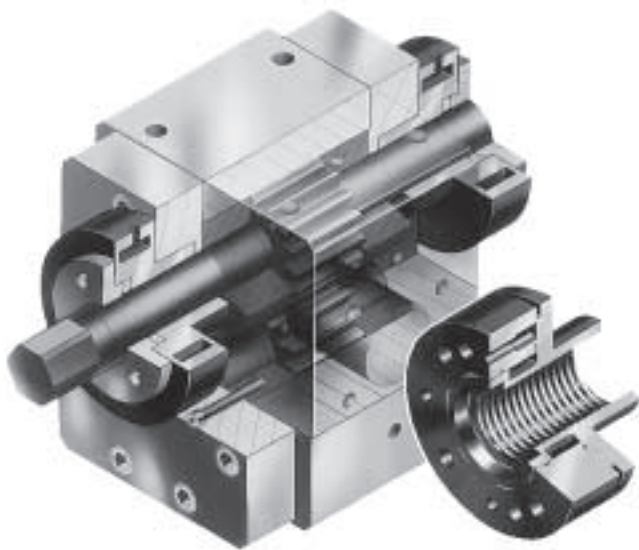


# Zenith® Pumps PEP-II Series Gear Pumps

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Installation,  
Care and  
Maintenance

Zenith  
Polymer  
Extrusion  
Gear Pumps

**Zenith**®  
Pumps

**Thoroughly read and understand this entire manual before installation and operation of pump.**

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## Zenith® Pumps

In 1926, Zenith Pumps was approached by the synthetic fiber industry to design a pump to provide a precise, pulseless, and repeatable flow and assure better quality control.

Since then, Zenith has provided pumps for virtually every polymer utilized in the plastics extrusion industry. Over the years, Zenith has continually developed and improved its pump designs to meet the stringent demands made by new polymers and new processes.

Zenith Pumps' line of PEP-II polymer extrusion pumps has a unique positive displacement design, which provides consistent, accurate polymer delivery under varying extruder output conditions of pressure, temperature and viscosity. These virtually pulseless gear pumps are the ideal interface between the extruder and the die of extrusion systems, and provide a homogeneous melt at increased throughputs and tighter gauge tolerances.

## Benefits

For years, polymer processors have utilized gear-pump-assisted extrusion to solve critical issues in the diverse plastics industry.

The Zenith gear pump optimizes the extrusion process by allowing the screw to melt and homogenize the polymer. As the pump generates the needed pressure, it relieves the extruder of work; therefore, reducing heat from the shear, lowering the torque required, and eliminating surging. All this optimizes the performance of the extruder and offers the following benefits:

- **Improved Dimensional Stability—** Effectively isolates the die from upstream fluctuations.
- **Controlled Melt Quality—**Regulates the extruder back pressure while it reduces residence time, stabilizes the plasticating action, and lowers melt temperature.
- **Increased Production—**Provides very high efficiency regardless of its pressure building requirement.

- **Reduced Raw Material Usage—** Provides a narrower finished product gauge variation.
- **Eliminates Surging and Screw Beat—** Effectively handles problems caused by melt density or extruder parameters.
- **Increased Extruder Flexibility—** Allows varying process conditions such as higher regrind levels, temperatures, pressures, etc.
- **Crowned Root Gear Design—** Reduces shear internal to the pump, lowering the temperature and increasing the production rate per power required.
- **Streamlined Operation and Start-up—** Closed-loop controls provide easy operator interface.
- **Extended Extruder Life—**Reduces work required by the extruder such as pressure and torque.
- **Lower Operational Costs—**Provides a more efficient method of conveying, eliminating material giveaway, and increasing production per pound of extrudate, etc.

