



Ampco ZP2 Series

Positive Displacement Pumps



Installation and Maintenance Manual

Original Instructions

M-003 Rev D 5.23
Ampco Pumps Company ZP2 Manual

Safety Notices

IMPORTANT: Read and understand this manual BEFORE installation, operation, or maintenance of the pump. Improper installation, operation, or maintenance may result in severe injury or death. Equipment damage caused by user neglect will invalidate the pump warranty.

Definitions

There are safety symbols used throughout this manual identifying safety concerns.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This applies to the most extreme situations.

Warning

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

Caution

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

Notice

Indicates information considered important, but not hazard-related (e.g. messages relating to property damage).

NOTE: Indicates useful, extra information about the procedure you are performing.

Intended Use

This pump is intended for pumping liquids, especially in food and beverage applications. Do not use the pump in any manner that exceeds the specifications that appear in this manual.

Warning

Use of this pump in a capacity outside the instructions in this manual could result in death or serious injury, along with property damage.

General Safety Instructions

Warning

- Do not remove safety labels; doing so may result in injury to users.
- During installation, operation, and maintenance, keep fingers out of the pump's ports.
- Follow any provided lifting recommendations when lifting heavy pumps or components.
- Shut off and lockout all power and relieve system pressure before servicing to prevent accidental start-up and injury caused by rotating components.
- Before performing maintenance, make sure the pump is secured. As components are removed or added, tipping could occur, resulting in serious injury.

Caution

- Only trained personnel should perform installation, operation, and maintenance.
- After operation, allow the gear case to warm or cool before handling. Temperatures vary depending on product.
- Shut off product supply to the pump and drain the pump before piping disconnection and pump disassembly.
- During maintenance, handle the rotors, piping, and other pump components carefully as edges may be sharp. Wear personal protective equipment according to the requirements established by applicable directives.
- Protect hands when in contact with strong cleaning solutions.

Notice

- Do not rapidly cool or heat the pump.
- Do not run the motor with the pump dry, which causes damage to pump components.
- Do not obstruct the outlet of the pump, which results in system pressure above the pump's specified maximum.
- To avoid damage to metal and seal parts, do not use abrasive cleaning tools and chemicals.
- Do not use sharp tools to pry components during disassembly.

Table of Contents

	Safety Notices	2
	Definitions.....	2
	Intended Use	2
	General Safety Instructions.....	2
Section 1		
General Information		
	Introduction	5
	General Information.....	5
	Pump Receiving.....	5
	Shipping Damage or Loss.....	5
	Label Information	6
Section 2		
Pump Information		
	Pump Design	7
	Operating Parameters	7
Section 3		
Installation		
	Installation	9
	Base Arrangement.....	9
	Piping and Connections	10
	Check/Isolation/Relief Valves	11
	Strainers and Gauges.....	12
	Base Alignment	12
	Pump Rotation	13
	Seal Flushing	14
	Pre-Start-Up Checklist	14
	Start-Up Procedure.....	15
	Shutdown Procedure	15
	Emergency Shutdown Procedure	15

**Section 4
Maintenance**

Maintenance	17
Pump Lubrication	17
Preventive Maintenance/Inspection	18
Gear and Bearing Inspection	19
Annual Maintenance	20
Cleaning	21
Pump Disassembly	21
Seal Maintenance	23
Single Mechanical Seal	23
Double Mechanical Seal	24
Gear Case Maintenance	25
Disassembly	25
Assembly	27
Pump Assembly	32
Seal Assembly	34
Pump Clearances	37
Ampco Pumps Available Options	38
Vented Cover (Pressure Relief)	38
Jacketed Cover	38

**Section 5
Troubleshooting**

Troubleshooting	39
------------------------------	-----------

**Section 6
Appendix**

PD Pump Remanufacturing Program	41
ATEX Certification Information	41
Terms and Conditions	45
Return Policy	47
Credits	47

Section 1

General Information

Introduction

To ensure the best results and service, please read and fully understand this manual prior to putting this pump into service. For any questions regarding operation, maintenance, or installation, please contact your local distributor or Ampco Pumps Company:

Ampco Pumps Company
2045 W. Mill Road, Glendale, WI 53209
Phone: (800) 737-8671 or (414) 643-1852
Fax: (414) 643-4452
Email: ampcoocs@ampcopumps.com

General Information

Each Ampco ZP2 pump is fully assembled, lubricated, and tested at the factory and shipped ready for use. Standard maintenance practices are outlined in this manual. For more information, please refer to the Maintenance section on *page 17*. Following these guidelines will provide long-lasting, trouble-free service when the pump(s) is incorporated in a properly designed system.

Pump Receiving

Ampco covers the pump inlet and discharge ports prior to shipping, ensuring that foreign matter does not enter the pump during shipment. If the protective covers are missing upon arrival, remove the pump cover and inspect to ensure it is free from contaminate before turning the shafts. Please make note of the pump serial number; this will assist in the process of ordering replacement parts and/or a warranty claim. For more information regarding shipment damage or warranty, please refer to Terms and Conditions (*page 45*).

Shipping Damage or Loss

Upon receiving equipment that is damaged or if your shipment is lost in transit, immediately file a claim with the carrier. At time of pick-up, the carrier signed the bill of lading, acknowledging that they have received the product from Ampco in good condition.

Label Information

⚠ Warning

Labels are installed on the pump at the factory to ensure proper warning to users.

Do not remove these labels; doing so may result in injury.

The pump is installed with simple, but effective labels to help the customer better understand the ZP2 pump. An identification plate is applied at the factory to help track the life of the pump. The customer should be aware of the pump's serial number and model number prior to contacting Ampco with any concerns. These labels can be seen in *Figure 1*.

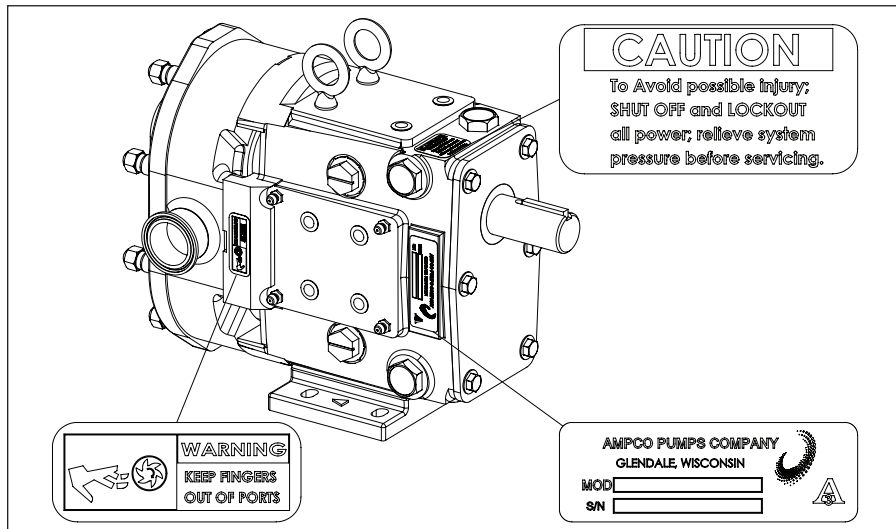


Figure 1. Important Label Information

Section 2

Pump Information

Pump Design

The design of the ZP2 pump gear case allows for the shaft location to be universal in order to fit any system requirement. This can be seen in *Figure 2* and *Figure 3*.

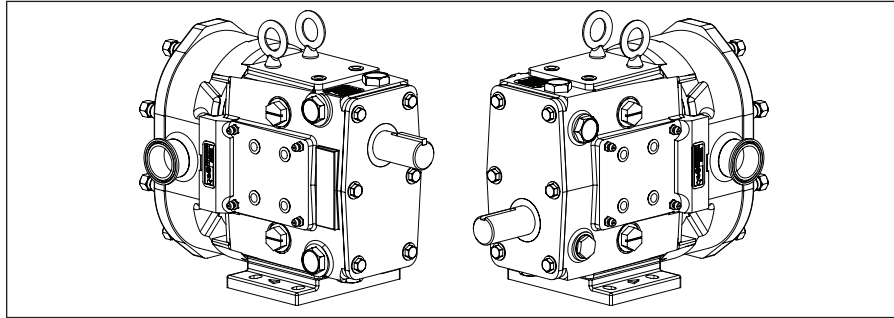


Figure 2. Shaft Mounts (Upper and Lower)

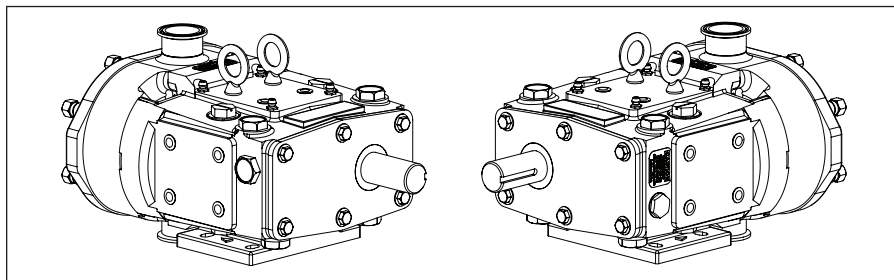


Figure 3. Shaft Mounts (Left and Right as Viewed from the Front)

Operating Parameters

Table 1. Standard Operating Parameters

Model	Maximum Nominal Capacity		Displacement		Maximum Differential Pressure		Temperature Range		Standard Connection Size		Optional Connection Size		Maximum Speed
	GPM	m ³ /hr	Gal./100 rev	Liters/rev	PSI	Bar	° F	° C	in.	mm	in.	mm	RPM
ZP2 6	8	1.8	0.8	0.030	300	21	-40° to 200°	-40° to 93°	1.0	25	1.5	40	1000
ZP2 15	11	2.5	1.4	0.052	250	17			1.5	38	2.0	50	800
ZP2 18	20	4.5	2.9	0.110	200	14			1.5	38	2.0	51	700
ZP2 30	36	8.2	6.0	0.227	200	17			1.5	38	2.0	51	600
ZP2 40	46	10.4	7.6	0.288	150	10			2.0	51	2.5	65	600
ZP2 45	58	13.2	9.8	0.371	450	31			2.0	51	2.5	65	600
ZP2 60	90	20.4	15.3	0.579	300	21			2.5	64	3.0	76	600
ZP2 130	150	34.1	25.3	0.958	200	14			3.0	76	4.0	102	600
ZP2 180	230	52.2	38.0	1.438	450	31			3.0	76	-	-	600
ZP2 210	300	68.1	50.2	1.900	500	34			4.0	102	-	-	600
ZP2 220	310	70.4	52.1	1.972	300	21			4.0	102	-	-	600
ZP2 320	450	102	75.2	2.847	300	21			6.0	152	-	-	600

Table 2. Rectangular Flange Model Operating Parameters

Model	Maximum Nominal Capacity		Displacement		Maximum Differential Pressure		Temperature Range		Rectangular Inlet (W x L)	Outlet		Maximum Speed
	GPM	m ³ /hr	Gal./100 rev	Liters/rev	PSI	Bar	° F	° C	in.	in.	mm	RPM
ZP2 34	24	5.5	6.0	0.227	250	17	-40° to 200°	-40° to 93°	1.81 x 6.84	2.0	51	400
ZP2 64	61	13.9	15.3	0.579	300	21			2.44 x 9.0	2.5	64	400
ZP2 134	101	22.9	25.3	0.958	200	14			3.19 x 9.38	3.0	76	400
ZP2 184	152	34.5	38.0	1.438	450	31			3.28 x 11.25	3.0	76	400
ZP2 214	200	45.4	50.2	1.900	500	34			3.45 x 12.70	4.0	102	400
ZP2 224	208	47.2	52.1	1.972	300	21			4.06 x 11.25	4.0	102	400
ZP2 324	300	68.1	75.2	2.847	300	21			4.25 x 12.70	6.0	152	400

- For operating parameters that fall outside the standard values defined in *Table 1* and *Table 2*, please contact the Engineering Department at Ampco Pumps Company (414-643-1852).
- Standard rotors operate within a temperature range of -40°F to 200°F. Hot clearance rotors operate between 180°F to 300°F. Consult Ampco for questions on application factors such as temperature, operational speed, and differential pressure.

⚠ Caution

Noisy pump operation may result from cavitation, air/gas in product, rotor to body contact, rotor to rotor contact, or external mechanical problems. See the Troubleshooting section, under "Noisy Operation" for corrective measures that may be taken to avoid injury from excessive sound pressure. Wear ear protection when levels may exceed 80 dBA.

Section 3 Installation

Installation

Follow local codes and restrictions when installing the pump and piping system. The practices outlined in this manual are intended to ensure the most optimal performance of the pump.

⚠ Caution

Use vibration isolation pads to reduce noise and vibration. Failure to reduce vibration as needed could cause minor or moderate injury.

Base Arrangement

The standard installation arrangement for a pump of this type consists of both the pump and drive unit mounted on the same base plate. Typical base plate arrangements consist of permanently fixed bases, bases with leveling and/or vibration isolation pads,

bases with attached adjustable legs, or portable/wheeled bases. All base arrangements must be level during operation. Standard base configurations (base, pump, coupling, coupling guard, gear reducer, and motor) can be seen in *Figure 4*.

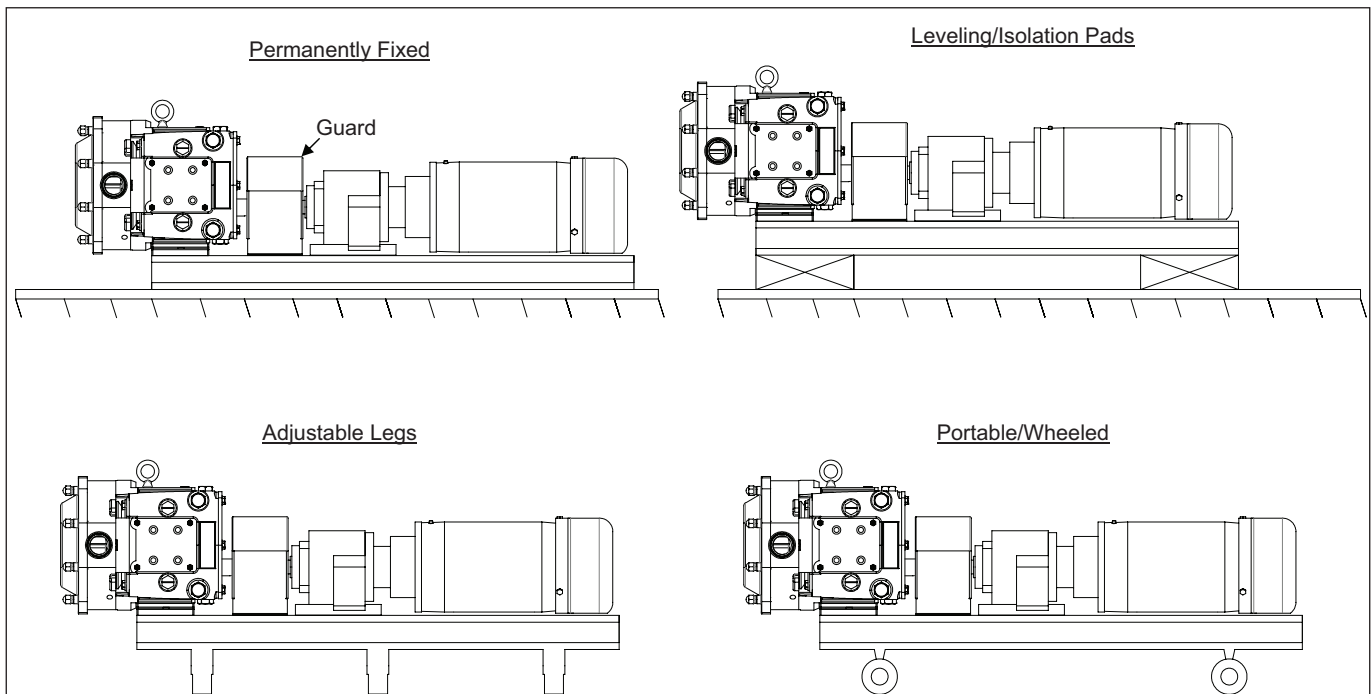


Figure 4. Base Layout Examples

⚠ Warning

To ensure safety, protective guards must be properly installed over all external rotating parts and components. Failure to do so may result in injury. Ampco provides protective guards for complete base packages (pump and drive unit).

Piping and Connections

It is important to minimize forces imposed on the pump. This can be done by independently supporting the piping going to and from the pump. Excessive force applied to the pump can cause misalignment of internal

parts which leads to the premature wear of rotors, bearings, and shafts. The use of hangers and pedestals on connecting pipes will help avoid such misalignment. Examples of such supports can be seen in *Figure 5*.

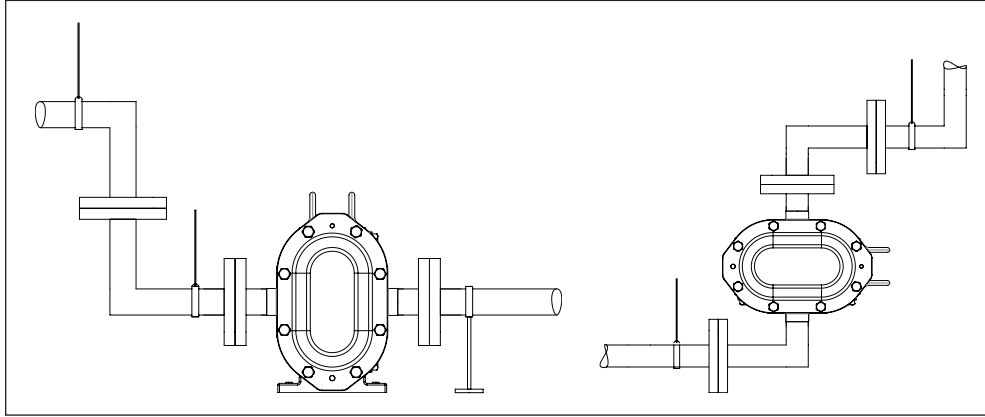


Figure 5. Piping Support Example

It is not recommended to weld custom fittings outside the factory. Shrinkage and warpage can occur to the pump housing which will affect the life and performance of the pump.

To prevent air pockets from entering the pump from the inlet, install the pump below the supply (*Figure 6*). This will create a constant supply of product on the suction side, and reduce the chance for air to enter the pump. Sloping the piping on the inlet side away from the pump will prevent air pockets if the pump is installed above the supply (*Figure 7*).

