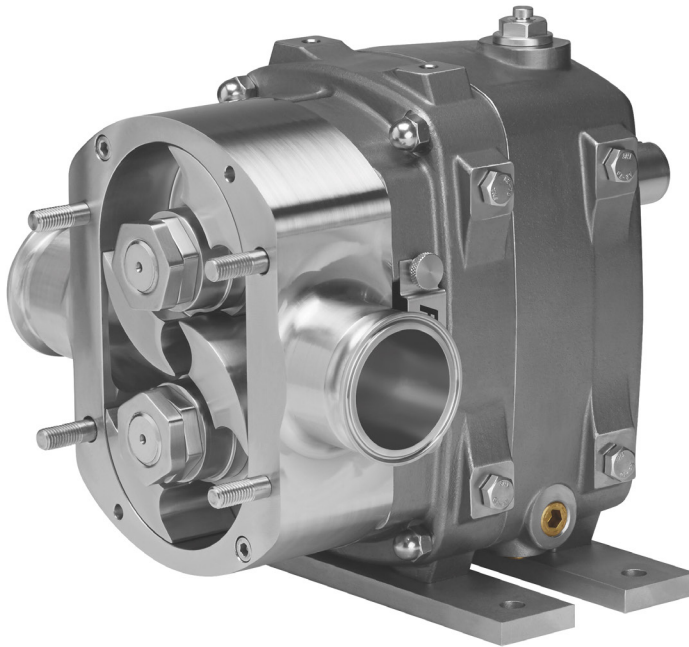




Engineered For Lasting Performance

Instruction and Maintenance Manual

FKL COP Positive Displacement Pump



DESCRIPTION

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

The FKL COP 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 COP 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 on most models. 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 COP 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 COP 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 300 PSI (model 25)

.....0 to 500 PSI (models 50–400)

Normal Speed Range 0 to 300 RPM (all models)

Normal Temperature Differential $\Delta 140^{\circ}\text{F}$

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)

LUBRICATION

Oil Grade* SAE 15W40

..... **Note: food grade lubricants available*

Oil Capacity (horizontal or vertical mount)

FKL COP 25..... 0.7 liters (0.75 US quart)

FKL COP 50..... 0.9 liters (1 US quart)

FKL COP 75..... 3.8 liters (4 US quarts)

FKL COP 150..... 4.7 liters (5 US quarts)

FKL COP 205..... 4.7 liters (5 US quarts)

FKL COP 250..... 5.7 liters (6 US quarts)

FKL COP 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 COP Recommended Torque Values							
Part	FKL 25	FKL 50	FKL 75	FKL 150	FKL 205	FKL 250	FKL 400
Cover Nut	15 ft-lb (20.3 N-m)	45 ft-lb (61 N-m)					
Rotor Nut	58 ft-lb (79 N-m)		75 ft-lb (102 N-m)	120 ft-lb (163 N-m)		150 ft-lb (204 N-m)	
Bearing Cap Screw	5 ft-lb (6.8 N-m)	15 ft-lb (20.3 N-m)			25 ft-lb (34 N-m)		
Bearing Lock Nut							
Mounting Strap Screw				70 ft-lb (95 N-m)			80 ft-lb (108 N-m)
Seal Housing Screw	2.5 ft-lb (3.4 N-m)						10 ft-lb (13.6 N-m)
Housing Screw	10 ft-lb (13.5 N-m)		45 ft-lb (61 N-m)				
Gearbox Nut	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 CLEARANCE GUIDELINES

Rotor Clearances: COP			
	Back Face	Front Face	Radial
25	0.04 - 0.10 (0.0015" - 0.0040")	0.02 - 0.14 (0.0010" - 0.0055")	0.03 - 0.11 (0.0010" - 0.0045")
50	0.04 - 0.10 (0.0015" - 0.0040")	0.02 - 0.14 (0.0010" - 0.0055")	0.03 - 0.11 (0.0010" - 0.0045")
75	0.04 - 0.10 (0.0015" - 0.0040")	0.02 - 0.14 (0.0010" - 0.0055")	0.03 - 0.11 (0.0010" - 0.0045")
150	0.05 - 0.11 (0.0020" - 0.0045")	0.03 - 0.15 (0.0010" - 0.0060")	0.04 - 0.12 (0.0015" - 0.0045")
205	0.05 - 0.11 (0.0020" - 0.0045")	0.03 - 0.15 (0.0010" - 0.0060")	0.03 - 0.13 (0.0010" - 0.0050")
250	0.06 - 0.12 (0.0025" - 0.0045")	0.04 - 0.16 (0.0015" - 0.0065")	0.04 - 0.14 (0.0015" - 0.0055")
400	0.06 - 0.12 (0.0025" - 0.0045")	0.03 - 0.17 (0.0010" - 0.0065")	0.04 - 0.14 (0.0015" - 0.0055")

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.

