ZM TECHNOLOGIES, INC.

ZD-U1 & EVOLUTION PUMP SERIES

Installation and Care Manual | ZMT, Inc.

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Table of Contents ZD-U1 & Evolution

Warranty

Warranty 4
Shipping Damage or Loss 4
Warranty Claim 4

Safety

Safety 5
Replacement Labels 6

Care of Stainless Steel Components

Stainless Steel Corrosion 9
Alloy W88 9
Elastomer Seal Replacement 10

Care of Stainless Steel Components

Pump Characteristics 11
Equipment Serial Number 11
Pump Shaft Location 11
Operating Parameters 13
Factory Remanufacturing Program 15

Installation

Install Pump and Drive Unit 16
Install Connections and Piping 17
Install Check Valves 19
Install Isolation Valves 19
Install Relief Valve 20
Install Side Strainer and Traps 21
Install Pressure Gauges 21
Check Coupling Alignment 22
Check Angular Alignment 22
Check Parallel Alignment 23
Check Belt and Drive Train Alignment 24
Check Pump Rotation 25

Maintenance

Important Safety Information 26
Lubrication 27
Gears and Bearings 27
Preventative Maintenance Inspection 28
Inspecting Shafts 29
Inspecting Gears 30
Annual Maintenance 31
Care and Cleaning 31
ZD - U1 and Evolution Body Disassembly 32
O-Ring Seal Maintenance 35
Mechanical Seal Maintenance 37
O-Ring Seal Replacement 35
Mechanical Seal Replacement 37
Gearbox Maintenance and Disassembly 41
Shaft Assembly 47
Gearbox Timing and Assembly 48
Pump-End Assembly 50
Rotor Clearances 51

Part Lists

ZD - U1 W006 - W320 Pump Parts 53
ZD - U1 W006 - W320 O-Ring Seal Parts 69
ZD - U1 W006 - W320 Mechanical Seal Parts 71
ZD - Z Evolution W006 - W383 Pump Parts 75
ZD - Z Evolution W006 - W2243 O-Ring Seal Parts 91
ZD - Z Evolution W006 - W2243 Mechanical Seal Parts 93

Troubleshooting

Troubleshooting 97

Warranty

ZM Technologies (Seller) warrants its products sold to be free from defective materials and workmanship for a period of one (1) year from the date of shipment. This warranty does not apply to products sold which require repair and/or replacement due to reasonable wear and tear or products that are subjected to accident, misuse, weather or improper maintenance. This warranty is valid only to the original buyer of the product. Products that are manufactured by other sources but are furnished by the Seller are exempt from this warranty and are limited to the original manufacturer's warranty implied.

Seller's obligation under this warranty will be limited to repair or replace any products that Seller determines to be defective upon review. Seller reserves the right to inspect the products at the customer's installation location or request the product be returned prepaid to the Seller. Seller is not responsible for any transportation charges, including duty, taxes, freight, labor or other costs that can be incurred. The expense of removing and/or installing products which have been repaired or replaced will be the responsibility of the Purchaser/Buyer.

Seller explicitly disclaims all other expressed or implied warranties, including without limitation any warranty merchantability of fitness for a particular purpose. This document sets forth the Seller's complete and limited liability, and Buyer's complete and sole remedy, for any claim of damages in reference with the sale of products. In no result shall the aforementioned Seller be liable for any special significant incidental or indirect damages (including without limitations attorney's fees and/or expenses), nor shall Seller be liable for any loss of profitability or merchandise arising out of or relating to the purchase, sale or operation of the products obtained through contract, torts (including negligence), strict liability or otherwise.

Shipping Damage or Loss

If product(s) is damaged or lost in transit, Buyer must file a claim immediately with the delivering carrier. The carrier has signed the Bill of Lading acknowledging that the shipment was received from ZM Technologies in acceptable condition. ZM Technologies is not responsible for the collection of claims or replacement of products due to transit errors, shortages or damages.

Warranty Claims

Warranty claims must have a Returned Materials Authorization (RMA) from the Seller before returns will be processed and accepted.

Claims for shortage, damage or other errors, exclusive of transit shortages and/or damages, must be made in writing to ZM Technologies within seven (7) days after receipt of delivery. Failure to give Seller such notice shall represent acceptance and waiver of all claims by Buyer.

Safety

YOU MUST READ AND UNDERSTAND THIS MANUAL PRIOR TO INSTALLATION, OPERATING OR SERVICING THIS EQUIPMENT!

ZM Technologies recommends all users of our equipment, products and designs follow the current Industrial Safety Standards. Improper installation, maintenance or operation of this equipment can result in severe injury or death. Equipment damage caused by end user neglect will immediately negate the pump warranty. Minimum guidelines should include the industrial safety requirements established by:

- Occupational Safety and Health Administration (OSHA), Title 29 of the CFR Section 1910.212- General Requirements for all Machines
- National Fire Protection Association, ANSI/NFPA 79 ANSI/NFPA 79- Electrical Standards for Industrial Machinery
- National Electrical Code, ANSI/NFPA 70 ANSI/NFPA 70- National Electrical Code ANSI/NFPA 70E- Electrical Safety Requirement for Employee Workplaces
- American National Standards Institute, Section B11

Attention: Servicing electrical industrial equipment can be hazardous. Severe injury or death can result from electrical shock, burns, or unintended actuation of controlled equipment. The recommended practice is to disconnect all power and lockout industrial equipment from unintentional actuation. Refer to the National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout-Tagout) and OSHA Electrical Safety Related Work Practices, including procedural requirements for:

- Lockout-Tag-out
- Personnel qualifications and training requirements

Locking and/or Interlocking Equipment: This equipment should be checked for proper working condition and ability of performing its intended functions. Make replacements with only original manufacturer's recommended renewal parts or kits. Adjust or repair equipment only within accordance of the manufacturer's instructions and recommendations.

Periodic Inspections: All operating industrial equipment should be inspected on a regular basis. The inspection should be based on the environmental and operational conditions the equipment is subject to as indicated by reasonable experience. An initial inspection after installation of equipment is recommended at 3 to 4 months minimum. Routine inspection of the electrical control systems should meet the recommendations specified in the National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, Preventative Maintenance of Industrial Control and Systems Equipment, for the general guidelines for setting up an effective periodic maintenance program for your equipment.

Replacement Equipment: Use ***only*** replacement parts and devices recommended exclusively by the manufacturer to maintain the safety and integrity of the equipment.

Warnings and cautions are provided in this manual to help avoid serious injury and/or unnecessary possible damage to equipment:

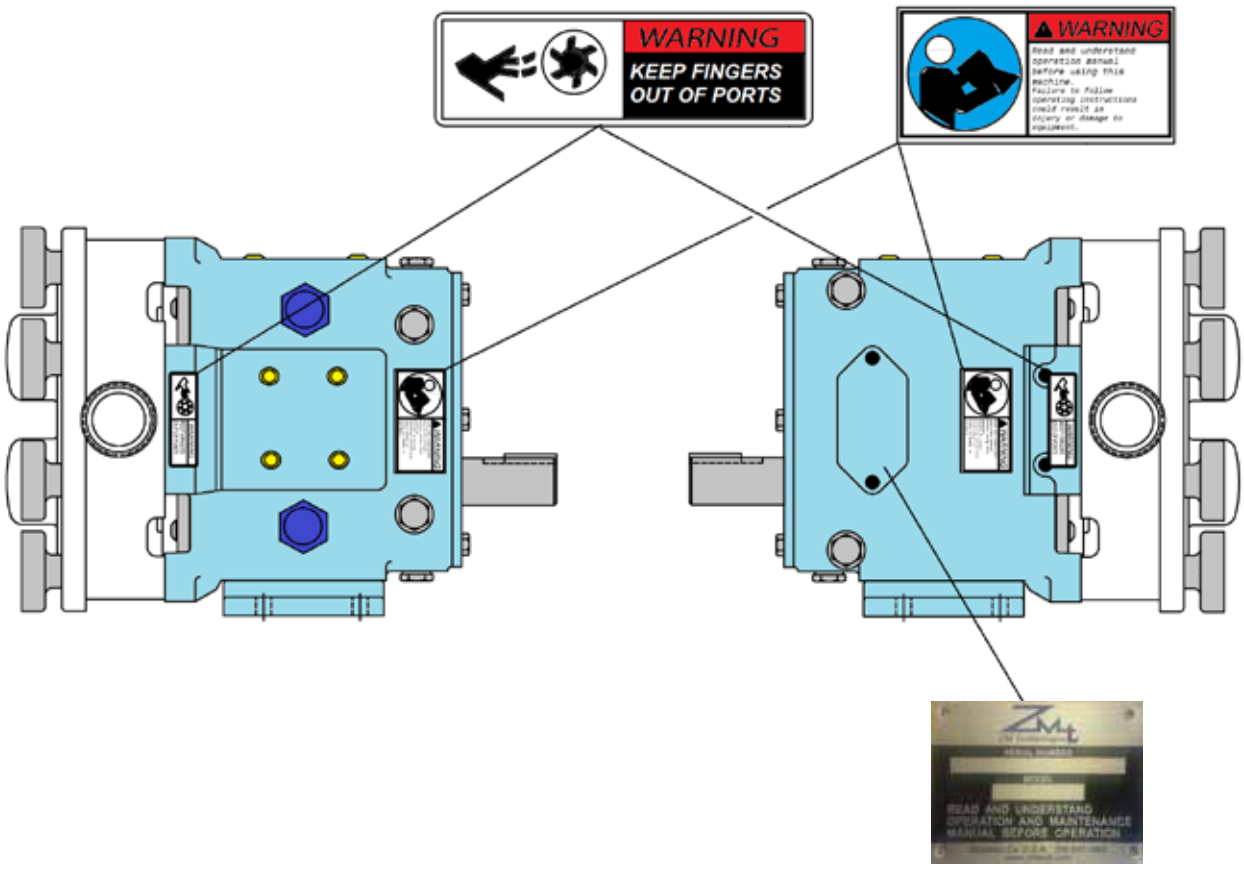
DANGER: marked with a stop sign.
Immediate hazard present and WILL result in severe personal injury or death.

WARNING: marked with a triangle.
Warns of hazardous or unsafe conditions or actions which COULD result in severe injury to self or death.

CAUTION: marked with a triangle.
Hazards or unsafe practices which COULD result in minor injury to self, product and/or property damage.

Replacement Labels

The following labels are installed on your industrial equipment. If these labels are damaged, missing or become unreadable to you, contact your local distributor and they will be provided to you at no charge.



Refer to the “Parts Lists” on page 53 for replacement part numbers.

Application Instructions

Apply new label to a clean, dry surface. Peel the removable backing from the label, place it in position, protect it with a cover sheet and rub out any air caught under it. (A soft rubber roller also may be used to press the new label into place.) Apply all labels to be readable when facing the front of the pump.

ZD-U1 and Evolution Pump Recommended Care of Stainless Steel

Stainless Steel Corrosion

Prevention of stainless steel corrosion is greatest when a layer of oxide film is formed on the outer surface of stainless steel. If the oxide film is disturbed or destroyed, the stainless steel can become less resistant to corrosion and the steel can rust, pit and even crack. Corrosion pitting, rusting and stress cracks can also occur from chemical attack on the metal. Use only specific cleaning chemicals recommended for use with 300 series stainless steel. Do not use excessive concentrations of chemicals, unusual elevated temperatures or exposure times. Avoid contact with highly corrosive acids such as hydrofluoric, hydrochloric or sulfuric to your skin or eyes. Also avoid prolonged contact with chemicals containing chloride, especially in presence of acid. If chlorine-based sanitizers are used, such as sodium hypochlorite (household bleach), do not exceed a concentration of 150 ppm available chlorine. When utilizing a sodium hypochlorite solution, ensure you do not exceed contact time of 20 minutes, and do not exceed a temperature higher than 104°F (40°C).

Deposits, pitting and/or corrosion can occur under gaskets. Keep all surfaces clean including areas under gaskets, in grooves and in tight corners. Always clean immediately after usage. Do not allow your equipment to sit unused, idle or exposed to air with accumulated foreign debris on the surface.

Pitting and corrosion may occur if equipment is not properly grounded and stray electrical current comes into contact with the stainless steel. Please ensure all devices connected to the equipment are properly grounded.

ZD-U1 and Evolution Pump Recommended Care of Stainless Steel

Alloy W88

Alloy W88 is the standard material utilized for rotors of the ZD-U1 and Evolution pump series. Alloy W88 was specifically developed to resist corrosion in close operating clearance requirements of high performance pumps. Alloy W88 is a corrosion resistant, nickel based, non-galling or seizing metal.

This material is listed in the 3-A Sanitary Standards as acceptable for product contact surfaces.

The above listed properties make Alloy W88 the supreme material for ZM Technologies stainless steel ZD-U1 and Evolution pumps. The non-galling Alloy W88 rotors allow close operating clearances in the liquid end. This feature provides the expected low slip and minimum shear damage to equipment. The rotors will not seize or gall if they come in contact with the body or cover during equipment operation.

The corrosion resistance of Alloy W88 is approximately equal to AISI 300 Series Stainless Steel. Please note, Alloy W88 has a limited resistance to certain common aggressive chemicals that may be commonly used in contact with AISI 300 Series Stainless Steel.

Do not expose Alloy W88 to nitric acid, CIP cleaning chemicals. Do not expose Alloy W88 rotors to nitric acid, CIP cleaning chemicals. If nitric acid must be used, you must remove the rotors prior to cleaning. Use a mild detergent to clean rotors by hand separately when utilizing CIP chemicals for cleaning.

Elastomer Seal Replacement

CIP cleaning chemicals can damage contact areas of ZD-U1 and Evolution equipment. Elastomers (aka rubber components) can be affected by these cleaning chemicals. It is important to regularly inspect all seals after chemical or CIP cleaning. Immediately replace seals that show signs of wear or damage from chemicals. Signs of damage or instability of the seals may include loss of elasticity, swelling, cracks or any other visible changes when comparing the seal to a new one.

If you have questions or are unsure regarding any other aggressive chemicals, please contact ZM Technologies directly for guidance.

Introduction

Pump Receiving

DANGER: The U1 and Evolution pump contains moving parts! **DO NOT** put hands, fingers or materials into the pump's body or drive areas at any time while the pump is in operation! For your safety, **DO NOT** install, service, clean or repair the equipment unless all power has been disconnected and locked out. This will avoid serious injuring from occurring.

All ports are covered at the factory to keep out foreign objects during transit. If covers are missing or damaged, remove the pump cover for a thorough inspection of the fluid head. It is important to be sure that the pump body is clean and free of foreign material before rotating the shaft.
NOTE: Any foreign object located within the pump body will damage the pump and may cause the pump to seize or lock-up.

Each ZMT ZD-U1 and Evolution pump is shipped completely assembled, lubricated with oil and grease and is therefore ready for use. Review "Pump Installation" on page 26 before operating the pump.

Pump Characteristics

Equipment Serial Number
Each ZD-U1 and Evolution pump is fitted with a metal plate containing a seven or more digit identifier number.

Pump Shaft Location

ZM Technologies ZD-U1 and Evolution pumps are low-slip, positive displacement, stainless steel pumps designed with diameter shafts that are larger for greater strength and stiffness. Each pump is mounted on a heavy-duty cast iron frame with double-tapered roller bearings.

- Specifications support up to 450 psi (31.0 bar) pressure capability.
- No bearings exist in the product zone.
- All bearings are greased and lubed for positive lubrication over capable range of speed, pressure and temperature.
- Our non-galling Alloy W88 rotors are standard. This allows the pump to function at tighter clearances and allow for a wide variety of fluid viscosity.

All ZD-U1 and Evolution pumps are identified by a serial number plate on the gearbox, which is attached on the cover and body of the pump.

CAUTION: It is important the gear casing, body and cover be kept intact as a unit due to the backface, rotor and cover clearances of the equipment. Failure to do this will damage the equipment.

There are four pump drive shaft locations on the equipment, see figure 1 and figure 2:

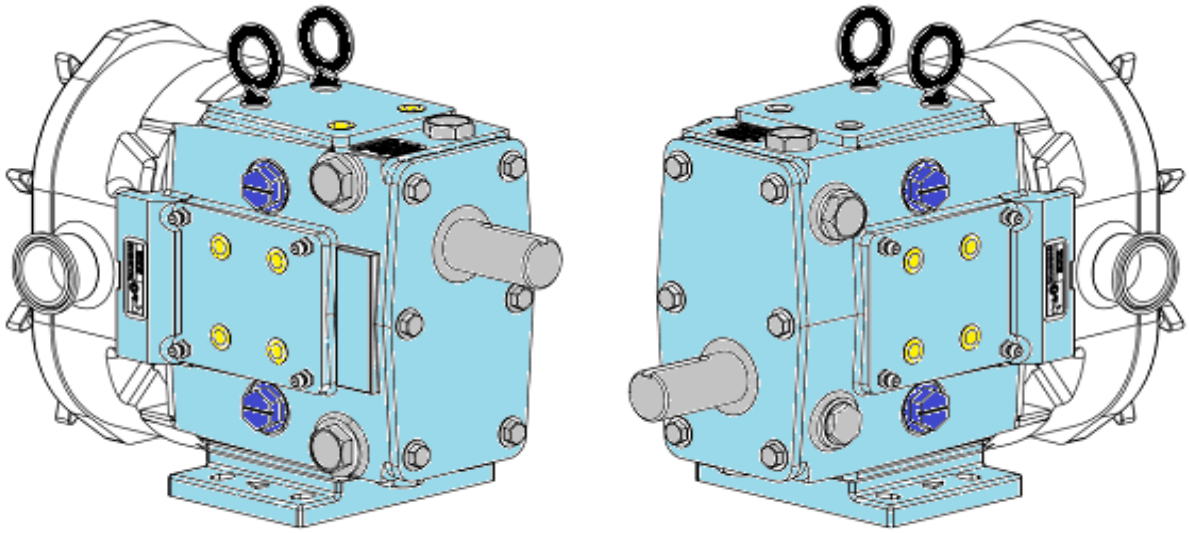


Figure 1 - Upper Shaft Mount and Lower Shaft Mount

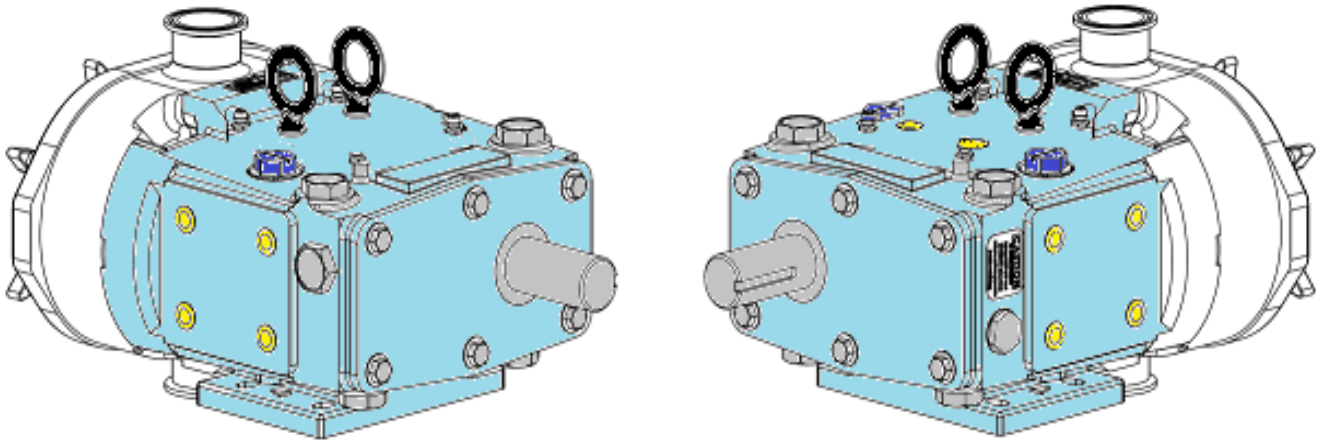


Figure 2 - Bottom Mount Left Hand and Bottom Mount Right Hand

ZD-U1 and Evolution Introduction

ZM Technologies ZD-U1 Model Operating Parameters

ZD-U1 Model	Maximum Nominal Displacement	Displacement per Revolution	Maximum Pressure	Maximum RPM	Standard Inlet/Outlet	Optional Inlet/Outlet	Temperature Range	
							Std. Rotors	Hot Rotors
006-U1	6 GPM (1.7 m³/hr.)	0.0082 GAL. (0.031 Liter)	200 PSI (13.8 bar)	800	1"	1-1/2"	-40° F (-40° C) to 200° F (93° C)	180° F (82° C) to 300° F (149° C)
015-U1	9 GPM (2.0 m³/hr.)	0.0142 GAL. (0.054 Liter)	200 PSI (13.8 bar)	700	1-1/2"	---		
018-U1	17 GPM (3.8 m³/hr.)	0.029 GAL. (0.110 Liter)	200 PSI (13.8 bar)	600	1-1/2"	2"		
030-U1	36 GPM (8.2 m³/hr.)	0.060 GAL. (0.227 Liter)	200 PSI (13.8 bar)	600	1-1/2"	2"		
060-U1	90 GPM (20.4 m³/hr.)	0.153 GAL. (0.579 Liter)	200 PSI (13.8 bar)	600	2-1/2"	3"		
130-U1	150 GPM (34.1 m³/hr.)	0.254 GAL. (0.961 Liter)	200 PSI (13.8 bar)	600	3"	---		
220-U1	310 GPM (70.4 m³/hr.)	0.522 GAL. (1.976 Liter)	200 PSI (13.8 bar)	600	4"	---		
320-U1	450 GPM (102 m³/hr.)	0.754 GAL (2.854 Liter)	200 PSI (13.8 bar)	600	6"	---		
323P-U1	450 GPM (102 m³/hr.)	0.754 GAL (2.854 Liter)	200 PSI (13.8 bar)	600	6"	---		

ZM Technologies ZD-E Evolution Pump Operating Parameters

ZD-E Model	Maximum Nominal Displacement	Displacement per Revolution	Maximum Pressure	Maximum RPM	Standard Inlet/Outlet	Optional Inlet/Outlet	Temperature Range	
							Std. Rotors	Hot Rotors
006-E	7 GPM (1.6 m³/hr.)	0.0082 GAL. (0.031 Liter)	300 PSI (20.7 bar)	800	1"	1-1/2"	-40° F (-40° C) to 200° F (93° C)	180° F (82° C) to 300° F (149° C)
015-E	10 GPM (2.3 m³/hr.)	0.0142 GAL. (0.054 Liter)	250 PSI (17.2 bar)	700	1-1/2"	---		
018-E	17 GPM (3.8 m³/hr.)	0.029 GAL. (0.110 Liter)	200 PSI (13.8 bar)	600	1-1/2"	2"		
030-E	36 GPM (8.2 m³/hr.)	0.060 GAL. (0.227 Liter)	250 PSI (17.2 bar)	600	1-1/2"	2"		
045-E	58 GPM (13.2 m³/hr.)	0.098 Gal. (0.371 Liter)	450 PSI (31.0 bar)	600	2"	2-1/2"		
060-E	90 GPM (20.4 m³/hr.)	0.153 GAL. (0.579 Liter)	300 PSI (20.7 bar)	600	2-1/2"	3"		
130-E	150 GPM (34.1 m³/hr.)	0.254 GAL. (0.961 Liter)	200 PSI (13.8 bar)	600	3"	---		
180-E	230 GPM (52.2 m³/hr.)	0.380 Gal. (1.438 Liter)	450 PSI (31.0 bar)	600	3"	4"		
220-E	310 GPM (70.4 m³/hr.)	0.522 GAL. (1.976 Liter)	300 PSI (20.7 bar)	600	4"	---		
210-E	300 GPM (68.1 m³/hr.)	0.502 Gal. (1.900 Liter)	300 PSI (20.7 bar)	600	4"	---		
320-E	450 GPM (102 m³/hr.)	0.754 GAL (2.854 Liter)	250 PSI (17.2 bar)	600	6"	---		
323P-E	450 GPM (102 m³/hr.)	0.754 GAL (2.854 Liter)	250 PSI (17.2 bar)	600	6"	---		
380-E	660 GPM (150 m³/hr.)	1.10 GAL (4.164 Liter)	250 PSI (17.2 bar)	600	6"	---		

ZM Technologies ZD-U1 Rectangle Flange Model Operating Parameters

ZD-U1 Model	Maximum Nominal Displacement	Displacement per Revolution	Maximum Pressure	Maximum RPM	Rectangle Inlet (W x L)	Optional Outlet	Temperature Range	
							Std. Rotors	Hot Rotors
034-U1	24 GPM (5.5 m³/hr.)	0.060 GAL. (0.227 Liter)	200 PSI (13.8 bar)	400	1.75 x 6.75	2"	-40° F (-40° C) to 200° F (93° C)	180° F (82° C) to 300° F (149° C)
064-U1	60 GPM (13.6 m³/hr.)	0.153 GAL. (0.579 Liter)	200 PSI (13.8 bar)	400	2.24 x 8.82	2-1/2" (3")		
134-U1	100 GPM (22.7 m³/hr.)	0.254 GAL. (0.961 Liter)	150 PSI (10.3 bar)	400	2.97 x 9.25	3"		
224-U1	200 GPM (45.4 m³/hr.)	0.522 GAL. (1.976 Liter)	300 PSI (20.7 bar)	400	3.87 x 11	4"		
324-U1	300 GPM (68.1 m³/hr.)	0.754 GAL (2.854 Liter)	300 PSI (20.7 bar)	400	5 x 17.38	6"		

ZM Technologies ZD-E Rectangle Flange Model Operating Parameters

ZD-U1 Model	Maximum Nominal Displacement	Displacement per Revolution	Maximum Pressure	Maximum RPM	Rectangle Inlet (W x L)	Optional Outlet	Temperature Range	
							Std. Rotors	Hot Rotors
034-E	24 GPM (5.5 m³/hr.)	0.060 GAL. (0.227 Liter)	200 PSI (13.8 bar)	400	1.75 x 6.75	2"	-40° F (-40° C) to 200° F (93° C)	180° F (82° C) to 300° F (149° C)
064-E	60 GPM (13.6 m³/hr.)	0.153 GAL. (0.579 Liter)	200 PSI (13.8 bar)	400	2.24 x 8.82	2-1/2" (3")		
134-E	100 GPM (22.7 m³/hr.)	0.254 GAL. (0.961 Liter)	150 PSI (10.3 bar)	400	2.97 x 9.25	3"		
184-E	152 gpm (34.5 m3/hr.)	0.380 Gal. (1.438 Liter)	450 psi (31.0 bar)	400	3.28 x 11.25	3"		
224-E	208 gpm (47.2 m3/hr.)	0.522 GAL. (1.976 Liter)	350 PSI (23.8 bar)	400	3.87 x 11	4"		
214-E	200 GPM (45.4 m3/hr.)	0.502 Gal. (1.900 Liter)	500 psi (34.5bar)	400	3.45 x 12.70	4"		
324-E	300 GPM (68.1 m³/hr.)	0.754 GAL (2.854 Liter)	350 PSI (23.8 bar)	400	5 x 17.38	6"		

Contact ZMT, Inc. Application Engineering for higher pressures or higher temperature applications.

NOTE: "Standard" clearance rotors may be used with liquid temperatures up to 200°F (93°C). However, between 180°-200°F (82°-93°C), consider other application factors such as:

- differential pressure
- speed of operation
- temperature of CIP or cleaning fluids
- lubricating properties of liquid being pumped.

If these factors trend toward a difficult application (high speed, high pressure, non-lubricating) then larger "Front Face" clearances and/or "Hot" rotor clearances are recommended.

ZD - U1 and Evolution Pump Remanufacturing Program

ZM Technologies ZD-U1 pumps are designed to sustain factory remanufacturing four times or more and a new warranty provided each time. The Evolution pumps are designed to sustain factory remanufacturing two or more times and a new warranty provided each time.

Our factory remanufacturing of the ZD-U1 and Evolution pumps include replacement of all shafts, oil seals, gears, bearings, etc. The body and cover of the pump are re-machined and new oversized rotors are placed. The pump is then stamped with a 3-digit code after the serial number indicating the reconditioned status of the body cover and rotor.

Please contact a ZM Technologies Service Representative at 209-547-1965 and furnish the pump serial number of the pump being considered for the remanufacturing process.

Install Pump and Piping System

Install the pump and piping system in accordance with local manufacturer's instructions, codes, and restrictions. The information and guidance provided in this manual are recommended for your equipment's optimum performance.

All pump system equipment, such as sheaves, motors, drive couplings, speed reducers, etc., must be properly sized and installed to ensure optimum and satisfactory operation of your ZD-U1 and Evolution pump within normal limits.

CAUTION: The U1 and Evolution pumps are a positive displacement with limited slip design and can be severely damaged if operated under conditions of a closed valve in the discharge or inlet lines. Should this occur, the warranty is not valid for any damages caused by error of a hydraulic overload from operating or starting the pump with a closed valve in the system.

Install Pump and Drive Unit

WARNING: You must install the full guards in order to isolate operators and maintenance personnel from the pump's rotating components. The guard system is provided with every U1 and Evolution complete pump and drive package.

In a typical configuration for installation the pump and drive kit is mounted on a common base plate. The unit can be installed in any of the following configurations depicted in the figures on page 13.

Base Arrangement

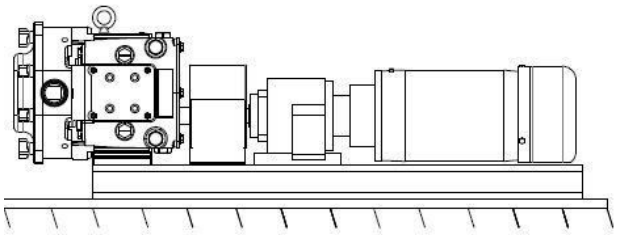


Figure 3 – Permanent Installation

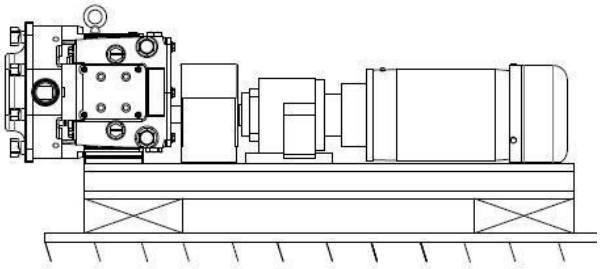


Figure 3a - Leveling/Isolation Pads

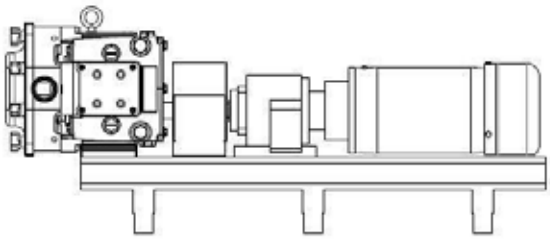


Figure 4 - Adjustable Legs

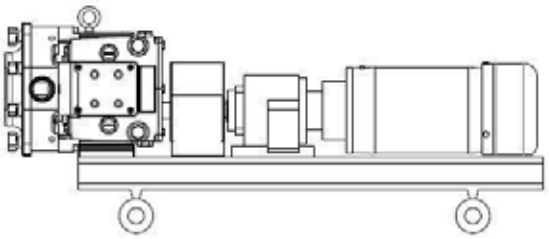


Figure 4a - Portable Wheels

Piping and Connections

Piping Support

To prevent misalignment of the pump parts and excessive wear on rotors, bearings, and shafts, it is imperative to minimize forces exerted on the pump. To accomplish that all pump piping must be supported independently with hangers and/or pedestals. **DO NOT** rely upon the pump to support the piping. This will cause the pump to "wear out" prematurely.

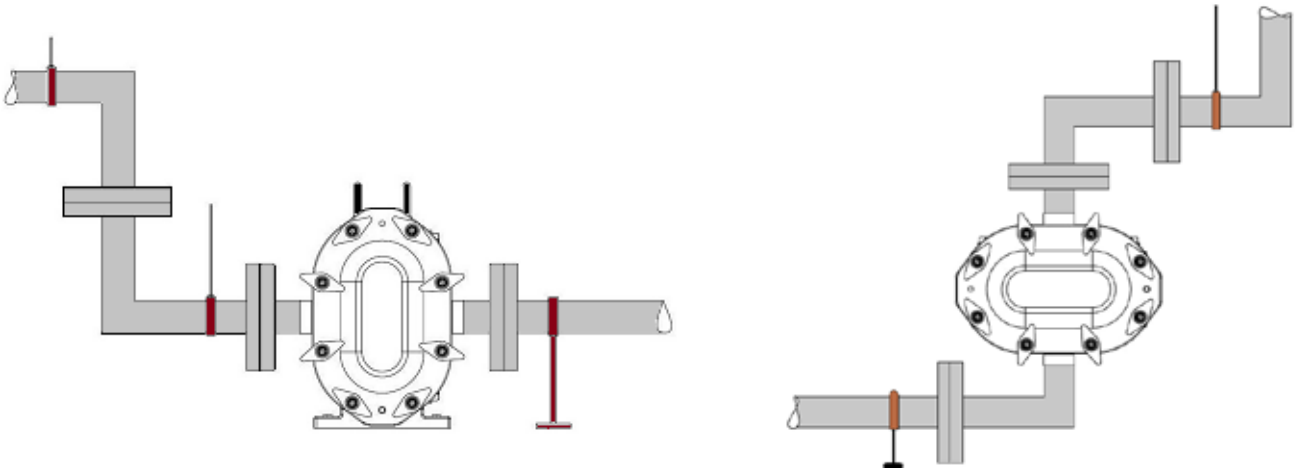


Figure 5 - Example Piping Support

Expansion Joints

Heat (aka thermal expansion) of piping can cause incredible forces. It is important to utilize thermal expansion joints to minimize force and damage to the pump.

Flexible joints are also valuable in limiting the transmission of mechanical vibrations during system operation. Ensure installation of free ends of the flexible joints and connections are anchored properly.

Inlet Piping

To prevent air or flooding in the system, install the pump below the supply liquid level.

