

SUMMIT PUMP

Model 2196 / 2196-LF / 2196-R / 2796

Standard Process Pump Family

Installation, Operation, and Maintenance Manual



WARRANTY

Pumping units assembled by Summit Pump, Inc., Green Bay, WI are guaranteed to be free from defects in material and workmanship for one year from date of shipment from factory in Green Bay, WI. The obligation under this Warranty, statutory or otherwise, is limited to replacement or repair at Green Bay, WI, of such part as shall appear to us upon inspection at such point, to have been defective in material or workmanship.

This Warranty does not obligate Summit Pump, Inc. to bear the cost of labor or transportation charges in connection with replacement or repair of defective parts; nor shall it apply to a pump upon which repairs or alterations have been made unless authorized by Summit Pump, Inc.

No warranty is made in respect to engines, motors, or trade accessories, such being subject to warranties of their respective manufacturers.

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The equipment is not for use in or with any nuclear facility or fire sprinkler system. Buyer accepts the responsibility for insuring that the equipment is not used in violation and Buyer shall indemnify and hold Seller harmless from any and all liability (including such liability resulting from seller's negligence) arising out of said improper use.

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1. INTRODUCTION

This installation, operation, and maintenance manual is designed to help you achieve the best performance and longest life from your Summit Pump models 2196, 2196-LF, 2196-R, and 2796.


This pump is an open impeller, centrifugal model with end suction / top discharge. The pump is designed for handling mild industrial corrosives.


If there are any questions regarding the pump or its application, which are not covered in this manual or in other literature accompanying this unit, please contact your Summit Pump distributor.


For information or technical assistance on the power source, contact the power source manufacturer's local dealer or representative.

SAFETY

The following message types are used in this manual to alert maintenance personnel to procedures that require special attention for the protection and safety of both equipment and personnel:

 DANGER
Imminently hazardous situation which, if not avoided, will result in death or serious injury.

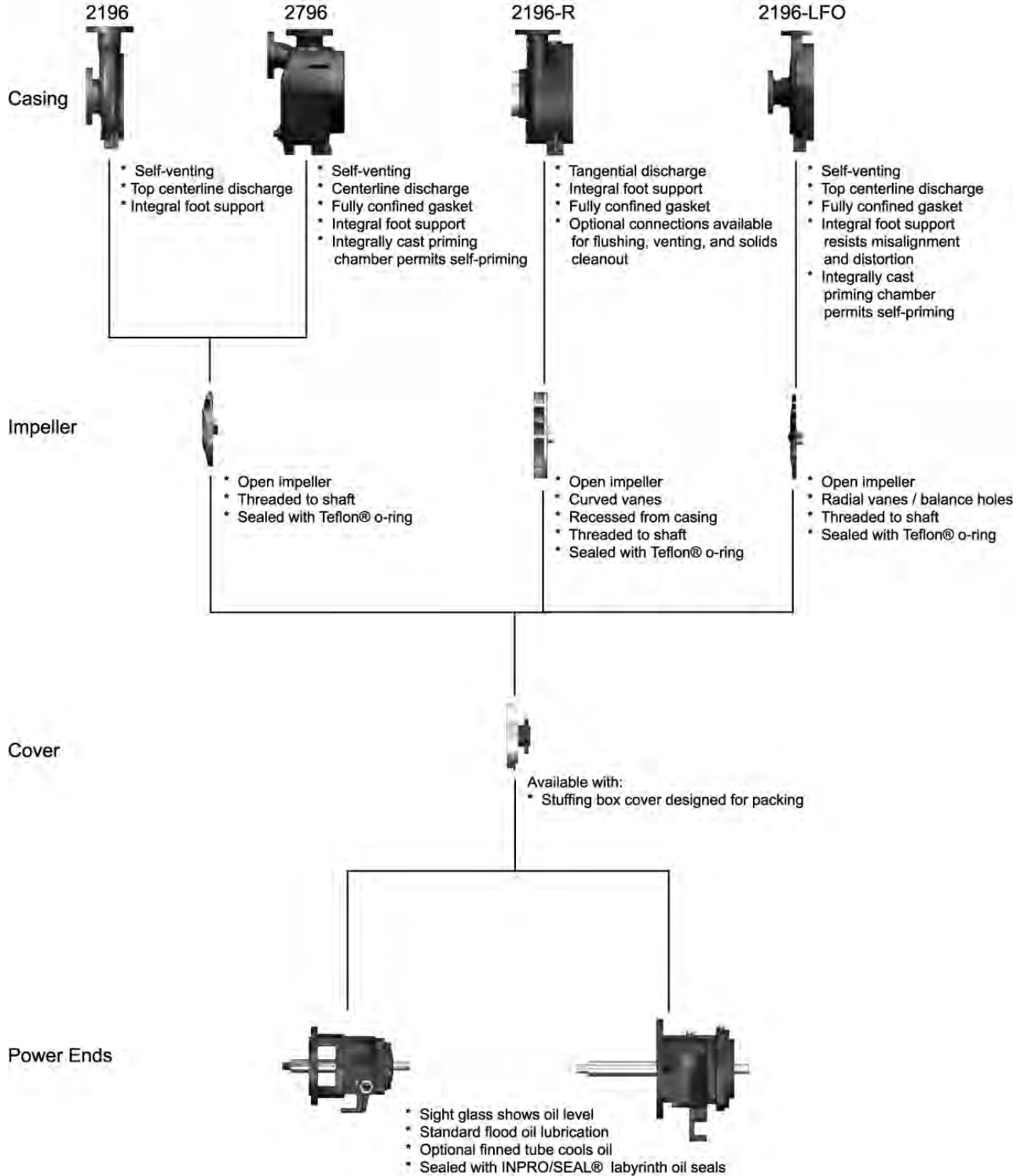
 WARNING
Potentially hazardous situation which, if not avoided, could result in death or serious injury.

 CAUTION
Potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE
Includes Information on operation, maintenance, rules or directions. May indicate possible property damage.

2196 MODEL RELATIONSHIP CHART

The following chart shows the relationship and parts commonality within the 2196 family.



2. RECEIPT AND STORAGE

RECEIVING THE PUMP

 **WARNING**

Pump and assemblies are heavy, improper handling could result in serious injury.

Immediately upon arrival, carefully inspect the pump for evidence of damage during transit. Immediately report any damage to your Summit Pump Distributor.

STORING THE PUMP

Store the pump in a clean dry place. **Do not remove piping connection covers.** Rotate the pump shaft by hand **at least once per week** to maintain a protective film of oil or grease on the bearings. If you anticipate long-term storage, special treatment is available for purchase from Summit Pump, Inc.

3. INSTALLATION

LOCATION

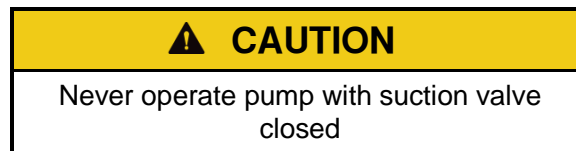
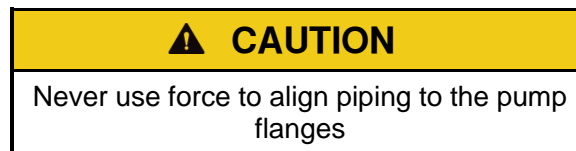
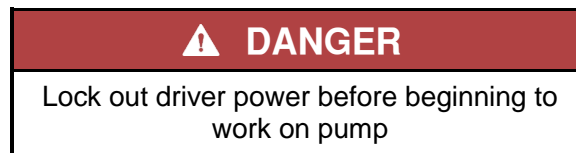
When choosing a location for the pump, select an area that provides easy access for inspection and maintenance. Locate the pump as close as possible to the source which will provide NPSH (Net Positive Suction Head) equal to or greater than that required by the pump at any capacity over its expected operating range.

FOUNDATION

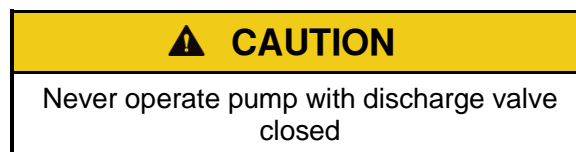
Use a foundation that is sufficient enough to support all points of the pump base-plate. Level and grout the base-plate per standard construction practices (see ANSI/HI 1.4.2-1997).

PIPING CONNECTION – SUCTION / DISCHARGE

All piping must be independently supported and accurately aligned to the pump suction and discharge flanges. Ideally, you should place a short length of flexible or bellows type spool piece in the connections directly next to the pump flange.



At a minimum, use suction pipe that is one size larger than the flange. Use an eccentric reducer to meet the suction pipe with the pump. Mount the reducer flat side up. Elbows must be a minimum of ten diameters from the suction flange.

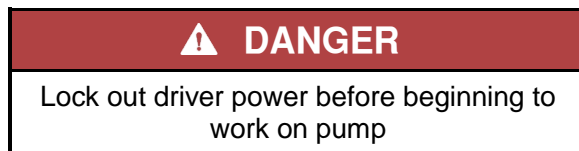


The discharge piping should include isolation and check valves. The check valve prevents the pump from rotating backward. Place the check valve between the pump

and isolation valve. The isolation valve is used for priming, starting, and shutting down the system. If you use pipe diameter increasers, place them between the pump and the check valve.

ALIGNMENT

The alignment at the pump and drive shaft is one of the most important considerations in the pump installation.



■ TO ALIGN THE PUMP

1. Use flexible spacer couplings to achieve proper alignment.
2. Check and adjust the parallel and angular alignment to within .005 inches prior to connecting the coupling halves.
3. Jog the motor to check rotation. Its arrow should match up with the arrow on the pump.
4. Install a coupling guard when the pump is aligned.

Pumps in hot service will need an alignment check at operating temperatures.

STUFFING BOX

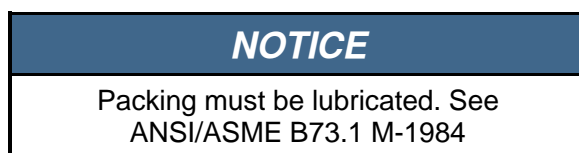
Packed Box

Braided packing is supplied as standard equipment on all pumps. Install gland bolt nuts finger-tight only. Adjust the gland bolt nuts during start-up to achieve 40-65 drops of leakage per minute. Specific packing type is dependent on pH, temperature, etc. of the liquid being pumped.

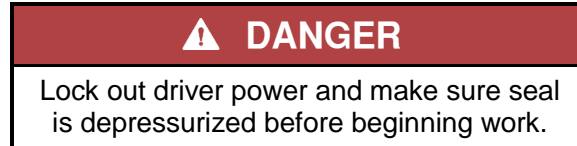
Table 1

	Pump Model				
	STO	MTO	LTO	XLO	XLO-17
Lantern Ring Width	7/16"	5/8"	5/8"	5/8"	5/8"
Packing Size	5/16"	3/8"	3/8"	7/16"	7/16"
Number of Rings	5				

Clean and cool pumpage may be used to lubricate the packing. If the pumpage is not suitable, you must supply an external source of lubrication.



Cartridge Mechanical Seal



Refer to the manufacturer's installation, operating, and maintenance instructions. Failure to do so can result in environmental damage, personal injury, and seal malfunction and / or seal failure.

Start Up

Read, understand and follow the manufacturer's installation, operation, and maintenance instructions.

Storage, Assembly and Disassembly

Read, understand and follow the manufacturer's installation, operation, and maintenance instructions.

Type 1 Mechanical Seal

■ TO INSTALL TYPE 1 MECHANICAL SEAL

1. **MTO, LTO, XLO** Slide the stuffing box cover over the shaft/sleeve. Bolt the cover (184) to the frame adapter(108).
STO Slide the 6" or 8" stuffing box cover (184) with adapter ring (108) over shaft and bolt to bearing.
2. Mark / scribe the shaft at the face of the stuffing box.
3. Unbolt and remove the stuffing box cover.
4. Locate the installation reference dimension on the seal installation drawing. Normally this is the dimension from the face of the stuffing box to the rear of the seal.
5. Mark the shaft with a felt marker or marking tool at the dimension (i.e. 1/32").
6. Lubricate the shaft with silicon grease or soapy water. Slide the seal onto the shaft. Line up the face of the seal with your mark and secure with set screw.
7. Reassemble the pump.

4. OPERATION

LUBRICATION

⚠ CAUTION

Oil lubricated pumps are shipped with NO oil in the bearing frame.

NOTICE

Grease lubricated pumps are packed with Mobil Grease XHP222 at the factory

NOTICE

Grease lubricated pumps are intended to use grease only. Do not add oil to the bearing housing

Ball bearings are very sensitive to both over and under lubrication, both being detrimental to bearing performance. Use a thermometer to monitor bearing temperature. Overheating will reduce bearing life.

The relationship between bearing temperature and pumpage temperature is an indication of performance. *Table 2* indicates the relationship between these temperatures.

Table 2

	Degrees Fahrenheit		
Pumping liquid temperature	60°	200°	300°
Approximate normal line bearing temperature	115°	140°	160°

The information shown in *Table 2* is based on a room temperature of 70°F. Maximum bearing operating temperature is 175°F. It is necessary to flush water through the stuffing box for liquid temperatures above 250°F. This can be done either through a flushing gland or the stuffing box seal cage.

Oil Lubrication

Use only high quality turbine oil with rust and oxidation inhibitors. Service temperatures determine oil viscosity. See *Table 3*.

Use a 300 SSU viscosity at 100° F for applications where pumping temperatures are below 200° F. At pumping temperatures above 350° F, use 470 SSU at 100° F with optional cooler.

Table 3

Bearing Temperature	ISO Grade	Viscosity at 100 Degrees F
Up to 150° F	46	215 SSU
150° F to 200° F	68	300 SSU
Above 200° F	100	470 SSU

Adding Oil

To add oil to bearing frame, remove filler plug (113A). Fill to center of sight glass with the appropriate oil using *table 4* as a reference. Replace filler plug (113A).

Routine Inspection (daily)

Check oil level through sight glass. Add or remove oil if level is not at center of sight glass.

To add oil to the frame, remove oil fill plug (113A) and fill until oil level is at center of sight glass (319). Replace oil fill plug (113A). To remove oil from the frame, loosen frame drain plug (408A) and capture the excess oil in an appropriate container. Change oil immediately if oil appears cloudy or contaminated.

Changing oil

Change oil every three months or 2000 hours. Change more frequently if pump is located in an extremely adverse atmosphere.

To change oil in frame, remove filler plug (113A). Have an appropriate container in place to catch the oil and remove frame drain plug (408A). Inspect drained oil for excess contaminants or moisture. Replace frame drain plug (408A). Fill to center of sight glass with the appropriate oil using *table 4* as a reference. Replace filler plug (113A).

NOTICE
Under filling or over filling of the bearing frame can cause damage.

Table 4

Acceptable Lubricating Oils				
Chevron GTS Oil		46	68	100
Exxon Terrestrial		46	68	100
Lubriplate		AC1	AC2	AC3
Mobil:	DTE	-	Medium	Heavy
Mobil:	Synthetic	525	626	627
Shell:	Tellus Fluids HD	46	68	100

Grease Lubrication

Regrease grease lubricated bearings with NLG1 No. 2 consistency grease for pumpage temperatures -60° F to 350° F. Grease is not recommended for temperatures above 350° F. Regrease bearings every three months.

Table 5

Acceptable Greases	
Citgo	Mystic EP2
Keystone	81EP2
Mobil	Mobil Grease XHP222
Mobil Synthetic	SCH 100

■ TO REGREASE LUBRICATED BEARINGS

1. Wipe dirt and foreign matter from the fittings.
2. Remove grease relief plugs from the bottom of the frame.
3. Fill grease through fittings until it comes out through the relief holes.
4. Reinstall grease relief plugs.

ROTATION

■ TO ROTATE THE PUMP

1. Lock out power to the pump driver.
2. Remove the coupling guard and coupling.
3. Momentarily restore power and energize the motor to determine rotation.
4. Confirm that motor rotation coincides with proper pump rotation. The proper pump rotation is counterclockwise when facing the pump's suction. Lock out power to pump driver.

NOTICE

Operating the pump in the opposite rotation may cause severe damage to the impeller and/or casing.