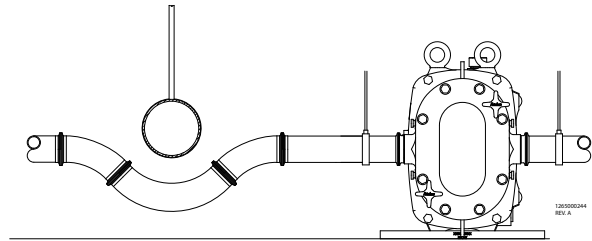
PIPING

CAUTION: Because the FKL COP 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 COP series pump:

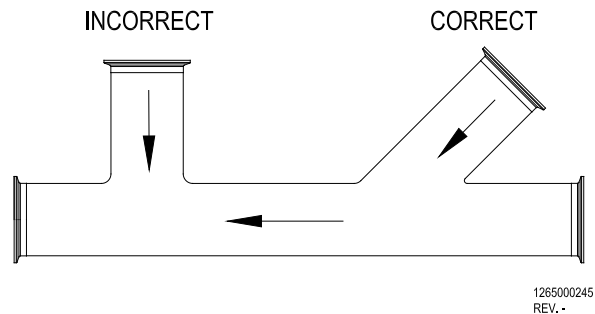
- Slope inlet piping up to pump to avoid air pockets (support all piping independently to minimize the forces exerted on the pump).
- Ensure that the piping can accommodate thermal expansion without stressing the pump.
- Slope inlet piping up to pump to avoid air pockets.

FIGURE 3



- 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).

FIGURE 4



- 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 than 2 pipe diameters (figure 6).

FIGURE 5

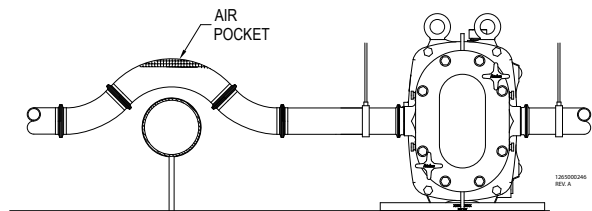
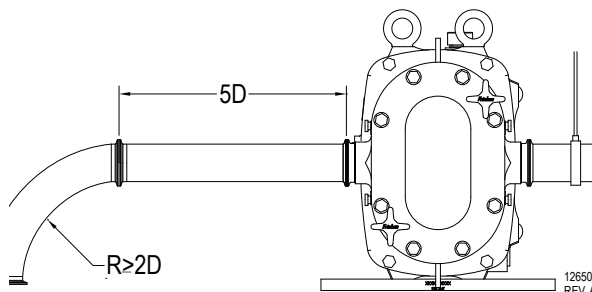


FIGURE 6



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. 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 parallel, 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 table A1. If a correction is necessary, be sure to recheck the parallel alignment.
- Reinstall the wire ring on the O.D. of the coupling sleeve.

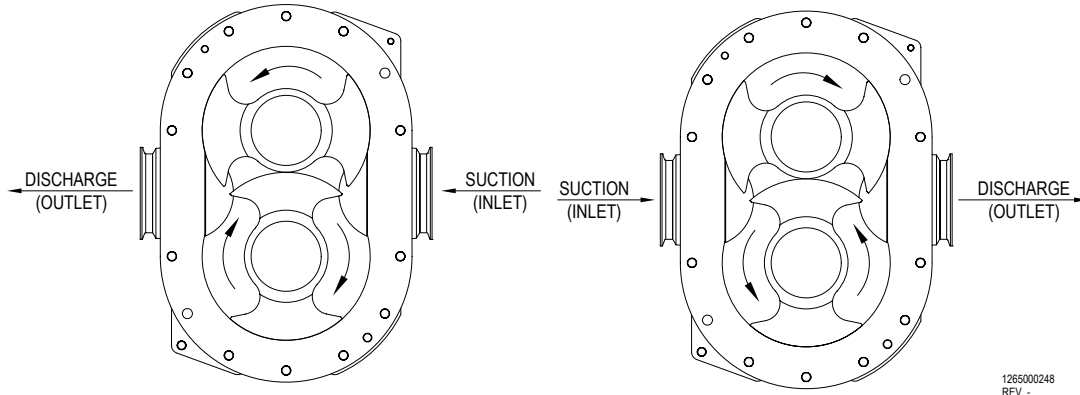
ELECTRICAL CONNECTIONS

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.

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. 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. 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.

Fristam Pumps 10



RECOMMENDED PREVENTIVE MAINTENANCE

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.

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.

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 COP pump is extremely small, below are the recommended temperature differential maximum.

FKL COP Temperature Differential

$\Delta 140^{\circ}\text{F}$ standard rotors

CLEANING RECOMMENDATIONS

The FKL COP pump is designed to be disassembled and cleaned daily. Clean all product contact parts according to normal COP equipment procedures and replace all O-rings during cleaning.

A recommended cleaning procedure is as follows:

1. Remove cover nuts
2. Remove front cover using jack screws
3. Inspect cover gasket and clean gasket and groove
4. Remove rotor nuts and clean
5. Remove rotors and clean
6. Remove housing by removing housing cap screws, then slide housing forward
7. Place housing face down, remove and inspect housing O-rings. Clean housing including housing O-ring groove
8. Remove shaft sleeves and clean
9. Remove shaft O-rings and clean shaft and O-ring groove
10. Inspect all O-rings. If damaged, frayed, or hard replace
11. Lube all O-rings with food grade grease
12. Install shaft O-rings in O-ring groove in shaft
13. Inspect shaft sleeve. If grooving is found reverse sleeve and install sleeve opposite way. If grooving is found on both sides of sleeve replace sleeve
14. Place shaft sleeve on shaft
15. Install the housing O-rings into the grooves inside the housing
16. Install housing by carefully sliding the housing onto the studs and over the shafts
17. Install rotors onto shafts. Rotors with one dot should match shaft with one dot. Rotors with 2 dots should match shaft with 2 dots
18. Tighten 1st rotor jam nut and then the 2nd. Repeat for 2nd shaft
19. Place a 1/2" diameter dowel between the rotors. Use a torque wrench to tighten the rotor nuts
20. Install cover O-ring
21. Install cover nuts and cover nut washers and torque