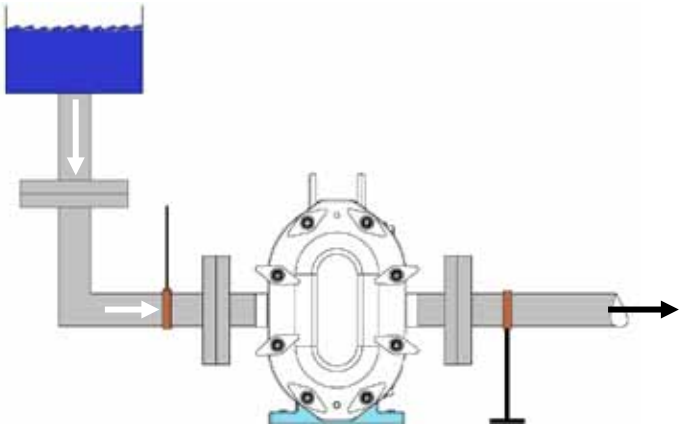


Figure 6 - Pump Below Supply

If the equipment is installed above the supply liquid level, the piping on the inlet side must have a slope towards the pump, preventing unnecessary air pockets in the pipes.

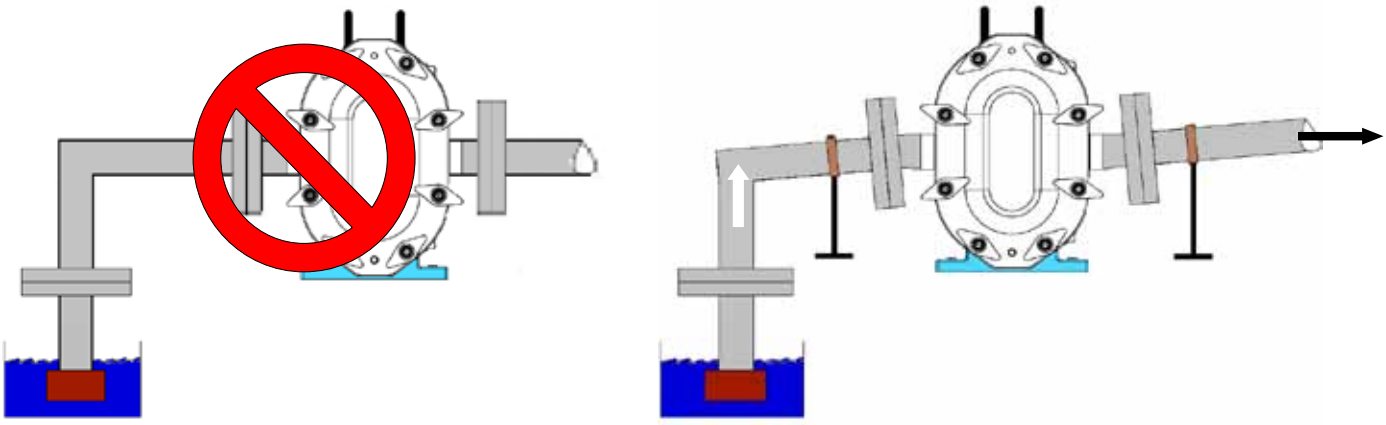


Figure 7 - Correct Piping to Prevent Inlet Air Pockets

Install Check Valves

A check valve is necessary when the equipment is lifted. Install a check valve on the inlet side of the pump, Figure 8.

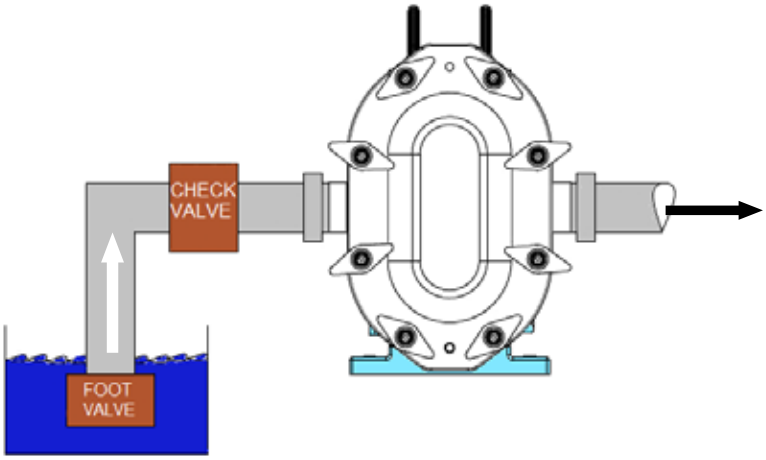


Figure 8 - Inlet Check Valve

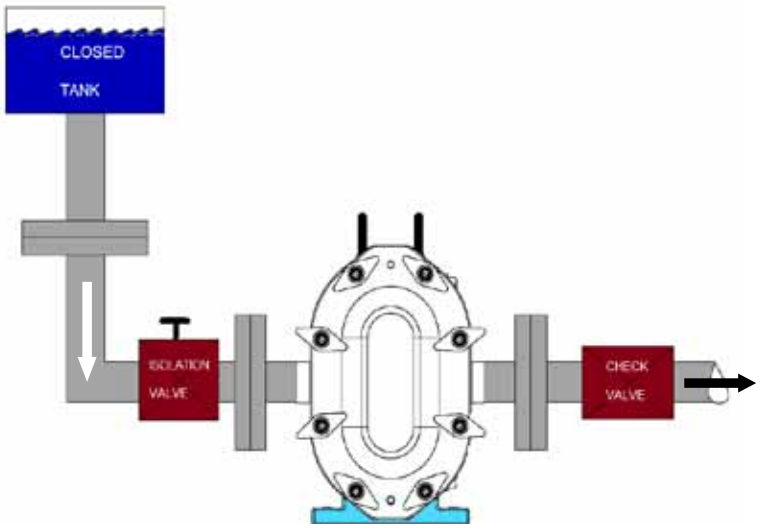


Figure 9 - Discharge and Isolation Valves

Install Discharge Side Check Valve

If the system is closed or under a vacuum, it is important to install a check valve on the discharge side of the pump. This will prevent backflow problems for the equipment and assists in providing the assistance in the initial start by minimizing the required differential pressure supplied by the pump to start the flow, Figure 9.

Install Isolation Valves

Isolation valves are valuable and permit pump maintenance and safe removal of the equipment without draining the system, Figure 9.

Install Relief/Bypass Valves

Relief valve or a Bypass valve protects the pump from excessive pressure. We recommend the installation of an external relief valve to reduce pressure on the system, Figure 10 and Figure 11.

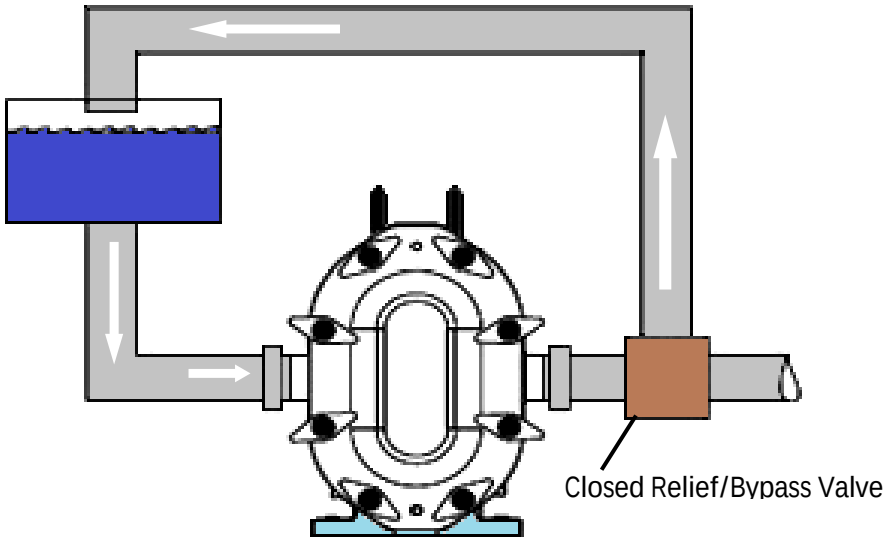


Figure 10–Relief/Bypass Valve to a Closed Tank

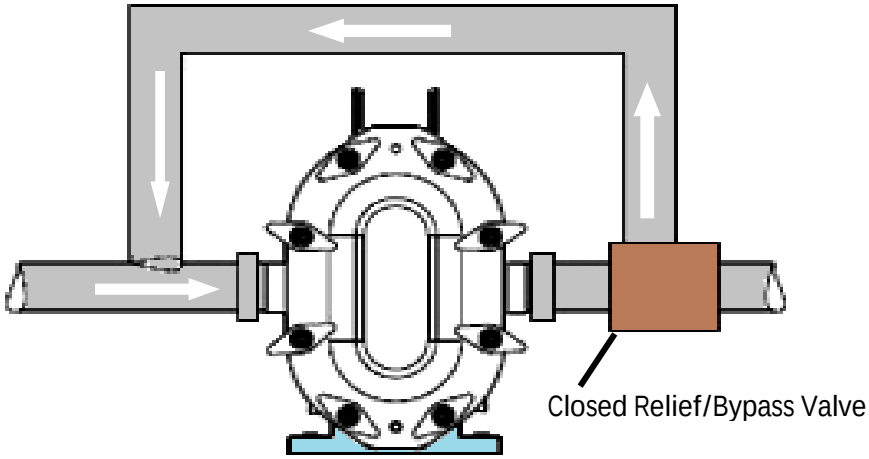


Figure 11 - Relief/Bypass Valve to Pump Inlet

CAUTION: The ZMT ZD-U1 and Evolution pumps are manufactured to extremely tight clearances. The result is a low slip between rotors and pump body. These are positive displacement pumps and must **NOT** be operated with closed discharge valve. **DAMAGE** or **HARM** will occur if the pump is operated with a closed outlet valve or inlet valve.
NOTE: Operating a pump in bypass mode for a long period time will cause pumped product to overheat. If a relief/bypass valve is only partially open, pumped product may overheat causing pump or seal **DAMAG**E, if this is the case a bypass to discharge externally should be considered.

Inlet Side Strainers, Traps and Gauges

Strainers and traps should be installed and used to prevent any foreign substances from entering the pump. It is important to service and clean strainers and traps on a regular maintenance schedule to prevent restriction of flow. In order to determine quality control of the pump, install vacuum and pressure gauges on your inlet and discharge piping system, Figure 12.

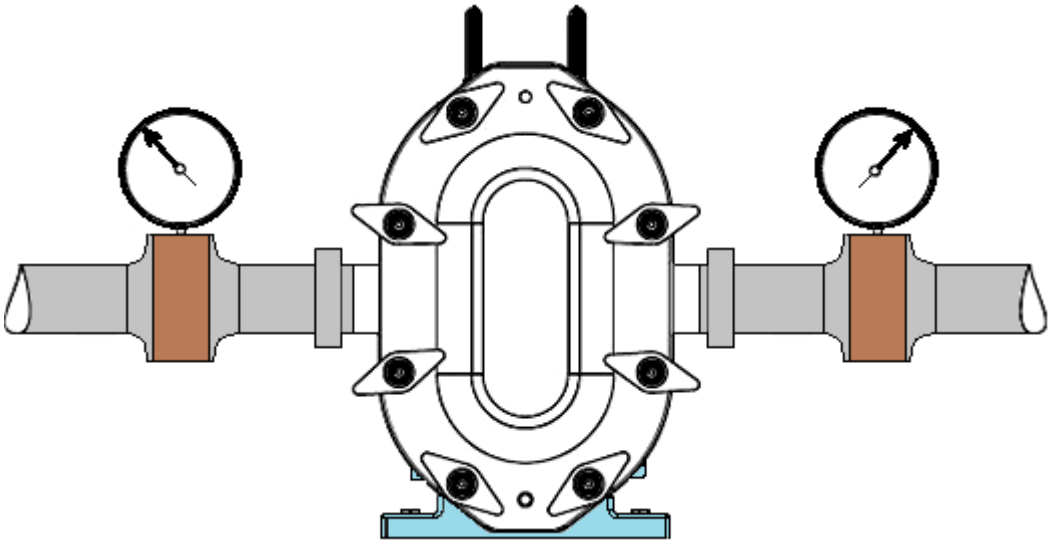


Figure 12 - Proper Gauging

Using pressure and vacuum gauges are useful in providing information about pump performance and operation.

Using gauges properly or proper instrumentation provides the following information:

- Normal pressures, pressure variations, abnormal pressures.
- Indicates pump is operating.
- Changes in pump performance.
- Changes that may have occurred to the system.
- Product viscosity changes.

Check Coupling Alignment

Pumps and bases are aligned directly from the manufacturer prior to shipment. Alignment is crucial and must be checked prior to initial operation and as routine maintenance. Misalignment of equipment can cause unnecessary damage and wear, reducing the life of the pump. ZM Technologies recommends a flexible coupling to allow reasonable end play and small differences in alignment.

Check Vertical Angular Alignment

To check the coupling alignment start by first checking the vertical angular alignment by measuring the gaps between couplings on the pump and motor side. (Figure 8) The gap must be equal at all points. Shims may be required to complete alignment. You can shim the equipment to reach proper distances recommended by the manufacturer.

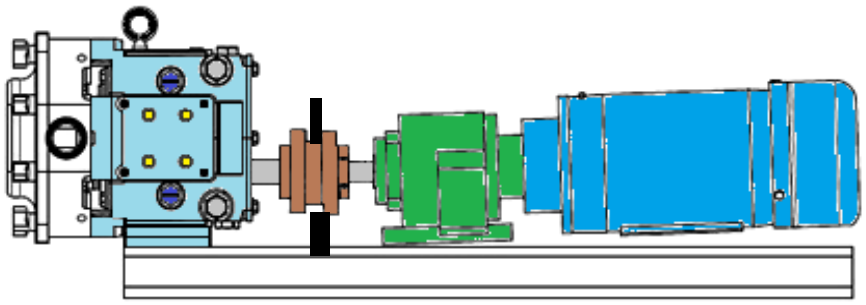


Figure 13 - Vertical Angular Alignment

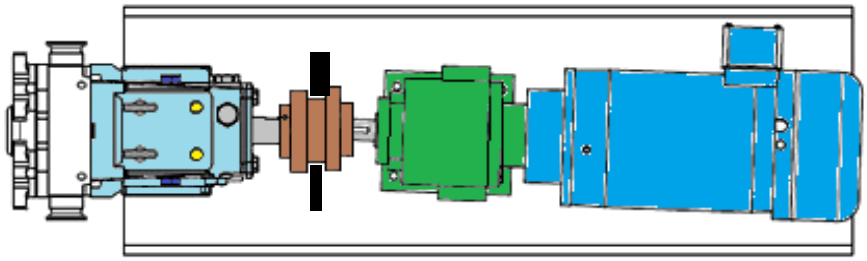


Figure 14 - Horizontal Angular Alignment

Steps to Vertical Angular Alignment

I. Using feeler gauges, or taper gauges, check the alignment at all four points, (every 90 degrees) around the coupling. Adjust as necessary to accomplish equal dimension at all points.

II. Set the space in between the coupling halves to the manufacturer's recommended distance.

III. Install any necessary shims to bring the system into recommended alignment.

Check Vertical Parallel Alignment

Next check the parallel alignment of the equipment. Using a straight edge, check vertical and horizontal alignment of the coupling. In order to verify both sides are concentric, place the straight edge along the coupling, Figures 15 & 16, then use a feeler gauge or taper gauge between straight edge and coupling to determine amount of parallel movement.

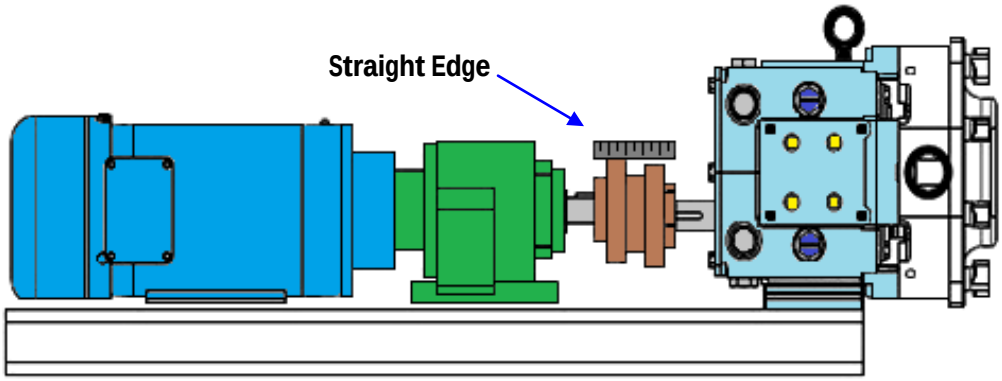


Figure 15 - Parallel Vertical Alignment

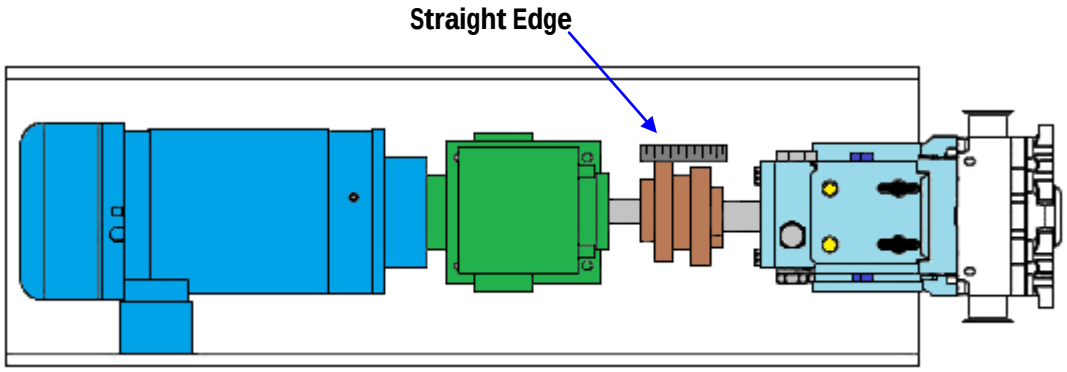


Figure 16 - Parallel Horizontal Alignment

Align the pump drive shaft as closely as possible to the gearbox drive shaft. If base, motor, gearbox, and pump are purchased from the factory, the pump and gearbox are aligned at the factory before shipping.
Re-check all alignment after installation and before starting up your equipment. It also is imperative you re-check alignment periodically during scheduled routine maintenance in order to maximize the life of your equipment.

Steps to Parallel Alignment

I. Check the horizontal and vertical alignment of the pump and drive system using a straight edge.
II. Use a feeler gauge to determine the direction and movement needed on the equipment.
III. If necessary, align with shims or move drive as needed.

Check Belt and Chain Drive Alignment

Use a straight edge along belt sheaves to visually check the belt and/or chain alignment. It is important to keep the shaft distance to a minimum. After the piping is complete and before the belts are installed, manually rotate the pump shaft to ensure it turns freely.

Check Pump Rotation

Check the direction of the drive unit rotation to determine the rotation direction of the pump, Figures 17 & 18. Once the correct drive rotation has been determined and verified, connect the coupling; assemble the pump and the coupling guards. NEVER operate the pump without the guards in place. This can be hazardous.

NOTE: Covers are shown removed for demonstration purposes only. **NEVER** operate the pump with the covers removed. Always keep fingers from rotors during rotation.

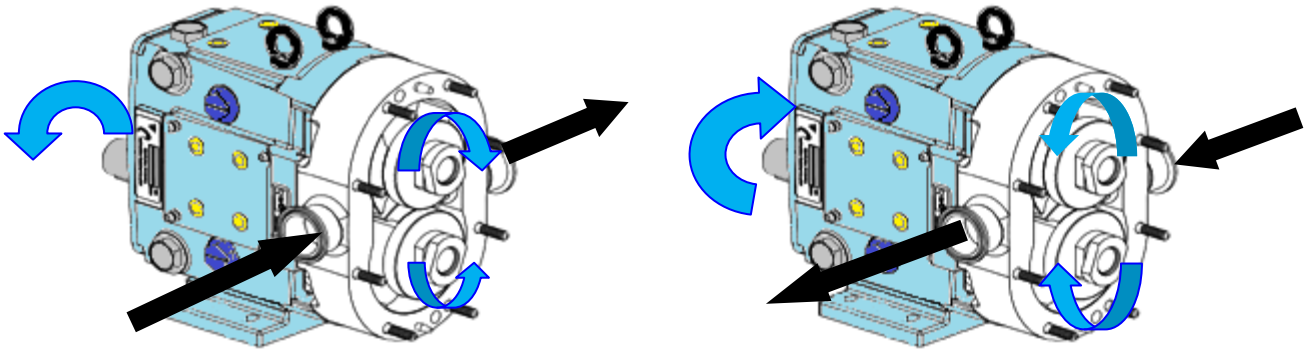


Figure 17 - Lower Drive Shaft

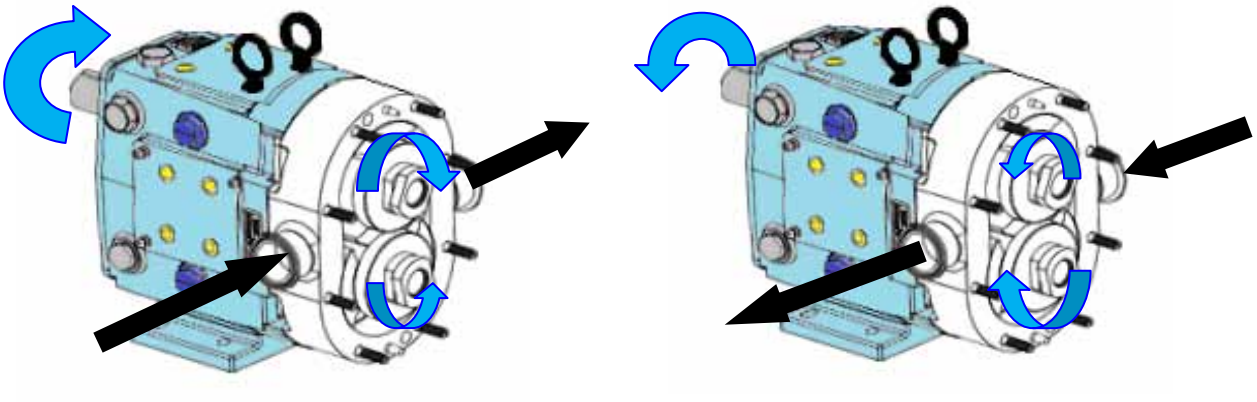


Figure 18 - Upper Drive Shaft

DANGER: The machinery contains internal moving parts. DO NOT place hands, fingers or loose objects into the pump body ports or drive mechanism at any time during the operation! To avoid serious injury DO NOT install, service or clean the equipment without all power off and locked out.

NOTE: Before detaching any port connections, make sure the following is done:

- ü Close suction and discharge valves.
- ü Drain the pump of all liquid and clean or rinse.
- ü Shut off, disconnect or lock out all electrical power to the pump.

Pump Lubrication

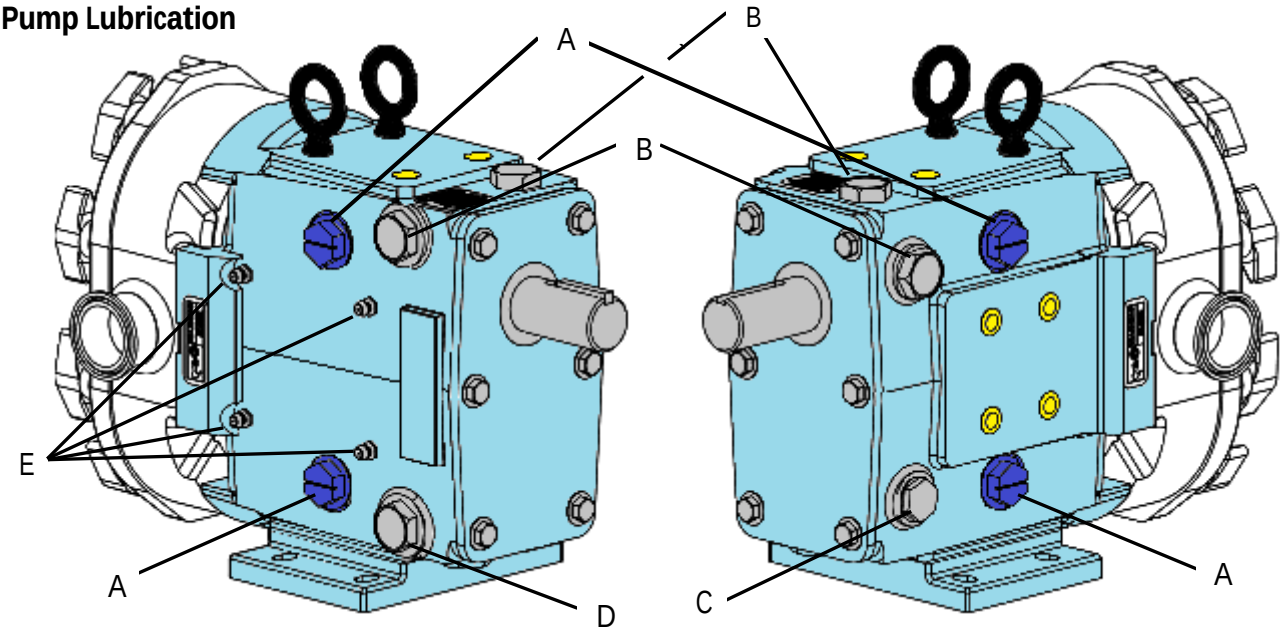


Figure 19 - Lubrication Points

	Part	Qty
A	Clean-Out Plugs	4
B	Oil Fill Plug	4
C	Sight Glass	1
D	Oil Drain Plug	1
E	Grease Fittings	4

Gears and Bearings

All gears and bearings in the U1 and Evolution pump are factory-lubricated with the appropriate grease and oil. The oil used to lubricate the gears should be changed every 500 hours of use. The bearings should be re-greased every 250 hours of use. Be careful not to over oil or grease parts. This can cause a build up inside the gear casing. The gear casing should be cleaned through the port of the clean-out plugs shown in Figure 19. See following table for oil capacity.

Gear Oil Specifications:
ISO Grade 320, SAE 140 or AGMA Number 6EP

Bearing Grease Specifications:
NLGI Grade No. 2, Halo-Guard FG-2, NSF H1 FOOD-GRADE,

Lubrication Quantity Table

ZD-U1 & Evolution	Gear Oil Capacity		Grease per Bearing	
	Upper or Lower Mount	Side Mount	Front	Rear
006, 015, 018	1.3 oz. (40 ml)	3.3 oz. (100 ml)	0.37 oz. (11 cc)	0.13 oz. (4 cc)
030, 034	2.0 oz. (60 ml)	4.0 oz. (120 ml)	0.60 oz. (18 cc)	0.21 oz. (6 cc)
045, 060, 064, 130, 134	6.0 oz. (170 ml)	9.5 oz. (280 ml)	0.84 oz. (25 cc)	0.76 oz. (22 cc)
180, 220, 224	11 oz. (320 ml)	20 oz. (600 ml)	1.33 oz. (39 cc)	1.03 oz. (30 cc)
210, 320, 323, 380	17 oz. (500 ml)	44 oz. (1300 ml)	1.96 oz. (58 cc)	1.16 oz. (34 cc)

Preventative Maintenance Inspections

DANGER: The U1 and Evolution pump contains moving parts! **DO NOT** put hands, fingers or materials into the pumps body or drive areas at any time while the pump is in operation! For your safety, **DO NOT** install, service, clean or repair the equipment unless all power has been disconnected and locked out. This will avoid serious injuring from occurring.

Being vigilant to detect wear in the early stages of your equipment can ultimately reduce costs and down time. A brief look and feeler gauge inspection of the pump during cleaning and breakdown is highly recommended to detect signs early of wear and tear. It is recommended that a detailed maintenance inspection be scheduled and performed on a regular basis.

Inspection of Rotor Tips

Remove the pump cover **AFTER** disconnection of power and lock out. Check for metal-to-metal contact between the rotor wings and body, and rotor and cover. If contact is detected, repair or replace the equipment. Visually inspect the rotors for rotor to rotor tip (A) and rotor tip to rotor hub (B) contact issues. Manually rotate the drive shaft to ensure the rotor tip clearance is equally balanced on both sides.

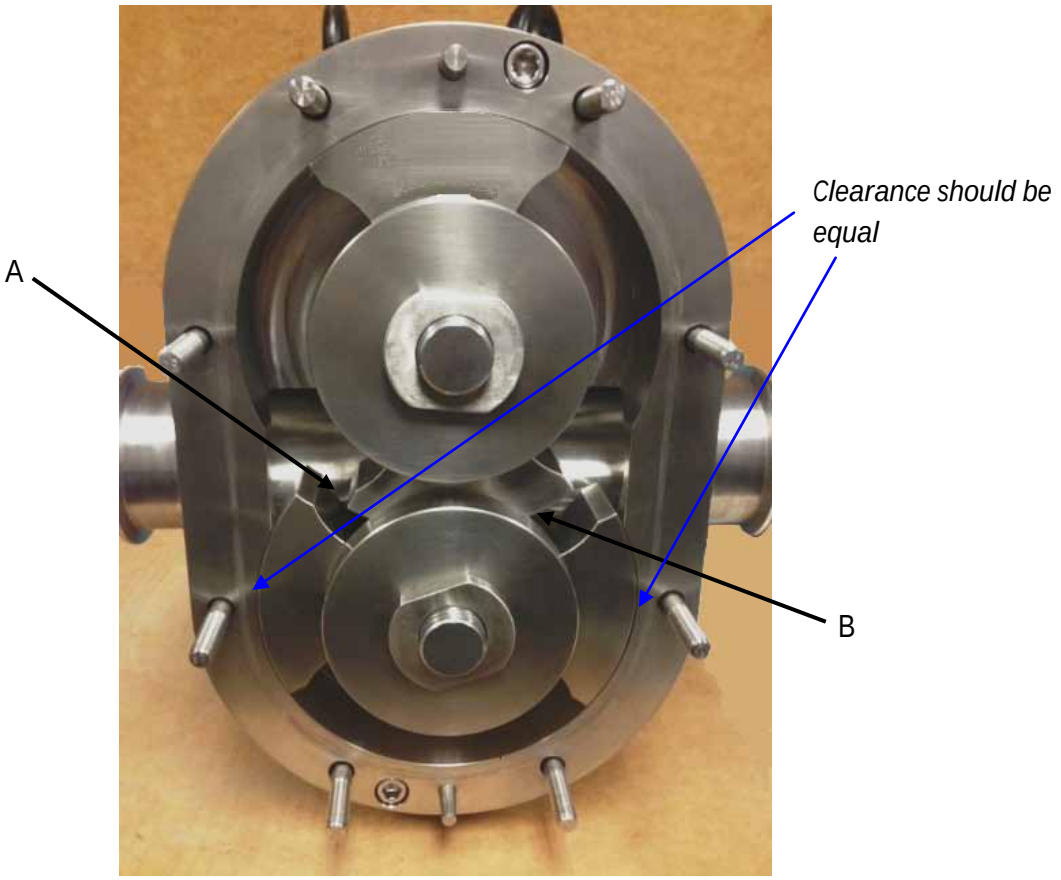


Figure 20 - Rotor to Rotor Tip Clearance

Inspection of Shaft and Shaft Shoulder

Shoulder and Spline

Inspect the shaft visually looking for any twisting or bending. Replace it if necessary. If you discover a sharp edge on the shaft shoulder, remove it gently with a file to prevent cutting the shaft o-ring when installing. Shaft splines should be inspected for wear or grooving.

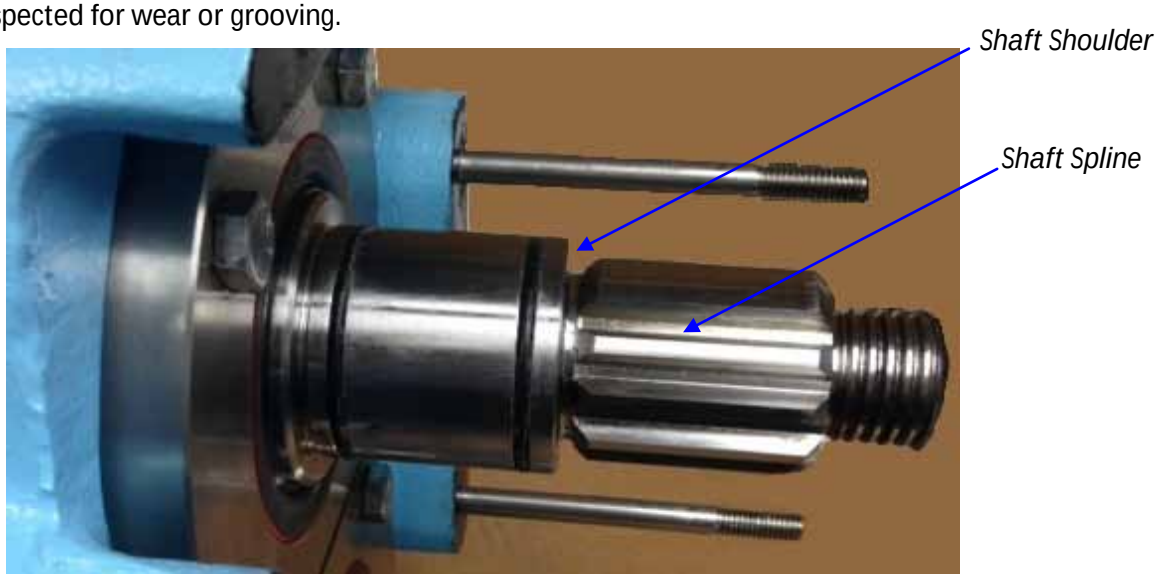
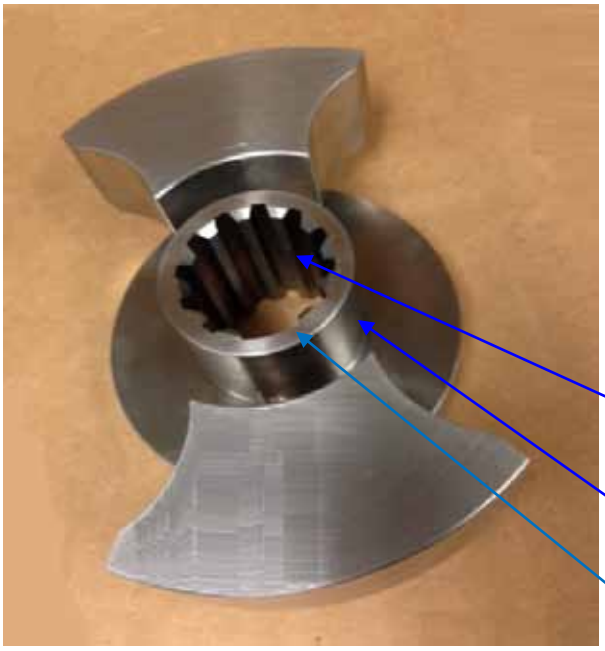


Figure 21 - Shaft Inspection Points



Inspection of Rotor Hub End

Inspect the rotor hub end visually for any excessive wear. Replace it if necessary. For Evolution rotors, each time rotors are removed, it is highly recommended the o-rings on the hub be replaced.