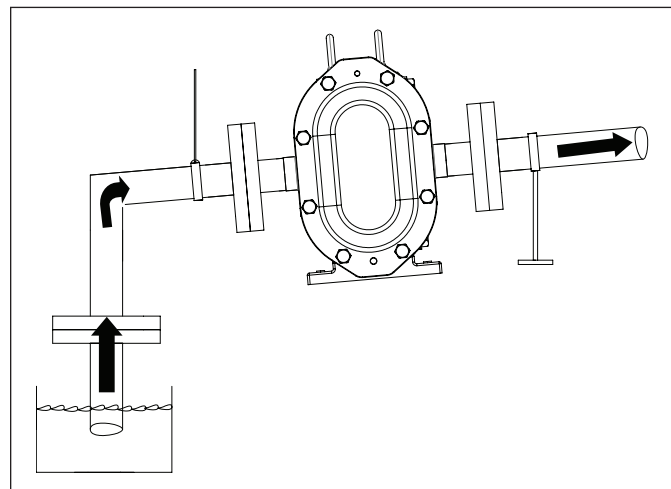


Figure 7. Correct Piping (Supply Below)

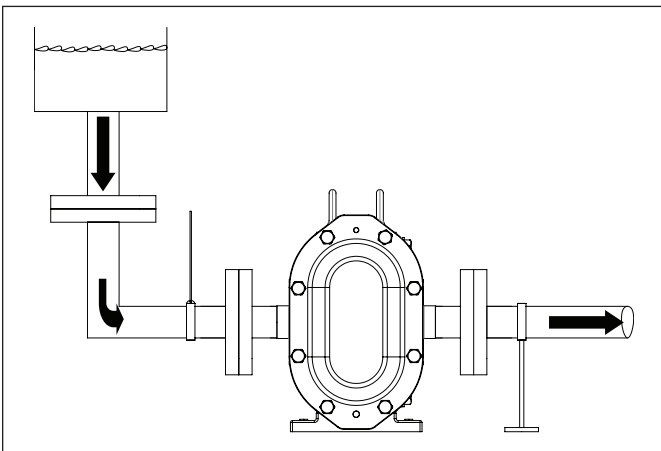


Figure 6. Correct Piping (Supply Above)

Always verify all electrical devices connected to the equipment are properly grounded to avoid risk of potential corrosion from stray current.

Check/Isolation/Relief Valves

Check valves should be used on the inlet side for any application when the product is lifted (Figure 8). This is to ensure a full inlet and is especially important with low-viscosity fluids. If the system has liquid under a vacuum, such as closed tank applications, it is important to have a check valve on the discharge side to prevent backflow during initial start-up (Figure 9).

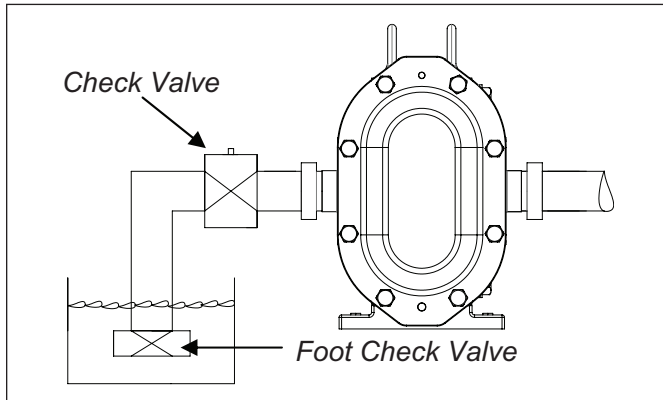


Figure 8. Check Valve (Inlet Side)

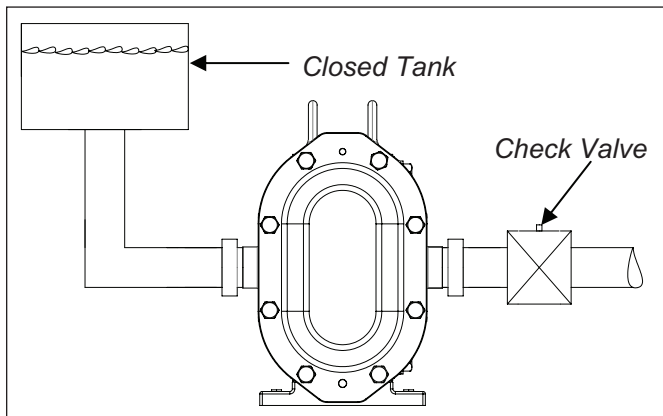


Figure 9. Check Valve (Discharge Side)

When shutdown time is not possible, a bypass system may be installed with a backup pump in parallel series to allow production to continue while maintenance is performed on the down pump. Isolation valves may also be used on both the inlet and discharge sides of the pump to shut down the flow of product to the pump. This will allow for maintenance and removal of the pump without draining the entire system and risking the loss of product.

Notice

Ampco's ZP positive displacement pumps are designed with extremely tight tolerances allowing only low slip internally between rotors and pump housing. **DAMAGE** will occur if the pump is operated with discharge or inlet lines closed. **DO NOT** operate pump with lines closed.

In order to prevent damage to the pump, it is recommended a relief valve be installed on the pump's discharge side. The relief valve can either divert flow into a drain or back to the inlet side (Figure 10).

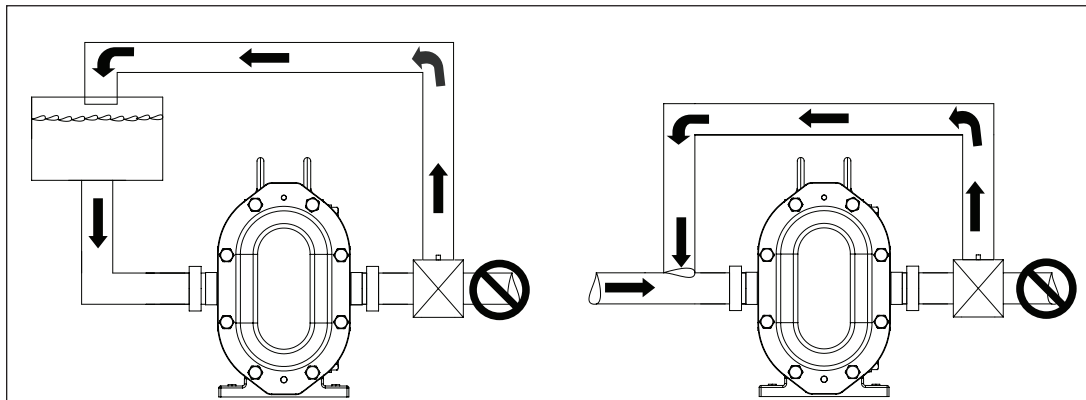


Figure 10. Relief Valve Examples

Strainers and Gauges

Strainers and magnetic traps should be used to prevent foreign matter from entering the pump. It is essential to service strainers and traps regularly to prevent restriction of flow. To determine the performance of the pump, install pressure and vacuum gauges on the inlet and discharge piping (Figure 11).

Proper Gauging Shows:

- Unusual pressure variations
- Indicates flow
- Changes in pump performance
- Variations in the system
- Differences in fluid viscosities

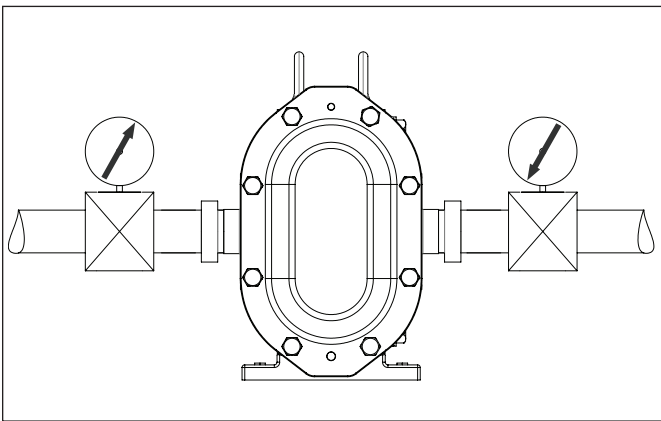


Figure 11. Proper Gauging

Base Alignment

Pump and base assemblies sent directly from Ampco's factory are aligned prior to shipment. Assemblies must be checked once they are installed and prior to operation. Misalignment may cause unnecessary wear and shorten the life of the pump. If couplings are not specified, Ampco will use a flexible coupling which permits minor compensation for alignment and endplay.

To check the coupling alignment, start with checking the angular alignment by measuring the gaps between the couplings on both the pump and motor side (Figure 12, Angular Alignment). Shim the assembly accordingly so the gap is equal distance at all points. Next, using a straight edge, check the horizontal and vertical alignment of the coupling. Place the straight edge along the coupling to ensure that both sides are concentric (Figure 12, Parallel Alignment).

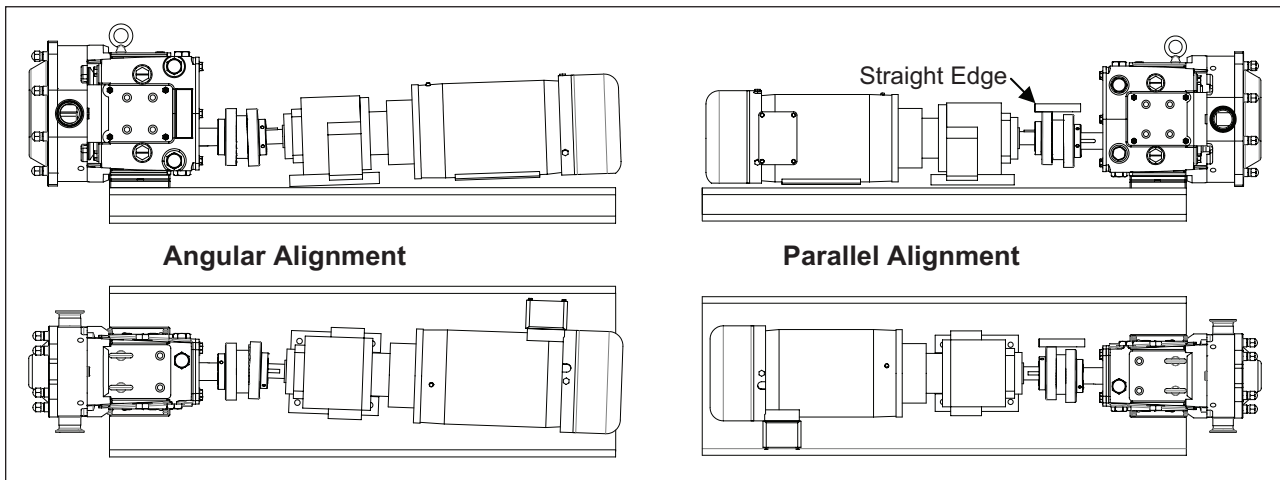


Figure 12. Check Alignment

Pump Rotation

Check the direction of rotation (both on drive unit and pump) prior to connecting the pump to the drive. This will ensure correct product flow at start-up (*Figure 13* and *Figure 14*). Also check that the pump turns freely and is free of any foreign contaminants. Connect the pump and check to make certain all guards are in place.

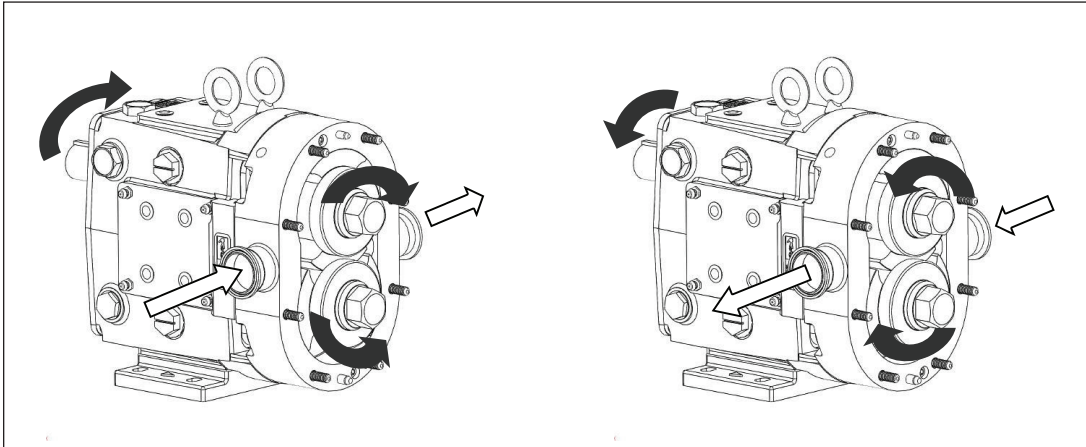


Figure 13. Top Drive Shaft

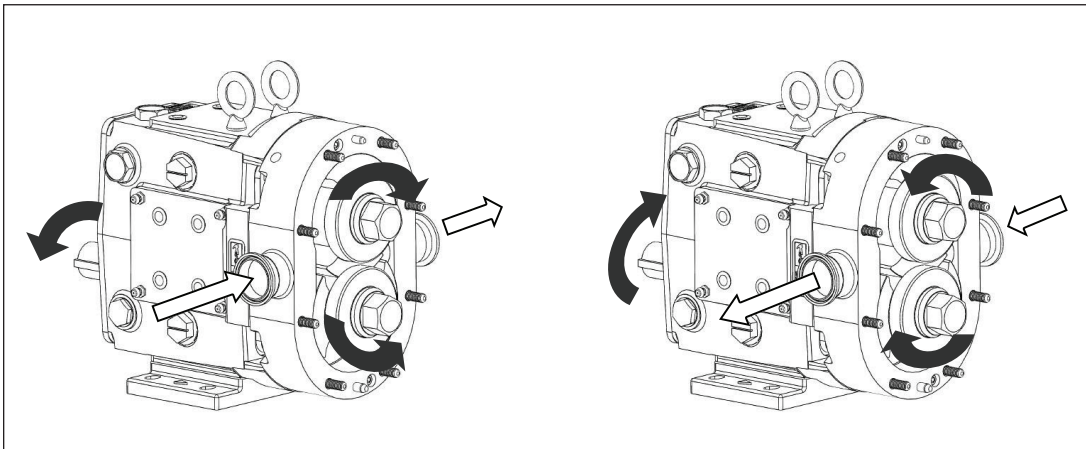


Figure 14. Bottom Drive Shaft

Seal Flushing

For pumps with double seals, connect seal flushing before operation. Operation of the pump without proper flushing will **damage** seal faces. Flushing connections are typically 1/8" female NPT with one side being the inlet and the other the discharge. Flush from the bottom to the top, using the lower connection as the inlet and the upper connection as the discharge. This ensures that air is removed from the flush line with the flush area completely flooded (*Figure 15*). Flush flow rate should be 1/4 GPM (30 psi max pressure). For high temperature applications flush flow may be increased to remove excess heat.

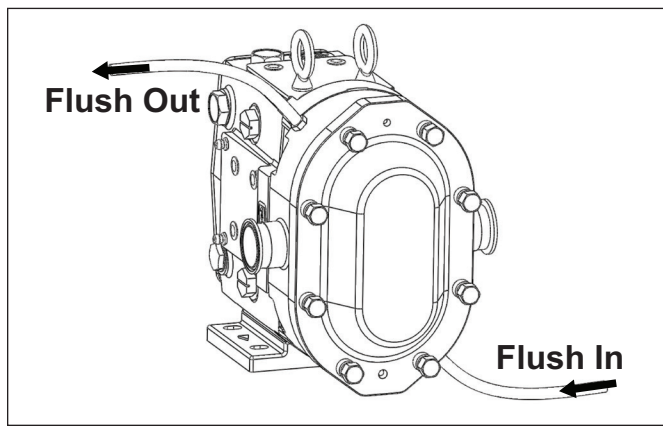


Figure 15. Proper Flushing for ZP2 Double Seal

Pre-Start-Up Checklist

⚠ Caution

DO NOT flush a new system for the first time with this pump. Severe damage may be caused to the pump from debris during start-up, which could result in injury. Remove the rotors during system flushing to prevent any debris from getting trapped between rotors and pump body.

⚠ Warning

All guards must be installed to protect operators and maintenance personnel from the rotating components. Guards are supplied as part of pump and motor full assemblies. The gap between the pump body and gearcase is required for 3-A sanitary standards.

⚠ Warning

Do not start a pump with a seal flush unless the seal flush is installed and on.

1. Review setup and make sure the pump is correctly installed as described in Section 3 "Installation" on *page 9*. Review "Check/Isolation/Relief Valves" on *page 11* and install valves as needed.
2. Check the coupling alignment. See base and coupling alignment on *page 12*.
3. Check the pump and piping and make sure they are clean and free of any foreign material.
4. Make sure that all piping connections are secure and leak-free. If possible, checking the system with non-hazardous fluid like water is advisable.
5. Double check the pump and drive to see if they are adequately lubricated. See "Pump Lubrication" on *page 17*.
6. Check that all guards are secured properly and in place.
7. Ensure double mechanical seals have proper supply and flow of clean fluids when flushing.
8. Make sure all valves are open on INLET side and allow fluid to fill the pump. Flooding the suction is recommended on installation.
9. Discharge side valves should be open and free of obstructions.
10. Check the pump and drive rotation to verify the correct product flow at start-up. See "Pump Rotation" on *page 13*.

Start-Up Procedure

⚠ Warning

Pump damage could result in death or serious injury.

- Do not run the motor with the pump dry, which causes damage to pump components.
- Do not obstruct the outlet of the pump. Obstruction will result in increased system pressure, above the specified maximum pressure of the pump.
- Do not introduce sudden extreme product temperature changes to the pump (temp flashing). Gradually adjust the temperature of the pump components or the product.

NOTE: Sanitize the pump before start-up for sanitary applications.

1. Start the pump slowly.
2. When the pumphead is filled with product, stop the pump and allow the pump's fluid components to thermally adjust to the product temperature for 15 minutes.
3. Re-start the pump.

Shutdown Procedure

1. Disconnect the pump from the drive.
2. Disconnect the supply and discharge lines.

Emergency Shutdown Procedure

Emergency Shutdown is dependent on system requirements. Document the procedure after assessment of the application.

Section 4 Maintenance

Maintenance

⚠ Warning

Shut off and lockout all power and relieve system pressure before servicing to prevent accidental start-up and injury.

⚠ Warning

Make sure the pump is secured prior to performing maintenance. As components are removed or added, tipping could occur.

⚠ Caution

Only trained personnel should perform maintenance.

The Ampco ZP2 pump is designed to be easily disassembled for cleaning and maintenance purposes. When performing maintenance on the pump it is important to inspect all wetted parts for standard wear and damage. For inspection instructions please see *page 18*. For rebuild information, see PD Pump Remanufacturing Program details on *page 41*. Prior to disconnecting pump, shut off all inlet and discharge valves, drain the pump (rinse if necessary), and turn off all electrical supply to the pump (follow standard lockout procedures).

