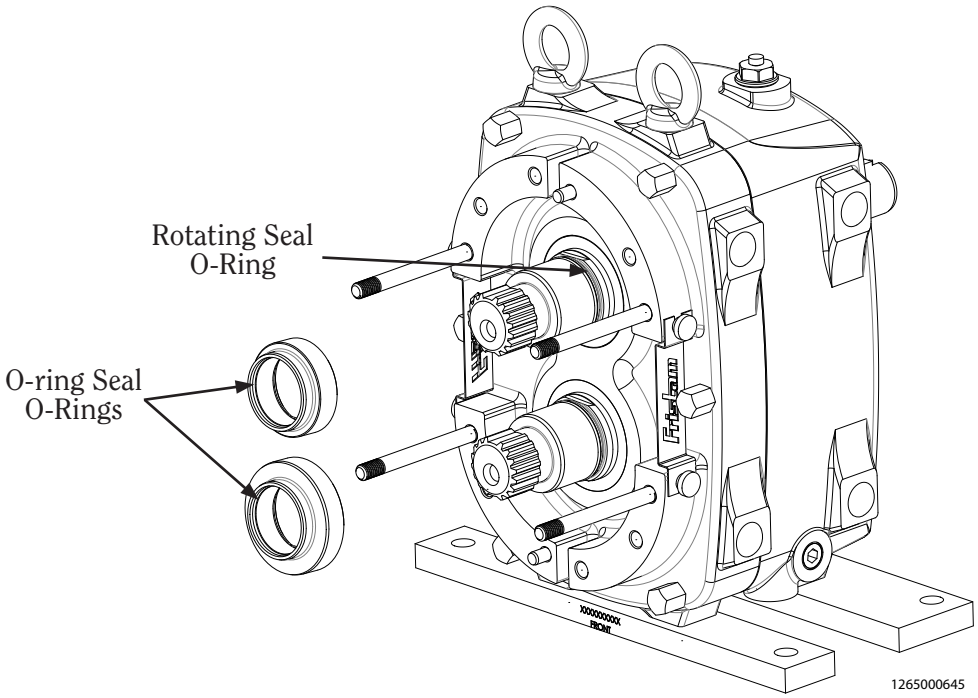


O-RING SEAL ASSEMBLY (MODELS 15-20 ONLY)

- Install the inner seal o-rings (right).
- Double Seal Only: Install the outer seal o-rings.
- Note: If the pump is changing from mechanical seals to o-ring seals, the seal pins must be removed from the housing prior to installing the o-ring seals.



- Lubricate and install the rotating seal o-rings (bottom right).
- Install the o-ring seal o-rings onto the o-ring seals.
- Lubricate and install the single or double o-ring seals making sure to align the flats on the seals with the flats on the shafts.



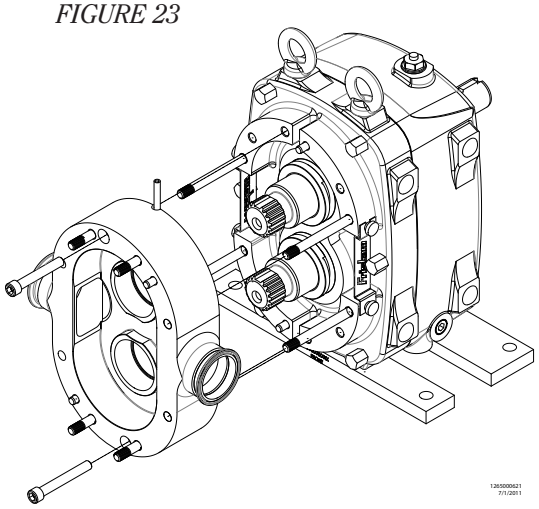
PUMP HEAD ASSEMBLY

Note: Any debris between the gearbox and pump housing will affect the rotor gap. Make sure the raised faces on the front of the gearbox and the back face of the housing are clean.

INSTALL HOUSING

- Carefully slide the housing onto the studs and over the shafts (Figure 23).
- Use a torque wrench to tighten the housing screws.

FIGURE 23



INSTALL ROTORS

- Install the rotor o-ring on the back side of each rotor (Figure 24).
- Insert the rotor keys into the shaft keyways (models 15–20 only).
- Install the rotors with the rotor o-rings facing the housing (Figure 25).
- Note: The rotor with one dot should be installed on the drive shaft and the rotor with two dots should be installed on the idle shaft (Figure 26).

