VIKING PUMP

TECHNICAL SERVICE MANUAL

SL SERIES ROTARY LOBE PUMPS
MODELS SLAS, SLAL, SLBS, SLBL, SLCS, SLCL,
SLDS, SLDL, SLES, SLEL, SLFS, SLFL, SLGS, SLGL

SECTION	TSM 288
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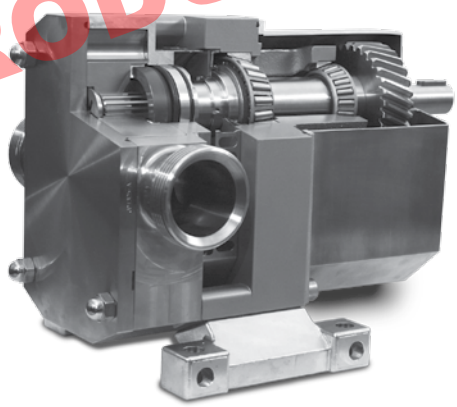


SL SERIES PUMP CUTAWAY

SL SERIES PUMP WITH HEAD REMOVED

1.0 SAFETY INFORMATION

INCORRECT INSTALLATION, OPERATION OR MAINTENANCE OF EQUIPMENT MAY CAUSE SEVERE PERSONAL INJURY OR DEATH AND/OR EQUIPMENT DAMAGE AND MAY INVALIDATE THE WARRANTY.

This information must be read fully before beginning installation, operation or maintenance and must be kept with the pump. All installation and maintenance must be undertaken by suitably trained or qualified persons only.

Symbol Legend :

⚠ **Danger -** Failure to follow the listed precautionary measures identified by this symbol may result in serious injury or death.

WARNING **Warning -** Safety instructions which shall be considered for reasons of safe operation of the pump or pump unit and/ or protection of the pump or pump unit itself are marked by this symbol.

⚠ **DO NOT OPERATE PUMP IF:**

- The head is not installed correctly.
- Any guards are missing or incorrectly installed.
- The suction or discharge piping is not connected.

⚠ **DO NOT** place fingers, etc. into the pumping chamber or its connection ports or into any part of the gearbox if there is **ANY** possibility of the pump shafts being rotated. Severe injury will occur.

⚠ **DO NOT** exceed the pumps rated pressure, speed, and temperature, or change the system/duty parameters from those for which the pump was originally supplied, without confirming its suitability for the new duty. Running the pump outside of its operating envelope can cause mechanical contact in the pump head, excessive heat and can represent a serious risk to health and safety.

⚠ Installation and operation of the pump must always comply with health and safety regulations.

WARNING A device must be incorporated into the pump, system, or drive to prevent the pump exceeding its stated duty pressure. It must be suitable for both directions of pump rotation where applicable. Do not allow pump to operate with a closed/blocked discharge unless a pressure relief device is incorporated. If an integral relief valve is incorporated into the pump, do not allow re-circulation through the relief valve for extended periods, refer to section 3.8

⚠ The mounting of the pump or pump unit should be solid and stable. Pump orientation must be considered in relation to drainage requirements. Once mounted, shaft drive elements must be checked for correct alignment. Rotate pump shaft by at least one full revolution to ensure smoothness of operation. Incorrect alignment will produce excessive loading and will create high temperatures and increased noise emissions. It may also be necessary to earth the pump to avoid the build up of a potential charge difference that could cause a spark.

⚠ The installation must allow safe routine maintenance and inspection (to check for leakage, monitor pressures, etc) and provide adequate ventilation necessary to prevent overheating.

WARNING SL series pumps are shipped fully lubricated with a lithium based extreme pressure Grease suitable for sealed for life units.

WARNING Before operating the pump, be sure that it and all parts of the system to which it is connected are clean and free from debris and that all valves in the suction and discharge pipelines are fully opened. Ensure that all piping connecting to the pump is fully supported and correctly aligned with its relevant connections. Misalignment and/or excess loads will cause severe pump damage. This could result in unexpected mechanical contact in the pump head and has the potential to be a source of ignition.

WARNING Be sure that pump rotation is correct for the desired direction of flow (refer to section 3.1).

WARNING Do not install the pump into a system where it will run dry (i.e. without a supply of pumped media) unless it is equipped with a flushed shaft seal arrangement complete with a fully operational flushing system. Mechanical seals require a thin fluid film to lubricate the seal faces. Dry running can cause excessive heat and seal failure.

WARNING Pressure gauges/sensors are recommended, next to the pump suction and discharge connections to monitor pressures.

⚠ Caution must be taken when lifting the pump. Suitable lifting devices should be used as appropriate. Lifting eyes installed on the pump must only be used to lift the pump, not pump with drive and/or base plate. If pump is base plate mounted, the base plate must be used for all lifting purposes. If slings are used for lifting, they must be safely and securely attached.

⚠ **DO NOT** attempt any maintenance or disassembly of the pump or pump unit without first ensuring that:

- The pump is fully isolated from the power source (electric, hydraulic, pneumatic).
- The pumping chamber, pneumatic relief valve and any shaft seal support system are depressurized and purged.
- Any temperature control devices (jackets, heat-tracing, etc) are fully isolated, that they are depressurized and purged, and components are allowed to reach a safe handling temperature.

⚠ **DO NOT** attempt to dismantle a pressure relief valve, which has not had the spring pressure relieved, is still connected to a pressurized gas/air supply or is mounted on a pump that is operating. Serious personal injury or death and/or pump damage may occur.

⚠ **DO NOT** loosen or undo the head, any connections to the pump, shaft seal housings, temperature control devices, or other components, until sure that such action will not allow the unsafe escape of any pressurized media.

⚠ Pumps and/or drives can produce sound power levels exceeding 85dB (A) under certain operating conditions. When necessary, personal protection against noise must be taken

⚠ Avoid any contact with hot parts of pumps and/or drives that may cause injury. Certain operating conditions, temperature control devices (jackets, heat-tracing, etc.), bad installation, or poor maintenance can all promote high temperatures on pumps and/or drives.

WARNING When cleaning, either manually or by an in-line cleaning method, the operator must ensure that a suitable procedure is used in accordance with the system requirements. During a in-line cleaning cycle, a pump differential pressure of between 2 and 3 bar (30 and 45 psi) is recommended to ensure suitable velocities are reached within the pump head. The exterior of the pump should be cleaned periodically.

⚠ Surface temperature of pump is also dependent on the temperature of pumped medium.

1.1 RISK ASSESSMENT RELATING TO THE USE OF VIKING PUMP SL SERIES ROTARY LOBE PUMPS AND PUMP UNITS IN POTENTIALLY EXPLOSIVE ATMOSPHERES

NOTE

For a feature to be suitable for an application, the feature must be fit for its designated purpose and also suitable for the environment where it is to be installed.

Source of Hazards	Potential Hazards	Frequency of Hazards	Recommended Measures
Unvented Cavities	Build up of explosive gas	**Very Rare**	Ensure that pump is totally filled. Consider mounting ports vertically.
Casing / Rotors / Head	Unintended mechanical contact	**Rare**	Ensure that operating pressures are not exceeded. Ensure that sufficient NPSH to prevent cavitation. Service Plan.
Pump External Surfaces	Excess temperature. Electrostatic charging	**Rare**	User must ensure temperature limits. Do not overfill gearboxes with lubricant. Provide a ground contact for pump. Service plan.
Cover O-Ring	Pump liquid leakage. Build up of explosive gas	**Very Rare**	Check selection of elastomers are suitable for application. Ensure cover retaining nuts are tight. Service plan.
Pump Casing / Cover	Pump liquid leakage. Build up of explosive gas	**Very Rare**	Stainless Steel. Corrosion Resistant.
Shaft Seals	Excessive temperature. Unintended mechanical contact. Leakage. Build up of explosive gas	**Rare**	Selection of seal system must be suitable for application. Manual. Service plan. Seals must never run dry.
Auxiliary System for Shaft Sealing	Pump liquid leakage. Build up of explosive gas	**Rare**	Selection of auxiliary seal system must be suitable for application. Seals must never run dry.
Rotation Direction Test	Excess Temperature	**Very Rare**	If flushed seals are installed, ensure that flush is applied to seal assemblies. Only allow pump to run for minimum period - just a few seconds.
Closed Valve Condition	Excess Temperature. Excess Pressure. Mechanical Contact	**Rare**	Can cause excessive pressure, heat and mechanical contact. Manual.
Shaft	Random induced current	**Very Rare**	Provide a ground contact for pump.
Mechanical Shaft Coupling (Torque Protection)	Temperature from friction. Sparks from break up of shear pins. Electrostatic charging	**Rare**	Coupling selection must suit application. Provide ground contact for pump.
Mechanical Shaft Coupling (Standard)	Break up of spider. Unintended mechanical contact. Electrostatic charging	**Rare**	Coupling selection must suit application. Service plan. Provide ground contact for pump.

2.0 INTRODUCTION

2.1 GENERAL

SL Series rotary lobe pumps are manufactured by Johnson Pump (UK) Ltd. , a subsidiary of Viking Pump Co., (a unit of the IDEX Corporation).

This manual includes all the necessary information for SL Series pumps and should be read prior to beginning installation, operation, or maintenance.

Should you require any additional information regarding the SL Series pumps contact Viking Pump or their local authorized distributor, refer to section 2.2.

When asking for assistance please provide the pump model and serial number. This information can be obtained from the pump nameplate which is located on the side of the bearing housing, refer to section 2.7.

Should the nameplate be unreadable or missing the serial number is also stamped on either side of the casing refer to section 2.7.

If the system or product characteristics are to be changed from the original application for which the pump was selected, or their authorized distributor should be consulted to ensure the pump is suitable for the new application.

2.2 VIKING PUMP DISTRIBUTORS

Viking Pump distributes its products internationally via a network of authorized distributors. Throughout this manual where reference is made to Viking Pump, service and assistance will also be provided by any Viking Pump authorized distributor for SL Series pumps.

2.3 RECEIPTS AND STORAGE

Upon receipt of the pump, immediately examine it for any signs of visible damage. If any damage is noted, contact Viking Pump or your Viking Pump distributor and clearly mark upon the carriers' paperwork that the goods have been received in a damaged condition, with a brief description of damage.

If the pump is not required for immediate installation then it should be stored in a clean, dry environment. It is recommended that storage temperature should be between –10°C and 40°C (14°F and 105°F).

Additionally, if the pump is not intended for installation or use within 18 months or more then refer to Viking Pump or the Viking Pump authorized distributor for storage recommendations.

2.4 CLEANING

The SL Series pump range is suitable for manual cleaning and in-line cleaning refer to section 3.4.1.

The mechanical seals are mounted directly behind the rotor and are designed and to minimize product entrapment and maximize the effects of cleaning.

This strategic positioning of the mechanical seals, combined with their ease of access provides an arrangement that can be more effectively cleaned by both manual and in-line cleaning procedures.

Whenever the pump head is dismantled, and at regular intervals as determined by local operating conditions and verified cleaning procedures, including installations where the pump is only operated using n-line cleaning procedures, the areas behind the rotor case adjacent to the mechanical seals and the

seals/area behind the rotor retainers including the threads in the shafts should be inspected for seal deterioration or product contamination. If any is found then the pump head should be fully disassembled, cleaned and sanitized using a combination of appropriate cleaning solutions and brushes and new seals installed. Refer to Section 5 for seal assembly instructions.

It is recommended that the exterior of the pump be cleaned periodically with a non-aggressive, non-abrasive cleaning solution.

2.5 PUMP MODEL DESIGNATION

The designations of pump models are as follows:

SLAS SLBS SLCS SLDS SLES SLFS SLGS
SLAL SLBL SLCL SLDL SLEL SLFL SLGL

This information, together with the pump serial number, should be provided when requesting additional information on the pump or when ordering spare parts. The pump serial number is stamped on the pump nameplate and the casing, (refer to section 2.7, Figures 3 and 4).

For the maximum operating pressures, temperatures and speeds refer to section 3.3, Figure 7.

2.6 ATEX INFORMATION PLATE

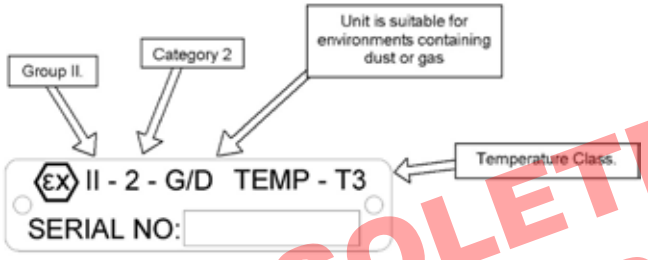


FIGURE 1

2.6.1 EQUIPMENT GROUPS & CATEGORIES

Equipment-groups (Annex I of the EC-Directive 94/9/EC)							
Group I (mines, mine gas & dust)		**Group II** (other explosive atmospheres gas/dust)					
Category M		**Category 1**		**Category 2**		**Category 3**	
1	2	**G** (gas) **(Zone 0)**	**D** (dust) **(Zone 20)**	**G** (gas) **(Zone 1)**	**D** (dust) **(Zone 21)**	**G** (gas) **(Zone 2)**	**D** (dust) **(Zone 22)**
for equipment providing a very high level of protection when endangered by an explosive atmosphere	for equipment providing a high level of protection when likely to be endangered by an explosive atmosphere	for equipment providing a very high level of protection when used in areas where an explosive atmosphere is very likely to occur		for equipment providing a high level of protection when used in areas where an explosive atmosphere is likely to occur		for equipment providing a normal level of protection when used in areas where an explosive atmosphere is less likely to occur	

FIGURE 2

2.7 PUMP MODEL AND SERIAL NUMBER

Should you require any information regarding your SL Series rotary lobe pump contact Viking Pump or your Viking Pump (distributor, providing the pump model and serial number as stated on the pump nameplate, see Figure 3, which is fixed to the bearing housing (see Figure 5 for standard pump build).

Should this be damaged or missing, the pump serial number is also stamped on opposite corners of the casing, (see Figure 4).

