Zenith® Pumps Planetary Gear Pumps

Installation,
Care And
Maintenance

Zenith® Pumps

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

Zenith® Pumps

Since 1926, Zenith Pumps has provided the man-made fiber industry with precise, pulseless and repeatable gear metering pumps. From the earliest applications in viscose and hot-melt fiber spinning, through the more recent applications in high performance, specialty fibers, Zenith Pumps has met the challenges of the fiber industry with pumps of unmatched performance and quality.

As the largest spin pump supplier to the leading fiber producers in the world, Zenith Pumps has remained in the forefront of gear pump developments through an ongoing program of research and development into both pump design advancements and precision part manufacturing technologies.

In addition to these development efforts, Zenith Pumps is also committed to providing superior quality and customer service with two state-of-the-art, ISO certified production facilities fully integrated to ensure our fiber producer customers have a reliable source of supply for their critical gear pump needs. Further enhancing our customer support efforts is a worldwide network of direct offices, service facilities and sales representatives to respond to the demands of the fiber industry.

Benefits

High Accuracy

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

Temperature Capability

Operating temperatures to 644° F (340° C) for Tool Steel Pumps. Operating temperatures limited due to bolting. Higher temperature bolting is available.

Maximum Life

Minimal moving parts, components are through-hardened steels.

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 and doweled construction allow for the closest fit between gears and gear pockets.

Specifications

Pump Model	Displacement Range (cm3/rev/port)	Outlet Ports	Gear Levels	Speed Range (rpm)	Inlet Press. Range		Outlet Press. Maximum*		Viscosity Maximum	
					(bar	psi)	(bar	psi)	(Poise	Pa-s)
HSC-6188	0.4 - 3.6	2	1	6 - 38	10-100	145-1450	500	7200	5000	500
HSD-6191	0.4 - 3.6	3	1	6 - 38	10-100	145-1450	500	7200	5000	500
HSE-6187	0.4 - 3.6	4	1	6 - 38	10-100	145-1450	500	7200	5000	500
HSG-6189	0.6 - 4.8	6	1	5 - 25	10-100	145-1450	450	7200	5000	500
HSH-6192	0.4 - 3.6	6	2	6 - 38	10-100	145-1450	500	7200	5000	500
HSI-6190	1.2 - 6.0	8	1	4 - 19	10-70	145-1000	400	6000	5000	500
HSJ-6182	0.4 - 3.6	8	2	6 - 38	10-100	145-1450	500	7200	5000	500

*** Assumes inlet pressure of 100 bar, (70 bar for HSI-6190, 8X1)**

Design

A typical Zenith metering pump consists of two gears rotating in mesh within a closely fitted housing that is comprised of at least three plates. The gear plate fits closely around the outside diameter of the metering gears. The front and rear plates sandwich the gear plate and restrict axial movement of the gears. Power is transmitted to the gears by the drive shaft.

Planetary pumps are more complicated than the simple concept just described, but only in that they can have more parts. The sun and planet gear arrangement allows the metering of a number of streams in a compact package requiring only one drive system. Referring to the appropriate pump drawing and bill of material, there can be up to two gear plates; a front gear plate, which is between the front side plate and the middle plate, and a rear gear plate, which is between the middle plate and the rear side plate. The middle plate serves as a common side plate for both gear plates.

The driving gears (up to two) which reside in the gear pockets of the gear plates, are each engaged with the drive shaft by a key. The outer end of the shaft provides connection to the outer drive device. Equally spaced around each driving gear are up to eight driven gears, which rotate on stationary shafts called arbors. The arbors have interference fit with holes in the plate. The driven gears are housed in the planetary gear pockets of the center plates.

A coupling seal plate sits on top of the front plate and encloses a seal coupling, which is held in the housing by a seal cover plate. This coupling creates a seal by being forced against the seal cover plate by the fluid pressure within the pump. Polymer may leak very slightly between the coupling and cover plate, but only black carbonized polymer should come from the pump. This type of seal requires no adjustment. The alternate seal is a conventional stuffing box utilizing graphite and foil packing rings. As with any stuffing box, this seal requires periodic adjustment.

One central inlet port in the rear plate distributes the incoming fluid to up to eight equally spaced radial passages. These grooves intersect with through-holes that conduct the fluid into up to eight sets of gear teeth in the gear plate. The central driving gear can be concurrently in mesh with up to eight driven gears. In multiple gear-stack pumps, half of each of the incoming streams is metered by the rear set of gears. The other half passes through ports in the middle plate and is drawn into the teeth of the front set of gears.

The rear set of gears discharge fluid directly back through the rear plate. The front set discharges into grooves in the middle plate, which connect with through-holes in the middle plate leading to mating holes in the rear center plate and rear plate.

Operation

Fluid enters the pump via the central port in the rear plate. As each individual set of gears rotate out of mesh, fluid flows in to fill these spaces and as the gears continue to rotate, the fluid is trapped in the spaces by the side walls of the gear pockets.

These trapped volumes are transported by the gears' rotation to the discharge side of the pump where the gear teeth again come into mesh. This action forces the fluid out of the gear teeth spaces. The pressure developed is determined by the pump size, the gear clearances, pump speed, fluid viscosity, and resistance to flow.

Pump speed is limited by practical considerations. If a high viscosity fluid is being metered and pump speed is increased beyond a certain point, the fluid will not be able to fill the gear teeth spaces, and the pump will not obtain enough fluid to maintain normal volumetric efficiency. Lack of sufficient fluid is called starvation or cavitation. This can be remedied by increasing the inlet pressure or reducing pump speed.

The metering of thin fluids presents a different problem. Since the pump depends upon the metered fluid for lubrication of internal bearing surfaces, i.e., the journal bearings in the front, middle, and rear plates and the driven gear/arbor, speeds are normally limited.

Accelerated wear and even pump seizure is the result of higher speeds, especially if attended by low lubricity or a fluid containing an excess of abrasive constituents. In certain applications, it is better to use a pump of larger capacity and operate at a lower speed. Contact our Applications Department for assistance.