5. Reinstall the coupling and coupling guard.
6. Unlock power to pump driver.

IMPELLER CLEARANCE

NOTICE

Check impeller clearance prior to starting pump. Setting may have changed during transit.

⚠ DANGER

Lock out driver power before beginning to work on pump

Impeller clearance is the measurement between the impeller vanes and the surface of the casing. This clearance is set at .015 inches during assembly, but may need to be adjusted before initial startup. (See APPENDIX A for detailed procedures on setting the impeller clearance.)

PRIMING

Prior to starting a centrifugal pump, it is imperative that you prime the pump by flooding the suction piping and casing with fluid. Priming will occur when you open the suction isolation valve and the packing sealing liquid valve.

NOTICE

Do not operate pump dry.

START UP

■ TO START UP THE PUMP

1. Rotate the pump by hand; making sure that the rotating element is spinning freely.
2. Be sure the suction valve is open.
3. Partially close the discharge valve.

⚠ DANGER

Do not operate with discharge valve closed for an extended period of time.

4. Unlock power to the pump driver.
5. Slowly open the discharge valve as soon as the motor reaches operating speed.

6. Check stuffing box leakage and adjust, if necessary, to achieve leakage of 40-65 drops per minute.
7. Adjust the discharge valve as needed while checking piping for leaks.
8. Check mechanical operation of the pump and motor.

 **DANGER**

Do not operate the pump without the proper guard. See ANSI/ASME B15.1-1996

SHUT DOWN

■ TO SHUT DOWN THE PUMP

1. Gradually close the discharge valve and turn off the power to the motor.
2. Lock out power to the pump driver.

APPENDIX A - IMPELLER CLEARANCE SETTING

A gradual loss in head and/or capacity can occur. You may restore performance by adjusting the impeller clearance, which is the measurement between the impeller vanes and the surface of the casing.

Table 6

Impeller Clearances					
Pumping Temperature	STO	MTO/LTO	XLO/XLO-17	2196LF and 2796	2196R*
-20 to 150° F (-29-66° C)	.005 (.13)	.008 (.20)	.015 (.38)	.015 (.38)	.060 (1.52)
Up to 175° F (80° C)	.005 (.13)	.008 (.20)	.015 (.38)	.015 (.38)	.060 (1.52)
Up to 200° F (93° C)	.005 (.13)	.008 (.20)	.015 (.38)	.015 (.38)	.060 (1.52)
Up to 225° F (107° C)	.006 (.16)	.009 (.23)	.016 (.40)	.016 (.40)	.060 (1.52)
Up to 250° F (121° C)	.007 (.18)	.010 (.26)	.017 (.43)	.017 (.43)	.060 (1.52)
Up to 275° F (135° C)	.008 (.21)	.011 (.28)	.018 (.46)	.018 (.46)	.060 (1.52)
Up to 300° F (149° C)	.009 (.23)	.012 (.30)	.019 (.48)	.019 (.48)	.060 (1.52)
Up to 350° F (177° C)	.011 (.28)	.014 (.36)	.021 (.53)	.021 (.53)	.060 (1.52)
Up to 400° F (204° C)	.013 (.33)	.016 (.41)	.023 (.58)	.023 (.58)	.060 (1.52)
Over 400° F (204° C)	.015 (.38)	.018 (.46)	.025 (.64)	.025 (.64)	.060 (1.52)

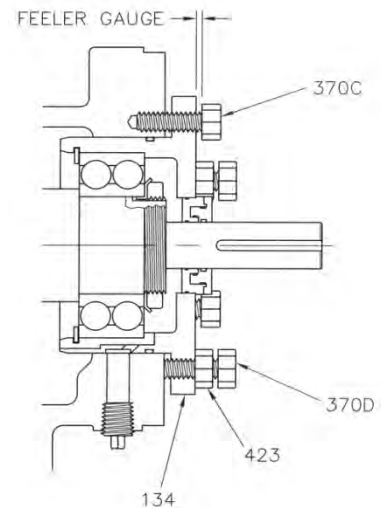
* Impeller clearance is set between back side of impeller and stuffing box cover (2196R only).

FEELER GAUGE TECHNIQUE

Models 2196, 2196-LF and 2796

■ TO USE THE FEELER GAUGE TECHNIQUE FOR IMPELLER CLEARANCE SETTING FOR MODELS 2196, 2196-LF & 2796

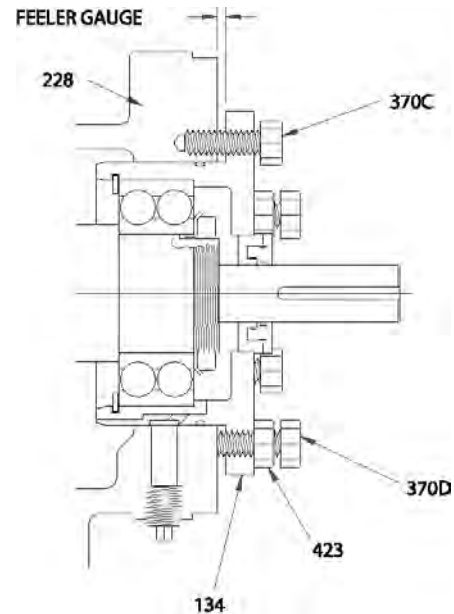
1. Lock out power to the pump driver.
2. Remove the coupling guard.
3. Loosen jacking bolts (370D) and jam nuts (423).
4. Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller starts to rub on the casing (100).
5. Using a feeler gauge, set the gap between the 3 housing bolts (370C) and the bearing housing (134). (Refer to *Table 6* for settings.)
6. Tighten jack bolts (370D) evenly until bearing housing backs out and contacts the bearing housing bolts (370C).
7. Tighten jam nuts (423) evenly, rotating the shaft to make sure the assembly turns freely.
8. Reinstall the coupling guard.
9. Unlock power to the pump driver.



Model 2196R Feeler Gauge Technique

■ TO USE THE FEELER GAUGE TECHNIQUE FOR IMPELLER CLEARANCE SETTING FOR MODEL 2196-R

1. Lock out power to the pump driver.
2. Remove the coupling guard.
3. Remove coupling.
4. Loosen bearing housing bolts (370C) several turns.
5. Loosen jam nuts (423) and turn jackbolts (370D) evenly around several turns until impeller contacts stuffing box cover (184). Turn shaft to ensure contact is complete.
6. Use feeler gauge to measure the gap between the bearing frame (228) and the bearing housing (134). Reduce the measurement by .060" and place the resulting feeler gauge thickness between the bearing housing (134) and the bearing frame (228).
7. Loosen the jacking bolts (370D) several turns. Tighten the locking bolts (370C) to move the impeller away from the stuffing box cover (184) until the bearing housing (134) snugs up the feeler gauge between the bearing housing (184) and the bearing frame (228).
8. Turn jacking bolts (370D) in and tighten jam nuts (423) evenly, rotating the shaft to make sure the assembly turns freely.
9. Reinstall the drive coupling.
10. Reinstall the coupling guard.
11. Unlock power to the pump driver.

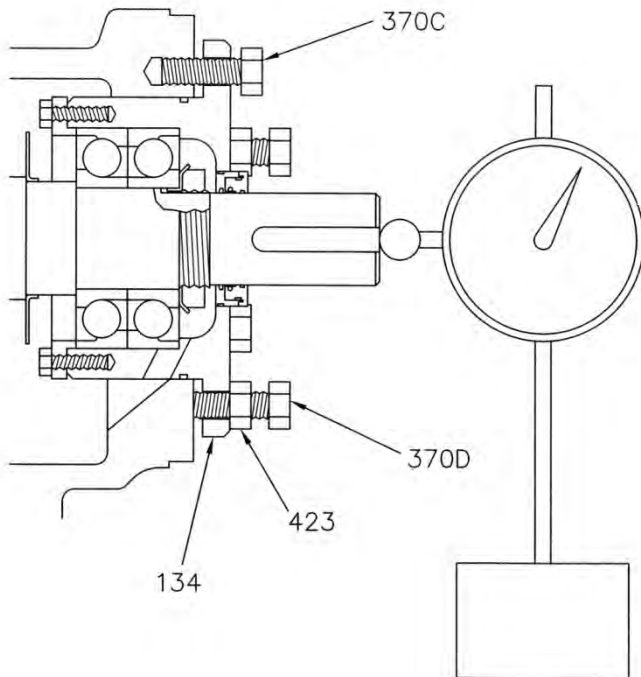


DIAL INDICATOR TECHNIQUE

Models 2196, 2196-LF and 2796

■ TO USE THE DIAL INDICATOR TECHNIQUE FOR IMPELLER CLEARANCE SETTING

1. Lock out power to the pump driver.
2. Remove the coupling guard.
3. Place a dial indicator with a magnetic base on the pump base plate. Place the indicator against the end of the pump shaft or coupling face.
4. Loosen jack bolts (370D) and jam nuts (423).
5. Tighten bearing housing bolts (370C) evenly while slowly rotating the shaft until the impeller starts to rub on the casing (100).
6. Set the dial indicator to zero.
7. Tighten the jack bolts (370D) evenly until they contact the frame. Continue to tighten until the dial indicator reads the proper clearance as shown in *Table 6*.
8. Tighten bearing housing bolts (370C) evenly; then tighten jack bolts (370D) evenly. Be sure the dial indicator **does not move** from the proper setting.
9. Rotate the shaft to be sure it turns freely.
10. Reinstall the coupling guard.
11. Unlock power to the pump driver.



Model 2196-R Dial Indicator Technique

1. Lock out power to the pump driver.
2. Remove the coupling guard.
3. Remove coupling.
4. Place a dial indicator with a magnetic base on the pump base plate. Place the indicator tip in contact with either the shaft end or coupling face. (See diagram on page 14.)
5. Loosen bearing housing bolts (370C) several turns.
6. Loosen jam nuts (423) on jack bolts (370D) evenly around several turns until impeller contacts the stuffing box cover (184). Turn the shaft to ensure contact is made.
7. Set the dial indicator to zero.
8. Loosen the jacking bolts (370D) evenly several turns and tighten the bearing housing bolts (370C) to move the impeller away from the stuffing box cover until the dial indicator shows a 0.060" clearance.
9. Turn in the jacking bolts (370D) and tighten the jam nuts (423) evenly.
10. Rotate the shaft to be sure it turns freely.
11. Reinstall coupling.
12. Reinstall the coupling guard.
13. Unlock power to the pump driver.

APPENDIX B - CENTRIFUGAL PUMP TROUBLESHOOTING

The following table provides possible solutions for symptoms that you may encounter with your centrifugal pump.

▲ WARNING
<p>Before attempting to service the pump:</p> <ol style="list-style-type: none"> 1. Follow the shutdown procedures. 2. Lock out the power source. 3. Allow the pump to cool. 4. Close the suction and discharge valves. 5. Drain the pump.

Table 7

CENTRIFUGAL PUMP TROUBLESHOOTING		
Symptom	Cause	Solution
Pump not delivering liquid	• Pump not primed.	• Re-prime pump.
	• Suction lift too high.	• Install shorter suction pipe.
	• Wrong direction of rotation.	• Change motor wiring.
	• Impeller clogged.	• Back-flush pump.
	• Suction line plugged.	• Remove debris.
Low flow and low head	• Air leak in stuffing box.	• Replace or adjust packing.
	• Worn suction side plate.	• Replace defective part.
	• Impeller worn or damaged.	• Inspect and replace impeller, if needed.
	• Air leak in suction line.	• Replace gasket.
	• Impeller clogged.	• Back-flush pump.
	• Wrong direction of rotation.	• Change motor wiring.

Table 7 (continued)

CENTRIFUGAL PUMP TROUBLESHOOTING		
Symptom	Cause	Solution
Pump loses prime	<ul style="list-style-type: none"> • Pump not primed correctly. 	<ul style="list-style-type: none"> • Re-prime pump.
	<ul style="list-style-type: none"> • Air leak in suction line. 	<ul style="list-style-type: none"> • Replace gasket or pipe plug.
	<ul style="list-style-type: none"> • Lantern ring in wrong location. 	<ul style="list-style-type: none"> • Repack moving lantern ring to correctly align with flush hole.
Bearings are running hot	<ul style="list-style-type: none"> • Misalignment. 	<ul style="list-style-type: none"> • Realign drive coupling.
	<ul style="list-style-type: none"> • Low or insufficient lubricant. 	<ul style="list-style-type: none"> • Check oil level and or grease.
Motor requires excessive amperage	<ul style="list-style-type: none"> • Stuffing box gland is too tight. 	<ul style="list-style-type: none"> • Readjust or replace packing.
	<ul style="list-style-type: none"> • Total dynamic head is too low. 	<ul style="list-style-type: none"> • Install throttle or reduce impeller diameter.
	<ul style="list-style-type: none"> • Rotary part rubbing stationary part. 	<ul style="list-style-type: none"> • Adjust part or replace parts.
	<ul style="list-style-type: none"> • Liquid is heavier than specified. 	<ul style="list-style-type: none"> • Check specific gravity of liquid.
Stuffing box is leaking excessively	<ul style="list-style-type: none"> • Stuffing box is incorrectly packed. 	<ul style="list-style-type: none"> • Repack stuffing box.
	<ul style="list-style-type: none"> • Shaft sleeve is scored or worn. 	<ul style="list-style-type: none"> • Replace shaft sleeve as required.
	<ul style="list-style-type: none"> • Wrong type of packing. 	<ul style="list-style-type: none"> • Install correct packing.
	<ul style="list-style-type: none"> • Shaft is bent. 	<ul style="list-style-type: none"> • Replace shaft.
	<ul style="list-style-type: none"> • Worn mechanical seal parts. 	<ul style="list-style-type: none"> • Rebuild seal; replace parts.

APPENDIX C - MAINTENANCE AND REPAIR

⚠ WARNING

WEAR EYE PROTECTION. Failure to do so can result in serious personal injury.

DISASSEMBLY PROCEDURES

(See APPENDIX D for cross-section of corresponding model.)

■ TO DISASSEMBLE YOUR MODEL 2196, 2196-LF, OR 2196-R PUMP

1. Lock out power supply at the motor starter.
2. Close off discharge, suction, sealing fluid, and cooling fluid.
3. Drain casing and flush, if needed.

⚠ WARNING

Pump parts are heavy. Use proper lifting methods to avoid personal injury.

4. Place lifting sling through frame to ensure safe handling during disassembly/assembly.
5. Remove bolts (370) holding the frame adapter (108) to casing (100).
6. Pull the frame adapter back from casing by tightening jack bolts (418).
7. Take the frame assembly to bench and secure for further work.
8. Scribe the location of coupling half on the shaft (122) and remove the coupling.

⚠ WARNING

Never use heat to remove impeller. Heat combined with trapped fluid could cause an explosion, which can result in serious personal injury.

9. Remove the impeller (101) from the shaft (122) while holding the shaft with a strap wrench or suitable tool that will not mark the shaft.

NOTICE

Threads are right-handed

NOTICE

XLO - Remove impeller plug (428Y) from impeller (101). Do not save impeller gasket (428D)

For a packed pump:

- a. Remove the packing gland nuts (353A).
- b. Slide gland toward frame (228).
- c. Remove seal chamber nuts (423B).
- d. Slide off stuffing box cover (184).
- e. Remove packing (106) and lantern ring (105).

For a mechanical seal:

- a. Remove seal gland nuts (353A).
 - b. Slide gland toward frame (228), exercising care so as to not drop stationary set from gland.
 - c. Remove seal chamber nuts (423B).
 - d. Slide off stuffing box cover (184).
 - e. Remove mechanical seal rotating element (383) and sleeve (128) from pump shaft.
 - f. Loosen set screws if present. Refer to cartridge seal manufacturer's instructions.
 - g. Slide off seal gland with stationary seal and o-ring gasket.
10. Remove the frame adapter (108) by removing two dowel pins (469B) and four adapter bolts (370B) and then separate the adapter (108) from the bearing frame (228).

NOTICE

This step does not apply to the 6" STO model.

