Fristam PUMPS®

Engineered For Lasting Performance®

INSTRUCTION AND MAINTENANCE MANUAL:

FM Series Pump

3A nqa. ISO 9001 Registered ANAB ACCREDITED

SANITARY CENTRIFUGAL PUMPS

Description

This manual contains installation, operation, assembly, disassembly and repair instructions for the Fristam FM multi-stage pump.

The motors are standard NEMA totally enclosed fan cooled (TEFC) motors. These motors do require feet. Replacement motors are readily available from local motor distributors.

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.

Table of Contents

Technical Information

Specifications

Maximum Inlet Pressure
- FM3 ..... 1000 PSI
- FM5 ..... 750 PSI

Temperature Range ..... -40°F - 400°F
Noise Level ..... 60 - 85 dB(A)

Standard Materials of Construction (Note: Other options available)

Product Contact Components ..... AISI 316L Stainless Steel
Pump Seal Components
- Single Rotating Seal ..... 316L Stainless Steel with Silicon Carbide Insert (silver/gray)
- Stationary Seals ..... Silicon Carbide (black)
- Double Rotating Seal ..... Carbon (white)

Product Contact Surface Finish ..... 32 in R_a
Gaskets / O-rings ..... Viton
Bearing Block ..... Cast Iron

Seal Information

Double Mechanical
- Recommended Seal Flush Pressure ..... 5 PSI Maximum
- Recommended Seal Flush Flow ..... 1-2 Gallons per Hour

Recommended Torque Values

Cover Nuts ..... 105 ft-lbs
Impeller Nut
- FM3 ..... 40 ft-lbs
- FM5 ..... 90 ft-lbs

Seal Retaining Ring Bolts ..... 5 ft-lbs
Seal Driver Set Screw (FM3 only) ..... 10 in-lbs
Housing Bolts ..... 50 ft-lbs
Bearing Cap Bolts ..... 10 ft-lbs
Bearing Locknut ..... 50 ft-lbs

Impeller Gaps (Impeller to Housing)

All FM Pumps ..... 0.8-1.0 mm (0.030-0.040”)

Lubrication

Bearing Block Oil ..... ISO VG 68

Tools for Assembly & Disassembly

7/16" socket ..... Seal Retaining Ring Bolts
Ratchet ..... For loosening bolts
Torque wrench..... For proper tightening
Adjustable pliers ..... For removing Water Pipes
Chain wrench..... For holding the Shaft when tightening & loosening the Impeller Nut
Food grade lubricant .....For lubricating o-rings & gaskets
Standard screwdriver..... For installing & removing the Bearing Lockwasher
Soft-face hammer ..... For installing & removing the Shaft
Feeler gages ..... For gapping the Impeller
FM3 Tools
- 15/16" socket ..... Impeller Nut
- 1" socket ..... Cover Nuts
- 3/32" Allen wrench socket..... Double Seal Driver Set Screw
- 3/4" socket ..... Housing Bolts
- 1/2" socket ..... Bearing Cap Bolts
- M50 Spanner wrench ..... Bearing Locknut

FM5 Tools
- 24mm socket ..... Cover Nuts
- 32mm socket ..... Impeller Nut
- 18mm socket ..... Housing Bolts
- 13mm socket ..... Bearing Cap Bolts
- M65 Spanner wrench ..... Bearing Locknut

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.

Elastomer Inspection

Inspect all elastomers when performing pump maintenance. We recommend replacing elastomers (o-rings and gaskets) during seal, pump shaft and/or motor replacement. If the impeller nut gasket fails, the threaded hole on the impeller nut and the threads on the end of the shaft will need to be cleaned. A wire brush is recommended for cleaning these threads.

Lubrication

The oil level should be maintained to the center of the sight glass on the side of the bearing block. It is recommended that when the pump is first installed the oil is changed after the initial 20 hours of operation. After this, the oil should be changed every 2,000 hours or 3 months under normal operating conditions. Make sure the oil drain pipe and cap are properly tightened to prevent any oil leakage from the bearing block.

Motor Maintenance

Consult motor manufacturer for recommended maintenance.

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. Remove the shaft guard and rotate the pump shaft by hand to make sure the impeller rotates freely. 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 (i.e. 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.

Piping Guidelines

This section describes good piping practices to obtain maximum efficiency and service life from your pump.

Maximum performance and trouble-free operation require adherence to good piping practices.

Figure 1

Ensuring proper piping support and alignment at both the suction inlet and discharge outlet can help prevent serious damage to the pump housing.

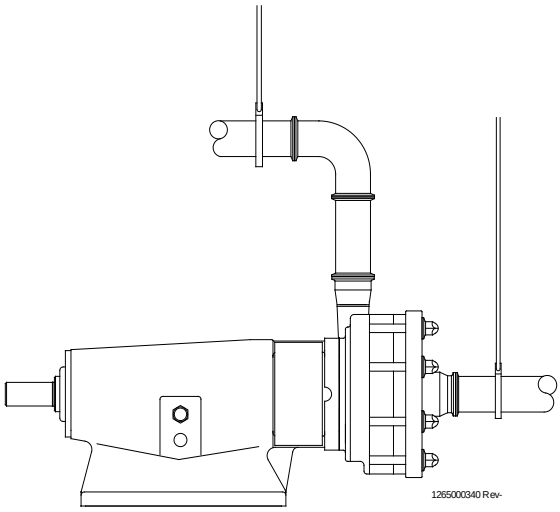


Figure 2

Avoid abrupt transitions in the piping system.

Avoid throttling valves in the suction piping.

Keep suction lines as short and direct as possible.

Ensure that the NPSH available in the system is greater than NPSH required by the pump.

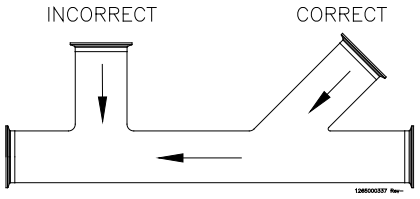


Figure 3

Avoid sump areas where sediments may collect.

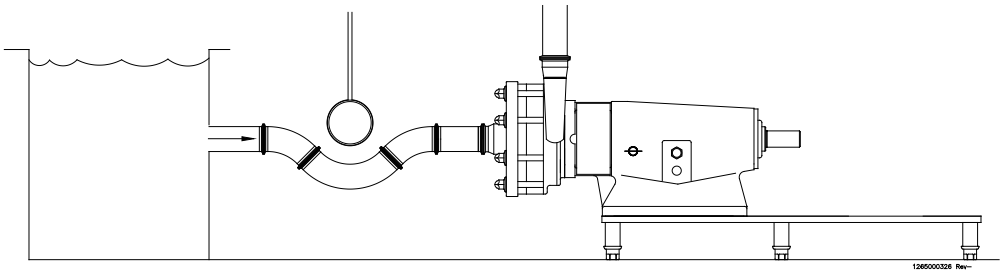


Figure 4

Avoid the formation of air pockets in the piping.

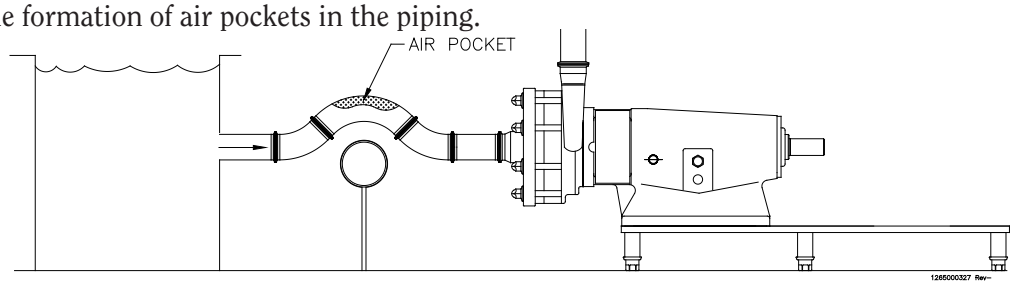
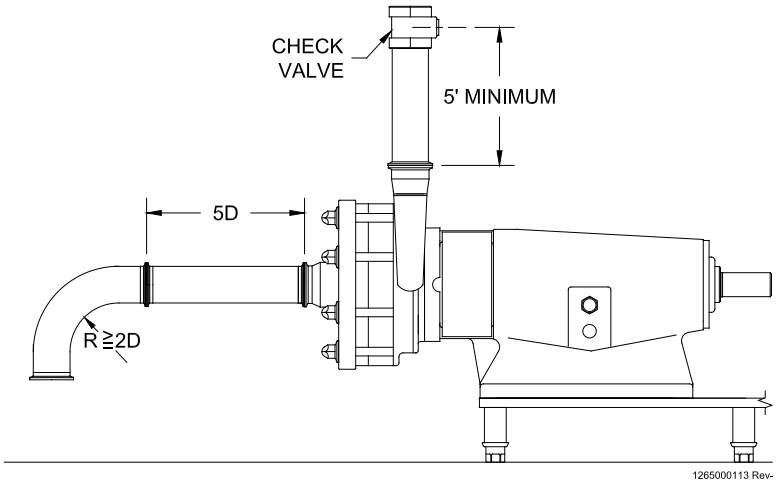


Figure 5

Avoid abrupt closure of shut-off valves, this maycause 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.

