Zenith® Pumps H-Series Gear Pumps




Installation, Care And Maintenance

Zenith High-Temperature Gear Pumps

Zenith Pumps

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

Zenith® Pumps

In 1926, Zenith Pumps was approached by the synthetic fiber industry to design a pump to provide a precise, pulseless, repeatable flow and assure better quality control. The options then were the same as those in the chemical process industry today–diaphragm, lobe, coarse gear, piston, plunger and screw pumps. Each had problems with pulsation, flow inaccuracies, multiple seal areas and slip, which required constant calibration, high maintenance and extended downtimes.

Zenith Pumps met the challenge and designed a rotary external gear pump of unique precision and simplicity. Manufacturing techniques were developed to hold tolerances to .00005", and an inter-nal pressure relief mechanism assured reliable precision metering. The pump's simple design of only three moving parts–two metering gears and a drive shaft–provided long life and easy maintenance.

For years since, Engineers have relied on Zenith to provide precision fluid handling solutions for their most difficult pumping applications. Zenith gear pumps can be found wherever precise, pulseless, repeatable metering of fluids is required.

Benefits

High Accuracy
Stable, repeatable flows are assured even under varying conditions of pressure, viscosity, and temperature.

High Temperature Capability
Operating temperatures to 950° F (510° C).

Maximum Life
Only three moving parts; components are through-hardened tool and die steels to 62 HRc or better. Replaceable sleeve bearings for low-cost rebuilds.

High Volumetric Efficiency
Maximum efficiency is achieved with optimum operating clearances and assured under pressure by built-in alignment dowels.

Minimum Pulsation
Unique design offers virtually pulseless flow without valves or flexible elements to hinder performance.

Precision Construction
Ground and lapped components for close control of operating clearances.

Specifications

Pump Type: Rotary external spur gear, single stream.

Rotation: Refer to pump drawing.

Operating Speed: 3-180 rpm depending upon application conditions and fluid viscosity.

Temperature: To 645° F (350° C), (950° F maximum with special fasteners and seals).

Design

Zenith H-Series metering pumps consist of two gears rotating in mesh within a closely fitted housing that is comprised of three plates. The center gear plate fits closely around the outside diameter of the metering gears. The front and rear plates sand-wich the center plate and restrict axial movement of the gears. Power is transmitted to the gears by the drive shaft which is either a through shaft, as in the packing gland type pump, or a shaft with a tang that engages a universal seal coupling. The coupling is both a connection to external power and the rotating member of a mechanical seal.

The two seal designs, mechanical face seal and packing seal, have different operating requirements. As mentioned above, the mechanical face seal design consists of a rotating universal seal coupling that seals against a fixed seal plate. The all-metal seal design is dependent upon sufficient inlet pressure (usually 25 - 50 psi) to force the inner rotating coupling against the outer stationary anchor. This design is commonly used in abrasive fluid or high temperature applications.

Since the metal seal requires sufficient inlet or working pressure to be effective, a packing seal design is also available. Pumps with this type of seal can have two to four packing rings. Common available materials are Grafoil and Teflon. To seal effectively, fluid must be able to travel axially along the shaft. Weepage in these pumps is a common occurrence and should be expected.

H-Series pumps are precision instruments requiring skilled and careful maintenance. Constructed of high-quality tool and die steels such as AISI D2, M2, M4 and CPM-M4, or other high-performance alloys, they are tempered after heat treatment to hardnesses ranging from HRc 58 to HRc 64. Since the thermal expansion rates for all three steels are almost identical and are otherwise entirely compatible, it is possible to combine them so as to take advantage of their best qualities in the most economical way.The Type D2 tool steel is often selected for the side and center plates as it offers good abrasion resistance, and it is the most economical of the three steels we most commonly use. Type D2 will also provide a higher degree of corrosion resistance than M2 or M4.

The portion of the side plate subject to the most wear is the shaft bearing hole, which has an easily replaceable, inexpensive sleeve bearing that can be made of the extremely wear resistant Type M4 tool steel. Types M2 and CPM-M4 steels are commonly used for the metering gears, drive shaft, and universal seal coupling, due to their superior torsional strength and abrasion resistance for these items that are the most critical to proper metering performance.