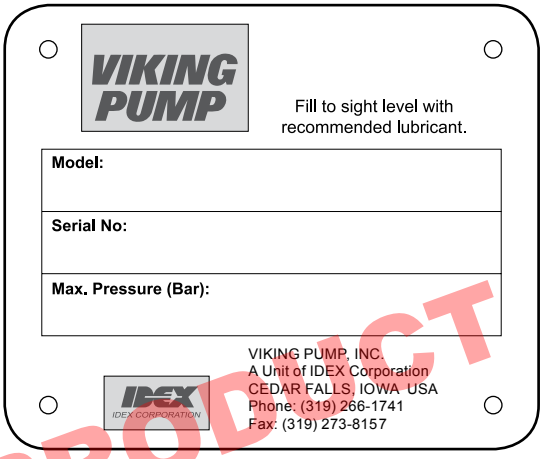


Figure 3
Nameplate

EG. 123456/A/04

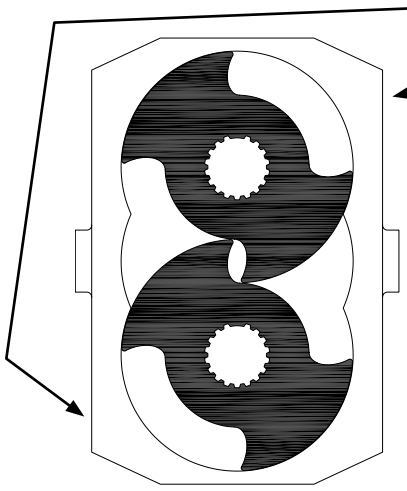


FIGURE 4

2.8 STANDARD PUMP COMPONENT TERMS

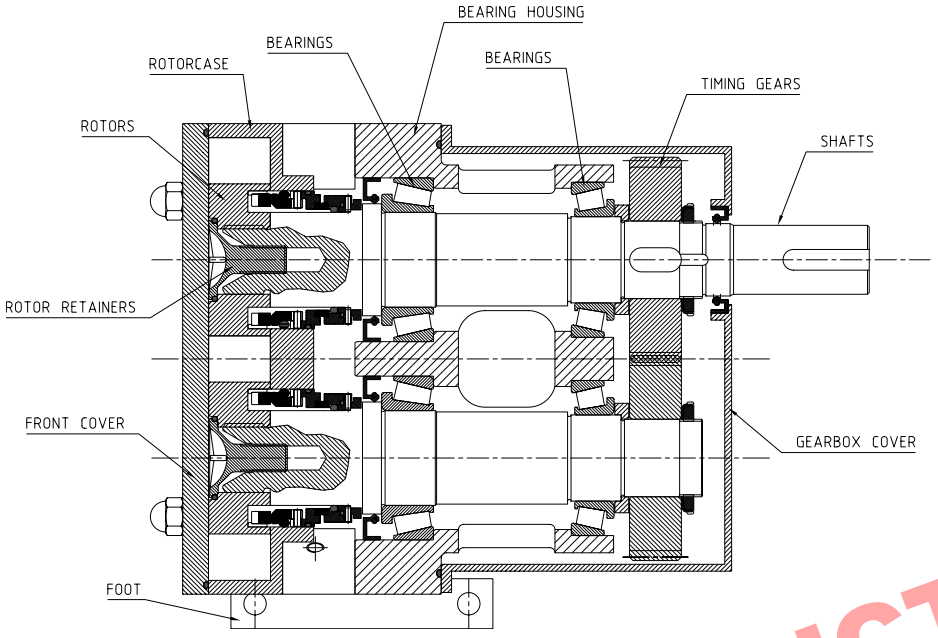


FIGURE 5

3.0 GENERAL

3.1 SL SERIES PUMPING PRINCIPLE

The pumping action of the rotary lobe pump principle is generated by the contra-rotation of two pumping elements (rotors) within a chamber (casing) see Figure 6.

The rotors are located on shafts that in turn are held within a bearing housing mounted to the back of the casing. The shaft assemblies comprise of, the shaft support bearings and the timing gears. The gears transfer the energy from the drive shaft to the driven shaft, synchronizing the rotors such that they rotate without contact with each other.

As the rotors pass the suction port, Figure 6a, the cavity increases creating a pressure decrease, which induces the pumped medium to flow into the casing.

The pumped medium is carried around the casing by the rotors, Figure 6b and 6c, to the discharge side of the pump, Figure 6d. Here the cavity decreases and the pumped medium is discharged from the casing, Figure 6e.

For pump component terms see Figure 5.

3.2 ROTARY LOBE PUMP PRINCIPLE

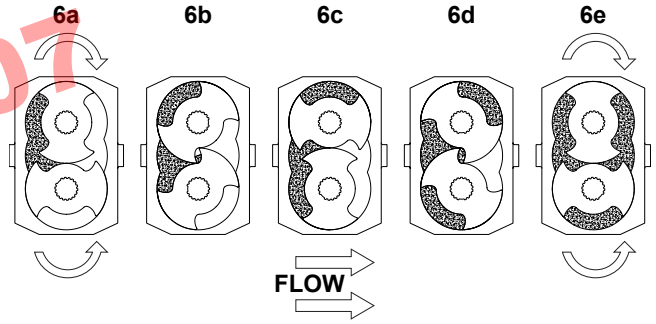


FIGURE 6

3.3 SL SERIES PUMP OPERATING PARAMETERS

The maximum pressure and speed operating parameters are given in Figure 7, page 6. In practice these may be limited due to the nature of the product to be pumped and/or design of the system in which the pump is to be installed. Consult Viking Pump or your distributor for assistance.

WARNING If the system or product characteristics are to be changed from the original application for which the pump was selected, Viking Pump or their authorized distributor should be consulted to ensure the pump is suitable for the new application.

The pump should not be subjected to sudden temperature changes to avoid the risk of damage from sudden expansion/contraction of components. Care should be taken when selecting pumps for handling liquids containing abrasive particles as these may cause wear of pump head components. For advice or assistance contact your Viking Pump distributor.

Pump Series	Theoretical Displacement			Nominal Connection Size		Max Diff. Pressure		Max Speed	Max Temp	
	Liter /rev	Imp. Gal /100 rev	US gal /100 rev	mm	in.	bar	psi	rev /min	°C	°F
SLAS	0.039	0.86	1.03	19	3/4”	15	218	1400	150	300
SLAL	0.059	1.30	1.56	25	1”	10	145	1400	150	300
SLBS	0.081	1.78	2.14	25	1”	15	218	1200	150	300
SLBL	0.122	2.68	3.22	38	1 1/2”	10	145	1200	150	300
SLCS	0.169	3.72	4.46	38	1 1/2”	15	218	1200	150	300
SLCL	0.254	5.59	6.71	50	2”	10	145	1200	150	300
SLDS	0.352	7.74	9.30	38	1 1/2”	15	218	1000	150	300
SLDL	0.528	11.61	13.95	50	2”	10	145	1000	150	300
SLES	0.732	16.10	19.34	50	2”	15	218	800	150	300
SLEL	1.099	24.18	29.03	76	3”	10	145	800	150	300
SLFS	1.524	33.52	40.26	76	3”	15	218	600	150	300
SLFL	2.285	50.26	60.36	101	4”	10	145	600	150	300
SLGS	3.17	69.73	83.74	101	4”	15	218	600	150	300
SLGL	4.754	104.58	125.59	152	6”	10	145	600	150	300
SLHS	6.4	140.78	169.07	152	6”	15	218	600	150	300

FIGURE 7

3.4 SYSTEM DESIGN AND INSTALLATION

When incorporating any pump into a system it is considered good practice to minimize piping runs and the number of pipe fittings (tees, unions, bends etc.) and restrictions. Particular care should be taken in designing the suction line, which should be as short and straight as possible with a minimum of pipe fittings to minimize restricting product flow to the pump. The following should be considered at the design stage of any system.

⚠ Be sure ample room is provided around the pump to allow for:

- Access to the pump and drive for routine inspection and maintenance, i.e. to remove pump head and rotors.
- Ventilation of the drive to prevent over heating.

⚠ The exterior of the pump unit may exceed 68°C (154°F); Appropriate measures must be taken to warn or protect operators.

WARNING The pump must not be used to support piping. All piping to and from the pump unit must be independently supported. Failure to observe this may distort the pump head components or assembly and cause serious consequential damage to the pump.

Valves should be provided adjacent to the pump suction and discharge connections to allow the pump to be isolated from the system for routine inspection and maintenance.

⚠ Rotary lobe pumps are of the positive displacement type and therefore an overload protection device must be provided. This can take the form of:

- An in-line pressure relief system, i.e. external to the pump.
- Incorporation of a torque-limiting device in the drive system.

WARNING It is recommended that all piping and associated equipment from the tank to the discharge point is thoroughly cleaned before installation of the pump to avoid the possibility of debris entering the pump and causing damage.

WARNING Pressure gauges should be installed adjacent to the pump suction and discharge connections such that system pressures can be monitored. These gauges will provide a clear indication of changes in operating conditions and where a relief valve is incorporated in the system, will be necessary for setting and checking the functioning of the valve.

WARNING It is imperative that the suction condition at the pump inlet meets the Net Positive Suction Head required (NPSHr) by the pump. Failure to observe this could cause cavitation, resulting in noisy operation, reduction in flow rate and mechanical damage to the pump and associated equipment.

WARNING The Net Positive Suction Head available (NPSHa) from the system must always exceed the Net Positive Suction Head required (NPSHr) by the pump.

Observing the following general guidelines should ensure the best possible suction condition is created.

- Suction piping is at least the same diameter as the pump connections.
- The length of suction piping is kept to the absolute minimum.
- The minimum number of bends, tees and pipework restrictions are used.
- Calculations to determine system NPSHa are carried out for the worst condition see below.

Should advice on pump or system NPSH characteristics be required contact the factory or their authorized distributor.

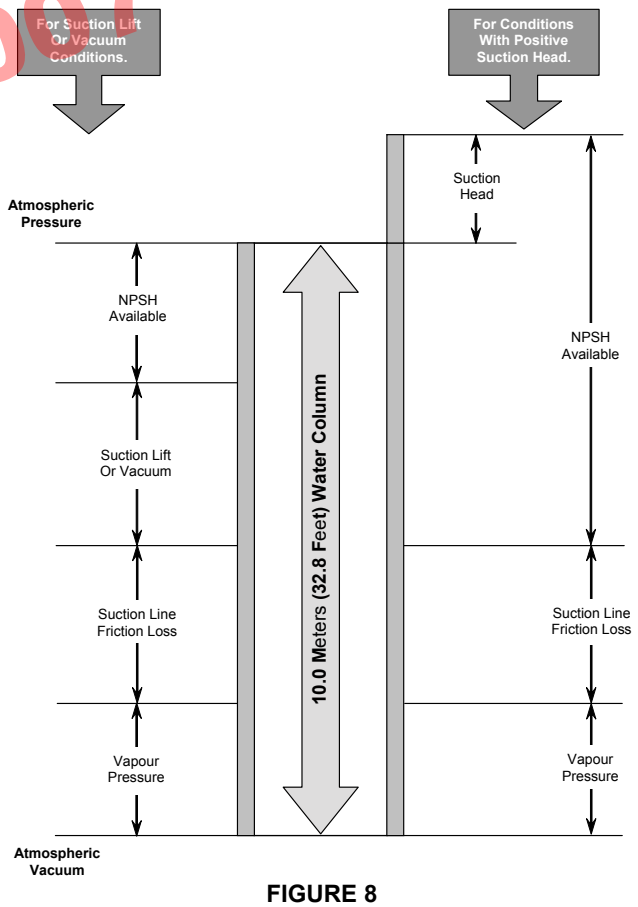


FIGURE 8

Where motor mounted options are to be installed follow the manufactures recommended guidelines. However, when installing a pump complete with base and drive, the following guidelines must be observed:

- The preferred drive arrangement for any rotary lobe pump is in-line direct coupled.
- Flexible couplings must always be incorporated and correctly aligned within the limits recommended by the coupling manufacturer. To check coupling alignment rotate the shaft by at least one full revolution and ensure that the shaft rotates smoothly.

Couplings of a non-flexible design must never be used.

- Couplings must always be enclosed in a suitable guard to prevent contact with rotating parts that could result in personal injury. Guards should be of suitable material, and of sufficiently rigid design to prevent contact with rotating parts under normal operating conditions.
- When installing pump sets in flammable or explosive environments, or for handling flammable or explosive materials, special consideration must be given not only to the safety aspects of the drive unit enclosure but also to the materials used for both the coupling and the guard to eliminate the risk of explosion.
- Baseplates must be secured to a flat level surface such that distortion and misalignment are avoided. **Once baseplates are fastened in position the drive alignment must be re-checked.**
- When using electric motor drives, ensure that the electrical supply is compatible with the drive and controls and that the method of wiring is correct for the type of starting required by the motor i.e. Direct On Line, or other similar method. Ensure all components are correctly grounded.

3.4.1 INSTALLATION WITH IN-LINE CLEANING SYSTEMS

The SL Series range has been designed to be effectively cleaned by procedures recommended for in-line cleaning of process plant. To assist in maximizing the effectiveness of cleaning within the pump head it is recommended that during the cleaning cycle a flow rate equivalent to a velocity of 1.5 metres per second (3.3 feet per second); in a pipe of equal diameter to the rotor case connections is achieved. With a differential pressure of 2 to 3 bar (30 to 45 psi) being developed across the pump head

For applications where maximum drainage of the pump head is required, and / or where in-line cleaning is employed, the pump ideally should be mounted with the rotor case connections in the vertical orientation. A procedure must be determined to ensure that the pump is effectively cleaned. It is recommended that this cycle would typically include a combination of some or all of the following: Acidic or Caustic based Detergents, 'Sanitizers', Disinfectants and Water rinses. These must be appropriate to both the products being handled and the materials of construction of the pump.

3.5 START UP PROCEDURE

WARNING
- Check that all piping and associated equipment are clean and free from debris and that all pipe connections are secure and leak free.

WARNING
- For pumps installed with flushed product seals check that all auxiliary services are in place and connected and provide sufficient flow and pressure for flushing purposes

WARNING
- Ensure lubrication is provided for both pump and drive. SL Series pumps are shipped pre-filled with grease, refer to section 6.4 grease capacities and grades.

WARNING
- If an external relief valve is incorporated in the system check that it is set correctly. For start up purposes it is considered good practice to set the relief valve lower than the system design pressure. On completion of start up the relief valve should be set for the application. The required setting should never exceed the lower of either the pumps maximum pressure rating or the system design pressure. For setting integral relief valves, refer to sections 3.8.1 and 3.8.2.

WARNING
- Ensure both suction and discharge valves are fully open, and pipe work is free from all obstructions. SL Series pumps are of the positive displacement type and should therefore never be operated against a closed valve as this would result in pressure overload, resulting in damage to the pump and possibly the system.

WARNING
- Ensure rotation of the drive shaft is correct for the direction of flow required see Figure 9.
- Ensure product is available in the tank before starting pump. This is very important for pumps installed with un-flushed product seals, as these sealing arrangements must never be allowed to run dry.
- Before beginning operation it is considered good practice to momentarily start/stop the pump to check the direction of rotation and ensure that the pump is free of obstructions. Once this has been carried out, begin operation keeping a visual check on suction and discharge pressure gauges and monitor pump temperature and power absorbed where possible.