Pump efficiency depends on four variables; fluid viscosity, operating clearances, differential pressure and pump speed. The more viscous the fluid, the less likely it is to flow through a given orifice. In a Zenith Pump this orifice is the operating clearance. The differential pressure is forcing the fluid through this clearance at a steady rate, regardless of the pump speed. Thus, the slippage is constant for a given amount of time. The actual delivery of fluid is the expected delivery minus the slippage. If we increase the pump speed we increase the expected delivery, while the slippage remains constant, causing the pump to become more efficient. Likewise, if we slow the pump down, the pump becomes less . Slippage is repeatable and predictable, and pump operation can be adjusted to compensate.

Installation

Planetary pumps are precision pumping devices made to close tolerances and will provide excellent service if applied correctly, handled carefully, and maintained. 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 brittle material. Treat them as you would any other precision gaging instrument.

1. The pump is coated inside with rust-preventive oil after assembly. If the presence of oil is detrimental to the process, it can be flushed out with a solvent before mounting. If critical, the pump must be completely disassembled to make sure that all traces of oil are removed. Flushing should be done by hand. The pump should not be power driven during the flushing operation.

2. If flushing is necessary, it is strongly recommended to then lubricate the pump with a substance which is compatible with the process or with the process fluid itself.

3. Make sure that the pump turns freely before it is mounted.

4. This pump is designed to be bolted to a mounting block with or without a wear plate that is as large as the pump itself, flat within .0001 inch (4 mm), and with a surface finish of 4 to 8 rms to prevent leakage between pump and block. If these conditions cannot be met, gaskets or special seals designed for the purpose may be used. The hardness of the wear plate is to be at least HRc 30 and it is preferable if it is above HRc 50.

5. Holes are provided for bolts for fastening the pump to the mounting block. Alternately torque the mounting bolts using an appropriate crossing pattern and tighten the bolts in two to three stages to the correct limit for the bolts as shown in the reference chart on page 10 of this booklet*. These figures assume some form of lubrication on the bolt threads. Lower torque is acceptable provided the pump does not move as a result of the torque load and no leakage occurs. Higher bolting torque may cause pump binding through center plate compression.

***NOTE:** The torque values provided have been established to achieve the optimum internal pump operating clearances. Significant departure from these values will result in poor pump efficiency due to lower torque or can lead to internal binding/damage if higher torque values are used. In either instance, the mechanical warranty will no longer apply.

6. Once the pump is mounted and the screws are torqued to the proper level, ensure that the pump turns freely by hand. Alignment of the pump shaft with the shaft from the drive system is critical and needs to be kept within (0.015 ((0.4 mm) and 0.5o angular. The coupling should allow a certain amount of misalignment. There must be spaces between the pump shaft, coupling, and drive system shaft in the axial direction. No overhung or side loads should be applied to the pump shaft.

7. Always be sure the pump can turn freely by hand prior to start-up.

8. Once the spinbeam has been allowed to heat up to operating temperatures (2 to 3 hours), there will almost certainly be movement of the various components. Due to this movement, the pumps may need realignment. Tighten the mounting bolts and coupling housing screws to Zenith's recommended torque at that operating temperature and check alignment of the pump shaft with the shaft from the drive system. This “Hot Alignment” is very critical.

Startup

1. Allow enough time for all components of the system to reach operating temperature before starting the pump. If the pumps are being heated on the spin beam, 2-3 hours should be allowed for the pump to be heated. Apply inlet pressure to the pump, allowing time to make sure that the process fluid has entered the pump to provide lubrication for the bearing areas. The pump should free wheel with the inlet pressure.

2. Before starting, refer to item 8 on previous page. Remove all restrictions to fluid flow downstream of the pump to allow initial operation with as low a back pressure as possible.

3. Start the pump at the slowest speed possible and watch the point of discharge for evidence of fluid being pumped. If no discharge is seen after a reasonable length of time, shut the pump off and check for obstructions in the system. The term "reasonable length of time" is subjective, and cannot be quantified because of differences in installations. If, for example, a connection can be broken within a few inches of the pump's outlet ports, the flow would be evident within several seconds. If the distance between the pump outlet and the point of final discharge is long, the pump could seize well before one would expect to see the discharge.

Listen for sounds of distress when first starting the pump and turn the pump off immediately if any are heard. Investigate for causes of distress.

4. If the pump is operating satisfactorily at low-speed and low-load conditions, slowly increase the speed to that of full operation and then slowly apply full operational pressure.

5. Once operating, never allow the pump to run dry.

Cleaning Pumps for Disassembly

After the pump has been in service for a period of time, there usually comes the time when the pump must be disassembled for routine maintenance, cleaning, or other reasons. The pump normally has to be cleaned for ease of disassembly. This can involve simply flushing the pump or a vacuum oven burnout at a maximum temperature of 900°F (482°C) in a protective atmosphere. Soak the pump in solvent (TEG for example for polyester) or heating to a moderate temperature of 300° to 600°F (150° to 315°C) to melt the process fluid and allow most of it to be flushed out of the pump. If a vacuum oven is available, the pump may be heated to higher temperatures to carbonize the polymer within the pump. Contact the factory for proper burnout temperatures.

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.

If present, always replace the carbon seal plate and the bolts 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

Cleaning Pumps for Disassembly (cont.)

before removing it from service and correlating the performance to the 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 downtime accordingly.

As with any other Zenith pump, Planetary Series pumps may be returned to Zenith for complete rehabilitation as necessary. This procedure may be desirable if only a few pumps are involved. Zenith offers a contract service program to repair and maintain your pumps. 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 Planetary Series pumps. Please contact Zenith for further information on contract repair service program or Maintenance seminar offerings.

In some cases spraying or soaking the pumps with one of several available penetrating oils can facilitate disassembly. Once cleaned, the pump is ready for disassembly.

Disassembly

The pump should rest on its rear, ported face during disassembly. Due care needs to be taken in choosing the surface on which the pump rests so as to prevent any damage to the pump. A fixture may be fabricated with pins that insert into the mounting bolt holes of the pump and prevent the pump from rotating. An alternative approach would be to clamp the pump into a large soft jaw vise, clamping on the rear plate. The pump should be oriented with the drive shaft vertical, and the ported side down. Refer to assembly drawings and illustrations found in the appendix of this manual (general reference only).