Pump Lubrication

Proper lubrication of gears and bearing is vital to the life of the pump. For pumps assembled on bases with a gear reducer and motor, please refer to the proper manufacturer manual for lubrication requirements. These manuals are sent with the pump from the factory. Important pump lubrication points can be seen in *Figure 16*.

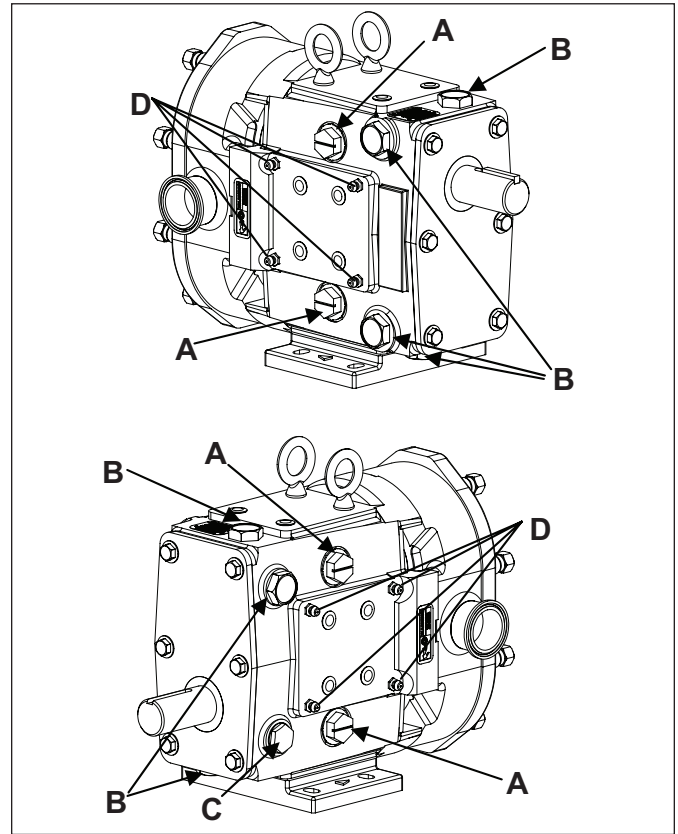


Figure 16. Lubrication Points

	Part	Qty.
A	Clean-out Plugs	4
B	Oil Plug (Drain and Fill)	5
C	Sight Glass	1
D	Grease Fittings	8

Both gears and bearing are shipped factory-lubricated with grease and oil. The oil used to lubricate the gears should be changed every 500 hours with the quantities shown in Table 3. The bearings should be re-greased every 250 hours. Excessive grease may build up inside the gear case and should be cleaned out through the clean-out plugs shown in *Figure 16, A*.

Table 3. Oil Capacity (Gears)

ZP2 Model	Top/Bottom Shaft	Side Mount
6, 15, 18	1.3 oz (40 ml)	3.3 oz (100 ml)
30, 34, 40	2.0 oz (60 ml)	4.0 oz (120 ml)
45, 60, 64, 130, 134	6.0 oz (170 ml)	9.5 oz (280 ml)
180, 184, 220, 224	11 oz (320 ml)	20 oz (600 ml)
210, 214, 320, 324	17 oz (500 ml)	44 oz (1300 ml)

Oil Specifications:

ISO Grade 320, SAE 140 or AGMA Number 6EP

Grease Specifications:

Halo-Guard FG-2, NSF H1 FOOD-GRADE, NLGI Grade No. 2

*Replacement oil and grease is available from Ampco.

Preventive Maintenance/Inspection

⚠ Caution

Handle the rotors, piping, and other pump components carefully as edges may be sharp. Wear gloves to avoid injuries.

While performing standard maintenance or cleaning, check for signs of damage or extreme wear. A simple inspection may show signs of a problem long before it becomes serious. Detection of such problems can avoid costly repairs and reduce down time.

Remove the cover and inspect the rotor tips to ensure that there is no metal-to-metal contact between the rotors. Measure the clearance between the rotor tips as seen in *Figure 17*. The clearance should be equal on both sides. If contact is detected, rotors may require replacement.

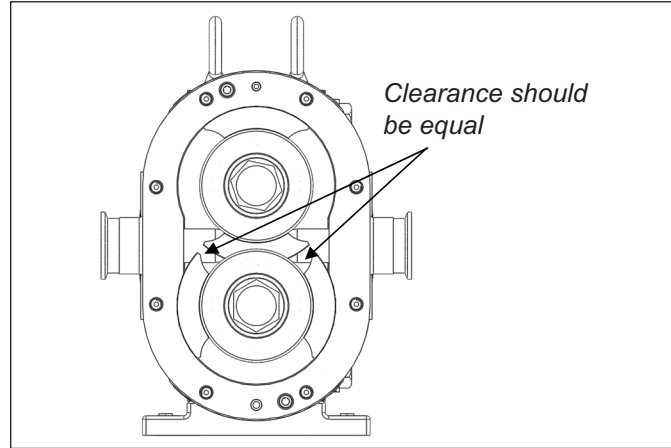


Figure 17. Clearance Between Rotor Tips

Inspect the shaft shoulder and shaft keyway (*Figure 18*) for wear and replace, if necessary.

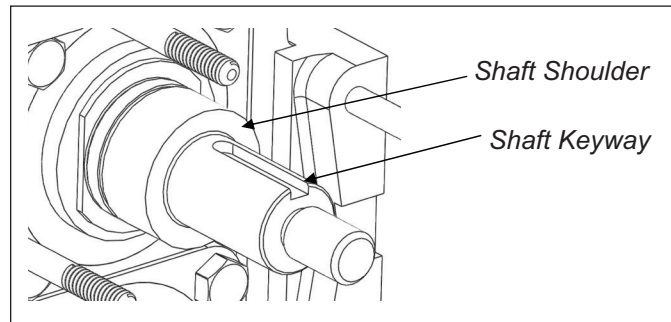


Figure 18. Shaft Inspection Points

Inspect the rotor hub and rotor keyway (*Figure 19*) for wear and replace, if necessary. Rotor and shaft wear at these locations is caused by extended operation with loose rotor nuts.

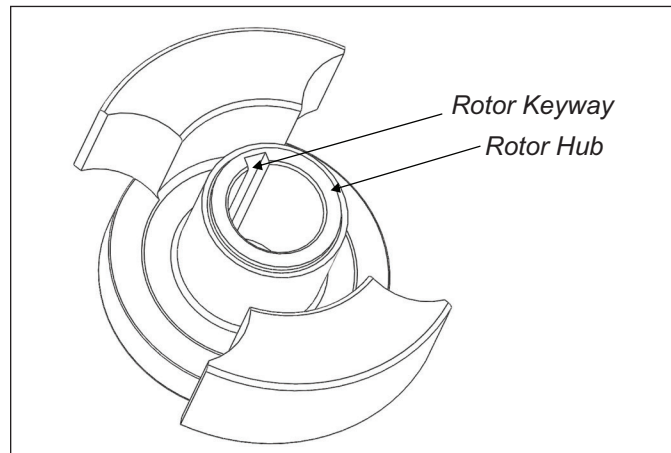


Figure 19. Rotor Inspection Points

Gear and Bearing Inspection

⚠ Caution

Temperatures may vary depending on product. To avoid injury, allow the gear case to warm or cool before handling.

While the fluid end is disassembled, feel for gear backlash (play between the gears) by rotating either shaft. Once turning has started the other shaft must engage (*Figure 20*). If gear backlash is present remove the gear casing cover (drain oil first, see *page 24* for disassembly information) and check for wear around the gear teeth. If evidence of gear teeth wear is present, replacement is recommended. If gear(s) are loose, check the shaft key and keyway, either may require replacement.

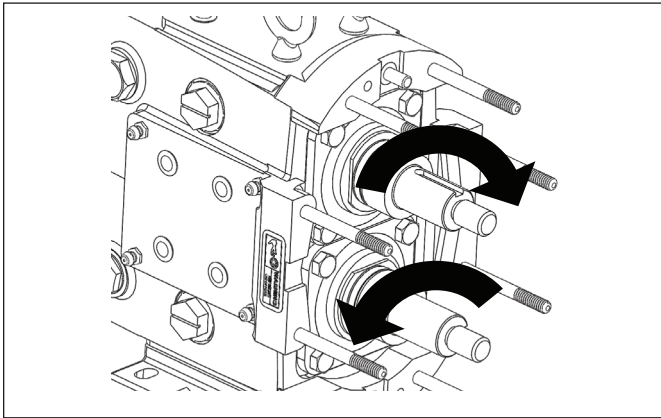


Figure 20. Check for Gear Backlash

Next, check the condition of the bearings. Do this by applying force in an up-and-down motion by hand on both shafts (*Figure 21*). Also check for any horizontal movement by pushing and pulling on the shaft. If any movement is felt, the bearing may need replacing. If disassembly of the entire gear case is required, please refer to *page 24* for instructions.

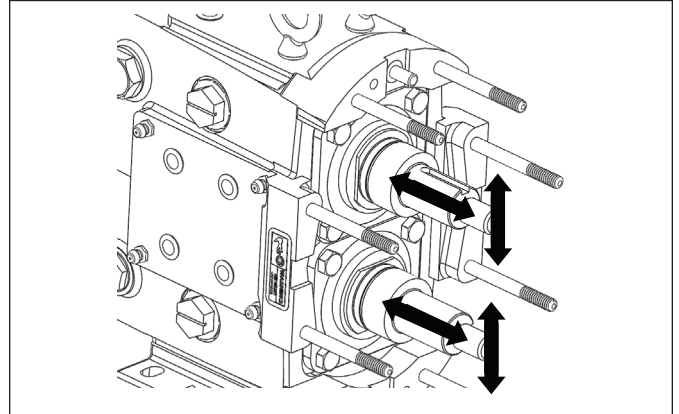


Figure 21. Check for Bearing Movement

Annual Maintenance

⚠ Caution

Handle the rotors, piping, and other pump components carefully as edges may be sharp. Wear gloves to avoid injuries.

⚠ Caution

Temperatures may vary depending on product. To avoid injury, allow the gear case to warm or cool before handling.

It is important to perform an annual maintenance check of the pump in addition to the preventive maintenance procedures listed on *page 18*. Annual maintenance practices are as follows:

- Check the gear case bearings by measuring the shaft's radial movement with a dial indicator (*Figure 22, A*). If the movement is greater than or equal to the rotor-to-body clearance found on *page 37* (*Table 10*) the bearings should be replaced.
- Remove the gear casing cover (see *page 24* for disassembly information) and inspect the gears for wear and damage (*Figure 22, B*). Also check for backlash and looseness.
- Inspect the rotors for signs of wear and stress cracks around the areas defined in *Figure 22, C*. Replace, if necessary.
- Check the pump clearances detailed on *page 37* to determine pump wear. Pump wear can be compensated by increasing pump speed.

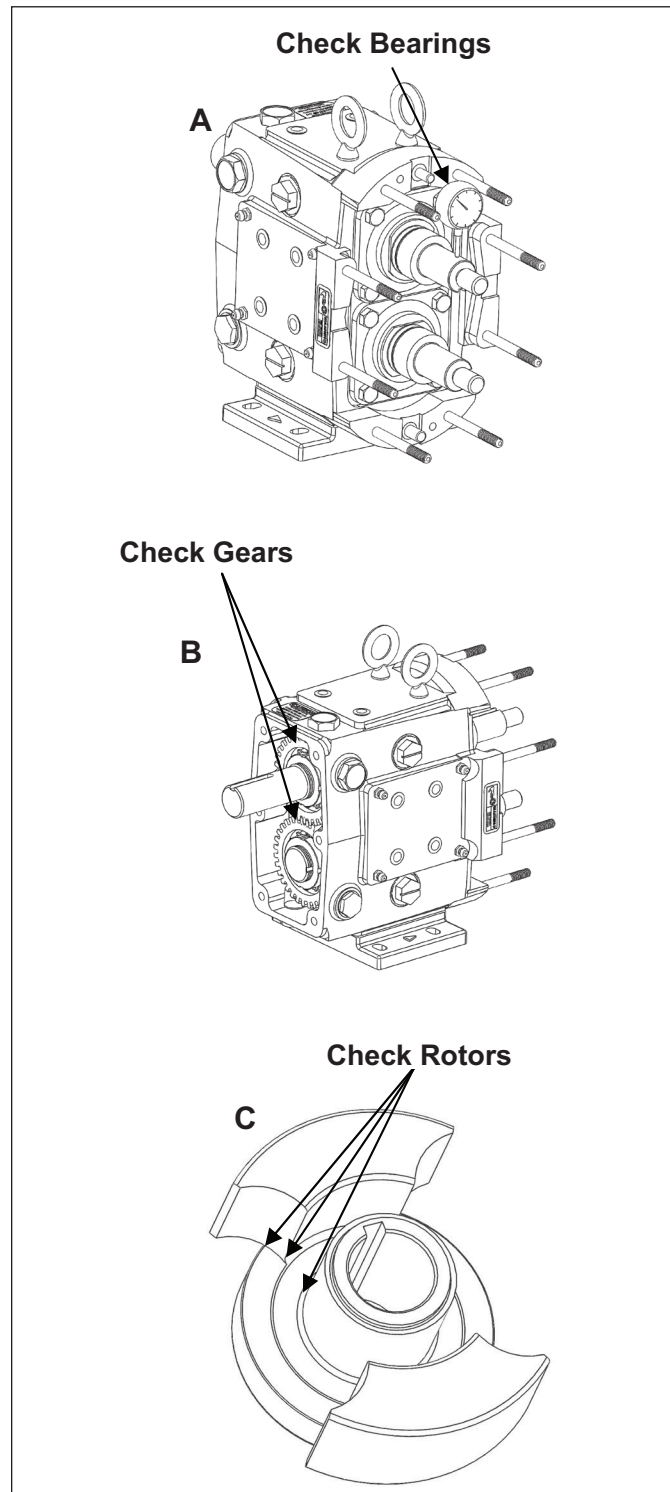


Figure 22. Annual Maintenance Checks

Cleaning

All wetted parts are designed and manufactured to be acceptable by 3A Sanitary Standards. The body, rotors and seals can be easily disassembled and cleaned simply by removing the cover and rotor nuts. Pump disassembly information begins on *page 21*.

⚠ Caution

Strong cleaning solutions are harmful to hands. Wear appropriate gloves to avoid injury.

Notice

Do not use abrasive cleaning tools and chemicals. Wire brushes or pads will physically damage metal and seal parts.

Once the fluid end is disassembled, follow standard practices for cleaning the product being pumped. If for any reason the rotor o-ring should fail and the internal threads of the rotor nut become soiled, a soft bristle brush and appropriate cleaning solution should be used to clean them. Do not use abrasive cleaning tools and chemicals. Wire brushes or pads will physically damage metal and seal parts. Pump parts should not be exposed to harsh acids for longer than necessary. Once the parts have been removed from a cleaning solution, rinse the parts so no residual deposits remain. Acids and cleaning solutions can be harmful. Take necessary steps to prevent bodily harm.

The ZP2 pumps can be retrofitted to have clean-in-place (CIP) capabilities. These modifications ensure that CIP solution reaches all surfaces inside the pump. The fluid velocity (typically 5 ft/sec) and differential pressure (30 psi recommended) are critical components of a correct CIP setup. For additional support, please contact the Engineering Department at Ampco Pumps Company (414-643-1852).

Pump Disassembly

⚠ Warning

Shut off and lockout all power and relieve system pressure before servicing to prevent accidental start-up and injury.

⚠ Caution

SHUT OFF product supply to the pump and drain the pump before disconnecting piping and disassembly.

⚠ Caution

Handle the rotors, piping, and other pump components carefully as edges may be sharp. Wear gloves to avoid injuries.

1. Start by removing the cover nuts using an appropriate wrench (*Figure 23*). During disassembly place all parts on a clean, protected surface with finished surfaces and seal faces facing up. Tap the cover off using a soft mallet. Remove the cover o-ring and inspect.

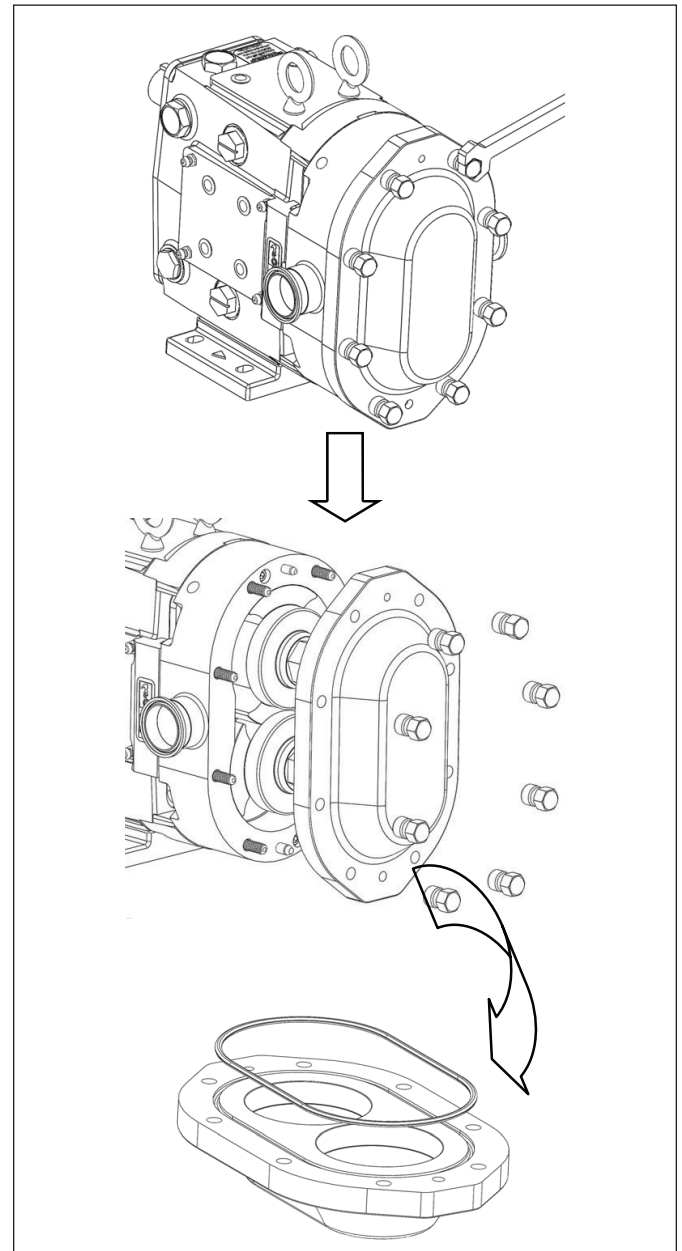


Figure 23. Removing ZP2 Cover

- Remove the rotor nut assembly using the appropriate size wrench and a non-metallic wedge to keep the rotors from moving (Figure 24). Remove the nuts, Belleville washers, and both rotor nut o-rings.