NOTE: Wear of the rotor hub, shaft shoulder, and/or shaft splines is caused by operating equipment with loose rotor nut(s) for extended periods of time.

Figure 22 - Rotor Inspection Points

Inspection of Gears and Bearings

Gear Backlash

Remove the body and seals to expose the gearbox only, use your hand to rotate a shaft and feel for gear backlash. Make sure the other shaft engages immediately. Perform this three times at 60-degree angle intervals. If backlash (play) is obvious, remove the gearbox cover, check gear teeth for wear, and make certain the gear is not loose on the shaft. If the gear teeth are worn, you must replace the gears before continuing use. If the gear is loose on the shaft, visually inspect the shaft key and keyway; if necessary, replace.

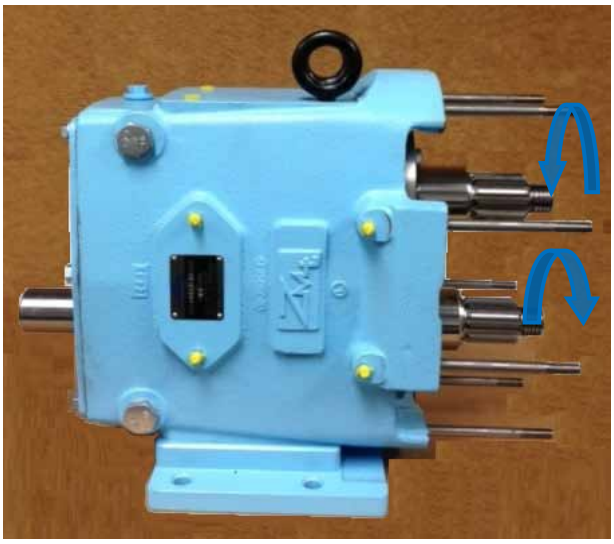


Figure 23 - Check Gear Backlash Movement

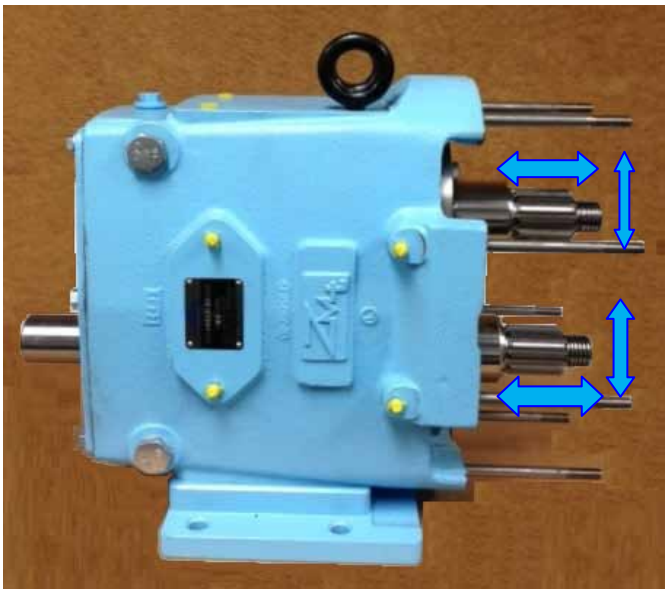


Figure 24 - Check Bearing Movement

Check Condition of Bearings

Check bearing deflection by applying force in an upward and downward motion with a hand on each shaft. Use a dial indicator on the top of the shaft to measure vertical shaft movement. If after applying a minimum of 30 lbs. (14 kg) of force, a reading of .002" (0.07 mm) or more is indicated, the gearbox and bearings need to be inspected. Either the bearing journal or the bearing may be failing.
Check bearing end play by horizontally pushing and pulling on the shaft. Use a dial indicator on the end of the shaft to measure horizontal shaft movement. After the shaft has been pushed one direction, apply a minimum of 30 lbs. (14 kg) of force to pull the shaft in the opposite direction, if a reading of .002" (0.06 mm) or more is indicated, the gearbox and bearings need to be inspected. The bearing or the front bearing retainer may be failing.

Annual Maintenance

It is imperative you perform an annual maintenance of the pump in addition to your regularly scheduled preventative maintenance. Annual maintenance should consist of the following:

- ü By using a dial indicator, check all the gearbox bearings by measuring the shaft's radial movement. If there is significant movement, T.I.R. should not exceed .004,the bearings should be replaced.
- ü Remove the gearbox cover and visually inspect the gears for damage and/or wear. Also, make sure to check for looseness or backlash. Re-torque the gear retaining nut, see Torque Table page 50.
- ü Inspect rotors for wear on the splines, hub wear, signs of pitting, stress cracks and unusual wear.
- ü Check pump clearances to determine unusual wear patterns. Pumps can compensate by increased wear by increasing the pump speed (RPM), see Rotor Clearance Table page 52.

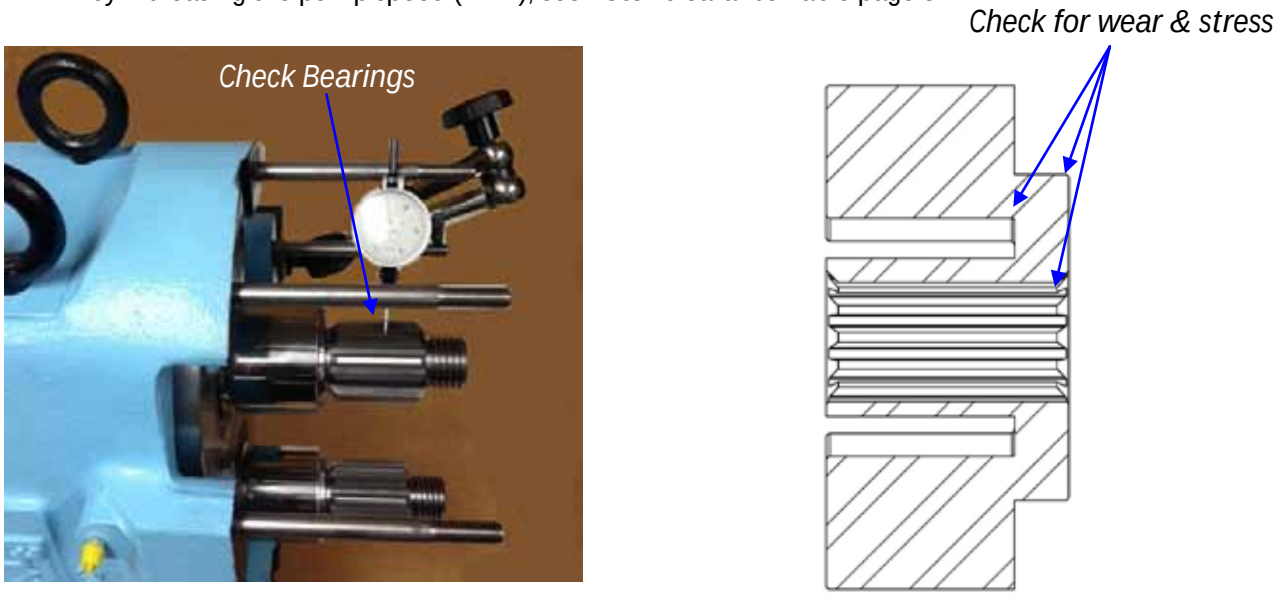


Figure 25 - Annual Maintenance Checks

Cleaning

The ZD-U1 pump is designed for Clean Out of Place (COP), the Evolution pump is designed for Clean in Place (CIP) practices. All parts wetted are designed and manufactured to be acceptable to 3-A Sanitary Standards.

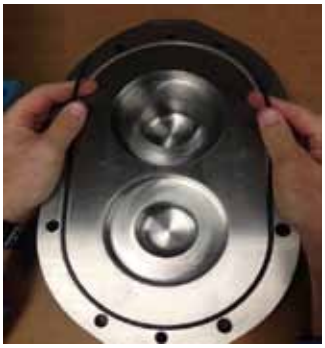
The ZD-U1 and Evolution pump body, rotors and seals can be easily disassembled and cleaned by removing the cover and rotor nuts from the pump. Follow standard safety practices when cleaning.

NOTE: *Do not use abrasive tools or chemicals for cleaning. It can physically damage the Alloy W88 metal* and seal parts. Do not expose pump parts to harsh acid for longer than necessary. Rinse each part to remove residue before reassembling for use. Store them to allow for free draining and air drying. Cleaning chemicals can be harmful; take necessary precautions to prevent harm to yourself or others.

Pump Disassembly

DANGER: The U1 and Evolution pump contains moving parts! **DO NOT** put hands, fingers or materials into the pumps body or drive areas at any time while the pump is in operation! For your safety, **DO NOT** install, service, clean or repair the equipment unless all power has been disconnected and locked out. This will avoid serious injuring from occurring.
NOTE: Close inlet and outlet valves before disassembling pump. Drain pump completely before cover is removed.

1. Remove the sanitary nuts or cover wing nuts from the cover, use a socket or tap softly with a soft hammer to loosen them (Figure 26).



2. Remove the pump cover. If stuck, loosen by tapping softly with a hammer. Remove and discard the cover o-ring. (Figure 27)

3. Place the pump cover on a protected surface with the pump cover finished surfaces facing up.

Figure 27 - Remove Cover O-Ring

4. Remove the rotor retaining nuts. Use the special wrench or socket supplied with the pump and sharply hit the handle with a soft hammer to loosen nuts (Figure 28).

Figure 28 - Remove Rotors Nuts

5. Move the rotors perpendicular to each other and remove the rotor with both wings exposed first. Be careful handling the rotors to avoid nicks, scratches or pitting. If your rotor is stuck, use a hardwood lever or gear puller if necessary to release the rotor hub and remove it from the shaft (Figure 29).

Figure 29 - Rotor Position

6. To remove the body off the pump, remove body retaining bolts , found on the front of the body face. Pull body straight off the studs. If the body is stuck, tap with a soft hammer to assist removal (Figure 30).

Figure 30 - Remove Body

7. See "Seal Maintenance" on page 35 for the seal disassembly instructions.

8. Clean the pump body and inspect it for any wear, gouging, grooves, or any other wear or damage issues.

CAUTION: The body, rotors, and cover must be reassembled on the gearbox with matching serial numbers stamped on the body and cover. **DO NOT** mix rotors and covers with other pumps.

W320, W323+, W324 Pump Disassembly

1. Remove the sanitary nuts or cover wing nuts from the cover, use a socket wrench or tap softly with a soft hammer to loosen them.

2. Remove the pump cover. If stuck, loosen by tapping softly with a hammer. Remove and discard the cover o-ring(s).

3. Remove the rotor retaining nuts, or remove the six 1/2" bolts (three per rotor).

4. Next, disconnect seal flush lines from the seal gland located near the rear of the body.

5. Remove a total of eight (four per gland) 3/8" bolts from the seal glands. Slide gland toward gearbox.

6. Remove the two body retaining bolts, found on the front of the body face. Pull body straight off the studs. If the body is stuck, tap with a soft hammer to assist removal.

7. Clean and inspect shafts. If a burr is found on a shaft, or as sharp edge on the shoulder of the shaft, use a fine file or emery cloth to remove burr or sharp edge. Failure to do this will cause damage to seal shaft o-rings during seal installation.

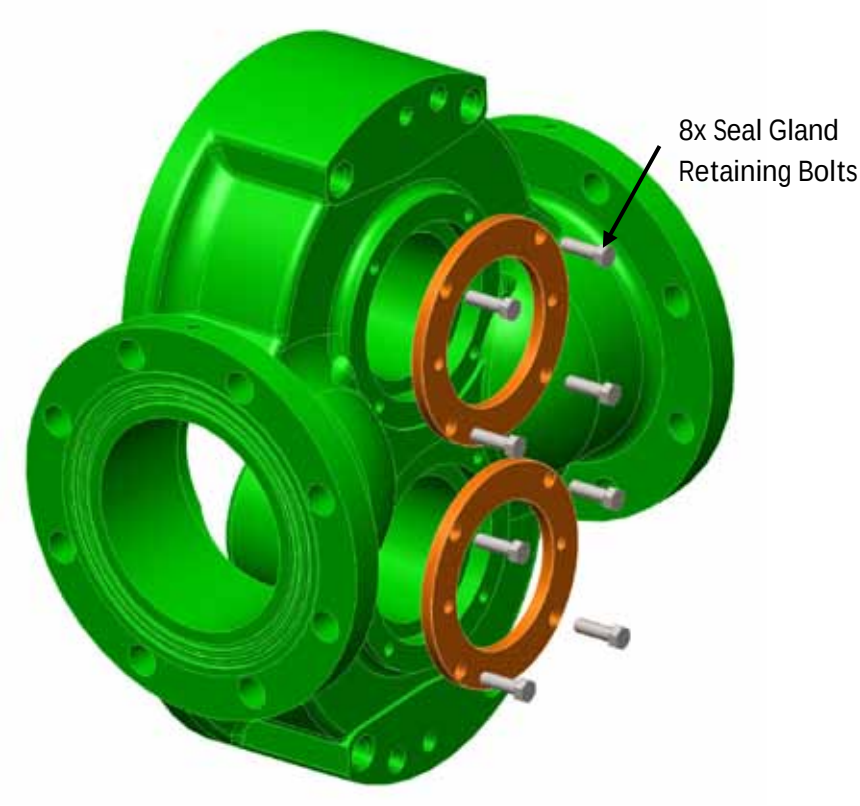


Figure 31 - Remove Retaining Nuts

ZD-U1 O-Ring Seal Maintenance

NOTE: Servicing the o-ring seals requires disassembly of the pump end first. See previous pages starting on page 32.

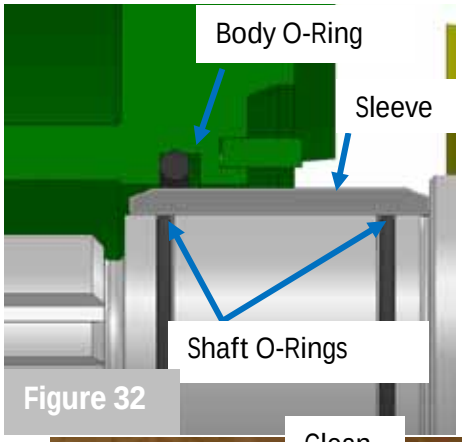


Figure 32

Single O-Ring Disassembly

1. Use the provided o-ring pick tool to remove the body o-ring.
2. Remove shaft sleeves and four (possibly two) shaft o-rings.
3. Clean and inspect the shafts, shaft and body grooves thoroughly. DO NOT re-use sleeves that are scratched or damaged. DO NOT re-located a groove on the sleeve under the body o-ring. Flip the sleeve so that the unused smooth surface of the sleeve is under the body o-ring, Figure 32.

Single O-Ring Assembly

1. Clean body and gearbox thoroughly removing rust or any product build-up on the body, Figure 33.
2. Clean both shafts and the four shaft grooves.
3. Lubricate the new shaft o-rings and place into shaft grooves.
4. Lubricate the new body o-rings and place into the grooves in the body.
5. Slide sleeves onto shaft. Take care to align shaft slots with drive pins located on shaft. figure 34.
6. Slide body onto studs. Observe when body o-ring engages sleeve. Take care so not to nick or damage body o-ring. See page 50 for pump-end assembly.

Figure 33


Figure 34

ZMT Slotted Sleeve is standard
Available in 316L & Zirconium

Double O-Ring Disassembly

1. Use the provided o-ring pick tool to remove the body o-ring.
2. Remove the o-ring carrier from the rear of the pump body.
3. Use the provided o-ring pick tool to remove the body o-ring fro the o-ring carrier and the outer o-ring in the o-ring carrier.
4. Remove shaft sleeves and four (possibly two) shaft o-rings, Figure 35.
5. Clean and inspect the shafts, shaft and body grooves thoroughly. DO NOT re-use sleeves that are scratched or damaged. DO NOT re-located a groove on the sleeve under the body o-ring. Flip the sleeve so that the unused smooth surface of the sleeve is under the body o-ring.

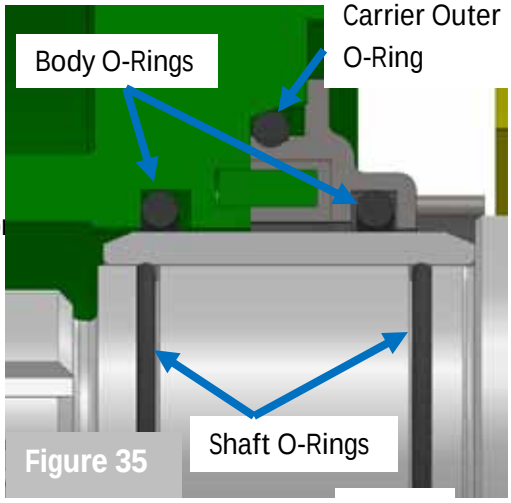


Figure 35

Double O-Ring Assembly

1. Clean body and gearbox thoroughly removing rust or any product build-up on the body, Figure 36.
2. Clean both shafts and the four shaft grooves.
3. Lubricate the new shaft o-rings and place into shaft grooves.
4. Lubricate the new body o-rings and place into the grooves in the body.
5. Place the outer o-ring carriers into the body. Align anti-rotation pin in body with the notch in the carrier.
6. Slide sleeves onto shaft. Take care to align shaft slots with drive pins located on shaft, Figure 37.
7. Slide body onto studs. Observe when body o-ring engages sleeve. Take care so not to nick or damage body o-ring. See page 50 for pump-end assembly.

Figure 36


Figure 37

ZD-U1 Single Seal Maintenance

NOTE: Servicing the mechanical seals requires disassembly of the pump end first. See previous pages starting on page 32.

Single Seal Disassembly

1. Remove inner seals from body. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.
2. Using o-ring pick, remove o-rings from pump body.
3. Remove rotary seal components from both shafts. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.
4. Use o-ring pick to remove o-ring from each shaft, Figure 38.
5. Clean grooves thoroughly, Inspect shafts and grooves for burrs, nicks, and sharp edges.

Single Seal Assembly

1. Lubricate new shaft o-rings and place in shaft groove closest to bearings.
2. Install rotary seal. Take care to align notch in back of rotary seal with shaft drive pin, Figure 39.
3. Lubricate new body o-rings and place into pump body.
4. Place the wave spring on the inner seal and place into pump body. Take care to slid inner seal into body o-ring while aligning inner seal notch with anti-rotation pin in body, Figure 40.
5. Place body onto studs and carefully slide body until seal faces contact.
6. See page 50 for pump end assembly.

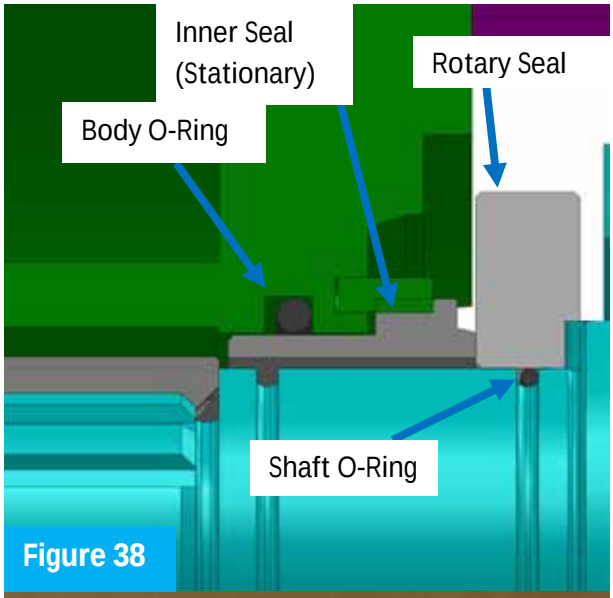


Figure 38

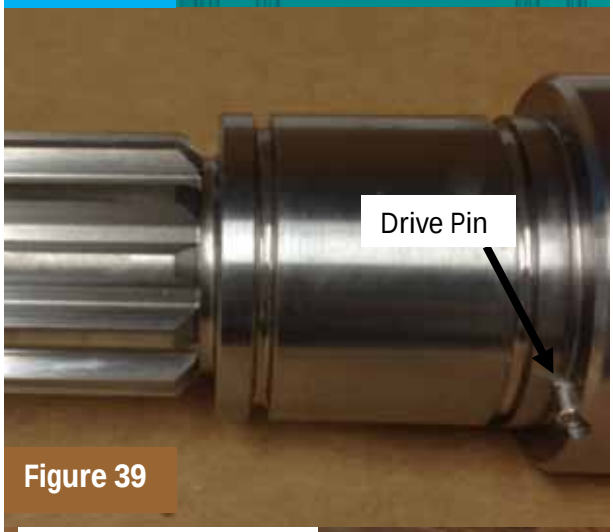


Figure 39

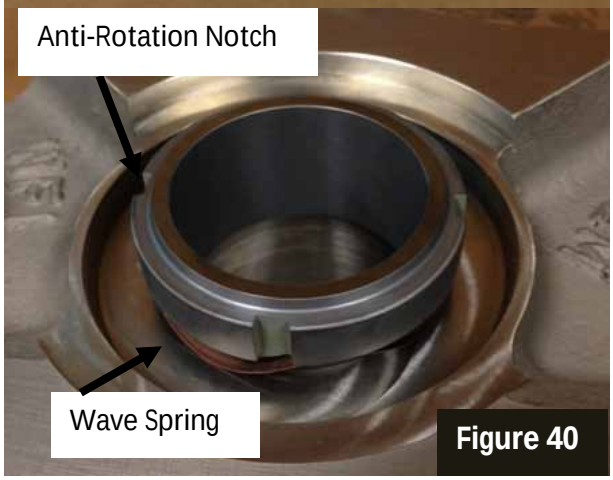


Figure 40

ZD-U1 Double Seal Maintenance

NOTE: Servicing the mechanical seals requires disassembly of the pump end first. See previous pages starting on page 32.

Double Seal Disassembly

1. Remove inner seals from body, Figure 41. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.
2. Using o-ring pick, remove o-rings from pump body.
3. Remove outer seal component from body.
4. Remove rotary seal components from both shafts. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.
5. Use o-ring pick to remove o-ring from each shaft.
6. Clean grooves thoroughly, Inspect shafts and grooves for burrs, nicks, and sharp edges.

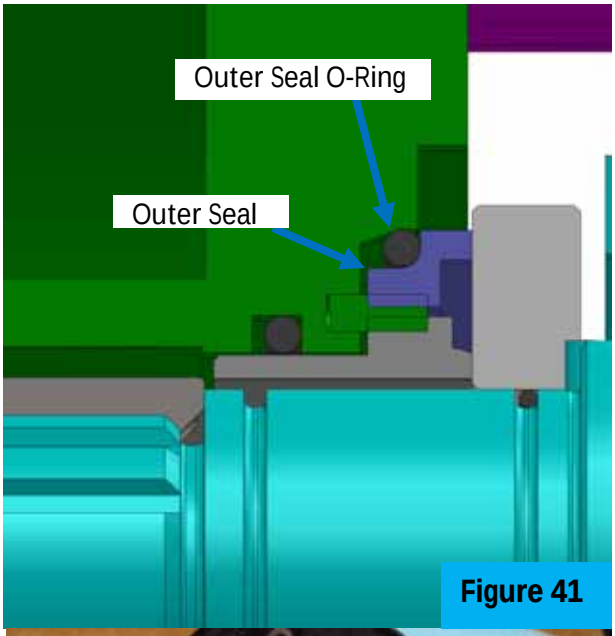


Figure 41

Double Seal Assembly

1. Lubricate new shaft o-rings and place in shaft groove closest to bearings.
2. Install rotary seal. Take care to align notch in back of rotary seal with shaft drive pin, Figure 42.
3. Lubricate new body o-rings and place into pump body.
4. Place the wave spring on the inner seal and place into pump body. Take care to slid inner seal into body o-ring while aligning inner seal notch with anti-rotation pin in body, Figure 43.
5. Lubricate outer seal o-ring. Place o-ring on outer seal. Place o-ring into body while aligning the notch with the anti-rotation pin.
6. Place body onto studs and carefully slide body until seal faces contact.
7. See page 50 for pump end assembly.

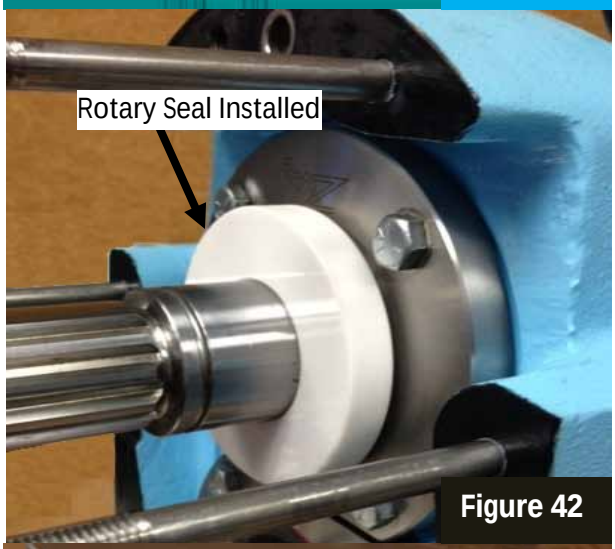


Figure 42

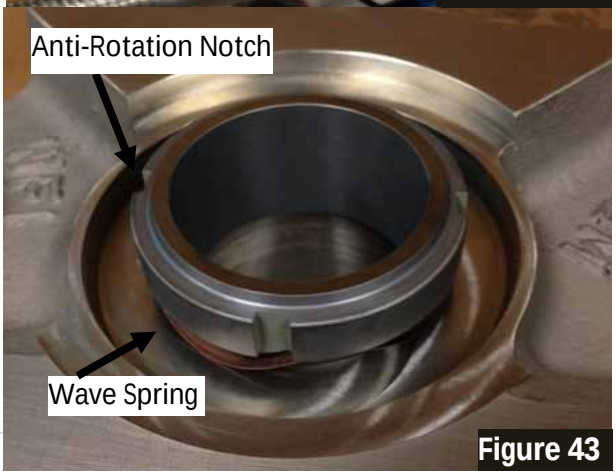


Figure 43

ZD-U1 W320 Single Seal Maintenance

NOTE: Servicing the mechanical seals requires disassembly of the pump end first. See previous pages starting on page 34.

Single Seal Disassembly. NOTE: The Inner or Outer Seal may be used as a single seal.

1. Clean shaft of all product on shafts and make sure shaft is free of all burrs and nicks. Loosen set screws from the inner seal and slide off shaft.
2. Slide seat off shaft. Take care not to touch seat ID on shaft, as this will cause the seat to chip. Remove gasket from seat and discard.
3. If outer seal is used, loosen set screws on outer seal and slide off shaft, Figure 44.
4. Remove inner seal face from retainer. Use provided o-ring pick to remove all o-rings. Discard all o-rings.

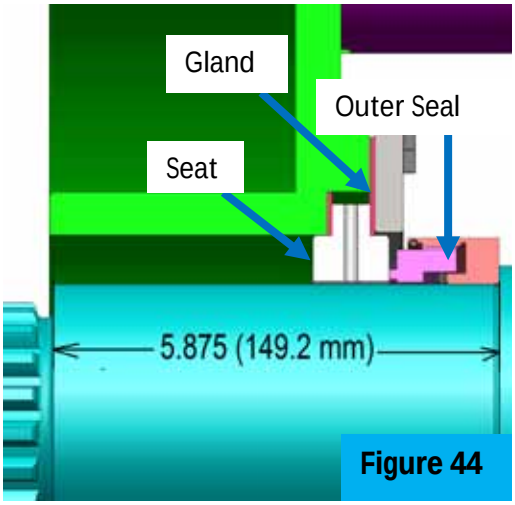


Figure 44

5. Thoroughly clean and inspect inner or outer seal retainers. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.

Single Seal Assembly

1. Using outer seal as a single seal, lubricate shaft, then slide outer seal on shaft, with seal face toward shaft splines, until seal reaches shaft shoulder or dimension shown, Figure 44. Tighten outer seal set screws.
2. Carefully guide gland over shaft and rest on outer seal retainer, or on shaft if just inner seal is used.
3. Place outer seat gasket on seat (If necessary, use lubricant on gasket to hold gasket in place). Place gasket on bearing side of seat. Carefully guide seat over shaft. DO NOT drag or touch shaft, as this may damage seat. Place against outer seal face, or let seat rest on shaft. Place inner gasket on seat.
4. Using inner seal, lubricate shaft, then slide inner seal on shaft, seal face toward bearings, to dimension shown, Figure 45. Tighten inner seal set screws.
5. NOTE: When placing body into position, take care of seat so that the seat is positioned in the body correctly. Failure not to position seat correctly will result in damaging the seat during installation.

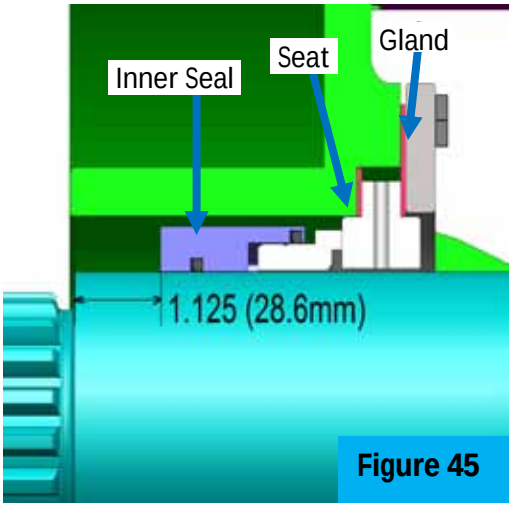


Figure 45

ZD-U1 W323 Plus Double Seal Maintenance

NOTE: Servicing the mechanical seals requires disassembly of the pump end first. See previous pages starting on page 34.

Double Seal Disassembly.

1. Clean shaft of all product on shafts and make sure shaft is free of all burrs and nicks. Loosen set screws from the inner seal and slide off shaft, Figure 46.
2. Slide seat off shaft. Take care not to touch seat ID on shaft, as this will cause the seat to chip. Remove gasket from seat and discard.
3. Loosen set screws on outer seal and slide off shaft.
4. Remove inner seal face from retainer. Use provided o-ring pick to remove all o-rings. Discard all o-rings.
5. Thoroughly clean and inspect inner or outer seal retainers. DO NOT re-use seal component. Return seal components to your distributor for reconditioning.

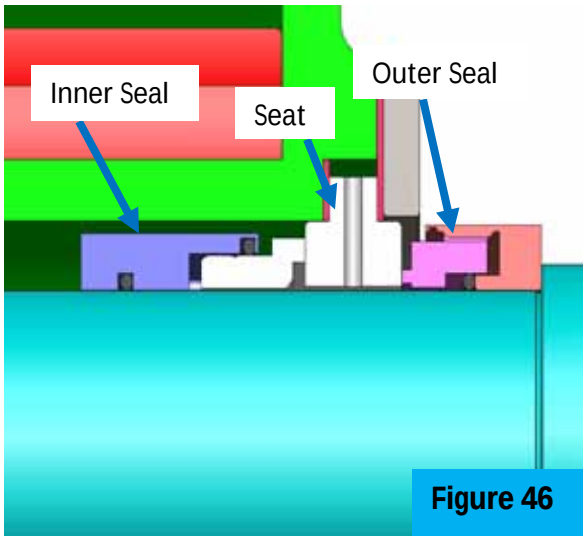


Figure 46

Double Seal Assembly

1. Lubricate shaft, then slide outer seal on shaft, with seal face toward shaft splines, until seal reaches shaft shoulder or dimension shown, Figure 47. Tighten outer seal set screws.
2. Carefully guide gland over shaft and rest on outer seal retainer, or on shaft if just inner seal is used.
3. Place outer seat gasket on seat (If necessary, use lubricant on gasket to hold gasket in place). Place gasket on bearing side of seat. Carefully guide seat over shaft. DO NOT drag or touch shaft, as this may damage seat. Place against outer seal face, or let seat rest on shaft. Place inner gasket on seat.
4. Using inner seal, lubricate shaft, then slide inner seal on shaft, seal face toward bearings, to dimension shown, Figure 47. Tighten inner seal set screws.

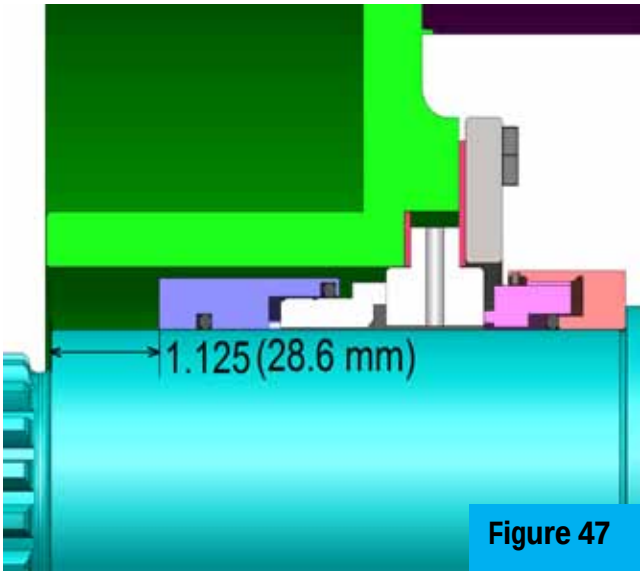


Figure 47

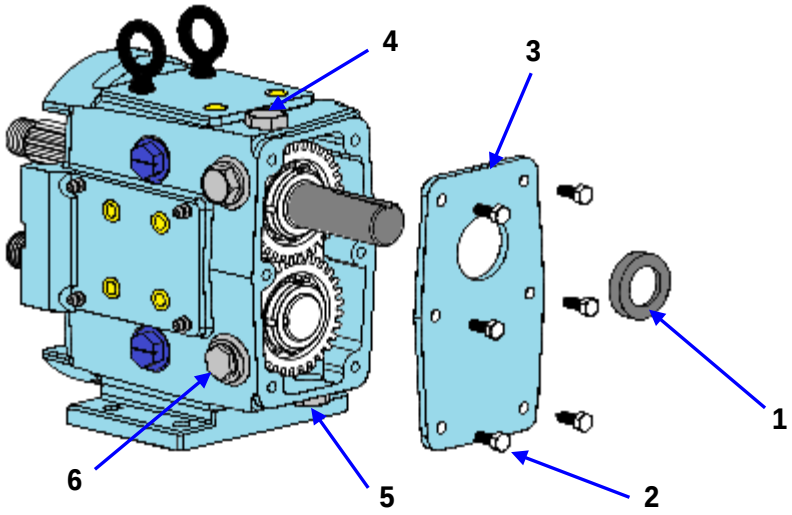
5. NOTE: When placing body into position, take care of seat so that the seat is positioned in the body correctly. Failure not to position seat correctly will result in damaging the seat during installation.