Check valves in discharge line should be a minimum of 5 ft. away from the pump outlet.



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 6). 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 exceeds the figure shown under "Parallel" in the table, 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. If a correction is necessary be sure to recheck the parallel alignment.
- Reinstall the wire ring on the O.D. of the coupling sleeve.

Woods Sure-Flex Coupling Alignment

Sleeve Size	Type E			Type E		
	Parallel A	Angular Y max. - Y min.	Y*	Parallel A	Angular Y max. - Y min.	Y*
6	0.015"	0.070"	2.375"	0.015"	0.070"	2.375"
7	0.020"	0.081"	2.563"	0.020"	0.081"	2.563"
8	0.020"	0.094"	2.938"	0.020"	0.094"	2.938"
9	0.025"	0.109"	3.500"	0.025"	0.109"	3.500"
10	0.025"	0.128"	4.063"	0.025"	0.128"	4.063"
11	0.032"	0.151"	4.875"	0.032"	0.151"	4.875"
12	0.032"	0.175"	5.688"	0.032"	0.175"	5.688"
13	0.040"	0.195"	6.688"	0.040"	0.195"	6.688"
14	0.045"	0.242"	7.750"	0.045"	0.242"	7.750"
* The "Y" dimension is shown for reference.						

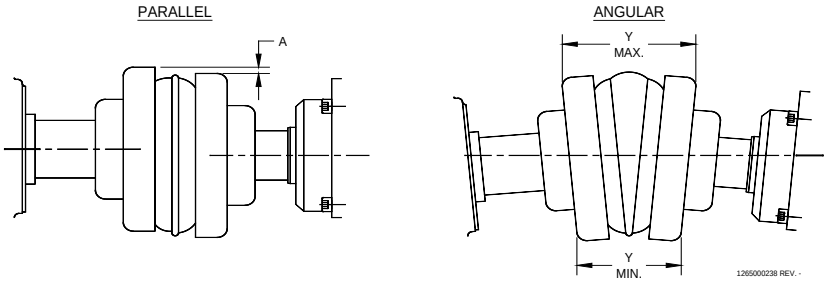


Figure 6

Electrical Installation

The size of the motor selected should meet the requirements of the operating conditions. A change in conditions (for example, higher viscosity, higher product specific gravity) can overload the motor. For technical assistance regarding operating condition changes, please contact Fristam Pumps.

Have an electrician connect the motor using sound electrical practices. Ensure that proper motor overload protection is provided.

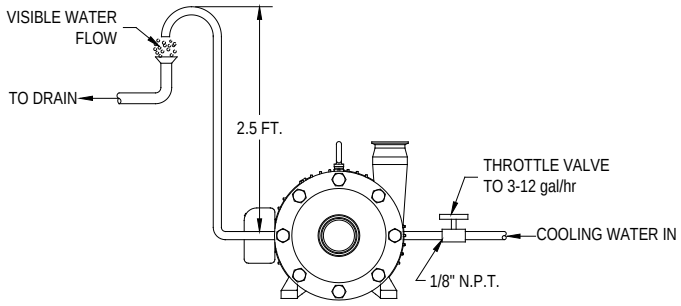
Water Flush Installation

Figure 7

Set up the water flush for the double mechanical seal as shown. **Use only 3-12 gallons per hour of water at a pressure of 1-2 PSI.** Excessive seal pressure and/or flow rate through the product seal cavity may cause increased seal wear and shorten seal life.

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.

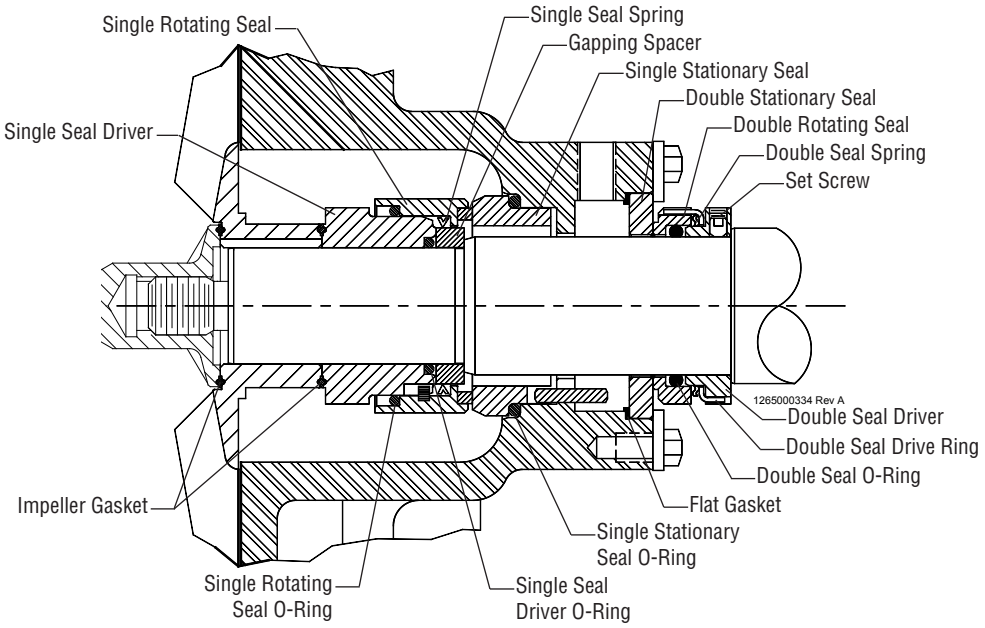


WATER FLUSH CONNECTIONS 1265000333 Rev-

Start-up Instructions

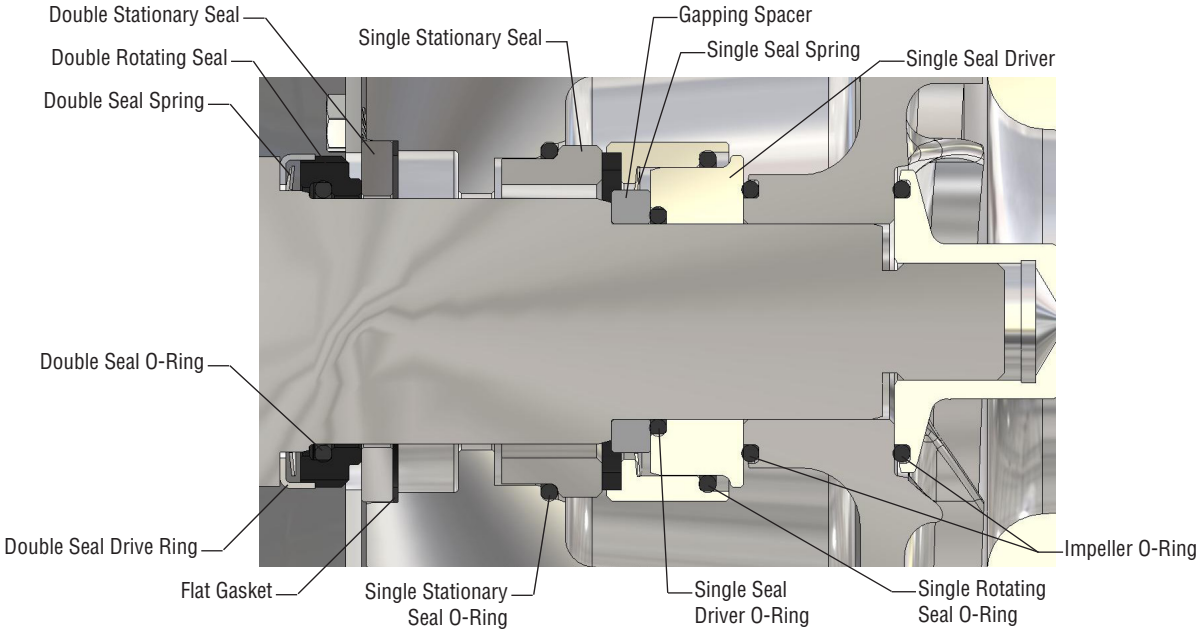
- Remove any foreign matter that may have entered the pump. Do not use the pump to flush the system.
- Before adding oil to the bearing block check the oil drain pipe and cap to make sure they are both properly tightened to avoid any oil leakage from the bearing block. Fill the bearing block with oil to the center of the sight glass on the side of the bearing block (see pages 4 & 5).
- Make sure the pump is flooded with product before start-up. **The pump must not run dry, even momentarily.**
- Make sure the pump is running in the proper direction. The motor fan must turn clockwise when looking at the end of the motor.