FIGURE 24

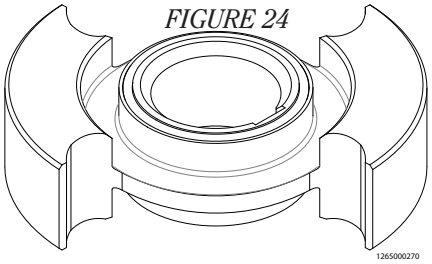


FIGURE 25

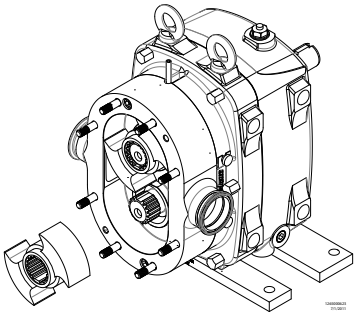
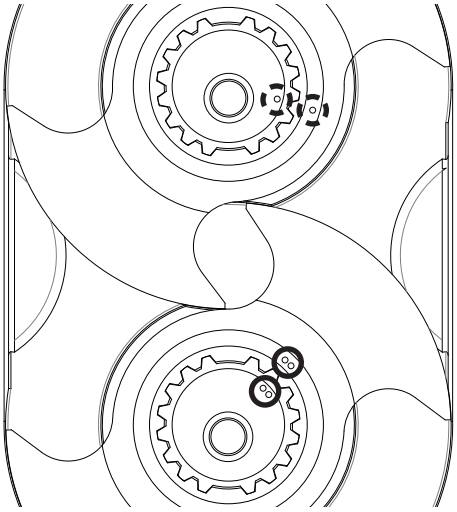


FIGURE 26



- Install the rotor bolt washer o-rings onto the rotor bolt washers.
- Install the rotor bolt washers making sure to align the holes with each other.
- Install the rotor bolt o-rings onto the rotor bolts.
- Install the rotor bolt assemblies onto the rotors. Place a 1/2” diameter wooden dowel between the rotors. Use a torque wrench to tighten the rotor bolts.

NOTE: If the shaft has been removed or replaced, it is necessary to check the back-face rotor clearance at this time before completing the pump assembly.

FIGURE 27

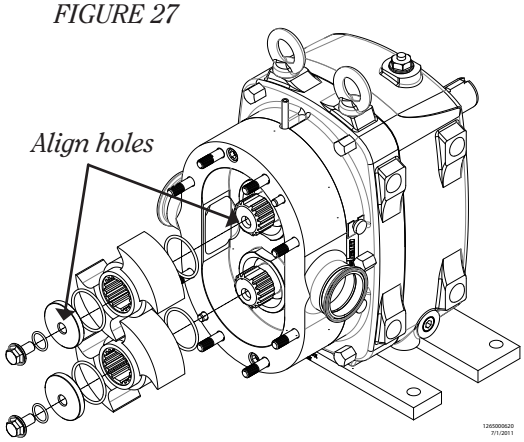
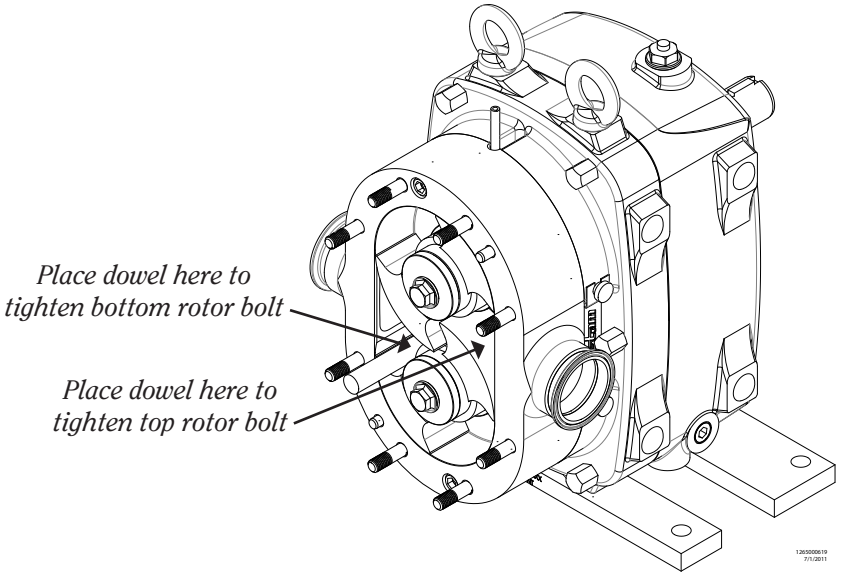
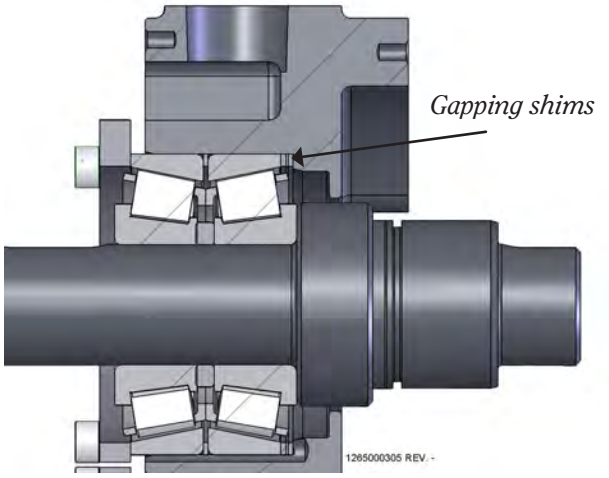