MAINTENANCE TOOLS REQUIRED

Pump head and seals

- Allen wrench set
- Socket set with torque wrench
- Flat-blade screwdriver
- Soft-faced hammer
- .5"-1.5" diameter dowel
- Food-grade lubricant
- Denatured alcohol and soft cloth
- COP nut wrench

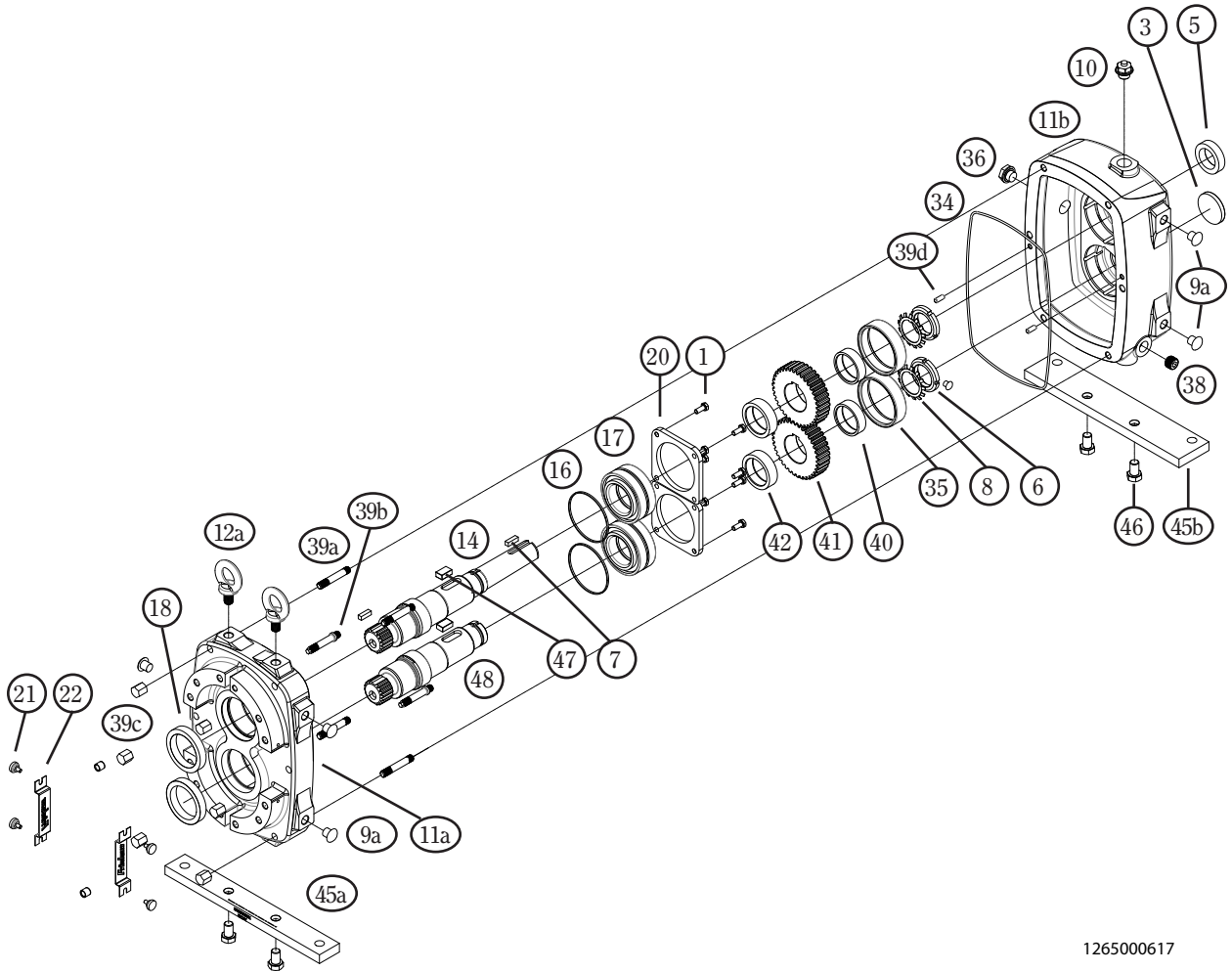
Model	25	50	75	150	205	250
Wrench sizes (mm)						
Cover nuts (socket)	13	19	19	19	19	19
COP rotor locknuts	38	58	58	70	70	89
Housing bolts (Allen)		10	13	19	19	19

Gearbox

- Hydraulic or Arbor press
- Long Allen wrench set
- Socket set with torque wrench
- Flat-blade screwdriver
- Soft-faced hammer
- 0.5"-1.5" diameter dowel
- Spanner wrench set
- Grease
- Food-grade lubricant
- Threading compound
- Shim packet

Model	25	50	75	150	205	250	400
Wrench sizes (mm)							
Gearbox nuts (socket)	13	17	19	19	24	24	24
Bearing retainer bolts (Allen)	5	5	6	6	6	6	8
Bearing locknut (spanner)	52	58	65	70	98	98	110

FKL COP PUMP GEARBOX ASSEMBLY



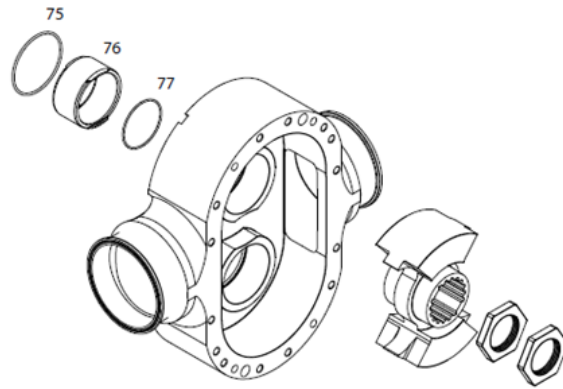
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PARTS LIST