FM3 (HP3) Seal Assembly



Description	Material	Qty.	Part No.
Single Seal Driver	SS	1	1224000010
Single Rotating Seal	SS/Silicon Carbide Insert	1	1810600155
Single Seal Spring	-	1	1820000025
Gapping Spacer (7.4mm)	SS	1	1224000100
Gapping Spacer (7.7mm)			1224000100
Gapping Spacer (8.0mm)			1224000100
Single Stationary Seal	Silicon Carbide	1	1815600196
Double Stationary Seal	Ceramic	1	1815600093
Double Rotating Seal	Carbon	1	1810600056
Double Seal Spring	-	1	1820000016
Set Screw	-	2	1101000112
Double Seal Driver	SS	1	1811000023
Double Seal Drive Ring	SS	1	1811000027
Double Seal O-Ring	Viton	1	1180000329
	EPDM		1180000348
Flat Gasket	Viton	1	1181000047
	EPDM		1181000147
Single Stationary Seal O-Ring	Viton	1	1181000099
	EPDM		1181000146
Single Seal Driver O-Ring	Viton	1	1180000344
	EPDM		1180000151
Single Rotating Seal O-Ring	Viton	1	1180000030
	EPDM		1180000247
Impeller Gasket	Viton	2*	1181000097
	EPDM		1181000145
* Quantity may vary			

FM5 (HP4) Seal Assembly



Description	Material	Qty.	Part No.
Single Seal Driver	SS	1	1811000035
Single Rotating Seal	SS/Silicon Carbide Insert	1	1810600156
Single Seal Spring	-	1	1820000028
Gapping Spacer (7.6mm)	SS	1	1224000091
Gapping Spacer (7.8mm)			1224000091
Gapping Spacer (8.0mm)			1224000091
Gapping Spacer (8.2mm)			1224000091
Gapping Spacer (8.4mm)			1224000091
Single Stationary Seal	Silicon Carbide	1	1815600197
Double Stationary Seal	Carbon	1	1815600096
Double Rotating Seal	Carbon	1	1810600100
Double Seal Spring	-	1	1820000028
Double Seal Drive Ring	SS	1	1811000036
Double Seal O-Ring	Viton	1	1180000030
	EPDM		1180000247
Flat Gasket	Viton	1	1181000140
	EPDM		1181000162
Single Stationary Seal O-Ring	Viton	1	1180000253
	EPDM		1180000278
Single Seal Driver O-Ring	Viton	1	1180000329
	EPDM		1180000348
Single Rotating Seal O-Ring	Viton	1	1180000233
	EPDM		1180000366
Impeller O-Ring	Viton	2*	1180000030
	EPDM		1180000247
* Quantity may vary			

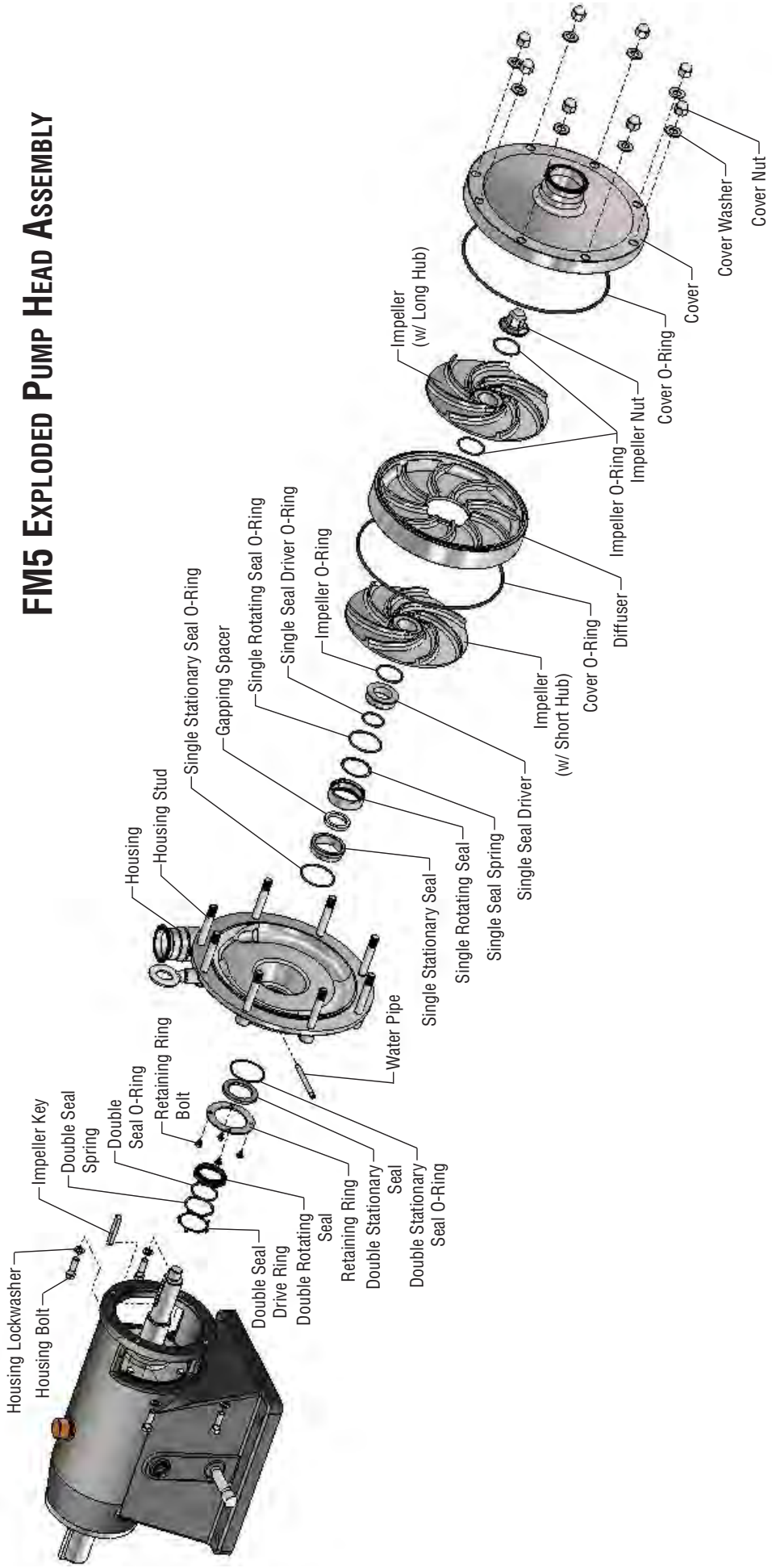
Parts List

Description	Qty	Model	
		FM3	FM5
Cover Nut	8	1103000050	1103000012
Cover Washer	8	1104000022	
Cover	1	1493620000	1498620000
Cover O-Ring	1*	1180000330	1180000779
Impeller Nut	1	1954000005	1954000036
Impeller (First Stage)	1	1493630171	1498630000
Impeller (Second, Third & Fourth Stage)	1*	1493630187	1498630001
Stage Bushing	1*	1224000048	N/A
Diffuser	1*	1493610001	1498610001
Housing Stud (1-Stage)	8	1103000011	1103000066
Housing Stud (2-Stage)		1103000009	1103000065
Housing Stud (3-Stage)		1103000007	N/A
Housing Stud (4-Stage)		1103000005	N/A
Housing	1	1493610000	1498610000
Water Pipe	2	1910000007	
Retaining Ring	1	1148000023	1148000030
Retaining Ring Bolt	4	1101000086	
Impeller Key (1-Stage)	1	1315000021	1315000036
Impeller Key (2-Stage)		1315000006	1315000035
Impeller Key (3-Stage)		1315000022	N/A
Impeller Key (4-Stage)		1315000007	N/A
Housing Lockwasher	4	1104000006	
Housing Bolt	4	1101000097	1101000037
Front Labyrinth Seal	1	1812000023	1812000037