FIGURE 28



SETTING THE ROTOR CLEARANCE

FIGURE 29



The housing and rotors must be installed to check the rotor clearance (seals and o-rings aren't necessary).

- Use feeler gages to verify the back face clearances. You must do this for both shafts, as they will most likely be different.
- If the clearances are incorrect (see rotor clearance table, page 6), you must set the rotor clearance.
- (Measured Back Face Clearance) minus (Standard Back Face Clearance) equals amount of shims to be added or removed from the gearbox. Remove the shafts and add or remove shims as necessary. You may use a combination of gapping shims of different thicknesses to get the correct gap (Figure 29).

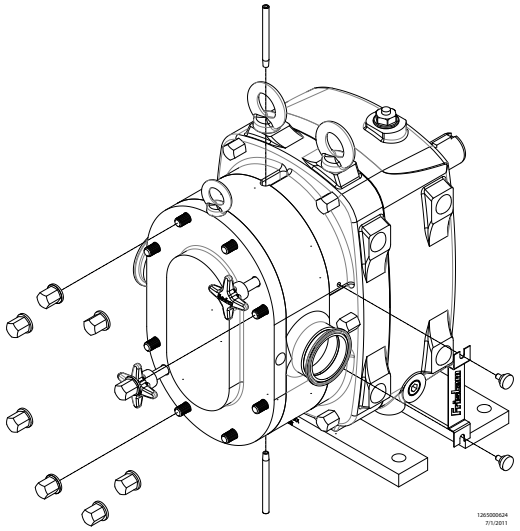
FORMULA	EXAMPLE "A"	EXAMPLE "B"
Measured back face clearance	0.14mm	0.07mm
– Median standard back face clearance	– 0.10mm	– 0.10mm
= Gapping shims to add (remove)	= 0.04mm to add	= 0.03mm to remove

- Once the clearances are correct, rotate the pump shaft to verify that the rotors turn freely.

INSTALL COVER, GUARD, PIPING

- Install the cover o-ring.
- Carefully slide the cover onto the housing (Figure 30).
- Install cover nuts and cover nut washers.
- Use a torque wrench to tighten the cover nuts.
- Install the gearbox guards around the housing and fasten with the guard screw.
- Reconnect the inlet and outlet piping (see page 10).
- Double Seal Only: Install the water pipes. Reconnect the seal flush supply and return lines.

FIGURE 30



GEARBOX AND SHAFT DISASSEMBLY

Prior to disassembling the gearbox, obtain a gearbox repair kit from Fristam, then complete the pump head disassembly section.

- Place an oil pan under the gearbox, below the oil drain hole.
- Remove the oil drain plug (Figure 31).
- Let the oil completely drain out of the gearbox and safely discard the oil.
- Remove the gearbox nuts (Figure 32).
- Use a flat screwdriver to loosen the gearbox forcing studs, which will force the front and rear gearbox to separate past the gearbox pins.
- Discard the gearbox gasket.