Operation

All H-Series pumps are rear ported. Fluid enters the pump through a port drilled into the rear side plate (the side opposite the drive shaft). The fluid fills the exposed gear tooth volumes and is transported around the outer diameter of the gear pocket. As the gears mesh together, the fluid is displaced in a very precise amount out through the discharge port that is drilled alongside the inlet port in the rear plate.

Since Zenith pumps are not self-priming, a flooded suction is usually the minimum inlet pressure required. However, 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 and to prevent cavitation.

Zenith pumps rely on the metered fluid for lubrication of internal bearing areas. **The pump should never be allowed to run dry or be allowed to run with non-lubricating fluids such as water.** Because of the close clearances in the bearing areas, lack of sufficient lubrication can cause pump seizure or some other catastrophic failure.

Slip can occur across the faces of the gears from the high-pressure side to the low-pressure side. The amount of slip depends on four factors: fluid 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.

The Zenith H-Series are designed for high-temperature and high-pressure operation. As such, operating temperatures to 950° F can be achieved. When operating at temperatures above ambient, heat jackets should be used and pumps should be heated slowly and uniformly to avoid warpage and internal component interference.

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.

While the pump is composed of steel, it is a precision instrument. Dropping the pump or hitting with a non-yielding material can cause serious damage to the components. All materials are through-hardened to maximum hardness resulting in a brittle material. Treat them as you would any other precision gaging instrument.

Zenith pumps are shipped filled with a rust preventative oil. Flush the oil thoroughly with a cleaning solvent. It may be necessary to disassemble the seal arrangement to remove all traces of the oil, but disassemble only if necessary.

After flushing, the pump should be lubricated internally for start-up purposes. Pour a suitable high-temperature lubricant into the inlet port. Rotate the metering gears until lubricant appears at the discharge port.

Mount the pump to a block with a flatness of true flat to .0001" convex and a surface finish of 4 to 8 rms to prevent leakage between the pump and block. Mounting bolts should be a Grade 8 or better. Make sure mounting bolts are lubricated with a high-temperature anti-seize compound such as DAG Dispersion #154. Bolts should be alternately torqued in even increments up to Zenith's recommended limit for the bolt size used. See Table 2 on page 10 for torque values.

The following is a brief "standard" installation procedure. For special applications, considerations, or simply to ask our advice, please contact our Applications Engineering Group.

To prepare the pump for use:

1) Always flush out the plumbing system before connecting the pump.

2) Filters should be installed prior to the pump inlet that filter ideally to half the pump running clearances.

3) Turn pumps by hand before running. Pumps should turn freely.

4) Engage the outer drive shaft carefully, making sure that it does not bottom in the slot of the coupling,***** and that it is aligned within 1° angular and .005" parallel with the true pump drive axis.

***NOTE:** The coupling is the rotating member of the seal and depends on the internal operating pressure of the pump to force it forward and effect a seal against the carbon or metal seal plate.

5) In pumps with a through shaft and compression packing seal, the pump-to-driver axis may shift unevenly due to pump heating expansion. To remedy this, we recommend connecting the pump driver to the pump shaft with the appropriate Zenith SJM Coupling or with a double universal joint arrangement. This type of joint will prevent bending loads from being transmitted to the pump shaft when misaligned. This greatly reduces the possibility of premature shaft failure due to fatigue. To prevent seizure, be sure to apply adequate high-temperature lubrication to the universal joints.

6) Heat the pump thoroughly and evenly (including the seal arrangement). A time-saving heating alternative would be to maintain a clean and ready-to-use pump in an oven at operating temperature. This avoids thermal shock and saves valuable heating time. Be sure to check the pack-ings prior to use as extended heat soaks tend to dry out some packing materials.

7) Tighten the mounting bolts and coupling housing screws to Zenith's recommended torque at that operating temperature.

8) Make sure fluid is in the pump before starting. Be sure to apply positive inlet pressure when metering high-viscosity fluids. Pumps with universal face seals require an inlet pressure of approximately 25-50 psi to set the seal.

9) Start pump slowly and, if possible, run it with a lubricating fluid.

10) When satisfactory operation is achieved, the pump and system may be gradually brought up to normal process speeds and pressures.

11) If your pump has a packing seal, take up firmly and evenly on the seal gland screws to compress the packing, then back off 1/2 turn of the screws or until slight weepage occurs. Be sure to adjust the gland properly. Do not overtighten. Overtightening can cause the packings to burn.