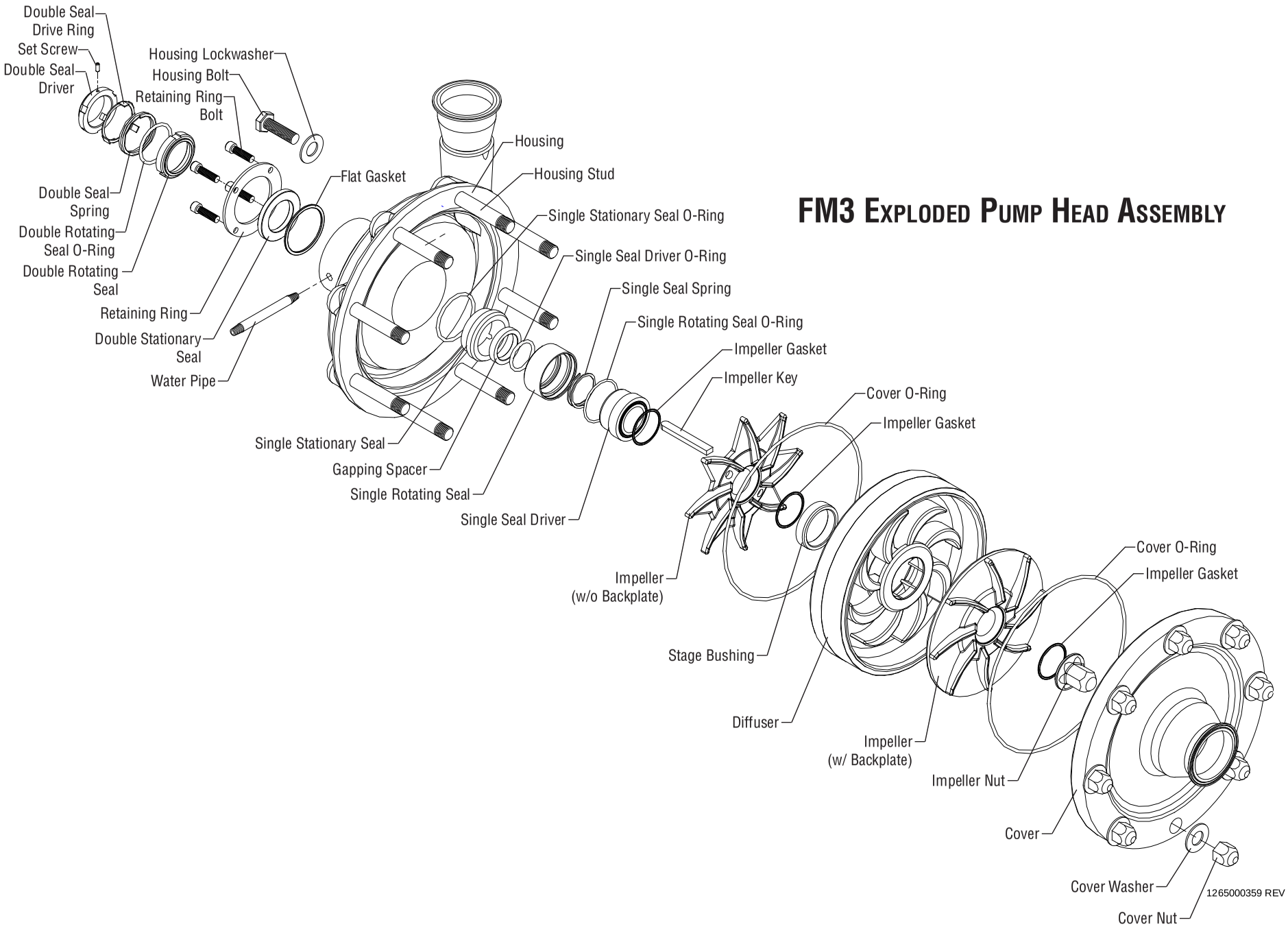
Description	Qty	Model	
		FM3	FM5
Bearing Cover Bolt	8*	1101000096	1101000011
Front Bearing Cover	1	1303000008	1303000013
Front Bearing Cover O-Ring	1	1180000148	1180000748
Snap Ring	1	1148000005	1148000031
Front Bearing	1	1173000012	1173000029
Shaft (1-Stage)	1	1340000008	1340000013
Shaft (2-Stage)		1340000009	1340000012
Shaft (3-Stage)		1340000010	N/A
Shaft (4-Stage)		1340000011	N/A
Coupling Key	1	1315000008	1315000041
Guard	2	1936000030	1936000135
Guard Screw	4	1102000000	
Drain Plug Cap	1	1226000007	
Drain Plug Nipple	1	1226000006	
Sight Glass	2	1248000018	
Bearing Block	1	1310600038	1310600108
Vent Cap	1	1248000007	1248000013
Vent Cap Cover	1	1248000009	N/A
Rear Bearing	2	1173000036	1173000030
Bearing Lockwasher	1	1104000016	1104000058
Bearing Locknut	1	1306000005	1306000074
Rear Bearing Cover O-Ring	1	1180000149	1180000747
Rear Bearing Cover	1	1303000009	1303000014
Rear Labyrinth Seal	1	1812000023	1812000038