1. Remove the seal plate bolts with the appropriately sized hex key.

A good quality key should be used. Inferior quality keys can contribute to damage of the bolts.

2. Remove seal plate. This will expose the universal seal coupling.

3. Remove the binder bolts which hold the main plates of the pump together.

4. Separate the coupling seal housing plate by inserting a prying tool into the semicircular prying slots and applying leverage.

5. Lift up on the coupling seal housing plate to expose and remove the universal seal coupling.

6. Separate the front plate assembly by inserting a prying tool into the semi-circular prying slots and applying leverage. When separating the front plate, hold the end of the drive shaft down with thumbs so as not to lift out with plate. If possible, the gears should also be separated from the front plate, so they are not lifted with it. If this is impossible, extreme care should be taken not to allow the gears to separate from the front plate during removal. The gear teeth will be damaged if the gears fall against the other pump components or onto any other hard surface. If the gears were not removed with the plate, separate them from it now using brass putty knives or other relatively soft tools. If needed, a press and an appropriately sized drift can be used to remove the bearing from the front plate. **Use caution not to damage the front plate.**

7. The drive shaft assembly may now be removed from the gear plate. Be careful not to drop or lose the keys when removing the driving gear from the shaft.

Disassembly (cont.)

8. Separate the gear plate by inserting a prying tool into the semi-circular prying slots and applying leverage. Use caution as to not lose or drop any of the driven gears. Remove the driven gears. Turning these may help release them from the rear plate, if they develop vacuum pressure.

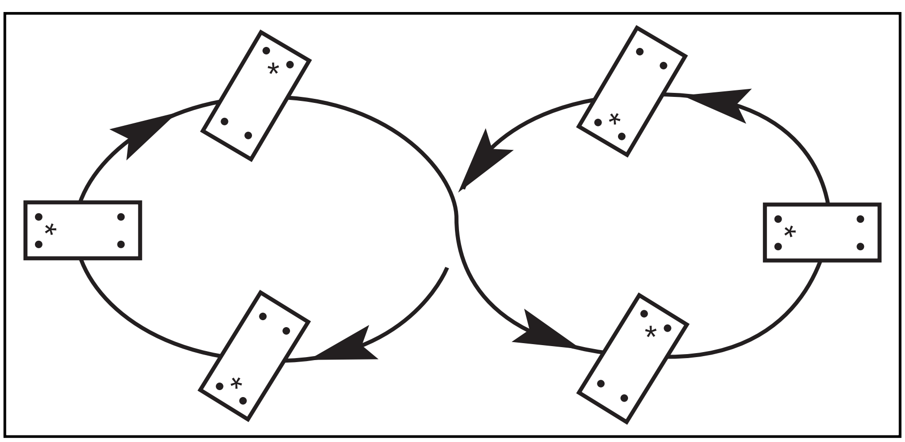
9. Press out the dowels in the shortest direction possible using a press and a similarly sized pin. Optimally, the pin should pilot into the dowel I.D. and step up in size to nearly the dowel O.D. Care needs to be taken to be sure the rear, porting surface of the pump is not damaged during this operation. Place a clean backing material (hardwood, plastic, etc.) on the arbor press platen to prevent damage to the pump.

10. Remove the arbors using the same method used for the dowels. Use caution not to damage the porting surface.

Inspection and Part Preparation

After the parts have been cleaned, they should be inspected for nicks and burrs and stubborn residue. The gears and the edges of the center plate gear pockets are the most likely areas to be damaged because of the sharp edges. An illuminated magnifier facilitates the examination.

1. All flat surfaces of plates and gears should be "blocked." Blocking is the act of rubbing the flat surface of a part on 400-grit, 500-grit, or 3/0 abrasive paper, which is supported on a machinist's or inspector's surface plate. A few light but firm rubs usually is enough to remove the last of the residue and remove minor metal disturbances. Remember to use a figure 8 pattern to retain flatness and perpendicularity of holes when lapping plates.



Heavy disturbances or residue on side plates (NOT gear plates!) may require stronger rubbing on 320-grit or even 240-grit abrasive paper followed by blocking on the finer abrasive. Deep score marks or metal transfer cannot be removed by blocking, and the surfaces must be ground. When surfaces are ground, care must be taken to maintain the perpendicularly of the precision ground holes with the inner plate surface. After each resurfacing procedure is carried out with the side plates, 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 slippage from the high pressure discharge port section across the throat to the lower pressure inlet port reducing efficiency. Therefore, carefully gauge this area for flatness after each resurfacing.

Gear plates should never be ground; to do so would reduce the axial gear clearance to the point where interference might occur when the pump was assembled. Gears can be ground but interchangeability and clearances are ruined. **Grinding gears is not recommended.**

2. Gears, shafts, and arbors should be lightly polished on the O.D.

3. Any nicks in the gear teeth should be removed by careful stoning with a fine India oilstone or an Arkansas stone.

Inspection and Part Preparation
(cont.)

4. The edges of the I.D. of gears, bearing holes, and dowel holes should be lightly stoned with a round Arkansas stone to remove any nicks. Then polish the I.D.'s with a small piece of fine abrasive paper.

5. After all preparation has been completed, remove the abrasive grain and loose residue in an ultrasonic cleaner or other suitable cleaning method. Abrasive grain is larger in size than the pump's clearances.

6. At this point, dimensional inspection may be made if desired.

Re-assembly

NOTE: If the pump will not turn freely after each component is installed, then the last piece installed needs additional attention or replacement.

Provide a can of clean oil, preferably a process-acceptable grade of mineral oil. During assembly, considerable care should be taken to prevent wedging or jamming of close fitting components. Never force the parts together. They will drop into place if properly aligned. As parts are disassembled, place them carefully on a clean surface such as a soft cloth. Do not allow them to touch each other.

1. Locate the rear plate on an assembly fixture, or in a soft jaw vise, as was done for the disassembly process. Orient the plate with the inside face up.