11. Remove the bearing housing bolts (370C) and loosen the jam nuts (423).
12. Tighten the jack-bolts (370D) evenly to push the bearing housing out of frame.
13. Slide shaft assembly, with housing, out of bearing frame.
14. On the STO and MTO, remove the bearing housing snap ring (361A).
On the LTO and XLO, remove bearing cover screws (370G) and remove bearing cover (109C). Then remove the bearing housing (134) by tapping with a rubber hammer.
15. Remove bearing lock nut (136) and bearing lock washer (382).
16. Remove inboard bearing (168A) and outboard bearing (112). Use an arbor press or bearing puller to facilitate. On LTO models only, do not remove oil ring (248A) unless it is damaged.

NOTICE

Do not use a hammer, which may cause damage to the shaft

17. Complete disassembly of bearing frame (228). Remove oil plug (408A) (not shown), oil sight glass (145), oil cooler inlet (408L), outlet plugs (408M), and frame foot attachment bolt (529) and foot (241), where applicable.
18. Inspect all parts for cracks, erosion, pitting, rusting, damaged threads, corrosion, and groove worn shaft/sleeve. Replace casing if grooves and pits are greater than 1/8" deep. Replace impeller if grooves are greater than 1/16" or even wear exceeds 1/32". Inspect shaft sleeve if grooved or pitted. Shaft run out or bearing shoulder damage is cause for replacement.

ASSEMBLY PROCEDURES

(See APPENDIX D for cross-section of corresponding model.)

■ TO ASSEMBLE YOUR PUMP

Refer to Bolt Torque Values when assembling pump.

Bolt Torque Values, Ft-Lbs (N-m)			
Description	Frame	Model 2196	
		Lube	Dry
Bolt, casing to adaptor (370)	STO 6"	71 (96)	107 (145)
	STO 8"	35 (47)	54 (73)
	MTO, LTO	71 (96)	107 (145)
	XLO	71 (96)	107(145)
	XLO-17	141 (191)	212 (287)
Bolt, frame to adaptor (370B)	All	20 (27)	30 (40)
Bolt, clamp ring (370G)	STO, MTO	10* (1.1)	17* (1.9)
	LTO	55* (6.2)	83* (9.4)
Bolt, bearing end cover (371C)	XLO, XLO-17	9 (12)	12 (16)
*Values are in inch-lbs (N-m)			

1. Clean the bearing frame and inspect all tapped holes. Chase as needed.
2. Install oil fill plug (113A), oil sight glass (144), and frame lubrication plugs (408H).
3. Attach bearing frame foot (241) with bolts (529), where applicable.
4. On the LTO model, install oil ring (248A) on shaft (122), if removed. Oil ring is a press fit onto shaft.

▲ CAUTION
Use proper size drive tool to prevent damage and personal injury

5. On the LTO model, install bearing cover (109C) over shaft (122).
6. Install outboard bearing (112) on shaft (122).
 If grease lubricated, install with shield away from impeller end.
 If oil lubricated, there should be no seals or shields.

The recommended bearing installation method is heating the bearing using an induction heater.

⚠ WARNING

WEAR INSULATED GLOVES when using heater. Failure to do so can result in serious personal injury while handling hot bearings.

NOTICE

LTO frames use duplex angular contact bearings. Make sure bearings are mounted in the correct order, back to back.

7. Install a bearing lock washer (382) on the shaft.
 - a. Place tang of lock washer in shaft keyway.
 - b. Install lock-nut (136) on shaft.
 - c. Using a spanner wrench, tighten the nut until snug; then bend any one of the tangs into a lock-nut slot.
8. Install inboard bearing (168A) on shaft (122).

If grease lubricated, install with shield toward impeller end.

If oil lubricated, there should be no seals or shields.
9. Install the outboard labyrinth oil seal (332) in the bearing housing (134). Follow Maintenance instructions in *Appendix E*.

NOTICE

Make sure drain slots face down

10. Apply a thin coating of lubricant to the inside of the bearing housing (134).
11. Slide the bearing housing (134) over the outboard bearing assembly (112) and shaft (122). Place the coupling end of the shaft into the bearing housing through the labyrinth oil seal.

On the XLO model, install the bearing cover gasket (360G).

On the STO and MTO models, install the bearing housing snap ring (361A) into the groove on the bore of the bearing housing. Make sure the flat side is toward the bearing and the snap ring's opening is in the 6 o'clock position to allow oil drainage.

On the LTO and XLO models, install bearing cover (109C) and bolts (370G).
12. Install a new O-ring (496) over the O.D. of the bearing housing.
13. Apply a thin coating of lubricant to the outside of the bearing housing (134) and

slide the assembly into the bearing frame (228).

14. Install bearing housing bolts (370C) into bearing frame (228) and install jack bolts (370D) and jam nuts (423). Hand-tighten evenly.
15. Attach frame (228) to adapter (108).
 - a. Align dowel pins (469B), adapter bolts (370B) and frame to adaptor gasket (360D).
 - b. Tighten using crisscross pattern.
 - c. Rotate shaft 360 degrees. It should be free.

NOTICE

These steps do not apply to the 6" STO model

16. Set frame (228) and adapter (108) upright. Clamp to bench for safety as assembly continues.
17. Install inboard bearing labyrinth seal in adapter frame. Make sure that the seal's drain slots face down. Follow Maintenance instructions in *Appendix E*.
18. Put anti-seize compound on the shaft and, if equipped, install shaft sleeve (126) onto shaft (122).
19. Align anti-rotation pin with notch in sleeve (126).

For mechanical seal pumps, read manufacturer's instructions for assembly. (See **STUFFING BOX** on page 5.)
20. Install stuffing box cover (184) onto adapter with studs (353) and nuts (353A).
21. Install impeller (101) with new O-ring (412).
22. Using an impeller wrench or strap wrench on the coupling end of the shaft, tighten by rotating clockwise. Make sure coupling is tight to the shaft.
23. For packed pumps, install the appropriate packing (106) in the stuffing box cover (184) according to fluid being pumped (105).
 - a. First, insert two packing rings into bottom of box.
 - b. Next, insert the lantern ring (105). Make sure to stagger packing joints and lantern ring joint by 90 and be sure lantern ring lines up with flushing connection. Install gland halves (107).
 - c. Hand-tighten nuts (353A). You must make final adjustments after the pump has begun operation.

For mechanical seal pumps, continue by following manufacturer's instructions noted in *Step 19*.

24. Install casing gasket (351) onto stuffing box cover (184). At this point, the power end is ready for reinstallation into the casing or for storage for future use.

25. If returning to service, slide assembly into casing (100).
26. Install casing bolts (370) into frame to pull assembly into casing.
27. Rotate the shaft to ensure that no rubbing exists.
28. Adjust impeller clearance according to the instructions beginning on page 12.
29. Align drive coupling according to the instructions beginning on page 5, in addition to coupling manufacturer instructions.
30. If the motor was replaced, check rotation prior to reconnecting coupling halves. (See rotation instructions on page 9).

⚠ CAUTION

Check that motor rotation agrees with pump rotation

31. Reinstall coupling guard.

RECOMMENDED SPARE PARTS

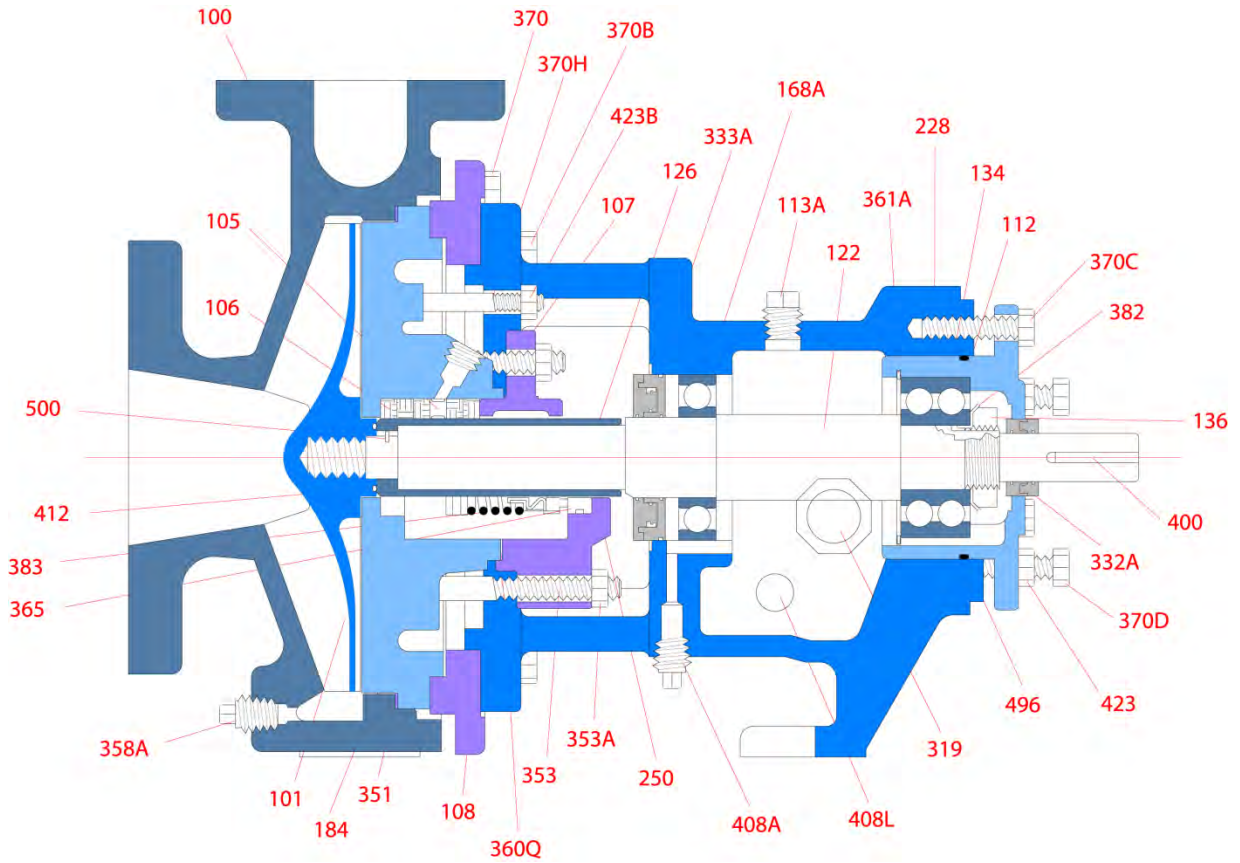
SHAFT KIT

MAINTENANCE KIT (902)

IMPELLER (101)	IMPELLER O-RING (412)
SHAFT (122)	BEARING HOUSING O-RING (496)
SHAFT SLEEVE (126)	OUTBOARD LABYRINTH SEAL (332A)
OUTBOARD BEARING (112)	INBOARD LABYRINTH SEAL (333A)
INBOARD BEARING (168)	BEARING LOCKNUT (136)
CASING GASKET (351)	BEARING HOUSING RETAINING RING (361A)
FRAME-TO-ADAPTOR GASKET (360D)	

APPENDIX D – PUMP CROSS SECTIONS AND PARTS LISTS

MODEL 2196 STO CROSS SECTION



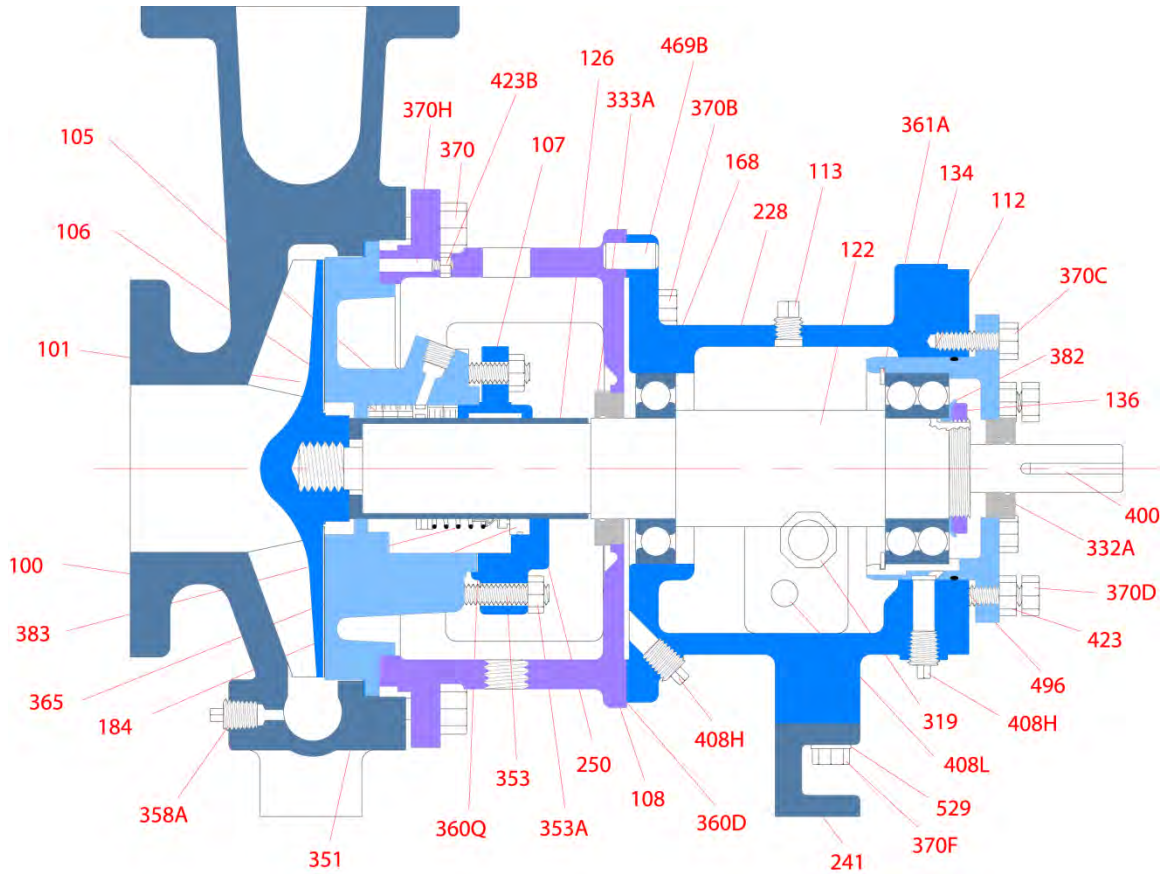
MODEL 2196 STO PARTS LIST

Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360Q	1	Gasket; Gland, Mech. Seal
101	1	Impeller	361A	1	Snap Ring, Bearing
105	1	Ring, Lantern	365	1	Seal, Mechanical Stationary Element
106	5	Packing	370	3	Bolt, Casing
107	1	Gland, Packing	370B**	4	Bolt, Frame / Adapter
108**	1	Adapter Ring	370C	3	Bolt, Bearing Housing
112	1	Bearing, Outboard	370D	3	Jack Bolt, Bearing Housing
113A	1	Plug, Oil Fill	370H	2	Stud, SBC / Adapter
122	1	Shaft	382	1	Lockwasher, Bearing
126	1	Sleeve, Shaft	383	1	Seal, Mechanical Rotating Element
134	1	Housing, Bearing	400	1	Key, Coupling
136	1	Locknut, Bearing	408A	1	Plug, Frame Lubrication Port
168A	1	Bearing, Inboard	408L	1	Plug, Oil Cooler Inlet (Not Shown)
184	1	Cover, Stuffing Box	408M	1	Plug, Oil Cooler Outlet (Not Shown)
228	1	Frame	412	1	O-ring, Impeller
250	1	Gland, Mechanical Seal	423	3	Jamnut, Bearing Housing / Frame
319	1	Sight Glass	423B	2	Nut, Box Cover/Adapter Stud
332A	1	Labyrinth, OB	496	1	O-ring,, Bearing Housing / Frame
333A	1	Labyrinth, IB	500	1	Pin, Sleeve
351	1	Gasket, Case			
353	4	Stud, Gland			
353A	4*	Nut, Gland Stud			
358A	1	Plug, Casing Drain			