Item	Description	Qty	25	50	75	150	205	250	400
1	Bearing cover bolt	8*	1101000255	1101000239	1101000239	1101000239	1101000256 (*10)	1101000256 (*10)	1101000256 (*12)
3	Shaft hole plug	1	1812000065	1812000062	1812000064	1812000061	1812000067	1812000066	1812000068
5	Rear oil seal	1	1812000055	1812000058	1812000051	1812000048	1812000056	1812000046	1812000047
6	Bearing lock nut	2	1306000006	1306000112	1306000002	1306000005	1306000004	1306000004	1306000007
7	Coupling key	1	1315000013	1315000011	1315000026	1315000026	1315000042	1315000025	1315000028
8	Bearing lock nut washer	2	1104000019	1104001051	1104000021	1104000018	1104000017	1104000017	1104000020
9a	Gearbox hole plug (mild steel)	5*	1101000251	1101000251	1101000253	1101000253	1101000253	1101000253	1101000254
	Gearbox hole plug (stainless steel)		1101000252	1101000252	1101000206	1101000206	1101000206	1101000206	1101000266
9b	Cover hole plug	1	N/A	N/A	N/A	N/A	1101000252	1101000252	1101000252
10	Vent plug	1	1248000034	1248000036	1248000036	1248000036	1248000036	1248000036	1248000036
11a	Front gearbox (cast iron)	1	1310600204	1310600189	1310600197	1310600185	1310600220	1310600213	1310600252
	Front gearbox (stainless steel)		1310600203	1310600188	1310600196	1310600183	1310600219	1310600212	1310600251
11b	Rear gearbox (cast iron)	1	1310600206	1310600191	1310600199	1310600186	1310600222	1310600215	1310600254
	Rear gearbox (stainless steel)		1310600205	1310600190	1310600198	1310600184	1310600221	1310600214	1310600253
12a	Gearbox Eyebolt (mild steel)	2	1101000072	1101000073	1101000164	1101000164	1101000164	1101000164	1101000152
	Gearbox Eyebolt (stainless steel)		1101000248	1101000244	1101000242	1101000242	1101000242	1101000242	1101000267
12b	Cover Eyebolt	1	N/A	N/A	N/A	N/A	1101000244	1101000244	1101000244
14	Drive shaft (COP)	1	1372600219	1372600215	1372600217	1372600207	1372600221	1372600209	1372600223
15	Housing stud (long)	4*	1103000146 (*2)	1103000123 (*2)	1103000130	1103000102	1103000157	1103000105	1103000169
16	Gapping shim kit	1	1080000054	1080000099	1080000056	1080000056	1080000057	1080000057	1080000058
17	Front bearing assembly	2	1173000013	1173000048	1173000014	1173000016	1173000018	1173000017	1173000019
18	Front oil seal	2	1812000054	1812000046	1812000053	1812000047	1812000057	1812000045	1812000049
20	Front bearing cover	2	1304000040	1304000035	1304000036	1304000034	1304000042	1304000041	1304000043
21	Guard screw	4	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000	1102000000
22	Gearbox guard	2	1936000165	1936000159	1936000161	1936000158	1936000172	1936000169	1936000187
23	Housing/Cover pin	4*	1891000069	1891000069	1891000073	1891000073	1891000076	1891000076	1891000076
24	Housing screw	2	1101000249	1101000245	1101000246	1101000243	1101000257	1101000257	1101000265
25	Pump housing	1	1656610052	1658610091	1660610053	1668610060			
26	Housing stud (short)	4*	1103000147	1103000101 (*2)	1103000099	1103000091	1103000095 (*10)	1103000097 (*10)	1103000103 (*12)
27	Rotor o-ring (viton)	2	1180000243	1180000120	1180000014	1180000115	1180000253	1180000212	1180000234
28	Rotor (COP)	2	1657630020	1658630101	1661630025	1669630028	1665630012	1671630026	1673630006
31	Cover gasket (buna - standard)	1	1180000165	1180000595	1180000593	1180000590	1180000817	1180000586	1180000757
32	Pump cover	1	1656620012	1658620018	1660620018	1668620020	1664620002	1670620011	1670620006
33	Forcing screw	2	1018000074	1018000074	1018000075	1018000075	1018000089	1018000089	1018000089
34	Gearbox gasket	1	1180000983	1180000948	1180000951	1180000952	1180000847	1180000991	1180001164
35	Rear bearing assembly	2	1173000050	1173000045	1173000049	1173000044	1173000051	1173000051	1173000053
36	Oil sight glass	1	1248000029	1248000028	1248000028	1248000028	1248000028	1248000028	1248000028
38	Oil drain plug	2	1248000030	1248000031	1248000031	1248000031	1248000031	1248000031	1248000031
39a	Gearbox stud	4*	1103000148	1103000124	1103000142	1103000142 (*6)	1103000154 (*6)	1103000154 (*6)	1103000168 (*6)
39b	Gearbox forcing stud	2	1103000149	1103000126	1103000125	1103000125	1103000158	1103000155	1103000155
39c	Gearbox nut	6*	1103000032	1101000137	1103004835	1103004835	1103000012 (*8)	1103000012 (*8)	1103000012 (*8)
39d	Gearbox pin	2	1891000067	1891000069	1891000069	1891000069	1891000076	1891000076	1891000076
40	Gear spacer (rear)	2	1224000021	1224000113	1224000115	1224000112	1224000117	1224000016	1224000020
41	Gear	2	1365000003	1365000005	1365000004	1365000014	1365000013	1365000001	1365000002
45a	Front mounting strap (mild steel)	1	1925000031	1925000026	1925000027	1925000029	1925000044	1925000035	1925000045
	Front mounting strap (stainless steel)		1925000032	1925000022	1925000020	1925000016	1925000043	1925000034	1925000046
45b	Rear mounting strap (mild steel)	1	1925000031	1925000026	1925000028	1925000030	1925000044	1925000035	1925000045
	Rear mounting strap (stainless steel)		1925000032	1925000022	1925000021	1925000017	1925000043	1925000034	1925000046
46	Mounting strap screw (mild steel)	4	N/A	N/A	1101000033	1101000033	1101000033	1101000033	11010000270
	Mounting strap screw (stainless steel)		1101018615	1101018615	1101000206	1101000206	1101000206	1101000206	1101000039
47	Gear key	2	1315000014	1315000030	1315000029	1315000012	1315000043	1315000024	1315000027
48	Idle shaft (COP)	1	1372600220	1372600216	1372600218	1372600208	1372600222	1372600210	1372600224
50	Rotor bolt o-ring (viton)	2	1180000085	1180000085	1180000085	1180000095	1180000398	1180000398	1180000398
51	Rotor nut	4	1102000057	1102000057	1102000049	1102000049	1102000050	1102000050	1102000055
52	Cover nut washer	8*	1104000000 (*6)	1104000002 (*4)	1104000002	1104000002	1104000002 (*14)	1104000002 (*14)	1104000002 (*16)
53	Cover nut	8*	1103000032 (*6)	1103000018 (*4)	1103000018	1103000018	1103000018 (*14)	1103000018 (*14)	1103000018 (*16)
72	Rotor Key	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A