* Quantity may vary

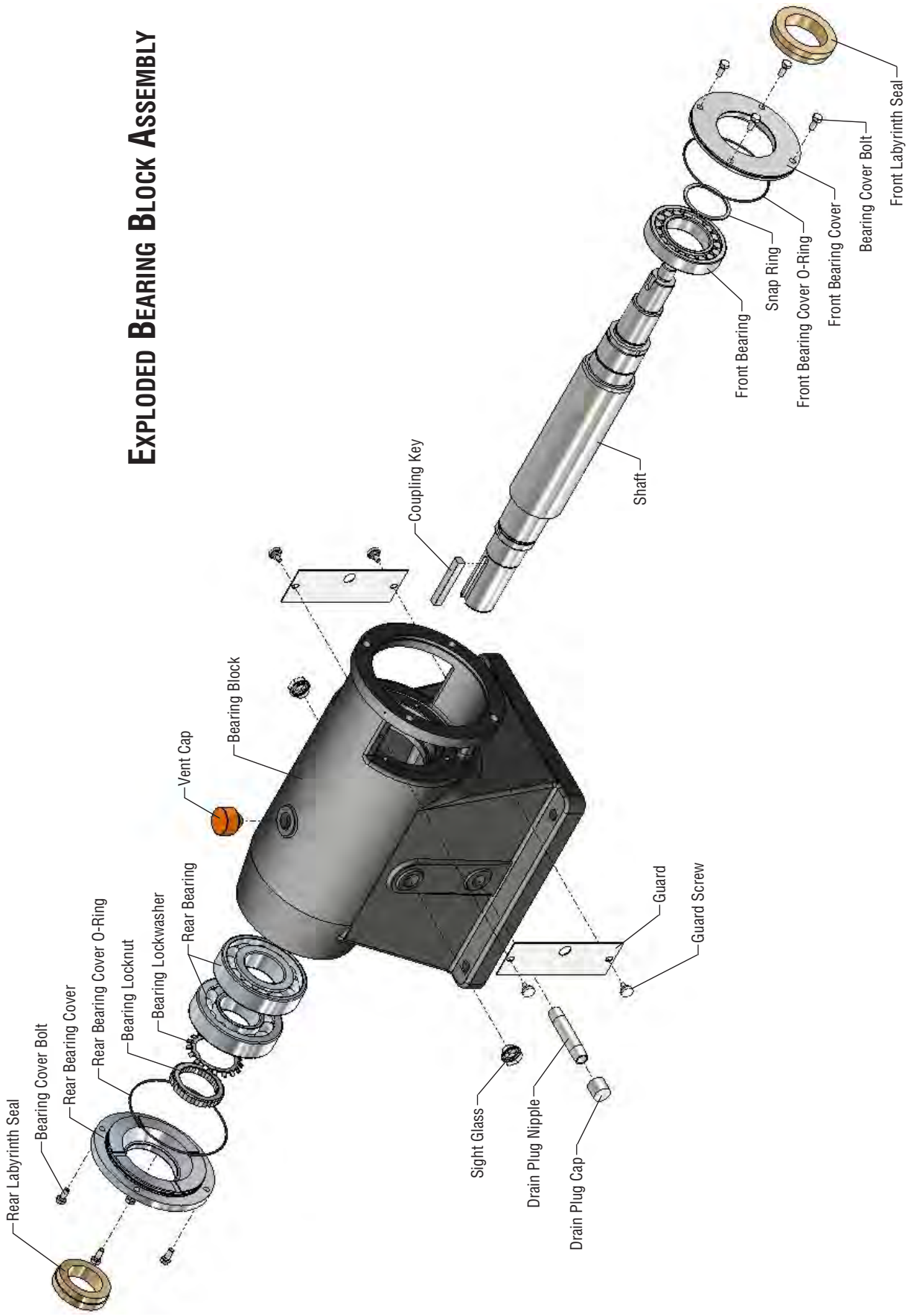
FM5 Exploded Pump Head Assembly



FM3 Exploded Pump Head Assembly



Exploded Bearing Block Assembly



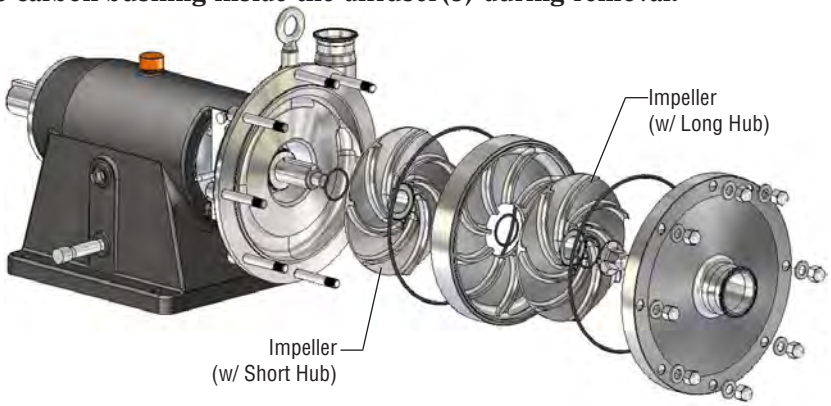
Pump Head Disassembly

Figure 8

Remove the cover and discard the o-ring.

Place a chain wrench on the shaft to prevent it from rotating. Remove the impeller nut and discard the o-ring or gasket.

Remove the impeller(s) and diffuser(s) and discard the o-ring(s) and gasket(s). **FM3 Only: Be careful not to damage the carbon bushing inside the diffuser(s) during removal.**



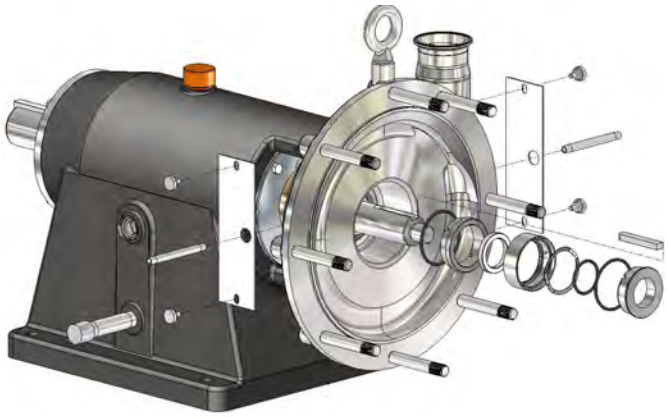


Figure 9

Remove the single seal components and discard the single rotating seal, spring, stationary seal and o-rings. **Note: Do not discard the single seal driver and gapping spacer.**

Remove the guards.

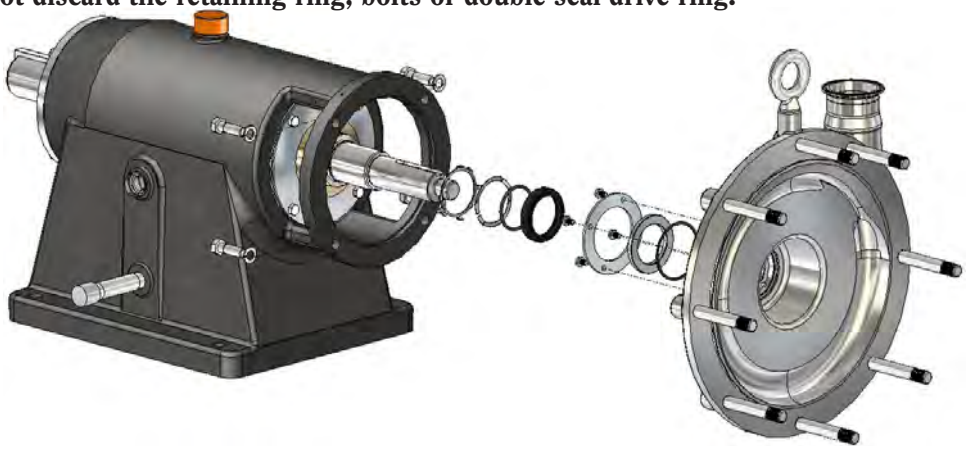
Remove the water pipes.

Figure 10

Remove the housing. Remove the retaining ring from the back of the housing.

Remove the double seal components and discard the double rotating seal, stationary seal, flat gasket, spring and o-rings.

Note: Do not discard the retaining ring, bolts or double seal drive ring.



Pump Head Assembly

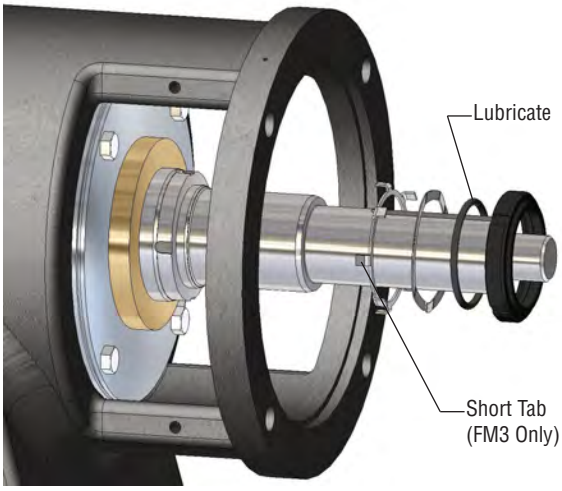


Figure 11

Install the double seal drive ring making sure to slide the tabs on the ring into the slots on the shaft.

FM3 Only: The shorter tabs on the seal driver slide into the shaft slots.

Install the spring, o-ring and the double rotating seal. Be sure to slide the tabs on the drive ring into the slots in the rotating seal.

FM3 Only: The flush seal spring has a painted white stripe on all models except the 722 so that it is not confused with the single seal spring.

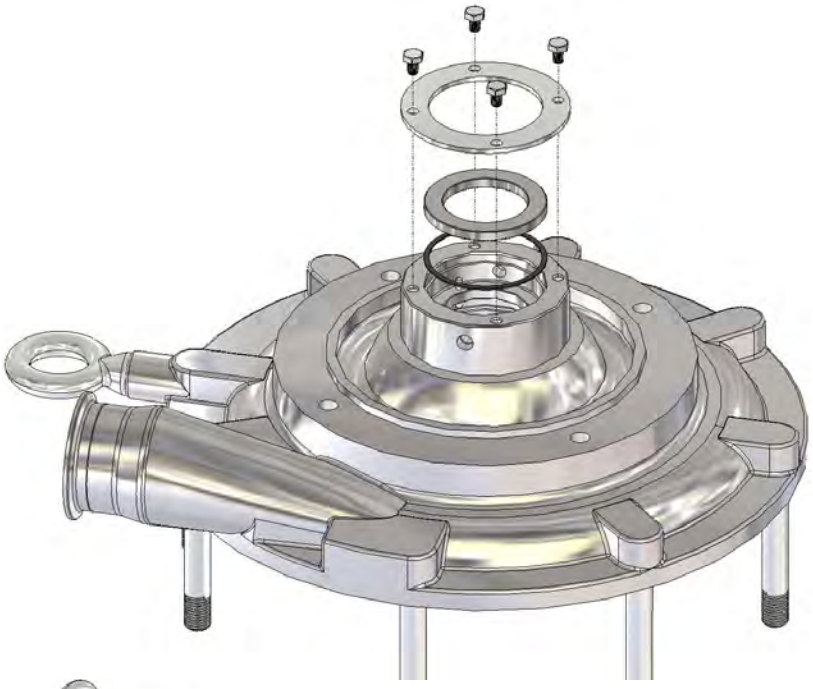


Figure 12

Install the flat gasket, double stationary seal and retaining ring. Use a torque wrench to tighten the retaining ring bolts.