* Packing Gland has only 2 Studs & Nuts

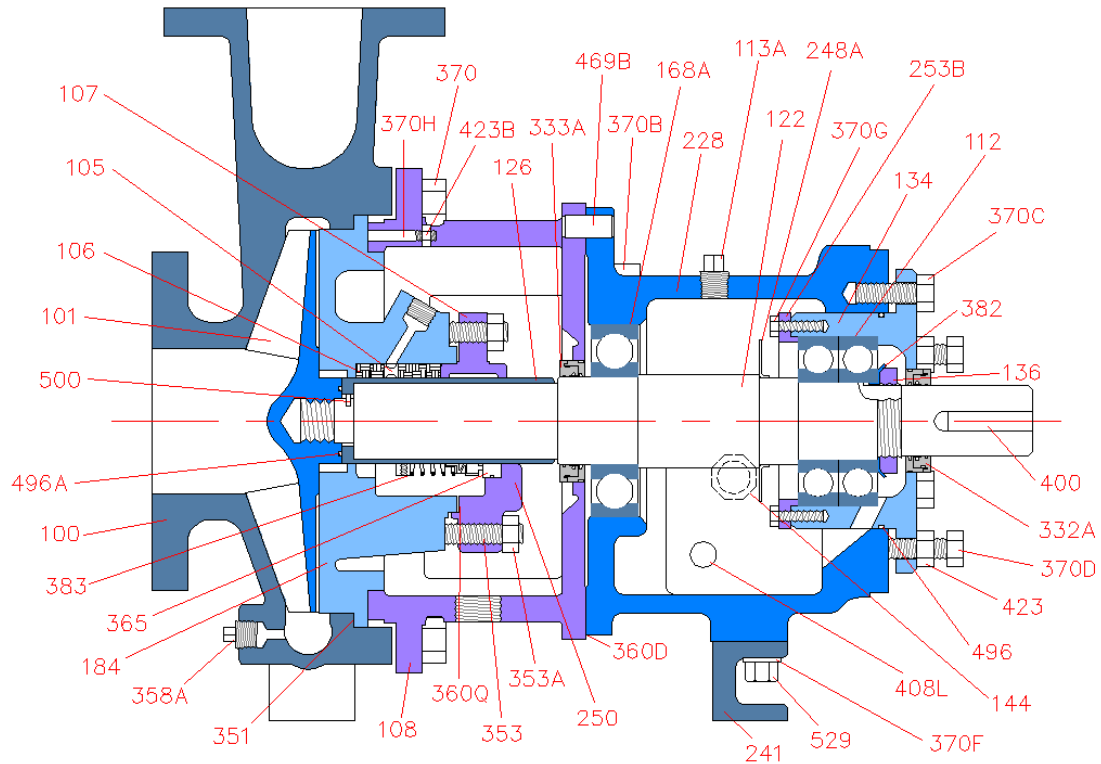
** Only Required on 8" Pump

MODEL 2196 MTO CROSS SECTION



MODEL 2196 MTO PARTS LIST					
Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360D	1	Gasket, Frame/Adapter
101	1	Impeller	360Q	1	Gasket; Gland, Mech. Seal
105	1	Ring, Lantern	361A	1	Snap Ring, Bearing
106	5	Packing	365	1	Seal, Mechanical Stationary Element
107	1	Gland, Packing	370	8, 12, 16	Bolt, Casing
108	1	Adapter	370B	4	Bolt, Frame / Adapter
112	1	Bearing, Outboard	370C	3	Bolt, Frame / Bearing Housing
113	1	Plug, Oil Fill	370D	3	Jack Bolt, Bearing Housing
122	1	Shaft	370F	2	Bolt, Frame Foot
126	1	Sleeve, Shaft	370H	2	Box Cover/Adapter Stud
134	1	Housing, Bearing	382	1	Lockwasher, Bearing
136	1	Locknut, Bearing	383	1	Seal, Mechanical Rotating Element
168	1	Bearing, Inboard	400	1	Key, Coupling
184	1	Cover, Stuffing Box	408A	1	Plug, Frame Drain (Not Shown)
228	1	Frame	408H	4	Plug, Frame Lubrication Port
241	1	Foot Frame	408L	1	Plug, Oil Cooler Inlet
250	1	Gland, Mechanical Seal	408M	1	Plug, Oil Cooler Outlet
319	1	Gauge; Sight, Oil	412	1	O-ring, Impeller
332A	1	Labyrinth, Outboard Frame	423	3	Jamnut, Bearing Housing Jack Bolt
333A	1	Labyrinth, Inboard Frame	423B	2	Nut, Box Cover/Adapter Stud
351	1	Gasket, Case	469B	2	Dowel Pin, Frame / Adapter
353	4	Stud, Gland	496	1	O-ring, Bearing Housing / Frame
353A	4*	Nut, Gland Stud	529	2	Washer, Frame Foot to Frame
358A	1	Plug, Casing Drain			* Packing Gland has only 2 Studs & Nuts

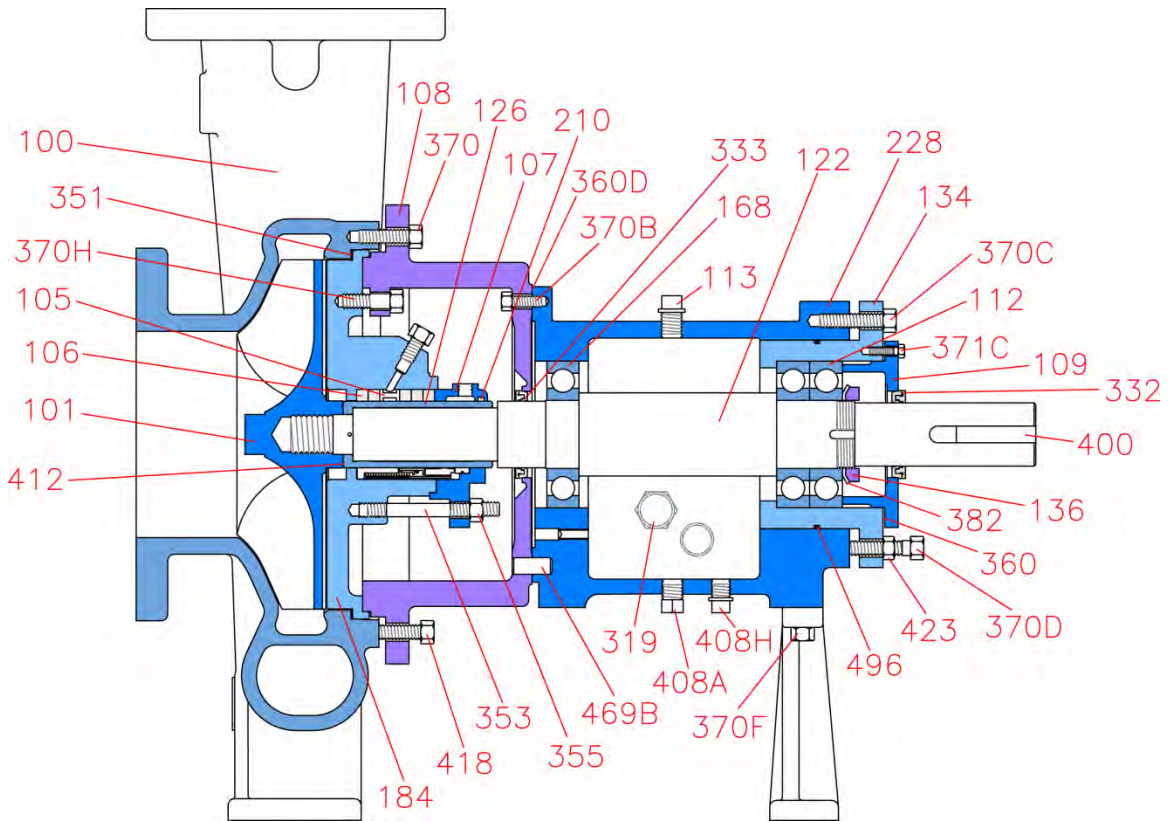
MODEL 2196 LTO CROSS SECTION



MODEL 2196 LTO PARTS LIST

Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360D	1	Gasket, Frame/Adapter
101	1	Impeller	360Q	1	Gasket; Gland, Mech. Seal
105	1	Ring, Lantern	361A	1	Snap Ring, Bearing
106	5	Packing	365	1	Seal, Mechanical Stationary Element
107	1	Gland, Packing	370	8, 12, 16	Bolt, Casing
108	1	Adapter	370B	4	Bolt, Frame / Adapter
109C	1	Cover; Bearing, Outboard	370C	3	Bolt, Bearing Housing
112	2	Bearing, Outboard	370D	3	Jack Bolt, Bearing Housing
113	1	Plug, Oil Fill	370F	2	Bolt, Frame Foot
122	1	Shaft	370G	6	Bolt, Bearing Cover
126	1	Sleeve, Shaft	370H	2	Box Cover/Adapter Stud
134	1	Housing, Bearing	382	1	Lockwasher, Bearing
136	1	Locknut, Bearing	383	1	Seal, Mechanical Rotating Element
168	1	Bearing, Inboard	400	1	Key, Coupling
184	1	Cover, Stuffing Box	408A	1	Plug, Frame Drain (Not Shown)
228	1	Frame	408H	4	Plug, Frame Lube Port (Not Shown)
241	1	Foot Frame	408L	1	Plug, Oil Cooler Inlet
248A	1	Ring, Oil	408M	1	Plug, Oil Cooler Outlet (Not Shown)
250	1	Gland, Mechanical Seal	412	1	O-ring, Impeller
319	1	Gauge; Sight, Oil	423	3	Jamnut, Bearing Housing Jack Bolt
332A	1	Labyrinth, Outboard Frame	423B	2	Nut, Box Cover/Adapter Stud
333A	1	Labyrinth, Inboard Frame	469B	2	Dowel Pin, Frame / Adapter
351	1	Gasket, Case	496	1	O-ring, Bearing Housing / Frame
353	4	Stud, Gland	500	1	Pin, Sleeve
353A	4*	Nut, Gland Stud	529	2	Washer, Frame Foot to Frame
358A	1	Plug, Casing Drain			* Packing Gland has only 2 Studs & Nuts

MODEL 2196 XLO CROSS SECTION



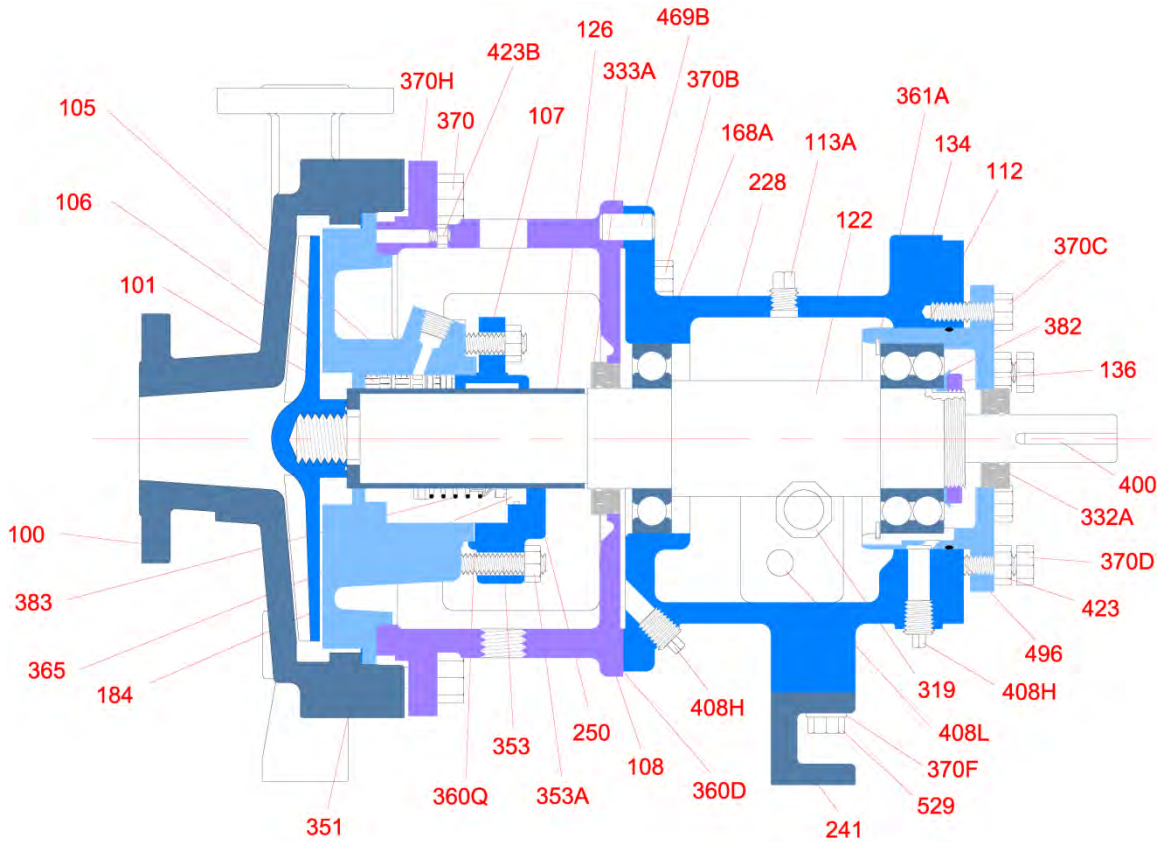
MODEL 2196 XLO PARTS LIST

Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360	1	Gasket, End Cover
101	1	Impeller	360D	1	Gasket, Frame/Adapter
105	1	Ring, Lantern	370	16/24 ¹	Bolt, Adapter / Case
106	5	Stuffing Box Packing	370B	4	Bolt, Frame / Adapter
107	1	Gland	370C	4	Bolt, Housing / Frame
108	1	Frame Adapter	370D	4	Jack Bolt, Housing Adjustment
109	1	Bearing End Cover, Outboard	370F	2	Bolt, Frame Foot
112	2	Bearing, Thrust, Outboard	370H	2	Stud, Cover / Adapter
113	1	Oil Fill Plug	371C	6	Bolt, Cover/Housing
122	1	Shaft, Sleeve Type	382	1	Lockwasher
126	1	Sleeve	400	1	Coupling Key
134	1	Housing, Bearing	408A	1	Drain Plug
136	1	Locknut, Bearing	408H	1	Plug, Frame Lubrication Port
168	1	Bearing, Radial, Inboard	408J ²	1	Oiler Plug
184	1	Cover, Stuffing Box	408L ²	1	Cooler Plug
210	1	Packing, Gland	408M ²	1	Cooler Plug
228	1	Frame	408N ²	1	Sight Plug
319	1	Sight Glass	412	1	O-Ring, Impeller
332	1	Labyrinth Seal, Outboard	418	3	Bolt, Case Jackout
333	1	Labyrinth Seal, Inboard	423	4	Housing Jam Nut
351	1	Gasket, Casing	469B	2	Pin, Frame / Adapter
353	2	Stud, Gland	496	1	O-Ring, Bearing Housing
355	2	Nut, Gland			