2. Stack the gear plate on top of the rear plate, and align the dowel holes by eye. Make certain the port holes in the rear plate match up with the port cut-outs in the gear plate. If they do not, turn the gear plate over. Pass the dowels through the gear plate and use a press to insert them into the rear plate. The gear plate acts as a fixture to ensure the dowels enter the rear plate perpendicular. Place a clean backing material (hardwood, plastic, etc.) on the arbor press platen to prevent damage to the pump.

3. Using the same method, install the arbors. The gear plate should remain in place. A driven gear can be used to assure proper alignment of the arbor. Inserting the arbor in a non-perpendicular direction can damage the plate.

4. Lubricate the drive shaft bearing hole and arbor with a few drops of oil. Also place a few drops of oil on the rear plate where the driving gear will rest.

5. Oil the keys and insert them into the drive shaft. The oil should hold the keys in place. Install the driving gear. Insert the drive shaft into the shaft hole in the rear plate, lowering the driving gear into the driving gear pocket in the gear plate.

6. Install a driven gear on each arbor, being careful not to bind the gear as it is lowered down the arbor and into the gear plate. The teeth on the driven gear will need to be rotated until they mesh with the driving gear. Rotate the drive shaft at this time to be certain the gears rotate freely.

7. Press the bearing into the front plate using a press and a properly sized drift pin. The bearing should not extend past either surface of front plate. Once bearing is in place, it might be necessary to hone the bearing to correct size. Please check with the factory for the proper bearing size specification.

8. Lower the front plate assembly over the dowels.

9. Lower the seal coupling housing plate over the dowels.

10. Lubricate the binder bolt threads and under the bolt heads with a high-temperature thread lubricant. Insert the binder bolts and tighten them in a crossing pattern until full bolting torque is reached.

Re-assembly
(cont.)

Each bolt should be torqued at least three times during this process to ensure proper bolt loading. Final tightening should be done with a torque wrench.

11. Place the universal seal coupling into the seal coupling housing plate and install the seal plate.

12. Lubricate the seal bolt threads with a high-temp thread lubricant. Insert the bolts and tighten them in a crossing pattern until full bolting torque is reached. Each bolt should be torqued at least three times during this process to ensure proper bolt loading. Final tightening should be done with a torque wrench.

13. Pour oil into the inlet port to lubricate the internal components, then rotate the pump to check for free rotation. If there is a problem, release the binder bolts and check the internal components for damage. Disassemble per the previous instructions.

Bolt Torque

Size (UNC Alloy Steel)	Recommended Torque (in -Lbs)*	(Nm)*
#10-24	43	5
#12-24	68	7
1/4-20	103	12
5/16-18	213	24
3/8-16	378	43
1/2-13	922	104
5/8-11	1836	207
3/4-10	3257	368
Size (Metric Alloy Steel)	**Recommended Torque (in -Lbs)***	**(Nm)***
M3	12	1.4
M5	56	6.3
M6	96	11
M8	232	26
M10	460	52
M12	803	91
M16	1993	225

***Screws lubricated with high temperature thread lubricant, anti-seize compound.**

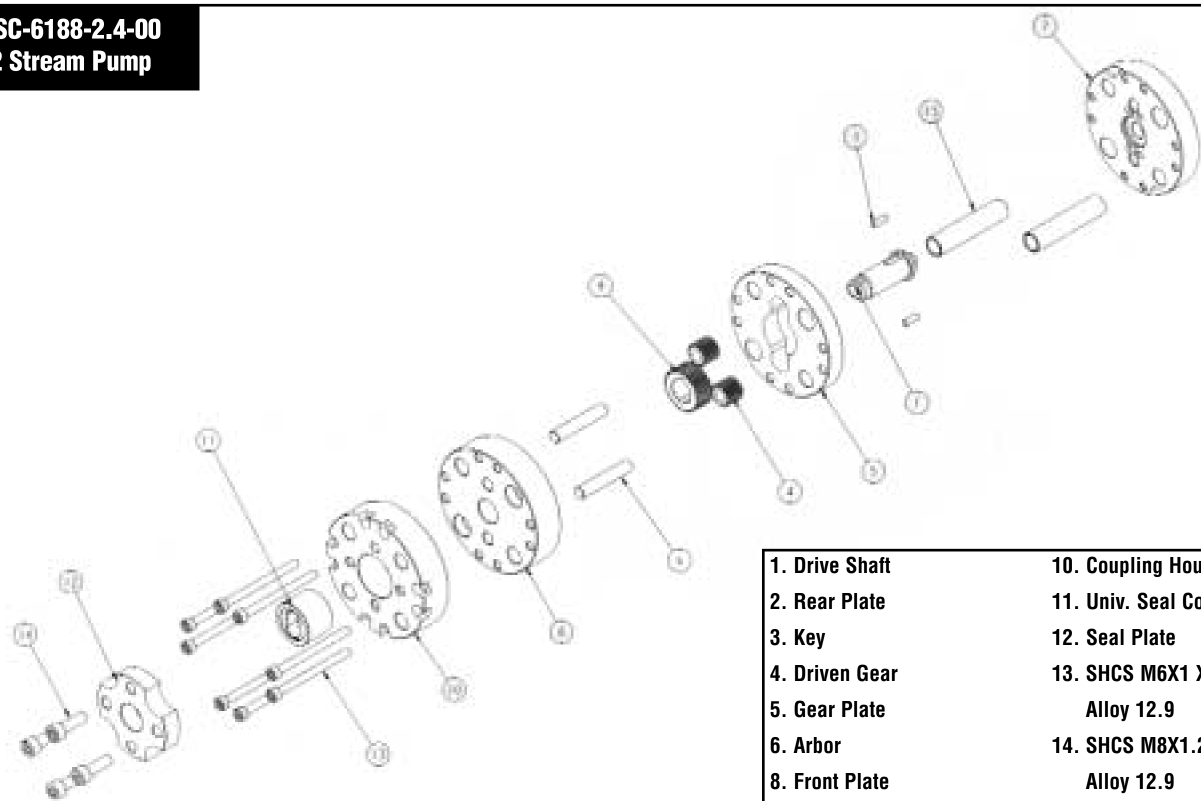
Troubleshooting

Possible malfunctions of the pump with their causes and remedies are listed in the following table.