## Specifications

**Capacities:** 0.16 to 750 cc/rev.

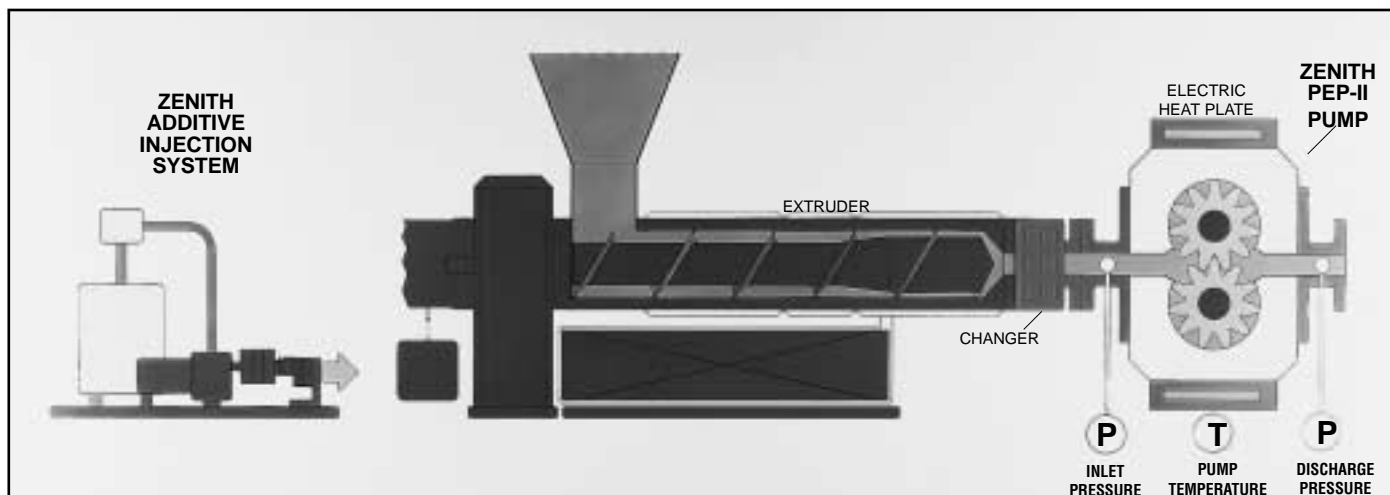
**Operating Speed:** 10 - 90 rpm on most extrusion processes depending upon process parameters

**Differential Pressure:** Up to 5,000 psi (345 bar)

**Body Pressure:** 10,000 psi (690 bar).

**Temperature:** To 645° F (340° C),  
(950° F maximum with special fasteners and seals).

# Zenith® Pumps and The Extrusion Process



**Zenith Pumps can handle all your extrusion pumping applications including additive injection for on-line compounding of tackifiers, colorants, stabilizers, etc.**

## Design

The PEP-II pump is constructed of two gears rotating in mesh within a closely fitted housing that is comprised of three plates. The center, or gear plate, fits closely around the outside diameter of the metering gears and bearings. The front and rear, or cover plates, sandwich the center plate and restrict axial movement of the gears and bearings. In capacities of 5 cc/rev and larger, the driving gear is manufactured integral with the drive shaft, and the driven gear is machined integral with its shaft. In capacities of 3.0 cc/rev and below, the gears are keyed to their respective shafts. In all capacities the shafts are supported by “D” shaped bearings which fit into the center plate. In capacities of 40 cc/rev and above, these bearings are located by two screws which pass through the cover plates. In capacities of 20 cc/rev and below, the bearings are keyed to each other for accurate location.

Each cover plate is secured to the center plate by 10 screws (6 screws for below 5 cc/rev). Each side of the center plate has a circular port in the center of a bolt circle for the mounting of adapter flanges that fit the pump to your equipment. Threaded holes are provided on the top and bottom of the center plate for the mounting of heat plates and for the mounting of the pump to its stand. Thermocouple wells (1/8-27 NPT) are located on the body of the pump.

A Zenith Rheoseal assembly secured to each cover plate (front cover plate only on 3.0 cc/rev and below) prevents leakage

around the shaft, using both dynamic and static types of sealing mechanisms. A Rheoseal consists of a helical groove on the inner diameter, a cooling jacket and a static, backup seal counter bore and gland. These spiral grooves allow the Rheoseal to act as a screw-type pump. As the fluid attempts to leave the gear pump, the shaft's rotary motion forces the fluid into the grooves. This creates a pressure greater than the pressure forcing polymer out of the pump, thus returning the polymer back towards the pump. Since the rotary motion is required of the shaft, two other static types of seals are employed on the Rheoseal—a spring energized lip-seal or a packing seal secured by the gland. Also a flushing cooling jacket surrounds a portion of the grooved seal. Use of the cooling jacket may be required for effective sealing if the viscosity is below 1,000 poise at process conditions. If used, water passing through the housing cools the polymer, increasing the effectiveness of the seal's pumping action. A thermocouple well is provided in the seal housing to allow for measuring the temperature close to the region where sealing actually occurs.