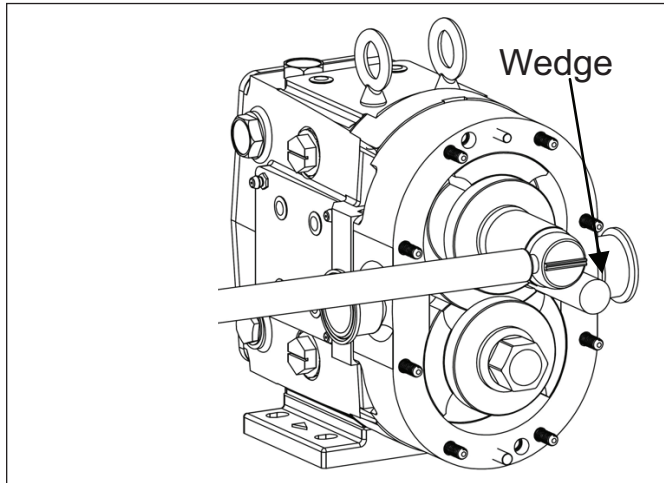


Figure 24. Removing Rotor Nuts

- Remove the rotors by orientating them perpendicular to each other and then pulling them out. It is important to be cautious with the rotors so that they are not damaged. If rotors are difficult to remove, use a nylon or wood lever to pry them out without damaging the body or the rotors. If necessary, remove the body hold down screws and tap the body forward to loosen the rotors. Use (Figure 25) to ensure that all parts are removed.

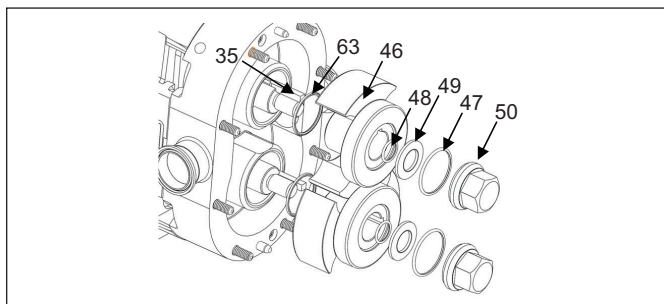


Figure 25. Fluid End Exploded View

Item No.	Qty	Description
50	2	Rotor Nut
47	2	O-Ring, Rotor Nut
49	2	Belleville Washer
48	2	O-Ring, Retainer
46	2	Rotor
63	2	O-Ring, Rotor Hub
35	2	Rotor Key

- Remove the two body hold-down bolts using the appropriate driver. Pull the pump body off by sliding it along the studs (Figure 26). If the body is stuck, use a soft mallet to tap the body. Inspect the body for excessive wear, clean, and continue on to seal maintenance. It is important to reassemble the pump body back onto the original gear case because the shafts are shimmed for that particular body.

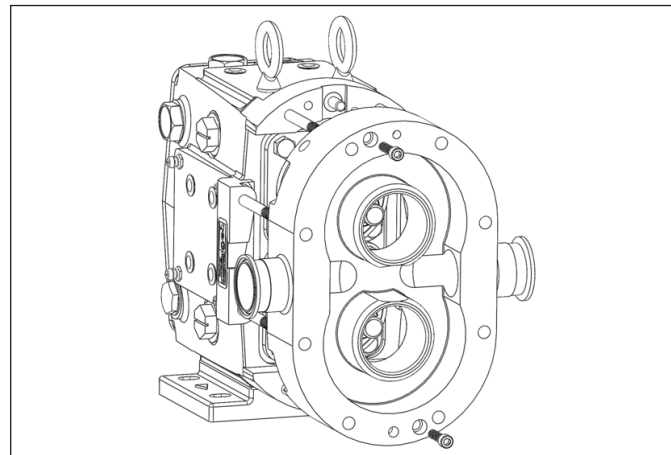


Figure 26. Removing Pump Body

Seal Maintenance

SINGLE MECHANICAL SEAL

Disassembly:

Use caution not to damage the seals during removal.

1. Remove the Inner stationary seals from the pump body (*Figure 27*, item 57).

2. Remove the wave springs and stationary o-rings from the stationary seals.
3. Slide the seal seats from each shaft and remove the seal seat o-ring from the shaft.

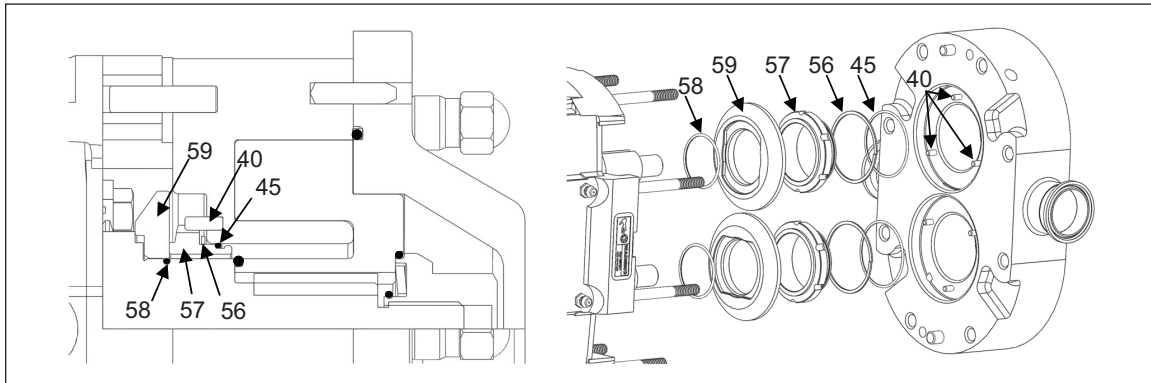


Figure 27. Single Mechanical Seal

Item No.	Qty	Description
45	2	O-Ring, Rotor Face Seal
40	6	Seal Stop Pin
56	2	Inner Seal Wave Spring
57	2	Inner Seal
58	2	Or-Ring, Shaft
59	2	Seal Seat

DOUBLE MECHANICAL SEAL

Disassembly:

Use caution not to damage the seals during removal.

1. Remove both the inner and outer stationary seals from the pump body (*Figure 28*, items 57 and 62).

2. Remove the wave springs and stationary o-rings from the inner and outer stationary seals.
3. Slide the seal seats from each shaft and remove the seal seat o-ring from the shaft.

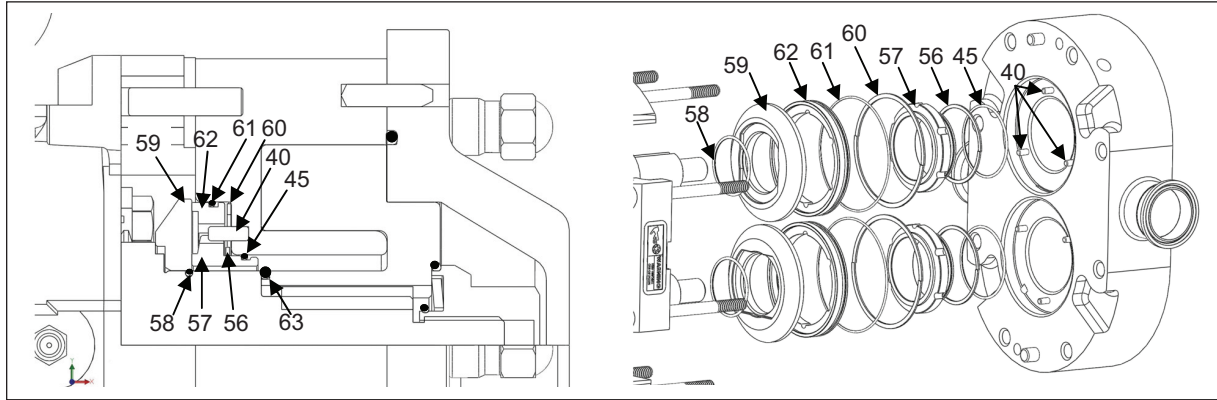


Figure 28. Double Mechanical Seal Disassembly

Item No.	Qty	Description
45	2	O-Ring, Rotor Face Seal
40	6	Seal Stop Pin
56	2	Inner Seal Wave Spring
57	2	Inner Seal
58	2	Or-Ring, Shaft
59	2	Seal Seat
60	2	Outer Seal Wave Spring
61	2	O-Ring, Outer Seal
62	2	Outer Seal
63	2	O-Ring, Rotor Hub

Gear Case Maintenance

⚠ Warning

Shut off and lockout all power and relieve system pressure before servicing to prevent accidental start-up and injury.

⚠ Caution

SHUT OFF product supply to the pump and drain the pump before disconnecting piping and disassembly.

DISASSEMBLY

1. Remove the pump head as described on *page 21* (Pump Disassembly). Remove the bottom oil plug and drain the oil from the gear case (remove oil fill plug for faster drain). Remove the six hex head cap screws and washers from the gear case cover and slide the cover off the drive shaft (*Figure 29*). If the cover is stuck, use a soft mallet to tap around the edges until it breaks free. Using a straight edge remove the liquid gasket used to seal the cover to the gear case. Remove and discard the oil seal from the cover using an arbor press.

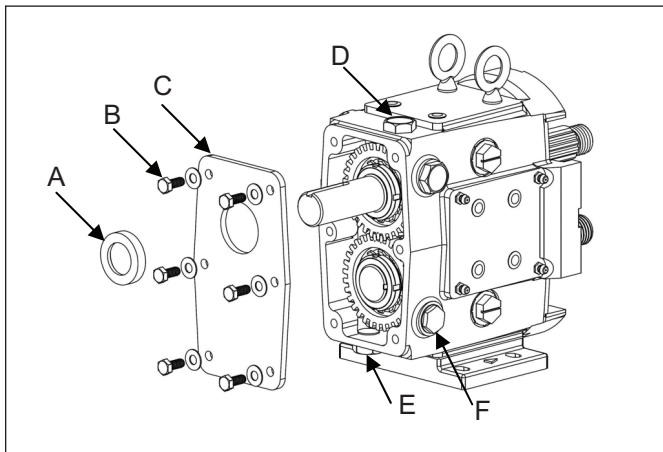


Figure 29. Gear Case Disassembly (Gear Case Cover)

	Part
A	Oil Seal
B	Cap Screws and Washers
C	Gear Case Cover
D	Oil Plug (Fill)
E	Oil Plug (Drain)
F	Sight Glass

2. Using a hammer and a punch, bend the tabs straight on the lock washers (*Figure 30*). Use a wedge (wood or plastic) to keep the shafts from turning while removing the lock nuts (*Figure 31*). Using a spanner wrench or the nut removal tool (available from Ampco), remove the gear lock nuts. Slowly remove the gears from the shafts. Remove the gear keys and gear spacers from the shafts.

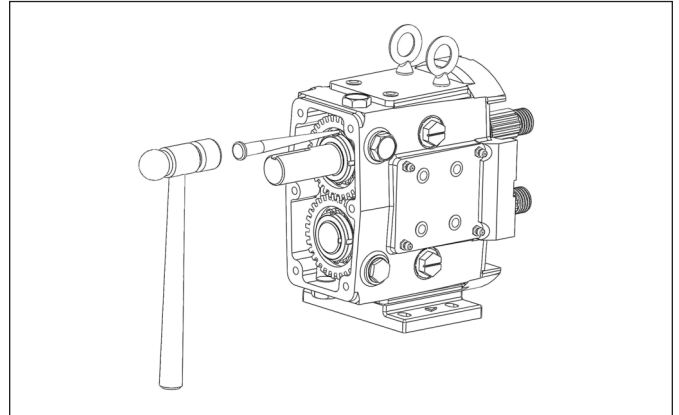


Figure 30. Bending Tabs on Lock Washers

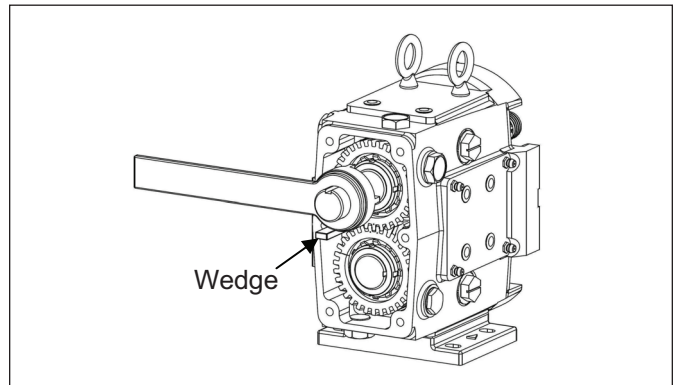


Figure 31. Removing Lock Washers

3. To prevent damage to the shafts, wrap the splines and rotor nut threads with tape (*Figure 32, A*). Any damage to the splines or threads may require the shaft be replaced. Remove the cap screws holding the bearing retainer and splash plates in place and slide both off the shaft (*Figure 32, B*). If they are stuck, use a flat head screw driver as a wedge to pry them from the gear case or leave them in place and when the shafts are removed they will press off with the shafts. Using a straight edge, remove the liquid gasket used to seal bearing retainer to the gear case.

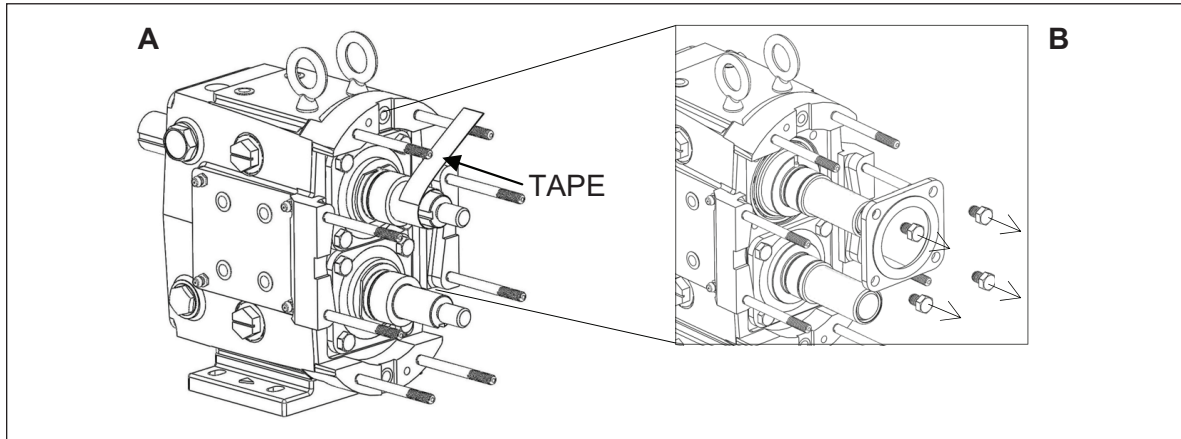


Figure 32. Tape Shafts and Remove Bearing Retainers

4. Set the gear case in a press with the fluid end side facing down (Figure 33). Use a wooden block to protect the shafts from hitting the ground when pushed out. Once the protective block is in place push the shafts out of the gear case. Reference Table 4 for the required force (in tons) needed to press the shafts out of the gear case.

Table 4. Required Force to Remove/Install shafts

ZP2 Model	6, 15, 18	30, 34, 40	45, 60, 64, 130, 134	180, 184, 220, 224	210, 214, 320, 324
In (Tons)	0.25	0.25	0.50	0.50	0.50
Out (Tons)	0.50	0.50	1.00	1.00	1.00

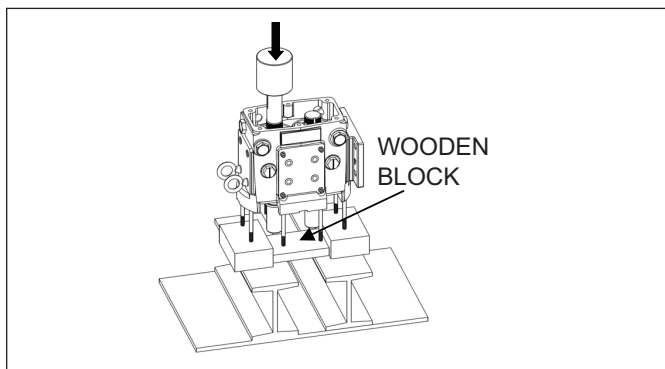


Figure 33. Pressing Shafts from Gear Case

5. Remove all the shaft shims from the gear case and label which shaft and bore they came from. If the shafts are to be reused, they will need to be reinstalled with the original shims. Failure to do so could result in damage and misalignment in the pump body. Remove and discard the rear oil seals from the back of the gear case. Use a long, non-metallic rod and a soft mallet to punch the seal out from the front side (Figure 34, A). Remove and discard the front bearing seals from the bearing retainers by pressing them out (Figure 34, B). Clean the bearing retainers as they will be reused. Clean excess grease and sludge inside of the gear case before reassembling.

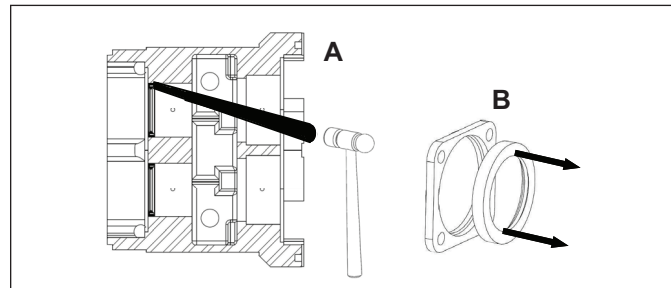


Figure 34. Removing Oil Seals

6. Using a press and a V-block, remove the front and rear bearings along with the bearing spacer. To prevent damage to the shafts make sure that both ends are protected (Figure 35). Reference Table 5 for the required force (in tons) needed to press the bearings off the shafts.