12) Be sure to follow up closely throughout the running-in period of the packing until the seal is thoroughly seated. Do not completely seat the packing in one adjustment.

13) If at any time during operation the pump does not appear to be running smoothly, stop the pump immediately to avoid any serious internal damage.

Cleaning, Inspection and Repair

REMEMBER: Zenith metering pumps are made for exacting duty. In order to develop the high pressure demanded, the clearance between the metering gears and their housing must be as small as possible, yet large enough to allow adequate lubrication.
All parts are machined to extreme accuracy; critical dimensions are held between one and two ten-thousandths of an inch (.0001"/.0002"). Because of these close running clearances, Zenith pumps require careful maintenance and handling, especially of component parts. The slightest burr, nick or particle of foreign matter can cause scoring or even seizure. Zenith pumps are precision instruments; you can't keep them too clean. Please treat them with care, and if it's at all possible, set aside a separate clean area for pump maintenance.

To clean H-Series metering pumps, place them in a suitable furnace and gradually heat in an inert atmosphere for the initial hour to prevent flashing of the polymer. Time at temperature will be related to the pump size and the degree of polymer contamination and should be determined by trial.

NOTE: Careful control of the furnace temperature and atmosphere is critical. Should the temperature exceed the original tempering temperature, the steel hardness will draw back and the dimensional stability of the pump may be upset. Consult Table 1 for proper tempering temperature.

Another acceptable cleaning method is to immerse the pump in a fluidized bed cleaning bath. The bath should be heated to a temperature that is sufficient to carburize the polymer. The carburization process usually takes between 3 to 12 hours, depending on the polymer type, temperature, pump size, and furnace load.

CAUTION: Avoid exposing the pump to thermal shock when using this method of cleaning.

After gradually cooling to room temperature, the pump should be thoroughly flushed in a clean solvent. It may be necessary to disassemble the seal arrangement to remove polymer ash.

Always replace the carbon seal plate (if equipped) and fasteners after pump burnout. If the pump was performing satisfactorily when removed from service and still turns freely after burnout, pressure test it and add a high-temperature lubricant to prepare it for return to service. To store for future use, simply add a rust preventative oil.

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 down-time accordingly.

As with any other Zenith pump, H-Series 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 personnel attend a maintenance seminar at the Zenith factory to view the manufacturing, gaging, and assembly techniques involved in producing the H-Series pump. In addition, Zenith also offers a contract service program. Please contact Zenith for further information on these items.

AISI Type	Tempered at	HRc
D2	950° F (510° C)	58-60
M2	1,050° F (566° C)	61-64
M4	1,050° F (566° C)	61-64