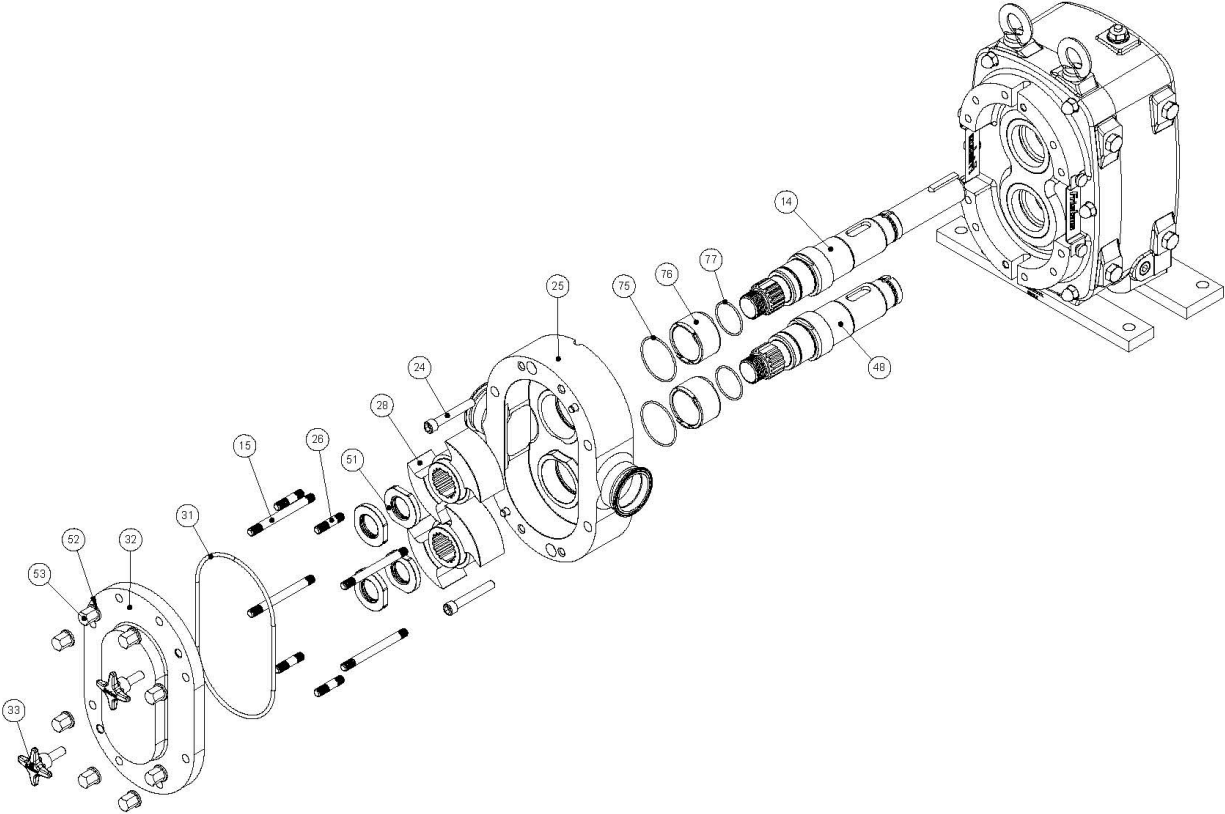
* Quantities may vary

FKL COP O-RING SEAL ASSEMBLY



SINGLE FKL COP O-RING SEAL									
Item	Description	Qty	25	50	75	150	205	250	250
75	Outer seal o-ring (viton)	2	1180000457	1180000467	1180000467	1180000231	1180000216	1180000212	1180000239
76	Shaft sleeve: 316L (standard)	2	1810600369	1810600370	1810600371	1810600372	1810600373	1810600374	1810600375
	Shaft sleeve: 316L (hardened)		1810600367	1810600365	1810600366	1810600359	1810600368	1810600360	1810600376
77	Inner seal o-ring (viton)	2	1180000086	1180000243	1180000383	1180000111	1180000122	1180000232	1180000217

FKL COP PUMP HEAD ASSEMBLY



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.