FIGURE 31

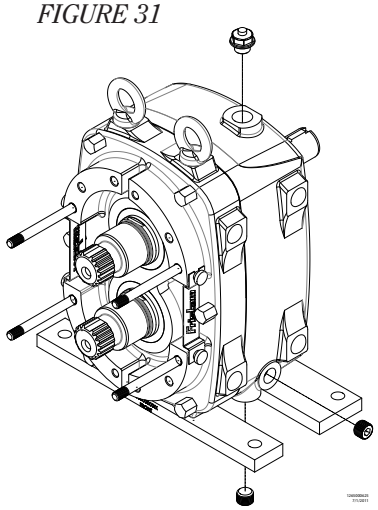
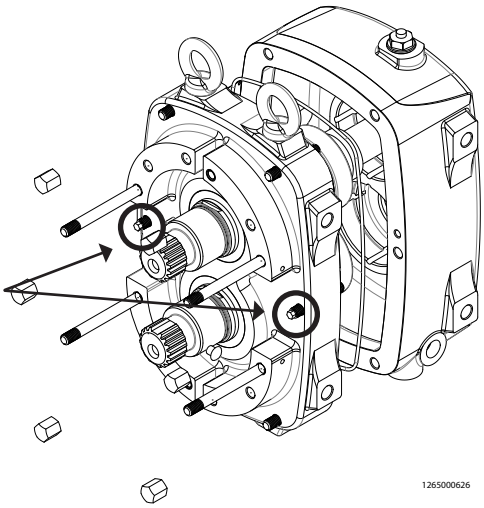


FIGURE 32



- Remove and discard the rear oil seal and shaft hole plug (Figure 33).
- Use a screwdriver to remove and discard the rear outer bearing race by pressing through the shaft holes.
- Install the rotor keys (models 15–20 only) and rotors onto the shafts.
- Place a 1/2” wooden dowel between the rotors to prevent the shafts from turning.
- Use a screwdriver to straighten the bent tab on each bearing locknut (Figure 34).
- Remove the bearing locknuts.
- Remove the bearing cover bolts (Figure 35).
- Remove the rotor bolts and rotors.
- Remove the shaft assemblies.

FIGURE 33

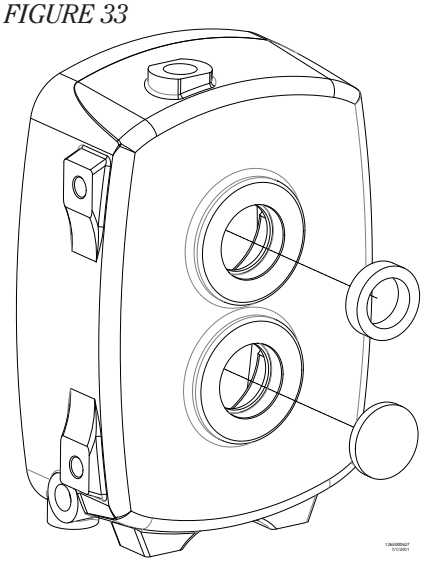


FIGURE 34

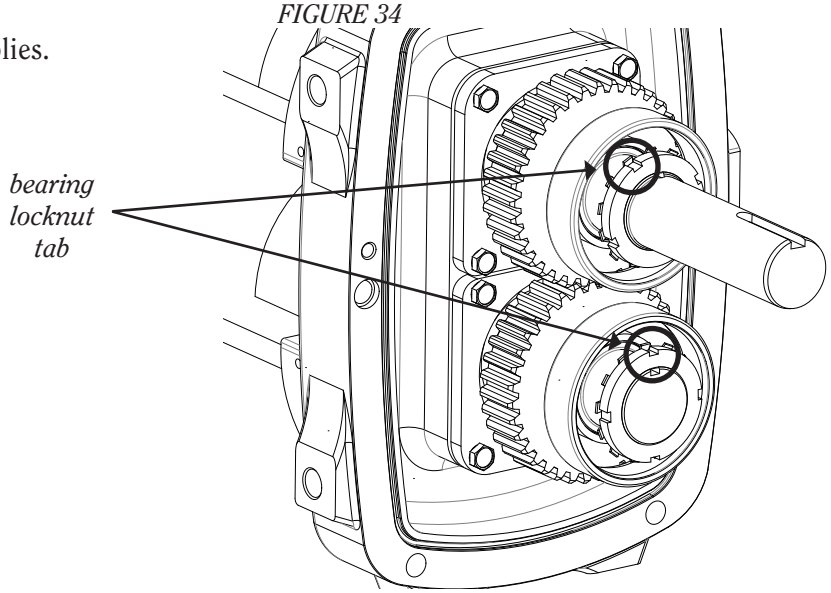
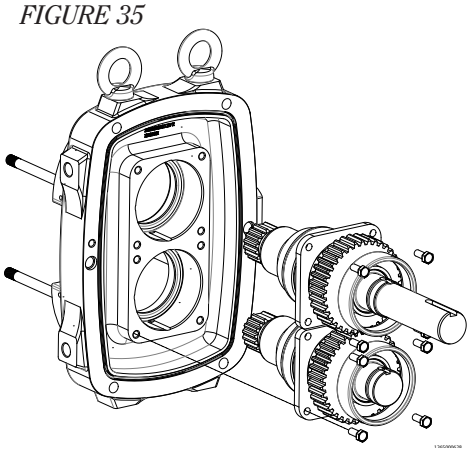