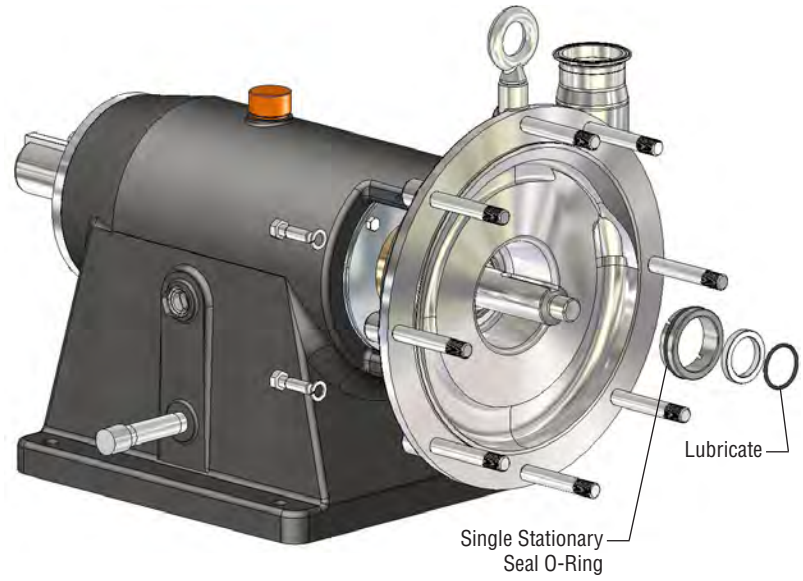


Figure 13

Install the housing. Use a torque wrench to tighten the housing bolts.

Install the single stationary seal o-ring onto the single stationary seal.

Install the stationary seal making sure to align the pin(s) in the housing with the slots in the seal. Press the seal into the housing until it snaps into place.

Install the gapping spacer.

Install the seal driver o-ring.

If you replaced the shaft and/or bearings, the impeller gap must be checked before proceeding (Figure 25, page 23).

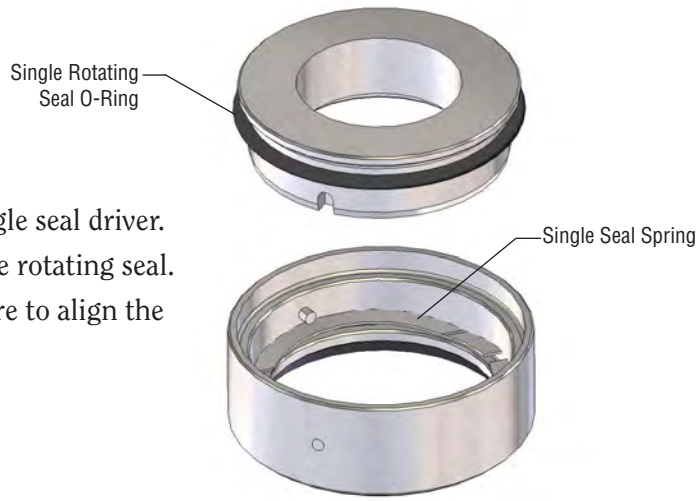


Figure 14

Install the single rotating seal o-ring onto the single seal driver.

Install the single seal spring behind the pins in the rotating seal.

Install the driver into the rotating seal making sure to align the pins with the slots.

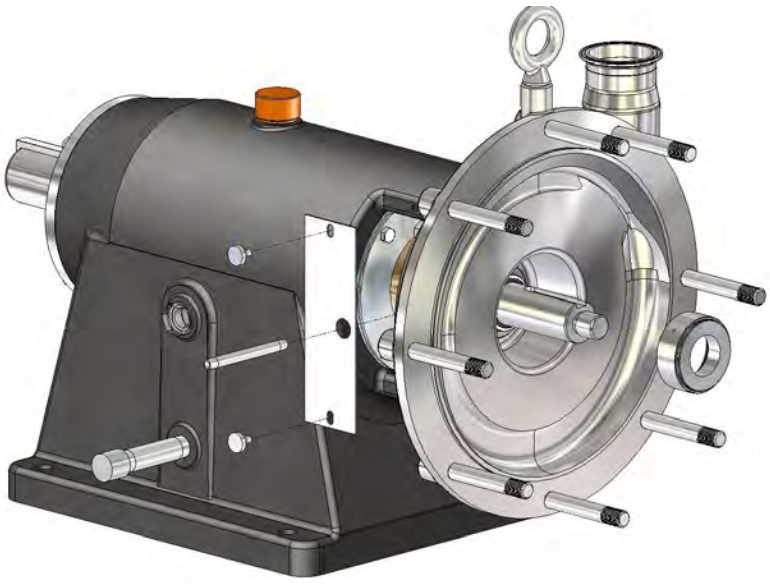


Figure 15

Install the single rotating seal and driver assembly.

Install the water pipes and guards.

Figure 16 (Single Stage Pump Only)

Install the impeller key.

Install the impeller o-ring/gasket into the groove on the back of the impeller.

Install the impeller nut o-ring/gasket into the groove on the back of the impeller nut.

Install the cover o-ring into the groove on the back of the cover.

Install the impeller and impeller nut. Place a chain wrench on the shaft to prevent it from rotating while tightening the impeller nut. Use a torque wrench to tighten the impeller nut.

Install the cover. Use a torque wrench to tighten the cover nuts in a cross-tightening pattern.

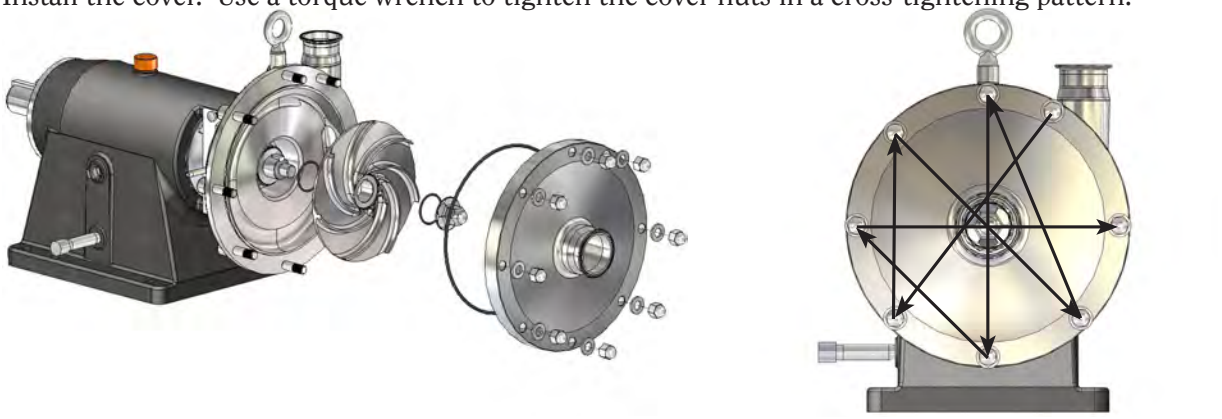


Figure 16 (Multi Stage Pump Only)

Install the impeller key.

Install the impeller o-rings/gaskets into the groove on the back of the impellers.

Install the impeller nut o-ring/gasket into the groove on the back of the impeller nut.

Install the cover o-ring into the groove on the back of the cover.