FIGURE 11

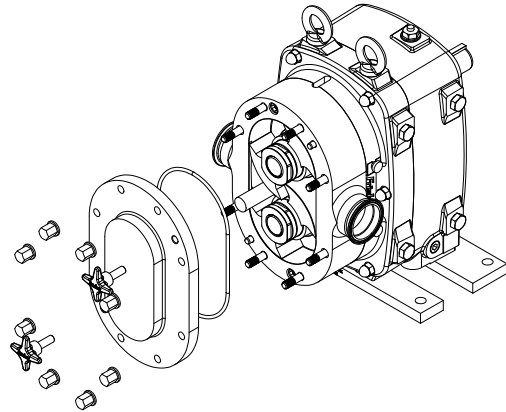
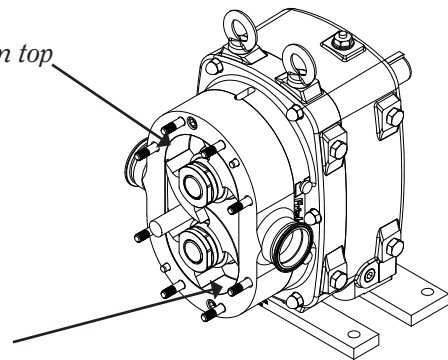


FIGURE 12

REMOVE THE ROTORS

- Place a 1/2" diameter dowel between the rotors (Figure 12).
- Remove the rotor nuts (Figure 13).
- Remove the rotors. Note: Keep rotors free from damage (i.e. nicks, dings) to ensure high efficiency the pump was designed for.

Place dowel here to loosen top rotor nut



Place dowel here to loosen bottom rotor nut

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.

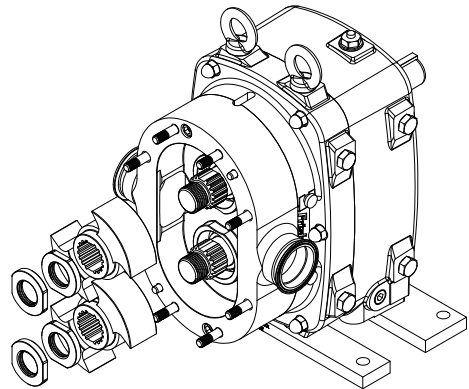
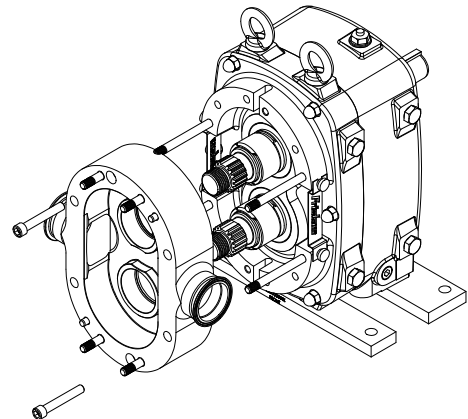
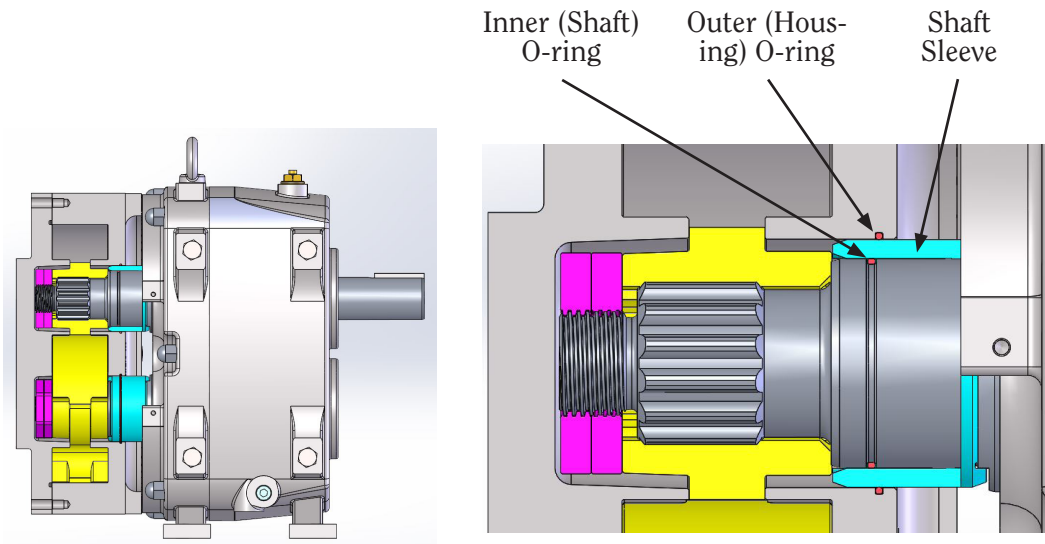


FIGURE 14



COP O-RING SEAL REMOVAL

- Place the housing face down.
- Remove and discard the housing O-rings.
- Remove the shaft sleeves and set aside.
- Remove and discard the shaft O-rings.