A complete line of accessories is available and includes heating plates (electric, oil and steam), adapter flanges, mounting blocks and pump drive systems complete with power package controls and process controls. Please contact Zenith or your local Zenith representative for further information.





# Operation

Polymer enters the PEP-II pump on the suction side where shaft rotation exposes gear tooth volumes between the gear teeth. Polymer fills these spaces and is transported to the discharge side where the gear teeth mesh together, decreasing the gear tooth volumes and displacing the polymer. Due to the precision tolerances and close clearances within the rotating spaces, very high pressures can be achieved at the pump discharge with extremely high volumetric efficiencies.

As PEP-II pumps rely on the metered polymer for lubrication of internal bearing surfaces, the operating speed is designed to be from 10 to 90 rpm on most extrusion processes depending on process parameters. **Do not allow the pump to run dry or attempt to pump poor lubricating**

**fluids such as water or solvent.** When high-viscosity fluids are used, more time is required to fill the tooth volumes. As a result, the inlet pressure must be increased or the gears must rotate at a slower speed to ensure complete volume filling. Proper speed and inlet pressure must always be maintained to prevent cavitation and to ensure proper lubrication.

Slip can occur across the sides of the gears from the high-pressure side to the low-pressure side. The amount of slip depends on four factors: polymer viscosity, speed, differential pressure and pump clearances. Under reasonably stable operating conditions, slip is repeatable and predictable, and pump operation can be adjusted to compensate.

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# Installation

Pumps should be carefully unpacked to make sure that the shipment is complete. If any items are missing or damaged, the freight carrier and Zenith should be notified immediately.

To prepare the pump for use:

1) Where required, install the heat plates as follows. Zenith-supplied heat plates are machined to tolerances that eliminate the need for heat transfer cement. All bolts used should be lubricated with high-temperature thread lubricant such as DAG Dispersion 154, Felpro C-100 or equivalent.

2) Place the top heat plate on the pump, then place the insulation jacket on top of the heat plate. Install and tighten the bolts, taking care not to crack the insulation block.

3) Repeat for the bottom plate, noting that bottom heat plate mounting bolts are typically used to mount the pump to its mounting block.

4) Place the supplied metal O-rings into the counterbores in the pump ports, and attach the inlet and discharge porting flanges with lubricated screws. Replace the O-rings after each use. Torque down the screws in a crisscross pattern, taking them first to 1/4 the recommended torque value, then to 1/2, to 3/4 and finally to their full recommended torque value as shown on the table on page 10. If the flanges are not supplied by Zenith, make

certain that their mating faces are flat, with no pilots that protrude into the pump. Check that the pump rotates freely by turning the shaft with your hand.

5) The pump drive shaft should be connected to the motor drive assembly with a flexible coupling, a double universal joint shaft or an appropriate Zenith SJMC coupling. Side loading on the pump shaft is to be avoided at all costs.

6) If water is used for sealing, connect either 1/8-27 or 1/4-18 NPT fittings to the Rheoseal and turn on the water. Be sure to avoid excessive cooling, or damage to the pump may occur.

7) Turn on the pump heaters. A 250° F temperature rise per hour is recommended for cold starts. No attempt should be made to start the pump until the entire pump is at operating temperature. **Cold starts are the most common cause of pump failure.**

On start-up, a small amount of molten polymer should be introduced into the pump by slowly rotating (less than 5 rpm) the pump by hand to ensure that the pump is free turning and well lubricated. With sufficient inlet pressure, the pump can then be started at a very slow speed, with discharge pressure low enough to maintain low loading. When operating satisfactorily, the pump and system may now be gradually brought up to normal process speeds and pressures.

# Cleaning, Inspection, Repair and Service

After removal from the system, the assembled pump can be cleaned by placing it in a suitable furnace (i.e. vacuum oven, fluidized bed, etc.) and slowly increasing the temperature to 800-850° F in no less than two hours. Special care should be taken to avoid flashing of the polymer. Control of temperature is essential as it is possible to draw back the hardness of the steel and affect dimensional stability if the pump is overheated. The time to completely carbonize the polymer is three to twelve hours, depending on the polymer, temperature, pump size and furnace load.