Table 5. Force Required to Press Bearings

ZP2 Model	Front Bearings		Rear Bearings	
	On (Tons)	Off (Tons)	On (Tons)	Off (Tons)
6, 15, 18	0.50	1.00	0.50	1.00
30, 34, 40	0.50	1.00	0.50	1.00
45, 60, 64, 130, 134	2.00	5.00	3.00	5.00
180, 184, 220, 224	5.00	15.00	5.00	15.00
210, 214, 320, 324	5.00	20.00	5.00	20.00

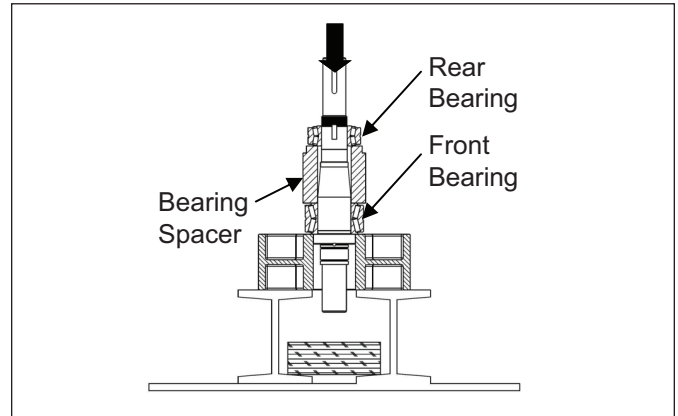


Figure 35. Removing Bearings and Sleeve from Shaft

ASSEMBLY

1. Clean all reusable parts prior to reassembly. Apply a light coat of lubricant on the shaft area where the front bearing will sit. Position the shaft upright in the press with the splines facing down (Figure 36, Drawing 1). Open the new front bearing assembly and be sure not to interchange any parts. All bearings are manufactured as sets and assembled to have a precise overall length. Place the front bearing over the shaft along with the bearing spacer

(Figure 36, Drawing 2). Make sure the bearing and spacer are aligned before pressing them on. Reference Table 5 for the required force (in tons) needed to press the bearings on to the shafts. Using a sleeve that rests on the bearing spacer and rides over the shaft, press the bearing on until it seats against the shaft shoulder. A shim can be used to ensure that the bearing is fully rested on the shaft shoulder (Figure 36, Drawing 3).

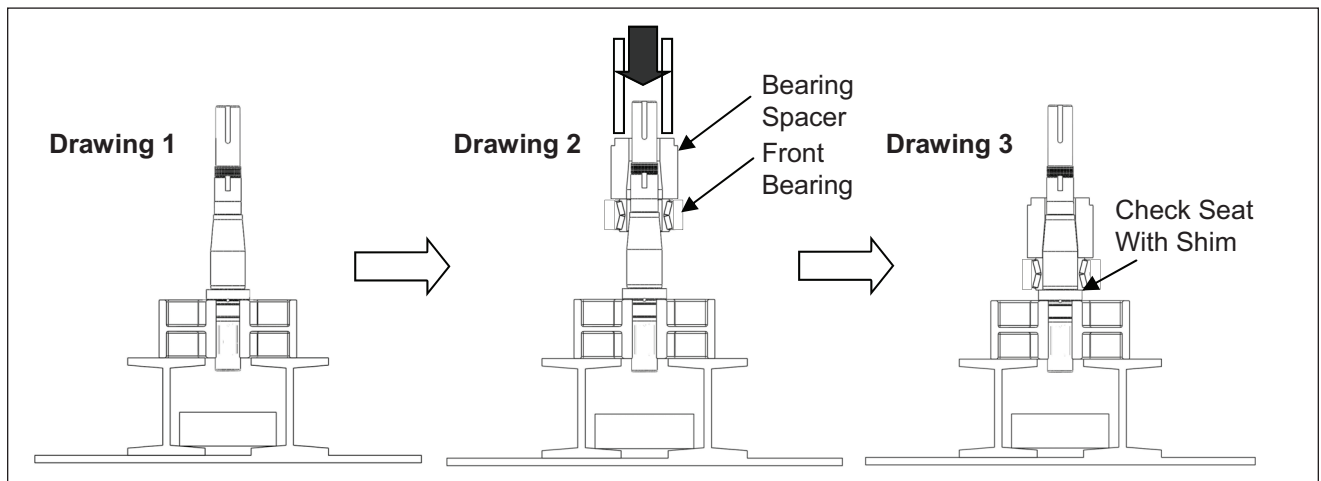


Figure 36. Pressing Front Bearing onto Shaft

2. Single ball bearings are used for the rear bearing in models ZP2 6, ZP2 15, ZP2 18, ZP2 30, and ZP2 34 and will require a light press to install. Tapered roller bearings are used for all other models and will be pressed on similar to the front bearings.
 - For pump models with single ball bearings apply a light coat of lubricant on the shaft. Open the new rear bearing assembly and place it over the shaft above the bearing spacer with the shielded side of the bearing facing the spacer (*Figure 37, Drawing 1*). Press the bearing on by pressing only on the inner race.

- For pump models with tapered roller bearings, apply a light coat of lubricant on the shaft. Open the new rear bearing assembly and do not interchange any parts. Place the rear bearing over the shaft above the bearing spacer (*Figure 37, Drawing 2*). Reference Table 5 for the required force (in tons) needed to press the bearing onto the shaft. Using a sleeve that rests on the inner cone of the bearing and rides over the shaft, press the bearing on until it seats against the spacer.

Make sure the bearing is rested on the bearing spacer using a shim (*Figure 37, Drawing 3*).

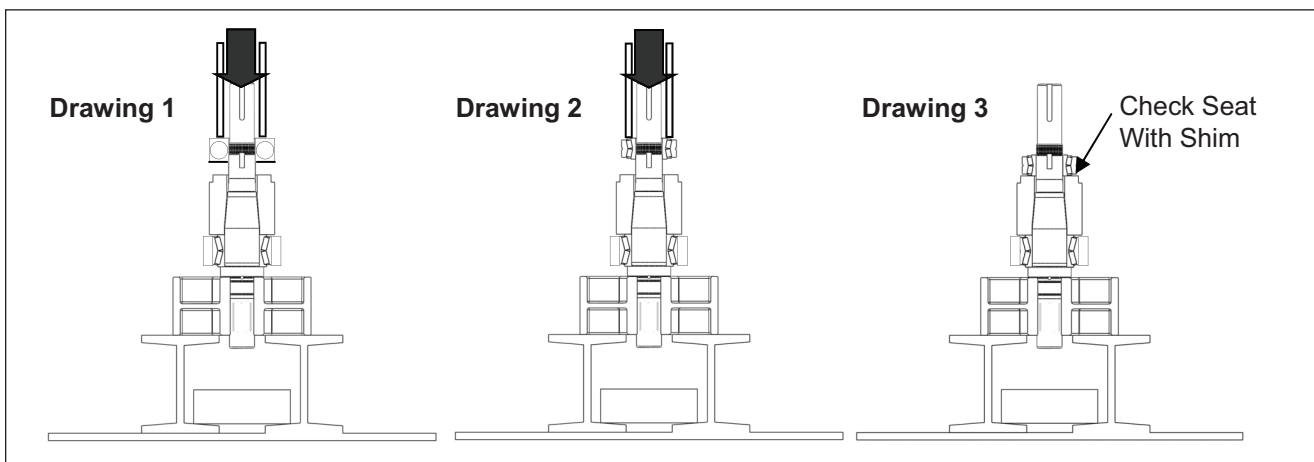


Figure 37. Pressing Rear Bearing onto Shaft

3. Shims located on the shaft behind the front bearing control the backface clearance of the pump; the space between the body and the rotor. If neither the shafts or bearings are being replaced, use the shims (if properly marked) removed at disassembly and reuse making sure they are installed in the correct bores. If replacing shafts or bearings, a process of calculating the required shims is necessary. Use *Figure 38* and the following equation to calculate. To find the correct backface clearance see *Table 10, page 37*.

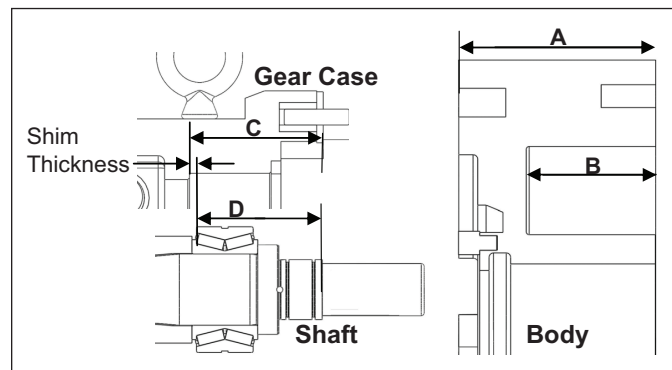


Figure 38. Calculating Shims

- Measure A, B, C, and D
- Find Correct Backface Clearance
- Backface Clearance+C+A-D-B = Shim Thickness
 - A. Body Width
 - B. Depth of Rotor Bore
 - C. Distance from gear case pads to bottom of front bearing pocket
 - D. Distance from shaft shoulder to back of bearing race

- Set the gear case on a press with the fluid end side facing up. Place the required thickness of shim stock so it sits on the shoulder of the front shaft bore of gear case. Apply lubricant to the outside of the bearings. Place shaft assembly (one shaft at

a time) in the gear case with the spline end facing up. Making sure that the drive and the short shafts are in the correct bores, press the shafts into gear case until bearings are fully seated (*Figure 39*). See *Table 4* on *page 26* for the required force.

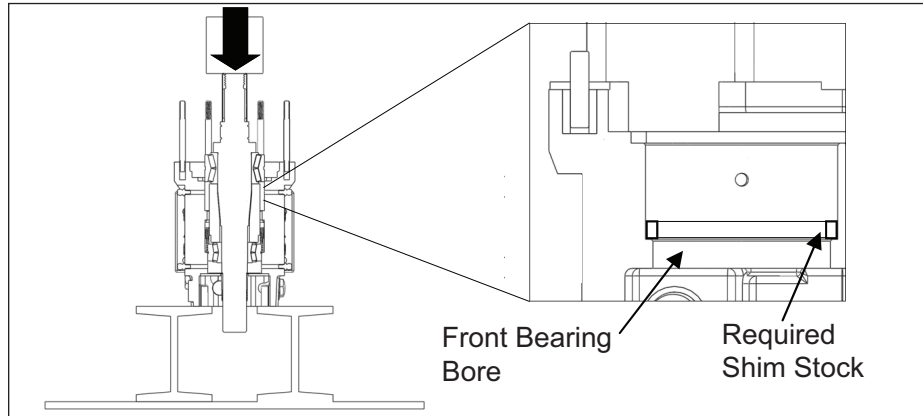


Figure 39. Pressing Shafts into Gear Case

- Once the shafts are pressed into the gear case, install the bearing retainers to hold the shafts in place temporarily (do not install liquid sealant). Ensure there is proper clearance between the retainer and the gear case, as seen in *Figure 40*. Place the body on the gear case, making sure it is seated correctly. Assemble the rotors into the body and tighten down using the jam nuts. Measure dimensions A, B, and C seen in *Figure 41* and refer to *Table 10* on *page 37* to verify the clearances. If clearances are not correct, the shafts must be removed and the shims will need to be adjusted. If the clearances are correct, remove the rotors and body.

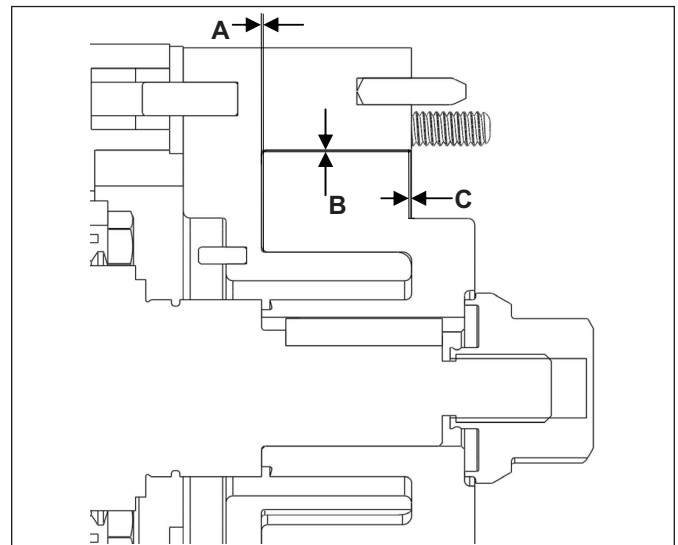


Figure 41. Important Clearances

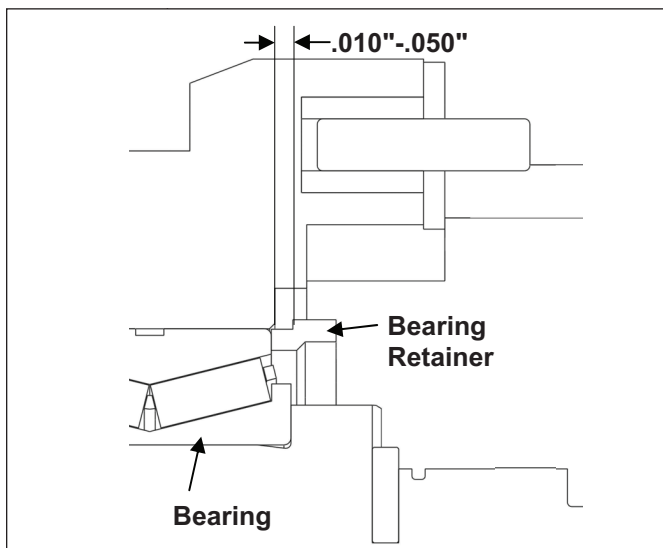


Figure 40. Bearing Retainer Clearance

- Once the correct backface clearance is achieved, fill all bearings with grease through the fittings on the mounting pads until grease is noticeable around the bearing assemblies. The shafts should be rotated during this initial greasing to distribute the grease evenly. Apply a light film of lubricant to the inside and outside diameters of the oil seals and install them into the bearing retainers. Apply silicone sealant to the outside flanges on the bearing retainer (*Figure 42*). Once the silicone sealant is applied, install the bearing retainers onto the gear case.

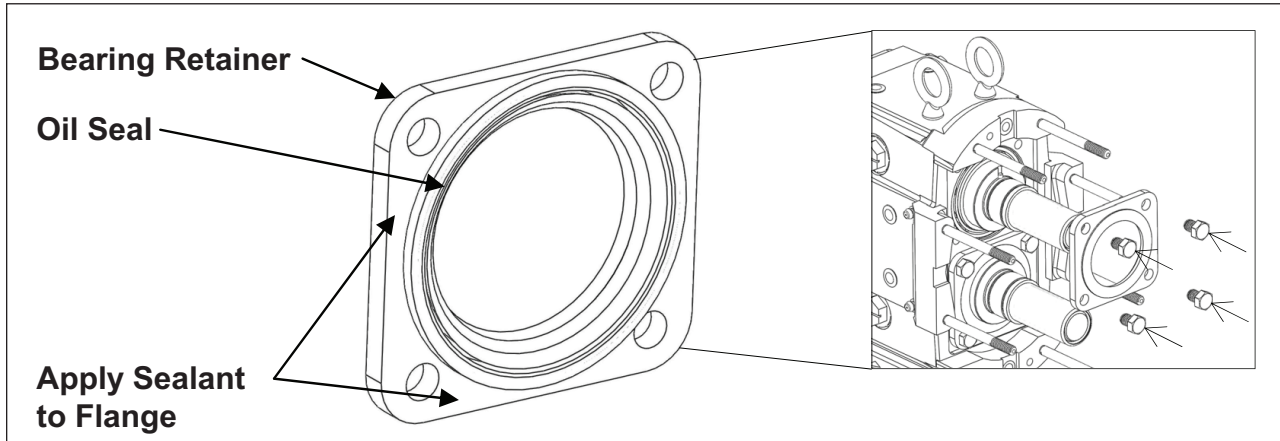


Figure 42. Bearing Retainer Installation

7. Apply a light film of lubricant to the inside and outside diameters of the rear oil seals and install them into the back of the gear case with the spring side facing outward toward the gear. Install the gear spacers onto the shaft and place the gear keys into the shaft key slots (Figure 43).

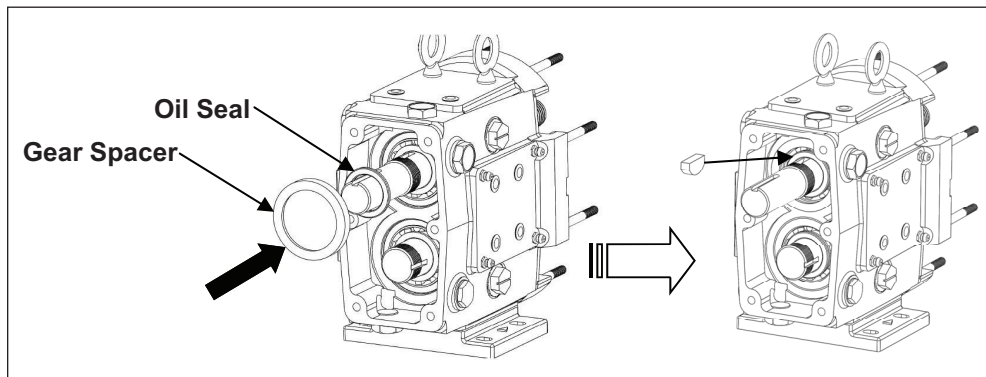


Figure 43. Rear Oil Seal and Gear Key Installation

8. Once the gear keys are installed, orientate the shafts so that the keyways on the drive shaft are pointing in the 12 o'clock direction (Figure 44, A). Slide the right-handed gear with the single punch mark onto the drive shaft. Slide the second gear with two punch marks on the short shaft. To time the gears, align so that the single punch mark falls between the two punch marks on the opposite gear (Figure 44, B).

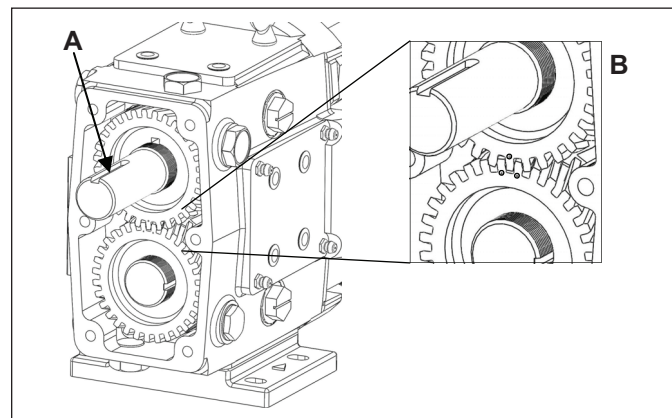


Figure 44. Installing Gears with Correct Timing

- Install the lock washers on the shaft by aligning the tab inside the lock washer with the slot in the shaft (Figure 45, A). Lubricate the threads of the lock nuts and thread them on the shafts. Using a spanner wrench, tighten them to the specified torque in Table 6. Use a wedge (wood or plastic) between the gear teeth to keep the shafts from turning while tightening the lock nuts (Figure 45, B).