COP O-RING SEAL INSTALLATION

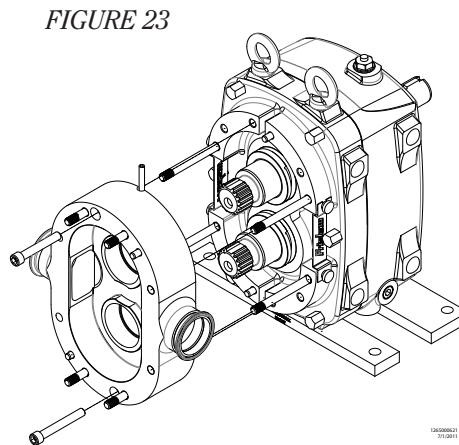
- Install the shaft O-rings onto the grooves in the shafts.
- Install the shaft sleeves onto the shafts.
- Install the housing O-rings into the grooves inside the housing.

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.

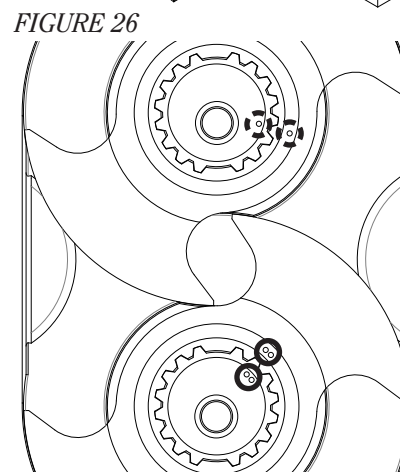
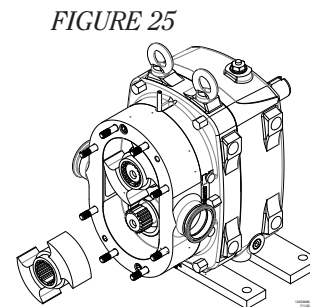
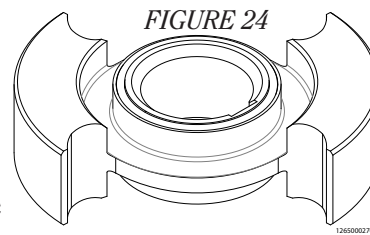
INSTALL HOUSING

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



INSTALL ROTORS

- 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).



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- Install the rotor nut assemblies onto the rotors. Tighten the first rotor nut, then the second on each shaft.
- Place a 1/2" diameter dowel between the rotors. Use a torque wrench to tighten the rotor nuts (Figure 28).

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

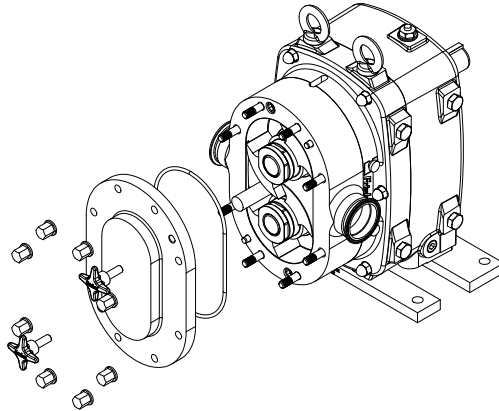
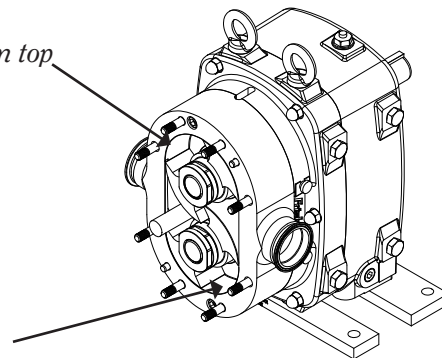


FIGURE 28

Place dowel here to loosen top
rotor nut



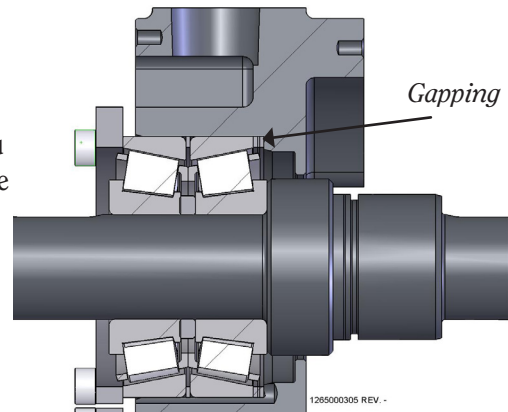
Place dowel here to loosen bottom
rotor nut

SETTING THE ROTOR CLEARANCE

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).

FIGURE 29

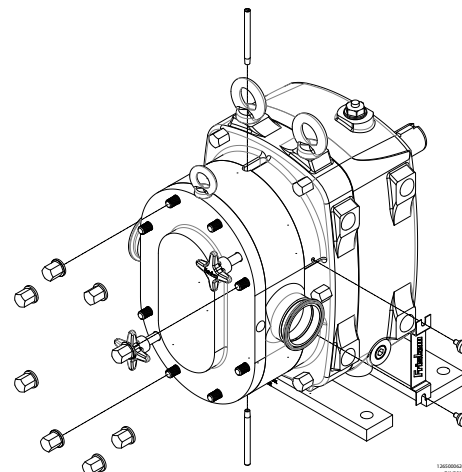


FORMULA	EXAMPLE "A"	EXAMPLE "B"
Measured back face clearance	0.14mm	0.07mm
– Median standard back face clearance	– 0.10mm	– 0.10mm
= Gapping shims to add (remove)	= 0.04mm to add	= 0.03mm to remove

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.