FIGURE 35



- Remove the rear bearing, gear and gear spacers by pressing on the bearing cover (Figure 36).
- Remove the rear bearing cover and gear key.
- Discard the rear bearing.
- Remove the front bearings and bearing spacers by pressing on the inner race of the front bearing.
- Discard the front bearings (Figure 37).
- Remove and discard the gapping shims (Figure 38).
- Remove and discard the front oil seals (Figure 39).

Note: Clean the gearbox, gears and shafts.

FIGURE 36

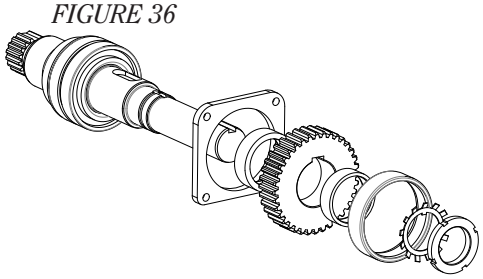


FIGURE 37

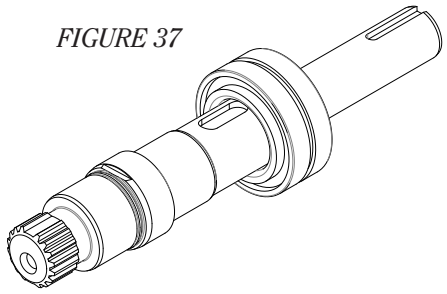


FIGURE 38

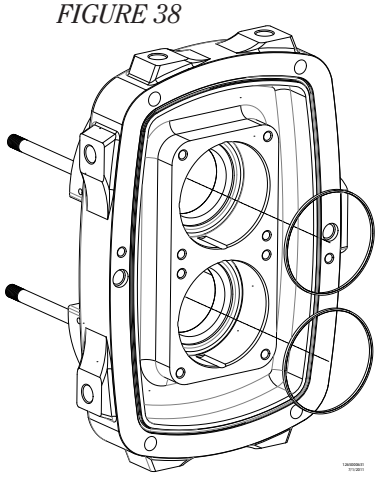
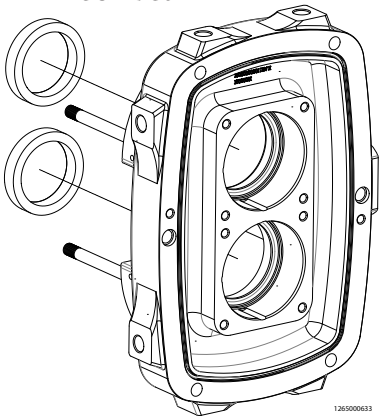