Table 1

HPB Series

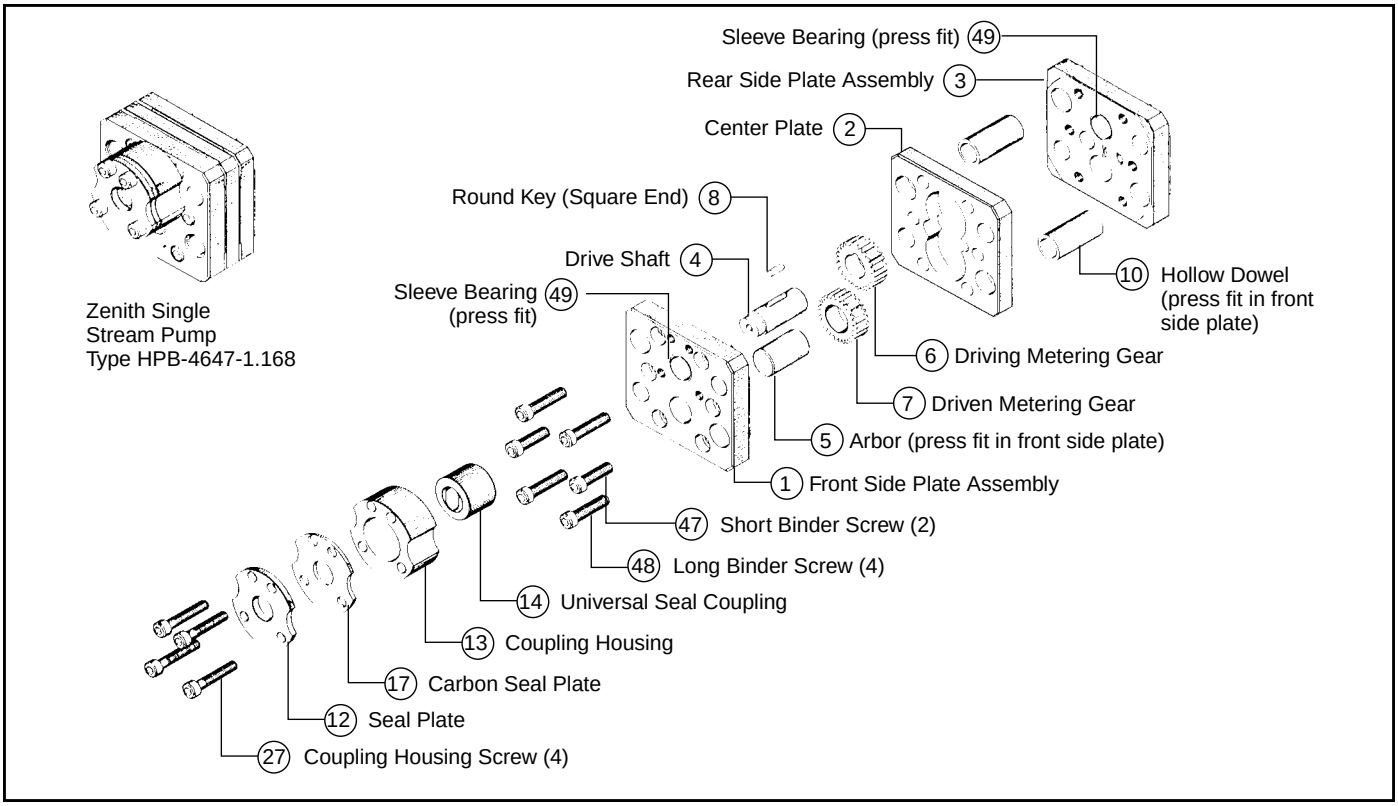

Diagram 1

HMB Series

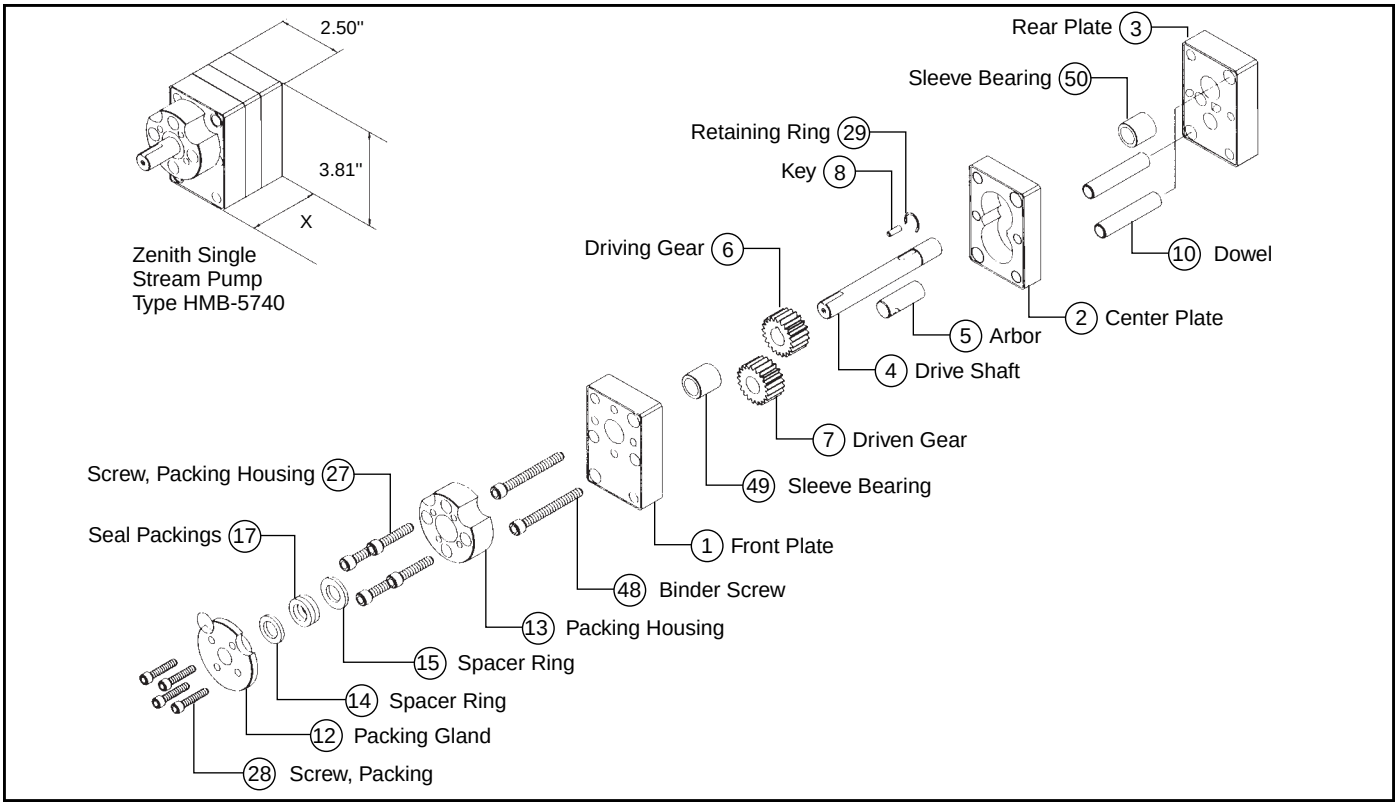

Diagram 2

HLB Series

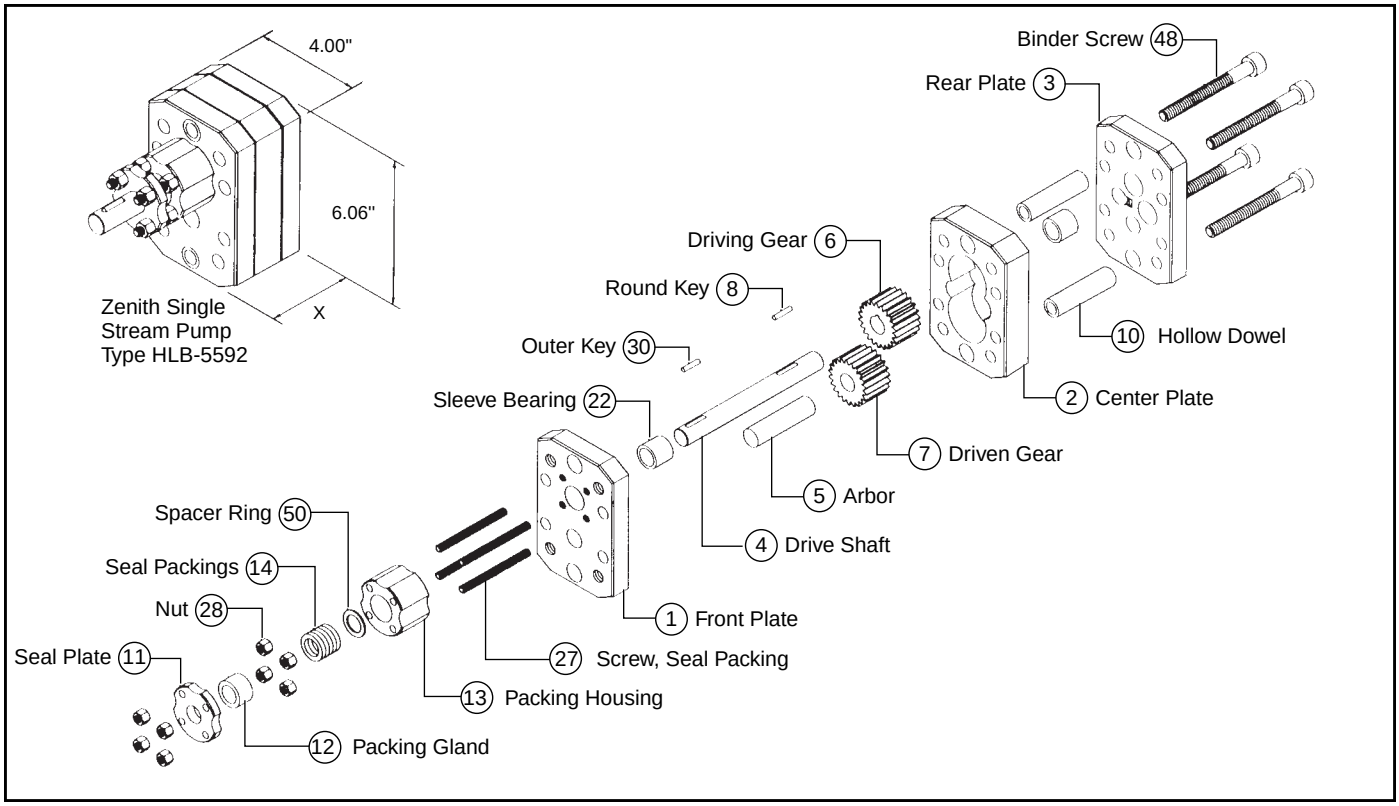