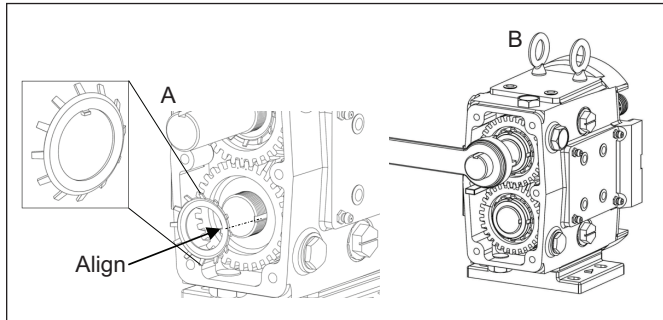


Figure 45. Installing Lock Washer and Lock Nut

Table 6. Recommended Lock Nut Torque Values

ZP2 Model	Torque	
	ft-lbs	N-m
6, 15, 18	75	102
30, 34, 40	100	136
45, 60, 64, 130, 134	140	190
180, 184, 220, 224	230	312
210, 214, 320, 324	320	434

Secure the nut in place by bending the locking tabs on the lock washer into the lock nut slots (Figure 46).

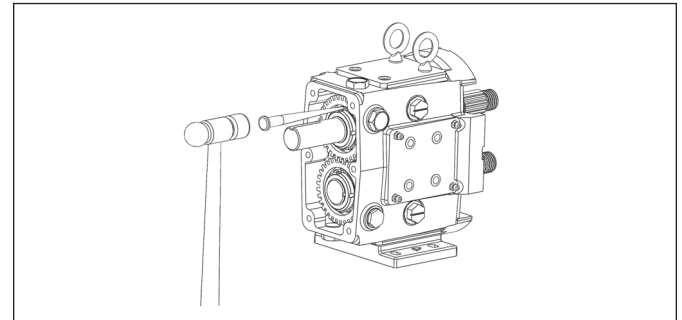


Figure 46. Bending Tabs on Lock Washer

- Apply a light film of lubricant to the inside and outside diameters of the gear case cover oil seal. Using a press, install the oil seal into the back cover so that it is flush with the outside of the back cover and the spring is facing the gears. Apply a silicone sealant to the edges on the back of the gear case making sure there are no gaps. Slide the back cover onto the gear case, making sure that the shaft is centered on the oil seal, and secure it with the retaining bolts (Figure 47). It is important not to cut the oil seal on the shaft keyway; tape may be used to cover any sharp edges on the shaft. Install the oil plugs and fill the gear case with the recommended amount of oil using Table 3 on page 18.

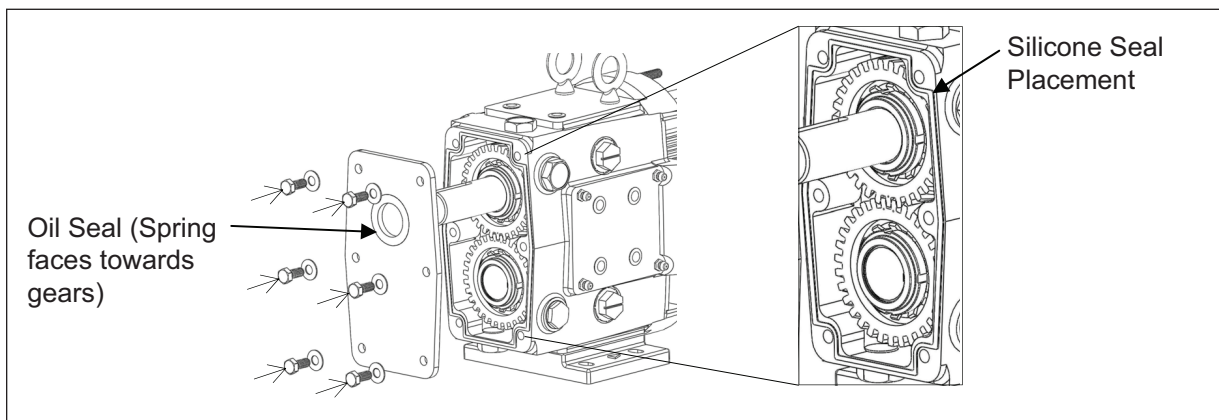


Figure 47. Installing Gear Casing Back Cover

Pump Assembly

⚠ Caution

Handle the rotors, piping, and other pump components carefully as edges may be sharp. Wear gloves to avoid injuries.

⚠ Warning

The body must be re-assembled to existing sub-assembly from which it was removed. Reference serial numbers on the body and sub-assembly to verify the match. Failure to correctly re-assemble the pump could result in damage and severe injury.

1. Make sure all seal components are installed by following “Seal Maintenance” instructions provided on page 23. Ensure all dowels are in place and that all parts including body, rotors, and rotor nuts are clean and free of foreign matter. Slowly slide the body over the gear case studs and shafts, ensuring the seals are kept in place and not damaged (Figure 48). Install the two hold-down bolts and tighten the body against the gear case to ensure the dowels are engaged. Rotate the shafts to make sure there is no interference with the seals.

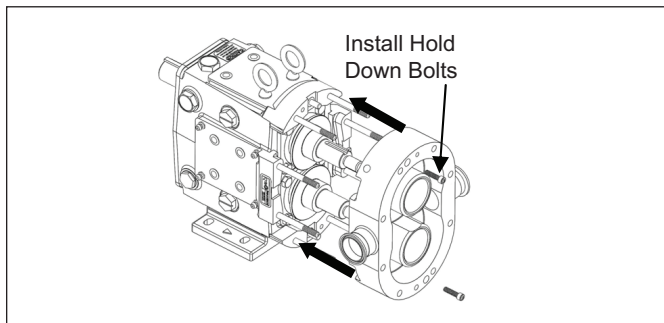


Figure 48. Installing Pump Body

2. Insert rotor key in the keyway on the shaft. Install a new rotor hub o-ring on the rotor hub and align the rotor keyway to the key in the shaft (Figure 49, A). Slide the rotor on until it seats against the shaft. Install the Bellville washer in the rotor nut and hold it in place using the small retaining o-ring (Figure 49, B). Place one nut on at a time, tightening them down using the appropriate wrench and a non-metallic wedge to hold the rotor in place (Figure 49, C). See Table 7 for required torque values. Repeat with the second rotor.

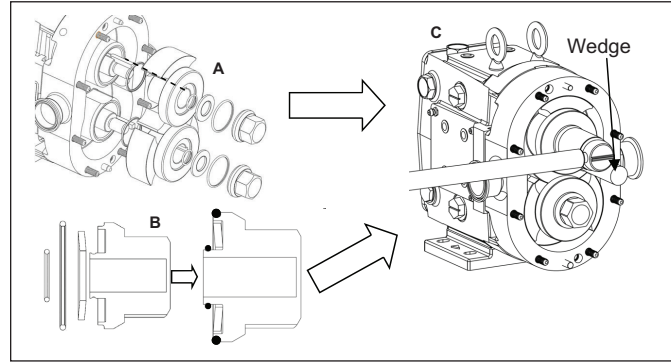


Figure 49. Installing and Securing the Rotor

Table 7. Recommended Jam Nut Torque Values

ZP2 Model	Torque	
	ft-lbs	N-m
6, 15, 18	50	68
30, 34, 40	120	163
45, 60, 64, 130, 134	250	339
180, 184, 220, 224	325	441
210, 214, 320, 324	375	508

3. Install the new cover o-ring and slide the cover over the studs making sure that the dowels in the body are aligned with the correct dowel holes in the cover (Figure 50). Visually inspect to ensure that the cover o-ring remained in place. Turn the cover nuts (clockwise) by hand and fully tighten them by using the appropriate wrench. Tighten the rotor nuts in an opposing manner as seen in Figure 50, so that the cover is evenly tightened to the body.

Table 8. Cover Nut Torque Chart

PUMP MODEL	COVER NUT TORQUE
006, 015, 018	7 ft-lb (10 N•m)
030, 040	11 ft-lb (15 N•m)
045, 060	56 ft-lb (76 N•m)
130	25 ft-lb (34 N•m)
180, 220	110 ft-lb (149 N•m)
210, 320	158 ft-lb (214 N•m)

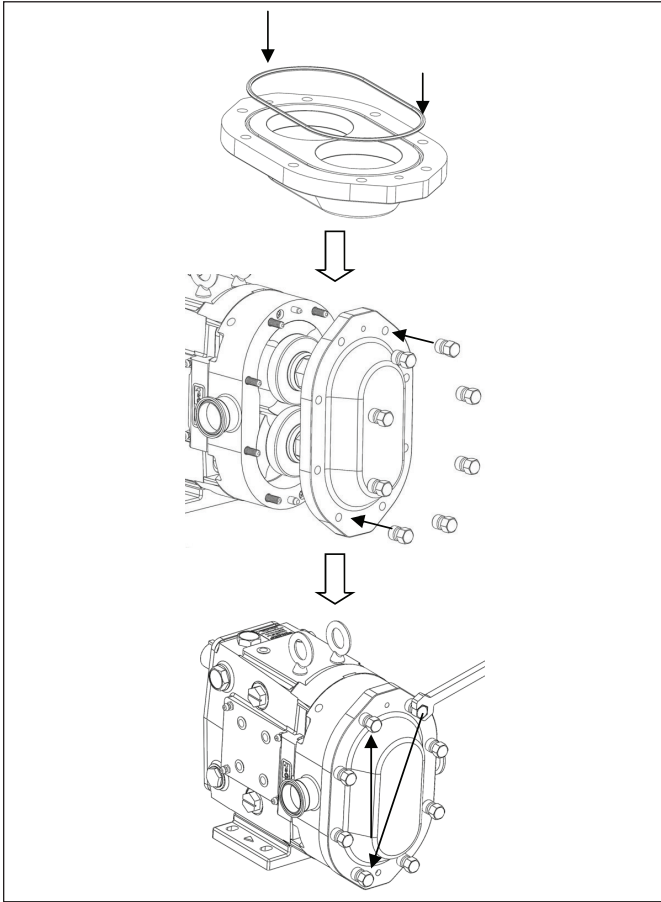


Figure 50. Installing Cover Assembly

SEAL ASSEMBLY

1. Clean both shaft ends and the body before assembling. Apply a light film of lubricant to NEW seal seat o-rings and insert them on the shafts slots.

Slide the seal seat onto shaft by pushing it against the shaft shoulder making sure to align the drive flats on the seal seat and shaft (*Figure 51*).

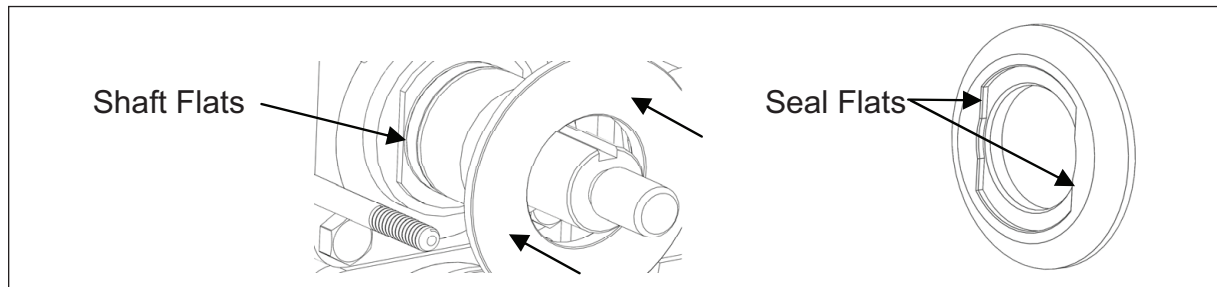


Figure 51. Aligning Flats

2. Apply a light film of lubricant to NEW inner stationary o-rings and install them on the inner stationary seals. Place the inner wave spring into the body and install the inner stationary seal into the seal groove (*Figure 52*). Make sure the seal stop pins are aligned with the notches on the inner stationary seal. For double seals, apply a light film

of lubricant to NEW outer stationary o-rings and install them on the outer stationary seals. Place the outer wave spring into the body and install the outer stationary seal in the seal groove (*Figure 52*). Check that the seal stop pins are aligned with the notches on the outer stationary seal.

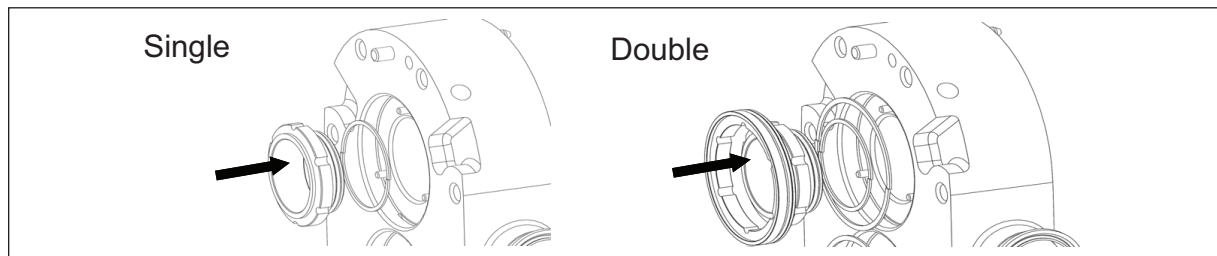


Figure 52. Installing Single/Double Stationary Seals

Item No.	Qty	Description
45	2	O-Ring, Rotor Seal Face
40	6	Seal Stop Pin
56	2	Inner Seal Wave Spring
57	2	Inner Seal
58	2	O-Ring, Shaft

Item No.	Qty	Description
59	2	Seal Seat
60	2	Outer Seal Wave Spring
61	2	O-Ring, Outer Seal
62	2	Outer Seal
63	2	O-Ring, Rotor Hub

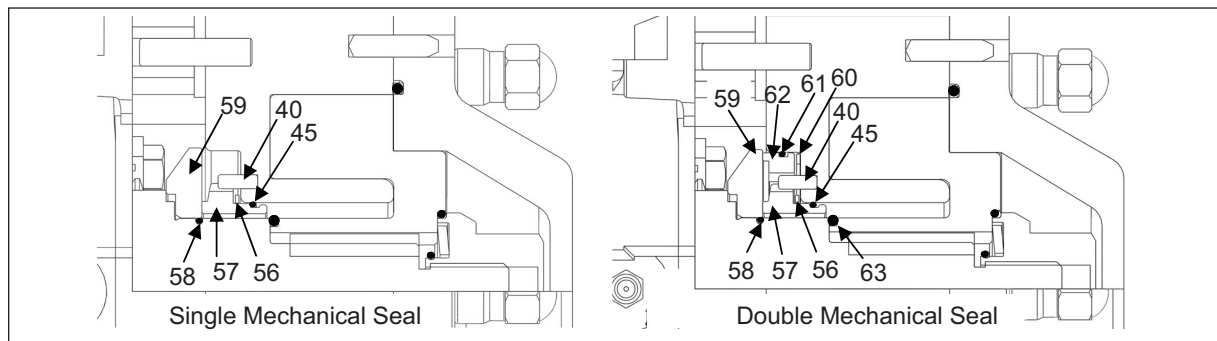


Figure 53. Installing Single/Double Stationary Seals

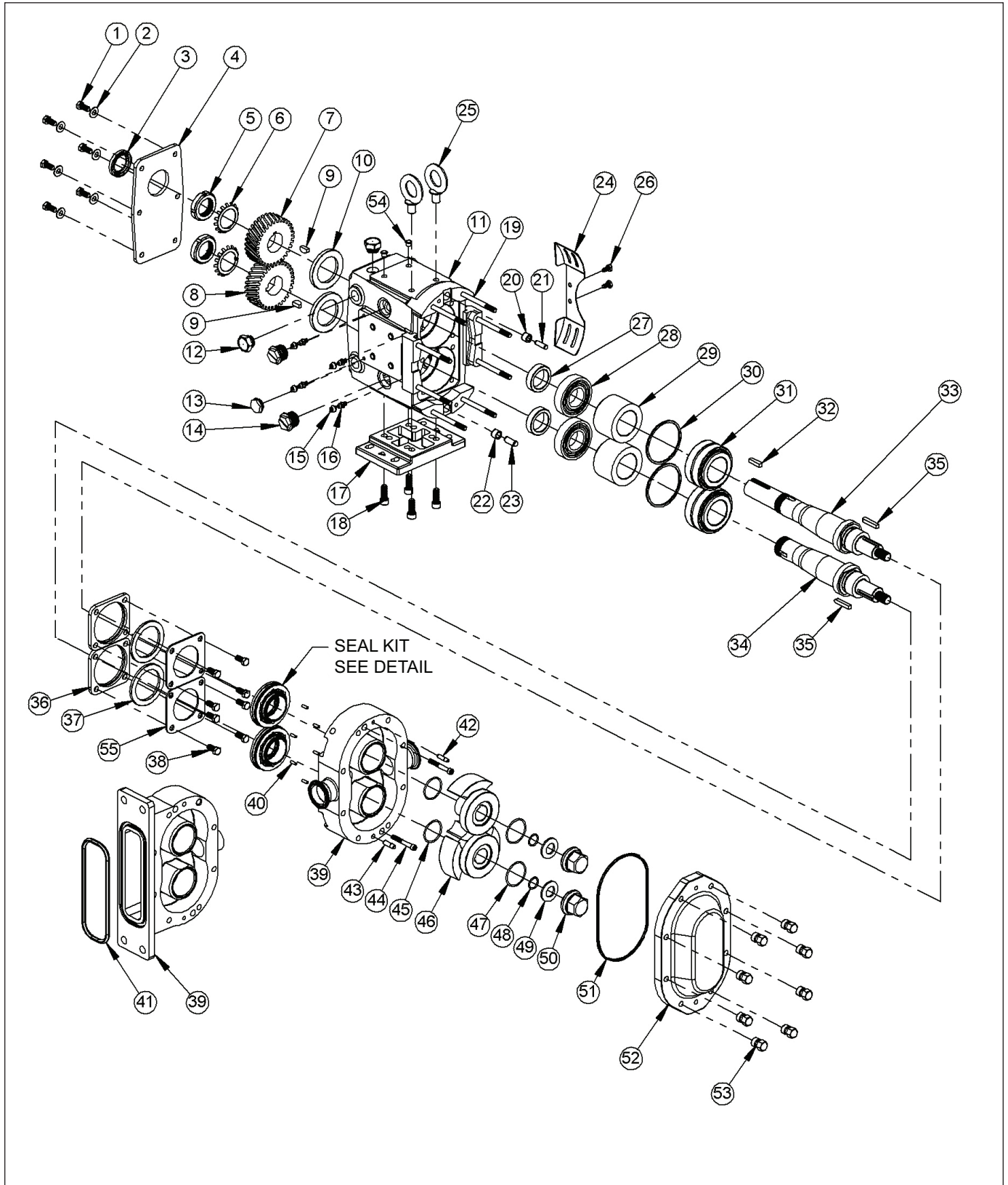


Table 9. ZP2 SERIES PARTS BREAKDOWN

ITEM	QTY	DESCRIPTION
1	6	GEAR CASE COVER BOLT
2	6	GEAR CASE COVER WASHER
3	1	GEAR CASE COVER OIL SEAL
4	1	GEAR CASE COVER
5	2	GEAR LOCK NUT
6	2	GEAR LOCK WASHER
7	1	GEAR, DRIVE SHAFT
8	1	GEAR, IDLE SHAFT
9	2	GEAR KEY
10	2	OIL SEAL, REAR
11	1	GEAR CASE
12	5	OIL PLUG, DRAIN/FILL
13	1	OIL PLUG, LEVEL SIGHT
14	4	PLUG, CLEANOUT
15	8	GREASE FITTING COVER
16	8	GREASE FITTING
17	1	GEAR CASE BASE
18	4	BOLT, GEAR CASE BASE
19	8	STUD
20	1	DOWEL BUSHING, UPPER
21	1	DOWEL PIN, GEAR CASE, UPPER
22	1	DOWEL BUSHING, LOWER
23	1	DOWEL PIN, GEAR CASE, LOWER
24	2	SEAL GUARD
25	2	EYE BOLT
26	4	NAIL, SEAL GUARD
27	2	SPACER, GEAR TO REAR BEARING
28	2	REAR BEARING
29	2	SPACER, BEARING
30	2	SHIM KIT
31	2	FRONT BEARING
32	1	DRIVE KEY
33	1	DRIVE SHAFT
34	1	IDLE SHAFT
35	2	ROTOR KEY
36	2	BEARING RETAINER
37	2	BEARING RETAINER LIP SEAL
38	8	BOLT, BEARING RETAINER
39	1	BODY
40	2	SEAL STOP PIN
41	1	O-RING, RECT. FLANGE INLET