¹ Item # 370: (16) – 6X8-13, 8X10-13, (24) – 6X8-15, 8X10-15, 8X10-15G

² 408J, 408L, 408M & 408N – NOT SHOWN ON THE DRAWING

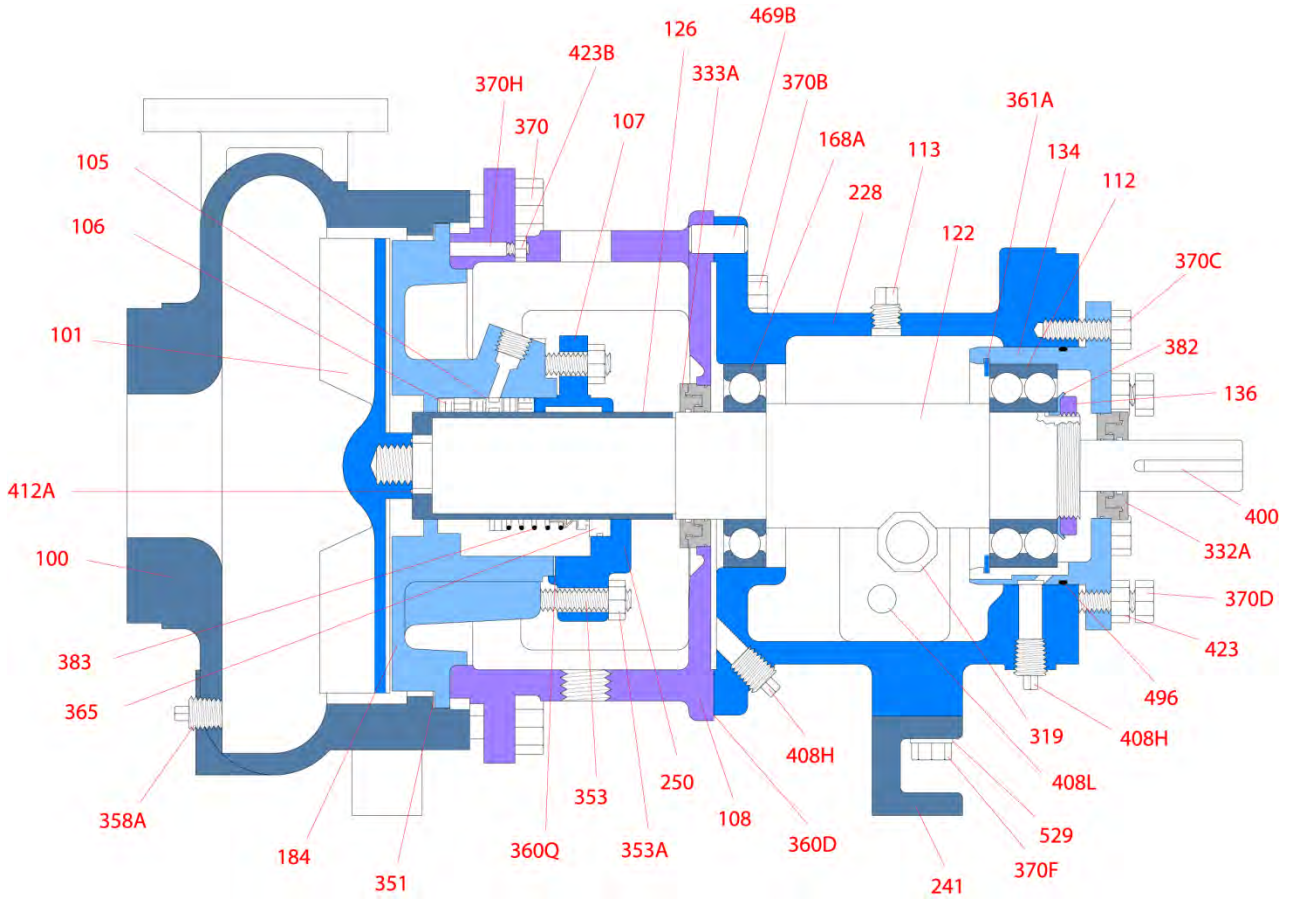
MODEL 2196-LF CROSS SECTION



MODEL 2196-LF PARTS LIST

Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360D	1	Gasket, Frame/Adapter
101	1	Impeller	360Q	1	Gasket; Gland, Mech. Seal
105	1	Ring, Lantern	361A	1	Snap Ring, Bearing
106	5	Packing	365	1	Seal, Mechanical Stationary Element
107	1	Gland, Packing	370	8, 12, 16	Bolt, Casing
108	1	Adapter	370B	4	Bolt, Frame / Adapter
112	1	Bearing, Outboard	370C	3	Bolt, Frame / Bearing Housing
113	1	Plug, Oil Fill	370D	3	Jack Bolt, Bearing Housing
122	1	Shaft	370F	2	Bolt, Frame Foot
126	1	Sleeve, Shaft	370H	2	Box Cover/Adapter Stud
134	1	Housing, Bearing	382	1	Lockwasher, Bearing
136	1	Locknut, Bearing	383	1	Seal, Mechanical Rotating Element
168	1	Bearing, Inboard	400	1	Key, Coupling
184	1	Cover, Stuffing Box	408A	1	Plug, Frame Drain (Not Shown)
228	1	Frame	408H	4	Plug, Frame Lubrication Port
241	1	Foot Frame	408L	1	Plug, Oil Cooler Inlet
250	1	Gland, Mechanical Seal	408M	1	Plug, Oil Cooler Outlet
319	1	Gauge; Sight, Oil	412A	1	O-ring, Impeller
332A	1	Labyrinth, Outboard Frame	423	3	Jamnut, Bearing Housing Jack Bolt
333A	1	Labyrinth, Inboard Frame	423B	2	Nut, Box Cover/Adapter Stud
351	1	Gasket, Case	469B	2	Dowel Pin, Frame / Adapter
353	4	Stud, Gland	496	1	O-ring, Bearing Housing / Frame
353A	4*	Nut, Gland Stud	529	2	Bolt, Frame Foot to Frame
358A	1	Plug, Casing Drain			* Packing Gland has only 2 Studs & Nuts

MODEL 2196-R CROSS SECTION

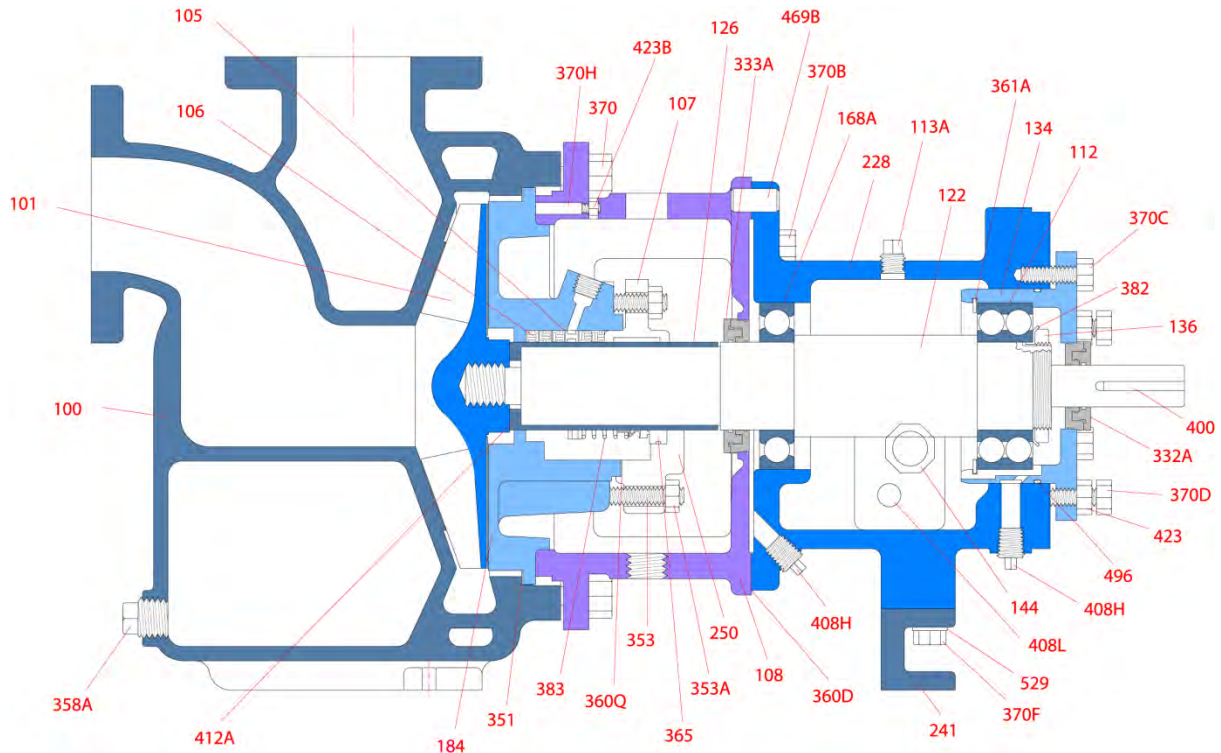


MODEL 2196-R PARTS LIST

Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360Q	1	Gasket; Gland, Mech. Seal
101	1	Impeller	361A	1	Snap Ring, Bearing
105	1	Ring, Lantern	365	1	Seal, Mechanical Stationary Element
106	5	Packing	370	3	Bolt, Casing
107	1	Gland, Packing	370B**	4	Bolt, Frame / Adapter
108**	1	Adapter Ring	370C	3	Bolt, Bearing Housing
112	1	Bearing, Outboard	370D	3	Jack Bolt, Bearing Housing
113	1	Plug, Oil Fill	370F	1	Bolt, Foot to Frame
122	1	Shaft	370H	2	Stud, SBC / Adapter
126	1	Sleeve, Shaft	382	1	Lockwasher, Bearing
134	1	Housing, Bearing	383	1	Seal, Mechanical Rotating Element
136	1	Locknut, Bearing	400	1	Key, Coupling
168A	1	Bearing, Inboard	408H	4	Plug, Frame Lubrication Port
184	1	Cover, Stuffing Box	408L	1	Plug, Oil Cooler Inlet (Not Shown)
228	1	Frame	408M	1	Plug, Oil Cooler Outlet (Not Shown)
250	1	Gland, Mechanical Seal	412A	1	O-ring, Impeller
319	1	Sight Glass	423	3	Jamnut, Bearing Housing / Frame
332A	1	Labyrinth, OB	423B	2	Nut, Box Cover/Adapter Stud
333A	1	Labyrinth, IB	496	1	O-ring, Bearing Housing / Frame
351	1	Gasket, Case	500	1	Pin, Sleeve
353	1	Stud, Gland	529	2	Washer, Foot to Frame
353A	4*	Nut, Gland Stud			
358A	1	Plug, Casing Drain			

* Packing Gland has only 2 Studs & Nuts
 ** Only Required on 8" Pump

MODEL 2796 CROSS SECTION



MODEL 2796 PARTS LIST					
Item #	Qty	Description	Item #	Qty	Description
100	1	Casing	360D	1	Gasket, Frame/Adapter
101	1	Impeller	360Q	1	Gasket; Gland, Mech. Seal
105	1	Ring, Lantern	361A	1	Snap Ring, Bearing
106	5	Packing	365	1	Seal, Mechanical Stationary Element
107	1	Gland, Packing	370	8, 12, 16	Bolt, Casing
108	1	Adapter	370B	4	Bolt, Frame / Adapter
112	1	Bearing, Outboard	370C	3	Bolt, Bearing Housing
113A	1	Plug, Oil Fill	370D	3	Jack Bolt, Bearing Housing
122	1	Shaft	370F	2	Bolt, Frame Foot
126	1	Sleeve, Shaft	370H	2	Box Cover/Adapter Stud
134	1	Housing, Bearing	382	1	Lockwasher, Bearing
136	1	Locknut, Bearing	383	1	Seal, Mechanical Rotating Element
144	1	Gauge; Sight, Oil	400	1	Key, Coupling
168A	1	Bearing, Inboard	408A	1	Plug, Frame Drain (Not Shown)
184	1	Cover, Stuffing Box	408H	4	Plug, Frame Lubrication Port
228	1	Frame	408L	1	Plug, Oil Cooler Inlet
241	1	Foot Frame	408M	1	Plug, Oil Cooler Outlet
250		Gland, Mechanical Seal	412A	1	O-ring, Impeller
332A	1	Labyrinth, Outboard Frame	423	3	Jamnut, Bearing Housing Jack Bolt
333A	1	Labyrinth, Inboard Frame	423B	2	Nut, Box Cover/Adapter Stud
351	1	Gasket, Case	469B	2	Dowel Pin, Frame / Adapter
353	4	Stud, Gland	496	1	O-ring, Bearing Housing / Frame
353A	4*	Nut, Gland Stud	529	2	Washer, Frame Foot to Frame
358A	1	Plug, Casing Drain			* Packing Gland has only 2 Studs & Nuts

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APPENDIX E – MAINTENANCE INSTRUCTIONS FOR LABYRINTH BEARING ISOLATORS

DETAILS OF OPERATIONS

The Labyrinth seal performs two functions:

1. Maintains the clean oil in the bearing housing.
2. Keeps contaminants from entering the bearing housing.

The unit is comprised of three major components: the **rotor**, the **stator**, and the o-ring.

The **rotor** fits over the shaft and is held in place by an elastometric drive ring. The drive ring causes the rotor to turn with the shaft and also provides a positive static seal on the shaft. There is no metal-to-metal contact between the shaft and rotor, thus no wear and friction concerns.

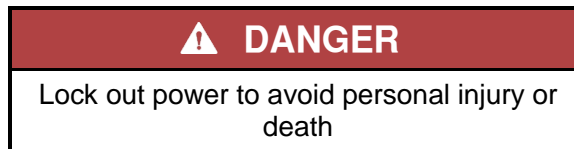
The **stator** is held in the housing by a nominal .002” interference fit. An o-ring gasket on the outside diameter of the stator secures a positive seal between the stator and the housing bore. The designed Labyrinth grooves and lube return trough on the stator inside diameter retains the lubricant inside the bearing housing.

The rotor and stator act together to keep contamination out of the bearing housing.

The o-ring, stator, and rotor are a unit and must not be pulled apart. If the unit is pulled apart or comes apart, it must be replaced with a new unit. The o-ring is intended to be an inseparable design.

Repairs or replacement of seals are only necessary if excessive oil leakage is visible. If or when the bearing housing is disassembled, it is recommended that the rotor o-rings be replaced.

DISASSEMBLY PROCEDURES



1. Remove shaft assembly (122) per instructions for pump disassembly. (See page 18.)
2. STO removal. Insert a bar (wood or plastic) through the outboard bearing housing end of the bearing frame (228). Contact the inboard bearing isolator (333A). Remove by tapping the bar or pushing with an arbor press.

MTO and XLO removal. Disassemble the bearing frame adapter (108) per pump disassembly instructions. Remove the inboard bearing isolator (333A) with a bar (wood or plastic) by tapping or by pushing with an arbor press.

3. STO, MTO, and XLO outboard bearing isolator (332A) removal. Block up the outboard bearing housing (134) on the bench, coupling the end toward the bench top. Tap the isolator out of the housing or use an arbor press.
4. Inspect the bearing isolators. If the unit pulls apart, a new isolator is needed for reassembly.

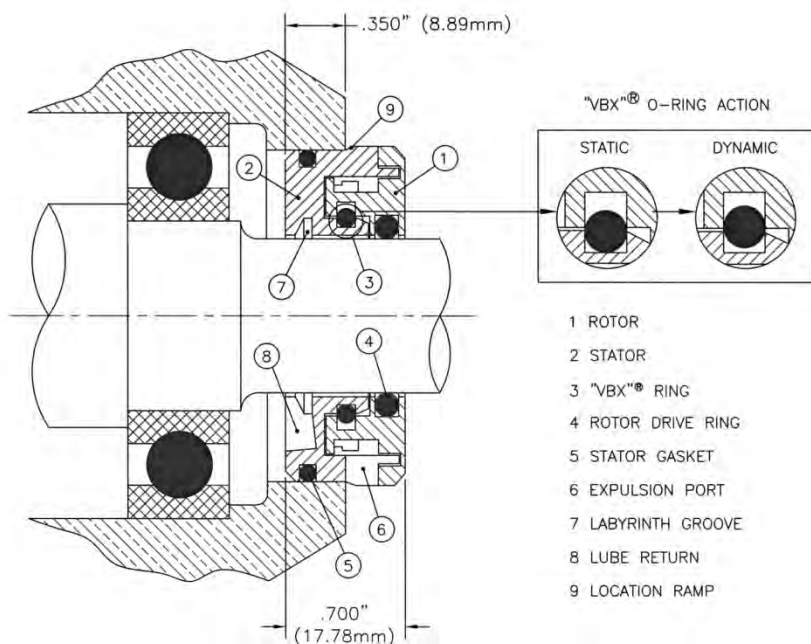
- Replace the rotor 0-rings and stator 0-rings each time the units are removed from the pump assembly.

INSTALLATION PROCEDURES



- STO, MTO, and XLO Inboard Isolator.** Position the bearing frame (228) or adapter (108) inboard bearing side up. Place the isolator seal (333A) stator side in the bore. **THE EXPULSION PORT MUST BE IN THE 6 O'CLOCK POSITION.** While using a block large enough to cover the entire flange of the isolator, use an arbor press to press the stator into the bore. Press into place until the location ramp begins. (See *Figure 1*.)