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

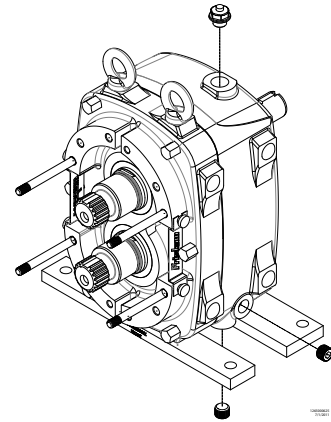
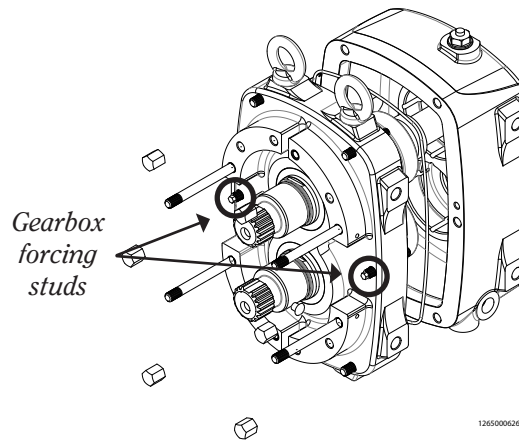


FIGURE 32



- 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.
- 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 retainer bolts (Figure 35).
- Remove the rotor nuts and rotors.
- Remove the shaft assemblies.

FIGURE 33

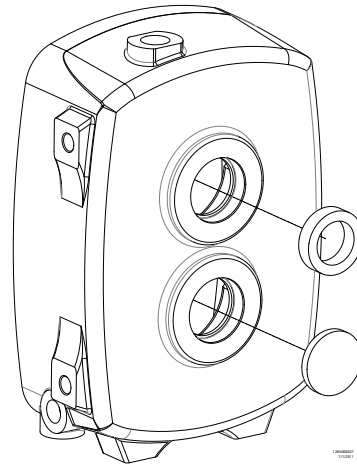


FIGURE 34

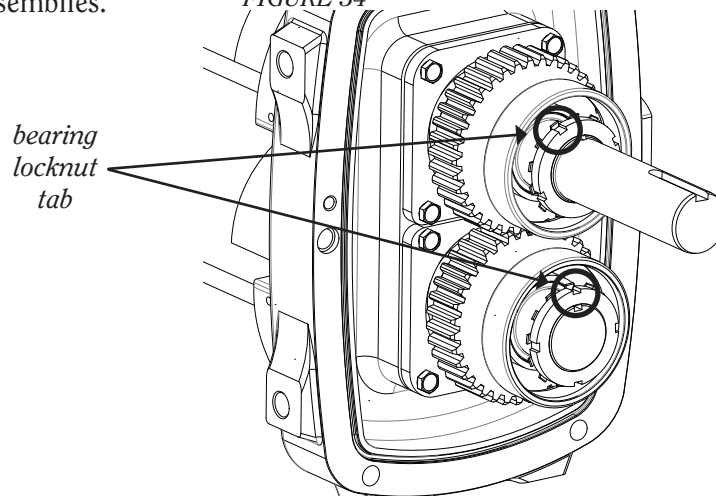
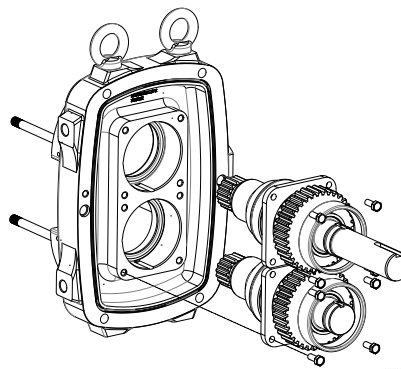


FIGURE 35



SHAFT AND GEARBOX ASSEMBLY

SHAFT ASSEMBLY

- 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 retainer onto the shaft (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.

FIGURE 40

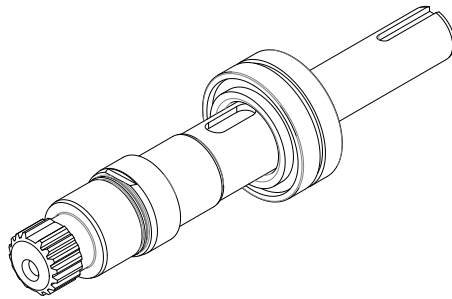


FIGURE 41

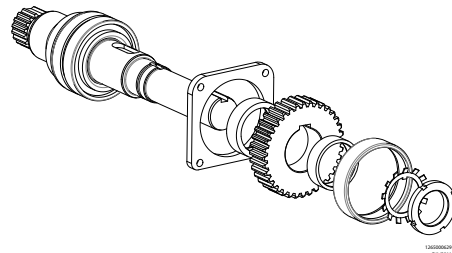
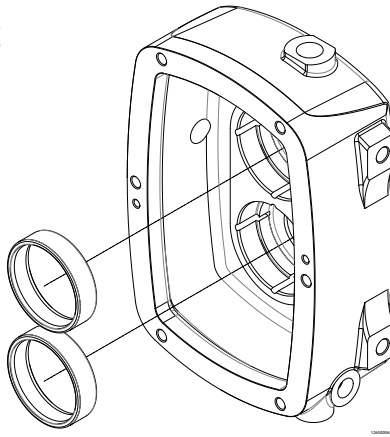


FIGURE 42



SHAFT ASSEMBLY INSTALLATION

- 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).

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