Gearbox Maintenance

DANGER: The U1 and Evolution pump contains moving parts! **DO NOT** put hands, fingers or materials into the pumps body or drive areas at any time while the pump is in operation! For your safety, **DO NOT** install, service, clean or repair the equipment unless all power has been disconnected and locked out. This will avoid serious injuring from occurring.

Gearbox Disassembly

1. Remove the pump head as described on page 32.
2. Drain all the oil from the gearbox by removing the bottom oil drain plug.
3. Unscrew and remove the six hexed cap screws and washers.
4. Slide the cover off the drive shaft.
5. Remove the oil seal and discard.



	Part
1	Rear Oil Seal
2	Hex Head Cap Screws
3	Gearbox Cover
4	Oil Fill Plug
5	Oil Drain Plug
6	Sight Glass

Figure 48 – Gearbox Cover Disassembly

Gearbox Disassembly, cont.

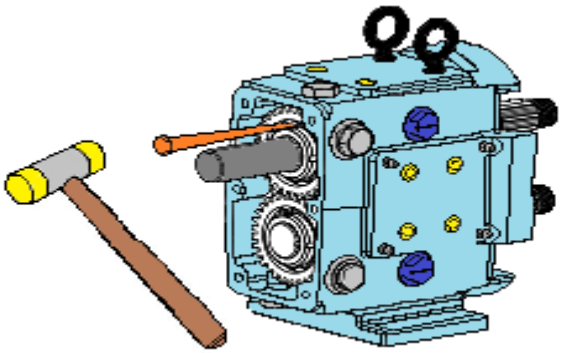


Figure 49 - Bend tabs on Lock Washers

6. You will need to use a hammer and a punch to bend the lock-nut tab(s) into a straight position on the lock washers., Figure 49.

7. Remove the gear lock nut..Use a plastic rod or wedge to keep the shafts from spinning when removing the gear lock nuts. Carefully remove the gears from the shafts. Continue to remove the gear keys and gear spacers from the shafts.

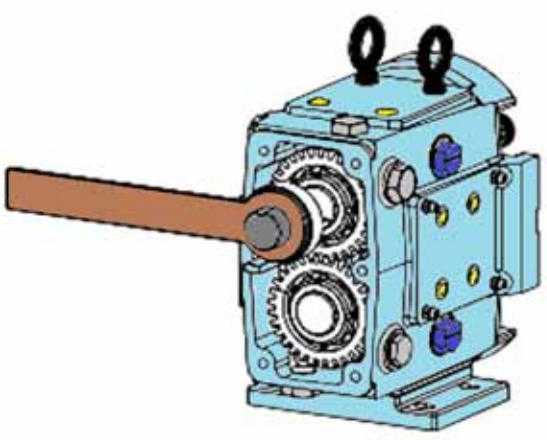


Figure 50 – Remove the Lock Nut

8. Next, remove the front bearing retainer screws and pry off the bearing retainer. If a retainer becomes stuck, leave it. It will press out upon removal of the shaft.

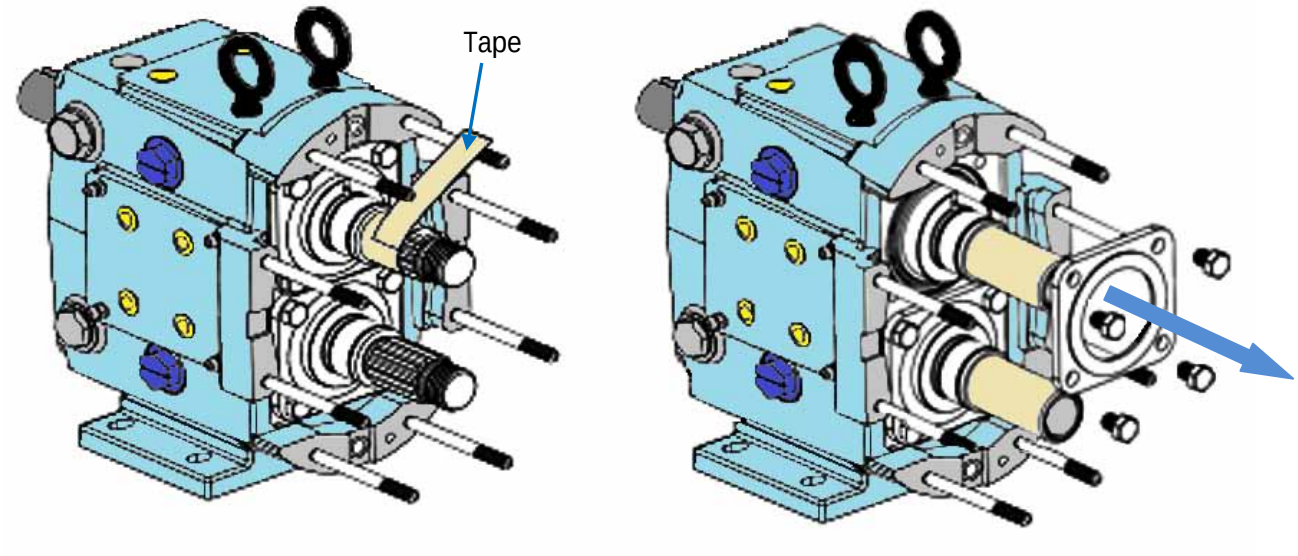


Figure 51 – Tape Shafts and Remove Bearing Retainers

Gearbox Disassembly, cont.

9. Remove the silicone sealant from the bearing retainer and gearbox.

10. In order to prevent damage to your shafts, wrap the shaft splines and threads with tape. Place the gearbox on an arbor face down on wooden blocks. Protect the shafts when they fall from the gearbox with wood o plastic blocks placed beneath them. Then press the shafts out of the gearbox, Figure 52.

Pressure Required to Remove/Install Bearings from Shafts

ZD-U1 Model	006, 015, 018	030, 034	045, 060, 064, 130, 134	180, 220, 224	210, 320, 323+, 380
Removing Bearings (Tons)	0.6	0.6	1.3	1.8	**2.5**
Installing Bearings (Tons)	0.3	0.3	0.8	1.0	**1.5**

11. For the front bearing seals, press them out and discard them. You can clean and reuse any of the bearing isolators, if your pump is equipped with them.

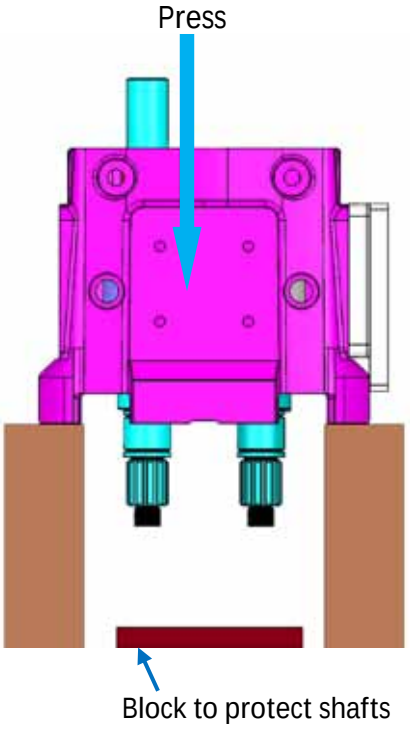


Figure 52 – Pressing Shafts from Gearbox

12. Next, remove the bearing shims. NOTE: Inspect both the gearbox bearing bore and front bearing for shims. If you are reusing the shafts and bearings, be sure to match and mark which shims go with the drive and idle shaft.

13. Thoroughly clean gearbox of sludge, oil, grease. Wash out any metal shavings if present.

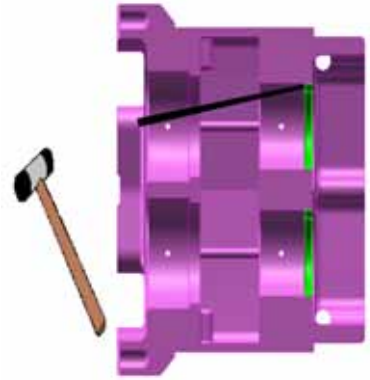


Figure 53 – Removing Rear Oil Seals from Gearbox

14. Remove and discard the gearbox rear oil seals, Figure 53.

15. You will need to use a hydraulic press and V-blocks to remove the bearings and spacer, Figure 54. Protect the shafts when they fall with wood or plastic blocks placed beneath them.

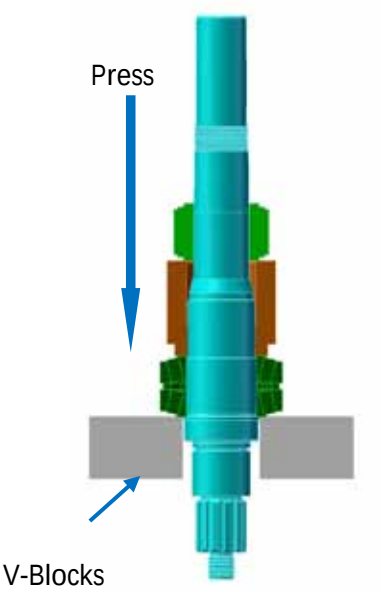


Figure 54 – Removing Bearings from Shaft

Gearbox Assembly

Front Bearing Shaft Assembly

NOTE: *The following instructions cover the assembly of a six-piece front bearing assembly. For a four-piece assembly, only one spacer and cup is used.*

1. Use a light coating of lubricant on the shaft where the front bearing will sit. Put the shaft in the upright position in the press. Make sure the protected splines are facing down.

2. Open the new front bearing assembly.
   NOTE: DO NOT *interchange the parts of one bearing assembly with another. The bearing are matched as a set at the factory and must be installed as a matched assembly. See Figure 55.*

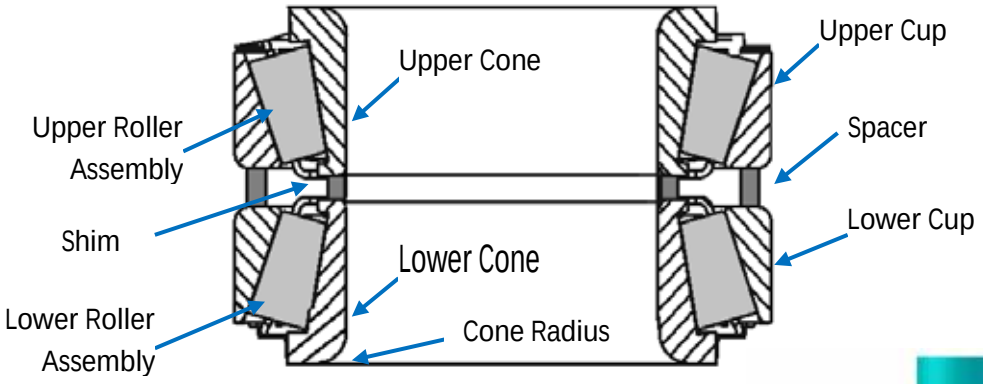


Figure 55 –Tapered Roller Bearing Assembly

3. Take the front bearing lower cone with roller assembly and place it over the shaft with the cone radius facing down. Make sure that the bearing assembly and cone are aligned properly before pressing them onto the shaft, Figure 56.
   NOTE: *Press only on the cone.*

4. Press the bearing until it seats against the shaft shoulder. You can use a thin shim to ensure the bearing is positioned and seated correctly.

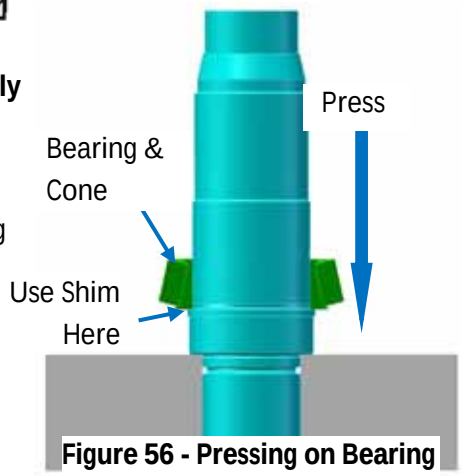


Figure 56 - Pressing on Bearing

5. Place the shim, Figure 56a, over the shaft and onto the lower cone and bearing roller assembly.

6. Place the lower cup over the lower cone and roller assembly, keeping the cup opening toward the assembly.

7. Place the spacer over the shaft and onto the lower cup, Figure 56a.

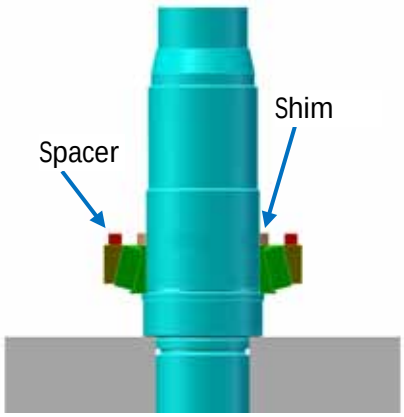


Figure 56a - Placing Shim and Spacer

Gearbox Assembly, cont.

Front Bearing Shaft Assembly, cont.

8. Place the upper cup on top of the spacer, Figure 57.

9. Lubricate the shaft for the remaining upper cone and roller assembly with oil or grease. Slip it over the shaft with the roller radius facing up. Press it onto the shaft and into the cup, Figure 57.
   NOTE: *Make sure all components are aligned before pressing.* Press only on the inner cone.

10. Slide the bearing spacer over shaft and against bearing cup.

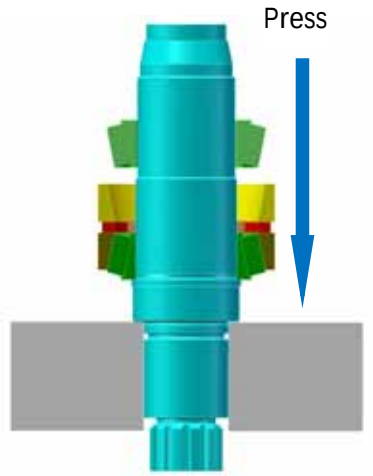


Figure 57 –Pressing Lower Bearing Assembly onto Shaft

Rear Bearing Shaft Assembly

NOTE: Models 006, 015, 018, use a single ball bearing assembly for the rear bearing. All other models use a tapered roller bearing assembly similar to the front bearings.

1. Use a light coating of lubricant on the shaft where the rear bearing will sit.

2. Open the new rear bearing assembly. Repeat process described above in steps 3 - 9, Figure 58.
   NOTE: DO NOT *interchange the parts of one bearing assembly with another. The bearing are matched as a set at the factory and must be installed as a matched assembly. See Figure 55.*
   NOTE: *DO NOT heat the bearings, If bearings are heated, do not exceed 300°F (149°C).*

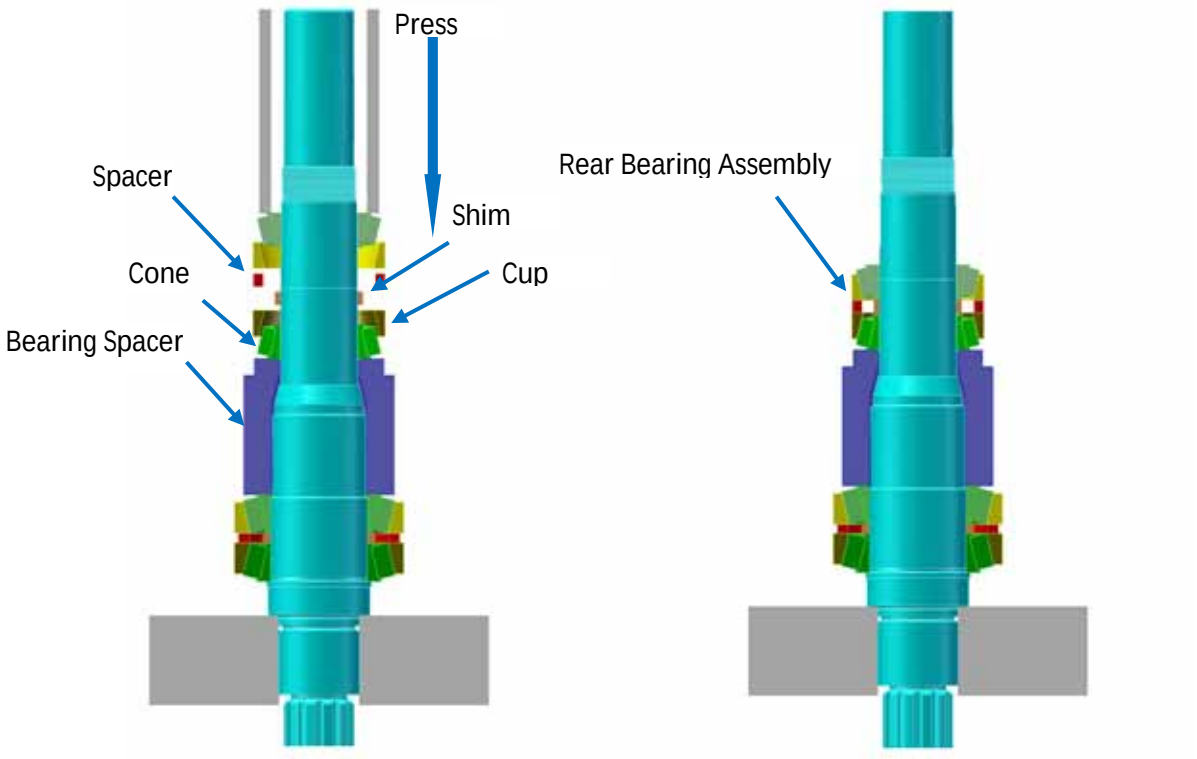


Figure 58 –Pressing Upper Bearing Assembly onto Shaft

Gearbox Assembly, cont.

Instructions about Bearing Shims

1. When installing the shafts in the gearbox, shim behind the front bearing to achieve the proper rotor backface clearance between the back of the rotors and the body.
   NOTE: *Backface clearance must be equal for both rotors to prevent the rotors from hitting each other during operation.*
   NOTE: Do not use silicone sealant on the front bearing retainer, gears, or gear locknuts until the correct shimming has been verified.

2. If the shafts and/or bearings do not need to be replaced and the shims were previously marked with the matching shaft and bearing, a shim adjustment probably will not be needed. Reuse the existing tagged shims, shafts and bearings in the same gearbox bores. **DO NO**T reuse shims with any dents or damage.

3. If existing shims are lost or a new shaft is used, it will be necessary to calculate the required shims for the new replacement shafts and bearings, see Figure 59 and Figure 60. It is important to carry measurements and calculations to three decimal places, i.e. 0.074.

4. Determine the shim thickness required for the front bearing:
   a. Measure dimensions “A” in the gearbox and “B” on the shaft (Figure 59).
   b. Measure dimensions “C” and “C” on the body (Figure 60).
   c. Determine the proper backface clearance. Refer to Rotor Clearance Table on page 52.
   d. **Required Shims** = Backface Clearance + (A - B) + (C - D).
   e. Place the "**Required Shims**" in the gearbox front bearing bore, against the counterbore shoulder. Lubricate with grease to hold shims together and provide lubrication during shaft installation.

Dimension	Description
B	Front Face of Gearbox to Back of Bearing Bore
C	Shaft Shoulder to Back of Bearing Cone
D	Overall Body Thickness
E	Depth of Rotor Bore

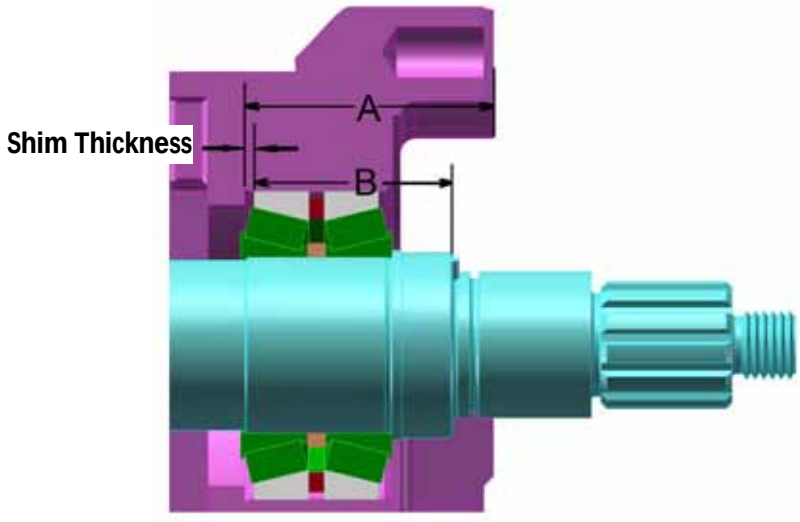


Figure 59 –Measuring Gearbox Dimensions

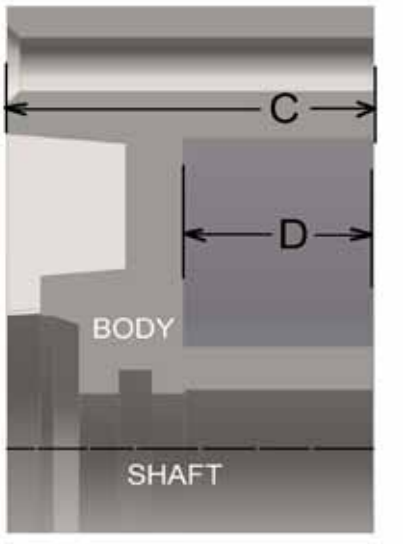


Figure 60 – Measuring Body Dimensions

Installing Shafts

1. Set the gear casing on a press with the pump side facing up. Use the required thickness of a shim. Apply a lubricant to the bearings to aid in shaft installation. One shaft at a time, place shafts into the gearbox with the splines facing upward. Make sure the idle and drive shafts are placed in the appropriate bores. Press shafts in until bearings are completely seated. See Table on page 43 for required pressure.

2. To check the clearance, temporarily secure the shaft and bearing in place with retainers.
   NOTE: DO NOT use silicone sealant on front bearing retainers now.

3. Bearing retainers need to rest firm against the bearing. Measure Dimension "A" to confirm there is a 0.010" to 0.050" (0.25 to 1.25 mm) clearance between the front of the gearbox and the back of the front bearing retainer. Use shims on front of bearing if necessary to increase space for front bearing retainers.

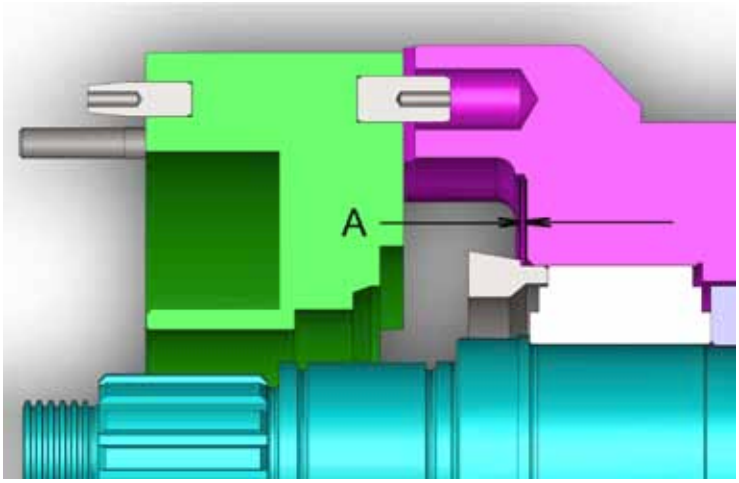


Figure 61 – Bearing Retainer Clearance

4. Mount the body on the gearbox.

5. Secure body by using retaining screws.

6. Install rotors and tighten rotor nuts. **NOTE:** O-rings, washers and retainer o-rings are not needed at this time.

7. Using feeler gauges, measure clearance of the rotor backface. Both must be the same in order to prevent damage and rotor crossover.

8. Check all clearances: rotor to body, dimension "B", rotor to front face, dimension "C", and rotor to backface, dimension "D". If the clearance is not accurate, disassemble the pump and adjust the shims to achieve the correct clearance, Figure 62.

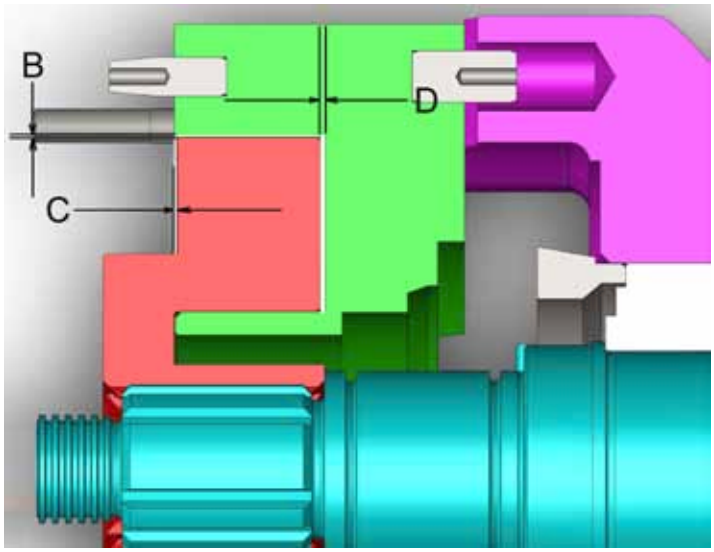


Figure 62 – Rotor to Body Clearances

9. If the backface clearance is not according to the clearance table, disassemble the pump and adjust the shimming to achieve the correct backface clearance. If the rotor to body clearances are not able to specifications or are inconsistent, contact ZM Technologies for proper adjustment procedures.

10. Once proper clearance is achieved, remove rotor nuts, rotors, body and bearing retainer and fasteners.

Installing Shafts, cont.

11. Through the grease fittings on the equipment, grease the front and rear bearings until grease is visible around the bearing assemblies. Make sure to rotate the shaft as you add lubricant for even distribution.

12. Next, lubricate all seal lips, make sure the compression spring is on the inside and install the greased seals in the bearing retainers.

13. Use silicone sealant to coat the front bearing retainer flanges. **NOTE:** The greased seal should be flush with the front of the bearing retainer.

14. Install bearing retainers and tighten the fasteners.

IMPORTANT: To protect the seal from accidental cutting during installation, use tape or material over the shaft.

Install Rear Seal Assembly

1. Install the gear spacers.

2. Lubricate inner and outer diameters of the seals with grease.

3. Install the oil seal, making sure the spring is facing outward toward the gears.

Install Timing Gears

NOTE: To assist in gear timing set up, rotate pump rotors until they are at right angles to each other before gear installation.

1. Put gear keys into shaft key slots and angle the keys outward.

2. Locate the spur drive gear. It will have one punch mark on the gear. Slide it onto the drive shaft.

3. Locate the idle shaft and slide the idle shaft gear onto it. The idle shaft gear is identifiable by two distinct punch marks on the gear. Line up the punch mark of the spur drive gear in between the two punch marks on the idle shaft gear, Figure 63.

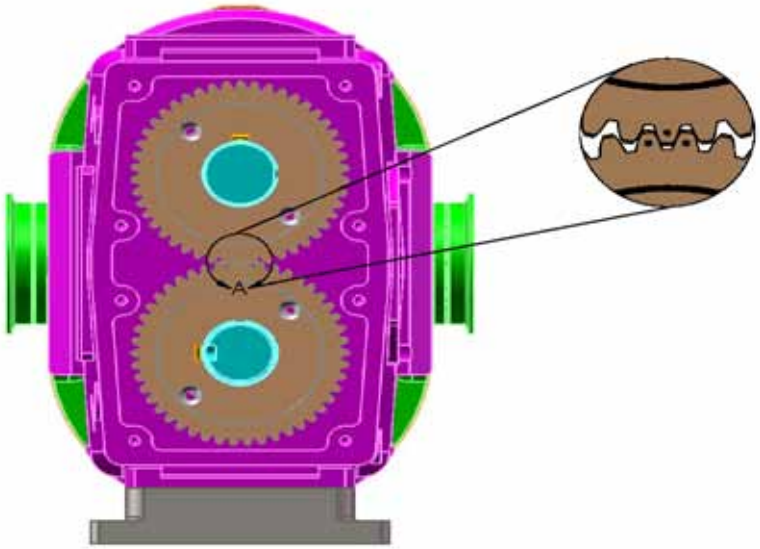


Figure 63 – Gear Timing Marks

Install Timing Gears, cont.

4. In order to keep shafts from turning use a wood or nylon block or rod.
5. Align inner tab with shaft groove and slide lock washers onto shaft with outer tabs bend away from the gear. Lubricate the face of the lock nuts and the threaded area on the shafts with grease or oil.
6. Using a drift or spanner wrench tighten gear lock nuts, Figure 64.
7. Use a torque wrench to tight gear lock nuts to specified torque in table.

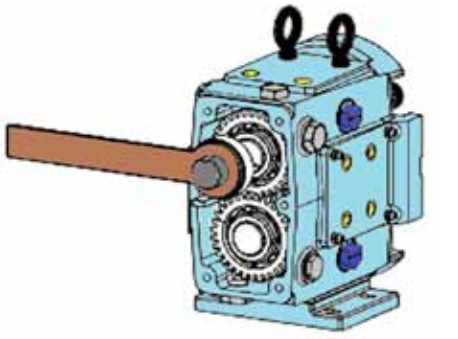


Figure 64 – Tightening Lock Nuts

ZD-U1 & Evolution Model	Torque	
	Ft -lbs	N-m
006, 015, 018	75	102
030, 034	100	135
045, 060, 064, 130, 134	150	203
180, 220, 224	250	339
210, 320, 323, 324, 380, 383	350	475

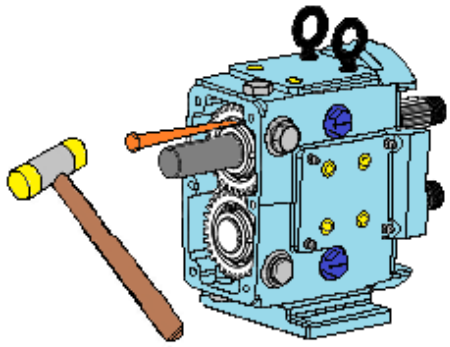


Figure 65 – Installing Lock Nuts

8. Next bend the tab on the lock washer into the locking nut slots. This secures the gear lock nut into place, Figure 65.

Install Gearbox Cover

1. Lubricate the inside diameter of a new oil seal with a thin film of gear oil.
2. Press the new oil seal into the gearbox cover, flush with the outside face, with the spring facing in toward the gears.
3. Apply silicone sealant to the back of the gearbox. (TFE sealing tape can be used on silicone-free models.). Place tape on the inside of the screw holes, Figure 66.
4. Place tape the end of the shaft to prevent cutting the oil seal on the drive shaft keyway. Mount the cover assembly on the gearbox and tighten the cap screws.

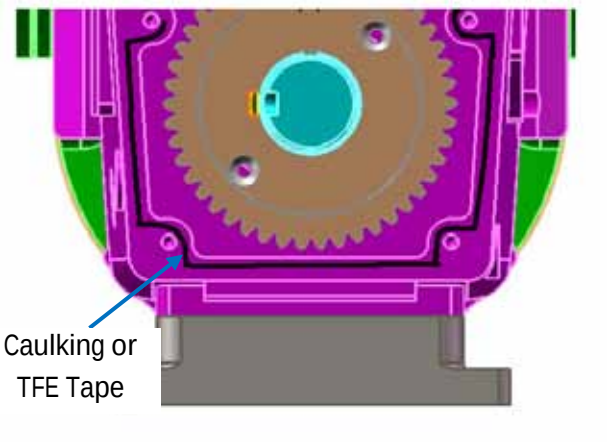


Figure 66 – Caulking Back of Gearbox

Install Timing Gears, cont.

5. Remove the tape from the shaft end. **NOTE:** Make sure that the shaft is centered in the lip seal before tightening the cap screws.

6. Install the oil drain plug.

7. Fill gearbox with gear oil to proper level. Refer to "Lubrication" on page 27.

Pump End Assembly

NOTE: See Seal Assembly first: See "Seal Maintenance" on page 35.

1. Slide the body over the shafts and studs, taking care that the seal components are not knocked out of place or dislocated from drive/anti-rotation pins. Press the body firmly against gearbox, engaging the dowels, Figure 67.

2. The bodies are secured to the gearbox with two socket head cap screws through the pump body.

3. Slide a rotor onto the shaft, align the large spline tooth with the large groove in the rotor. Rotate the shaft until the rotor wings are on a vertical centerline, Figure 68. Slide the second rotor onto the shaft.

4. Tighten the rotor nuts clockwise. See table for rotor nut torque values, Figure 69.

5. Install the o-ring in the cover groove.

6. Mount the cover on the studs and push it against the body, making sure that the o-ring remains in the groove.

7. Attach the wing nuts (clockwise) and tighten by hitting them sharply with a soft hammer. Use a socket and torque wrench for tightening sanitary cover nuts. See table for cover nut torque values.

Torque Values for Rotor and Cover Nuts

ZD-U1 & Evolution Model	Torque	
	Ft -lbs	N-m
006, 015, 018	30	41
030, 034	60	81
045, 060, 064, 130, 134	75	102
180, 220, 224	150	203
210, 320, 323, 324, 380, 383	190	258

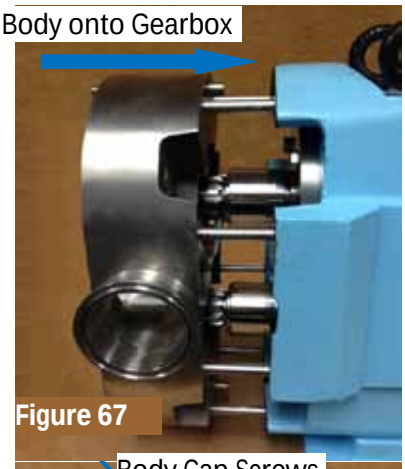


Figure 67

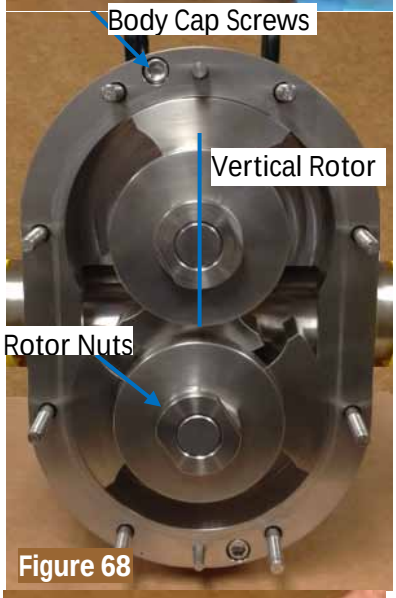


Figure 68

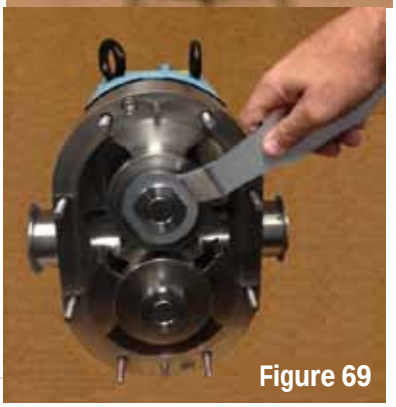


Figure 69

Checking for Proper Clearance

ZD-U1 and Evolution pumps are designed to have close running clearances. The backface clearances are set with shims during installation.