Figure 1

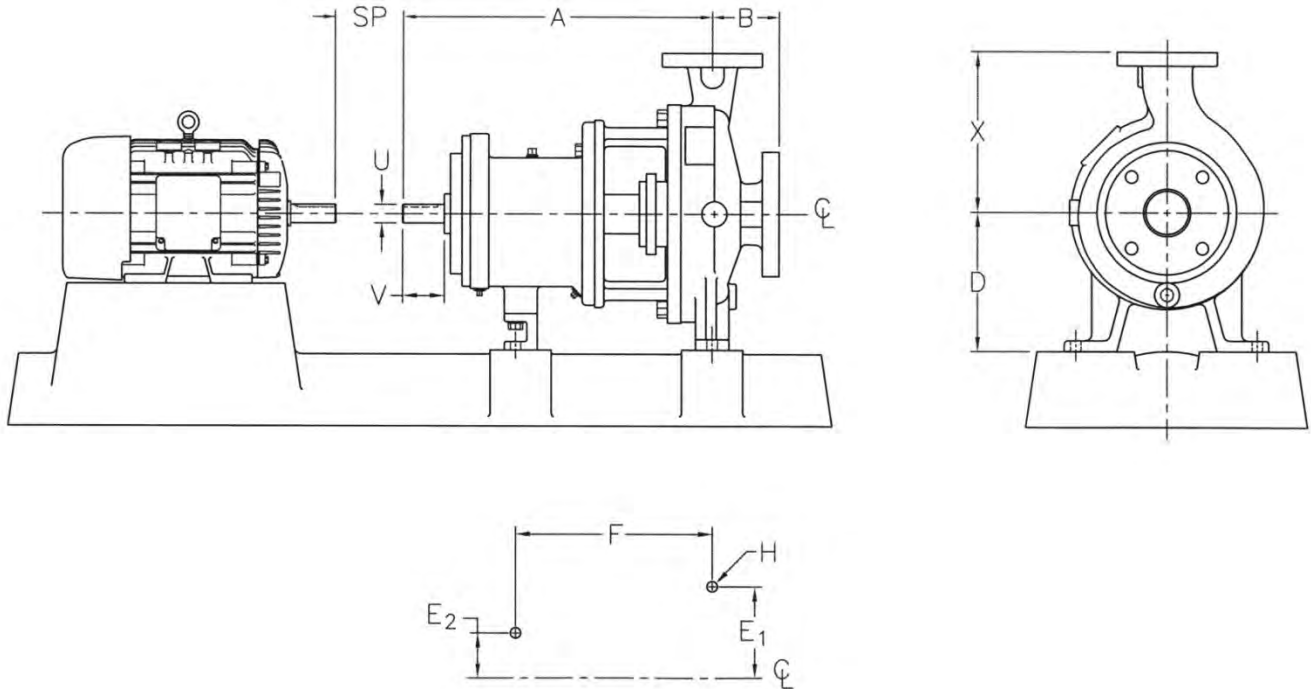


- Outboard Isolator (332A).** Position the bearing housing (134) outside flange up. Place the isolator in the bore and press into place using the same technique as in *Step 1* above.
- Lightly lube the sleeve end of the shaft and rotor drive ring. Slide the bearing frame (228) or adapter (108) over the shaft per assembly instructions.
- To assemble the outboard end, tape the shaft (122) keyway with black tape. Lube the tape and rotor drive ring. Slide the bearing housing (134) over the shaft (122) end and continue per assembly instructions.

MAKE SURE EXPULSION PORT AND LUBE RETURN ARE IN THE 6 O'CLOCK POSITION IN FINAL ASSEMBLY.

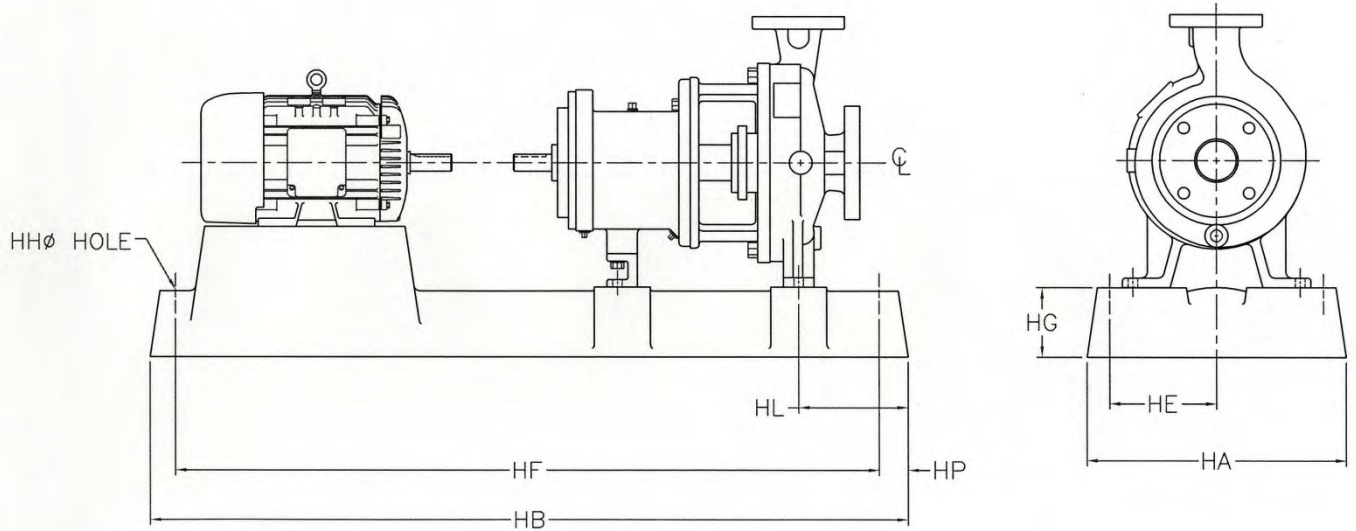
APPENDIX F – DIMENSIONAL DATA

MODEL 2196 DIMENSIONAL DATA



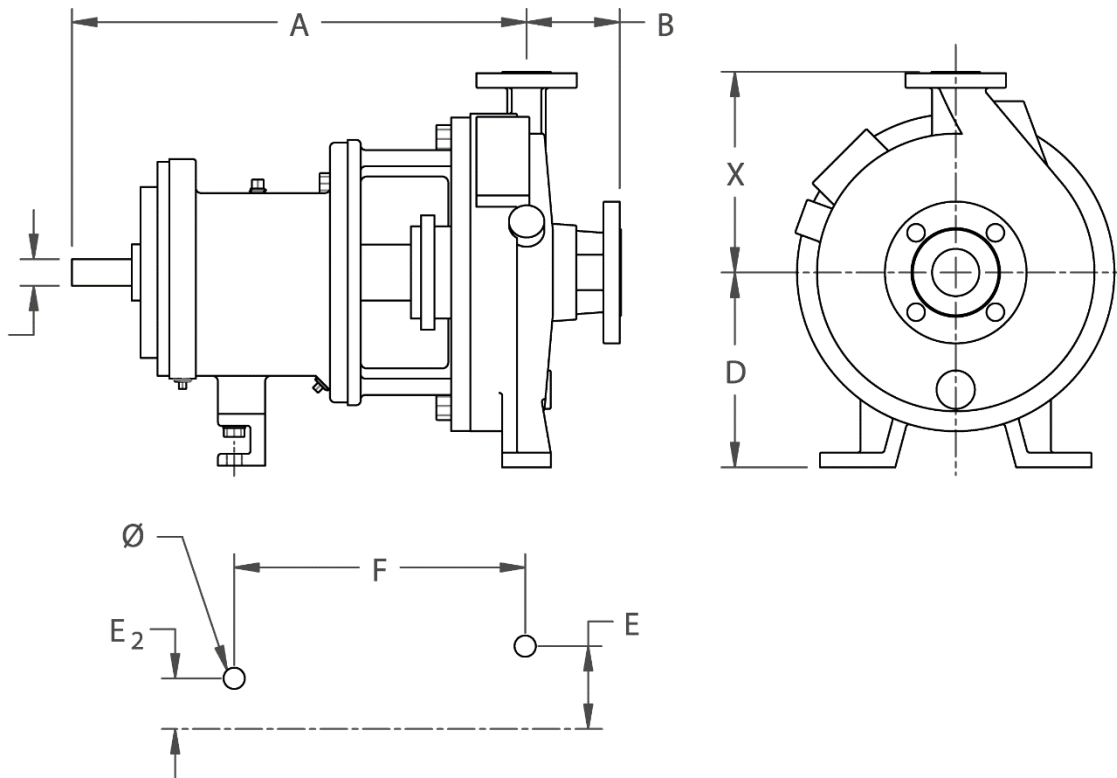
2196 DIMENSIONS																		
PUMP FRAME	ANSI	SIZE			X	D	B	A	SP	FOOT PATTERN				SHAFT			APPROX. BARE PUMP WT. (LBS.)	
		DIS	SUC	IMP						E1	E2	F	H	U	KEYWAY	V		
STO	AA	1	1.5	6	6 1/2	5 1/4	4	13 1/2	3 3/4	3	0	7 1/4	5/8	.875	3/16 X 3/32	2	85	
	AB	1.5	3	6													90	
		2	3	6													95	
		1	1.5	8													100	
MTO	AB	1.5	3	8	8 1/4	8 1/4	4	19 1/2	3 3/4	4 7/8	3 5/8	12 1/2	5/8	MTO 1.125	MTO 1/4X1/80	2 5/8	110	
	A60	2	3	8													9 1/2	200
	A70	3	4	8													11	220
	A70	3	4	8G													11	220
	A05	1	2	10													8 1/2	200
	A50	1.5	3	10													8 1/2	220
	A60	2	3	10													9 1/2	230
	A70	3	4	10													11	265
	A40	3	4	10H													12 1/2	275
	A80	4	6	10													13 1/2	305
LTO	A80	4	6	10H	13 1/2	305												
	A20	1.5	3	13	10 1/2	245												
	A30	2	3	13	11 1/2	275												
	A40	3	4	13	12 1/2	330												
	A80	4	6	13	13 1/2	405												
	A90	6	8	13	16	560												
XLO	A100	8	10	13	14 1/2	6	27 7/8	5 1/4	8	4 1/2	18 3/4	7/8	2.375	5/8 X 5/16	4	670		
	A110	6	8	15												610		
	A120	8	10	15												740		
	A120	8	10	15G												19	710	
		4	6	17												16	660	
		6	8	17												18	735	
		8	10	17												19	840	

MODEL 2196 CAST IRON BASEPLATE RELATED DIMENSIONS



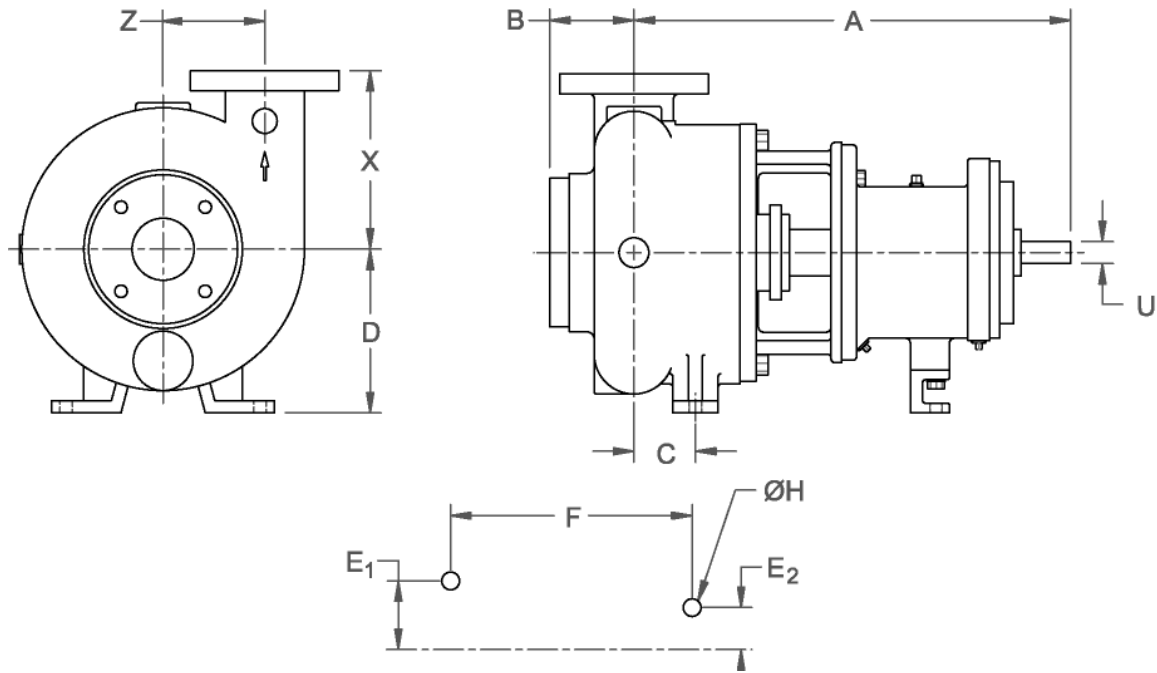
CAST IRON RELATED BASEPLATE RELATED DIMENSIONS										
PUMP FRAME	BASEPLATE NUMBER	MAX MOTOR FRAME	HA	HB	HE	HF	HP	HG	HH	HL
STO	1	145	10	35	4	32 1/2	1 3/8	3 3/16	3/4	4 5/8
	2	215	12	39	4 1/2	36 1/2	1 1/4	3 3/8	3/4	4 1/2
	3	286	15	46	6	43 1/2	1 1/4	6	3/4	4 1/2
MTO or LTO	4	215	12	45	4 1/2	42 1/2	1 1/4	4	3/4	4 1/2
	5	286	15	52	6	49 1/2	1 1/4	4 3/8	3/4	4 1/2
	6	365	18	58	7 1/2	55 1/2	1 1/4	5	1	4 1/2
	7	444	18	60	7 1/2	57 1/2	1 1/4	5	1	4 1/2
XLO	8	286	26	62	11 1/4	47	13	4	1	5 1/4
	9	365	26	68	11 1/4	47	13	4	1	5 3/16
	10	447	26	74	11 1/4	47	13	4 1/8	1	5 1/4

MODEL 2196-LF DIMENSIONAL DATA



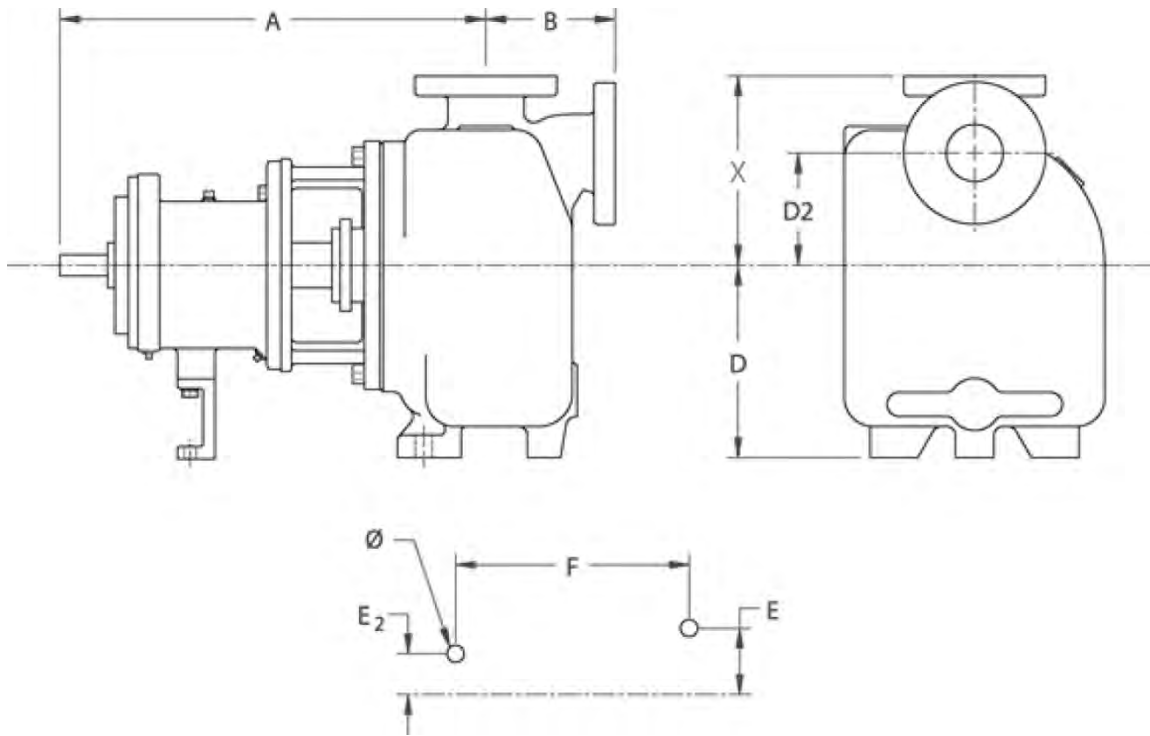
2196-LF DIMENSIONS										
PUMP FRAME	ANSI	SIZE			X	A	B	D	SP	APPROX. BARE PUMP WT. (LBS.)
		DIS	SUC	IMP						
STO	AA	1	1.5	4	6.5	13.5	4.0	5.25	3.75	84
	AA	1	1.5	8	6.5	13.5	4.0	5.25	3.75	100
MTO/LTO	A05	1	2	10	8.5	19.5	4.0	8.25	3.75	200
										245
LTO	A20	1.5	3	13	10.5	19.5	4.0	10.0	3.75	285