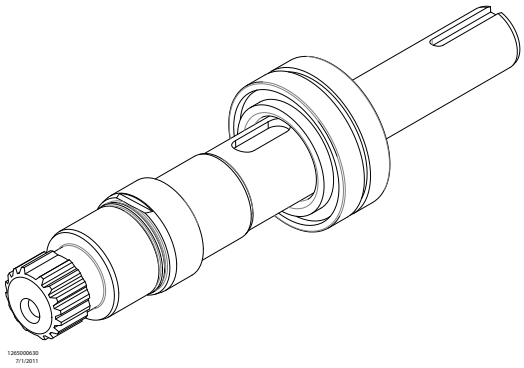
FIGURE 39



SHAFT AND GEARBOX ASSEMBLY

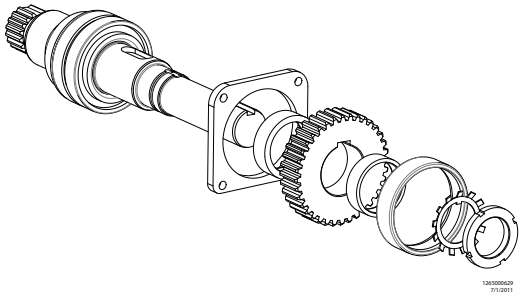
SHAFT ASSEMBLY

FIGURE 40



- Make sure to keep all bearing components together when removing them from the packaging. They must stay together in matched sets.
- Lightly grease the front bearing step of the shaft.
- Position shaft vertically, with front end down.
- Install the first bearing onto the shaft by pressing on the inner race (Figure 40).
- Install the inner and outer bearing spacers onto the shaft.
- Install the second bearing onto the shaft by pressing on the inner race.
- Note: Make sure the outer bearing spacer is flush with the outside of the bearings.
- Place the front bearing cover onto the shaft (Figure 41).

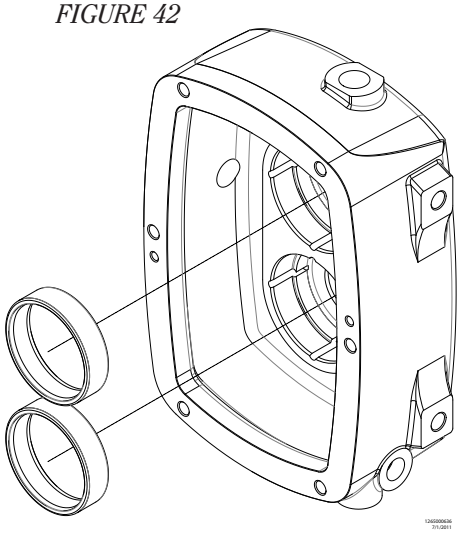
FIGURE 41



- Install the gear spacers, gear key and gear.
- Remove the outer race from the rear bearing and set aside.
- Install the remainder of the rear bearing onto the shaft by pressing on the inner race.
- Install the bearing locknut washer and bearing locknut.
- Repeat shaft assembly procedure for the other shaft.

SHAFT ASSEMBLY INSTALLATION

FIGURE 42



- Lightly grease the rear bearing bores.
- Install the gapping shims into the front gearbox.
- Press the outer bearing races (that had been set aside from the rear bearings) into the rear gearbox bearing bores (Figure 42).

- Install the gapping shims into the front gearbox (Figure 43).
- Install the shafts into the gearbox front by pressing on the inner bearing race of the rear bearing. Be sure to install the drive shaft into its original position (Figure 44).
- The gear keyways must be parallel.
- Rotate the bearing covers so the guideline stripe on each bearing cover meets in the middle (Figure 45).
- Tighten all of the bearing cover bolts.
- Install the rotor keys (models 15–20 only) and rotors onto the shafts.
- Place a 1/2" wooden dowel between the rotors to prevent the shafts from turning.
- Tighten the bearing locknuts with a torque wrench (Figure 45).
- Use a screwdriver to bend the bearing lockwasher tab into one of the slots on the locknut for each shaft.
- Remove rotors.