Diagram 3

HXB Series

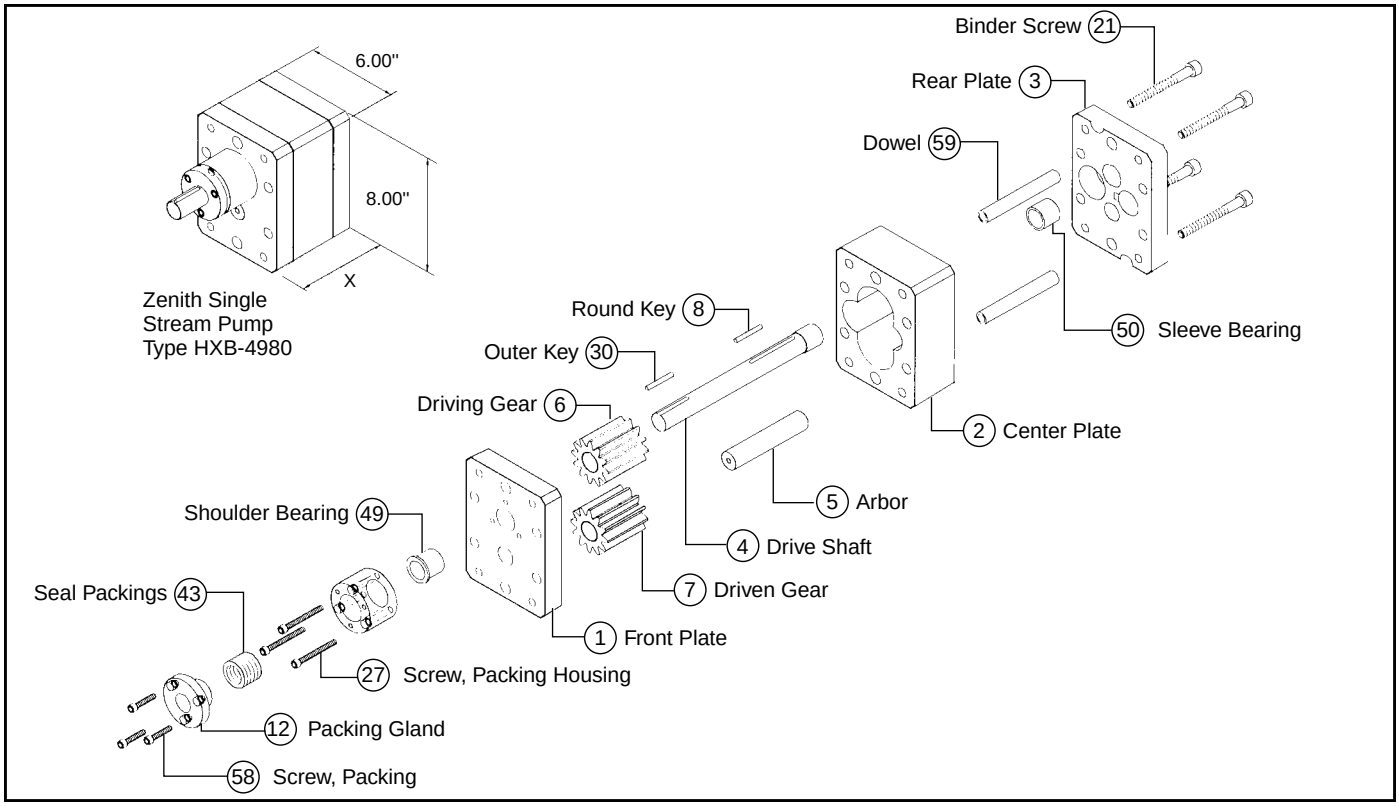

Diagram 4

H-Series Disassembly

If pumps are to be disassembled on a regular basis, we recommend that you establish a pump room with all the necessary tools and equipment for disassembly and cleaning with a separate “clean” area for assembly, testing and storing of rebuilt pumps.