MODEL 2196-R DIMENSIONAL DATA



2196-R DIMENSIONS														
Pump Frame	Size	Z	X	A	B	C	D	SP	Foot Pattern				Shaft	
									E1	E2	F	H	U	KEYWAY
STO	2x2-8	4.25	6.5	16	2.75	2.5	6	3.75	3	0	7.25	.63	0.875	.19 x .09
MTO or LTO	2x2-10	5.25	8.5	21.75	3.5	2.25	8.25		4.88	3.63	12.5		1.125	.25 x .125
	3x3-10	5.13	9	22.50	4.25	2.94	10							
	2x3-13	6.63	10.5	22.38	4.12	2.81								
3x4-13	22.81			3.31										
LTO	4x6-13		11.5	23.13	4.75	3.63						1.875	.5 x .25	

MODEL 2796 DIMENSIONAL DATA



2796 DIMENSIONS													
PUMP FRAME	SIZE			X	A	B	D	D2	FOOT PATTERN				APPROX. BARE PUMP WT. (LBS.)
	DIS	SUC	IMP						E	E2	F	H	
STO	1	1.5	6	7.25	15.5	5	7.5	4	3	0	7.25	.63	170
	1.5		8	7.88									
MTO/LTO	2	2	10	10	21.75	6.5	10	6	4.88	3.63	12.5		370
	3	3			22.63	6.75							315
	4	4			23.38	9.19							370
	3	3	13	11.5	22.63	6.75							400
	4	4			22.38	9.19						470	
	6	6			15	27.75						7.50	12

MODEL 2196 STUFFING BOX RELATED DIMENSIONS

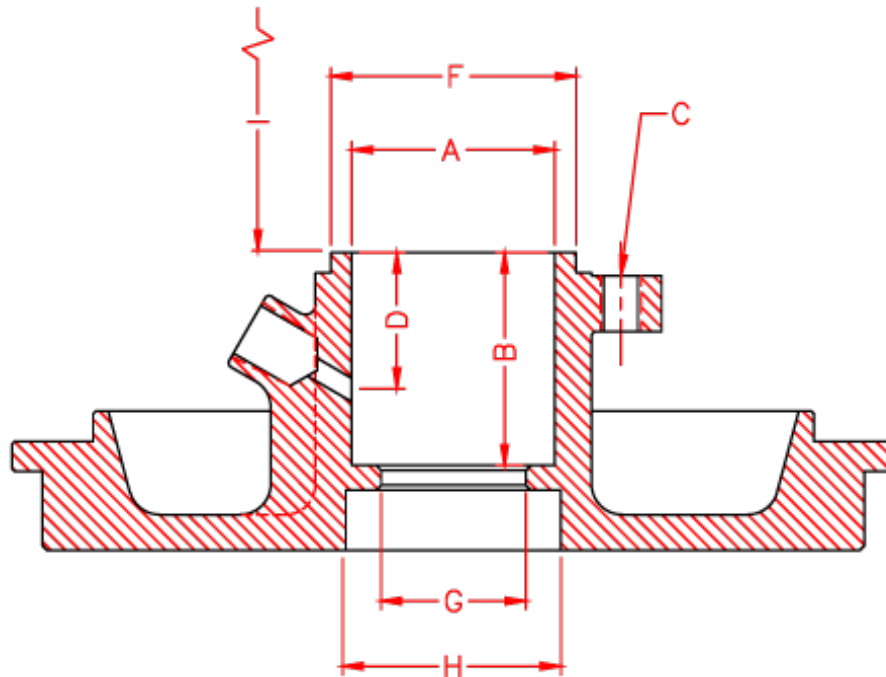


Figure 1: Standard bore stuffing box

STANDARD BORE DIMENSIONS										
PUMP FRAME	A	B	C		D	E	F	G	H	I
			B.C.	TAP						OBSTRUCTION
STO	2.00	2.13	3.25	3/8-16 UNC	0.97	1/4-18 NPT	2.39	1.40	-	2.18
MTO	2.50	2.61	4.13	1/2-13 UNC	1.56	3/8-18 NPT	3.02	1.78	2.65	3.00
LTO	2.88	2.63	4.50	1/2-13 UNC	1.56	3/8-18 NPT	3.52	2.15	2.63	3.00
XLO	3.38	3.00	5.38	5/8-11 UNC	1.75	3/8-18 NPT	4.37	3.53	3.38	2.90
XLO-17	3.63	3.00	5.38	5/8-11 UNC	1.63	1/4-18 NPT	4.38	2.78	3.50	2.90

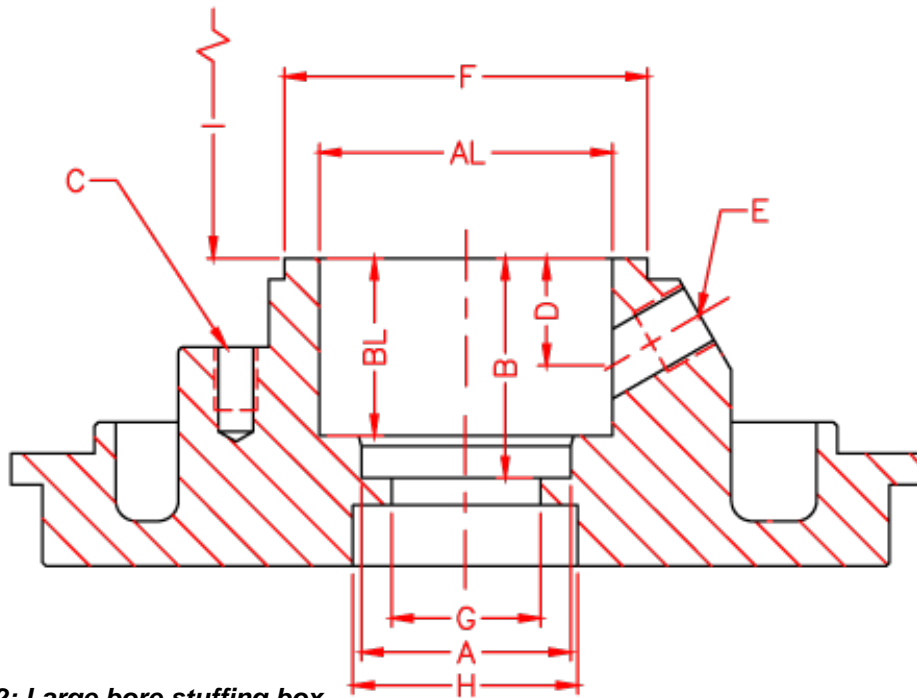


Figure 2: Large bore stuffing box

LARGE BORE DIMENSIONS													
PUMP FRAME	A	AL	B	BL	C		D	E	F	G	H	I	
					B.C.	TAP						OBSTRUCTION	
STO	2.00	2.86	2.13	1.69	4.50	3/8-16 UNC	0.88	1/4-18 NPT	3.60	1.40	N/A	2.18	
MTO	2.50	3.50	2.61	2.12	5.50	1/2-13 UNC	1.28	1/2-14 NPT	4.34	1.78	2.69	3.00	
LTO	2.88	3.88	2.63	2.06	6.00	5/8-11 UNC	1.38	3/8-18 NPT	4.71	2.16	2.77	3.00	
XLO	3.38	4.75	3.00	2.50	6.75	5/8-11 UNC	1.38	3/8-18 NPT	5.45	2.53	3.38	2.90	
XLO-17	3.63	4.75	3.00	2.45	6.75	5/8-11 UNC	1.41	3/8-18 NPT	5.45	2.75	3.50	2.90	

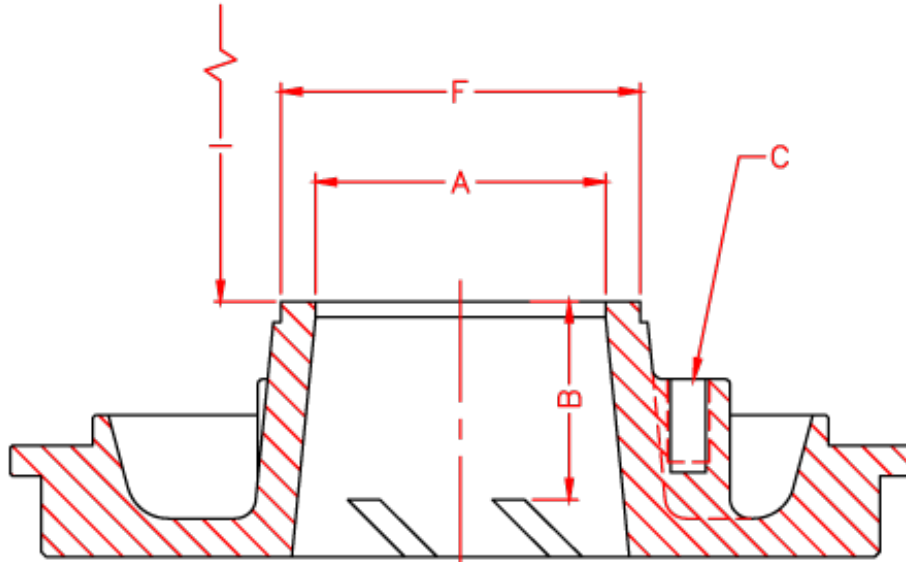


Figure 3: Taper bore stuffing box

TAPER BORE DIMENSIONS						
PUMP FRAME	A	B	C		F	I
			B.C.	TAP		OBSTRUCTION
STO	2.88	1.75	4.50	3/8-16 UNC	3.60	2.18
MTO	3.50	2.23	5.50	1/2-13 UNC	4.34	3.00
LTO	3.88	2.21	6.00	5/8-11 UNC	4.71	3.00
XLO	3.88	2.14	6.00	5/8-11 UNC	4.71	2.90
XLO-17	4.75	2.02	6.75	5/8-11 UNC	5.45	2.90

APPENDIX G – CONSTRUCTION DETAILS

MODEL 2196 CONSTRUCTION DETAILS

Construction Details All dimensions in inches and (mm).					
		STO	MTO	LTO	XLO
Shaft	Diameter at Impeller	.75 (19)	1 (25)	1.25 (32)	1.5 (38)
	Diameter in Stuffing Box (Solid shaft const.)	1.375 (35)	1.75 (45)	2.125 (54)	2.5 (64)
	Diameter Between Bearings	1.5 (38)	2.125 (54)	2.5 (64)	3.125 (79)
	Diameter at Coupling	.875 (22)	1.125 (29)	1.875 (48)	2.375 (60)
	Overhang	6.125 (156)	8.375 (213)	8.375 (213)	9.969 (253)
	Maximum Shaft Deflection	0.002 (0.05)			
	Shaft Deflection Index (L ³ /D ⁴) (With Sleeve) (Less Sleeve)	143 64	116 63	48 29	62 25
Sleeve	O.D. thru Stuffing Box/Seal Chamber	1.375 (35)	1.75 (45)	2.125 (54)	2.5* (64)
Bearings	Radial	SKF 6207	SKF 6309	SKF 6311	SKF 6313
	Thrust	SKF 5306 A/C3	SKF 5309 A/C3	SKF 7310 BECBM	SKF 5313 A/C3
	Bearing Span	4.125 (105)	6.75 (171)	6.875 (164)	9.25 (235)
Stuffing Box	Bore	2 (51)	2.5 (64)	2.875 (73)	3.375 (86)
Power Limits	HP (kW) per 100 RPM	1.1 (.82)	3.4 (2.6)	5.6 (4.2)	14 (10.5)

*XLO-17 pumps with sleeved shafts have a 2.75" (70) sleeve O.D. for packing, and 2.50" (64) sleeve O.D. for mechanical seals.

MODEL 2196 SHAFT RUNOUT TOLERANCES

Shaft Runout Tolerances All dimensions in inches and (mm)	
At Stuffing Box	At Coupling
.002 (.051)	.001 (.026)

MODEL 2196 SHAFT END PLAY

Shaft End Play All dimensions in inches and (mm)				
	STO	MTO	LTO	XLO
Double Row	.0011/.0019 (.028/.047)	.0013/.0021 (.033/.054)	NA	.0014/.0023 (.036/.058)
Duplex	.0007/.0010 (.018/.026)	.0009/.0012 (.022/.030)	.0010/.0015 (.026/.038)	.0010/.0015 (.026/.038)

MODEL 2196 BEARING FITS & TOLERANCES

Bearing Fits & Tolerances All dimensions in inches and (mm)				
According to ABEC I Standards				
	STO	MTO	LTO	XLO-X, XO-17
Shaft O. D. Inboard	1.3785 (35.013)	1.7722 (45.013)	2.1660 (55.015)	2.5597 (65.015)
	1.3781 (35.002)	1.7718 (45.002)	2.1655 (55.002)	2.5592 (65.002)
Clearance	0.0010 (0.025) tight	0.0010 (0.025) tight	0.0012 (0.030) tight	0.0012 (0.030) tight
	0.0001 (0.002) tight	0.0001 (0.002) tight	0.0001 (0.002) tight	0.0001 (0.002) tight
Bearing I. D. Inboard	1.3780 (35.000)	1.7717 (45.000)	2.1654 (55.000)	2.5591 (65.000)
	1.3775 (34.988)	1.7712 (44.988)	2.1648 (54.985)	2.5585 (64.985)
Frame I. D. Inboard	2.8346 (72.000)	3.9370 (100.000)	4.7244 (120.000)	5.5118 (140.000)
	2.8353 (72.019)	3.9379 (100.022)	4.7253 (120.022)	5.5128 (140.025)
Clearance	0.0012 (0.032) loose	0.0015 (0.037) loose	0.0015 (0.037) loose	0.0017 (0.043) loose
	0.0000 (0.000) loose	0.0000 (0.000) loose	0.0000 (0.000) loose	0.0000 (0.000) loose
Bearing O. D. Inboard	2.8346 (72.000)	3.9370 (100.000)	4.7244 (120.000)	5.5118 (140.000)
	2.8341 (71.987)	3.9364 (99.985)	4.7238 (119.985)	5.5111 (139.982)
Shaft O. D. Outboard	1.1815 (30.011)	1.7722 (45.013)	1.9690 (50.013)	2.5597 (65.015)
	1.1812 (30.002)	1.7718 (45.002)	1.9686 (50.002)	2.5592 (65.002)
Clearance	0.0008 (0.021) tight	0.0010 (0.025) tight	0.0010 (0.025) tight	0.0012 (0.030) tight
	0.0001 (0.002) tight	0.0001 (0.002) tight	0.0001 (0.002) tight	0.0001 (0.002) tight
Bearing I. D. Outboard	1.1811 (30.000)	1.7717 (45.000)	1.9685 (50.000)	2.5591 (65.000)
	1.1807 (29.990)	1.7712 (44.988)	1.9680 (49.988)	2.5585 (64.985)
Housing I. D. Outboard	2.8346 (72.000)	3.9370 (100.000)	4.3307 (110.000)	5.5118 (140.000)
	2.8353 (72.019)	3.9379 (100.022)	4.3316 (110.022)	5.5128 (140.025)
Clearance	0.0012 (0.032) loose	0.0015 (0.037) loose	0.0015 (0.037) loose	0.0017 (0.043) loose
	0.0000 (0.000) loose	0.0000 (0.000) loose	0.0000 (0.000) loose	0.0000 (0.000) loose
Bearing O. D. Outboard	2.8346 (72.000)	3.9370 (100.000)	4.3307 (110.000)	5.5118 (140.000)
	2.8341 (71.987)	3.9364 (99.985)	4.3301 (109.985)	5.5111 (139.982)