FIGURE 43

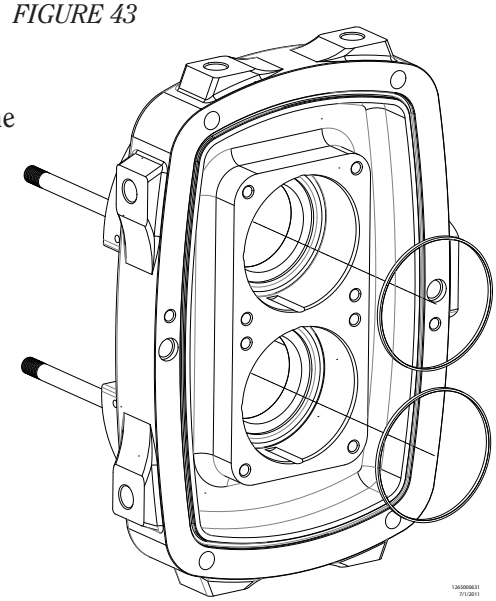


FIGURE 44

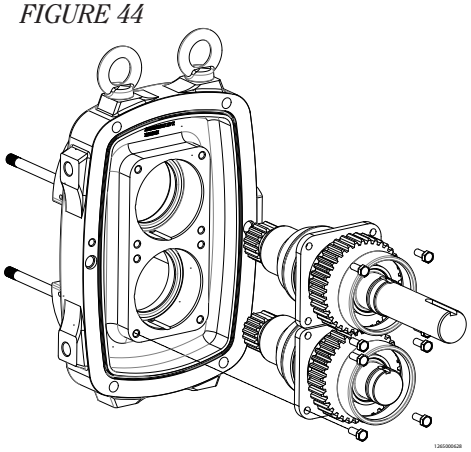
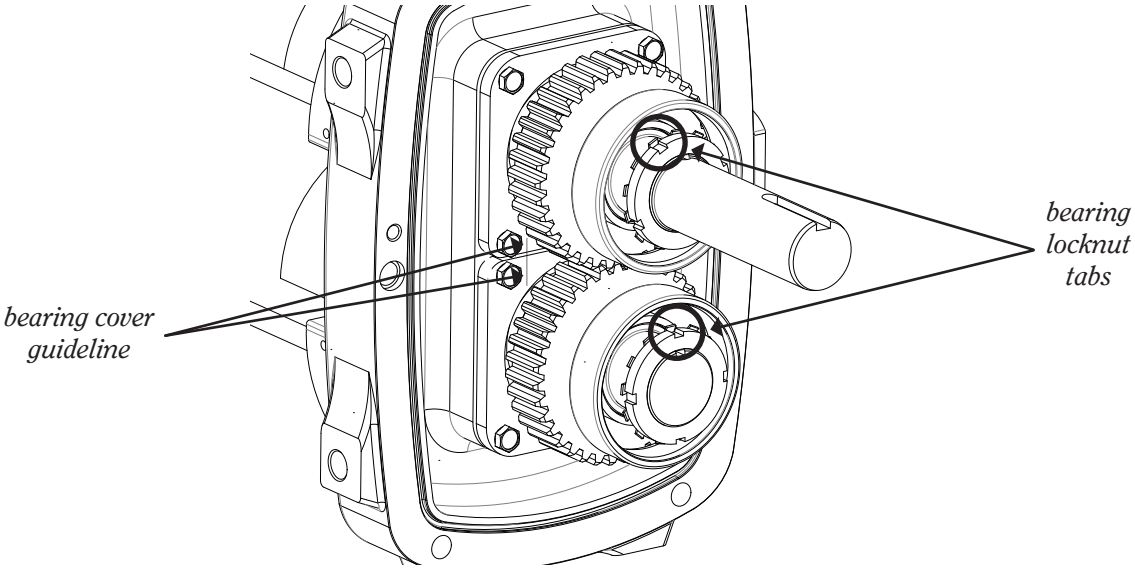


FIGURE 45



GEARBOX ASSEMBLY

- Install the gearbox o-ring (Figure 46).
- Install the rear gearbox onto the front gearbox.
- Use a torque wrench to tighten the gearbox nuts.
- Install the front oil seals into the front gearbox. Align the drain ports to 6:00 position (Figure 47).
- Install the rear oil seal inside the drive shaft bore in the rear gearbox. Align the drain port to 6:00 position (Figure 48).
- Install the shaft hole plug in the idle shaft bore in the rear gearbox.
- Install the oil drain plugs (Figure 49).
- Remove the vent cap and fill the gearbox with oil to the center of the sight glass.
- Replace the vent cap.

Once the gearbox is assembled, the seals and pump head can be assembled.