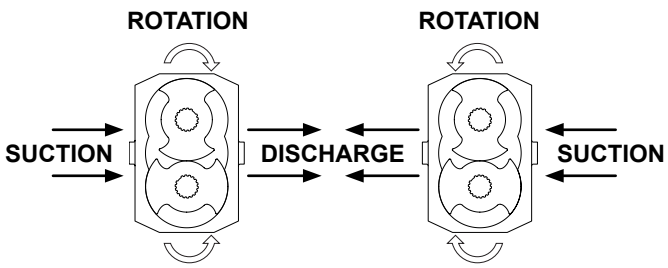


FIGURE 9

3.6 SHUTDOWN PROCEDURE

After shutting the pump down close both the suction and discharge valves and ensure that the necessary safety precautions are taken:

- The prime mover power source has been isolated.
- If installed, the pneumatically operated integral relief valve has been depressurized.
- If installed, flushed product seal auxiliary services have been isolated and de-pressurized.
- Pump head and piping have been drained and purged.

3.7 ROUTINE MAINTENANCE

- SL Series pumps are shipped fully lubricated with a lithium based extreme pressure lubricant suitable for sealed for life units.
- For lubricant capacities refer to section 6.4.

3.8 INTEGRAL PRESSURE RELIEF VALVES

See Figures 10, 11, 12, 13, 14, and 15.

Most models in the SL Series series can be supplied with integral pressure relief valves with both spring and air loaded versions available. The function of the valves can be further enhanced with the option of manual or airlift override offering particular benefits where in-line cleaning is employed. Valves incorporating this option can be opened to regulate the volume of the cleaning media within the pump chamber thereby avoiding the need for manual cleaning or external by-pass.

Where the pump is mounted onto a portable base plate complete with motor and drive to be used as a mobile set, it is strongly recommended that a integral pressure relief valve is installed.

The SL Series integral pressure relief valves available include:

Spring Loaded - see Figure 10, 11, 12, & 13.

Valve can be set to required pressure relief setting.

Spring Loaded with Manual Lift - see Figure 11.

Valve can be set to required pressure relief setting. Manual lift override can be used to open valve without disturbing pressure relief setting.

Spring loaded with airlift - see Figure 13.

Valve can be set to required pressure relief setting. Airlift override, which operates on an air supply of up to 7 Bar (105 psi) depending on pressure relief setting, can be used to open valve without disturbing pressure relief setting.

Air loaded with airlift - see Figure 14.

Valve, which operates on an air supply of up to 7 Bar (100 psi) for SLA - E, and 10 Bar (145 psi) for SLF, can be set to required pressure relief setting. Airlift override, which operates on an air supply of up to 7 Bar (100 psi) for SLA - E and 10 Bar (145 psi) for SLF, depending on pressure relief setting, can be used to open valve without disturbing pressure relief setting.

Air actuated relief valves can be operated remotely and interfaced with other elements of the system or process control.

Integral pressure relief valves are normally used to protect the pump from the effects of increases in system pressure caused, for example, by a restricted or closed discharge line. In response to a pressure increase the valve opens and internally circulates the pumped media within the pump chamber.

WARNING When the valve opens, because the volume of fluid circulating is relatively small, the temperature of the fluid in the pump chamber may rise if the pump continues to operate for an extended period. In severe cases this may result in temperatures in excess of the pumps operating limits or vaporisation of the fluid, both of which should be avoided. For these reasons when the valve is activated the cause of the system pressure increase should be eliminated as continuous operation of the pump with the valve open is not recommended and may cause severe damage to the pump.

If the pump on which the valve is installed is to be installed in either a pressurized system or one incorporating a vessel under vacuum, the application of the valve should be referred to Viking Pump or their authorized distributor.

The selection, setting and application of integral relief valves is influenced by the viscosity and nature of the pumped media, the pump operating speed and the required pressure relief setting and mode of operation. For these reasons, and to cover the diverse range of products, the conditions under which they are pumped, and application demands, it is not practical to factory set integral relief valves. The setting of the valve should be carried out on site under the proposed duty conditions for which the pump and valve were selected.

Before beginning the relief valve setting procedure the pump should be installed, (see section 3.4) with a pressure gauge in the discharge line adjacent to the pump discharge port.

3.8.1 SETTING AND OPERATING SPRING LOADED VALVES

See Figures 10, 11, 12 and 13.

- Remove cover (108). For integral relief valve with manual lift, see Figure 11; first remove nut (129) and hand wheel (111).
- Loosen nut (107) using a pry bar in the holes provided, to relieve spring compression. For integral relief valve with airlift, see Figure 13, the air cylinder must be exhausted prior to unscrewing the nut (107).
- Start pump, refer to section 3.5.
- Screw in nut (107) using pry bar in holes provided until required pressure relief setting is reached.

WARNING **NOTE: Care should be taken not to exceed the lower of either the pumps maximum pressure rating or the system design pressure.**

- Reinstall cover (108). For integral relief valve with manual lift, see Figure 11; reinstall hand wheel (111) and nut (129).
- The relief valve is now set.

For Integral Relief Valve with Manual Lift - see Figure 11.

- To operate the manual lift, turn the hand wheel (111) clockwise, which will lift the valve head (102/128). To resume normal operation turn the hand wheel (111) counter-clockwise.

For Integral Relief Valve with airlift - see Figure 13.

- To actuate the air lift connect an air supply not exceeding 7 Bar for SLA -E and 10 Bar for SLF to the cylinder (123) which will lift the valve head (112). To resume normal relief valve operation, exhaust the Cylinder (123).

3.8.2 SETTING AND OPERATING AIR LOADED VALVE

See Figure 14.

- Connect an air supply, via a regulating valve to the relief valve connection A in the cylinder (114). Do not turn on the air supply.
- Start the pump, refer to section 3.5.
- Using the regulating valve gradually increase the air pressure until required pressure relief setting is reached. The air pressure must not exceed 7 Bar SLA - E and 10 Bar SLF.
- The relief valve is now set.

WARNING

- **SLF Only - If the valve assembly is disassembled, e.g. for maintenance or repair, it is necessary to apply a thread locking compound (Loctite 270 or similar) to the piston retaining screw (120).**

NOTE: Care should be taken not to exceed the lower of either the pumps maximum pressure rating or the system design pressure.

- To use the air lift system the regulated air supply must be routed through a change over valve in order to transfer air from the relief valve load air chamber, connection A, to the lift air chamber, connection B while depressurizing the load chamber and vice versa. The change over valve will actuate the air lift which will lift when the air supply is diverted to connection B, and will close, restoring normal relief valve operation, when the air supply is diverted back to connection A.

DANGER !

Under no circumstances should any attempt be made to dismantle a pressure relief valve which has not had the spring pressure relieved, is still connected to a pressurized air supply, or is mounted on a pump that is operating. Serious personal injury or pump damage may occur.

Spring Loaded Integral Pressure Relief Valve

SLA – E Typical.

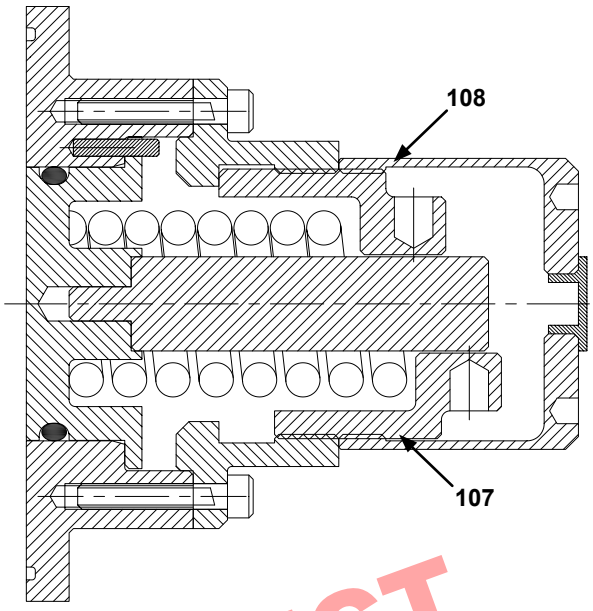


FIGURE 10

Spring Loaded Integral Pressure Relief Valve with Manual Lift

SLA - E Typical.

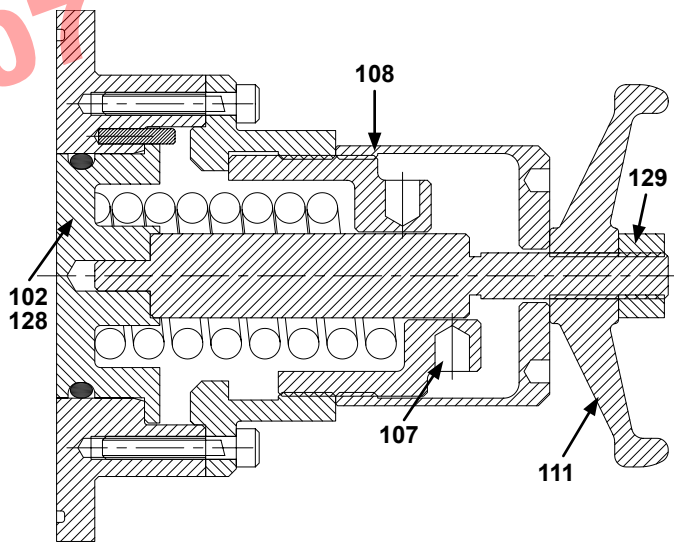


FIGURE 11

Spring Loaded Integral Pressure Relief Valve
SLF Typical.

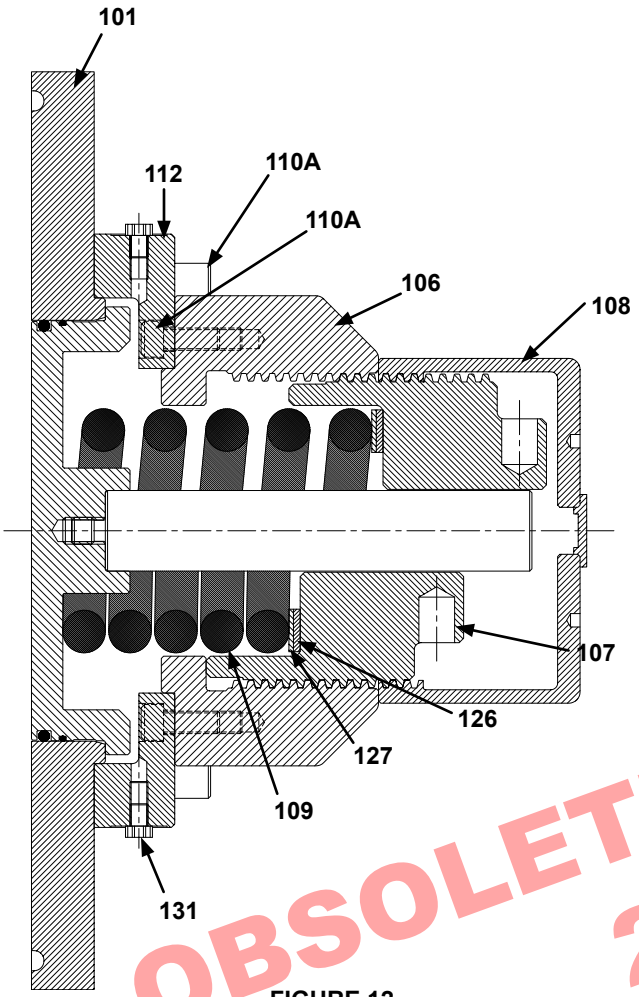


FIGURE 12

Spring Loaded Integral Pressure Relief Valve with Airlift
SLA – E Typical.

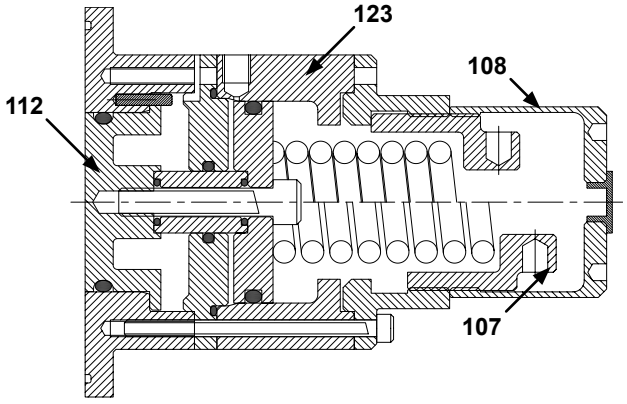


FIGURE 13

Air Loaded Integral Pressure Relief Valve with Airlift
SLA – E Typical.