APPENDIX H – ANSI B15.1 COUPLING GUARDS

**INSTALLATION INSTRUCTIONS FOR SUMMIT PUMP
ANSI B15.1 COUPLING GUARDS**

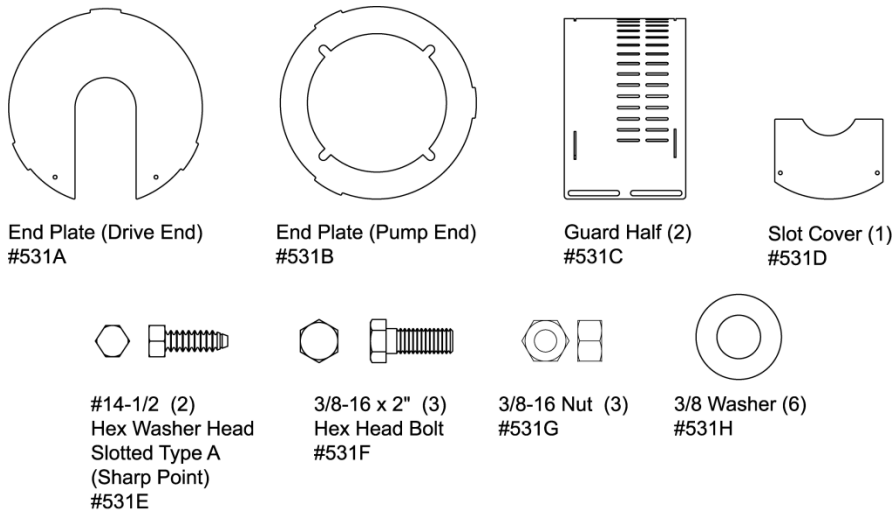
⚠ DANGER
Lock out/Tag out driver power before performing any work on pump

⚠ DANGER
Replace all guards before re-energizing the driver

⚠ WARNING
Before assembling or disassembling the coupling guard, de-energize the motor, lock out the motor controller/starter, and place a caution tag at the starter indicating that it is disconnected. Before resuming normal pump operation, replace the coupling guard.

NOTICE
Summit Pump assumes no liability when these procedures are avoided

Figure H-1



The design's simplicity allows complete coupling guard assembly, including the end plate (pump end), in about fifteen minutes.

ASSEMBLY PROCEDURES

■ TO ASSEMBLE YOUR COUPLING GUARD

NOTICE

If the end plate (pump end) was previously installed, make any necessary adjustments to the coupling and kip to step 2

1. On the STO, MTO, and LTO, align the end plate (pump end) to the bearing frame. (Impeller adjustment is not required.)

On the XLO-X, align the end plate (pump end) to the pump bearing housing with the small slots on the end plate aligned to the impeller adjusting bolts and the large slots clearing the bearing housing tap bolts. Then attach the end plate to the bearing housing using the jam nuts on the impeller adjusting bolts as shown in *Figure H-3*.

After attaching the end plate to the bearing housing, check and reset the impeller clearance as detailed in *APPENDIX A - IMPELLER CLEARANCE SETTING*.

NOTICE

Complete the coupling adjustments before proceeding with the coupling guard assembly.

Figure H-2
STO, MTO, LTO

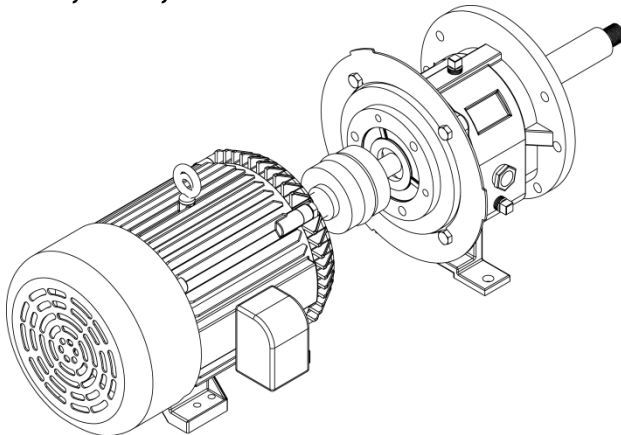
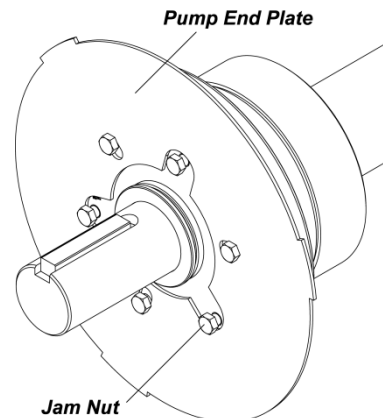


Figure H-3
XLO-X



2. Slightly spread the bottom of the coupling guard half (pump end) and place it over the pump end plate as shown in *Figure H-4*. The annular groove in the guard half is located around the end plate. (See *Figure H-5*.)

Figure H-4

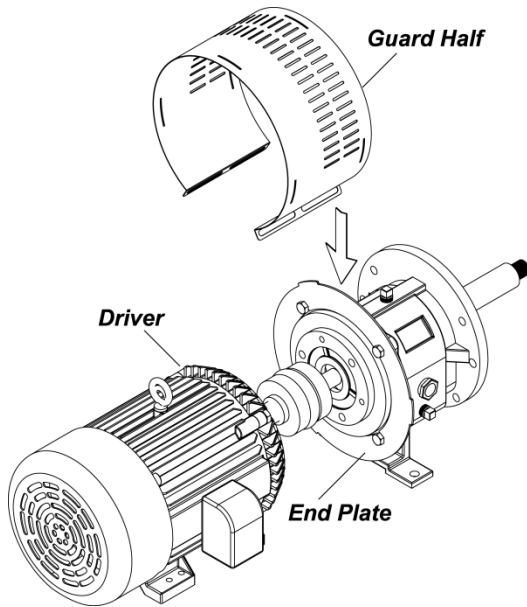
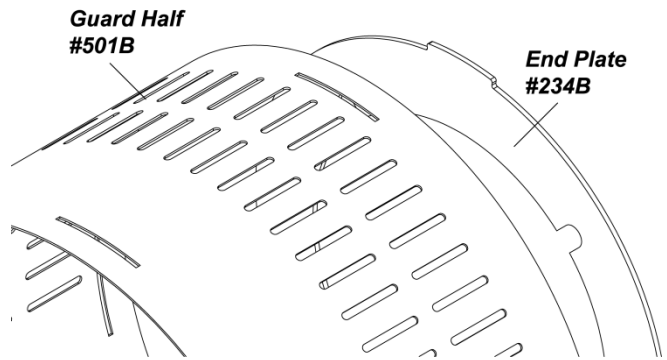


Figure H-5



3. After placing the coupling guard half (pump end) around the pump end plate, secure it with a bolt, nut and two (2) washers through the round hole in the front end of the guard half as shown in *Figure H-6*. Tighten securely. (See *Figure H-7*.)

Figure H-6

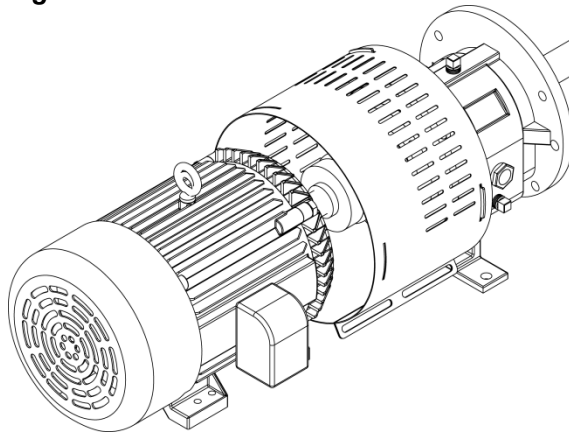
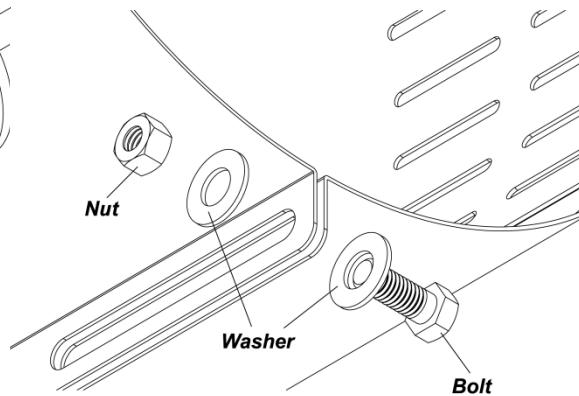
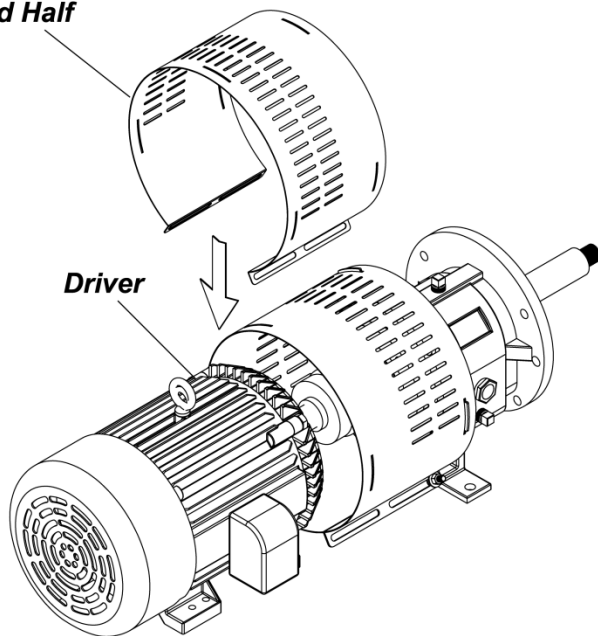


Figure H-7



4. Slightly spread the bottom of the coupling guard half (driver end) and place it over the coupling guard half (pump end) so that the annular groove in the coupling guard half (driver end) faces the motor as shown in *Figure H-8*.

Figure H-8
Guard Half



5. Place the end plate (driver end) over the motor shaft as shown in *Figure H-9*. Position the end plate in the annular groove at the rear of the coupling guard half (driver end) and secure it with a bolt, nut, and two (2) washers through the round hole at the rear of the guard half. Finger-tighten only.

Figure H-9

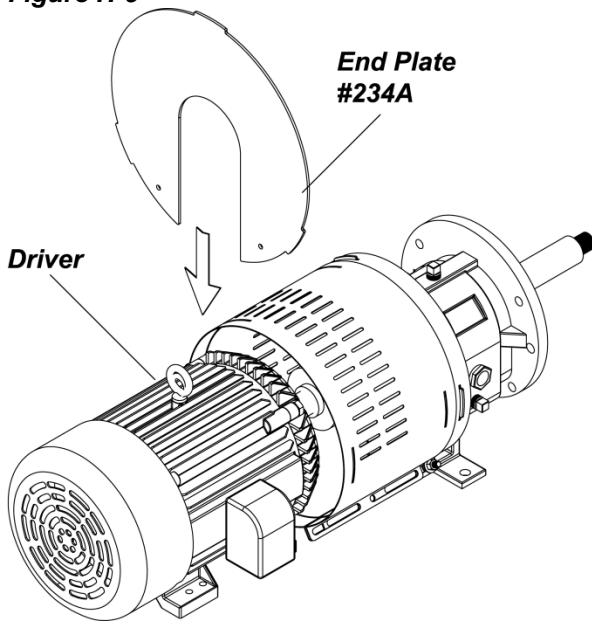
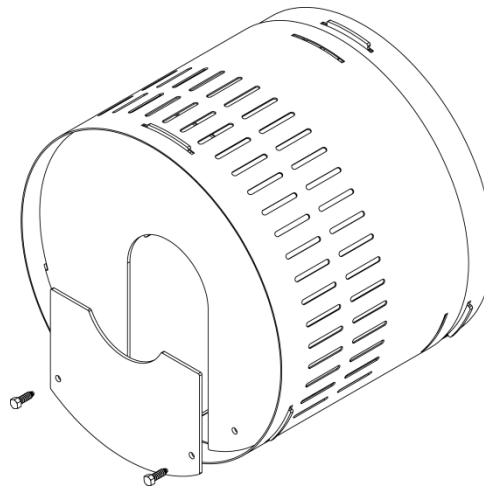


Figure H-9.5



6. Adjust the length of the coupling guard to completely cover the shafts and coupling as shown in *Figure H-10*, by sliding the coupling guard half (driver end) toward the motor. After adjusting the length, secure the guard with a bolt, nut and two (2) washers through the slotted holes at the center of the guard and tighten. Check tightness on all of the nuts on the guard assembly.

⚠ DANGER

Lock out/Tag out driver power before performing any work on pump

⚠ DANGER

Replace all guards before re-energizing the driver

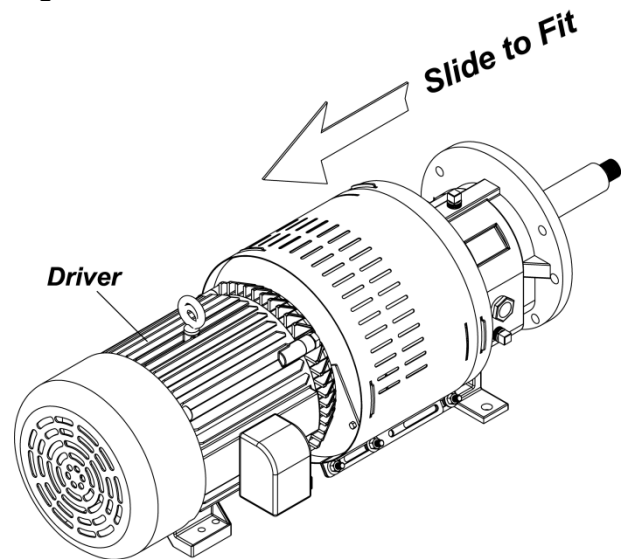
⚠ WARNING

Before assembling or disassembling the coupling guard, de-energize the motor, lock out the motor controller/starter, and place a caution tag at the starter indicating that it is disconnected. Before resuming normal pump operation, replace the coupling guard.

NOTICE

Summit Pump assumes no liability when these procedures are avoided

Figure H-10



DISASSEMBLY PROCEDURES

■ TO DISASSEMBLE YOUR COUPLING GUARD

It is necessary to remove the coupling guard for certain pump maintenance and adjustments, such as coupling adjustment, impeller clearance adjustment, and so forth. Replace the coupling guard after completing maintenance.

DO NOT resume normal pump operation while the coupling guard is removed.

NOTICE

Refer to the assembly illustrations and instructions in reverse order for disassembly

1. Remove the nut, bolt and washers from the center-slotted hole on the coupling guard. Slide the motor end of the coupling guard half toward the pump. (See *Figure H-10.*)
2. Remove the nut, bolt and washers from the driver end of the coupling guard half and remove the end plate. (See *Figure H-9.*)
3. Slightly spread the bottom of the coupling guard half and lift it off. (See *Figure H-8.*)
4. Remove the remaining nut, bolt and washers from the pump end of the coupling guard half. Slightly spread the coupling guard half and lift it off. (See *Figure H-4.*)

This concludes the coupling guard disassembly procedures.

NOTICE

It is unnecessary to remove the end plate (pump end) from the bearing housing. If internal pump part maintenance is necessary, the bearing housing tap bolts are accessible without removing the end plate. Refer to APPENDIX C - MAINTENANCE AND REPAIR before removing the pump bearing housing

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Purchase Date: _____

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