The pump must be gradually cooled to room temperature (no forced cooling or quenching), then disassembled and cleaned as instructed in the following section. Close adherence to these instructions should be maintained for maximum pump life and performance.

It is recommended that pump users institute a program of dimensional inspection of critical parts in order to keep maintenance and operating costs at a minimum. By noting the performance of a pump immediately before removing it from service and correlating the performance to measured component wear, the user can establish the maximum wear limits for the pump's critical components. Further, he can predict the service life of the pump, and schedule his downtime accordingly.

After a pump has been disassembled,

all parts should be carefully inspected for nicks, burrs, scoring or other signs of wear. The side plates, D-bearings (and sides of the gears on the 3.0 cc/rev and smaller pumps) can be hand blocked on 600 grit paper, and any nick or burrs and other sharp edges very lightly touched with an Arkansas stone.

**Note:** After cleaning, all seals, O-rings and fasteners must be discarded.

**CAUTION:** As the thickness relationship between metering gears, center plate and D-bearings is critical to metering performance, care should be taken that these parts are only polished and that no metal is removed. Lapping of these components should not be done under any circumstances.

As with any other Zenith pumps, PEP-II pumps may be returned to Zenith for complete rehabilitation as necessary. This procedure may be desirable if only a few pumps are involved. If a large number of pumps are to be maintained at the user's plant, it may be worthwhile to have key maintenance personnel attend a maintenance seminar at the Zenith factory to view the manufacturing, gauging and assembly techniques involved in producing the PEP-II pump. In addition, Zenith also offers a contract service program. Please contact Zenith for further information on these services.

## Disassembly

These instructions should be thoroughly read and understood before starting disassembly.

General instructions that should be observed to ensure correct disassembly of the pump are as follows:

- If the pump is to be disassembled on a regular basis, set up a room with a separate clean area with all the tools required for disassembly, reassembly and storage.
- During disassembly, note the location and orientation of all parts to ensure proper reassembly.
- Use a soft-jawed vise to hold the pump during disassembly.

When maintenance is required, refer to the exploded view and disassemble the pump as follows:

**CAUTION:** Careful handling of the parts is imperative. Do not drop or allow parts to strike each other. The slightest nick or burr can cause difficulty in reassembly and may cause further damage to the pump.

1) Clearly mark which side of the pump is the inlet port and drive input side.

2) Remove the screws securing the Rheoseal seal plate cover to the seal housing and remove the cover.

3) Remove the screws securing the Rheoseal seal housing to the cover plate and withdraw the housing from the cover plate and shaft, taking care not to damage the drive shaft. After removal of the seal housing, disassemble and clean the Rheoseal housings either mechanically or chemically (always replace the O-rings).

4) Carefully pry out and discard the lipseals at this time, taking care not to damage the seal countersink in the housing, as damage here could cause polymer leakage at start-up.

5) Loosen and remove the D-bearing retainer screws (40 cc/rev and above only).

6) Loosen all cover plate screws one turn, then back them out and remove them from the pump. Remove each cover

# Disassembly continued

plate and set aside in a safe place to prevent damage. At this point, make certain to note the orientation of the groove on the rear of each bearing with respect to the inlet port. They **MUST** be reassembled in the same way as disassembled; that is, they must point toward the inlet port, or severe pump damage may result when the pump is started.

**WARNING:** (Read before steps 7 & 8) Extreme caution must be exercised when removing the gear shafts and bearing. For the 40 cc/rev and above capacity pumps, which have two (2) tapped holes in the D-bearing faces, an optional disassembly method is possible. If the gear shaft and two D-bearings will not slide out as a complete assembly after tapping with a soft-faced hammer, it is recommended that a gear puller tool be used to extract the individual D-bearings from *each* side of the gear shafts. If these still exhibit force, soaking in a lubricating (penetrating) oil will help the disassembly.

For 20 cc/rev and smaller capacities, there are no tapped holes in the D-bearing faces to be utilized. The gear shaft and D-bearings must be removed as a complete assembly. Again, soaking the parts in lubricating (penetrating) oil or other non-damaging solution will help ease the disassembly. *Do not force* the parts out one side with a hammer or arbor press.