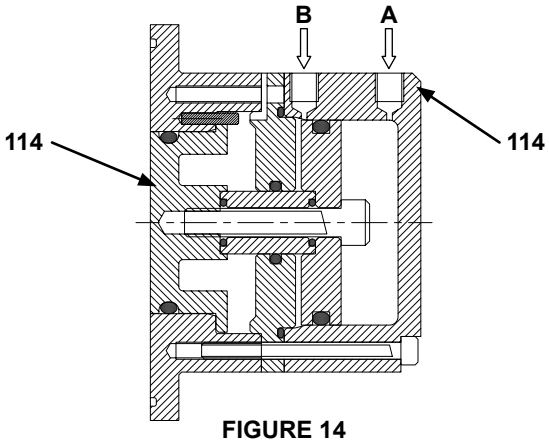


FIGURE 14

Air Loaded Integral Pressure Relief Valve with Airlift
SLF Typical

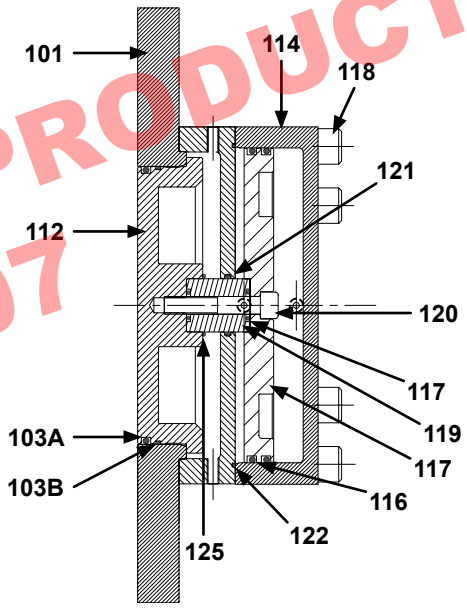
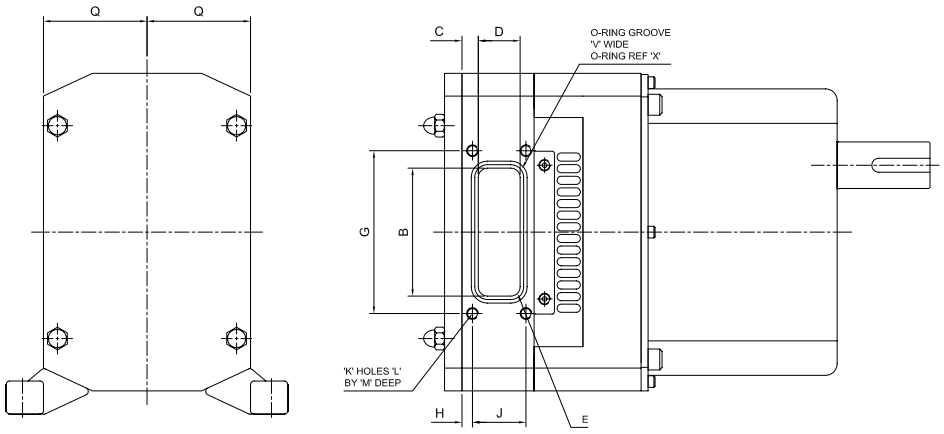


FIGURE 15

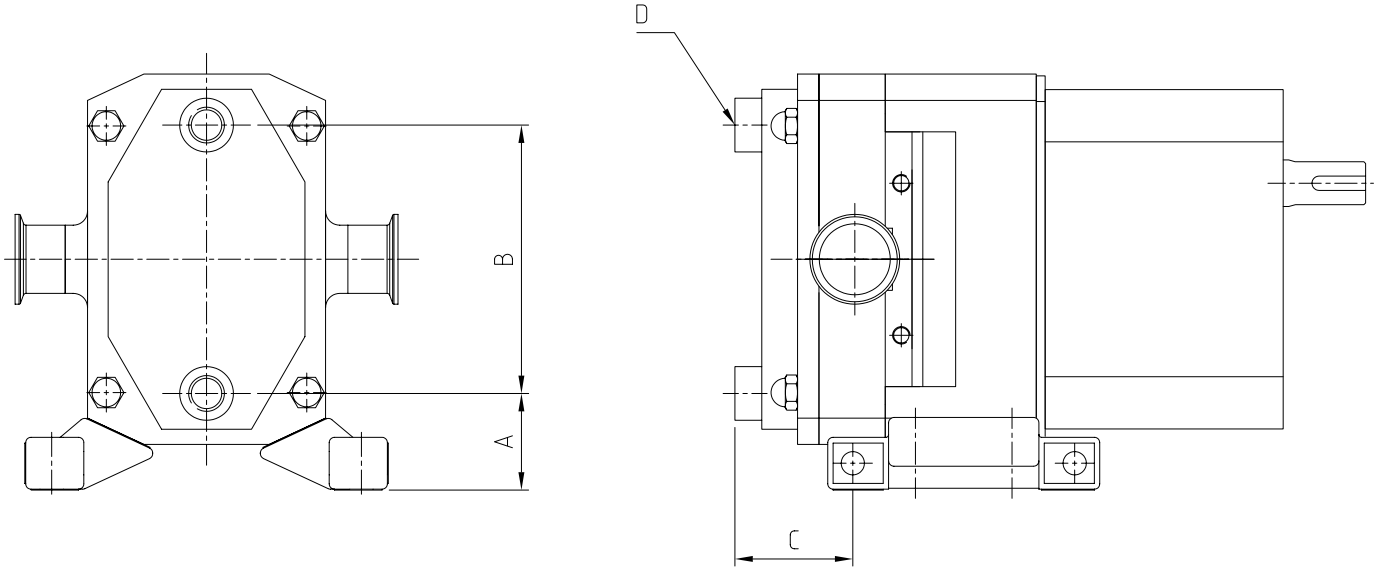
3.9 RECTANGULAR INLET



	SLAS	SLAL	SLBS	SLBL	SLCS	SLCL	SLDS	SLDL	SLES	SLEL	SLFS	SLFL	SLGS	SLGL
B	64	64	64	64	80	80	110	110	138	138	156	156	188	188
C	6	6	8	8	9	9	11	11	11	11	11	11	11	11
D	11.5	20	15	27	21	35	23	42	34	58	56	90	96	149
E	5	5	5	5	8	8	8	8	8	8	8	8	8	8
G	80.2	80.2	86.2	86.2	102.2	102.2	140.3	140.3	188.3	188.3	216.3	216.3	248.3	248.3
	79.8	79.8	85.8	85.8	101.8	101.8	139.7	139.7	187.7	187.7	215.7	215.7	247.7	247.7
20H	11.75	11.75	6	7	7	9	9	10	12	10	10	15	15	20
J	N/A	20.2	17.2	29.2	21.2	35.2	25.3	40.3	36.3	60.3	48.3	82.3	78.3	131.3
		19.8	16.8	28.8	20.8	34.8	24.7	39.7	35.7	59.7	47.7	81.7	77.7	130.7
K	2	4	4	4	4	4	4	4	4	4	4	4	4	4
L	M6	M6	M8	M8	M8	M8	M10	M10	M12	M12	M16	M16	M16	M16
M	8	8	10	10	10	10	12	12	14	14	18	18	18	18
Q	45	45	60	60	66.5	66.5	89	89	117	117	132	132	149	149
V	3	3	3	3	3	3	3	3	3	3	3	3	3	3
X	134	137	137	141	144	150	152	154	156	158	160	163	167	173

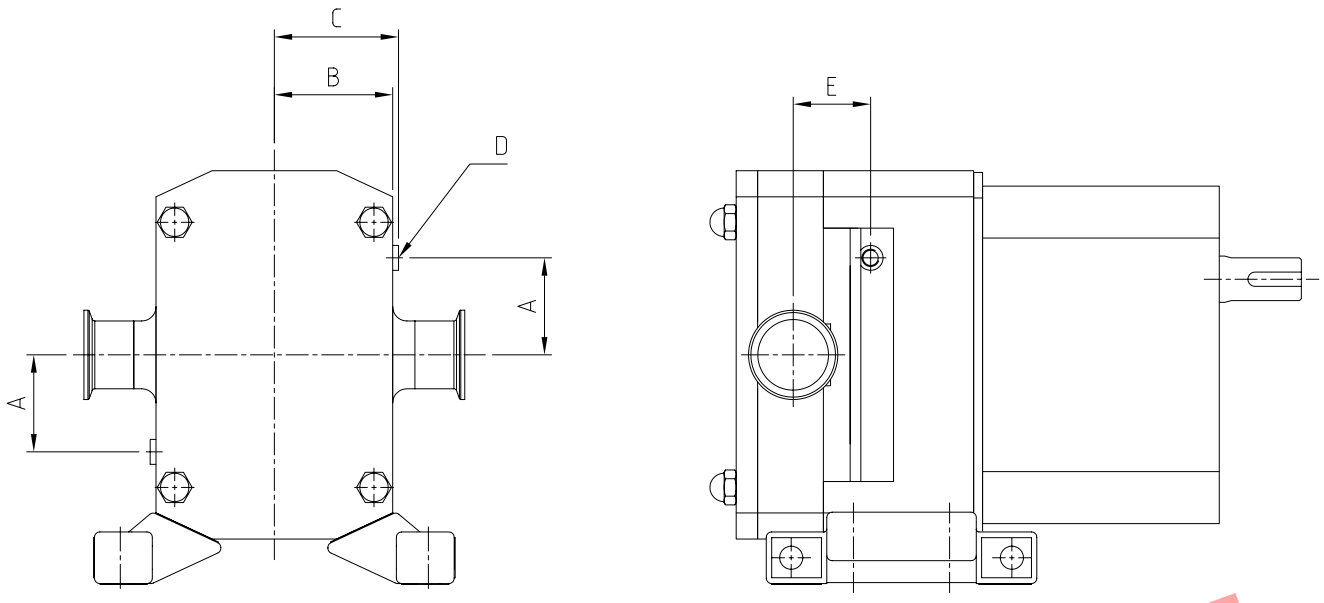
FIGURE 16

3.9.1 JACKETED HEAD



	SLAS	SLAL	SLBS	SLBL	SLCS	SLCL	SLDS	SLDL	SLES	SLEL	SLFS	SLFL	SLGS	SLGL
A	43		46.5		54		52		62		66		66	
B	90		110		150		210		260		300		370	
C	67.3	76	83.5	95.5	65.9	79.9	77	96	67.2	91.2	102.5	136.5	154	207
D	1/4" BSP		1/2" BSP											

3.9.2 JACKETED CASING



	SLAS	SLAL	SLBS	SLBL	SLCS	SLCL	SLDS	SLDL	SLES	SLEL	SLFS	SLFL
A	28		42.4		54.5		65.5		86		67	
B	54.5		62		70		93		95		102	
C	45		60		66.5		89		117		132	
D	1/8" BSP											
E	37 - 39	41 - 43	41 - 43	46 - 48	44 - 46	52 - 54	51 - 53	61 - 63	53 - 55	65 - 67	65 - 67	80 - 82

4.0 SL SERIES PUMP DISMANTLING AND ASSEMBLY

⚠ Before undertaking any work on the pump the recommended shutdown procedure should be followed, refer to section 3.6, and site safety practices must be observed.

⚠ While dismantling or assembling the pump it is essential to ensure that the pump and/or components are secured to provide adequate stability.

⚠ Large pump components or sub assemblies should be lifted using suitable devices. Use threaded holes for the attachment of lifting eyes where appropriate.

During dismantling or before assembly all components should be inspected for fit, wear, and damage. If worn or damaged the components should be replaced before re-assembly.

The position of all parts should be identified as they are removed to ensure they are reinstalled in the same position.

Lipseals and O-rings are incorporated within the bearing housing assemblies and the gearbox cover to contain the lubricant for the bearings and timing gears. Regular inspection and correct maintenance of these items will ensure that the lubrication is sustained and the pump maximum working life is achieved. To ensure this, it is extremely important that care is taken when removing and installing new O-rings and lipseals. When removing and replacing lipseals ensure that the location bore for the outside diameter and the seat for the back of the lipseal is not damaged as this may create a leak path for the lubricant.

When removing and refitting lipseals or O-rings care should be taken to avoid cutting or tearing the sealing faces as they pass over keyways, splines, threads or other potentially sharp or abrasive edges. All lipseals and O-rings should be carefully examined and if damaged in any way, replaced on assembly.

All O-rings and sealing lips of lipseals should be lightly lubricated with a suitable lubricant (silicon grease, etc.) before installing.

When installing lipseals do not allow the rear face to come into contact with bearings see section 6.3 for details

Prior to beginning assembly, ensure all parts are clean and free from burrs or damage. Where a vice is to be used, it should have protective jaws to avoid damage to components. Do not hammer or apply undue force to install or position components.

All fasteners are required to be tightened to the required torque setting during assembly, refer to section 6.2.

⚠ The preferred method of installing bearing cones is to heat them to approximately 120°C (250°F) prior to installation. During this operation protective gloves should be used. Once bearing cones are installed in correct position they should be allowed to cool before proceeding with assembly. As an alternative, bearing cones may be pressed into position providing the proper equipment is employed and the necessary procedures are used to prevent component damage.

Under no circumstances should bearing cones or cups be hammered into position.

4.1 PUMP ASSEMBLY SLA-SLF

4.1.1 SHAFT ASSEMBLY

- Install a nominal 0.1 mm (0.003") shims (5.12) and bearing cone (5.03) onto shaft (5.01 / 5.02)

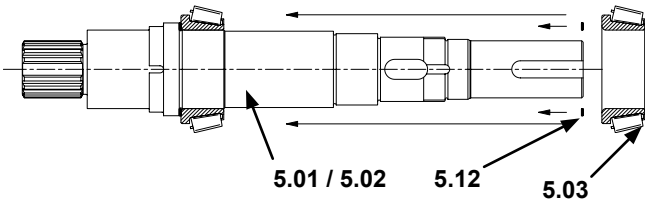


FIGURE 18

- Install bearing cups (5.03 / 5.04) into the bearing housing (4.01)

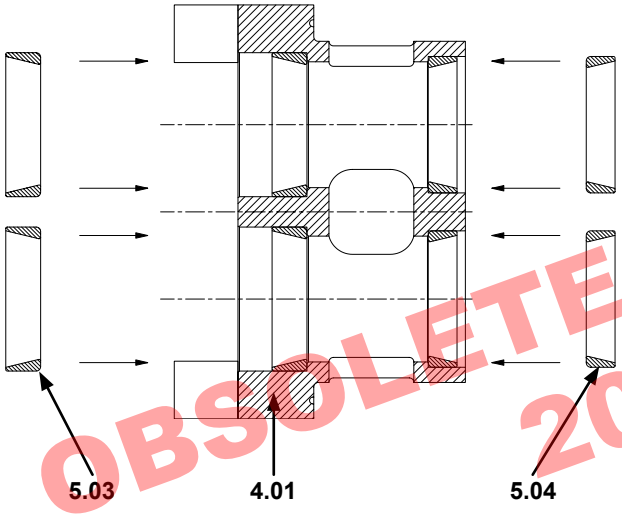


FIGURE 19

- Install shafts assemblies into the bearing housing (4.01)

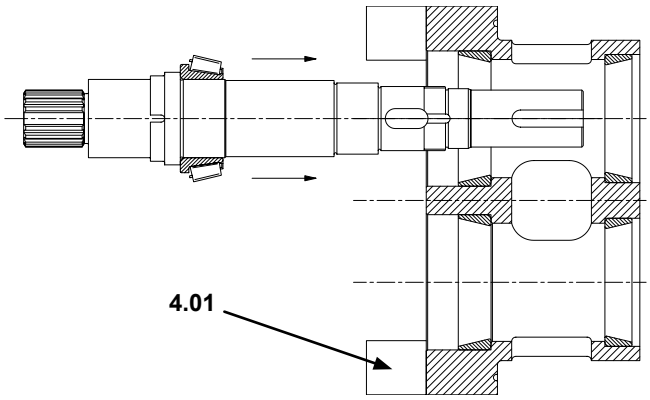


FIGURE 20

- Install rear bearing cone (5.04) into the bearing housing (4.01)

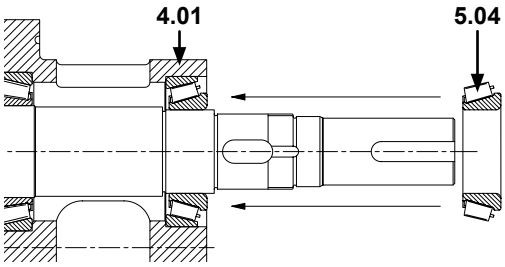


FIGURE 21

- To set the timing marks on the gears (5.06) place the gears next to each other and line up the keyways, you can now punch three timing marks to show the correct alignment of the gears see Figure 22i.