Trouble	Probable Cause	Remedy
Pump will not turn	Process temperature too low	Check thermocouple and control loop for proper setting or operation.
	Drive malfunction	Verify that drive is powered. Assure that alarm circuits are clear. Check motor drive current and speed settings. Check drive couplings.
	Process conditions changed	Check process fluid for proper melt temperature.
	Entrained particle	Disassemble and clean pump. Replace any damaged parts.
	Internal damage	Disassemble and clean pump. Replace damaged parts.
	Incorrect installation	Check mounting arrangement. Check evenness of heating. Shaft Alignments
	Lack of lubrication	Journal bearing design may not be adequate.
	Interference fit of moving part	Measure clearances and correct if possible.
No flow from pump	Same as above	Same as above.
	Pump rotation	Correct drive arrangement or power leads.
Reduced Pump Efficiency	Worn gear(s)	Replace worn gear(s).
	Worn side plate(s)	Resurface or replace worn plate(s).
	Worn gear plate	Replace gear plate.
	Worn shaft and/or bearing holes causing excessive leakage	Replace shaft and/or side plate(s).
Seal Leakage	Worn or scratched seal faces	Resurface or replace.

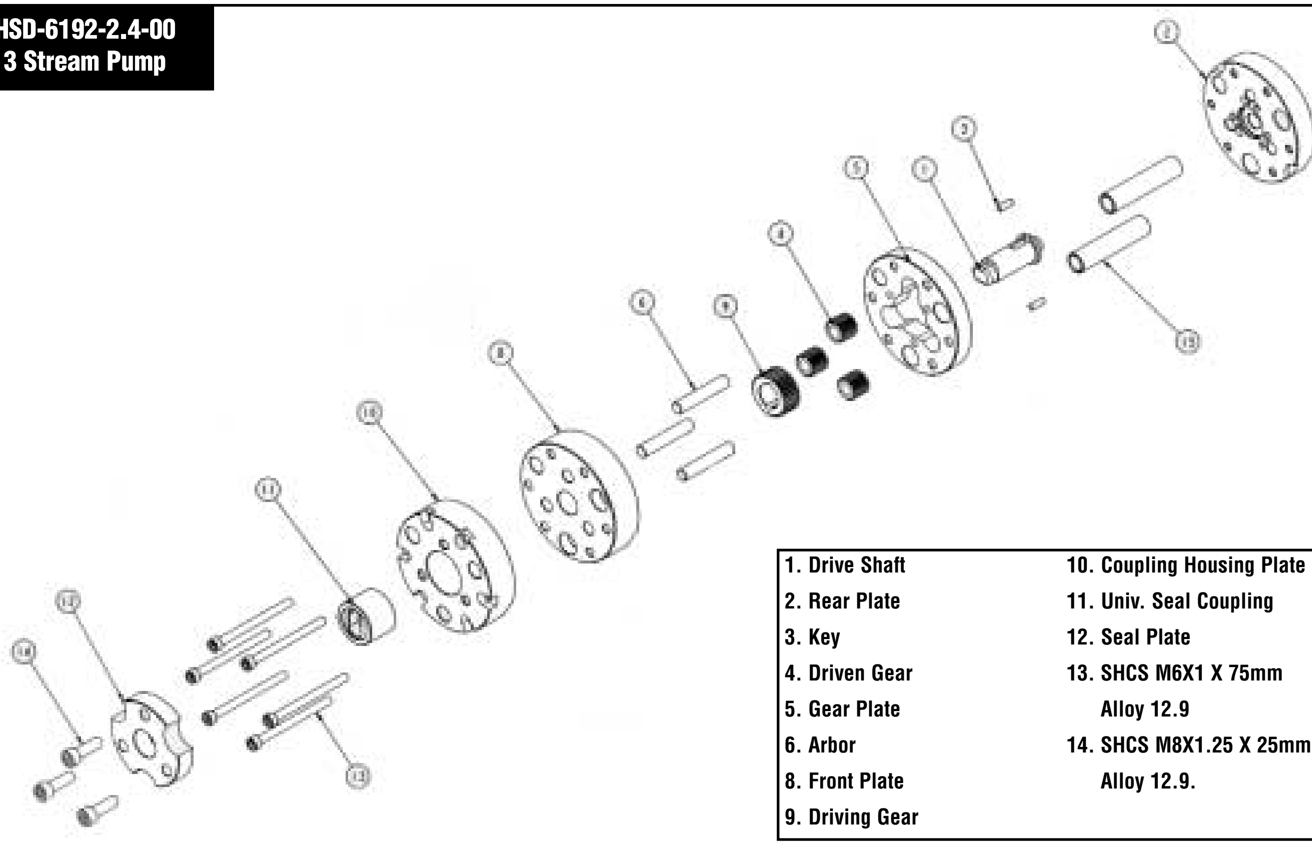
Appendix

HSC-6188-2.4-00
2 Stream Pump



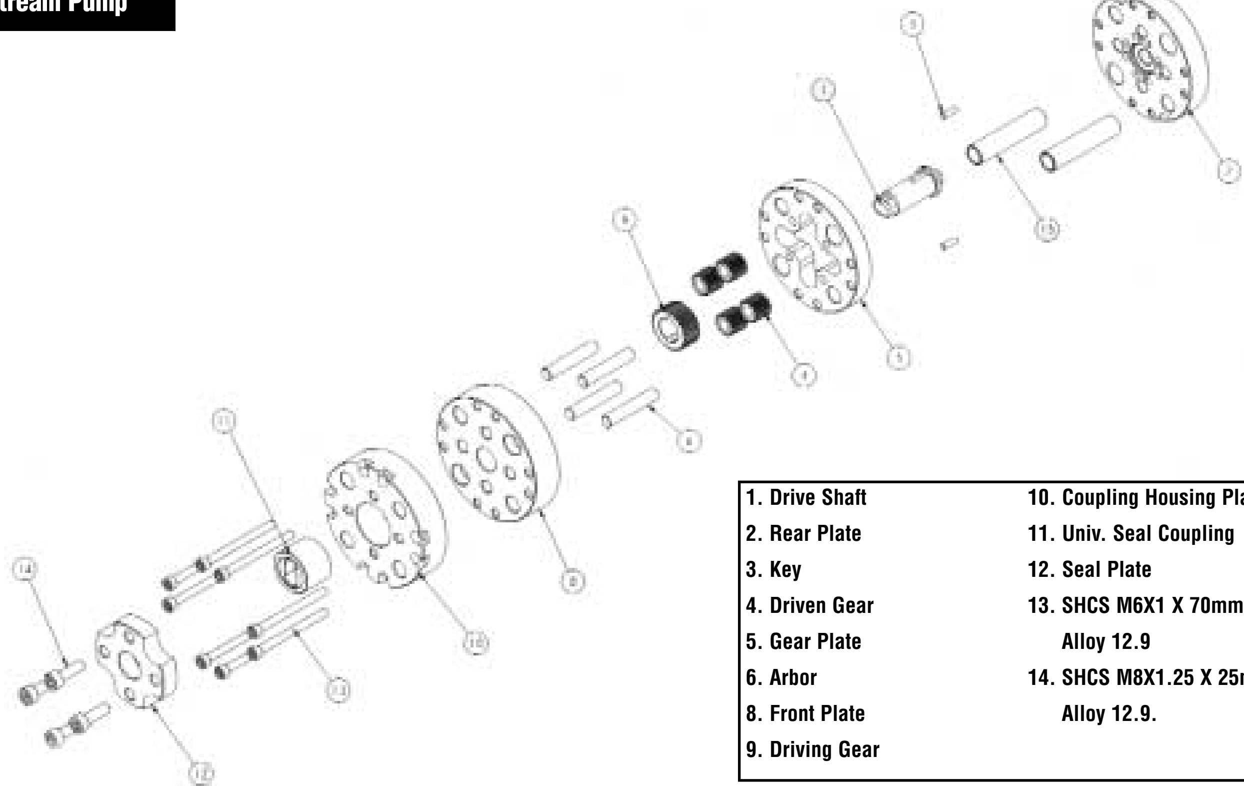
1. Drive Shaft	10. Coupling Housing Plate
2. Rear Plate	11. Univ. Seal Coupling
3. Key	12. Seal Plate
4. Driven Gear	13. SHCS M6X1 X 75mm
5. Gear Plate	Alloy 12.9
6. Arbor	14. SHCS M8X1.25 X 25mm
8. Front Plate	Alloy 12.9
9. Driving Gear	

HSD-6192-2.4-00
3 Stream Pump



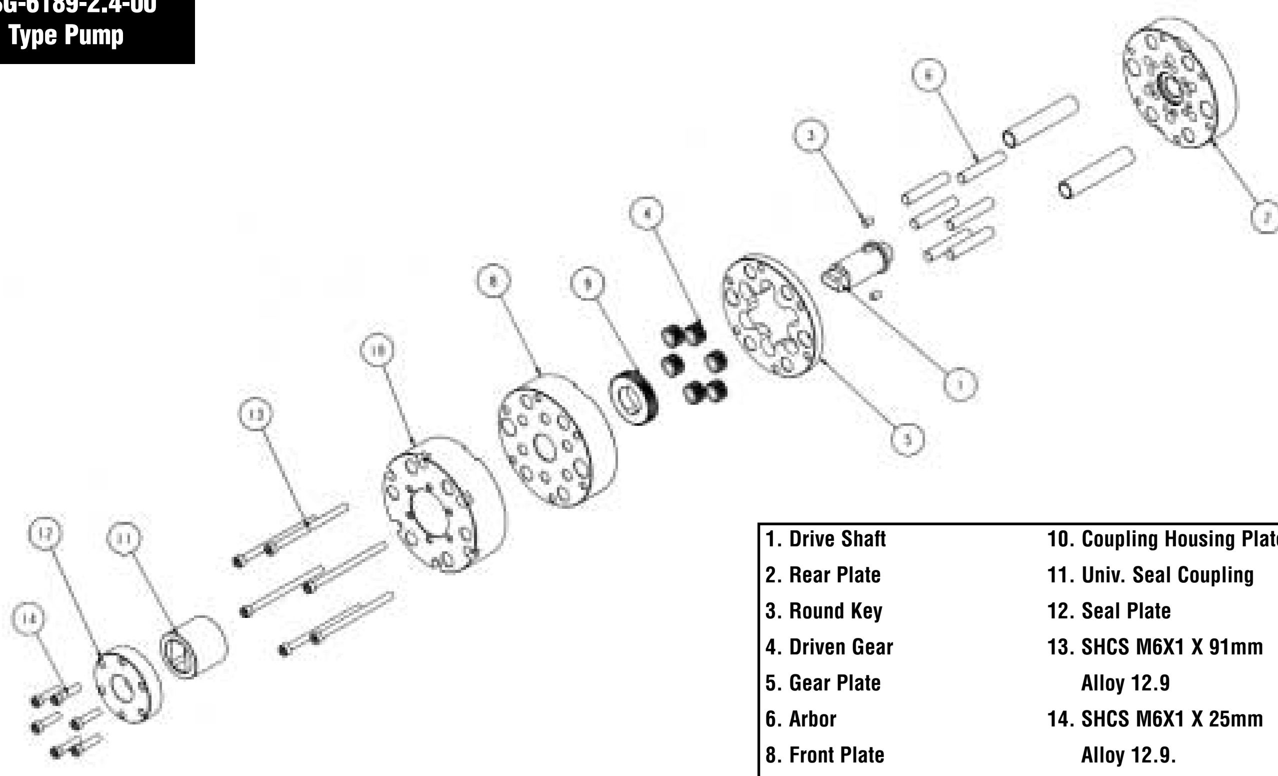
1. Drive Shaft	10. Coupling Housing Plate
2. Rear Plate	11. Univ. Seal Coupling
3. Key	12. Seal Plate
4. Driven Gear	13. SHCS M6X1 X 75mm
5. Gear Plate	Alloy 12.9
6. Arbor	14. SHCS M8X1.25 X 25mm
8. Front Plate	Alloy 12.9.
9. Driving Gear	