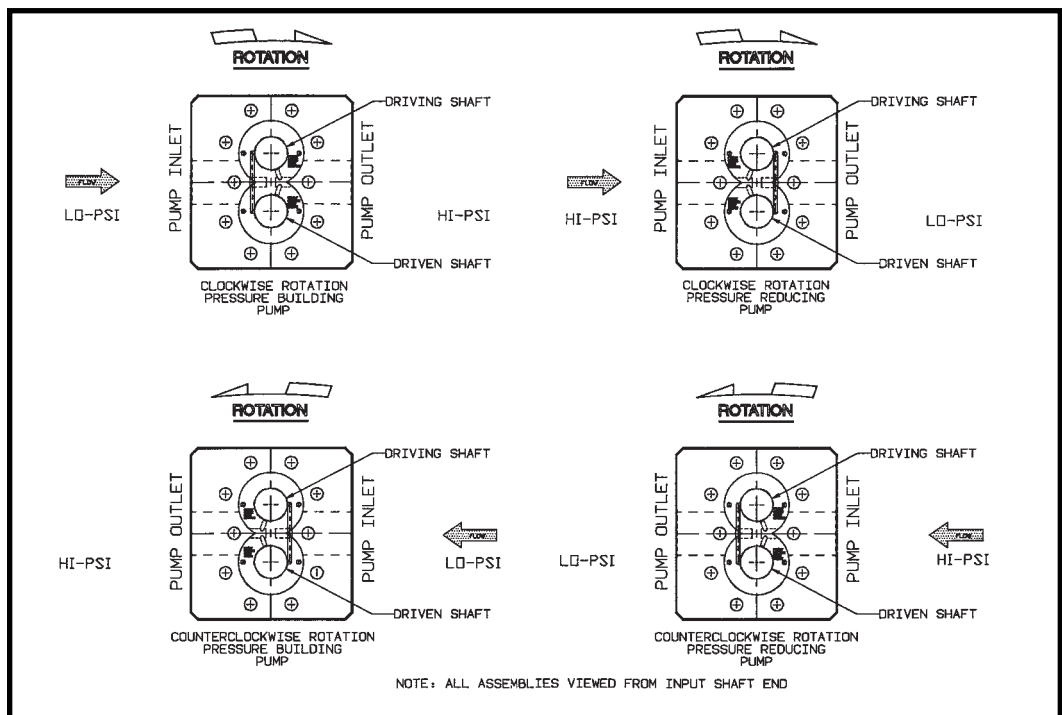
7) Slide the gear shafts and bearings out of the center plate. They will not come out separately as the gear teeth will not clear the bearings. Take extreme care not to nick or ding the gear teeth or the edges of the bearings. If they will not slide out easily, use a hammer with a plastic or soft brass head to gently tap them out. **DO NOT** use a steel-headed hammer.

Alternate taps on the shafts until the parts slide clear. Separate the two shaft/bearing assemblies, taking care not to lose the keys in the 10 cc/rev and smaller pumps. There are no keys in the 20 cc/rev and larger pumps.

8) Slide the bearings from the shafts, again taking extreme care not to damage the gear teeth, bearing edges or the shafts. If the bearings will not slide easily from the shaft (due to residual polymer), use a plastic or soft brass-headed hammer and a soft drift (**NOT** steel) to gently tap the bearings free. Do not pry them off with a screwdriver or other tool as this may damage the gear teeth. Identify which shaft the bearings came from, and set them aside in a safe place.

9) On the 3 cc/rev and smaller, slide the gears from their shafts and remove the keys from the shaft.

## D-Bearing Orientation Schematic





# Reassembly

These instructions should be thoroughly read and understood before starting reassembly.

General instructions that should be observed to ensure correct reassembly of the pump are as follows:

- Using a solvent such as trichloroethane or chloroethene Nu, clean all parts that are to be used in the reassembled pump.

**WARNING:** Use extreme care when using any solvent. Prolonged contact with the liquid or inhalation of the vapor can cause serious health problems.

- During and between each of the assembly steps, **manually turn the metering gears to ensure that they are free turning.** If binding occurs at any time during assembly, *determine* the cause and *correct it before* proceeding further. A tiny nick, burr or foreign particle can extensively damage a valuable part if allowed to remain. Never use excessive force in assembling or turning a pump. If properly aligned, the pieces will fit easily into the plate, and the drive shaft will turn freely. **All seals, O-rings and fasteners must be replaced with new parts prior to assembly.**

- Use a soft-jawed vise to hold the pump during reassembly.