ITEM	QTY	DESCRIPTION
42	1	DOWEL PIN, COVER, UPPER
43	1	DOWEL PIN, COVER, LOWER
44	2	BODY RETAINING SCREWS
45	2	O-RING, ROTOR SEAL FACE
46	2	ROTOR
47	2	O-RING, ROTOR NUT
48	2	O-RING, RETAINER
49	2	BELLEVILLE WASHER
50	2	ROTOR NUT
51	1	O-RING, COVER
52	1	COVER
53	8	COVER HEX NUT
54	12	PLASTIC CAP PLUG
55	2	SPLASH PLATES

Pump Clearances

The performance of a ZP2 is based on the tight clearances between the pump body and the rotors. These clearances are critical to ensure the pump performs up to the system requirements. The clearance between the rotor and the back face of the body is referred to as the backface clearance. The backface

clearances are set when the gear case is assembled (page 28) using shims placed between the gear case and the front bearing. Other clearances are shown in Figure 54 and should be in accordance to Table 10. Use shims and a depth micrometer to measure the clearances.

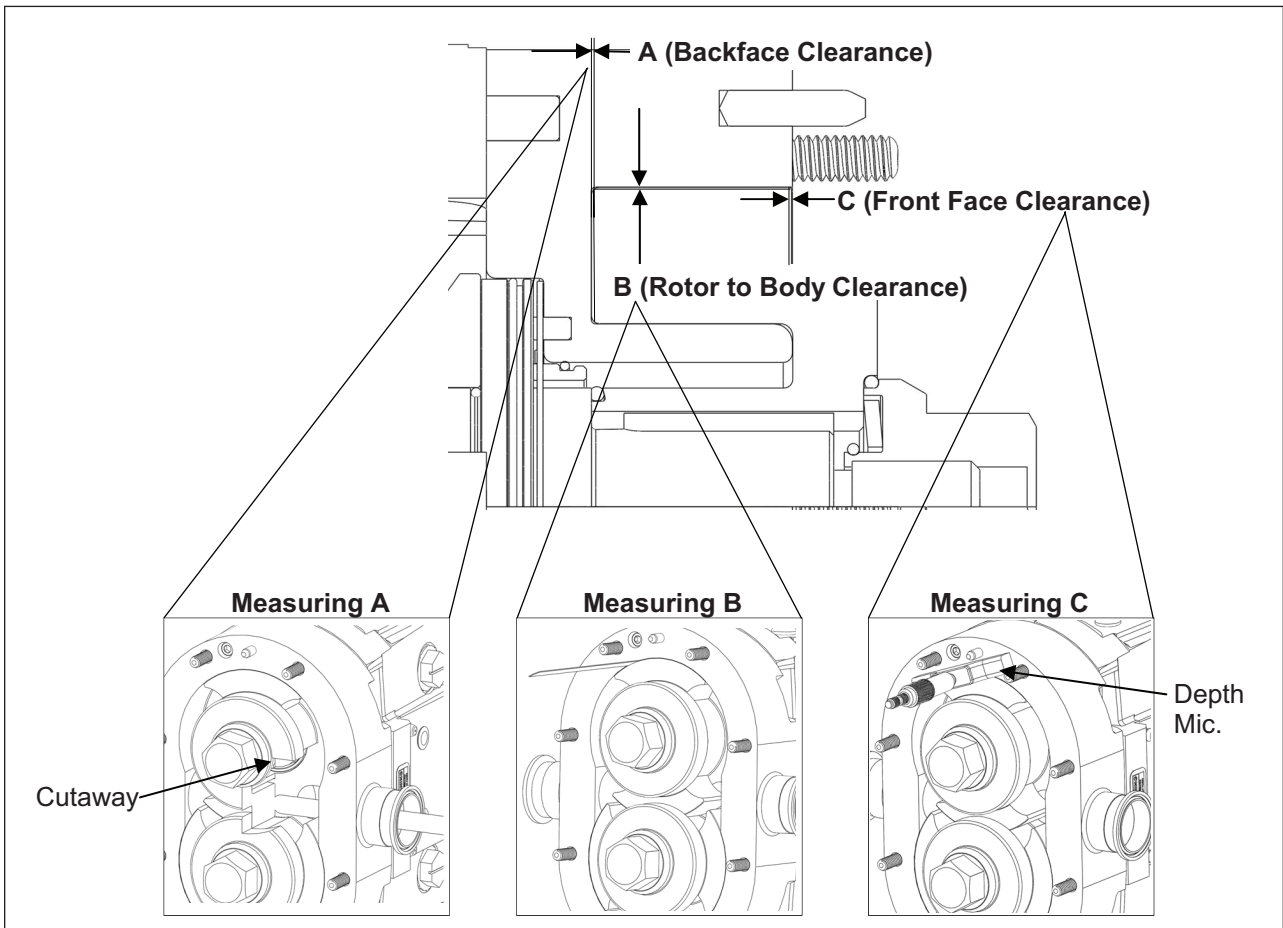


Figure 54. Critical Pump Clearances

Table 10. Critical Pump Clearance Dimensions

ZP2 Model	A (Backface Clearance)		B (Rotor to Body Clearance)		C (Front Face Clearance)	
	Inch	mm	Inch	mm	Inch	mm
6, 15, 18	.002	.05	.002	.05	.005	.13
30, 34, 40	.002	.05	.002	.05	.005	.13
45, 60, 64, 130, 134	.004	.10	.005	.13	.008	.20
180, 184, 220, 224	.005	.13	.006	.15	.008	.20
210, 214, 320, 324	.005	.13	.010	.25	.011	.28

Ampco Pumps Available Options

VENTED COVER (PRESSURE RELIEF)

The vented cover option is an internal pressure and flow control which works independent of flow (rotational direction). The complete assembly can be seen in *Figure 55*. The relief pressure is set with the adjustment screw and may require in-line pressure gauges for calibration. The vented cover is designed for COP (Clean-Out-of-Place) practices.

Notice

Ampco Pumps does not recommend using a vented cover on liquids over 5000Cp.

ITEM	QTY	DESCRIPTION
64	1	Vented Cover
65	1	Rubber Diaphragm
66	1	Diaphragm Bushing
67	1	Spring Plunger
68	1	Spring
69	1	Cover Nut
70	1	Lock Nut
71	1	Adjusting Screw

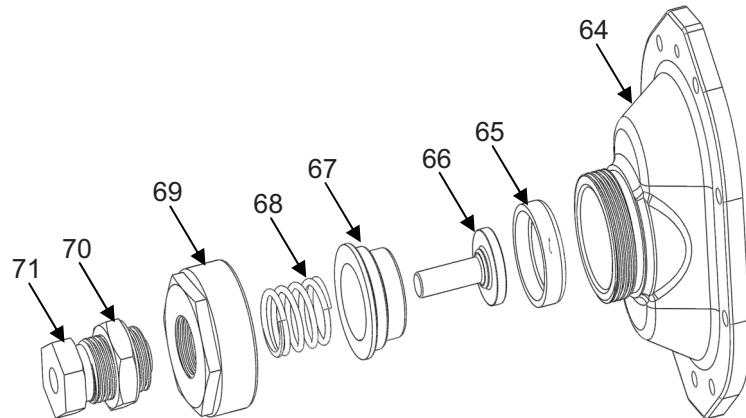


Figure 55. Vented Cover

JACKETED COVER

The jacketed cover option (*Figure 56*) allows for heating or cooling fluid to be circulated through to match the demands of certain products. This fluid (media) can preheat or cool the fluid end and sustain the product temperature during operation and short shutdowns.

The jacketed cover is not a heat exchanger and is not designed to primarily control the product temperature. This option requires longer gear case mounting studs. Please contact Ampco for replacement information. The pressure limit for the jacketed cover is 60 psi.

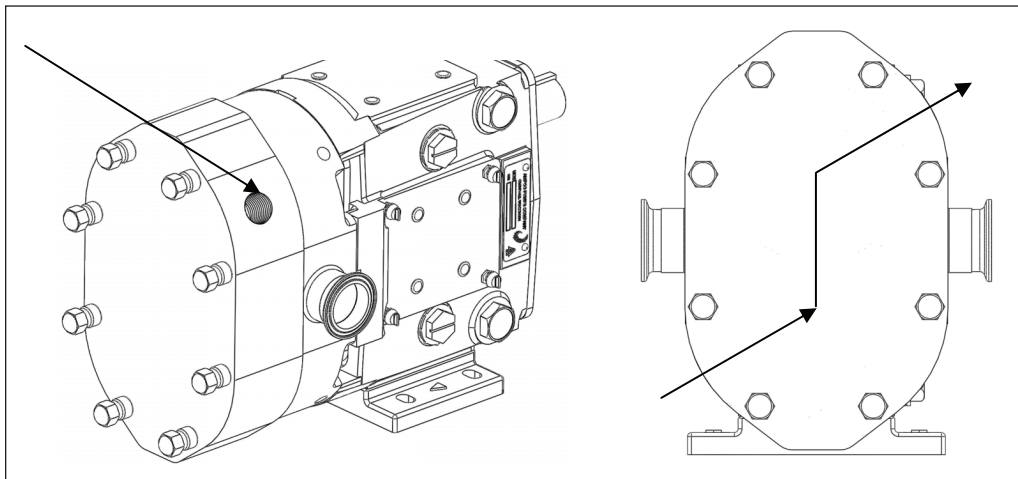


Figure 56. Jacketed Cover

ZP2 Pump Model	Thread Size
6, 15, 18, 30, 40	3/4" NPT

ZP2 Pump Model	Thread Size
45, 60, 130, 180, 220	1" NPT

Section 5 Troubleshooting

Troubleshooting

Each Ampco ZP2 is assembled and tested at the factory and is designed to have trouble-free operation. Problems may occur over the life of the pump due to system variations, standard wear, or user error. The following table has information that may help identify and solve a problem. For additional technical assistance, please contact Ampco with the pump's serial number.

Symptom	Cause	Solution
NO FLOW (rotors are not turning)	Drive motor is not running or connected	Check connection and power source to pump motor drive
	Keys (gear, drive shaft) are sheared or missing	Check or replace
	The pump's drive (gearbox, belts, transmission) is broken or slipping	Check, replace, or adjust
	Pump shafts or gears are broken	Check and replace, if necessary
NO FLOW (rotors are turning)	Rotors are turning in the wrong direction	Check motor connections for correct hookup (see "Pump Rotation" on <i>page 13</i>)
	Discharge port/valve is closed or blocked	Check and open, if necessary
	Inlet port/valve is closed or blocked	Check and open, if necessary
	Pump relief valve (optional) is not set correctly, or is held open by foreign matter	Check and clean, if necessary. Check system so that unwanted debris doesn't enter pump
NO FLOW (pump is not priming)	Inlet valve closed	Open valve, if necessary
	Inlet line restricted or clogged	Clean lines and check system
	Too much air in the inlet line	Check lines for leaks, replace gaskets or pipes, if needed
	The pump's speed is too low	Increase speed of pump
	The pump's speed is too high	Check viscosity of product, and reduce speed as needed
	No product in the inlet lines (lines drain or siphon when pump is off)	Foot valves or check valves may be used. Having product in the line is necessary for the pump to prime
	Pump is air locked	Install air bleeds to the pump and lines
	Pump may be worn out	Increase the pumps speed or replace worn out rotors
	Inlet pressures too low	Check pressure required. Change, if necessary
Differential pressure differences not developing	Install check valves on discharge to prevent large back pressures	
Inadequate Flow	Speed is too low or too high	Check published pump curve and adjust speed, if necessary
	Air leaks in inlet line	Check for bad seals, bad gaskets and piping connections
Inadequate Flow and Flow Is Bypassing Pump	Open valve (inlet drain, trap valve)	Check valves and close, if needed
	Relief valve not adjusted correctly or stuck	Check relief valve and adjust, if necessary
Inadequate Flow, Pump Is Noisy During Operation (slipping)	Non-standard rotors (Hot clearance, Hot Chocolate clearance, Stainless) are being used on low viscous fluids	Use appropriate rotors for product (contact Ampco for additional support, if needed)
	Body and rotors are worn	Increase speeds, replace rotors, or have the pump remanufactured (<i>page 41</i>)
	Pressures are too high for pump	Adjust system

Symptom	Cause	Solution
Starved Pump Inlet (fluid vaporization)	Strainers, valves (inlet side), fittings, or lines are plugged or restricted	Check and clean lines/valves
	The Inlet line is too small (inside diameter) or long, or both	Increase inlet pipe size and/or decrease pipe length
	Too many valves or fittings	Reduce number of fittings or valves
	Valves or strainers are too small	Check and change, if necessary
	The net inlet pressure is too low	Check pump and system requirements and change system or pump, if necessary
	Product viscosity greater than expected	Change system parameters (temperature, flow, pressure)
	Product temperature is higher than expected	Reduce speed, temperature and flow, if necessary
Excessive Power Is Required (pump overheats, stalls, draws high current, fuses/ breakers are tripping)	Viscosity losses higher than expected	Increase pump speed, if needed
	Pressures higher than expected	Decrease pump speeds and modify inlet line sizes
	Viscosity is higher than expected	Heat product, or change system parameters
	Viscous product sits in line during shutdown	Install a soft start on motor drive, clean lines or change system to avoid problem
Noisy Operation (cavitation)	Product's viscosity, vapor pressure and temperature are too high	Check system setup. Change speeds and temperatures, accordingly
	The inlet pressure available is less than required	Check inlet pressure requirements and adjust accordingly
Noisy Operation (air or gas in fluid)	Air leaks in the system	Check for leaks and correct, if needed
	Product emits gases	Install pressure relief valves
Noisy Operation (rotor to body contact)	Assembly without checking fluid end clearances	Check pump clearances and adjust, if necessary (<i>page 37</i>)
	Internal stresses in pump caused by improper piping support	Adjust system to eliminate stresses (<i>page 10</i>)
	Pressures are higher than what the pump is rated for	Reduce pressures
	Bearings are worn	Check for bearing movement (<i>page 19</i>) and replace, if necessary
Noisy Operation (rotor to rotor contact)	Gears are loose or incorrectly timed (damage to rotor may be severe)	Rebuild pump with new parts
	Keys are sheared	Inspect and rebuild, if necessary
	Gears are worn	Inspect and replace gears, if needed. Inspect damage to rotors and rebuild, if necessary
Noisy Operation (external mechanical problems)	Gear drive, drive belts, coupling or bearings are worn or not correctly adjusted	Check and replace. Adjust, if needed
Short Pump Life	Product is abrasive	Check system, and possibly implement a larger pump at lower speeds
	Pump speeds and pressures are higher than pump rating	Check system and change, if necessary. Reduce speeds and pressure of pump
	Improper gear case lubrication	Check and replace worn out gears and bearings; follow procedures on <i>page 17</i> for proper lubrication
	Water build up in gear case	Check that all gear case plugs are in place
	Misalignment in system (piping or pump drive)	Check and modify system to eliminate alignment issues

Section 6

Appendix

PD Pump Remanufacturing Program

With the purchase of each new ZP pump, Ampco guarantees two full remanufactures. Depending on wear, the ZP pumps (and equivalents) can be remanufactured up to four times. This process returns a used pump to new pump performance and appearance. Each fully remanufactured pump includes a one year warranty. The following upgrades are included when remanufacturing a competitor's pump: 17-4 shafts, stainless steel bearing retainers, helical gears, and sealed clean out plugs. These upgrades are standard to Ampco positive displacement new and remanufactured pumps.

Contact your local distributor or the factory (414) 643-1852 for more information.

ATEX Certification Information

1. Ampco pumps DOC (declaration of conformity) must be included with the pump. The declarations starting on *page 42* are provided for example purposes only. Please see the certificate you received with your pump.
2. ATEX certified pumps will be sent with black plugs on all drain and level ports at the rear of the gear case.
3. ATEX approval becomes void if non-Ampco replacement parts are used in the pump.

For additional support regarding ATEX certification, please contact the Engineering Department at Ampco Pumps Company, (414) 643-1852.

(1) **REGISTRATION CERTIFICATE**

(2) Equipment and Protective Systems intended for Use in Potentially Explosive Atmospheres – Directive 94/9/EC

(3) **Registration Number:**

TUVNA 12 ATEX 7223
File No. 31271925.001

(4) **Documentation:** Technical Construction File (TCF) dated May 12, 2012(5) **Equipment:** ZP1, ZP2, ZP3, and AL Series Mechanical Pumps(6) **Manufacturer:** Ampco Pumps Company(7) **Address:** 2045 West Mill Road
Glendale, WI 53209

(8) The aforementioned technical construction file has been received by TÜV Rheinland of North America and has been registered under Registration No. TUVNA 12 ATEX 7223, File No. 31271925.001 on behalf of our sister organization TÜV Rheinland Industrie Service GmbH, a Notified Body with ref-no NB 0035.