HSE-6187-2.4-00
4 Stream Pump



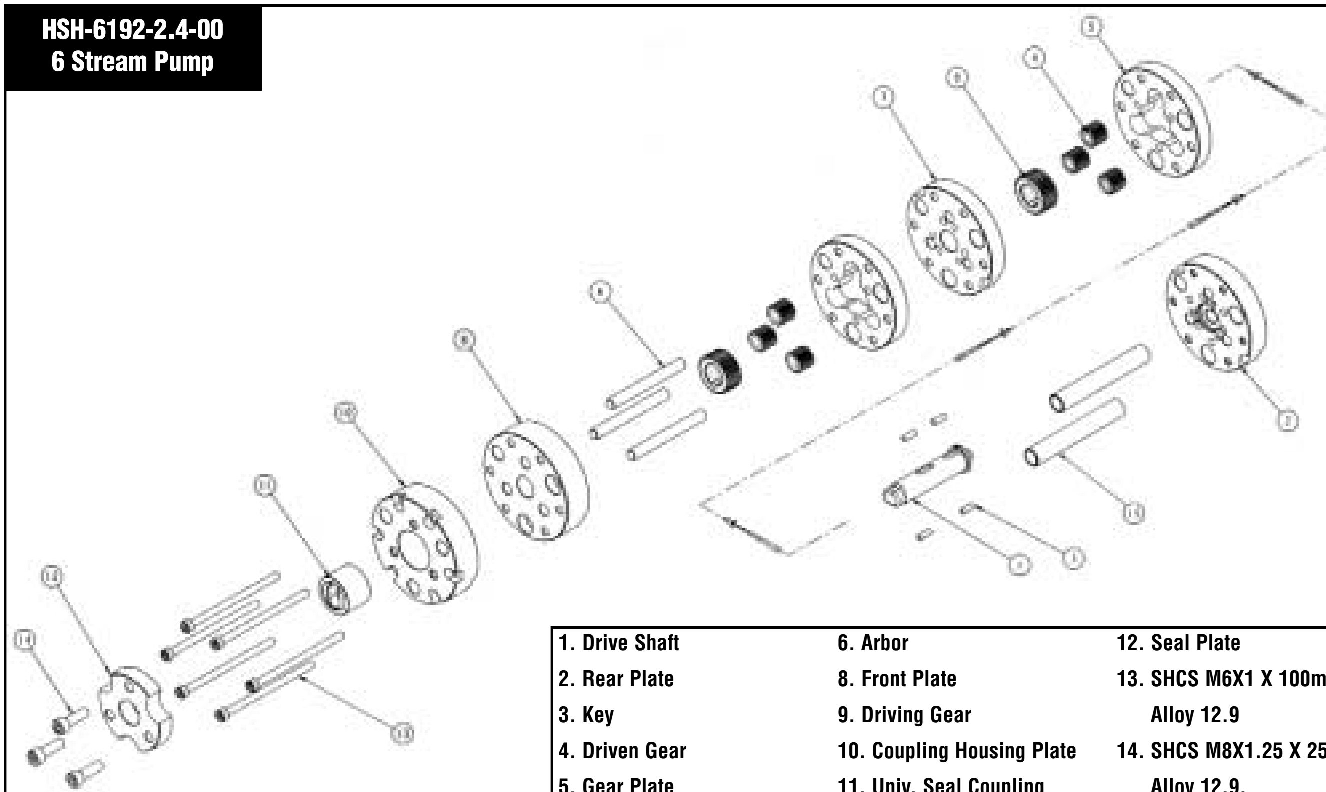
1. Drive Shaft	10. Coupling Housing Plate
2. Rear Plate	11. Univ. Seal Coupling
3. Key	12. Seal Plate
4. Driven Gear	13. SHCS M6X1 X 70mm Alloy 12.9
5. Gear Plate	14. SHCS M8X1.25 X 25mm Alloy 12.9.
6. Arbor	
8. Front Plate	
9. Driving Gear	

HSG-6189-2.4-00
Type Pump



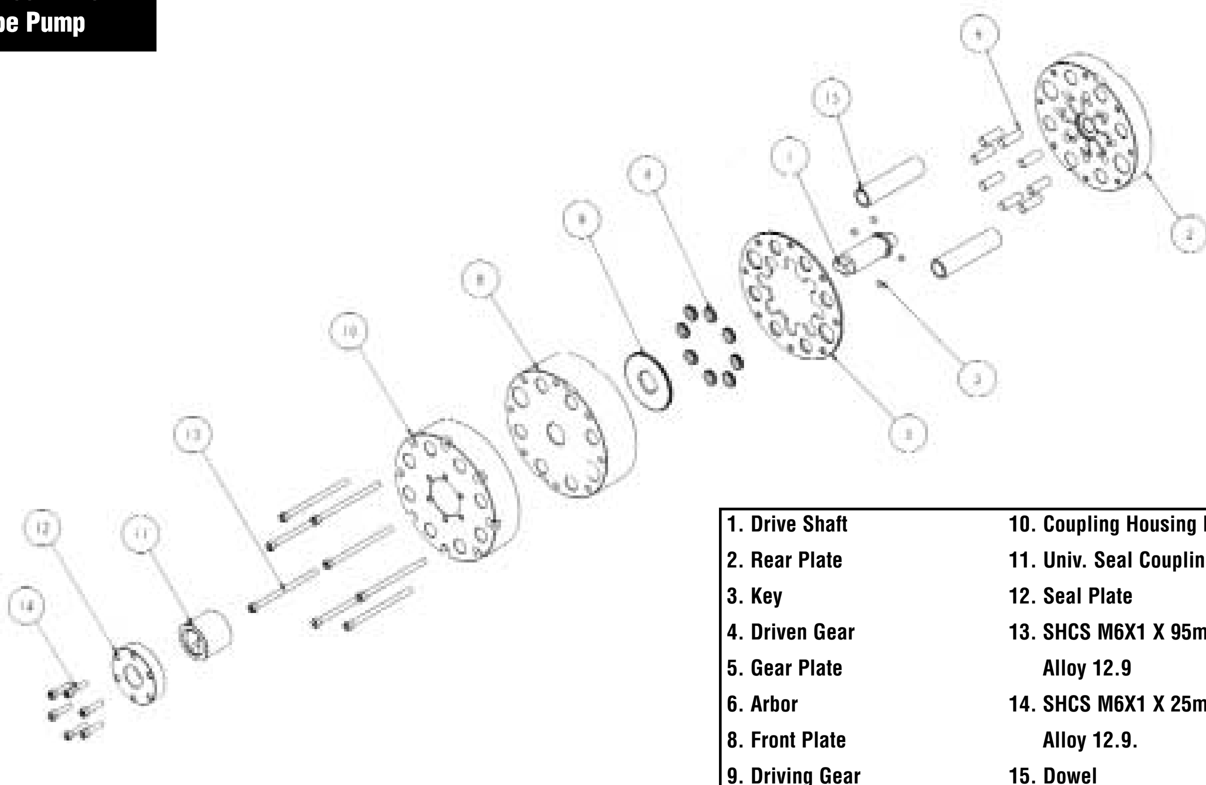
1. Drive Shaft	10. Coupling Housing Plate
2. Rear Plate	11. Univ. Seal Coupling
3. Round Key	12. Seal Plate
4. Driven Gear	13. SHCS M6X1 X 91mm Alloy 12.9
5. Gear Plate	14. SHCS M6X1 X 25mm Alloy 12.9.
6. Arbor	15. Dowel
8. Front Plate	
9. Driving Gear	