- Before installing screws, lubricate their threads with DAG Dispersion 154, Felpro C-100, or similar heat-resistant lubricant, and torque to prescribed values as shown on the table on page 10.

1) On 3.0 cc/rev and smaller pumps, place a gear key on each shaft and slide each gear onto its shaft, engaging the key.

2) Slide the gear shafts into the center plate, taking care not to damage the gear teeth. On 3.0 cc/rev and smaller pumps, note that each shaft has a larger diameter end. These larger ends must be on opposite sides of the pump for the bearing grooves to align properly.

3) Gently slide the gear shafts so that the rear ends of the shafts protrude from the rear of the center plate. On the 3.0 cc/rev and smaller pumps, take care not to slide the shafts out of the gears and allow the keys to drop out of the shafts.

4) Slide a bearing onto the drive shaft, taking special care to select a bearing with the proper groove configuration (and with the proper ID on the 3.0 cc/rev and smaller pumps). Slide the matching bearing onto the driven shaft, taking care to select a bearing with the proper groove

configuration. Set the flats on the circumference of the bearings against each other, and gently slide the bearings and shafts into the center plate. Slide them far enough through the center plate to allow the drive shaft to protrude out on the front side and allow the front bearings to be installed. See D-bearing orientation schematic on page 8.

5) Install the front bearings in the same manner as the rear bearings, and slide the bearings and shafts back into the center plate so that the gears are roughly in the center of the center plate.

6) For the 20 cc/rev and smaller pumps, the bearings should be allowed to protrude very slightly above the face of the center plate before the cover plates are installed. This will allow the bearings to fit flush against the cover plates as there are no bearing screws on these smaller pumps. For 20 cc/rev and smaller pumps, insert the bearing locating keys on each side.

7) At this point make certain again that there is no foreign matter on the faces of the cover plates or on the faces of the center plate. An accidental smudge of thread lubricant can cause the small pumps to bind.

8) Place the front cover plate on the pump (and center on pump), checking one more time that the configuration of the bearing grooves is correctly oriented for the inlet and discharge ports of the pump. Insert the lubricated cover plate screws into the pump and tighten them finger tight only. Repeat for the rear cover plate.

9) On the 40 cc/rev and larger pumps, insert the bearing retainer screws and tighten them finger tight at this time.

10) Torque down the cover plate screws in a crisscross pattern, taking them first to 1/4 the recommended torque value, then to 1/2, to 3/4 and finally to their full recommended torque value.

11) Torque down the bearing retainer screws in the same manner as the cover plate screws. (Install C-Rings if applicable.)

12) Fit the Rheoseal seal housing to the shaft. Loosely install but do not torque down the seal housing screws, as this will allow the lip seal to properly center the housing.

13) Install the lip seals, using the special Zenith installation tools as follows to prevent damaging the seal. Install the lip seals with the open face toward the body of the pump. Slide the installation