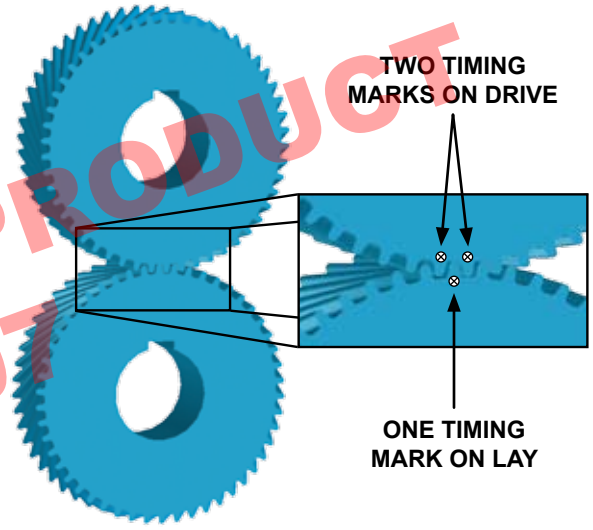
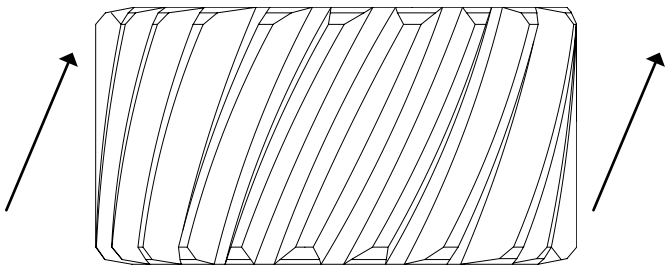


FIGURE 22i

NOTE: When installing the gears onto the shaft make sure that you use the right hand helical gear on the drive shaft (See Figure 22ii) The right hand helical gear will have the letter 'D' stamped on the face.



NOTE: On a right hand helical gear, the form of the teeth slants to the right.

FIGURE 22ii

Install 0.25 mm (0.009”) of shims (5.13) , pre-load spacer (5.05), gear (5.06) and locknut (5.09)

NOTE: Do not install the gear key or tab washer at this time

When setting the pre-load on the shafts note the pre-load has to be set on individual shafts, so only install one gear at a time.

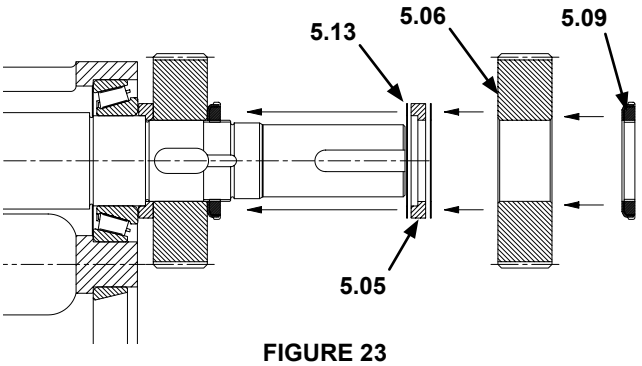
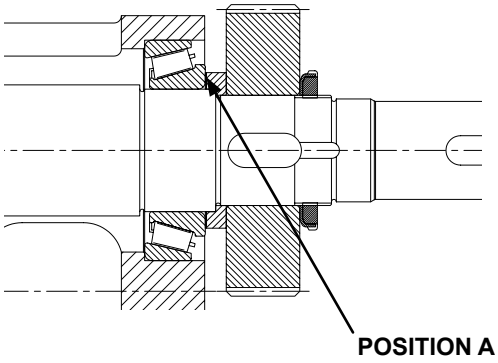


FIGURE 23



To increase the pre-load add shims to position A.

To decrease the pre-load remove Shims from position A.

See section 6.2 for pre-load settings.

FIGURE 25

4.1.2 ROLLING TORQUE / PRE-LOAD

Use a torque meter to check the rolling torque see section 6.2 for torque settings.

If the rolling torque is under / over the required amount add / remove shims to adjust the pre-load to suit (See section 6.2 Fasteners & Torque Settings).

NOTE: Rolling torque can only be set on new bearings, with no sealing devices installed i.e. lip-seals or O-rings.

When checking the rolling torque is it important to make sure the shaft is rotating freely, completely rotate the shaft 10 times before checking the rolling torque.

The pre-load is set by adding or removing shims in position A (See Figure 25).

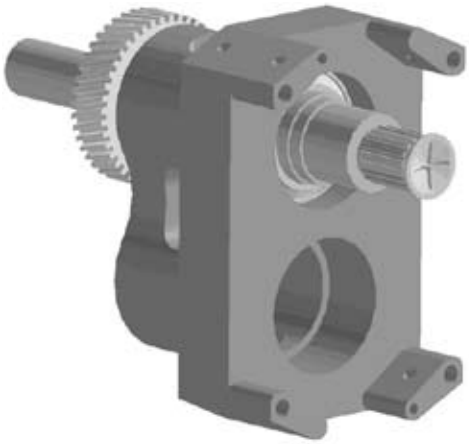


FIGURE 24

NOTE: The pre-load must be set one shaft at a time.

When the pre-load is set remove the gear and install the gear keys (5.07)

This procedure must be repeated for the second shaft

4.1.3 CASING ASSEMBLY

- Install the dowels (4.06) into the bearing housing (See Figure 26)

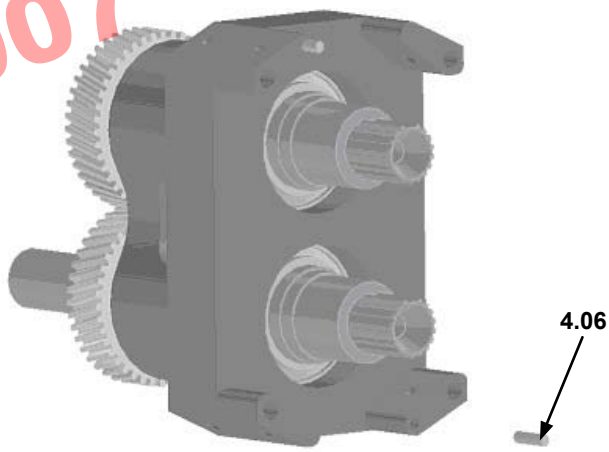


FIGURE 26

- Install the casing (3.01) onto the bearing housing (4.01) and use the bolts (4.07) to secure the casing (3.01)

NOTE: Without the gearbox cover spacers may be required to ensure the casing is fully clamped in position

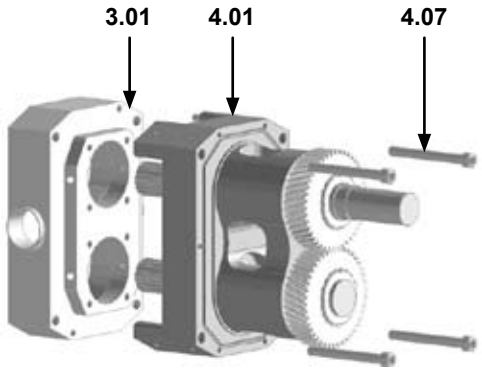


FIGURE 27

4.1.4 ROTOR ASSEMBLY

NOTE: For SLF Build see section 4.1.6

- Install the Rotors (2.01) and Rotor retainers (2.02)

FIGURE 28

4.1.5 SETTING FRONT CLEARANCES SLA – SLD

- Set the front clearance by adding / removing shim from position B.

(See Figure 29i)

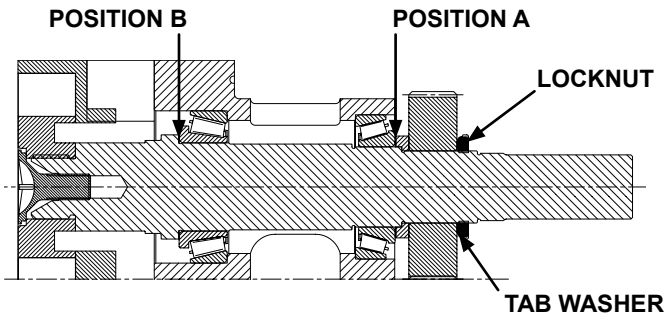


FIGURE 29i

NOTE: If any shims are added (or removed) from position B then the corresponding thickness of shims needs to be removed (or added) to position A to maintain the bearing pre-load. Adding additional shim in position B will reduce the front clearance (See section 6.1 for Clearance Charts)

When the front clearance is set install the tab washer and lock nut, bend one of the tabs onto the locknut to secure the assembly.

4.1.6 SETTING FRONT CLEARANCE SLE AND SLF

- Install the clearance spacer (5.17), shaft sleeve (5.18), rotor (2.01) and rotor retainer (2.02)

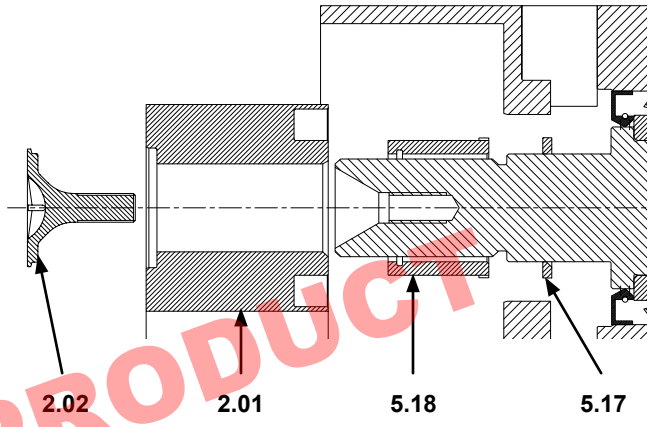


FIGURE 29ii

- The front clearance is set by machining the clearance spacer (5.17)

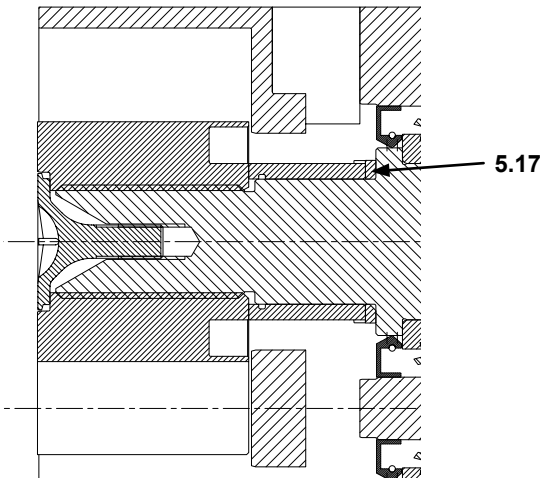


FIGURE 29iii

- Using a depth micrometer check the front clearance (distance from the front of the rotor to the front of the casing) and adjust the width of the front clearance spacer as necessary to set the front clearance see section 6.1 for pump head clearances

NOTE: When assembling the pump with a new front clearance spacer the rotor will be proud of the casing.

When the front clearance spacer has been machined to the correct width make sure that the spacer kept with the respective shaft.

- When the front clearance has been set Install the clearance spacer (5.17) and secure in place using the dowel (5.19).
- Install the O-ring (5.21) into the shaft sleeve (5.18) and assemble it onto the shaft. Note that the shaft sleeve has a drive slot which lines up with the dowel

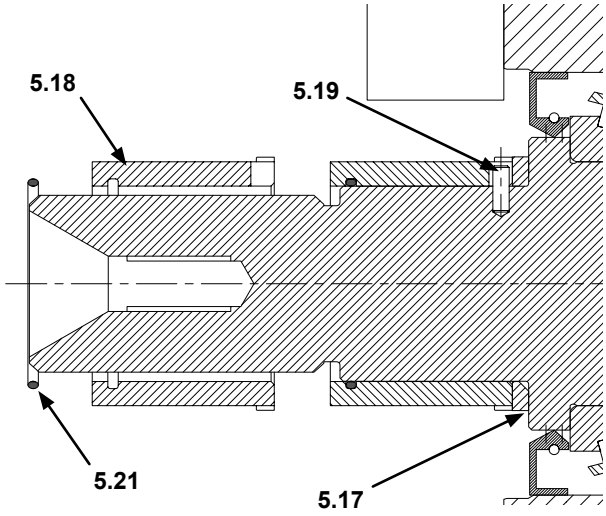


FIGURE 29IIII

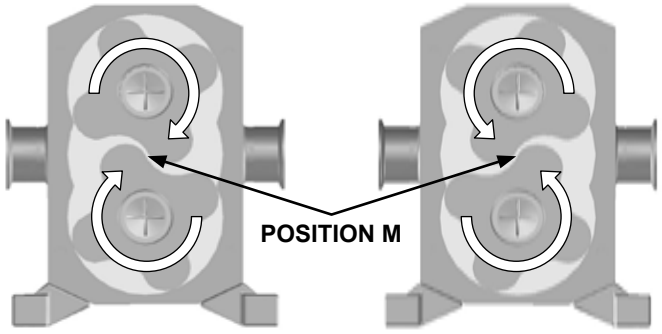


FIGURE 31

- To change the rotor timing add / remove shims from position C.