FIGURE 46

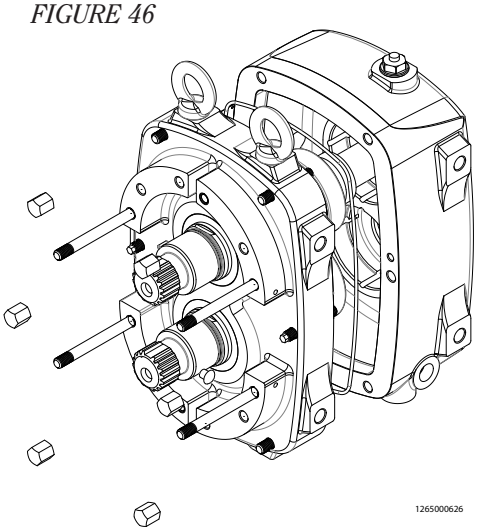


FIGURE 47

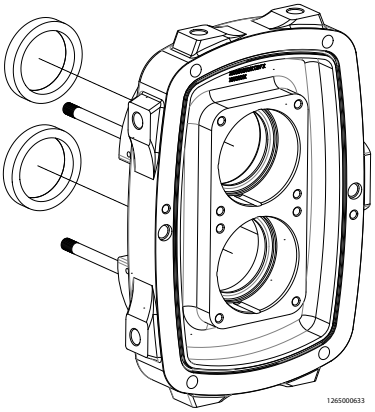


FIGURE 48

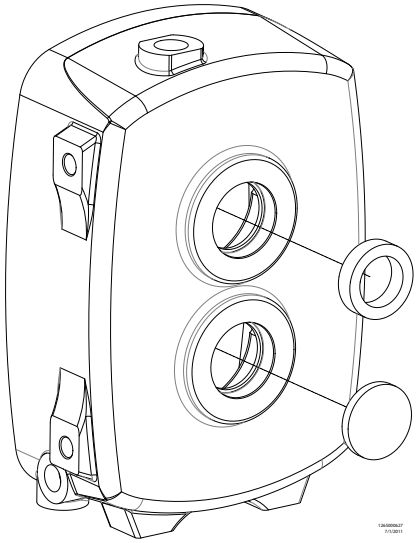
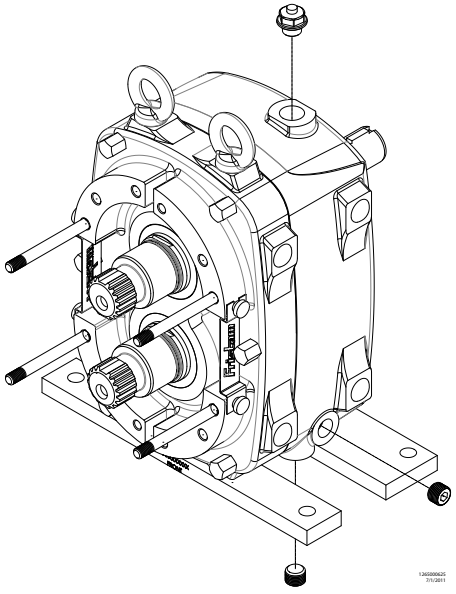


FIGURE 49



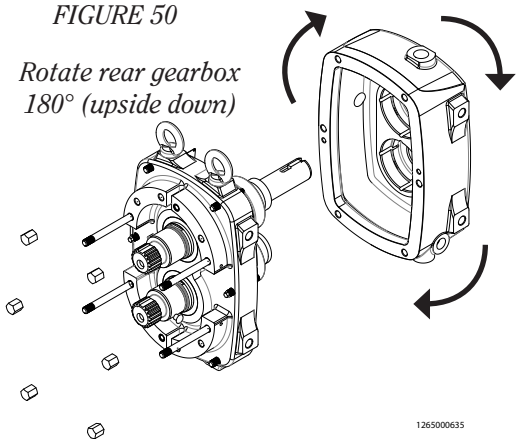
CHANGING DRIVE SHAFT POSITION

TOP-DRIVE TO BOTTOM DRIVE OR BOTTOM-DRIVE TO TOP-DRIVE

- Note: all oil must be drained from the gearbox during the entire drive shaft position changing procedure.
- Separate the rear gearbox from the front gearbox as explained in the “Gearbox Disassembly” section.
- Remove rear oil seal and shaft hole plug from the rear gearbox.
- Rotate the rear gearbox 180° so the vent cap hole moves to the bottom (Figure 50).
- Reinstall the rear gearbox into the front gearbox as explained in the “Gearbox Assembly” section, but do not refill with oil yet.
- Reinstall the rear oil seal and shaft hole plug so that the rear oil seal will match the new drive shaft position.

FIGURE 50

Rotate rear gearbox 180° (upside down)



- Rotate the entire assembled gearbox 180°. This will move the drive shaft to the opposite position and return the vent cap and sight glass to their correct positions.
- Uninstall and reinstall mounting straps or eyebolts, as necessary.

PUMP MAINTENANCE RECORD

DATE	SERVICED PERFORMED	PERFORMED BY

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2410 Parview Road • Middleton, WI 53562-2524
1-800-841-5001 • 608-831-5001
Website: www.fristam.com
Email: fristam@fristampumps.com