If maintenance is required due to low delivery or seizure, the following procedure is recommended for disassembly.
NOTE: Be sure to note the location and orientation of all parts to ensure reassembly.

Refer to diagrams on pages 6 and 7 for your correct pump type.
NOTE: Discard all fasteners, packings or carbon seal plates after burn-out.

1) Remove the seal arrangement .

2) Remove all binder screws.

3) Remove dowels (10) and arbor (5) with an arbor press in the direction which disengages the press fit in the shortest distance.
NOTE: Dowels and arbors for the HPB, HLB and HXB are press fit in the front side plate (1) and slip fit in the center (2) and rear side plates (3). In the HMB, they are press fit in the rear side plate. For the HPB, HLB and HXB, press these parts out from the front (drive) side and for the HMB, from the rear (port) side.

4) Separate the plates by lightly tapping them with a soft head hammer. If pry slots are available in the pump, you may use them instead of, or in conjunction with, the above method. In either case, great care should be taken not to scratch or damage the internal pump surface when prying the plates apart.

5) After disassembly, clean all components in a glass bead blast cabinet to remove any debris remaining after heat cleaning. Alternative, non-destructive cleaning methods such as water jet or solvents are also acceptable.

6) Wash components in an ultrasonic cleaning tank and air dry. Be careful not to bang parts together.

7) Inspect all parts for nicks, burrs, score marks and other signs of wear.
The plates and faces of the gears may be hand blocked on 400/600 grit paper and any nicks, burrs or sharp edges can be lightly removed with an Arkansas stone. Be careful not to round off the edges of the gear teeth while lapping.
CAUTION: Since the thickness relationship between the metering gears and center plate is critical to metering performance, and the center plate is non-wearing on its sides, lapping these components is not necessary and should not be done under any circumstances.

Place a layer of 400 Grit Emery Cloth on a lapping block or plate–a granite flat is suitable. Apply light pressure to the component and turn it in a figure 8 fashion (as shown in Figure 1 on page 9) approximately 10 times until a smooth finish appears. Turning in a circular fashion, or other non-uniform motion, may cause the ground holes to lose their perpendicularity to the faces.

Always use clean, lint-free rags and compressed air to clean components. Paper towels are not acceptable; they may leave small pieces of paper and dust on the components. Use chemical brushes to clean between gear teeth, bores, and reliefs.

8) Replace sleeve bearings as necessary and hone in the plate to the original new part specifications.

9) After each resurfacing, carefully gauge the area between the inlet and discharge ports at the mesh of the gears. This area, commonly referred to as the “throat,” is the most critical part of the plate. Scoring or wear marks here will allow increased slip from the high-pressure discharge port section across the throat to the lower inlet port reducing efficiency. Therefore, carefully gauge this area for flatness after each resurfacing.

10) After all components are “hospital clean,” the pump is ready for assembly.

H-Series Reassembly

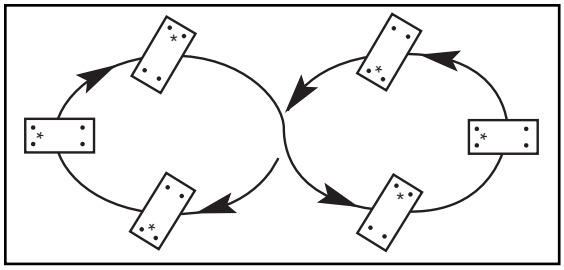

Figure 1

NOTE: During and between each reassembly step, manually turn the metering gears to ensure that they are free turning. If binding occurs at any time, determine the cause and correct it immediately. A tiny nick, burr, or foreign particle can extensively damage a valuable pump component. Never use force in reassembling or turning a Zenith pump. If properly aligned, the pieces will fit easily into place, and the pump will turn freely.

The HMB has a press fit arbor in the rear plate. As such, some of these instructions may need reversal of the front and rear plates.