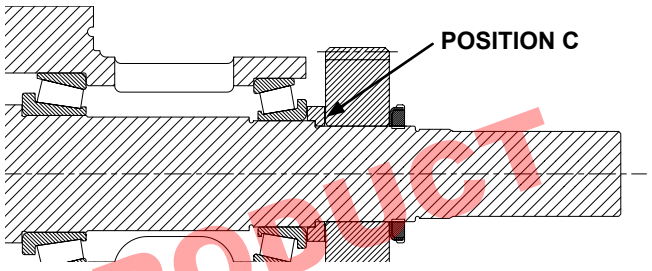


FIGURE 32

4.1.7 FOOT ASSEMBLY

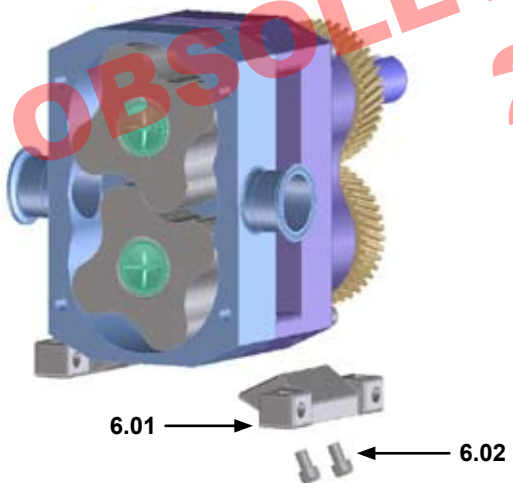


FIGURE 30

- Install the foot (6.01) and secure with screws (6.02)

4.1.8 TIMING – MULTILOBE ROTORS ONLY

- Using feeler gauge to check the mesh clearance in position 'M', ensure the rotor is turned in the correct orientation to minimize the mesh clearance.
- To adjust the drive rotor clockwise you need to add shim in position C on the drive shaft
- When the mesh clearance is set within tolerance (See clearance chart 6.1), remove the rotor retainers, rotors and casing

NOTE: When the gears are installed, tighten the locknut up to the correct torque (see section 6.2) and secure by knocking down one of the tabs on the tab washer

- Install the Front Lip-seals (5.11)

NOTE: see lip-seal fitting table for Instillation depths (Section 6.3)

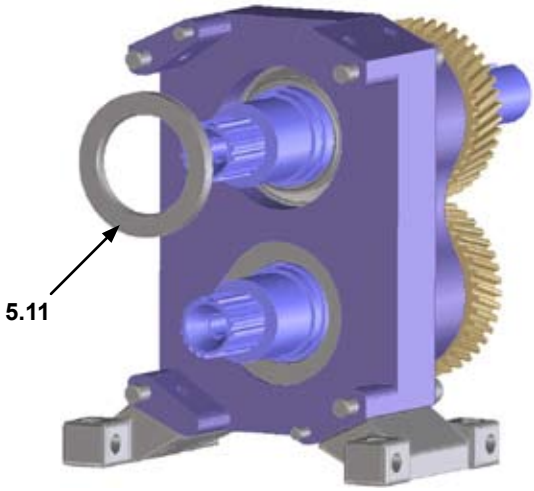


FIGURE 33

4.1.9 GEARBOX ASSEMBLY

- Install the rear lip-seal (4.03) into the bearing housing cover (4.04)

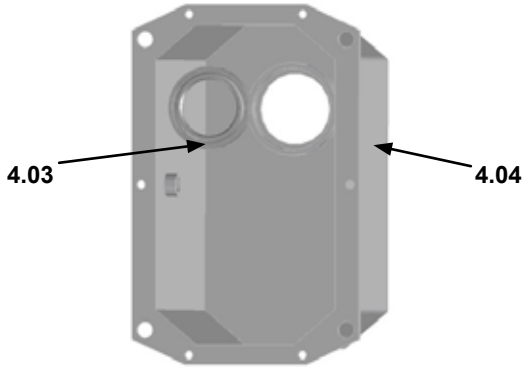


FIGURE 34

- Install the bearing housing O-ring (4.02) into the bearing housing (4.01)

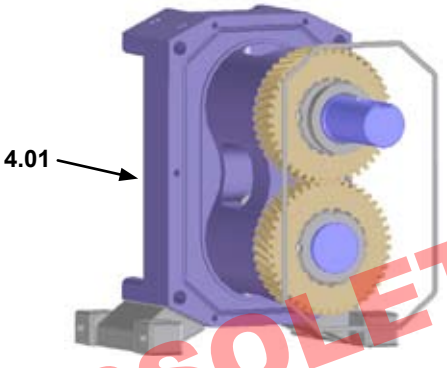


FIGURE 35

- Install the bearing housing cover (4.04) and the retaining screws (4.08)

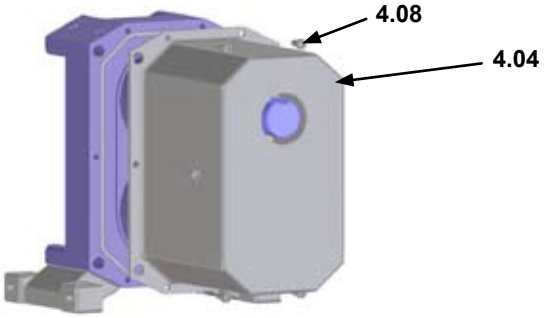


FIGURE 36

4.1.10 FINAL ASSEMBLY

NOTE: Before re-assembling the casing refer to the seal section for assembly instructions.

- Install the guard (7.03) onto the rear of the casing (3.01)

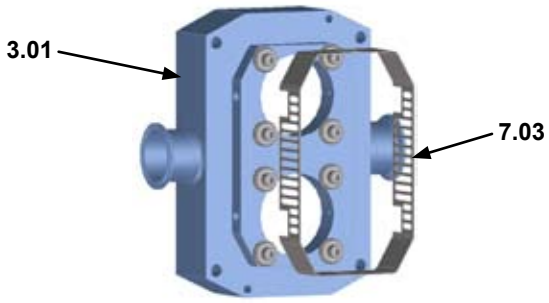


FIGURE 37

- Install the casing (3.01) and secure with screws (4.07)

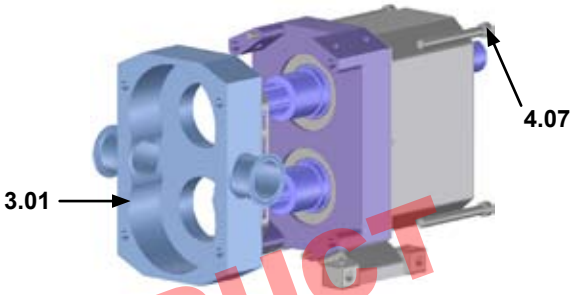


FIGURE 38

NOTE: For the SLF

- Install the rotors (2.01) and rotor retainer O-ring (2.03) and secure with rotor retainers (2.02) (See section 6.2 for torque settings)

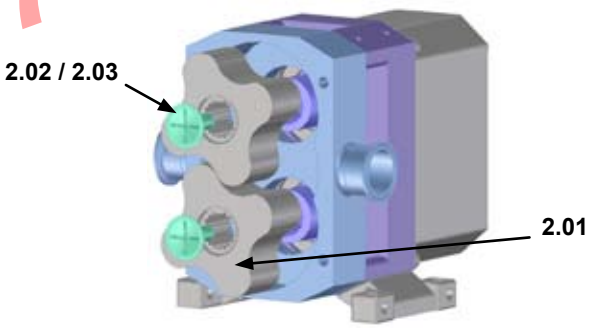


FIGURE 39

- Install the head studs (1.04) into the casing (3.01)

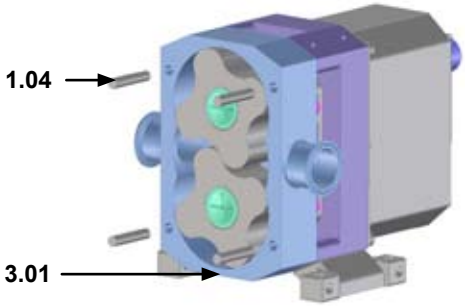


FIGURE 40

- Install the head O-ring (1.02) into the head (1.01)

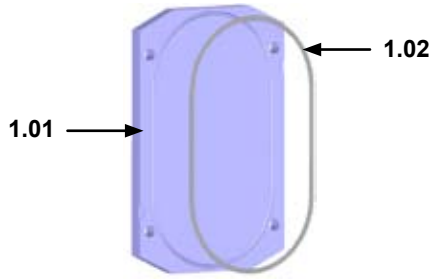


FIGURE 41

- Install the head (1.01) and secure with the dome nuts (1.03). (See section 6.2 for torque settings)

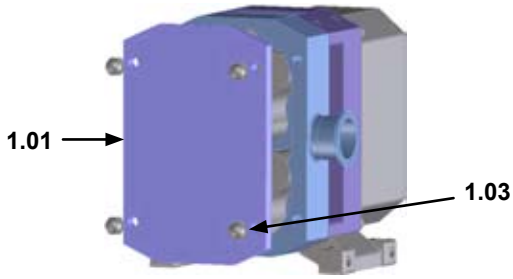


FIGURE 42I

- Rotate the pump so filler hole is uppermost, add lubricant. (See section 6.4 for lubricants and quantities)

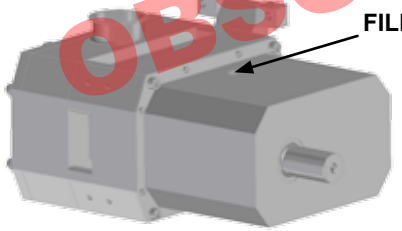


FIGURE 42II

4.2 PUMP ASSEMBLY SLG

4.2.1 SHAFT ASSEMBLY.

- Install the bearing cones (5.03) see Figure 43 and secure using the two locknuts (5.16) see section 6.2 for torque settings.

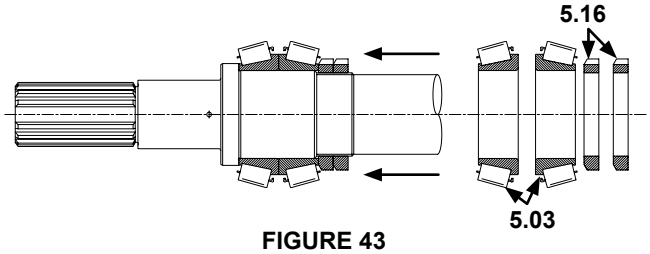


FIGURE 43

- Install the needle roller inner race (5.04)

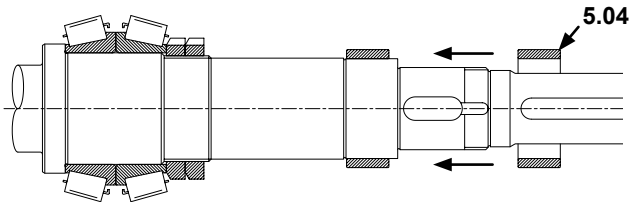


FIGURE 44

NOTE: The preferred method of installing bearing cones is that they are heated to approximately 125°C (250°F) prior to installation. During this operation protective gloves should be used. Once bearing cones are installed in correct position they should be allowed to cool before proceeding with assembly. As an alternative, bearing cones may be pressed into position providing the proper equipment is employed and the necessary procedures are used to prevent component damage.

Under no circumstances should bearing cones or cups be hammered into position.

- Install Bearing cups (5.03, 5.04) and the bearing pre-load adjustment spacer (4.10) into the bearing housing (4.01)

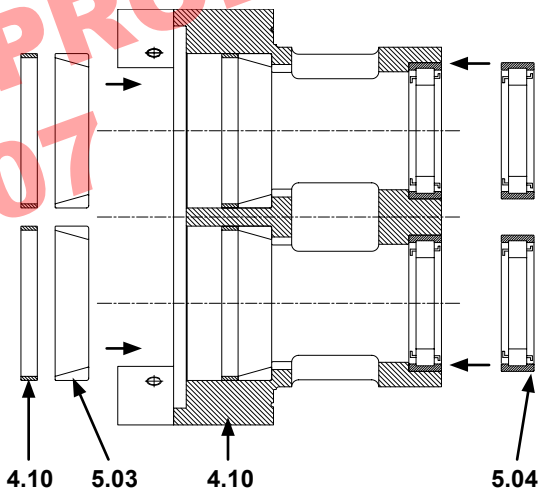


FIGURE 45

- Install the shaft assembly into the bearing housing.

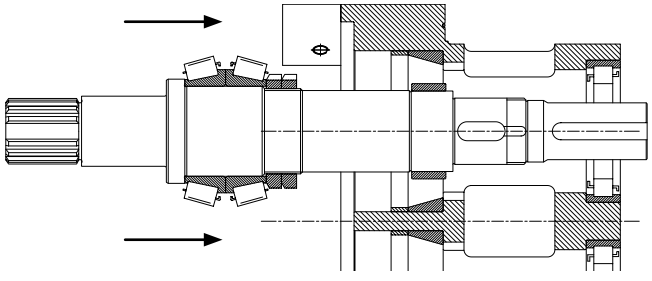


FIGURE 46

- Install the bearing cone (5.03) and the bearing pre-load spacer (5.05) secure using the M12 screws (5.20) see Figure 48 for the correct order to tightening the screws also see section 6.2 for torque settings.

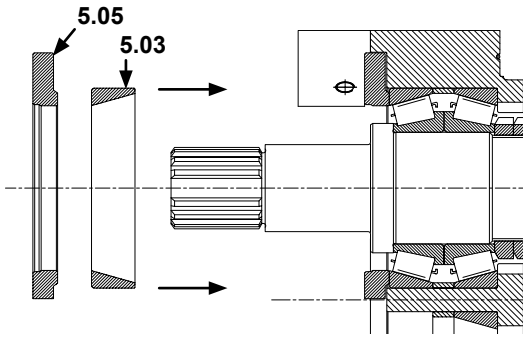


FIGURE 47

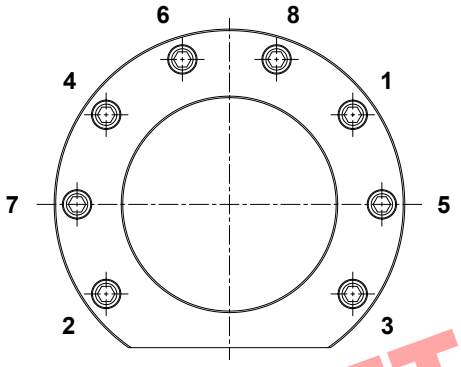


FIGURE 48

4.2.2 ROLLING TORQUE / PRE-LOAD

Use a torque meter to check the rolling torque see section 6.2 for torque settings

The rolling torque as standard with new components will be under the required amount and will require adjustment.

- To adjust the pre-load modify the size of the bearing pre-load adjustment spacer (4.10)

NOTE: When machining the spacer make sure small cuts are taken i.e. 0.02 mm – 0.03

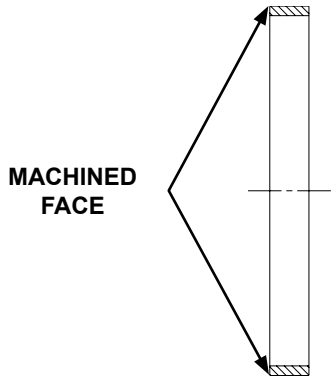


FIGURE 49

4.2.3 FINAL PRE-LOAD ASSEMBLY

- When the pre-load is set remove the bearing pre-load spacer (5.05) and install the front lip-seals (5.11) – refer to lip-seal setting distances section 6.3

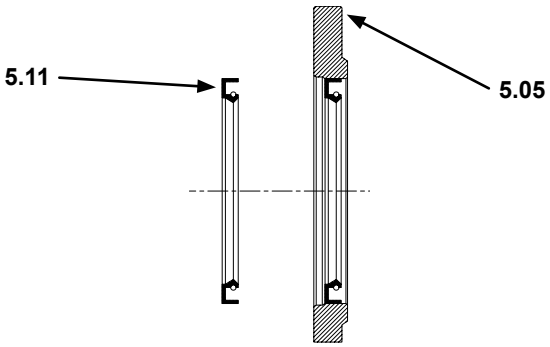


FIGURE 50

- Install the gearbox O-ring (5.22) and secure the pre-load spacer (5.05) with the M12 screws (5.20) see Figure 48 for the correct order to tightening the screws also see section 6.2 for torque settings.