The shafts of the pump are positioned with shims behind the front bearing. They are then locked into place with front bearing retainers. The rotors will lock against the shoulder of the shaft. The clearance between the body backface and the back of the rotor wing is referred to as backface clearance.

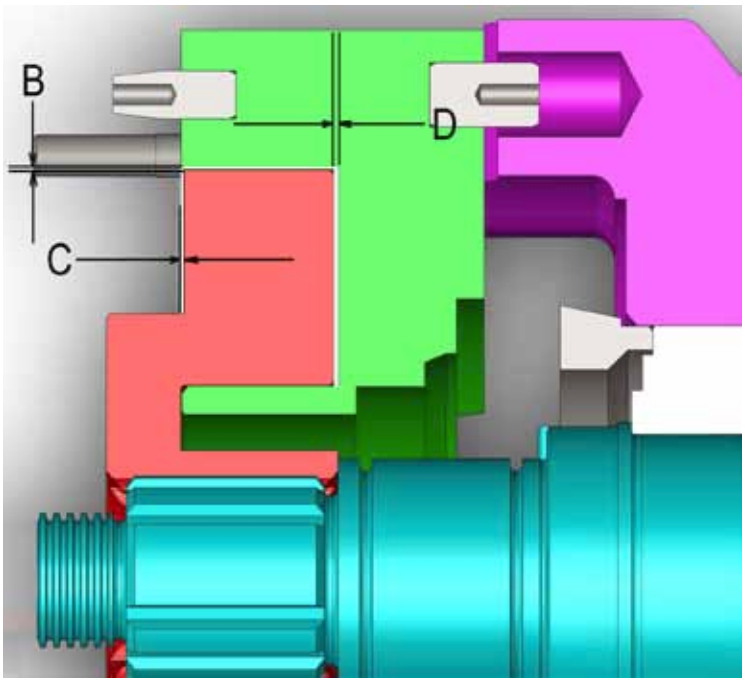
IMPORTANT: It is best to keep the pump's backface clearance minimized.

1. In order to check rotor clearances, mount the body without the seals on the housing. Assemble the rotors and secure with jam nuts.

2. Using feeler gauges, measure the rotor backface clearance, through either the port or from the front of the pump body, Dimension "D". **NOTE:** Make sure both rotors have the same backface clearance to prevent rotor crossover interference.

3. Use a depth micrometer to measure the front face clearance, Dimension "C". Refer to Clearance Table ensure optimum performance of your equipment.

4. Using feeler gauges, measure the rotor body clearance, through front of the pump body, Dimension "B".



Rotor Clearance Table

ZD-U1 & Evolution Rotor Clearances					
Model	**Clearance Type**	**Rotor to Body**	**Front Face**	**Back Face**	**Wing to Hub**
006, 015, 018	Standard	.0030	.0050	.0015	.0040
	Hot	.0035	.0065	.0015	.0070
030, 034	Standard	.0030	.0050	.002	.0040
	Hot	.0035	.0065	.002	.0070
045, 060, 064, 130, 134	Standard	.0045	.0055	.0030	.0060
	Hot	.0070	.0105	.0030	.0110
180, 220, 224	Standard	.0045	.0075	.0040	.0105
	Hot	.0080	.0125	.0040	.0155
210, 320, 323, 324	Standard	.007	.009	.0060	.008
	Hot	.0100	.0135	.0060	.0160
380, 383	Standard	.0070	.0010	.0060	.008
	Hot	.0100	.0135	.0060	.0160

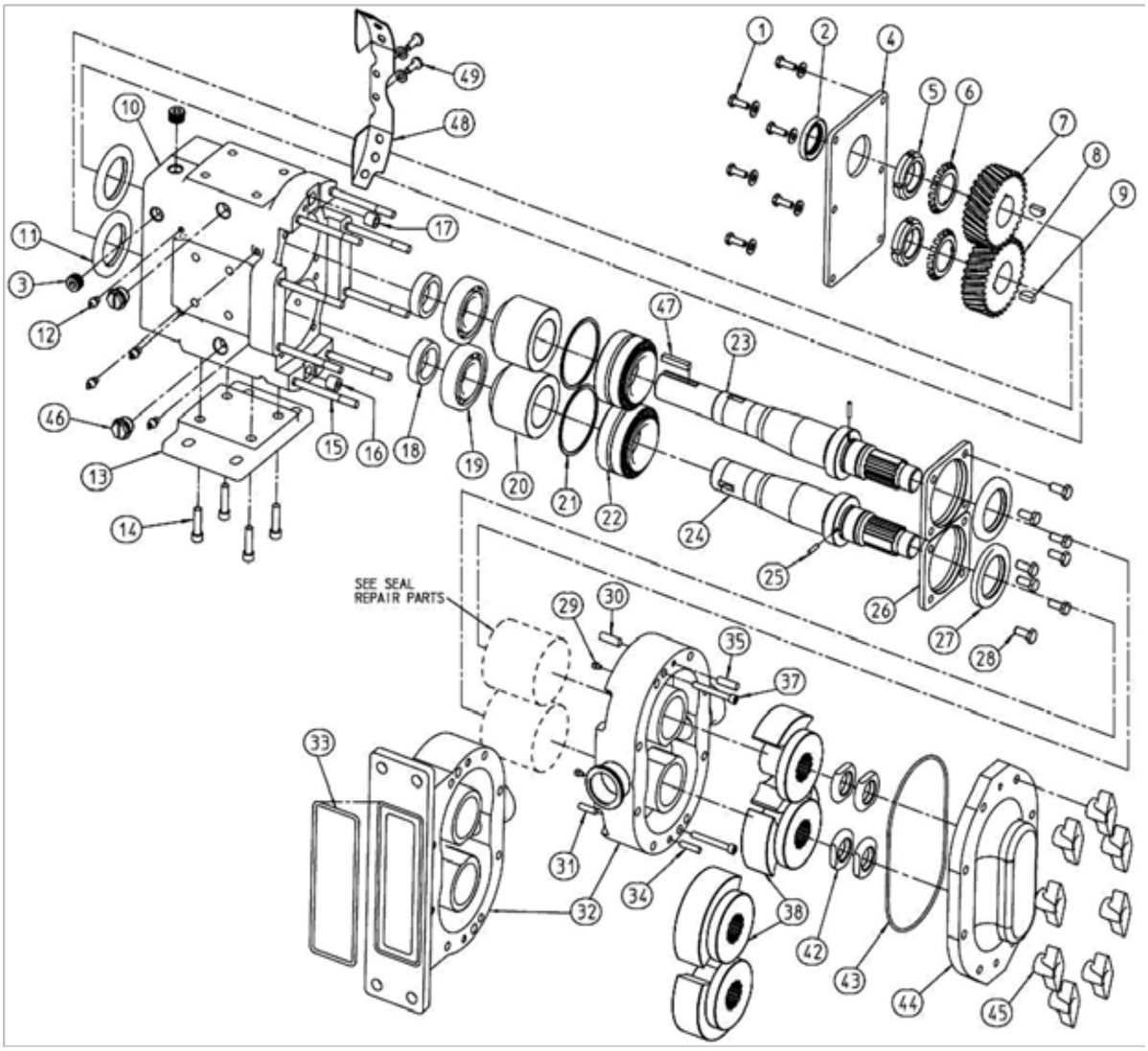
NOTE: Clearances listed are for standard and hot rotors. Contact ZM Technologies if non-standard rotors are needed. If clearances are not able to be achieved, contact ZM Technologies for assistance at (209)547-1965 or zmt@zmtech.com.

Troubleshooting Backface Clearance Problems

Problem	Condition	Correction
Too Much Backface Clearance, Dimension "D".	Dimension "D" is greater than the value in Rotor Clearance Table	"D" (measured) minus Backface Clearance from Table = thickness of shims to remove from the front bearing shim pack.
	Rotor wing face projects past the body face.	"C" (measured with depth micrometer) plus Frontface Clearance from Table = thickness of shims to remove from the front bearing shim pack.
Not Enough Backface, Dimension "D".	Dimension "D" is less than the value in Rotor Clearance Table.	Backface Clearance from Table minus Dimension "D" (measured) = thickness of shims to add to the front bearing shim pack.

NOTE: If clearance corrections are made and satisfactory pump performance is not meet, contact ZM Technologies for assistance at (209)547-1965 or zmt@zmtech.com.

PARTS LIST - ZDU1-006, 015, 018, 024



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 006--024	6	30-287	FHCS25020-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 006--024	6	43-108	FFW250C
2	Oil Seal - Gear Case Cover	1	000030016	W000-030-016
3	Oil Plug 006-018, Gearbox	6	000046002	W000-046-002
4	Gear Case Cover, Steel (includes installed seal)	1	020106000	W020-106-000
	Gear Case Cover, SS (includes installed seal)		102280	W102280
5	Lock Nut - Gear	2	STD236005	WSTD-236-005
6	Lock Washer - Gear	2	STD136005	WSTD-136-005
7	Gear Drive Shaft	1	015007001	W015-007-001

8	Gear Short Shaft	1	015007002	W015-007-002
9	Key, Gear	2	015037000	W015-037-000
10*	Gear Case, CI	1	102276	W102276
	Gear Case, SS		101831	W101831
11	Oil Seal Rear	2	000030017	W000-030-017
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13*	Mounting Shim (Gear Case Base), CI	1	020110000	W020-110-000
	Mounting Shim (Gear Case Base), SS		102284	W102284
14	SH Capscrew, G8Z, Mount/Base, Model 006-024	4	30-343	FSHCS31318-100-G8Z
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Part No.**
15	Stud	8	AD0011000	WAD0-011-000
	Stud Jacketed Cover		AD0011J00	WAD0-011-J00
	Stud	8	018011000	W018-011-000
	Stud Jacketed Cover		AD0011100	WAD0-011-100
	Stud	6	018011000	W018-011-000
	Short Stud, Std Cover - 024-U1	2	35547	W35547
	Stud Jacketed Cover	6	AD0011100	WAD0-011-100
	Stud, Jacketed Cover, U1-018	2	35548	W35548
16	Dowel Bushing, Lower	1	AD0116100	WAD0-116-100
17	Dowel Bushing, Upper	1	AD0116000	WAD0-116-000
18	Spacer Gear to Rear Bearing	2	015055000	W015-055-000
19	Rear Bearing	2	015035000	W015-035-000
20*	Spacer Bearing	2	101814	W101814
21*	006 - 024 Shim Kit	2	117889	W117889
22*	Front Bearing	2	101714	W101714
23*	Drive Shaft (316L SS) Model 006, 015 U1 (post 07/2001)	1	114642	W114642
	Drive Shaft (316L SS) Model 018 - 024 U1 (post 07/2001)		114644	W114644
24*	Idle Shaft (316L SS) Model 006, 015 U1 (post 07/2001)	1	114643	W114643
	Idle Shaft (316L SS) Model 018 - 024 U1 (post 07/2001)		114645	W114645
25	Drive Pin	2	CD0126000	WCD0-126-000
26*	Bearing Retainer Front	2	120332	W120332
27*	Grease Seal Front Brg Ret	2	121679	W121679
28	BH Capscrew, SS, Brg Ret, Model 006--024	8	30-58	FBHCS25020-075-SS
29	Stop Pin Seal	2	015126000	W015-126-000
30	Dowel Pin, Upper Gear Case Side	1	AD0040R00	WAD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	AD0040R10	WAD0-040-R10
32	Pump Body - 015 U1	1	--	W015-001-010
	Pump Body - 015 U1		--	W015-001-010

	Pump Body - 018 U1		--	W018-001-010
	Pump Body - 024 U1		--	W024-001-010
33	Flange O-Rimg - Buna (Model 024)	1	N70241	WN70241
	Flange O-Rimg - Viton® (Model 024)		V70241	WV70241
34	Dowel (lower cover)	1	AD0040100	WAD0-040-100
35	Dowel (upper cover)	1	AD0040000	WAD0-040-000
37	SH Capscrew, SS, Body Retaining, Model 006--015	2	30-523	FSHCS25020-125-SS
	SH Capscrew, SS, Body Retaining, Model 018--030		30-211	FSHCS25020-200-SS
38	Rotor Twin Blade - #W88 Alloy - Model 006 U1	2	006010000	W006-010-000
	Rotor Twin Blade - #W88 Alloy - Model 006 U1 + .040		-------	W006-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 006 U1 + .080		-------	W006-010-000-080
	Rotor Twin Blade - #W88 Alloy - Model 015 U1		015010000	W015-010-000
	Rotor Twin Blade - #W88 Alloy - Model 015 U1 + .040		-------	W015-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 015 U1 + .080		-------	W015-010-000-080
	Rotor Twin Blade - #W88 Alloy - Model 018 - 024 U1		018010000	W018-010-000
	Rotor Twin Blade - #W88 Alloy - Model 018 - 024 U1 + .040		-------	W018-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 018 - 024 U1 + .080		-------	W018-010-000-080
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Part No.**
42	Jam Nut	4	AD0052001	WAD0-052-001
43	Cover O-Ring - Buna	1	N70252	WN70252
	Cover O-Ring - Silicone		S75252	WS75252
	Cover O-Ring - Viton®		V70252	WV70252
	Cover O-Ring - EPDM		E70252	WE70252
44	Pump Cover	1	AD0002S00	WAD0-002-S00
	Pump Cover - Jacketed		AD0002J10	WAD0-002-J10
45	Wing Nut	8	105850	W105850
	Hex Nut		108369	W108369
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 3/16 X 3/16 X 1 1/8	1	000037001	W000-037-001

***Replacement Waukesha® pump parts manufactured before July 2001, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
10	Gear Case, CI	1	020005000	W020-005-000
20	Spacer Bearing	2	015055001	W015-055-001
21	006 - 024 Shim Kit	2	117889	W117889
22	Front Bearing	2	015036000	W015-036-000
23	Drive Shaft (316L SS) Model 006, 015 U1 (pre 07/2001)	1	015008000	W015-008-000
24	Idle Shaft (316L SS) Model 006, 015 U1 (pre 07/2001)	1	015009000	W015-009-000

26	Bearing Retainer Front	2	015080000	W015-080-000
27	Grease Seal Front Brg Ret	2	000030018	W000-030-018

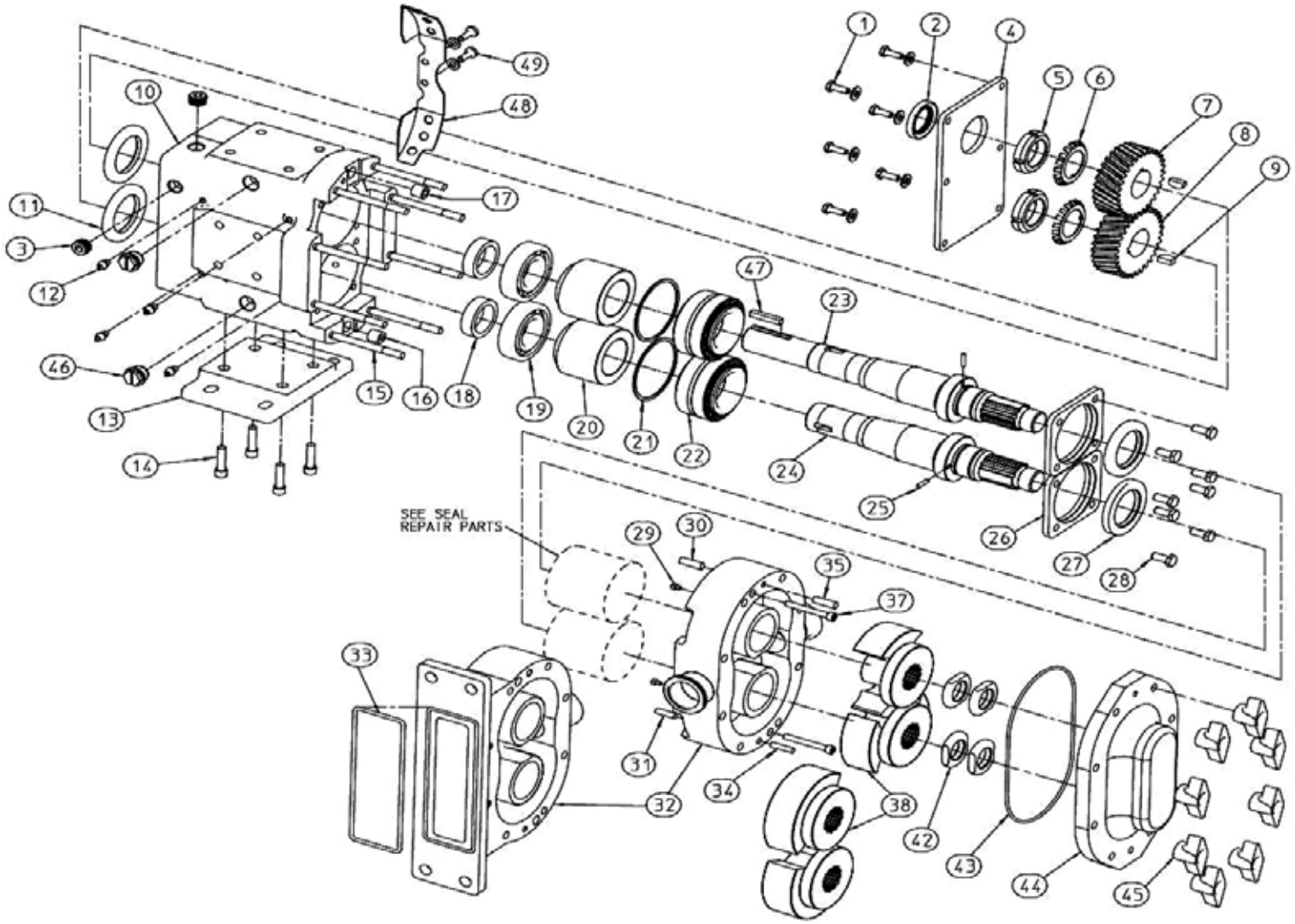
*Replacement parts for Waukesha® pumps manufactured after July 2001 but before 07/12/04, order the following parts.

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
26	Bearing Retainer Front	2	101810	W101810
27	Grease Seal Front Brg Ret	2	101716	W101716
33	Flange O-Rim - Buna (Model 024)*	1	N70245	WN70245
	Flange O-Ring - Viton® (Model 024)*		V70245	WV70245

Waukesha® - Registered Trademark of SPX Process Equipment

Viton® - Registered Trademark of DuPont Performance Elastomers.

PARTS LIST - U1 - 030, 034



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Pump Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 030-034	6	30-283	FHCS31318-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 030-034	6	43-194	FFW313C
2	Oil Seal - Gear Case Cover	1	000030013	W000-030-013
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	040106000	W040-106-000
	Gear Case Cover, SS (includes installed seal)		102281	W102281
5	Lock Nut - Gear	2	CD0036N00	WCD0-036-N00
6	Lock Washer - Gear	2	CD0036W00	WCD0-036-W00
7	Gear Drive Shaft	1	030007001	W030-007-001

8	Gear Short Shaft	1	030007002	W030-007-002
9	Key, Gear	2	015037000	W015-037-000
10*	Gear Case, CI	1	102276	W102276
	Gear Case, SS		101833	W101833
11	Oil Seal Rear	2	000030017	W000-030-017
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	Mounting Shim (Gear Case Base), CI	1	040110000	W040-110-000
	Mounting Shim (Gear Case Base), SS		102285	W102285
14	SH Capscrew, G8Z, Mount/Base, Model 030-034	4	30-344	FSHCS37516-100-G8Z
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Pump Part No.**
15	Stud	8	108842	W108842
	Stud Jacketed Cover		108845	W108845
	Stud	6	108842	W108842
	Stud, Short, U1-034	2	35555	W35555
	Stud Jacketed Cover	6	108845	W108845
	Stud, Short, Jacketed Cover, U1-034	2	35549	W35549
16	Dowel Pin, Lower Cover Side	1	BD0040100	WBD0-040-100
17	Dowel Pin, Upper Cover Side	1	BD0040000	WBD0-040-000
18	Spacer Gear to Rear Bearing	2	030055000	W030-055-000
19	Rear Bearing	2	030035000	W030-035-000
20*	Spacer Bearing	2	101815	W101815
21	030 - 034 Shim Kit	2	----------	W117890
22*	Front Bearing	2	030036000	W030-036-000
23*	Drive Shaft (17-4PH) Model 030, 034 U1 (post 07/2001)	1	114779	W114779
24*	Idle Shaft (17-4PH) Model 030, 034 U1 (post 07/2001)	1	114780	W114780
25	Drive Pin	2	CD0126000	WCD0-126-000
26*	Bearing Retainer Front	2	120333	W120333
27*	Grease Seal Front Brg Ret	2	121680	W121680
28	BH Capscrew, SS, Brg Ret, Model 030-034	8	30-29	FBHCS31318-075-SS
29	Stop Pin Seal	2	030126000	W030-126-000
30	Dowel Pin, Upper Gear Case Side	1	BD0040200	WBD0-040-200
31	Dowel Pin, Lower Gear Case Side	1	BD0040300	WBD0-040-300
32	Rotor Twin Blade - #W88 Alloy - Model 030 U1	1	030010000	W030-010-000
	Rotor Twin Blade - #W88 Alloy - Model 030 U1 + .040		-------	W030-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 030 U1 + .080		-------	W030-010-000-080
	Single Blade Rotor - #W88 Alloy - 90° - 030 U1		117291	W117291
33	Rectangular Flange O-Ring - Buna	1	N70357	WN70357
34	Dowel Pin, Upper Cover Side	1	BD0040000	WBD0-040-000
35	Dowel Pin, Lower Cover Side	1	BD0040100	WBD0-040-100
37	SH Capscrew, SS, Body Retaining, Model 018--030	2	30-211	FSHCS25020-200-SS

38	Rotor Twin Blade - #W88 Alloy - Model 030 U1	2	030010000	W030-010-000
	Single Blade Rotor - #W88 Alloy - 90° - 030 U1	1	117291	W117291
42	Jam Nut	4	BD0052001	WBD0-052-001
43	Cover O-Ring - Buna	1	N70261	WN70261
	Cover O-Ring - EPDM		E70261	WE70261
	Cover O-Ring - Viton®		V70261	WV70261
	Cover O-Ring - Silicone		S75261	WS75261
44	Pump Cover	1	BD0002S00	WBD0-002-S00
	Pump Cover - Jacketed		BD0002J10	WBD0-002-J10
45	Wing Nut	8	105851	W105851
	Hex Nut		108370	W108370
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 1/4 X 1/4 X 1 3/4	1	000037002	W000-037-002

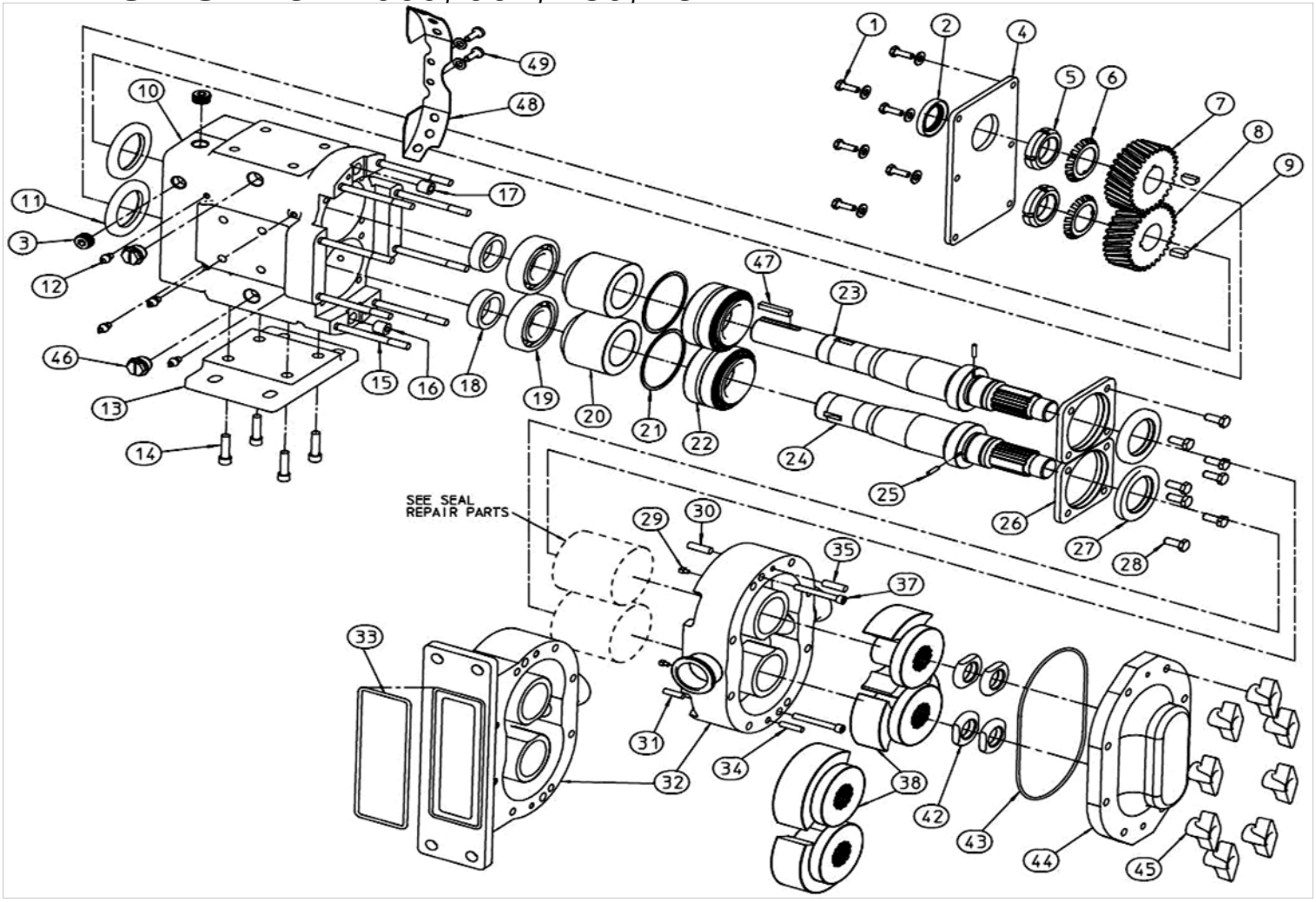
***Replacement parts for Waukesha® pumps manufactured before July 2001, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
10	Gear Case, CI	1	040005000	W040-005-000
20	Spacer Bearing	2	030055001	W030-055-001
22	Front Bearing	2	030036000	W030-036-000
23	Drive Shaft (17-4PH) Model 030, 034 U1 (pre 07/2001)	1	35341 / 030008000	W030-008-000
24	Idle Shaft (17-4PH) Model 030, 034 U1 (pre 07/2001)	1	35342 / 030009000	W030-009-000
26	Bearing Retainer Front	2	030080000	W030-080-000
27	Grease Seal Front Brg Ret	2	000030015	W000-030-015

***Replacement parts for Waukesha® pumps manufactured after July 2001 but before 07/12/04, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
26	Bearing Retainer Front	2	101811	W101811
27	Grease Seal Front Brg Ret	2	101717	W101717

PARTS LIST - U1 - 060, 064, 130, 134



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2	Oil Seal - Gear Case Cover	1	000030012	W000-030-012
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	070106000	W070-106-000
	Gear Case Cover, SS (includes installed seal)		102282	W102282
5	Lock Nut - Gear	2	STD236009	WSTD-236-009
6	Lock Washer - Gear	2	STD136009	WSTD-136-009
7	Gear Drive Shaft	1	060007001	W060-007-001
8	Gear Short Shaft	1	060007002	W060-007-002

9	Key, Gear	2	060037000	W060-037-000
10	Gear Case, CI	1	070005000	W070-005-000
	Gear Case, SS		101834	W101834
11	Oil Seal Rear	2	000030011	W000-030-011
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	Mounting Shim (Gear Case Base), CI	1	070110000	W070-110-000
	Mounting Shim (Gear Case Base), SS		102286	W102286
14	SH Capscrew, SS, Body Retaining, Model 018--030	4	30-211	FSHCS25020-200-SS
15	Stud	8	108843	W108843
	Stud	6	108843	W108843
	Stud, Short, U1-064	2	0C1050000	W0C1-050-000
	Stud Jacketed Cover	8	108846	W108846
	Stud Jacketed Cover	6	108846	W108846
	Stud, Short, Jacketed, U1-064	2	35556	W35556
	Stud	8	130011000	W130-011-000
	Stud	6	130011000	W130-011-000
	Stud, Short, U1-064	2	0C1050000	W0C1-050-000
	Stud Jacketed Cover	8	130011001	W130-011-001
	Stud Jacketed Cover	6	130011001	W130-011-001
	Stud, Short, Jacketed, U1-064	2	35556	W35556
16	Dowel Bushing, Lower	1	CD0116100	WCD0-116-100
17	Dowel Bushing, Upper	1	CD0116000	WCD0-116-000
21	045 - 134 Shim Kit	2	117891	W117891
18	Spacer Gear to Rear Bearing	2	107187	W107187
19	Rear Bearing	2	107186	W107186
20	Spacer Bearing	2	060055003	W060-055-003
22	Front Bearing	2	060036000	W060-036-000
23	Drive Shaft (17-4PH) Model 060, 064 U1	1	35145 / 060008001	W060-008-001
	Drive Shaft (17-4PH) Model 130, 134 U1		35394 / 130008001	W130-008-001
24	Idle Shaft (17-4PH) Model 060, 064 U1	1	35146 / 060009001	W060-009-001
	Idle Shaft (17-4PH) Model 130, 134 U1		35392 / 130009001	W130-009-001
25	Drive Pin	2	CD0126000	WCD0-126-000
26*	Bearing Retainer Front	2	121828	W121828
27	Grease Seal Front Brg Ret	2	000030009	W000-030-009
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	Stop Pin Seal	2	223126000	W223-126-000
30	Dowel Pin, Upper Gear Case Side	1	CD0040R00	WCD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	CD0040R10	WCD0-040-R10
32	Pump Body - 060 U1	1	--	W060-001-010
	Pump Body - 064 U1		--	W064-001-010

	Pump Body - 130 U1		--	W130-001-010
	Pump Body - 134 U1		--	W134-001-010
33	Rectangular Flange O-Ring - Buna (Model 064)	1	N70366	WN70366
	Rectangular Flange O-Ring - Buna (Model 134)		N70369	WN70369
35	Dowel Pin, Upper Cover Side	1	CD0040000	WCD0-040-000
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Part No.**
34	Dowel Pin, Lower Cover Side	1	CD0040100	WCD0-040-100
37	SH Capscrew, SS, Body Retaining, Model 060-064	2	30-319	FSHCS31318-325-SS
	SH Capscrew, SS, Body Retaining, Model 130-134		30-423	FSHCS31318-400-SS
38	Rotor Twin Blade - #W88 Alloy - Model 060 U1	2	060010000	W060-010-000
	Rotor Twin Blade - #W88 Alloy - Model 060 U1 + .040		-------	W060-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 060 U1 + .080		-------	W060-010-000-080
	Rotor Twin Blade - #W88 Alloy - Model 130 U1		130010000	W130-010-000
	Rotor Twin Blade - #W88 Alloy - Model 130 U1 + .040		-------	W130-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 130 U1 + .080		-------	W130-010-000-080
	Single Blade Rotor - #W88 Alloy - 90° - 060 U1		117343	W117343
	Single Blade Rotor - #W88 Alloy - 90° - 130 U1		117360	W117360
42	Jam Nut	4	060052001	W060-052-001
43	Cover O-Ring - Buna	1	N70272	WN70272
	Cover O-Ring - Silicone		S75272	WS75272
	Cover O-Ring - Viton®		V70272	WV70272
	Cover O-Ring - EPDM		E70272	WE70272
44	Pump Cover	1	CD0002S00	WCD0-002-S00
	Pump Cover - Jacketed		CD0002J10	WCD0-002-J10
45	Wing Nut	8	105852	W105852
	Hex Nut		108371	W108371
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 3/8 X 3/8 X 1 5/8	1	000037003	W000-037-003

***When purchasing replacement parts for Waukesha® pumps manufactured before 07/12/04, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
26	Bearing Retainer Front	2	101812	W101812