## Reassembly continued

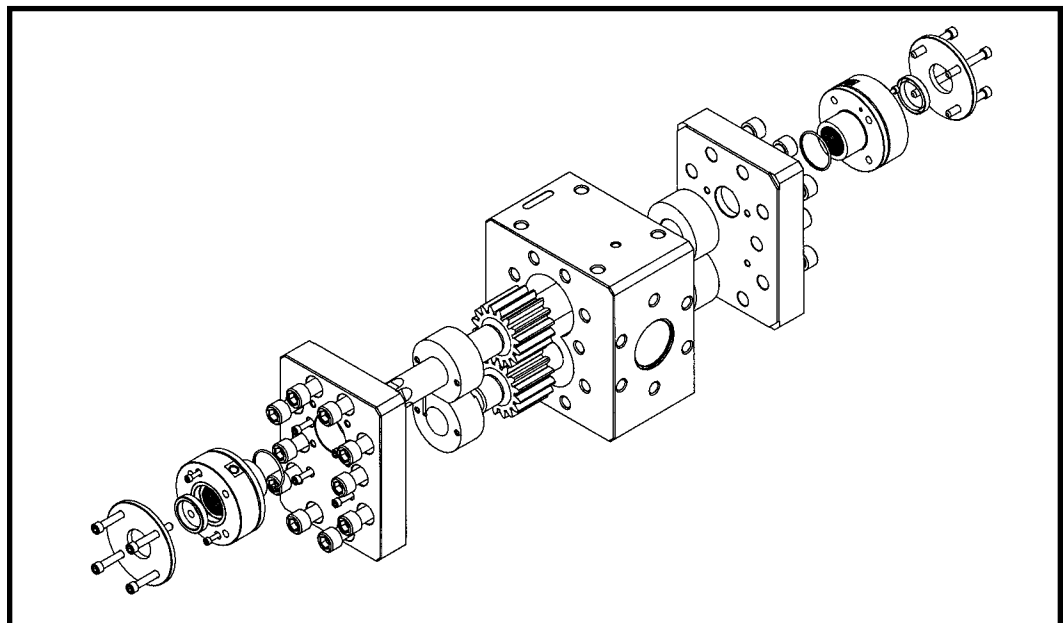
ring on the shaft with the ID tapering toward the pump. On the drive shaft ends, fit the bullnose on the end of the shaft. Work the seal gently over the end of the bullnose and down the shaft, as any damage could cause polymer leakage after start-up. Ease the seal into the wide end of the installation ring and, using the pressing tool, gently press the lip seal into the Rheoseal housing. Do not attempt to press on the lip seal with screwdriver or other pointed object, as this will damage the seal. Do not press the lip seal all the way into its cavity. Instead, allow it to protrude slightly so that it will be correctly seated by the seal cover. Carefully remove the special Zenith tools.

14) Slide the seal cover over the shaft until it rests on the protruding lip seal. Align the screw holes in the cover with those in the housing and insert the screws. Tighten them evenly in a criss-cross pattern so that the seal is slowly pressed into the seal housing. When the cover is touching the housing all the way around, remove the seal cover and torque the seal housing bolts down. Reinstall the seal cover on the shaft and torque it down. In reinstalling the pump, be certain to follow the instructions given in the Installation section of this manual.

## Bolt Torque

Size (UNC Alloy Steel)	Recommended Torque (in-lbs)	Size (UNC Alloy Steel)	Recommended Torque (in-lbs)
#8-32	30	1/2-13	922
#10-24	43	9/16-12	1,331
#10-32	49 (UNF thread)	5/8-11	1,836
1/4-20	103	3/4-10	3,257
5/16-18	213	7/8-9	5,800
3/8-18	378	1-8	8,000
7/16-14	605	1 1/8-7	12,000

## PEP-II ISO View



**Clockwise rotation, pressure building pump shown (standard).**

# Parts Replacement

When ordering replacement parts, please be sure to include the following information:

- 1) Pump model number
- 2) Part number (12-digit) and description
- 3) Quantity
- 4) Shipping instructions

Order parts from your local Zenith representative or direct from Zenith.

# Troubleshooting

<b>Trouble</b>	<b>Probable Cause</b>	<b>Remedy</b>
<b>Pump will not turn</b>	1) Low pump temperature	Check thermocouple and control loop for proper setting/operation. Allow sufficient heat-up time.
	2) Drive malfunction	Verify drive is powered. Check to assure all alarm circuits are clear. Check drive motor current and speed settings. Check all drive couplings.
	3) Process conditions changed	Check process conditions for proper melt temperature, pressures, viscosities and materials.
	4) Entrained particle	Disassemble and clean pump; replace any damaged parts.
	5) Possible internal damages	Disassemble and clean pump; replace damaged parts. Consult factory.
<b>Excessive seal assembly leakage</b>	1) Worn lip seal	Replace lip seals.
	2) Incorrect water flow	Monitor and adjust water flow to provide correct sealing temperature.
	3) Clogged Rheoseal channel	Disassemble two-piece seal housing and inspect.
<b>Reduced pump efficiency</b>	1) Worn gear(s)	Replace worn gear.
	2) Worn bearings	Replace worn bearings.
	3) Process conditions changed	Consult factory for clearance recommendations on new process conditions.



**FAILURE, IMPROPER SELECTION OR IMPROPER USE  
OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED  
HEREIN OR RELATED ITEMS CAN CAUSE DEATH,  
PERSONAL INJURY AND PROPERTY DAMAGE.**

WARNING

This document and other information from Zenith Pumps, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Zenith Pumps and its subsidiaries at any time without notice.



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