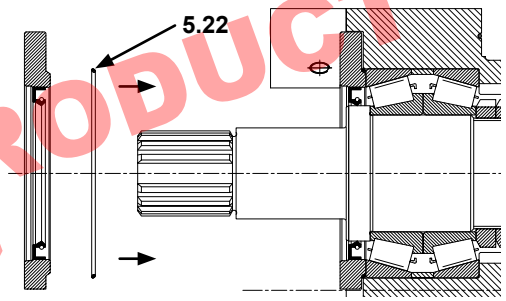


FIGURE 51

4.2.4 TIMING – MULTILOBE ROTORS ONLY

- To set the timing marks on the gears (5.06) lay the gears next to each other and line up the keyways, You can now punch three timing marks to show the correct alignment of the gears see Figure 52

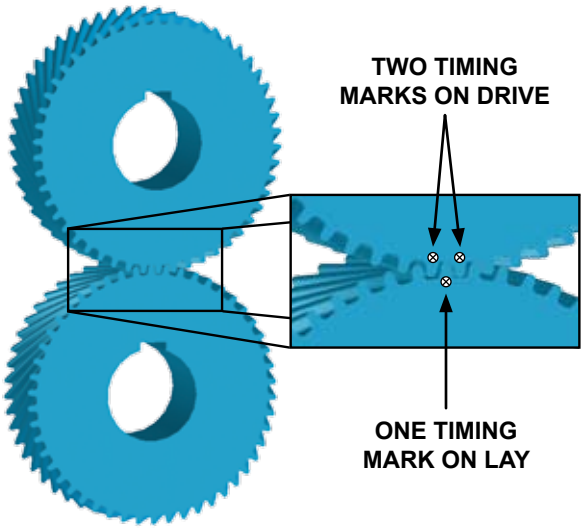
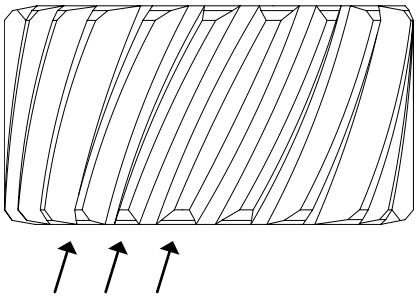


FIGURE 52

NOTE: When installing the gears onto the shaft make sure that you use the right hand helical gear on the drive shaft (See Figure 22ii) The right hand helical gear will have the letter 'D' stamped on the face.



NOTE: On a right hand helical gear, the form of the teeth slants to the right.

FIGURE 53

- Install the gear key (5.07) into the shaft, (5.01) then install the gear (5.06), tab washer (5.08) and locknut (5.09) – See section 6.2 for torque settings

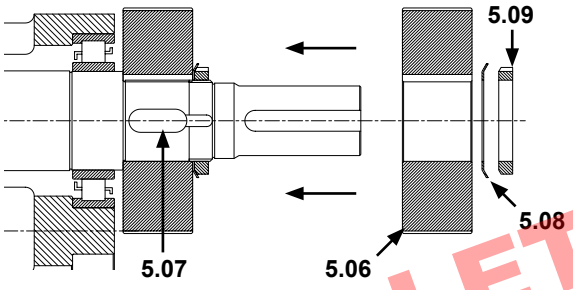


FIGURE 54

- Install the front clearance spacer (5.17), seal sleeve (5.18), multilobe rotors (2.01) and rotor retainers (2.02) See section 6.2 for rotor retainer torque setting

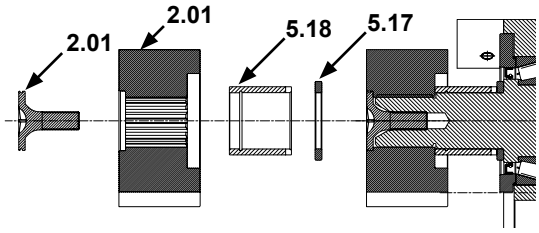


FIGURE 55

- Using feeler gauge to check the mesh clearance in position 'M', ensure the rotor is turned in the correct orientation to minimize the mesh clearance.

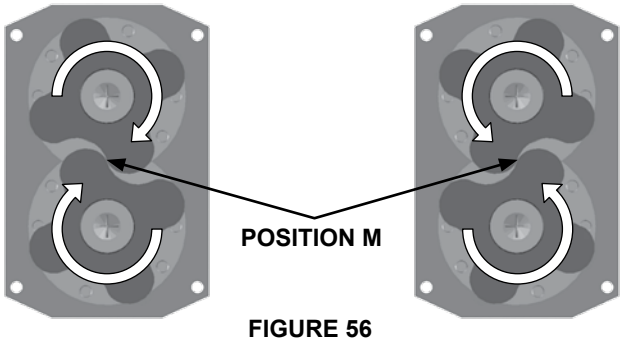


FIGURE 56

- To change the rotor timing add / remove shims from position C

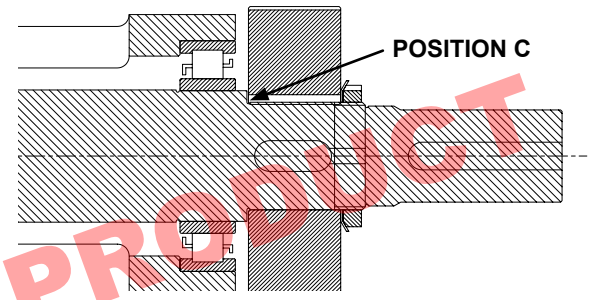


FIGURE 57

- To adjust the drive rotor clockwise you need to add shim in position C on the drive shaft
- When the mesh clearance is set and is within tolerance (See clearance chart 6.1), secure the locknut to the correct torque and knock down one of the tabs on the tab washer to secure the assembly (See assembly 6.2 for torque settings)

4.2.5 FOOT ASSEMBLY

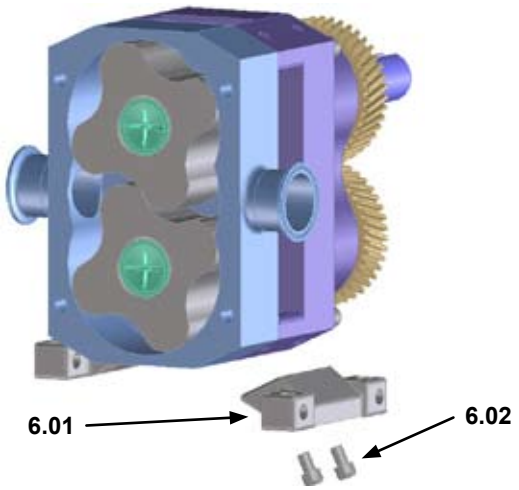


FIGURE 58

- Install the foot (6.01) and secure with screws (6.02)

4.2.6 SETTING FRONT CLEARANCE SLG

- Remove the rotor retainers (2.02), rotors (2.01) and install the dowels (4.07) into the bearing housing (4.01)

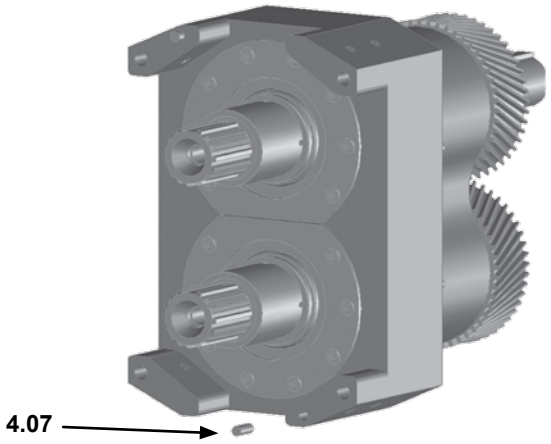


FIGURE 59

- Install the casing (3.01) onto the bearing housing (4.01) and use the bolts (4.07) to secure the casing (3.01)

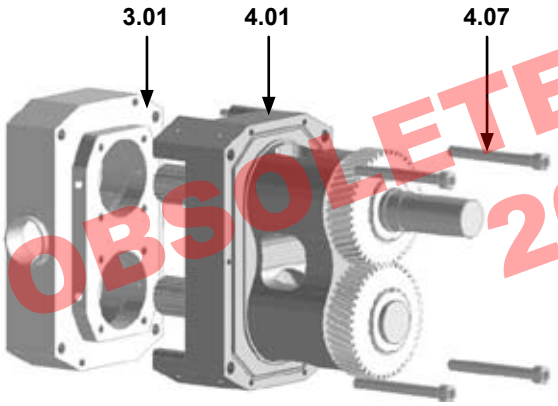


FIGURE 60

NOTE: without the gearbox cover spacers are required to ensure the casing is fully clamped

- The front clearance is set by machining the clearance spacer (5.17)

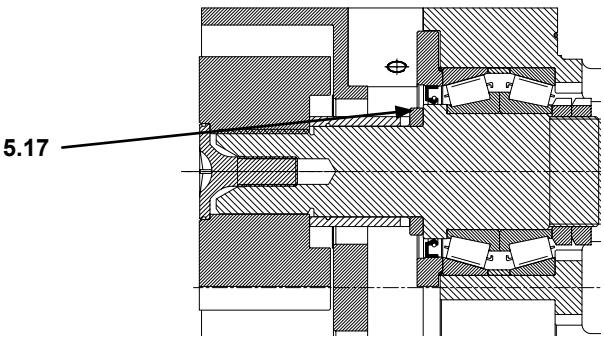


FIGURE 61

- Using a depth micrometer check the front clearance (Distance from the front of the rotor to the front of the casing) and adjust the width of the front clearance spacer as necessary to set the front clearance see section 6.1 for pump head clearances

NOTE: When assembling the pump with a new front clearance spacer the rotor will be proud of the casing.

When the front clearance spacer has been machined to the correct width make sure that the spacer kept with the respective shaft.

4.2.7 FINAL ASSEMBLY

- When the front clearance spacers have been set install the 5mm (0.19") pins (5.19) one per shaft.

The pin serves two main purposes

1) They secure the front clearance spacer

2) It provides anti-rotation for the seal sleeve and the seals

NOTE: When installing the pins use a locking compound like Loctite 648 or similar

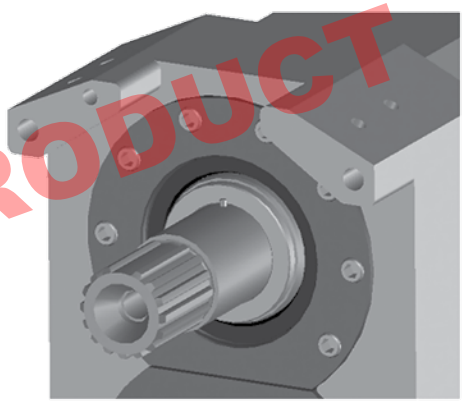


FIGURE 62

- Install the shaft sleeve O-ring (5.21) into the shaft sleeve (5.18) and then install the assembly onto the shaft

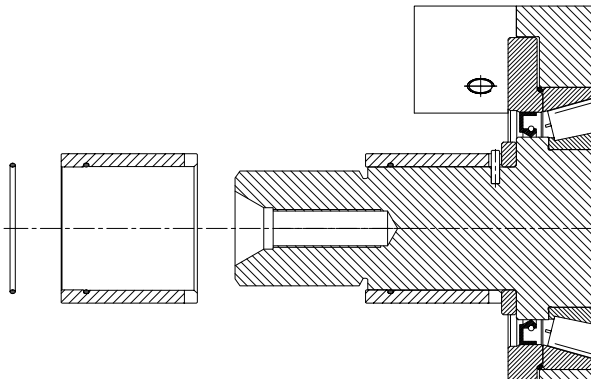


FIGURE 63

4.2.8 GEARBOX ASSEMBLY

- Install the rear lip-seal (4.03) into the bearing housing cover (4.04)

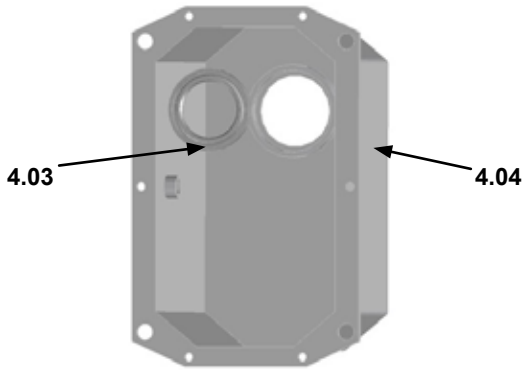


FIGURE 64

- Install the bearing housing O-ring (4.02) into the bearing housing (4.01). See Figure 65.