(9) This equipment and any acceptable variations thereto are specified in the aforementioned technical construction file.

(10) With respect to the ATEX Directive (94/9/EC), the manufacturer has declared compliance with the following standards.

EN 1127-1: 2007**EN 13463-1: 2009****EN 13463-5: 2003**

(11) The marking of the equipment shall include the following:

II 2 G Ex c IIB T4

(12) Other requirements as may be applicable are not covered by this Registration Certificate.

 Jim Dolphin

2012-09-10

 This Registration Certificate may only be reproduced in its entirety and without change.

Conformance Certificate for Material Shipped

Customer ID CUMM10
 Customer CUMMINS-WAGNER CO
 Date Signed 12/7/2020
 Customer PO No. POPA03399
 Ampco Order No. 57837
 Date Ordered 10/29/2020

Ampco Pumps Co. certifies that all items; including this report and the results of tests and values listed hereon are in full conformance with all purchase order and specification requirements. Further, the values shown represent the actual values obtained during testing, using the sample selection and test methods specified in the applicable material specification. It is also understood that knowingly and willfully falsifying or concealing a material fact on this form, or making false, fictions or fraudulent statements or representations herein could constitute a felony punishable under Federal Statutes. All material supplied is also free from mercury alpha or radium contamination and are animal derived ingredient free. NO PRODUCTS CURRENTLY MANUFACTURED BY AMPCO PUMPS COMPANY ARE MADE FROM ASBESTOS OR ASBESTOS-CONTAINING COMPONENTS. THIS APPLIES TO ALL PARTS INCLUDING SEALANTS, GASKETS AND SEAL COMPONENTS.

<u>Line No.</u>	<u>Item Number</u>	<u>Description</u>	<u>Qty</u>
5	ZP3-060	PUMP, ZP3-60, MECH SEAL <u>Line Notes</u> QN201671-2 <u>Specification</u> SS Gearcase w/CE Guards Bi-Wing Front Face Std Rotors Single Seal Viton Class 6 Elastomers Mech Seals - TC/SC Standard Body 2.5" Triclamp Bottom Drive Standard Cover Viton CLG Cover O Ring 20Ra Finish Base, Coupling & Guard Gear Reducer & Motor GEAR REDUCER:GR0000551: NORD,6.31,SK32,FLG,210TC,INL MOTOR: GM5G14356: 7.5, 213TC, SS, WD, 1750, 3, 60, 230-460, PREM EFF Cover Drain PER DRAWING # 48-1-1672 Speedy Sleeve	1
10	MISC-MTR	MATERIAL TEST REPORT	1
15	MISC-SURFACE FINISH	SURFACE FINISH MAP	1
20	MISC-CERT OF CONFOR	CERTIFICATE OF CONFORMANCE	1
25	MISC-CERTIFIED DRAWI	CERTIFIED PUMP DRAWING	1
30	MISC-CERT PERFORMA	CERTIFIED PERFORMANCE CURVE	1
35	MISC-FEE	WELD LOG	1

APC

1/2

Conformance Certificate for Material Shipped

Customer ID CUMM10
Customer CUMMINS-WAGNER CO
Date Signed 12/7/2020
Customer PO No. POPA03399
Ampco Order No. 57837
Date Ordered 10/29/2020

Ampco Pumps Co. certifies that all items; including this report and the results of tests and values listed hereon are in full conformance with all purchase order and specification requirements. Further, the values shown represent the actual values obtained during testing, using the sample selection and test methods specified in the applicable material specification. It is also understood that knowingly and willfully falsifying or concealing a material fact on this form, or making false, fictions or fraudulent statements or representations herein could constitute a felony punishable under Federal Statutes. All material supplied is also free from mercury alpha or radium contamination and are animal derived ingredient free. NO PRODUCTS CURRENTLY MANUFACTURED BY AMPCO PUMPS COMPANY ARE MADE FROM ASBESTOS OR ASBESTOS-CONTAINING COMPONENTS. THIS APPLIES TO ALL PARTS INCLUDING SEALANTS, GASKETS AND SEAL COMPONENTS.

<u>Line No.</u>	<u>Item Number</u>	<u>Description</u>	<u>Qty</u>
40	MISC-HYDROSTATIC TE	HYDROSTATIC TEST	1

Issued by Ampco Pumps Company Inc.
Glendale, WI


Authorized Representative

Terms and Conditions

AMPCO PUMPS Made of SELECTED corrosion-resistant alloys TERMS AND CONDITIONS OF SALE

1. **ENTIRE AGREEMENT.** This document contains all of the terms and conditions of the agreement ("the agreement") between Ampco Pumps Company, Inc. ("Seller") and the purchaser ("Purchaser") of the Products ("Products") to be sold to Purchaser, to the exclusion of any other statements and agreements, and to the exclusion of any terms and conditions incorporated in Purchaser's order or other documents of Purchaser. Seller's acceptance of Purchaser's order is expressly conditioned on Purchaser's acceptance of the terms and conditions contained herein, and Purchaser, upon placing an order, is presumed to have accepted all the terms and conditions without modification. No alteration, waiver, modification of or addition to the terms and conditions herein shall be binding on Seller unless set forth in writing and specifically agreed to by an officer of Seller. No course of dealing, usage of trade or course of performance will be relevant to supplement or explain any terms used in the agreement. All offers to purchase, quotations and contracts of sale are subject to final acceptance by Seller at its home office at Milwaukee, Wisconsin.
2. **PRICES.** Prices for Products manufactured by Seller pursuant to written accepted orders will remain firm for thirty (30) days from the date of any subsequent price change.
3. **TERMS OF PAYMENT.** Standard terms are ½% 10 days, 30 days net, from date of invoice unless otherwise stated. If, in the judgment of Seller, the financial condition of Purchaser at any time does not justify continuance of production or shipment on the terms of payment specified, Seller may require full or partial payment in advance. In cases of delays in payment, Seller reserves the right to charge interest on delinquent balances at the rate of 1 ½% per month.
4. **DELIVERY.** Except as otherwise provided expressly stated in the agreement, Products are sold F.O.B. Milwaukee. Seller will use reasonable commercial efforts to fill orders within the time stated, but the stated delivery date is approximate only, and Seller reserves the right to readjust shipment schedules without liability. Acceptance by Purchaser of the Products waives any claim for loss or damage resulting from a delay, regardless of the cause of the delay. Except as otherwise provided herein, Seller will not be responsible for freight, transportation, insurance, shipping, storage, handling, demurrage or similar charges. Claims by Purchaser for shortages in the Products must be made to Seller in writing within ten (10) days after date of receipt of the Products. No such shortage shall entitle Purchaser to withhold payment for Products which were received by Purchaser. Each such claim shall set forth in detail the basis and amount of such claim.
5. **TAXES AND FEES.** Seller shall pay all present and future sales, excise, privilege, use or other taxes, customs duties, and all other fees or other costs, imposed by any federal, state, foreign, or local authorities arising from the sale, purchase, transportation, delivery, storage, use or consumption of the Products or will, if applicable, provide Seller with an appropriate exemption certificate. Seller shall be under no obligation to contest the validity of any such taxes or to prosecute any claims for refunds or returns.
6. **INSTALLATION.** The Products shall be installed by and at the expense of Purchaser.
7. **LOSS, DAMAGE OR DELAY.** Seller will not be liable for loss, damage or delay resulting from causes beyond its reasonable control, including, without limitation, strikes or labor difficulties, lockouts, acts or omissions of any governmental authority or Seller, insurrection or riot, war, fires, floods, Acts of God, breakdown of essential machinery, accidents, embargoes, cargo or material shortages, delays in transportation, lack of production capacity or inability to obtain labor, materials or parts from usual sources. In the event of any such delay, performance will be postponed by such length of time as may be reasonably necessary to compensate for the delay. In the event performance by Seller under the agreement cannot be accomplished by Seller due to any of the foregoing causes within a reasonable period of time, Seller may, at its option, terminate the agreement without liability.
8. **RETURNS.** No Products or parts may be returned by Purchaser without the prior written consent of Seller.
9. **WARRANTY.** Seller warrants that the Products manufactured by Seller will be free from defects, material and workmanship under normal use and service for a period of one (1) year from date of shipment. In addition, the specified rating of each pump is warranted; however, the characteristic shape of the performance curves may vary from the published standards, and the capacity, head and efficiency guarantees are based on actual shop tests using clear cold water, and therefore the rating is specified in equivalent units of clear cold water. The sole obligation of Seller and the exclusive remedy of Purchaser for breach of this warranty shall be the repair (at Seller's facility) or replacement by Seller (F.O.B. Milwaukee, Wisconsin), at Seller's option, of any parts found to be defective, without charge and shall be conditioned upon Seller receiving written notice of any alleged breach of this warranty within a reasonable time after discovery of the defects, but in no event later than the end of the warranty period. The parts alleged to be defective shall be returned to Seller upon its request, freight prepaid. This warranty does not cover ordinary wear and tear, abuse, misuse, overloading, alteration or Products or parts which have not been installed, operated or maintained in accordance with Seller's written instructions. Seller shall not be liable for any expenses for repairs, additions or modifications to the Products outside of Seller's factory without its prior written consent, and any such repairs without such consent shall void this warranty. THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Seller may from time to time provide its facilities, personnel and experience to assist customers in the selection of materials, design, installation and operation of Products for maximum resistance to corrosion and abrasion with due consideration to the economy of the installation. This service is provided in an advisory capacity only and the final selection and operation of the Products and ancillary equipment shall be the sole responsibility of Purchaser or any user thereof. Accessories and parts manufactured by third parties are warranted only to the extent of such third party's warranty. IN NO EVENT SHALL SELLER BE LIABLE UNDER ANY CIRCUMSTANCES FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY LOST PROFITS OR LABOR COSTS) ARISING FROM THE BREACH OF THIS WARRANTY OR OTHERWISE ARISING FROM OR RELATING TO THE PRODUCTS OR THEIR SALE, USE OR INSTALLATION.

-
10. **CHANGES.** Changes in any work to be performed hereunder may be made only upon Purchaser's written instructions and acceptance by Seller in its discretion. Any change in drawings, materials or design of the Products, or to tools, fixtures or other items used to produce the Products, which affects Seller's cost to produce the Products will entitle Seller to adjust the price to take into account any additional costs. If work has been started, Seller shall be properly reimbursed for work already performed; if Products already produced are not accepted by Purchaser, Seller has the right to adjust the price to take into account any additional costs caused by an increase or decrease in quantities or in the time required for performance under the agreement.
11. **TERMINATION.** After Seller has commenced work, ordered any materials or made any other commitments pursuant to the agreement, it may be terminated only with the prior written agreement of Seller providing for equitable cancellation charges. Such charges shall reimburse Seller for any completed items at the contract price, and for any work-in-process items at the contract price less the cost to complete. Termination on any other basis must be specifically agreed on in writing in advance between Purchaser and Seller.
12. **DEFERRED DELIVERIES.** Orders or deliveries will be deferred only upon the prior written agreement of Seller in its discretion, and then only upon the following conditions:
- (a) The deferral period may not exceed sixty (60) days. At the end of the deferral period, if no release is provided by Purchaser, Seller reserves the right to render an invoice for and ship the completed portion of the order to the destination specified in Purchaser's order, or to store such material at Purchaser's expense at Seller's standard storage charges then in effect.
 - (b) For the portion of the order that is not completed, if no release is provided by Purchaser at the expiration of the deferral period, Seller reserves the right to render an invoice for any completed items at the contract price, and for any work-in-process items at the contract price less the cost to complete.
 - (c) Purchaser shall bear the risk of loss or damage to materials held at Purchaser's request.
13. **LIMITATION OF LIABILITY.** IN NO EVENT SHALL SELLER BE LIABLE UNDER ANY CIRCUMSTANCES: (a) FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY LOST PROFITS OR LABOR COSTS) ARISING FROM OR RELATING TO THE PRODUCTS OR THEIR SALE, USE OR INSTALLATION; (b) FOR DAMAGES TO PROPERTY (OTHER THAN THE PRODUCTS PURCHASED FROM SELLER); (c) FROM ANY BREACH OF ITS WARRANTY OR ANY OTHER OBLIGATIONS TO BUYER; OR (d) FOR ANY OTHER CAUSE WHATSOEVER, WHETHER BASED ON WARRANTY (EXPRESSED OR IMPLIED) OR OTHERWISE BASED ON CONTRACT, OR ON TORT OR OTHER THEORY OF LIABILITY, AND REGARDLESS OF ANY ADVICE OR REPRESENTATIONS (WHETHER OR NOT IN WRITING) THAT MAY HAVE BEEN RENDERED BY SELLER CONCERNING THE DESIGN, MANUFACTURE, SALE, USE OR INSTALLATION OF THE PRODUCTS.
14. **INFRINGEMENT.** Seller at its expense will defend and hold Purchaser harmless from and against all damages, costs and expenses arising from any valid claim of infringement by a third party with respect to any patent or other intellectual property rights (collectively, the "Intellectual Property Rights") caused by Products originally manufactured by Seller, provided Purchaser
- (a) has not modified such Products,
 - (b) gives Seller immediate notice in writing of any claim or commencement or threat of suit, and (c) permits Seller to defend or settle the same, and gives all immediate information, assistance and authority to enable Seller to do so. In the event any such originally manufactured Products are held to infringe an Intellectual Property Right and if Purchaser's use thereof is enjoined, Seller will, at its expense and option: (1) obtain for Purchaser the right to continue using the Products, (2) supply non-infringing Products, (3) modify the Products so that they become non-infringing, or (4) refund the then market value of such Products. In no event shall Seller's liability exceed the sale price of the infringing Products. THE FOREGOING REPRESENTS SELLER'S ENTIRE AND EXCLUSIVE OBLIGATION WITH RESPECT TO ANY CHARGE OF INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT AND IS IN LIEU OF ANY STATUTORY WARRANTY RELATING TO INFRINGEMENT. Notwithstanding the foregoing, Seller shall have no liability as to any Products or parts thereof that are manufactured or modified by Purchaser or a third party, or that are manufactured or modified by Seller in accordance with Purchaser's specifications. Purchaser will defend and hold Seller harmless from and against all damages, costs and expenses whatsoever arising from any claim for infringement of any Intellectual Property Rights relating to Products that have been manufactured or modified by Seller according to specifications provided by Purchaser.
15. **CERTAIN LAWS.** Seller will comply with the applicable requirements of the Fair Labor Standards Act of 1938, as amended, Executive Order 11246, and THE rules, regulations and orders of the Secretary of Labor relating thereto.
16. **PERIOD FOR ACCEPTING QUOTATIONS.** Unless accepted without modification within thirty (30) days of issuance, or prior to withdrawal by Seller if earlier, all quotations automatically expire at the end of such thirty (30) day period.
17. **PROVISIONS FOR INTERNATIONAL TRANSACTIONS.** The following provisions shall apply if the Products are to be shipped to Purchaser at a location outside the United States, and apply regardless of other provisions set forth in these Terms and Conditions:
- (a) The 1980 United Nations Convention on Contracts for the International Sale of Products shall not apply.
 - (b) Except as otherwise provided expressly stated in the agreement, terms of delivery are Ex-Works (within the meaning of INCOTERMS 2000) and all customs fees, import duties, cargo insurance, taxes and other charges imposed on or relating to the purchase or sale of the Products shall be paid by Purchaser in addition to the stated price.
 - (c) Except as otherwise provided expressly stated elsewhere in the agreement, payment shall be made by issuance to Seller of an irrevocable letter of credit which (i) is issued and confirmed by a U.S. bank acceptable to Seller, (ii) is governed by the Uniform Customs and Practice for Documentary Credits (UCP 600) and otherwise acceptable in form and substance to Seller, and (iii) provides for payment to Seller of the purchase price in U.S. dollars upon presentation by Seller of Seller's certification and/or such other documents as shall be required by the letter of credit. All banking and other charges for such letter of credit shall be for the account of Purchaser.
-

- (d) Prices include Seller's standard commercial export packaging which may vary depending on whether shipment is made by air, land or sea. Except as otherwise provided expressly stated in the agreement, Purchaser will bear any additional expenses required to satisfy Purchaser's packaging requirements. Packages will be marked in accordance with Purchaser's instructions, if any. Seller shall furnish packing lists and such other information as may be necessary to enable Purchaser's agent to prepare documents required for export shipment.
- (e) All shipments hereunder are subject to compliance with the U.S. Export Administration Act, as amended, regulations thereunder and all other U.S. laws and regulations concerning exports. Purchaser shall comply with all such laws and regulations concerning the use, disposition, re-export and sale of the Products provided hereunder.
18. **GENERAL.** No modification or waiver of the agreement or any of its provisions is valid unless expressly agreed to by Seller in writing, and no waiver by Seller of any default under the agreement is a waiver of any other or subsequent default. The unenforceability or invalidity of one or more of the provisions of the agreement will not affect the enforceability or validity of any other provision of the agreement. Purchaser may not assign any of its rights, duties or obligations under the agreement without Seller's prior written consent and any attempted assignment without such consent, even if by operation of law, will be void. The agreement is governed by and shall be construed in accordance with the laws of the State of Wisconsin, including the Uniform Commercial Code as enacted by such state, without giving effect to its conflict of laws principles.

Return Policy

This policy is intended for returns that are not covered by product warranty, i.e. wrong pump or part was ordered, customer canceled order, etc. Before returning any product, contact us for a Returned Material Authorization Number (RMA#). This will eliminate confusion when the parts are received and facilitate processing the return. No action will be taken on returned parts without an RMA.

Type of Return	Restocking Charge
Standard pump with a replacement order	10%
Standard pump without a replacement order	20%
Standard parts with a replacement order	5%
Standard parts without a replacement order	10%

Additional restocking charges may be assessed for any of the following circumstances.

1. Special order motors and seals are not returnable unless we have a use for them. Credit will be determined on a case-by-case basis.
2. Impellers that are trimmed to a diameter that we don't regularly use are not returnable. Credit will be determined on a case-by-case basis.
3. Used seals and motors are not returnable.
4. For any pumps and/or parts purchased over (1) year ago, credit will be determined on a case-by-case basis.

CREDITS

Credit will be issued only after parts are returned and inspected. Customer is responsible for packaging parts so they are returned in "as new" condition. Any labor required by Ampco to return the parts to "as new" condition will be deducted from the credit.

THIS PAGE INTENTIONALLY LEFT BLANK



Ampco Pumps Company
2045 W. Mill Road Glendale, WI 53209
Phone: (800) 737-8671 or (414) 643-1852
Fax: (414) 643-4452
Email: ampcoocs@ampcopumps.com

**For additional information on the ZP2 series and other Ampco Pumps products,
please visit our website: www.ampcopumps.com**