HSH-6192-2.4-00
6 Stream Pump



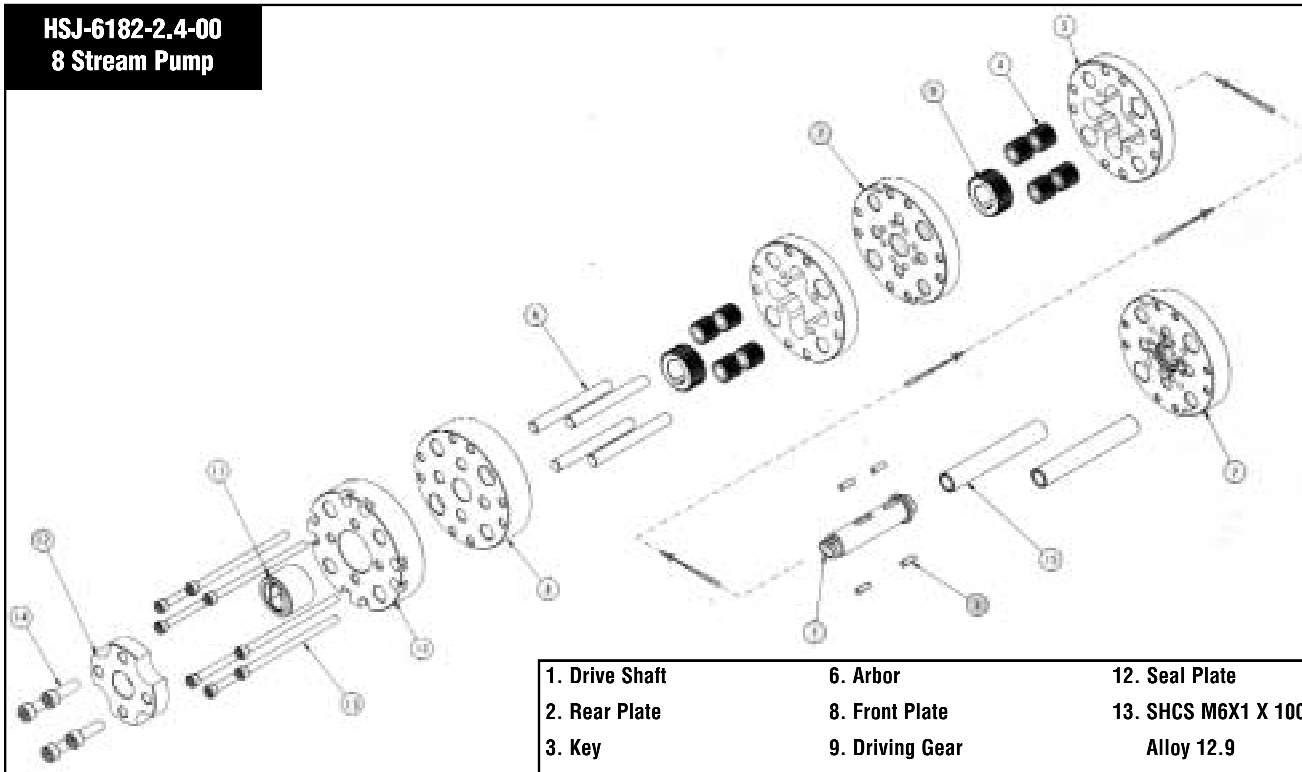
1. Drive Shaft	6. Arbor	12. Seal Plate
2. Rear Plate	8. Front Plate	13. SHCS M6X1 X 100mm Alloy 12.9
3. Key	9. Driving Gear	14. SHCS M8X1.25 X 25mm Alloy 12.9.
4. Driven Gear	10. Coupling Housing Plate	
5. Gear Plate	11. Univ. Seal Coupling	

HSI-6190-1.2-01
Type Pump



1. Drive Shaft	10. Coupling Housing Plate
2. Rear Plate	11. Univ. Seal Coupling
3. Key	12. Seal Plate
4. Driven Gear	13. SHCS M6X1 X 95mm Alloy 12.9
5. Gear Plate	14. SHCS M6X1 X 25mm Alloy 12.9.
6. Arbor	15. Dowel
8. Front Plate	
9. Driving Gear	

HSJ-6182-2.4-00
8 Stream Pump



1. Drive Shaft	6. Arbor	12. Seal Plate
2. Rear Plate	8. Front Plate	13. SHCS M6X1 X 100mm Alloy 12.9
3. Key	9. Driving Gear	
4. Driven Gear	10. Coupling Housing Plate	14. SHCS M8X1.25 X 25mm Alloy 12.9.
5. Gear Plate	11. Univ. Seal Coupling	

WARNING

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.

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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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