NOTE: Replace all fasteners, packings or seal plates with new parts prior to assembly.

Reassemble the pump as follows:

1) After all worn parts have been refinished or replaced, all parts should be thoroughly cleaned in a solvent and dried.

2) Using the driven gear (7) as an up-righting fixture, carefully locate the arbor (5) over its press fit hole in either the front or rear plate. Smoothly drive the arbor into its hole with the help of an appropriate arbor press.

3) Place the front side plate (1) with the arbor in position in a soft-jaw vise or holding fixture.

4) Slip together the driving metering gear (6), drive shaft (4) and key (8). Position in the front of the side plate by installing the drive shaft through the bearing (49).

5) Place the driven metering gear on its arbor and carefully mesh with the driving metering gear.

6) Carefully lower the center plate (2) over the gears.

7) Position the rear side plate (3).

8) Rotate the gears to ensure free rotation.

9) Press the dowels (10) into place moving in the direction of the shortest press distance. (Usually from the rear side of the pump.)

10) Lubricate the binder screws (47, 48) with DAG dispersion #154 or a similar heat re-sistant lubricant and install. Torque the screws in even increments, using a crossing pattern, to the manufacturer's recommended limit. It is especially important to rotate the gears frequently during this operation. See Table 2 on page 10 for screw torque specifications.

11) Reassemble the seal arrangement, making sure the sealing surfaces are perfectly clean and free of scratches, nicks,or burrs. When a carbon seal plate is used, always use a new carbon seal that has been lightly polished on 400/600 grit paper. When using a carbon seal, the coupling housing screws (27) should be torqued to the manufacturer's recommended limit. For pumps with a compression packing seal, be sure all old packing is removed from the packing housing.

12) Inspect the drive shaft at the seal area making sure that it is not scored, shouldered or worn. Worn shafts will result in premature seal leakage and should be replaced.

13) Dip the packing rings into high-temperature oil and graphite. This aids in assembly and running-in of the packing.

14) Place the first packing over the shaft and force it firmly and evenly to the bottom of the packing housing. Tap it firmly into place.

15) Rotate the drive shaft by hand after each ring is installed to aid in seating the packing. Continue to install the rings in this manner until the proper number of rings have been installed.

16) Firmly compress the packing by alternating and evenly tightening up the gland screws, then back off 1/2 turn. Be sure to adjust the gland evenly. The pump should not turn now.

17) In pumps with a universal seal coupling, the seal area should be lubricated with a high- temperature lubricant prior to installation.

18) Make sure that the rotating seal coupling is positioned with the shallow slot towards the internal pump shaft. Scoring on the seal faces is detrimental to pump performance. Lapping should only be done on the seal plate and not on the rotating coupling. Lapping the rotating coupling will increase the end play of the seal resulting in possible leakage and/or shaft misalignment.

Screw Torque

Screw Torque Values* (Standard Alloy Steel)

Screw Size &Thread (UNC Alloy Steel)	Torque (Lubricated Threads) lbs.-in.	lbs.-ft.
#10-24 (w/ Carbon Seal Gasket)	50	
#10-24 (w/o Carbon Seal Gasket)	64	
#12-24	120	10
1/4-20	150	12.5
5/16-18	305	25
3/8-16	545	45
1/2-13	1,300	110

Table 2

* In critical applications where control of bolt preload is important, the torque-tension relation should be determined by experimenting on the actual parts involved (including thread lubricants). At elevated temperatures, it is often desirable to reduce screw stress because of deformation (creep) under sustained loading. Screws constructed of type H-11 high-temperature alloy steel provide extremely high creep resistance.

Troubleshooting

Trouble	Probable Cause	Remedy
Pump will not turn	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.
Excessive seal assembly leakage	1) Worn seal plate	Replace seal plate and coupling if necessary.
	2) Drive shaft bottoming in coupling slot	Readjust drive shaft.
	3) Insufficient inlet pressure	Increase inlet pressure.
	4) Worn packings*	Replace packings.
Reduced pump efficiency	1) Worn gear(s)	Replace worn gear(s).
	2) Worn bearings	Replace worn bearings.
	3) Process conditions changed	Consult factory for clearance recommendations on new process conditions.

* A minor seal leak or weep is not abnormal and may be desirable for lubricating the seal surfaces.

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.

Zenith® Pumps

A Colfax Buisiness Unit

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