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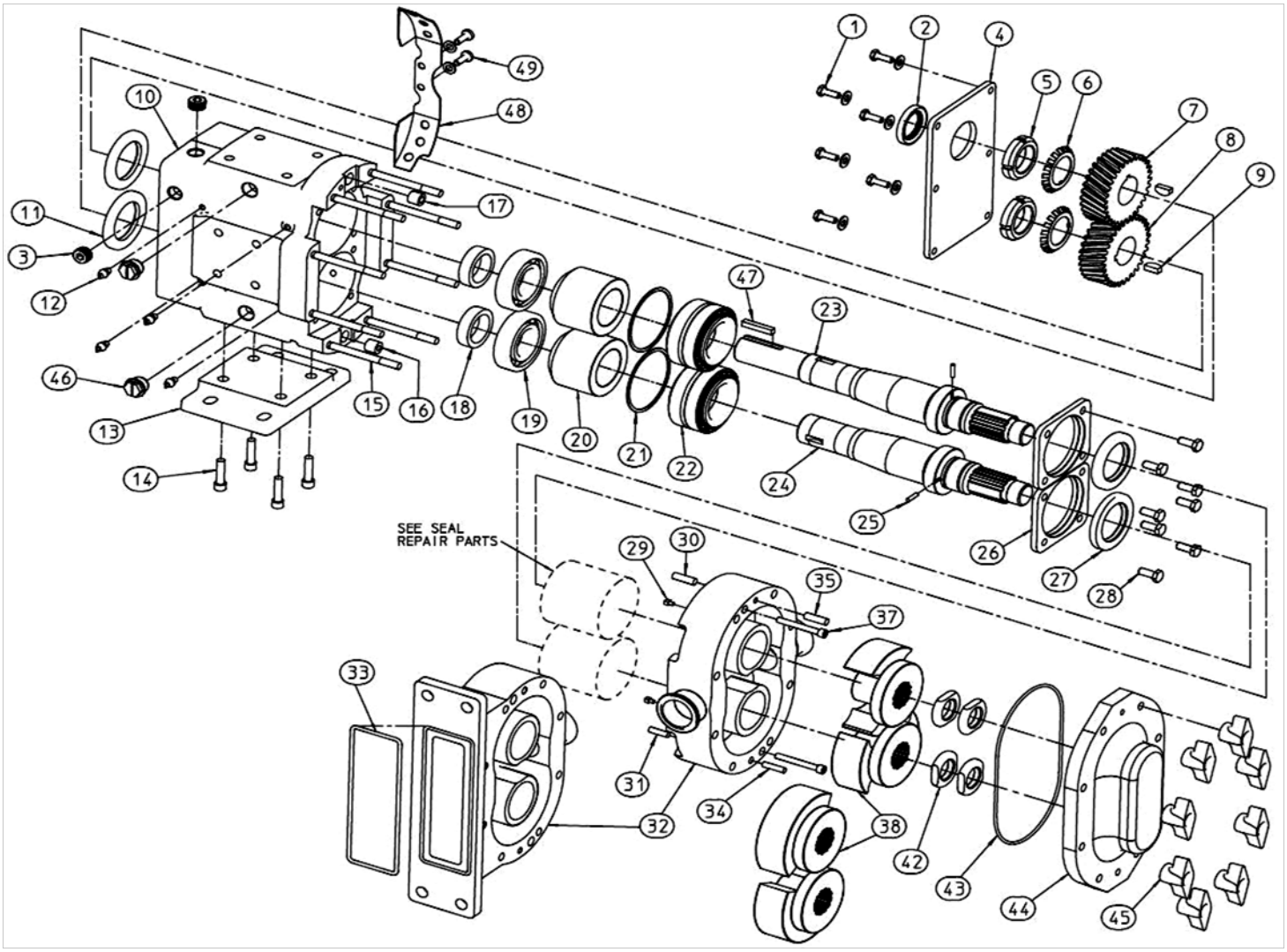
PARTS LIST - U1 -220, 224



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2	Oil Seal - Gear Case Cover	1	STD030006	WSTD-030-006
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	230106000	W230-106-000
5	Lock Nut - Gear	2	STD236011	WSTD-236-011
6	Lock Washer - Gear	2	STD136011	WSTD-136-011
7	Gear Drive Shaft	1	200007001	W200-007-001

8	Gear Short Shaft	1	200007002	W200-007-002
9	Key, Gear	2	200037000	W200-037-000
10	Gear Case, CI	1	230005000	W230-005-000
11	Oil Seal Rear	2	STD119002	WSTD-119-002
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	Mounting Shim (Gear Case Base), CI	1	230110000	W230-110-000
14	SH Capscrew, G8Z, Mount/Base, Model 220-224	4	30-111	FSHCS50013-200-G8Z
15	Stud	8	108844	W108844
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Part No.**
15	Stud	8	108844	W108844
	Stud	6	108844	W108844
	Stud, Short, U1-224	2	35550	W35550
16	Dowel Bushing, Lower	1	CD0116100	WCD0-116-100
17	Dowel Bushing, Upper	1	CD0116000	WCD0-116-000
18	Spacer Gear to Rear Bearing	2	40878	W40878
19	Rear Bearing	2	200035000	W200-035-000
20	Spacer Bearing	2	40752	W40752
21	180 - 224 Shim Kit	2	117892	W117892
22	Front Bearing	2	200036000	W200-036-000
23	Drive Shaft (17-4PH) Model 220, 224 U1	1	35349 / 220008001	W220-008-001
24	Idle Shaft (17-4PH) Model 220, 224 U1	1	35350 / 220009001	W220-009-001
25	Drive Pin	2	CD0126000	WCD0-126-000
26*	Bearing Retainer Front	2	121829	W121829
27	Grease Seal Front Brg Ret	2	121681	W121681
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	Stop Pin Seal	2	223126000	W223-126-000
30	Dowel Pin, Upper Gear Case Side	1	CD0040R00	WCD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	CD0040R10	WCD0-040-R10
32	Pump Body - 220 U1	1	--	W220-001-010
	Pump Body - 224 U1		--	W224-001-010
33	Rectangular Flange O-Ring - Buna	1	N70376	WN70376
35	Dowel Pin, Upper Cover Side	1	GD0040000	WGD0-040-000
34	Dowel Pin, Upper Cover Side	1	GD0040000	WGD0-040-000
37	SH Capscrew, SS, Body Retaining, Model 220/380	2	30-499	FSHCS37516-450-SS
38	Rotor Twin Blade - #W88 Alloy - Model 220 U1	2	220010000	W220-010-000
	Rotor Twin Blade - #W88 Alloy - Model 220 U1 + .040		-------	W220-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 220 U1 + .080		-------	W220-010-000-080
	Single Blade Rotor - #W88 Alloy - 90° - 220 U1		117391	W117391
42	Jam Nut	4	GD0052001	WGD0-052-001

43	Cover O-Ring - Silicone	1	GD0117SC0	WGD0-117-SC0
	Cover O-Ring - Buna		GD0117000	WGD0-117-000
	Cover O-Ring - Viton®		GD0117V00	WGD0-117-V00
	Cover O-Ring - EPDM		GD0117002	WGD0-117-002
44	Pump Cover	1	GD0002S00	WGD0-002-S00
45	Wing Nut	8	105853	W105853
	Hex Nut		108372	W108372
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 1/2 X 1/2 X 1 7/8	1	000037004	W000-037-004

***When purchasing replacement parts for Waukesha® pumps manufactured before 07/12/04, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
26	Bearing Retainer Front	2	101813	W101813

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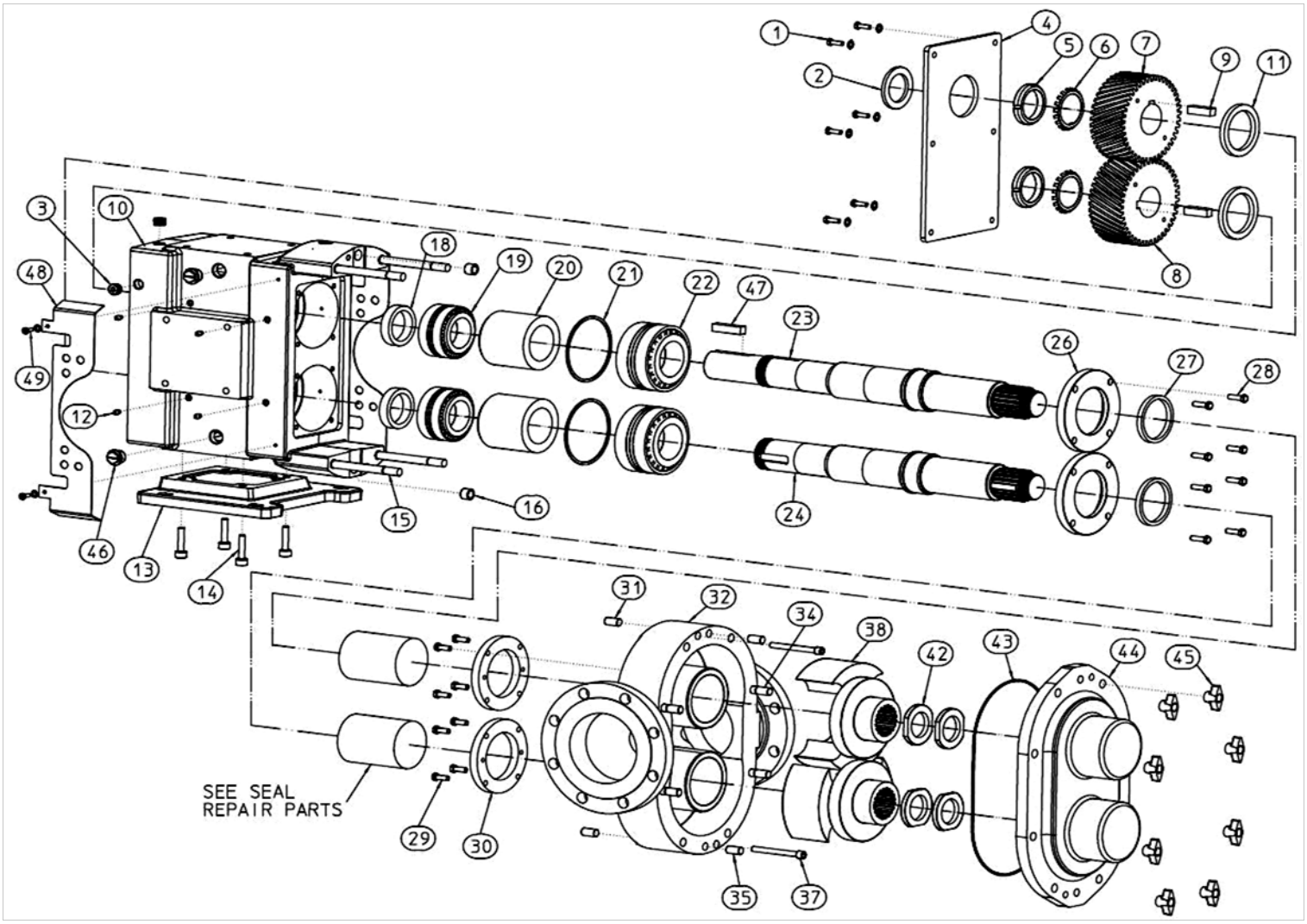
PARTS LIST - U1-320, 324



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2*	Oil Seal - Gear Case Cover	1	STD030006	WSTD-030-006
3	Oil Plug 030-523, Gearbox	46	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	40669	W40669
5	Lock Nut - Gear	2	105697	W105697
6	Lock Washer - Gear	2	STD136005	WSTD-136-005
7	Gear Drive Shaft	1	102470	W102470
8	Gear Drive Shaft	1	102470	W102470
9	Key, Gear	2	0H1037000	W0H1-037-000

10	Gear Case, CI	1	40616	W40616
11*	Oil Seal Rear	2	102475	W102475
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	Mounting Shim (Gear Case Base), CI	1	40288	W40288
14	SH Capscrew, G8Z, Mount/Base, Model 320-323	4	30-250	FSHCS50013-175-G8Z
15	Stud, Cover, Long	4	111291	W111291
16	Dowel Bushing, Gearbox	2	0H1116000	W0H1-116-000
18	Spacer Gear to Rear Bearing	2	102474	W102474
19	Rear Bearing	2	0H1036000	W0H1-036-000
Item	**Description**	**QuantityPer Pump**	**Reference Part No.**	**ZMT Part No.**
20	320 front Bearing Spacer	2	102472	W102472
21	210 - 324 Shim Kit	2	117893	W117893
22	Front Bearing	2	0H1036003	W0H1-036-003
23	Drive Shaft (17-4PH) Model 320, 323, 324 U1	1	113520 / 320008001	W320-008-001
24	Idle Shaft (17-4PH) Model 320, 323, 324 U1	1	113521 / 320009001	W320-009-001
26*	Bearing Retainer Front	2	123533	W123533
27	Grease Seal Front Brg Ret	2	121681	W121681
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	HH Capscrew, SS, Gland, Model 320-324	8	30-60	FHCS37516-125-SS
29a	Lock Washer, Gland, Model 320-324	8	43-28	FLW-375-SS
30	Seal Gland, No Flush	2	300034003	W300-034-003
	Seal Gland, W/Flush Holes		300034001	W300-034-001
31	Dowel Pin, Gear Case Side	2	--	W320-004-R00
32	Pump Body - 320 U1	1	--	W320-001-010
34	Stud, Cover, Short	4	111292	W111292
35	Dowel Pin, Cover Side	2	--	W320-004-000
37	SH Capscrew, SS, Body Retaining, Model 180/320/323	2	30-323	FSHCS37516-400-SS
38	Rotor Twin Blade - #W88 Alloy - Model 320 U1, 323+ ZD-Evo	2	320010000	W320-010-000
	Rotor Twin Blade - #W88 Alloy - Model 320 U1 + .040		-------	W320-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 320 U1 + .080		-------	W320-010-000-080
	Rotor Twin Blade - #W88 Alloy - Model 323 U1		323010000	W323-010-000
	Rotor Twin Blade - #W88 Alloy - Model 323 U1 + .040		-------	W323-010-000-040
	Rotor Twin Blade - #W88 Alloy - Model 323 U1 + .080		-------	W323-010-000-080
42	Pump Cover	4	0H1002002	W0H1-002-002
43	Cover O-Ring - Buna	1	N70280	WN70280
	Cover Gasket O-Ring - Silicone		323117013	W323-117-013
	Cover O-Ring - Viton®		V70280	WV70280
	Cover O-Ring - EPDM		E70280	WE70280

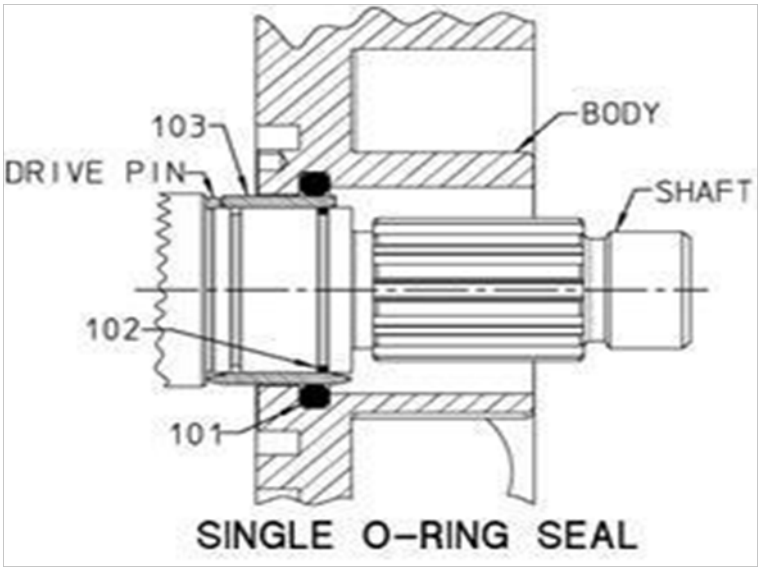
44	Pump Cover	1	0H1002002	W0H1-002-002
45	Wing Nut	8	110858	W110858
	Hex Nut (optional)		108373	W108373
46	Large Cleanout Plug	4	--	W35824
47	Drive Shaft Key, 5/8 X 5/8 X 2 3/4	1	000037005	W000-037-005

***When purchasing replacement parts for Waukesha® pumps manufactured before July 2001, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
2	Oil Seal, Gear Case Rear	2	STD119000	WSTD-119-000

***When purchasing replacement parts for Waukesha® pumps, order the following parts.**

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
2	Oil Seal - Gear Case Cover	2	STD030004	WSTD-030-004



ZD-U1 Single O-ring Seal:

Item	Description	Quantity Per Pump	U1-006, 015, 018, 024 ZMT Part No.	U1-030, 034 ZMT Part No.	U1-060, 064, 130, 134 ZMT Part No.	U1-220, 224 ZMT Part No.
101	Body O-Ring - Buna	2	WAD0-079-000	WN70327	WN70331	WN70338
	Body O-Ring - EPDM		WAD0-079-002	WE70327	WE70331	WE70338
	Body O-Ring - Viton®		WAD0-079-V00	WV70327	WV70331	WV70338
	Body O-Ring - Silicone		WAD0-079-SC0	WS75327	WS75331	WS75338
102	Shaft O-Ring - Buna	2	WN70022	WN70028	WN70131	WN70144
	Shaft O-Ring - EPDM		WE70022	WE70028	WE70131	WE70144
	Shaft O-Ring - Viton®		WV70022	WV70028	WV70131	WV70144
	Shaft O-Ring - Silicone		WS75022	WS75028	WS75131	WS75144
103	Sleeve SS	2	W015-098-000	W030-098-000	W060-098-000	W220-098-000
	Sleeve Zirconia		W015-098-004	W030-098-004	W060-098-004	W220-098-004

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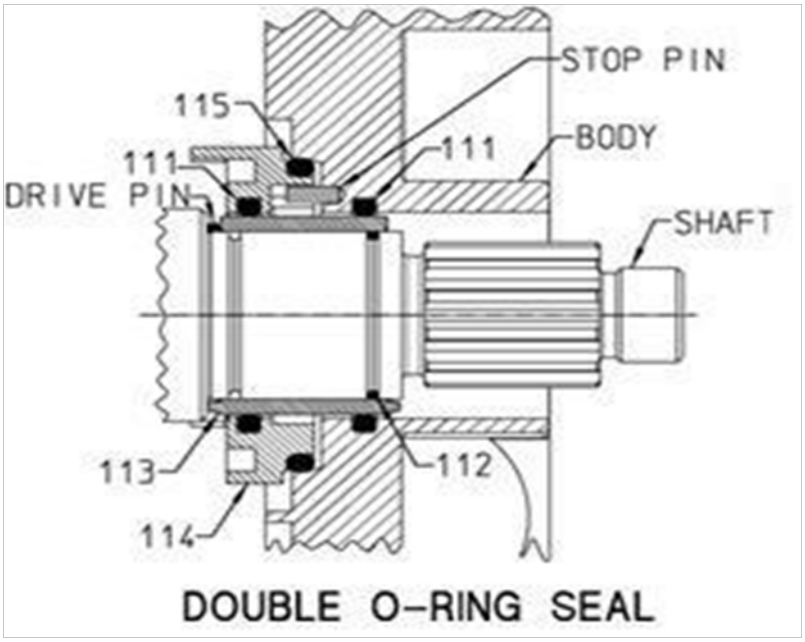
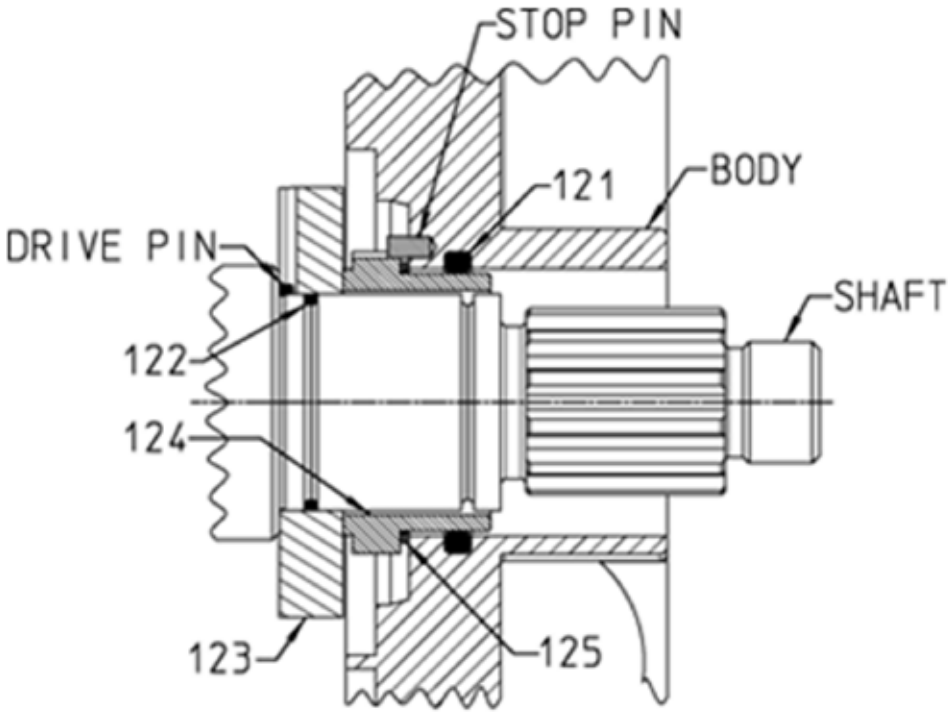


ZD-U1 Double O-ring Seal:

Item	Description	Quantity Per Pump	U1-006, 015, 018, 024 ZMT Part No.	U1-030, 034 ZMT Part No.	U1-060, 064, 130, 134 ZMT Part No.	U1-220, 224 ZMT Part No.
111	Body O-Ring - Buna	4	WAD0-079-000	WN70327	WN70331	WN70338
	Body O-Ring - EPDM		WAD0-079-002	WE70327	WE70331	WE70338
	Body O-Ring - Viton®		WAD0-079-V00	WV70327	WV70331	WV70338
	Body O-Ring - Silicone		WAD0-079-SC0	WS75327	WS75331	WS75338
112	Shaft O-Ring - Buna	2	WN70022	WN70028	WN70131	WN70144
	Shaft O-Ring - EPDM		WE70022	WE70028	WE70131	WE70144
	Shaft O-Ring - Viton®		WV70022	WV70028	WV70131	WV70144
	Shaft O-Ring - Silicone		WS75022	WS75028	WS75131	WS75144
113	Sleeve SS	2	W015-098-000	W030-098-000	W060-098-000	W220-098-000
	Sleeve Zirconia		W015-098-004	W030-098-004	W060-098-004	W220-098-004
114*	O-Ring Seal Carrier	2	W015-034-000	W030-034-000	W060-034-000	W220-034-001
115	Outer Seal O-Ring - Buna	2	WN50228	WN50335	WN50338	WN50344
	Outer Seal O-Ring - EPDM		WE50228	WE50335	WE50338	WE50344
	Outer Seal O-Ring - Viton®		WV50228	WV50335	WV50338	WV50344

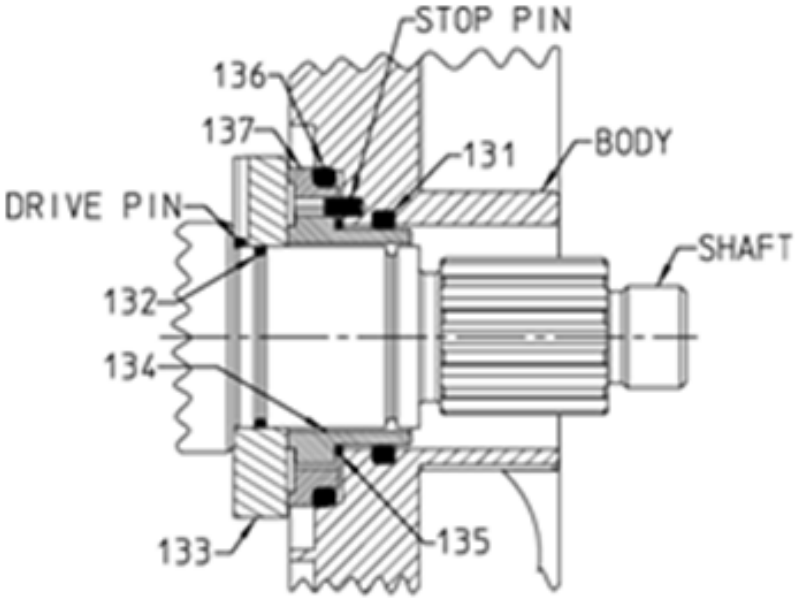


U1 Single Mechanical Seal - OEM Style

ZD-U1 Single Mechanical Seal:

Item	Description	Quantity Per Pump	U1-006, 015, 018, 024 ZMT Part No.	U1-030, 034 ZMT Part No.	U1-060, 064, 130, 134 ZMT Part No.	U1-220, 224 ZMT Part No.
121	Body O-Ring - Buna	2	WAD0-079-000	WN70327	WN70331	WN70338
	Body O-Ring - EPDM		WAD0-079-002	WE70327	WE70331	WE70338
	Body O-Ring - Viton®		WAD0-079-V00	WV70327	WV70331	WV70338
	Body O-Ring - Silicone		WAD0-079-SC0	WS75327	WS75331	WS75338
122	Shaft O-Ring - Buna	2	WN70022	WN70028	WN70131	WN70144
	Shaft O-Ring - EPDM		WE70022	WE70028	WE70131	WE70144
	Shaft O-Ring - Viton®		WV70022	WV70028	WV70131	WV70144
	Shaft O-Ring - Silicone		WS75022	WS75028	WS75131	WS75144
123	Seal Seat, Ceramic	2	W006-00-7000	W030-00-7000	W130-00-7000	W220-00-7000
	Seal Seat, Silicon Carbide		W006-00-2000	W030-00-2000	W130-00-2000	W220-00-2000
	Seal Seat, Silicon Carbide - 2 piece		W006Z-00-2000	W030Z-00-2000	W130Z-00-2000	W220Z-00-2000
	Seal Seat, Chrome Oxide		W015-014-001	W030-014-001	W060-014-001	W220-014-001
124	Inner Seal, Carbon - 1 piece	2	W006-00-0500	W030-00-0500	W130Z-00-0500	W220Z-00-0500
	Inner Seal, Ceramic		W006-00-0700	W030-00-0700	W130Z-00-0700	W220Z-00-0700
	Inner Seal, Silicon Carbide		W006-00-0200	W030-00-0200	W130Z-00-0200	W220Z-00-0200
	Inner Seal, Chrome Oxide		W015-306-002	W030-306-002	W060-306-002	W220-306-002
125	Wave Spring	2	W015-304-000	W030-304-000	W060-304-000	W220-304-000
--	006 - 024 ZMT Engineered Complete Single Seal	2	W006Z-00-2200E	W030Z-00-2200E	W130Z-00-2200E	W220Z-00-2200E

Seal Parts List ZD - U1 Double Mechanical Seal ZM Technologies



U1 Double Mechanical Seal - OEM Style

ZD-U1 Double Mechanical Seal:

Item	Description	Quantity Per Pump	U1-006, 015, 018, 024 ZMT Part No.	U1-030, 034 ZMT Part No.	U1-060, 064, 130, 134 ZMT Part No.	U1-220, 224 ZMT Part No.
131	Body O-Ring - Buna	2	WAD0-079-000	WN70327	WN70331	WN70338
	Body O-Ring - EPDM		WAD0-079-002	WE70327	WE70331	WE70338
	Body O-Ring - Viton®		WAD0-079-V00	WV70327	WV70331	WV70338
	Body O-Ring - Silicone		WAD0-079-SC0	WS75327	WS75331	WS75338
132	Shaft O-Ring - Buna	2	WN70022	WN70028	WN70131	WN70144
	Shaft O-Ring - EPDM		WE70022	WE70028	WE70131	WE70144
	Shaft O-Ring - Viton®		WV70022	WV70028	WV70131	WV70144
	Shaft O-Ring - Silicone		WS75022	WS75028	WS75131	WS75144
133	Seal Seat, Ceramic	2	W006-00-7000	W030-00-7000	W130-00-7000	W220-00-7000
	Seal Seat, Silicon Carbide		W006-00-2000	W030-00-2000	W130-00-2000	W220-00-2000
	Seal Seat, Chrome Oxide		W015-014-001	W030-014-001	W060-014-001	W220-014-001
134	Inner Seal, Carbon - 1 piece	2	W006-00-0500	W030-00-0500	W130Z-00-0500	W220Z-00-0500
	Inner Seal, Ceramic		W006-00-0700	W030-00-0700	W130Z-00-0700	W220Z-00-0700
	Inner Seal, Silicon Carbide		W006-00-0200	W030-00-0200	W130Z-00-0200	W220Z-00-0200
	Inner Seal, Chrome Oxide		W015-306-002	W030-306-002	W060-306-002	W220-306-002
135	Wave Spring	2	W015-304-000	W030-304-000	W060-304-000	W220-304-000
136	Outer Seal O-Ring - Buna	2	WN50228	WN50335	WN50338	WN50344
	Outer Seal O-Ring - EPDM		WE50228	WE50335	WE50338	WE50344
	Outer Seal O-Ring - Viton®		WV50228	WV50335	WV50338	WV50344
137	Outer Seal, Carbon - 1 piece	2	W006-00-0005	W030-00-0005	W130-00-0005	W220-00-0005

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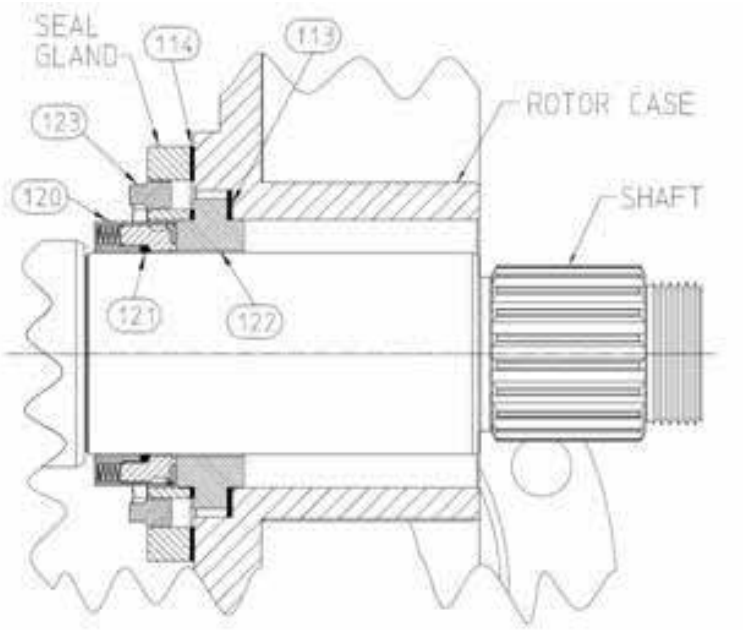
Seal Parts List ZD - U1 320 Single Mechanical Seal ZM Technologies

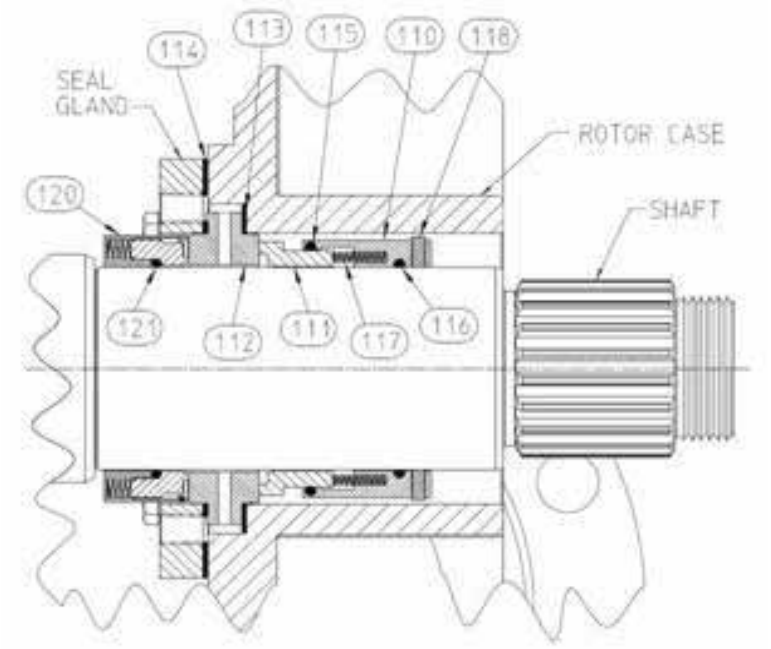


320U1 Outer Single Seal

Single Mechanical Seal (Outer):

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
113	Gasket, Inner	2	300042001	W300-042-001
114	Gasket, Outer W/Flush Holes	2	300042002	W300-042-002
120	8B2 Outer Seal, Carbon	2	323114003	W323-00-0050
	8B2 Outer Seal, Silicone Carbide		--	W323-00-0020
	8B2 Outer Seal, Chrome Oxide		323000060	W323-00-0060
121	Inner Seal O-Ring - Buna	2	N70234	WN70234
	Inner Seal O-Ring - EPDM		E70234	WE70234
	Inner Seal O-Ring - Viton®		V70234	WV70234
	Inner Seal O-Ring - Silicone		S75234	WS75234
122	"T" Seat, No Flush, Silicon Carbide	2	300014016	W320-52X-0200
123	Seal Gland, W/Flush Holes	4	300034001	W300-034-001
--	320 - 324 ZMT Engineered Cartridge Single Seal	2	--	W320Z-00-2200E

Seal Parts List ZD - U1 320 Single Mechanical Seal ZM Technologies



320U1 Double Seal

Double Mechanical Seal:

Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
110	Inner Seal, Silicon Carbide	2	40572	W323-00-2000
	Inner Seal, Chrome Oxide		40574	W40574
112	"T" Seat, With Flush, Silicon Carbide	2	300014031	W323-52-0200
	"T" Seat, With Flush, Chrome Oxide		300014029	W300-014-029
	"T" Seat, With Flush, Ceramic		300014027	W323-52-0700
113	Gasket, Inner	2	300042001	W300-042-001
114	Gasket, Outer W/Flush Holes	2	300042002	W300-042-002
116	Inner Seal O-Ring - Buna	2	N70234	WN70234
	Inner Seal O-Ring - EPDM		E70234	WE70234
	Inner Seal O-Ring - Viton®		V70234	WV70234
	Inner Seal O-Ring - Silicone		S75234	WS75234
120	8B2 Outer Seal, Carbon	2	323114003	W323-00-0050
	8B2 Outer Seal, Silicone Carbide		--	W323-00-0020
	8B2 Outer Seal, Chrome Oxide		323000060	W323-00-0060
121	Inner Seal O-Ring - Buna	2	N70234	WN70234
	Inner Seal O-Ring - EPDM		E70234	WE70234
	Inner Seal O-Ring - Viton®		V70234	WV70234
	Inner Seal O-Ring - Silicone		S75234	WS75234