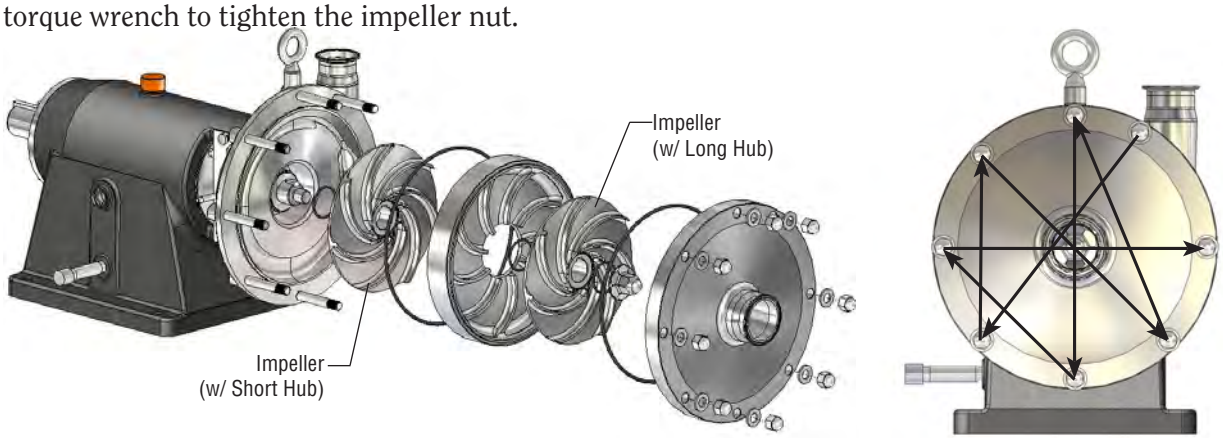
Install the short impeller first, then the diffuser, then the long impeller. **FM3 Only: Be careful not to damage the carbon bushing inside the diffuser(s) during installation.**

Note: The number of impellers and stages will vary, depending on the number of stages in the pump.

Install the impeller nut and hand tighten. **Note: On multi stage pumps, the cover nuts must be tightened prior to tightening the impeller nut.**

Install the cover. Use a torque wrench to tighten the cover nuts in a cross-tightening pattern.

Place a chain wrench on the shaft to prevent it from rotating while tightening the impeller nut. Use a torque wrench to tighten the impeller nut.



Bearing Block Disassembly

Prior to disassembling the bearing block, complete the pump head disassembly (Figure 8-10, page 16).

Figure 17

Place an oil pan below the drain plug. Remove the drain plug cap and drain the oil. Replace the drain plug.

Remove the bearing covers and discard the o-rings. **FM3 Only: Remove the double seal driver from the shaft prior to removing the front bearing cover.**

Remove the snap ring.

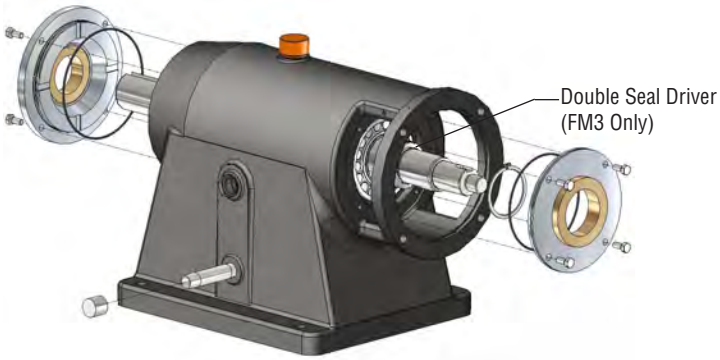


Figure 18

Tap on the threaded end of the shaft with a soft-faced hammer to remove the shaft assembly. **Support the shaft during removal so that it doesn't become damaged.**

Remove the outer race of the front bearing.

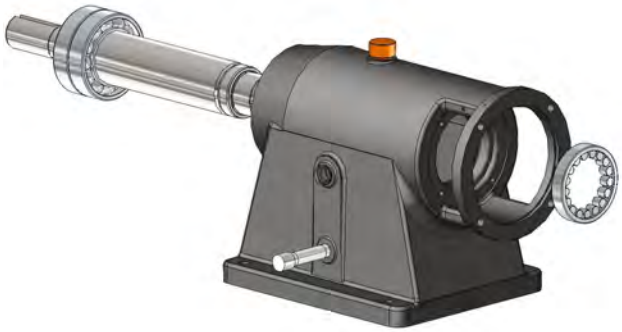
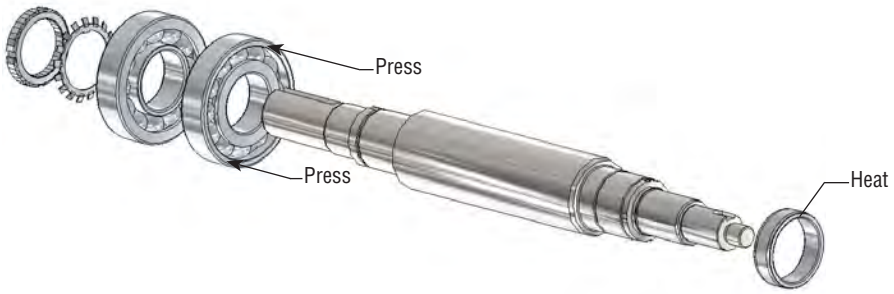


Figure 19

Straighten the bent bearing lockwasher tab and remove the bearing locknut and washer.

Remove the two rear bearings by pressing them off of the shaft.

Remove the inner race of the front bearing by heating it with a torch until it expands and can be slid off.



Bearing Block Assembly

Figure 20

Lightly grease the rear bearing step. Heat the rear bearings on a bearing heater to 230˚F. Install the bearings in the back-to-back arrangement shown. **Heating the bearings above 250˚F will cause damage.**

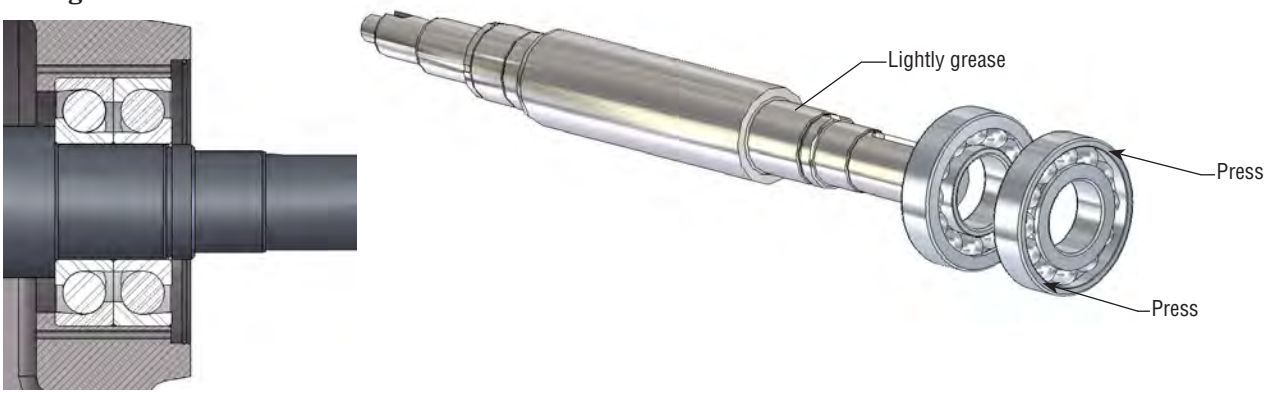


Figure 21

Install the bearing lockwasher and locknut. Use a torque wrench to tighten the locknut. Bend one of the lockwasher tabs into a slot on the locknut.

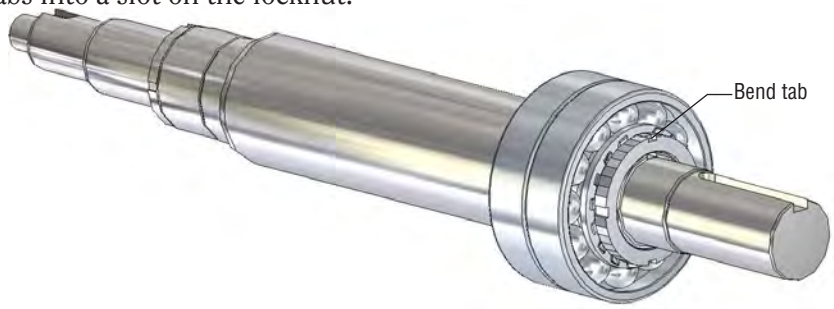


Figure 22

Lightly grease the front bearing step. Heat the inner race of the front bearing on a bearing heater to 230˚F. Install the inner race.