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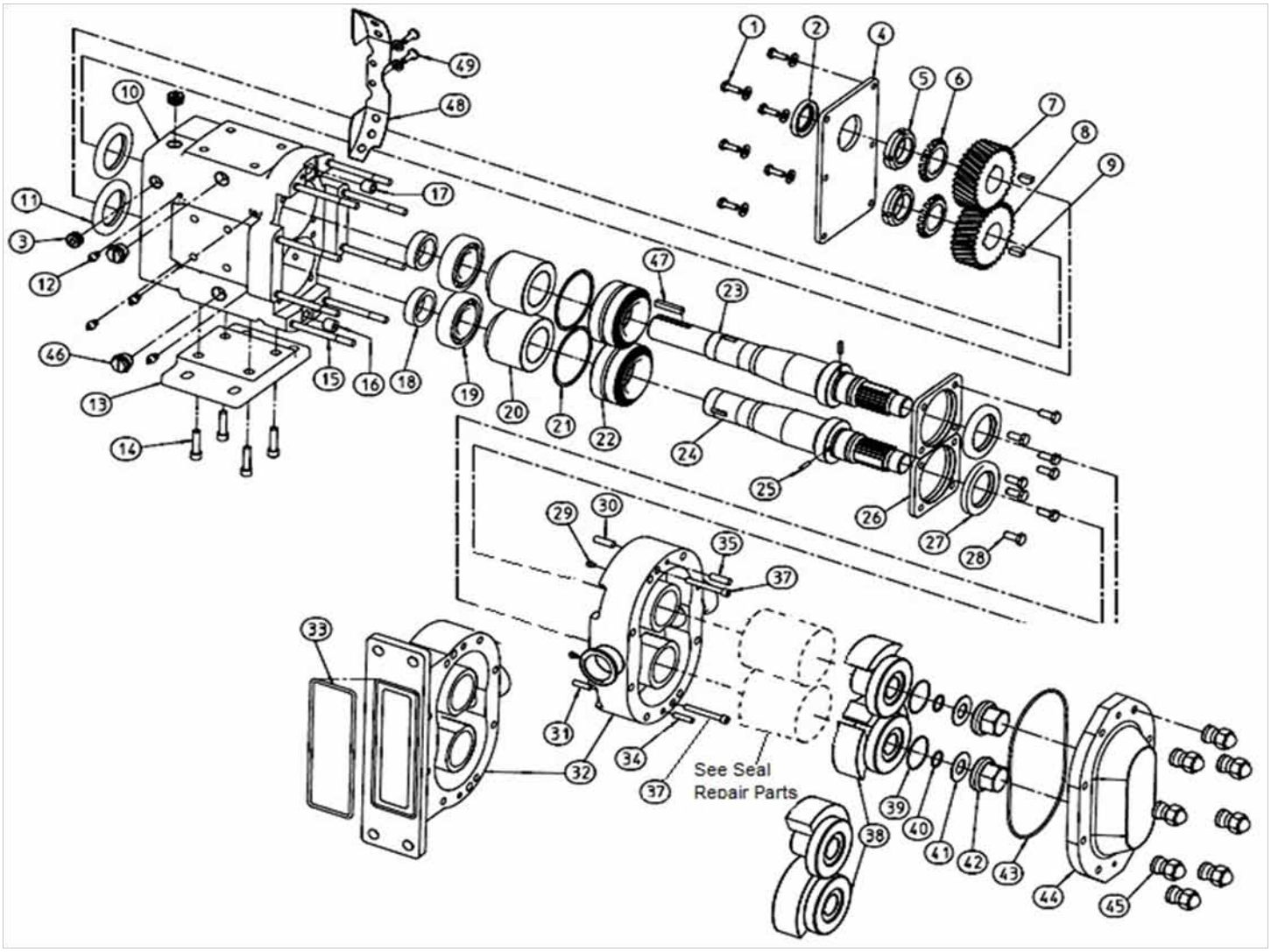
PARTS LIST - Evolution - 006, 015, 018 (fits a U1 or U2 footprint)



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 006--024	6	30-287	FHCS25020-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 006--024	6	43-108	FFW250C
2	Oil Seal - Gear Case Cover	1	000030016	W000-030-016
3	Oil Plug 006-018, Gearbox	6	000046002	W000-046-002
4	Gear Case Cover, Steel (includes installed seal)	1	020106000	W020-106-000
	Gear Case Cover, SS (includes installed seal)		102280	W102280
5	Lock Nut - Gear	2	STD236005	WSTD-236-005
6	Lock Washer - Gear	2	STD136005	WSTD-136-005
7	Gear Drive Shaft	1	015007001	W015-007-001

8	Gear Short Shaft	1	015007002	W015-007-002
9	Key, Gear	2	015037000	W015-037-000
10	ZD-Evo Gear Case, CI	1	--	W102276Z
	ZD-Evo Gear Case, SS		--	W101831Z
11	Oil Seal Rear	2	000030017	W000-030-017
,M	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	ZD-Evo Mounting Shim (Gear Case Base), CI	1	--	W020Z-110-000
	ZD-Evo Mounting Shim (Gear Case Base), SS		--	W102284Z
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
14	SH Capscrew, G8Z, Mount/Base, Model 006-024	4	30-343	FSHCS31318-100-G8Z
15	Stud	8	AD0011000	WAD0-011-000
	Stud Jacketed Cover		AD0011J00	WAD0-011-J00
	Stud	8	018011000	W018-011-000
	Stud Jacketed Cover		AD0011100	WAD0-011-100
	Stud	6	018011000	W018-011-000
	Short Stud, Std Cover - 024-U1	2	35547	W35547
	Stud Jacketed Cover	6	AD0011100	WAD0-011-100
	Stud, Jacketed Cover, U1-018	2	35548	W35548
16	Dowel Bushing, Lower	1	AD0116100	WAD0-116-100
17	Dowel Bushing, Upper	1	AD0116000	WAD0-116-000
18	Spacer Gear to Rear Bearing	2	015055000	W015-055-000
19	Rear Bearing	2	015035000	W015-035-000
20	Spacer Bearing	2	101814	W101814
21	006 - 024 Shim Kit	2	117889	W117889
22	Front Bearing	2	101714	W101714
23	Drive Shaft (316L SS) Model 006, 015 ZD-Evo	1	--	W114642Z
	Drive Shaft (316L SS) Model 018 ZD-Evo		--	W114644Z
24	Idle Shaft (316L SS) Model 006, 015 ZD-Evo	1	--	W114643Z
	Idle Shaft (316L SS) Model 018 ZD-Evo		--	W114645Z
25	Drive Pin	2	CD0126000	WCD0-126-000
26	Bearing Retainer Front	2	120332	W120332
27	Grease Seal Front Brg Ret	2	121679	W121679
28	BH Capscrew, SS, Brg Ret, Model 006--024	8	30-58	FBHCS25020-075-SS
29	Stop Pin Seal	2	015126000	W015-126-000
30	Dowel Pin, Upper Gear Case Side	1	AD0040R00	WAD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	AD0040R10	WAD0-040-R10
32	Pump Body - 006 ZD-Evo	1	--	W006Z-001-010
	Pump Body - 015 ZD-Evo		--	W015Z-001-010
	Pump Body - 018 ZD-Evo		--	W018Z-001-010

33	Rectangular Flange O-Ring - Buna	1	N70245	WN70245
34	Dowel (lower cover)	1	AD0040100	WAD0-040-100
35	Dowel (upper cover)	1	AD0040000	WAD0-040-000
37	SH Capscrew, SS, Body Retaining, Model 006--015	2	30-523	FSHCS25020-125-SS
	SH Capscrew, SS, Body Retaining, Model 018--030		30-211	FSHCS25020-200-SS
38	Rotor Twin Blade - #W88 Alloy - Model 006 ZD-Evo	2	006010000	W006Z-010-000
	Rotor Twin Blade - #W88 Alloy - Model 015 ZD-Evo		015010000	W015Z-010-000
	Rotor Twin Blade - #W88 Alloy - Model 018 ZD-Evo		018010000	W018Z-010-000
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
39	Rotor Nut O-Ring - Buna	2	N70126	WN70126
	Rotor Nut O-Ring - EPDM		E70126	WE70126
	Rotor Nut O-Ring - Viton®		V70126	WV70126
40	Retainer O-Ring - Buna	2	N70112	WN70112
	Retainer O-Ring - EPDM		E70112	WE70112
	Retainer O-Ring - Viton®		V70112	WV70112
41	Washer, Belleville	2	101691	W101691
42	Rotor Nut	2	101804	W101804
43	Cover O-Ring - Buna	1	N70249	WN70249
	Cover O-Ring - EPDM		E70249	WE70249
	Cover O-Ring - Viton®		V70249	WV70249
44	ZD-Evo Pump Cover	1	--	WAD0Z-002-S00
45	Hex Nut	8	108369	W108369
	Wing Nut		105850	W105850
46	Large Cleanout Plug	4	--	W35824
47	Drive Shaft Key, 3/16 X 3/16 X 1 1/8	1	000037001	W000-037-001
	O-Ring Removal Tool		AD0096001	WAD0-096-001
	Chevron RPM Universal Gear Oil SAE 85W-140		000140003	W000-140-003
	Grease, Chevron Ultra-Duty EP 2 NLGI, 14 oz. Cartridge		000140002	W000-140-002
	Sealant RTV		000142301	W000-142-301
	Grease Fitting Cap, Yellow Plastic	8	BD0093000	WBD0-93-000
	Plastic Cap Tapped Holes, Mounting Pad	12	000121003	W000-121-003
	Eye Bolt	2	30-360	W30-360

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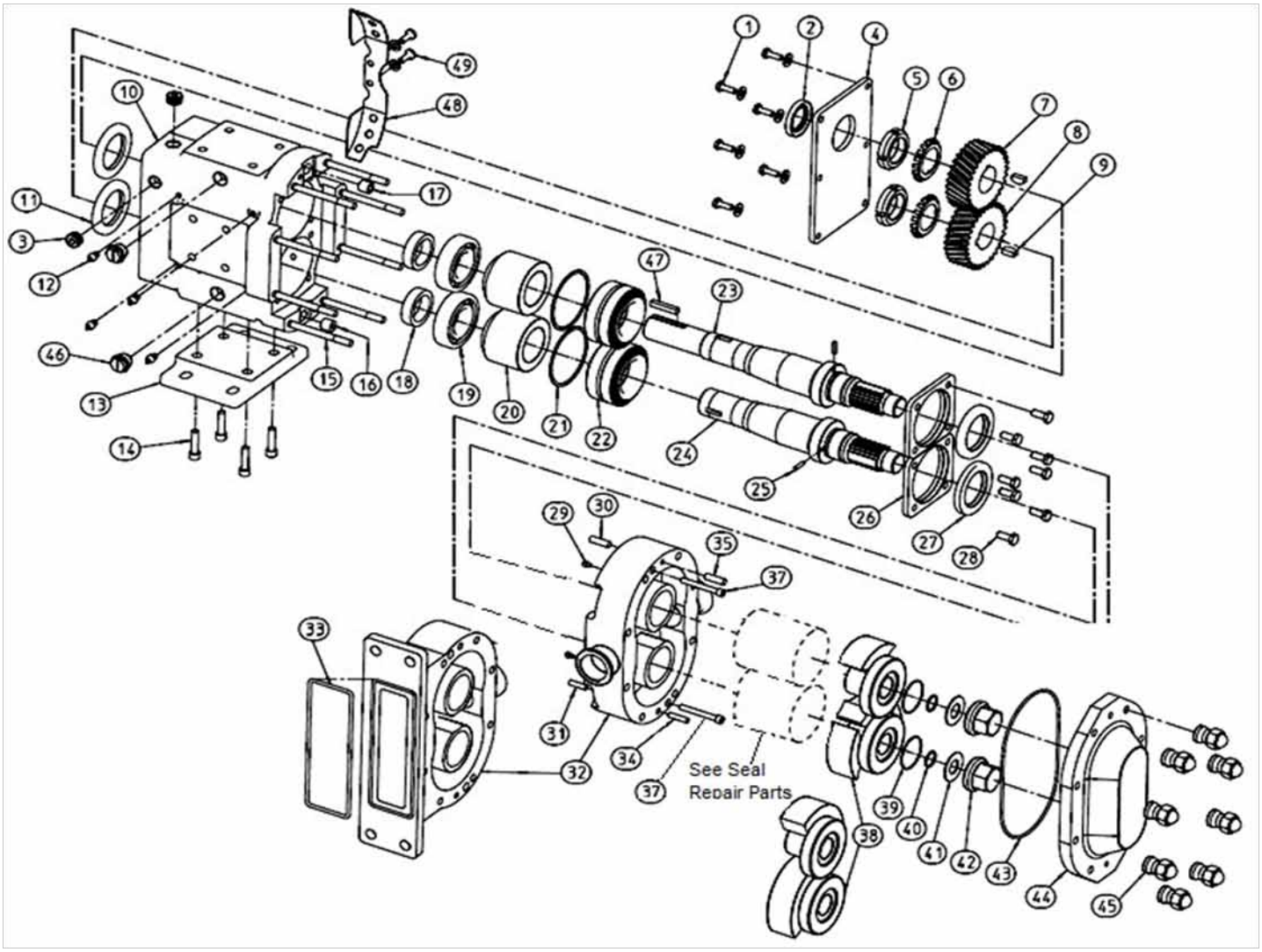
PARTS LIST - Evolution - 030, 034 (fits a U1 or U2 footprint)



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Pump Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 030-034	6	30-283	FHCS31318-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 030-034	6	43-194	FFW313C
2	Oil Seal - Gear Case Cover	1	000030013	W000-030-013
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	040106000	W040-106-000
	Gear Case Cover, SS (includes installed seal)		102281	W102281
5	Lock Nut - Gear	2	CD0036N00	WCD0-036-N00

6	Lock Washer - Gear	2	CD0036W00	WCD0-036-W00
7	Gear Drive Shaft	1	030007001	W030-007-001
8	Gear Short Shaft	1	030007002	W030-007-002
9	Key, Gear	2	015037000	W015-037-000
10	ZD-Evo Gear Case, CI	1	--	W102276Z
	ZD-Evo Gear Case, SS		--	W101833Z
11	Oil Seal Rear	2	000030017	W000-030-017
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	Mounting Shim (Gear Case Base), CI	1	040110000	W040-110-000
	Mounting Shim (Gear Case Base), SS		102285	W102285
14	SH Capscrew, G8Z, Mount/Base, Model 030-034	4	30-344	FSHCS37516-100-G8Z
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Pump Part No.**
15	Stud	8	108842	W108842
	Stud Jacketed Cover		108845	W108845
	Stud	6	108842	W108842
	Stud, Short, U1-034	2	35555	W35555
	Stud Jacketed Cover	6	108845	W108845
	Stud, Short, Jacketed Cover, U1-034	2	35549	W35549
16	Dowel Bushing, Lower	1	BD0116100	WBD0-116-100
17	Dowel Bushing, Upper	1	BD0116000	WBD0-116-000
18	Spacer Gear to Rear Bearing	2	030055000	W030-055-000
19	Rear Bearing	2	030035000	W030-035-000
20	Spacer Bearing	2	101815	W101815
21	030 - 034 Shim Kit	2	----------	W117890
22	Front Bearing	2	101715	W101715
23	Drive Shaft (17-4PH) Model 030, 034 ZD-Evo	1	114779	W114779Z
24	Idle Shaft (17-4PH) Model 030, 034 ZD-Evo	1	---	W114780Z
25	Drive Pin	2	CD0126000	WCD0-126-000
26	Bearing Retainer Front	2	120333	W120333
27	Grease Seal Front Brg Ret	2	121680	W121680
28	BH Capscrew, SS, Brg Ret, Model 030-034	8	30-29	FBHCS31318-075-SS
29	Stop Pin Seal	2	030126000	W030-126-000
30	Dowel Pin, Upper Gear Case Side	1	BD0040200	WBD0-040-200
31	Dowel Pin, Lower Gear Case Side	1	BD0040300	WBD0-040-300
32	Pump Body - 030 ZD-Evo	1	--	W030Z-001-010
	Pump Body - 034 ZD-Evo		--	W034Z-001-010
33	Rectangular Flange O-Ring - Buna	1	N70357	WN70357
35	Dowel Pin, Upper Cover Side	1	BD0040000	WBD0-040-000
34	Dowel Pin, Lower Cover Side	1	BD0040100	WBD0-040-100
37	SH Capscrew, SS, Body Retaining, Model 018--030	2	30-211	FSHCS25020-200-SS
38	Rotor Twin Blade - #W88 Alloy - Model 030 U1	2	030010000	W030-010-000

	Single Blade Rotor - #W88 Alloy - 90° - 030 U1	1	117291	W117291
35	Dowel (upper cover)	1	AD0040000	WAD0-040-000
38	Rotor Twin Blade - #W88 Alloy - Model 030 ZD-Evo	2	030010000	W030Z-010-000
	Single Blade Rotor - #W88 Alloy - 90° - 030 ZD-Evo		--	W117291Z
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
36	Rotor Hub O-Ring/ZD-Evo Inner/Outer Stationary O-Ring - Buna	2	N70127	WN70127
	Rotor Hub O-Ring/ZD-Evo Inner/Outer Stationary O-Ring - EPDM		E70127	WE70127
	Rotor Hub O-Ring/ZD-Evo Inner/Outer Stationary O-Ring - Viton®		V70127	WV70127
37	SH Capscrew, SS, Body Retaining, Model 018--030	2	30-211	FSHCS25020-200-SS
38	Rotor Twin Blade - #W88 Alloy - Model 030 U2	2	102151	W030U2-010-000
39	Rotor Nut O-Ring - Buna	2	N70130	WN70130
	Rotor Nut O-Ring - EPDM		E70130	WE70130
	Rotor Nut O-Ring - Viton®		V70130	WV70130
40	Retainer O-Ring - Buna	2	N70115	WN70115
	Retainer O-Ring - EPDM		E70115	WE70115
	Retainer O-Ring - Viton®		V70115	WV70115
41	Washer, Belleville	2	101692	W101692
42	Rotor Nut	2	101805	W101805
43	Cover O-Ring - Buna	1	N70259	WN70259
	Cover O-Ring - EPDM		E70259	WE70259
	Cover O-Ring - Viton®		V70259	WV70259
44	ZD-Evo Pump Cover	1	--	WBD0Z-002-S00
45	Hex Nut	8	108370	W108370
	Wing Nut		105851	W105851
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 1/4 X 1/4 X 1 3/4	1	000037002	W000-037-002
	O-Ring Removal Tool		AD0096001	WAD0-096-001
	Chevron RPM Universal Gear Oil SAE 85W-140		000140003	W000-140-003
	Grease, Chevron Ultra-Duty EP 2 NLGI, 14 oz. Cartridge		000140002	W000-140-002
	Sealant RTV		000142301	W000-142-301
	Grease Fitting Cap, Yellow Plastic	8	BD0093000	WBD0-93-000
	Plastic Cap Tapped Holes, Mounting Pad	12	000121002	W000-121-002
	Eye Bolt	2	30-360	W30-360

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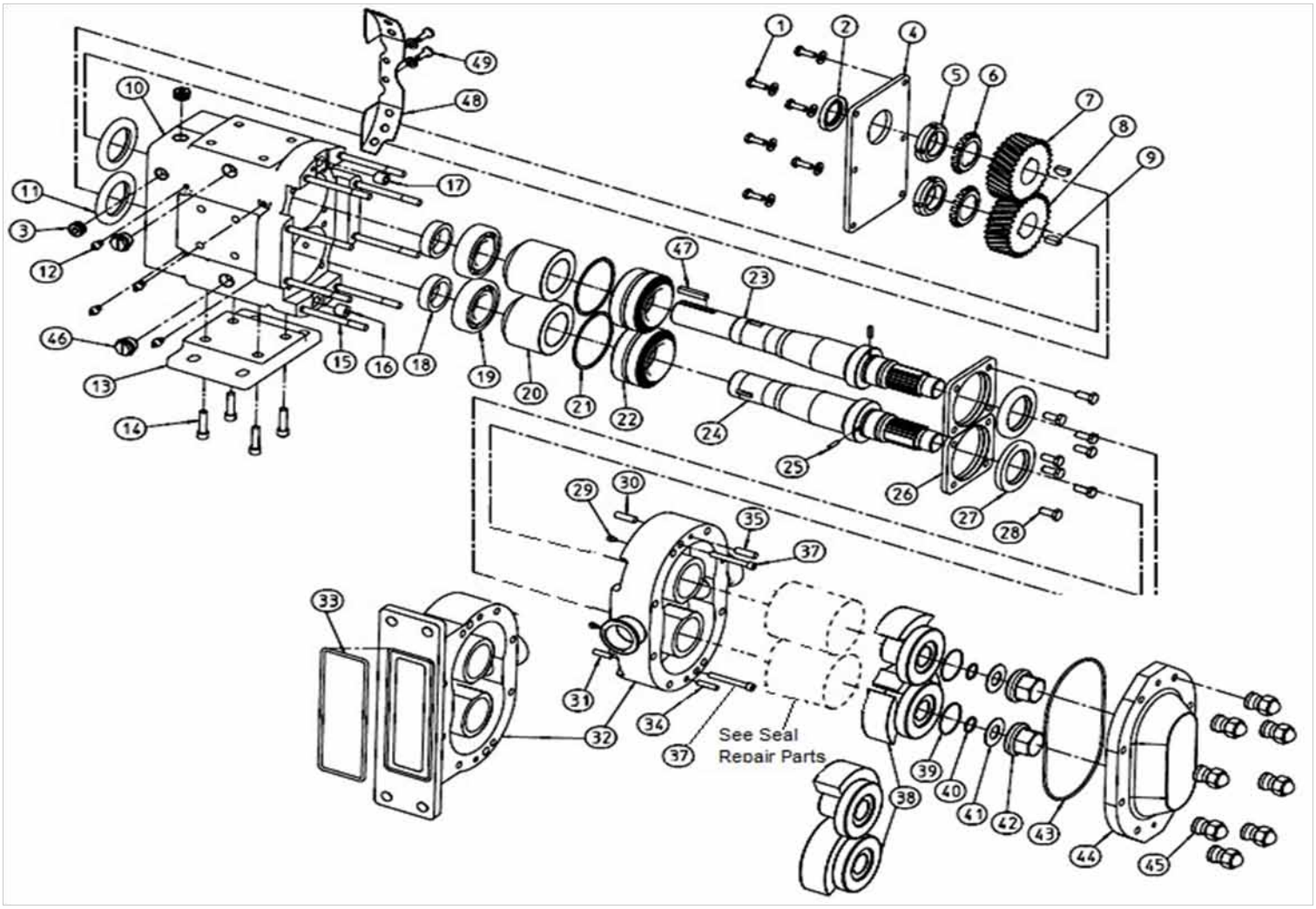
PARTS LIST - Evolution - 045, 060, 064, 130, 134 (fits a U1 or U2 footprint)



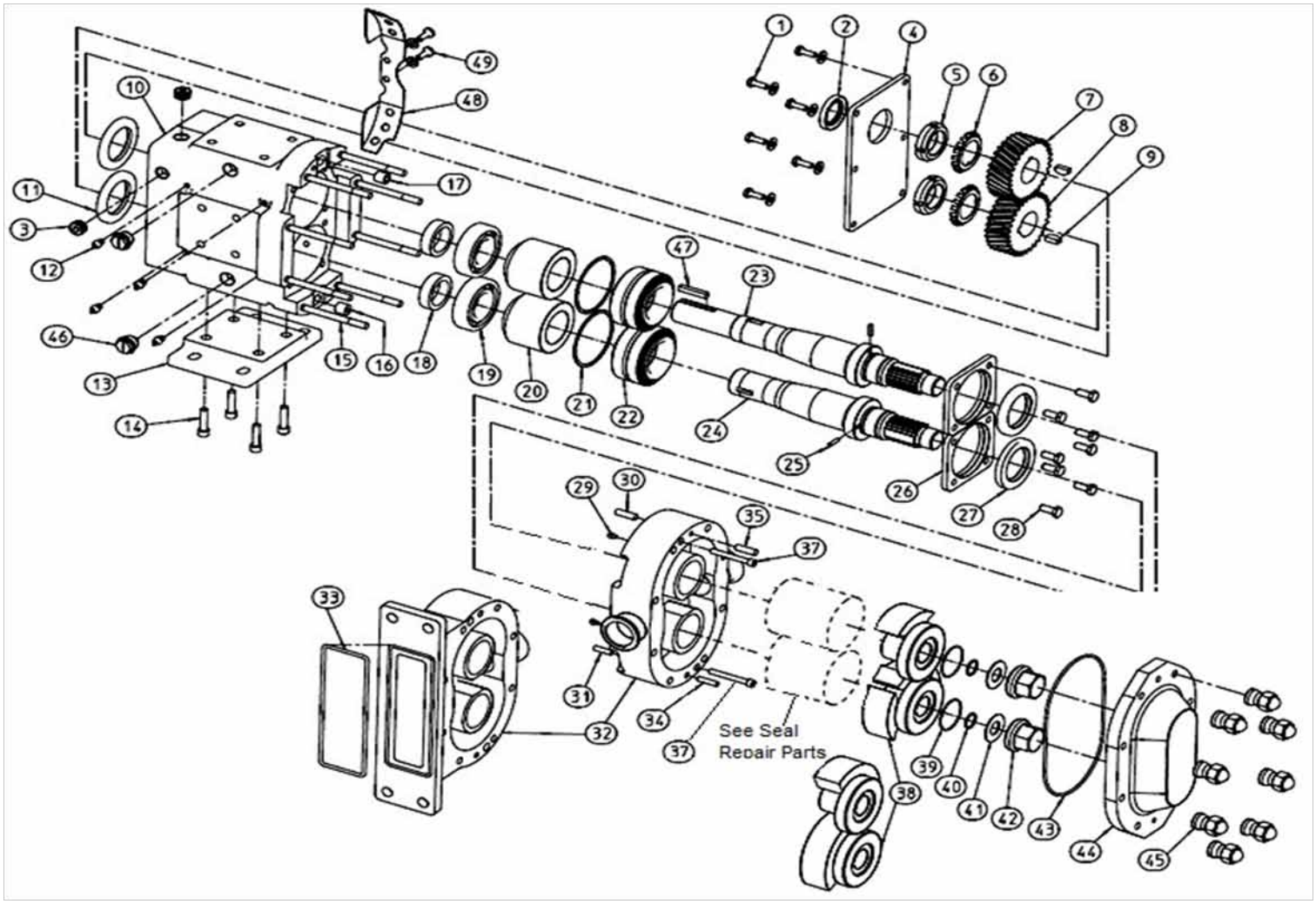
Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2	Oil Seal - Gear Case Cover	1	000030012	W000-030-012
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	070106000	W070-106-000
	Gear Case Cover, SS (includes installed seal)		102282	W102282
5	Lock Nut - Gear	2	STD236009	WSTD-236-009
6	Lock Washer - Gear	2	STD136009	WSTD-136-009
7	Gear Drive Shaft	1	060007001	W060-007-001
8	Gear Short Shaft	1	060007002	W060-007-002

9	Key, Gear	2	060037000	W060-037-000
10	ZD-Evo Gear Case, CI	1	--	W070Z-005-000
	ZD-Evo Gear Case, SS		--	W101834Z
11	Oil Seal Rear	2	000030011	W000-030-011
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	ZD-Evo Mounting Shim (Gear Case Base), CI	1	--	W070Z-110-000
	ZD-Evo Mounting Shim (Gear Case Base), SS		--	W102286Z
14	SH Capscrew, G8Z, Mount/Base, Model 060--134	4	30-275	FSHCS50013-125-G8Z
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
15	Stud	8	108843	W108843
	Stud	6	108843	W108843
	Stud, Short, U1-064	2	0C1050000	W0C1-050-000
	Stud Jacketed Cover	8	108846	W108846
	Stud Jacketed Cover	6	108846	W108846
	Stud, Short, Jacketed, U1-064	2	35556	W35556
	Stud	8	130011000	W130-011-000
	Stud	6	130011000	W130-011-000
	Stud, Short, U1-064	2	0C1050000	W0C1-050-000
	Stud Jacketed Cover	8	130011001	W130-011-001
	Stud Jacketed Cover	6	130011001	W130-011-001
	Stud, Short, Jacketed, U1-064	2	35556	W35556
16	Dowel Bushing, Lower	1	CD0116100	WCD0-116-100
17	Dowel Bushing, Upper	1	CD0116000	WCD0-116-000
21	045 - 134 Shim Kit	2	117891	W117891
18	Spacer Gear to Rear Bearing	2	107187	W107187
19	Rear Bearing	2	107186	W107186
20	Spacer Bearing	2	060055003	W060-055-003
22	Front Bearing	2	060036000	W060-036-000
23	Drive Shaft (17-4PH) Model 045 ZD-Evo	1	--	W045Z-008-001
	Drive Shaft (17-4PH) Model 060, 064 ZD-Evo		35145 / 060008001	W060Z-008-001
	Drive Shaft (17-4PH) Model 130, 134 ZD-Evo		--	W130Z-008-001
24	Idle Shaft (17-4PH) Model 045 ZD-Evo	1	--	W045Z-009-001
	Idle Shaft (17-4PH) Model 060, 064 ZD-Evo		35146 / 060009001	W060Z-009-001
	Idle Shaft (17-4PH) Model 130, 134 ZD-Evo		--	W130Z-009-001
25	Drive Pin	2	CD0126000	WCD0-126-000
26*	Bearing Retainer Front	2	121828	W121828
27	Grease Seal Front Brg Ret	2	000030009	W000-030-009
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	Stop Pin Seal	2	223126000	W223-126-000

30	Dowel Pin, Upper Gear Case Side	1	CD0040R00	WCD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	CD0040R10	WCD0-040-R10
32	Pump Body - 045 ZD-Evo	1	--	W045Z-001-010
	Pump Body - 060 ZD-Evo		--	W060Z-001-010
	Pump Body - 064 ZD-Evo		--	W064Z-001-010
	Pump Body - 130 ZD-Evo		--	W130Z-001-010
	Pump Body - 134 ZD-Evo		--	W134Z-001-010
33	Rectangular Flange O-Ring - Buna (Model 064)	1	N70366	WN70366
	Rectangular Flange O-Ring - Buna (Model 134)		N70369	WN70369
34	Dowel Pin, Upper Cover Side	1	CD0040000	WCD0-040-000
35	Dowel Pin, Lower Cover Side	1	CD0040100	WCD0-040-100
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
37	SH Capscrew, SS, Body Retaining, Model 045 U2	2	30-615	FSHCS31318-250-SS
	SH Capscrew, SS, Body Retaining, Model 060-064		30-319	FSHCS31318-325-SS
	SH Capscrew, SS, Body Retaining, Model 130-134		30-423	FSHCS31318-400-SS
36	Rotor Hub O-Ring - Buna	2	N70224	WN70224
	Rotor Hub O-Ring - EPDM		E70224	WE70224
	Rotor Hub O-Ring - Viton®		V70224	WV70224
38	Rotor Twin Blade - #W88 Alloy - Model 045 ZD-Evo	2	-------	W045Z-010-000
	Rotor Twin Blade - #W88 Alloy - Model 060 ZD-Evo		060010000	W060Z-010-000
	Rotor Twin Blade - #W88 Alloy - Model 130 ZD-Evo		130010000	W130Z-010-000
	Single Blade Rotor - #W88 Alloy - 90° - 060 ZD-Evo		---	W117343Z
	Single Blade Rotor - #W88 Alloy - 90° - 130 ZD-Evo		---	W117360Z
39	Rotor Nut O-Ring - Buna	2	N70227	WN70227
	Rotor Nut O-Ring - EPDM		E70227	WE70227
	Rotor Nut O-Ring - Viton®		V70227	WV70227
40	Retainer O-Ring - Buna	2	N70119	WN70119
	Retainer O-Ring - EPDM		E70119	WE70119
	Retainer O-Ring - Viton®		V70119	WV70119
41	Washer, Belleville	2	101693	W101693
42	Rotor Nut	2	101806	W101806
43	Cover O-Ring - Buna	1	N70373	WN70373
	Cover O-Ring - EPDM		E70373	WE70373
	Cover O-Ring - Viton®		V70373	WV70373
44	ZD-Evo Pump Cover	1	--	WCD0Z-002-S00
45	Hex Nut	8	108371	W108371
	Wing Nut		105852	W105852
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 3/8 X 3/8 X 1 5/8	1	000037003	W000-037-003
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**

	O-Ring Removal Tool		AD0096001	WAD0-096-001
	Chevron RPM Universal Gear Oil SAE 85W-140		000140003	W000-140-003
	Grease, Chevron Ultra-Duty EP 2 NLGI, 14 oz. Cartridge		000140002	W000-140-002
	Sealant RTV		000142301	W000-142-301
	Grease Fitting Cap, Yellow Plastic	8	BD0093000	WBD0-93-000
	Plastic Cap Tapped Holes, Mounting Pad	12	000121001	W000-121-001
	Eye Bolt	2	30-360	W30-360

PARTS LIST - Evolution - 180, 220, 224 (fits a U1 or U2 footprint)



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2	Oil Seal - Gear Case Cover	1	STD030006	WSTD-030-006
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	230106000	W230-106-000
5	Lock Nut - Gear	2	STD236011	WSTD-236-011
6	Lock Washer - Gear	2	STD136011	WSTD-136-011
7	Gear Drive Shaft	1	200007001	W200-007-001
8	Gear Short Shaft	1	200007002	W200-007-002

9	Key, Gear	2	200037000	W200-037-000
10	ZD-Evo Gear Case, CI	1	--	W230Z-005-000
	ZD-Evo Gear Case, SS		--	W101835Z
11	Oil Seal Rear	2	STD119002	WSTD-119-002
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	ZD-Evo Mounting Shim (Gear Case Base), CI	1	--	W230Z-110-000
	ZD-Evo Mounting Shim (Gear Case Base), SS		--	W102287Z
14	SH Capscrew, G8Z, Mount/Base, Model 220-224	4	30-111	FSHCS50013-200-G8Z
15	Stud	8	108844	W108844
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
15	Stud	8	108844	W108844
	Stud	6	108844	W108844
	Stud, Short, U1-224	2	35550	W35550
16	Dowel Bushing, Lower	1	CD0116100	WCD0-116-100
17	Dowel Bushing, Upper	1	CD0116000	WCD0-116-000
18	Spacer Gear to Rear Bearing	2	40878	W40878
19	Rear Bearing	2	200035000	W200-035-000
20	Spacer Bearing	2	40752	W40752
21	180 - 224 Shim Kit	2	117892	W117892
22	Front Bearing	2	200036000	W200-036-000
23	Drive Shaft (17-4PH) Model 180, 184 ZD-Evo	1	--	W180Z-008-001
	Drive Shaft (17-4PH) Model 220, 224 ZD-Evo		--	W220Z-008-001
24	Idle Shaft (17-4PH) Model 180, 184 ZD-Evo	1	--	W180Z-009-001
	Idle Shaft (17-4PH) Model 220, 224 ZD-Evo		--	W220Z-009-001
25	Drive Pin	2	CD0126000	WCD0-126-000
26	Bearing Retainer Front	2	121829	W121829
27	Grease Seal Front Brg Ret	2	121681	W121681
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	Stop Pin Seal	2	223126000	W223-126-000
30	Dowel Pin, Upper Gear Case Side	1	CD0040R00	WCD0-040-R00
31	Dowel Pin, Lower Gear Case Side	1	CD0040R10	WCD0-040-R10
32	Pump Body - 180 ZD-Evo	1	--	W180Z-001-010
	Pump Body - 184 ZD-Evo		--	W184Z-001-010
	Pump Body - 220 ZD-Evo		--	W220Z-001-010
	Pump Body - 224 ZD-Evo		--	W224Z-001-010
33	Rectangular Flange O-Ring - Buna	1	N70376	WN70376
34	Dowel Pin, Upper Cover Side	1	GD0040000	WGD0-040-000
35	Dowel Pin, Lower Cover Side	1	GD0040100	WGD0-040-100
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**

36	Rotor Hub O-Ring - Buna	2	N70230	WN70230
	Rotor Hub O-Ring - EPDM		E70230	WE70230
	Rotor Hub O-Ring - Viton®		V70230	WV70230
37	SH Capscrew, SS, Body Retaining, Model 180/320/323	2	30-323	FSHCS37516-400-SS
	SH Capscrew, SS, Body Retaining, Model 220/380		30-499	FSHCS37516-450-SS
38	Rotor Twin Blade - #W88 Alloy - Model 180 ZD-Evo	2	---	W180Z-010-000
	Rotor Twin Blade - #W88 Alloy - Model 220 ZD-Evo		220010000	W220Z-010-000
	Single Blade Rotor - #W88 Alloy - 90° - 220 ZD-Evo		---	W117391Z
39	Rotor Nut O-Ring - Buna	2	N70235	WN70235
	Rotor Nut O-Ring - EPDM		E70235	WE70235
	Rotor Nut O-Ring - Viton®		V70235	WV70235
40	Retainer O-Ring - Buna	2	N70122	WN70122
	Retainer O-Ring - EPDM		E70122	WE70122
	Retainer O-Ring - Viton®		V70122	WV70122
41	Washer, Belleville	2	101694	W101694
42	Rotor Nut	2	101807	W101807
43	Cover O-Ring - Buna	1	N70381	WN70381
	Cover O-Ring - EPDM		E70381	WE70381
	Cover O-Ring - Viton®		V70381	WV70381
44	ZD-Evo Pump Cover	1	--	WGD0Z-002-S00
45	Hex Nut	8	108372	W108372
	Wing Nut		105853	W105853
46	Large Cleanout Plug	4	--	W41013
47	Drive Shaft Key, 1/2 X 1/2 X 1 7/8	1	000037004	W000-037-004
	O-Ring Removal Tool		AD0096001	WAD0-096-001
	Chevron RPM Universal Gear Oil SAE 85W-140		000140003	W000-140-003
	Grease, Chevron Ultra-Duty EP 2 NLGI, 14 oz. Cartridge		000140002	W000-140-002
	Sealant RTV		000142301	W000-142-301
	Plastic Cap Tapped Holes, Mounting Pad	10	000121001	W000-121-001
	Eye Bolt	2	30-360	W30-360

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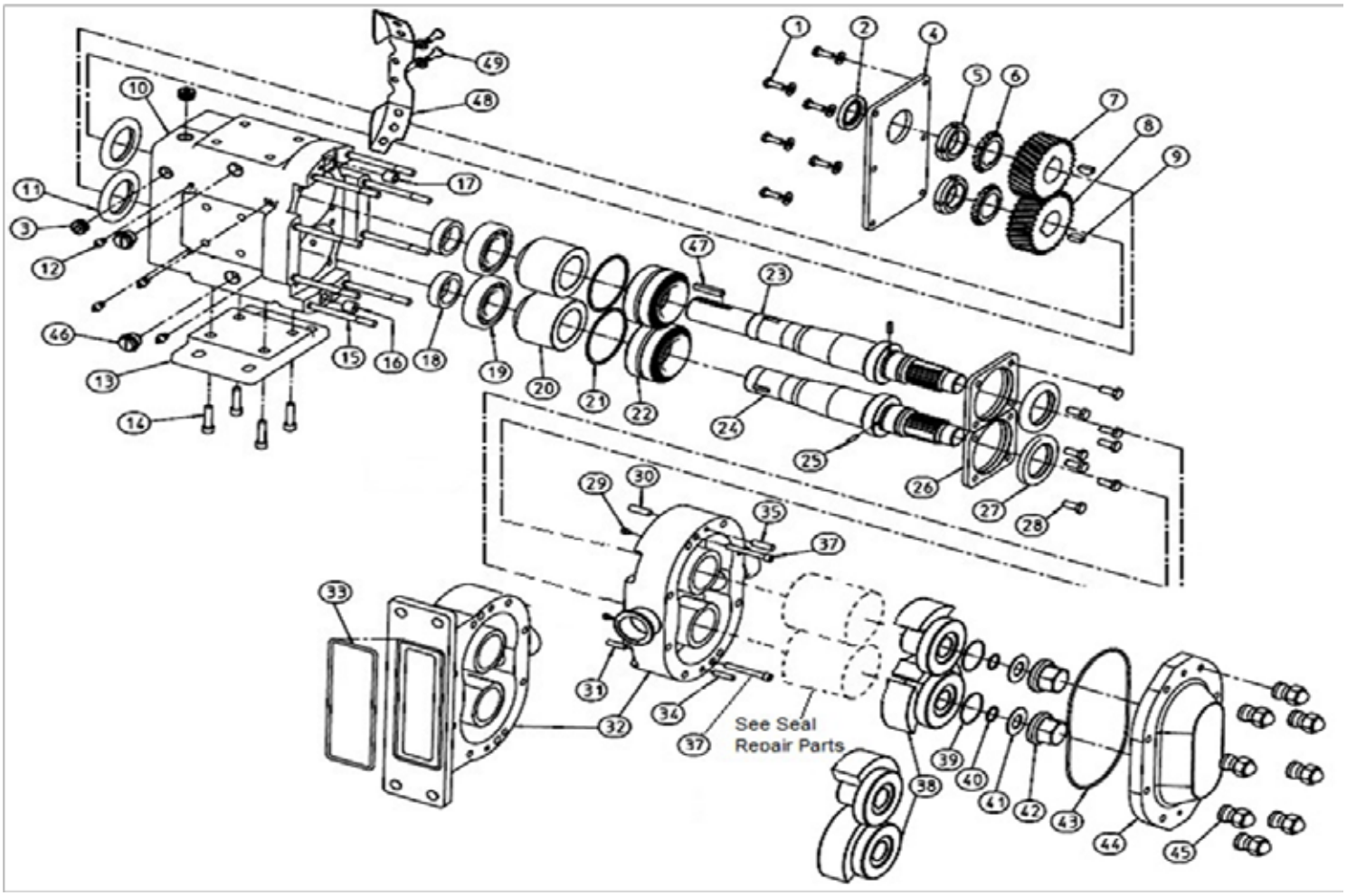
Parts List ZD-Z Evolution 210, 320, 323+, 324, 380, 383 ZM Technologies

PARTS LIST - Evolution - 210, 320, 323+, 380, 383 (fits a U1 or U2 footprint)



Item	Description	Quantity Per Pump	Reference Part No.	ZMT Part No.
1	HH Capscrew, G5Z, GBX Cover, Model 060--324	6	30-314	FHCS37516-075-G5Z
1a	Washer, GBX Cover Capscrew, Model 060--324	6	43-189	FFW375C
2	Oil Seal - Gear Case Cover	1	STD030006	WSTD-030-006
3	Oil Plug 030-523, Gearbox	6	000046004	W000-046-004
4	Gear Case Cover, Steel (includes installed seal)	1	40669	W40669
5	Lock Nut - Gear	2	105697	W105697
6	Lock Washer - Gear	2	STD136005	WSTD-136-005
7	Gear Drive Shaft	1	102470	W102470
8	Gear Drive Shaft	1	102470	W102470
9	Key, Gear	2	0H1037000	W0H1-037-000

10	ZD-Evo Gear Case, CI	1	--	W40616Z
11	Oil Seal Rear	2	102475	W102475
12	Grease Fitting 1/8	8	BD0092000	WBD0-092-000
13	ZD-Evo Mounting Shim (Gear Case Base), CI	1	--	W40288Z
14	SH Capscrew, G8Z, Mount/Base, Model 320-323	4	30-250	FSHCS50013-175-G8Z
15	Stud, Cover, Long	4	111291	W111291
16	Dowel Bushing, Gearcase	2	0H1116000	W0H1-116-000
18	Spacer Gear to Rear Bearing	2	102474	W102474
19	Rear Bearing	2	0H1036000	W0H1-036-000
20	320 front Bearing Spacer	2	102472	W102472
21	210 - 324 Shim Kit	2	117893	W117893
22	Front Bearing	2	0H1036003	W0H1-036-003
23	Drive Shaft (17-4PH) Model 320, 323+, 324 ZD-Evo	1	--	W320Z-008-001
	Drive Shaft (17-4PH) Model 380, 383 ZD-Evo		--	W380Z-008-001
24	Idle Shaft (17-4PH) Model 320, 323+, 324 ZD-Evo	1	--	W320Z-009-001
	Idle Shaft (17-4PH) Model 380, 383 ZD-Evo		--	W380Z-009-001
26	Bearing Retainer Front	2	123533	W123533
27	Grease Seal Front Brg Ret	2	121681	W121681
28	BH Capscrew, SS, Brg Ret, Model 060--324	8	30-60	FBHCS37516-125-SS
29	HH Capscrew, SS, Gland, Model 320-324	8	30-60	FHCS37516-125-SS
29a	Lock Washer, Gland, Model 320-324	8	43-28	FLW-375-SS
30	Seal Gland, No Flush	2	300034003	W300-034-003
	Seal Gland, W/Flush Holes		300034001	W300-034-001
31	Dowel Pin, Gear Case Side	2	--	W320-004-R00
32	Pump Body - 320 ZD-Evo	1	--	W320Z-001-010
	Pump Body - 323+ ZD-Evo		--	W323Z-001-010
	Pump Body - 380 ZD-Evo		--	W380Z-001-010
	Pump Body - 383 ZD-Evo		--	W383Z-001-010
34	Stud, Cover, Short	4	111292	W111292
35	Dowel Pin, Cover Side	2	--	W320-004-000
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
37	SH Capscrew, SS, Body Retaining, Model 180/320/323	2	30-323	FSHCS37516-400-SS
38	Rotor Twin Blade - #W88 Alloy - Model 320 U1, 323+ ZD-Evo	2	320010000	W320-010-000
	Rotor Twin Blade - #W88 Alloy - Model 380, 383 ZD-Evo		320010000	W380Z-010-000
39	Rotor Nut O-Ring - Buna	2	N70237	WN70237
	Rotor Nut O-Ring - EPDM		E70237	WE70237
	Rotor Nut O-Ring - Viton®		V70237	WV70237
40	Retainer O-Ring - Buna	2	N70125	WN70125
	Retainer O-Ring - EPDM		E70125	WE70125
	Retainer O-Ring - Viton®		V70125	WV70125

41	Washer, Belleville	2	105411	W105411
42	Rotor Nut	2	105409	W105409
43	Cover O-Ring - Buna	1	N70280	WN70280
	Cover Gasket O-Ring - Silicone		323117013	W323-117-013
	Cover O-Ring - Viton®		V70280	WV70280
	Cover O-Ring - EPDM		E70280	WE70280
44	ZD-Evo Pump Cover	1	--	W320Z-002-002
	ZD-Evo Pump Cover		--	W323Z-002-002
45	Hex Nut (optional)	8	108373	W108373
46	Large Cleanout Plug		--	W41013
47	Drive Shaft Key, 5/8 X 5/8 X 2 3/4		000037005	W000-037-005
Item	**Description**	**Quantity Per Pump**	**Reference Part No.**	**ZMT Part No.**
	O-Ring Removal Tool		AD0096001	WAD0-096-001
	Chevron RPM Universal Gear Oil SAE 85W-140		000140003	W000-140-003
	Grease, Chevron Ultra-Duty EP 2 NLGI, 14 oz. Cartridge		000140002	W000-140-002
	Sealant RTV		000142301	W000-142-301
	Grease Fitting Cap, Yellow Plastic	8	BD0093000	WBD0-93-000
	Plastic Cap Tapped Holes, Mounting Pad	10	000121001	W000-121-001
	Eye Bolt	3	30-360	W30-360

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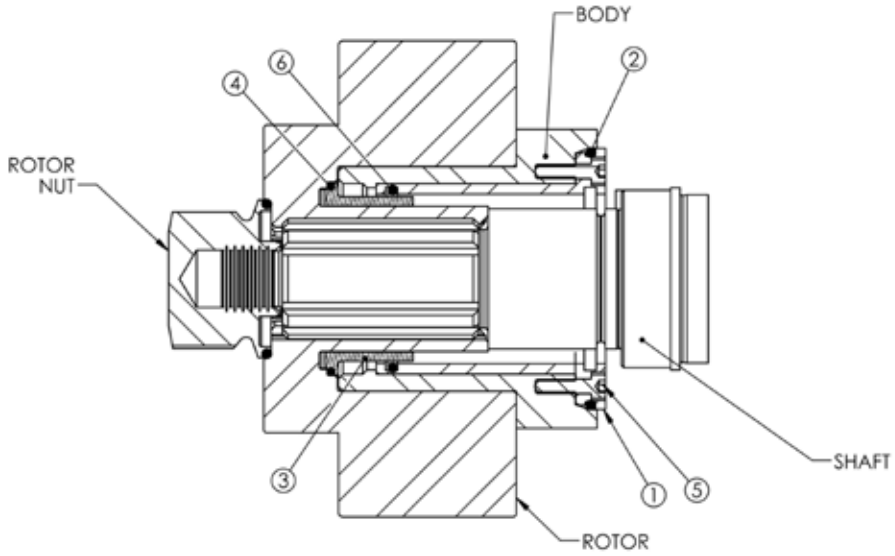
O-Ring Seal Parts List ZD-Z Evolution 006 - 045 ZM Technologies



ZD EVOLUTION SINGLE O-RING SEAL

Single O-ring Seal:

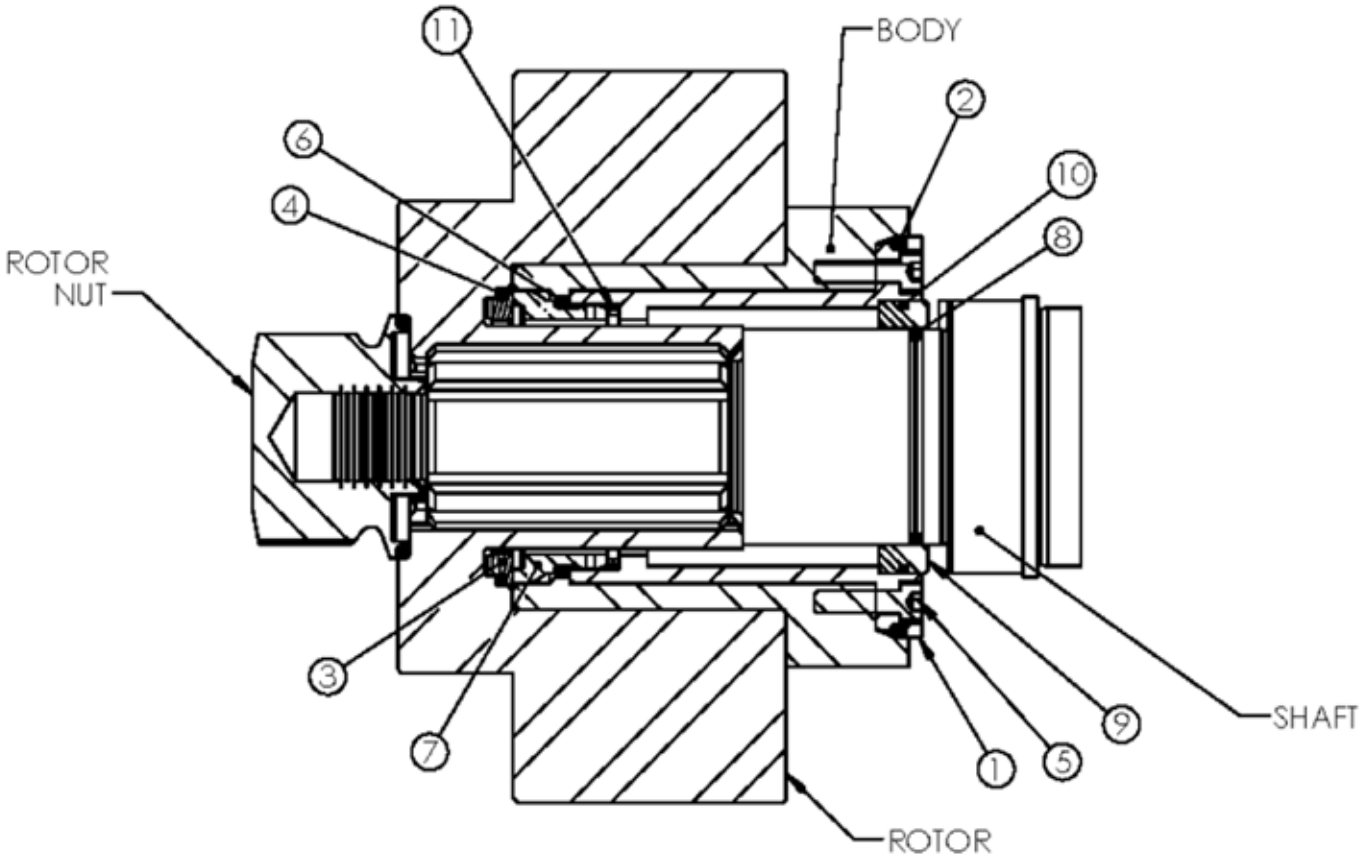
Item	Description	Quantity Per Pump	ZD Evolution 006 - 018 ZMT Part No.	ZD Evolution 030 - 034 ZMT Part No.	ZD Evolution 045 ZMT Part No.
	Single O-ring Seal:				
1	ZD-Evo Single Seal Gland, 316SS	2	W006FZ-08-0100	W030FZ-08-0100	W045FZ-08-0100
2	ZD-Evo Gland Outer O Ring	2	WN70226	WN70233	WN70236
	ZD-Evo Gland Outer O Ring		WE70226	WE70233	WE70236
	ZD-Evo Gland Outer O Ring		WV70226	WV70233	WV70236
	ZD-Evo Gland Outer O Ring		WS75226	WS75233	WS75236
3	ZD-Evo Inner O-Ring Seal Sleeve, 17-4 PH	2	W006FZ-11-0300	W030FZ-11-0300	W130FZ-11-0300
4	ZD-Evo Inner Rotary O Ring Seal	2	WN70134	WN70136	WN70140
	ZD-Evo Inner Rotary O Ring Seal		WE70134	WE70136	WE70140
	ZD-Evo Inner Rotary O Ring Seal		WV70134	WV70136	WV70140
	ZD-Evo Inner Rotary O Ring Seal		WS75134	WS75136	WS75140
5	ZD-Evo Gland Retaining Fasteners	4	FSHCS0832-075-SS	FSHCS1024-075-SS	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O Ring	2	WN70220	WN70226	WN70228
	ZD-Evo Inner/Outer Stationary O Ring		WE70220	WE70226	WE70228
	ZD-Evo Inner/Outer Stationary O Ring		WV70220	WV70226	WV70228
	ZD-Evo Inner/Outer Stationary O Ring		WS75220	WS75226	WS75228

O-Ring Seal Parts List ZD-Z Evolution 060 - 224 ZM Technologies

Item	Description	Quantity Per Pump	ZD Evolution 060- 064 ZMT Part No.	ZD Evolution 130-134 ZMT Part No.	ZD Evolution 180 ZMT Part No.
1	ZD-Evo Single Seal Gland, 316SS	2	W060FZ-08-0100	W130FZ-08-0100	W180FZ-08-0100
2	ZD-Evo Gland Outer O Ring	2	WN70236	WN70236	WN70244
3	ZD-Evo Gland Outer O Ring	2	WE70236	WE70236	WE70244
	ZD-Evo Gland Outer O Ring		WV70236	WV70236	WV70244
	ZD-Evo Gland Outer O Ring		WS75236	WS75236	WS75244
	ZD-Evo Inner O-Ring Seal Sleeve, 17-4 PH		W130FZ-11-0300	W130FZ-11-0300	W220FZ-11-0300
4	ZD-Evo Inner Rotary O Ring Seal	2	WN70140	WN70140	WN70152
5	ZD-Evo Inner Rotary O Ring Seal	4	WE70140	WE70140	WE70152
	ZD-Evo Inner Rotary O Ring Seal		WV70140	WV70140	WV70152
	ZD-Evo Inner Rotary O Ring Seal		WS75140	WS75140	WS75152
	ZD-Evo Gland Retaining Fasteners		FSHCS1024-075-SS	FSHCS1024-075-SS	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O Ring	2	WN70228	WN70228	WN70238
	ZD-Evo Inner/Outer Stationary O Ring		WE70228	WE70228	WE70238
	ZD-Evo Inner/Outer Stationary O Ring		WV70228	WV70228	WV70238
	ZD-Evo Inner/Outer Stationary O Ring		WS75228	WS75228	WS75238

Single O-ring Seal:

Item	Description	Quantity Per Pump	ZD Evolution 180 ZMT Part No.	ZD Evolution 220 - 224 ZMT Part No.
	Single O-Ring Seal:			
1	ZD-Evo Single Seal Gland, 316SS	2	W180FZ-08-0100	W220FZ-08-0100
2	ZD-Evo Gland Outer O-Ring	2	WN70244	WN70244
	ZD-Evo Gland Outer O-Ring		WE70244	WE70244
	ZD-Evo Gland Outer O-Ring		WV70244	WV70244
	ZD-Evo Gland Outer O-Ring		WS75244	WS75244
3	ZD-Evo Inner O-Ring Seal Sleeve, 17-4 PH	2	W220FZ-11-0300	W220FZ-11-0300
4	ZD-Evo Inner Rotary O-Ring Seal	2	WN70152	WN70152
	ZD-Evo Inner Rotary O-Ring Seal		WE70152	WE70152
	ZD-Evo Inner Rotary O-Ring Seal		WV70152	WV70152
	ZD-Evo Inner Rotary O-Ring Seal		WS75152	WS75152
5	ZD-Evo Gland Retaining Fasteners	4	FSHCS1024-075-SS	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O-Ring	2	WN70238	WN70238
	ZD-Evo Inner/Outer Stationary O-Ring		WE70238	WE70238
	ZD-Evo Inner/Outer Stationary O-Ring		WV70238	WV70238
	ZD-Evo Inner/Outer Stationary O-Ring		WS75238	WS75238



ZD-EVOLUTION SINGLE SEAL WITH BUSHING

Single Mechanical Seal:

Item	Description	Quantity Per Pump	ZD Evolution 006 - 018 ZMT Part No.	ZD Evolution 030 - 034 ZMT Part No.	ZD Evolution 045 ZMT Part No.
	Single Mechanical Seal:				
1	ZD-Evo Single Seal Gland, 316SS	2	W006FZ-08-0100	W030FZ-08-0100	W045FZ-08-0100
2	ZD-Evo Gland Outer O-Ring	2	WN70226	WN70233	WN70236
	ZD-Evo Gland Outer O-Ring		WE70226	WE70233	WE70236
	ZD-Evo Gland Outer O-Ring		WV70226	WV70233	WV70236
	ZD-Evo Gland Outer O-Ring		WS75226	WS75233	WS75236
3	ZD-Evo Inner Rotary Seal, Silicon Carbide	2	W006FZ-00-2000	W030FZ-00-2000	W060FZ-00-2000
	ZD-Evo Inner Rotary Seal, Tungsten Carbide		W006FZ-00-9000	W030FZ-00-9000	W060FZ-00-9000

4	ZD-Evo Inner Rotary O-Ring Seal	2	WN70134	WN70136	WN70140
	ZD-Evo Inner Rotary O-Ring Seal		WE70134	WE70136	WE70140
	ZD-Evo Inner Rotary O-Ring Seal		WV70134	WV70136	WV70140
	ZD-Evo Inner Rotary O-Ring Seal		WS75134	WS75136	WS75140
5	ZD-Evo Gland Retaining Fasteners	4	FSHCS0832-075-SS	FSHCS1024-075-SS	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O-Ring	2	WN70127	WN70137	WN70142
	ZD-Evo Inner/Outer Stationary O-Ring		WE70127	WE70137	WE70142
	ZD-Evo Inner/Outer Stationary O-Ring		WV70127	WV70137	WV70142
	ZD-Evo Inner/Outer Stationary O-Ring		WS75127	WS75137	WS75142
7	ZD-Evo Inner Stationary Seal, Silicon Carbide	2	W006FZ-00-0200	W030FZ-00-0200	W130FZ-00-0200
	ZD-Evo Inner Stationary Seal, Tungsten Carbide		W006FZ-00-0900	W030FZ-00-0900	W130FZ-00-0900
8	Shaft O-Ring - Buna	2	WN70022	WN70028	WN70131
	Shaft O-Ring - EPDM		WE70022	WE70028	WE70131
	Shaft O-Ring - Viton®		WV70022	WV70028	WV70131
	Shaft O-Ring - Silicone		WS75022	WS75028	WS75131
9	ZD-Evo Outer Quench Bushing, PEEK	2	W006FZ-20-000P	W030FZ-20-000P	W130FZ-20-000P
11	ZD-Evo Inner Seal Wave (Coil) Spring, 17-7	2	W006FZ-12-0303	W030FZ-12-0303	W130FZ-12-0303
	ZD-Evo Outer Seal Wave (Coil) Spring, 17-7		W006FZ-12-0303	W030FZ-12-0303	W130FZ-12-0303

Single Mechanical Seal:

Item	Description	Quantity Per Pump	ZD Evolution 060- 064 ZMT Part No.	ZD Evolution 130-134 ZMT Part No.	ZD Evolution 180 ZMT Part No.
	Single Mechanical Seal:				
1	ZD-Evo Single Seal Gland, 316SS	2	W060FZ-08-0100	W130FZ-08-0100	W180FZ-08-0100
2	ZD-Evo Gland Outer O-Ring	2	WN70236	WN70236	WN70244
	ZD-Evo Gland Outer O-Ring		WE70236	WE70236	WE70244
	ZD-Evo Gland Outer O-Ring		WV70236	WV70236	WV70244
	ZD-Evo Gland Outer O-Ring		WS75236	WS75236	WS75244
3	ZD-Evo Inner Rotary Seal, Silicon Carbide	2	W060FZ-00-2000	W060FZ-00-2000	W220FZ-00-2000
	ZD-Evo Inner Rotary Seal, Tungsten Carbide		W060FZ-00-9000	W060FZ-00-9000	W220FZ-00-9000
4	ZD-Evo Inner Rotary O-Ring Seal	2	WN70140	WN70140	WN70152
	ZD-Evo Inner Rotary O-Ring Seal		WE70140	WE70140	WE70152
	ZD-Evo Inner Rotary O-Ring Seal		WV70140	WV70140	WV70152
	ZD-Evo Inner Rotary O-Ring Seal		WS75140	WS75140	WS75152
5	ZD-Evo Gland Retaining Fasteners	4	FSHCS1024-075-SS	FSHCS1024-075-SS	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O-Ring	2	WN70142	WN70142	WN70153
	ZD-Evo Inner/Outer Stationary O-Ring		WE70142	WE70142	WE70153
	ZD-Evo Inner/Outer Stationary O-Ring		WV70142	WV70142	WV70153
	ZD-Evo Inner/Outer Stationary O-Ring		WS75142	WS75142	WS75153
7	ZD-Evo Inner Stationary Seal, Silicon Carbide	2	W130FZ-00-0200	W130FZ-00-0200	W220FZ-00-0200
	ZD-Evo Inner Stationary Seal, Tungsten Carbide		W130FZ-00-0900	W130FZ-00-0900	W220FZ-00-0900
8	Shaft O-Ring - Buna	2	WN70131	WN70131	WN70144
	Shaft O-Ring - EPDM		WE70131	WE70131	WE70144
	Shaft O-Ring - Viton®		WV70131	WV70131	WV70144
	Shaft O-Ring - Silicone		WS75131	WS75131	WS75144
9	ZD-Evo Outer Quench Bushing, PEEK	2	W130FZ-20-000P	W130FZ-20-000P	W220FZ-20-000P
11	ZD-Evo Inner Seal Wave (Coil) Spring, 17-7	2	W130FZ-12-0303	W130FZ-12-0303	W220FZ-12-0303
	ZD-Evo Outer Seal Wave (Coil) Spring, 17-7		W130FZ-12-0303	W130FZ-12-0303	W220FZ-12-0303

Single Mechanical Seal:

Item	Description	Quantity Per Pump	ZD Evolution 220 - 224 ZMT Part No.
	Single Mechanical Seal:		
1	ZD-Evo Single Seal Gland, 316SS	2	W220FZ-08-0100
2	ZD-Evo Gland Outer O-Ring	2	WN70244
	ZD-Evo Gland Outer O-Ring		WE70244
	ZD-Evo Gland Outer O-Ring		WV70244
	ZD-Evo Gland Outer O-Ring		WS75244
3	ZD-Evo Inner Rotary Seal, Silicon Carbide	2	W220FZ-00-2000
	ZD-Evo Inner Rotary Seal, Tungsten Carbide		W220FZ-00-9000
4	ZD-Evo Inner Rotary O-Ring Seal	2	WN70152
	ZD-Evo Inner Rotary O-Ring Seal		WE70152
	ZD-Evo Inner Rotary O-Ring Seal		WV70152
	ZD-Evo Inner Rotary O-Ring Seal		WS75152
5	ZD-Evo Gland Retaining Fasteners	4	FSHCS1024-075-SS
6	ZD-Evo Inner/Outer Stationary O-Ring	2	WN70153
	ZD-Evo Inner/Outer Stationary O-Ring		WE70153
	ZD-Evo Inner/Outer Stationary O-Ring		WV70153
	ZD-Evo Inner/Outer Stationary O-Ring		WS75153
7	ZD-Evo Inner Stationary Seal, Silicon Carbide	2	W220FZ-00-0200
	ZD-Evo Inner Stationary Seal, Tungsten Carbide		W220FZ-00-0900
8	Shaft O-Ring - Buna	2	WN70144
	Shaft O-Ring - EPDM		WE70144
	Shaft O-Ring - Viton®		WV70144
	Shaft O-Ring - Silicone		WS75144
9	ZD-Evo Outer Quench Bushing, PEEK	2	W220FZ-20-000P
11	ZD-Evo Inner Seal Wave (Coil) Spring, 17-7	2	W220FZ-12-0303
	ZD-Evo Outer Seal Wave (Coil) Spring, 17-7		W220FZ-12-0303

Trouble	Possible Reason	Solution
NO FLOW (rotors not turning)	Drive motor is not connected or running.	Check connections and power sources.
	Keys are sheared or missing.	Check and replace.
	Pump drive is slipping.	Check, adjust or replace.
	Pump gears or shaft are broken.	Replace if needed.
NO FLOW (rotors are turning)	Rotors are rotating in the wrong direction.	Check hookup for motor corrections.
	Discharge port or valve is blocked/closed.	Check if open, open if it is closed.
	Inlet valve or port blocked/closed.	Check if open, open if it is closed.
	(optional) Pump relief valve is stuck open.	Check, clean if needed.
NO FLOW (pump is not priming)	Inlet valve closed.	Open valve.
	Inlet line clogged or restricted.	Clean lines, check the system.
	Too much air in the inlet line.	Check for leaks, check gaskets and pipes, replace if needed.
	Pump speed too slow.	Increase speed.
	Pump speed too high.	Check lubricant viscosity, reduce speed as needed.
	No product in the inlet lines.	Use foot or check valves, product must be in the line for the pump to prime.
	Pump is air locked.	Obtain and install air bleeds for the lines and pump.
	Pump worn out.	Increase speed or replace rotors
	Inlet pressure low.	Check pressure and change as needed.
	Differential pressure no developing.	Install a check valve on discharge to prevent high pressures.

Trouble	Possible Reason	Solution
INADEQUATE FLOW	Speed too low or high.	Check pump curve and adjust.
	Air leaks in the inlet line.	Check for bad gasket, seal or piping.
INADEQUATE FLOW & PRODUCT FLOW IS BYPASSING THE PUMP	Open valve, inlet or trap valve.	Check valves and close as needed.
	Relief valve stuck or not adjusted.	Check valve and adjust as needed.
INADEQUATE FLOW, PUMP IS NOISY OR SLIPPING DURING OPERATION	Non-standard rotors, low viscosity fluids being used.	Use correct rotors for pump, contact ZM Technologies for assistance.
	Body or rotors worn.	Increase speed, have pump reconditioned or replace rotors.
	Pressure too high for pump.	Adjust pump system.
STARVED PUMP INLET (fluid is vaporizing)	Strainers, fittings, valves or lines plugged.	Clean lines and valves as needed.
	Inlet line too small in length or diameter.	Increase pipe size or decrease length as needed.
	Excessive number of valves or fittings.	Reduce number.
	Net inlet pressure low.	Check requirements and change system if needed.
	Valve or strainers too small.	Change if needed.
	Product viscosity is greater than desired.	Change parameters(pressure, flow, temp).
	Product temperature too high.	Reduce pump speed as needed.
PUMP REQUIRES EXCESSIVE POWER (pump overheating, drawing high current, fuse or breakers trip, pump stalls)	Loss of viscosity is excessive.	Increase pump speed.
	Pressure too high.	Decrease pump speed, modify inlet line size.
	Viscosity to high.	Heat product or change pump parameters.
	Product sits in line during shutdown.	Install a soft start on the motor drive, clean the lines or change the system.
	No product in the inlet lines.	Use foot or check valves, product must be in the line for the pump to prime.

Trouble	Possible Reason	Solution
NOISY OPERATION (cavitation)	Vapor pressure, temperature or viscosity too high.	Check set up. Change the speed and temperature as needed.
	Inlet pressure is low.	Check and adjust as needed.
NOISY OPERATION (air or gas in product)	Air leaks.	Check and correct.
	Product emits gas.	Install pressure relief valves as needed.
NOISY OPERATION (rotor to rotor contact)	Pump assembled with improper fluid or clearance.	Check and adjust pump clearance.
	Internal stress caused by incorrect piping support.	Adjust as needed to eliminate stresses.
	Pressures are greater than rated for the pump.	Reduce pressure.
	Bearings worn.	Check bearing movement and replace as needed.
NOISY OPERATION (external mechanical issues)	Gears out of timing or loose.	Rebuild pump.
	Gear keys sheared.	Rebuild as needed.
	Gears worn.	Replace gears as needed.
SHORT PUMP LIFE	Product is abrasive.	Check pump, obtain larger pump if needed.
	Pump speed and pressure is excessive.	Check and change system as needed.
	Gearbox is lubricated improperly.	Check and replace gears and bearings.
	Water build up in gearbox.	Check gearbox plugs are intact.
	Misalignment in piping or pump drive.	Check and modify for alignment issues.

Notes