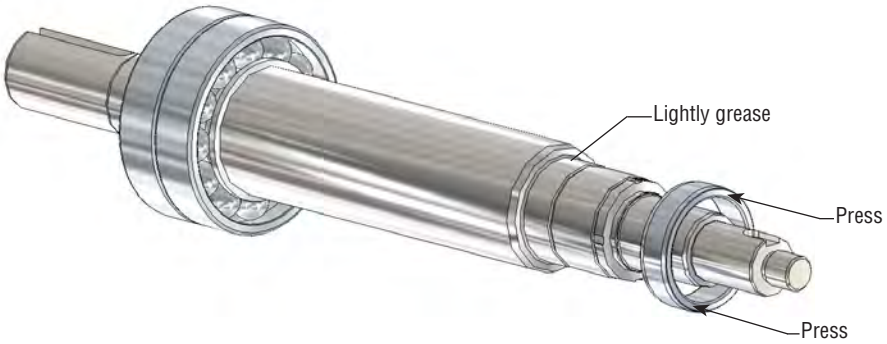


Figure 23

Press the outer race of the front bearing into the bearing block.

Install the shaft assembly into the bearing block. Press or tap on the outer race of the rear bearing while supporting the front end of the shaft. **Do not press on the shaft or on the inner race of the rear bearing.**

Figure 24

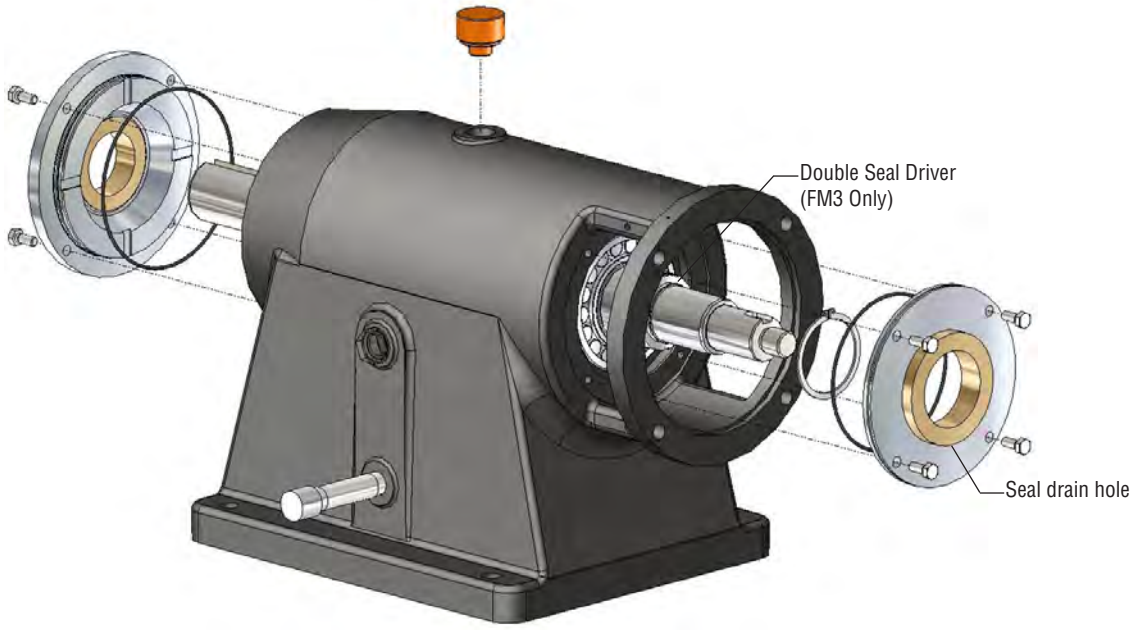
Install the snap ring.

To replace the labyrinth seals in the front or rear bearing cover: Press the seal out of the cover. Press the new seal in with the drain hole in the downward position. Lubricate the inside o-rings on the seals.

Install the front and rear bearing covers. Use a torque wrench to tighten the bolts.

Remove the vent cap and fill the bearing block with oil to the center of the sight glass.

FM3 Only: Prior to assembling the pump head, install the double seal driver. Use a torque wrench to tighten the set screw in the seal driver.



Checking the Impeller Gap

The impeller gap must be checked if the shaft and/or bearings have been replaced.

Figure 25 (Single Stage Pump Only)

Install the single seal driver and impeller key.

Install the impeller o-ring/gasket into the groove on the back of the impeller.

Install the impeller nut o-ring/gasket into the groove on the back of the impeller nut.

Install the impeller.

Place a chain wrench on the shaft to prevent it from rotating while tightening the impeller nut. Use a torque wrench to tighten the impeller nut.

Measure the gap between the impeller and pump housing using feeler gages. If the gap is incorrect, the gapping shim must be changed to one of a different width.

Once the gap is correct, remove the impeller nut, impellers, impeller key and single seal driver. Resume pump assembly (Figure 14-16, page 18-19).

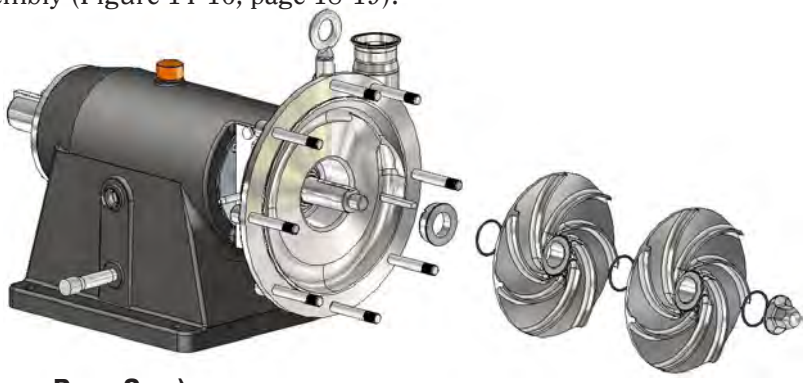


Figure 25 (Multi Stage Pump Only)

Install the single seal driver and impeller key.

Install the impeller o-rings/gaskets into the groove on the back of the impellers.

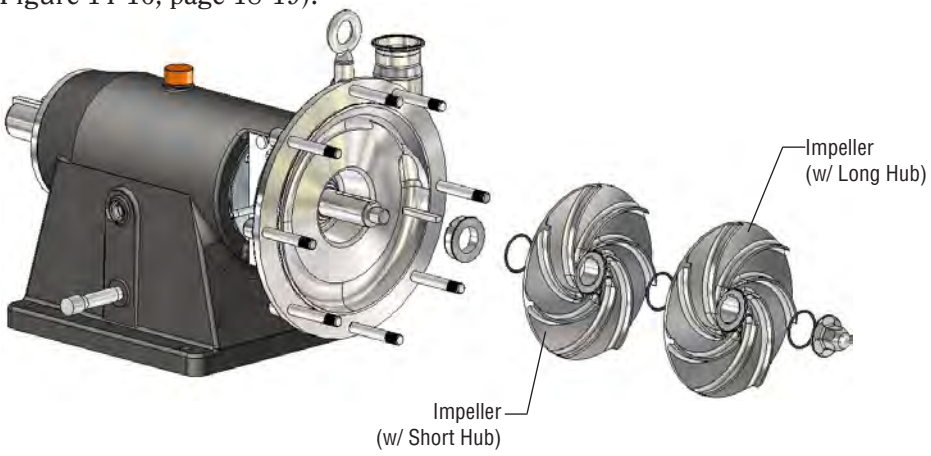
Install the impeller nut o-ring/gasket into the groove on the back of the impeller nut.

Install the short impeller first, then the long impeller(s).

Place a chain wrench on the shaft to prevent it from rotating while tightening the impeller nut. Use a torque wrench to tighten the impeller nut.

Measure the gap between the impeller and pump housing using feeler gages. If the gap is incorrect, the gapping shim must be changed to one of a different width.

Once the gap is correct, remove the impeller nut, impeller, impeller key and single seal driver. Resume pump assembly (Figure 14-16, page 18-19).



Pump Maintenance Record

Date	Service Performed	By

Pump Maintenance Record

Date	Service Performed	By

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