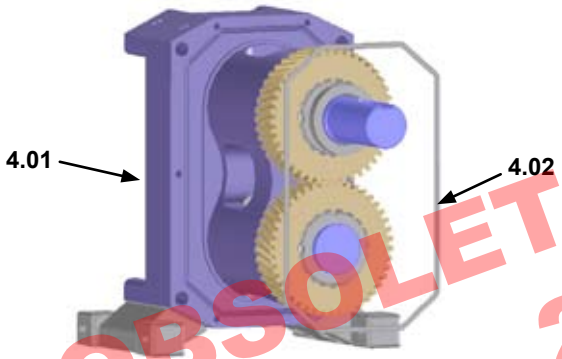


FIGURE 65

- Install the bearing housing cover (4.04) and the retaining screws (4.08)

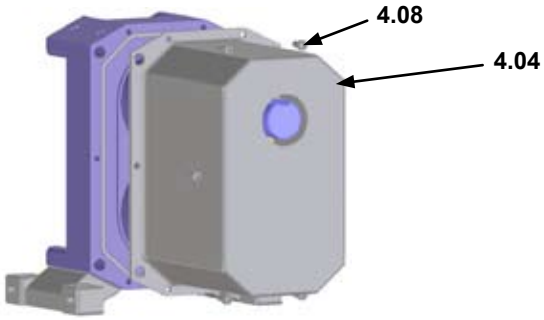


FIGURE 66

NOTE: Before re-assembling the casing refer to the seal section for instructions

- Install the guard (7.03) onto the rear of the casing (3.01)

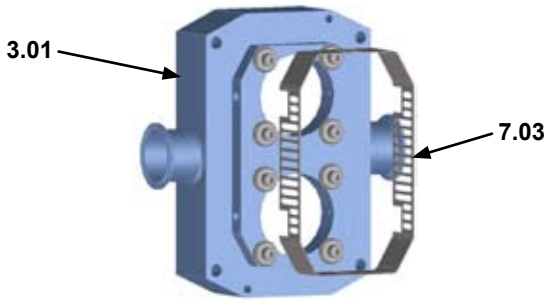


FIGURE 67

- Install the casing (3.01) and secure with screws (4.07

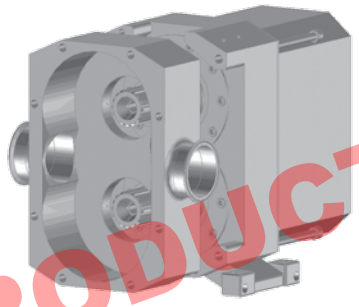


FIGURE 68

- Install the rotors (2.01) and rotor retainer O-ring (2.03) and secure with rotor retainers (2.02) (See section 6.2 for torque settings)

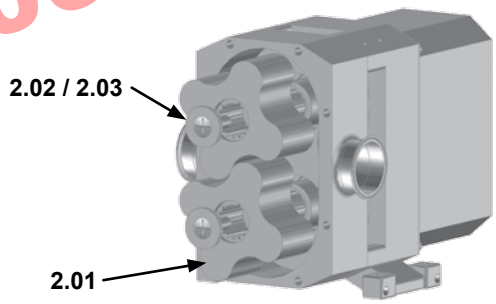


FIGURE 69

- Install the head studs (1.04) into the casing (3.01)

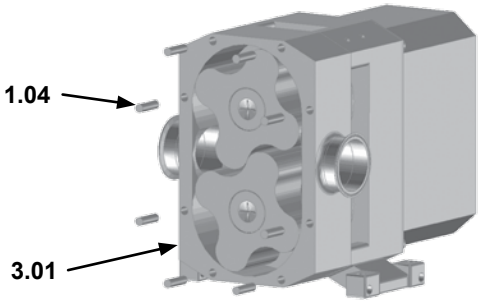


FIGURE 70

- Install the head O-ring (1.02) into the head (1.01)

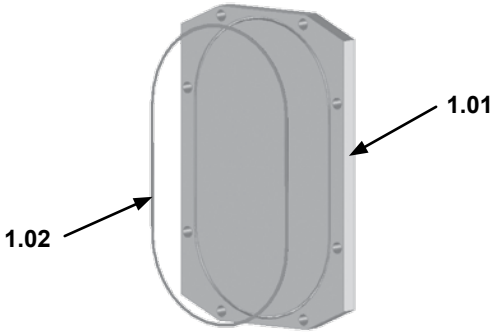


FIGURE 71

- Install the head (1.01) and secure with the dome nuts (1.03). (See section 6.2 for torque settings)

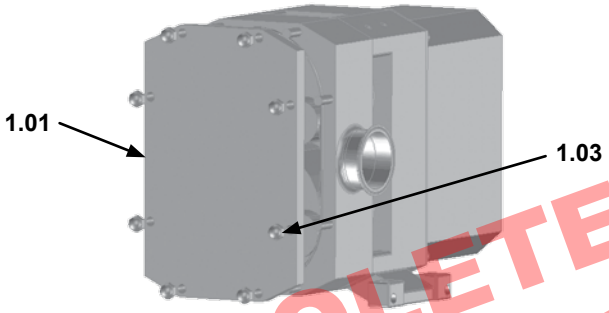


FIGURE 72i

- Rotate pump so filler hole is uppermost, add lubricant. (See section 6.4 for lubricants and quantities)

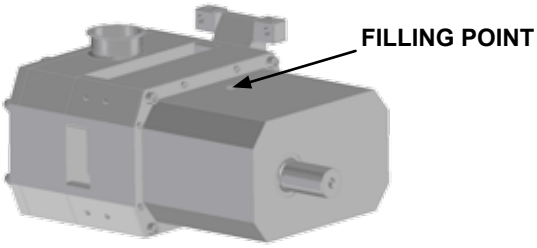


FIGURE 72ii

5.0 SEALS

5.1 SINGLE SEAL SLA – SLG

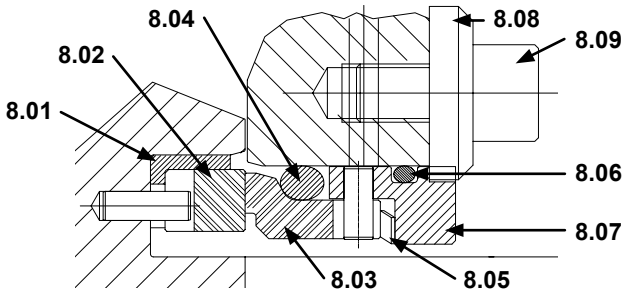


FIGURE 73

FIGURE 74

- Install the seal washers (8.08) and the seal screws (8.09)

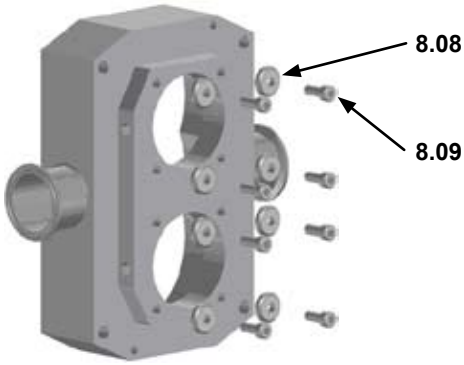


FIGURE 75

The washers overlap the seal bore – this locates and provides drive to the seal.

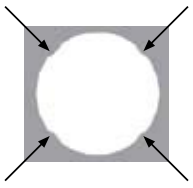


FIGURE 76

- Install the slinger (5.15)

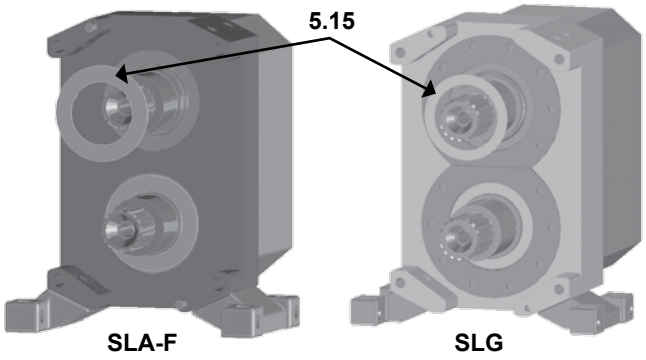


FIGURE 77

NOTE: the slinger has raised sections on the internal diameter, which press onto the shaft

- Install the guard (7.03) and casing (3.01) and secure with screws (4.07) (See section 6.2 for torque settings)

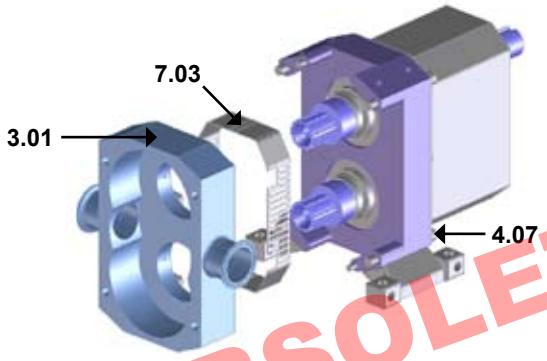


FIGURE 78

- Install the O-ring (8.06) into the seal housing and then install the seal housing (8.07) into the casing
- making sure that the location recesses line up with the seal washers (8.07)

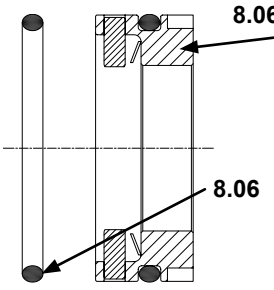


FIGURE 79

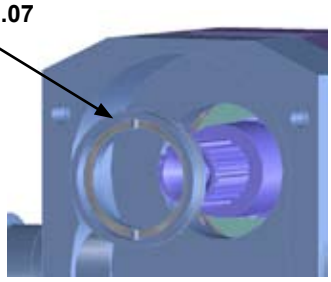


FIGURE 80

- Install the O-ring (8.04) onto the static seal (8.03) and then install the static seal into the casing – make sure that the location slots line up with the pins in the seal housing

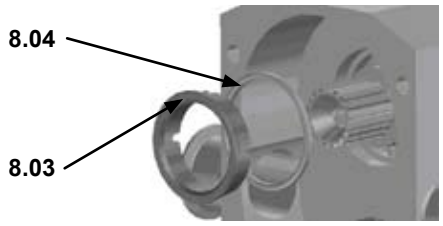


FIGURE 81

- Install the I-cup (8.01) and the rotary face (8.02) into the rotor (2.01)

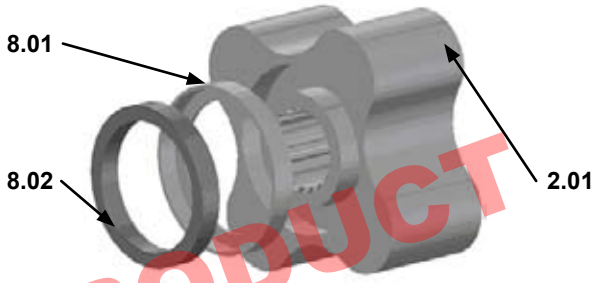


FIGURE 82

The seals are now assembled.

For rotor and head installation see pump assembly section

5.2 SINGLE FLUSH SLA – SLF

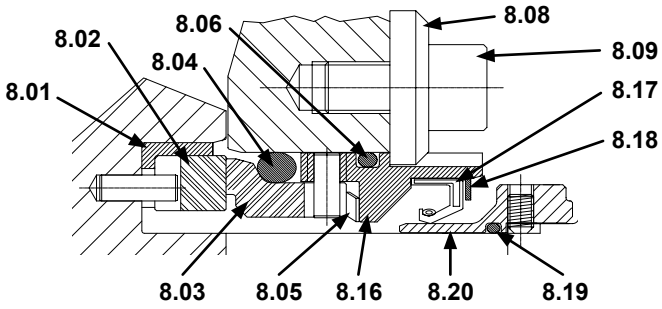


FIGURE 83

FIGURE 84

- Install the seal washers (8.08) and the seal screws (8.09)

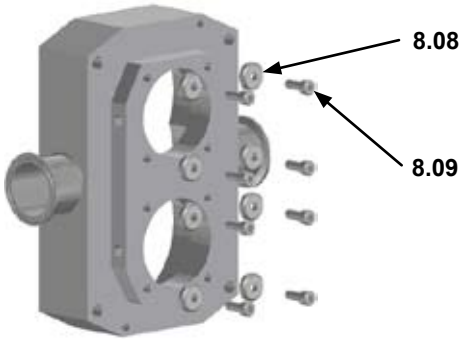


FIGURE 85

The washers overlap the seal bore – this locates and provides drive to the seal.

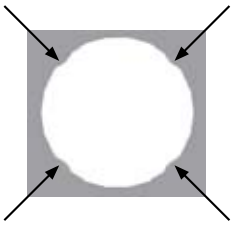


FIGURE 86

- Install the slinger (5.15)

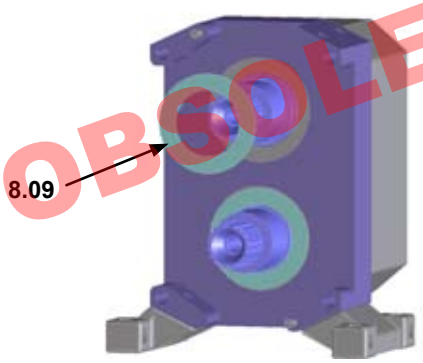


FIGURE 87

NOTE: the slinger has raised sections on the internal diameter, which press onto the shaft

- Install the O-ring (8.19) onto the sleeve (8.20) and then install the sleeve onto the shaft and secure with the grub screws (8.14)

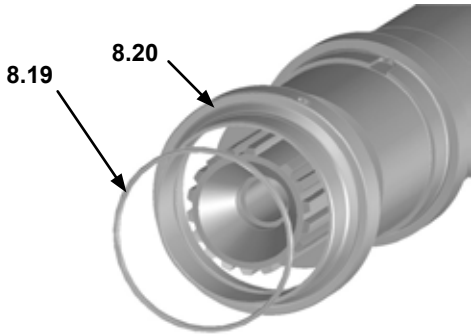


FIGURE 88

NOTE: The shaft has two location grooves which the grub screws in the seal sleeve locate into. (See Figure 89 and Figure 90)

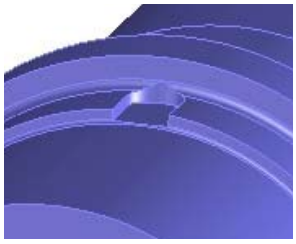


FIGURE 89

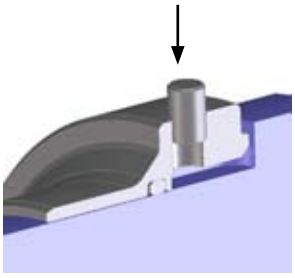


FIGURE 90

- Install the guard (7.03) and casing (3.01) and secure with screws (4.07) (see section 6.2 for torque settings)

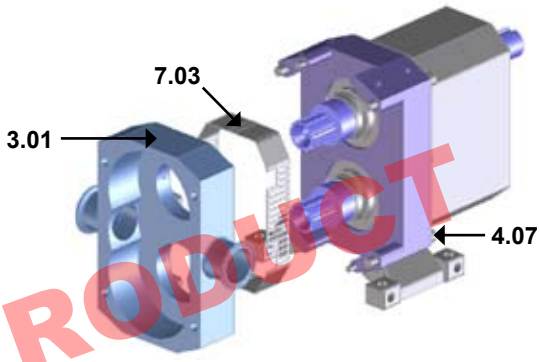


FIGURE 91

- Install the O-ring (8.06), lip-seal (8.17) and the cir-clip (8.18) into the seal housing and then install the seal housing (8.16) into the casing

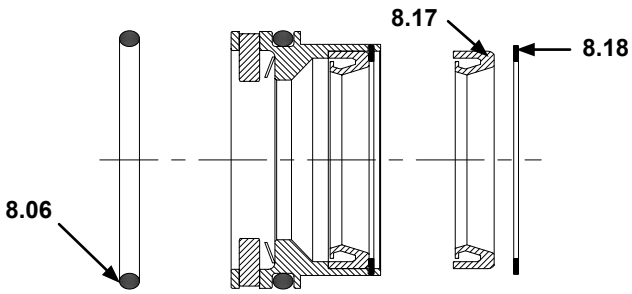


FIGURE 92

- Install the O-ring (8.04) onto the static seal (8.03) and then install the static seal into the casing – ensure that the location slots line up with the pins in the seal housing

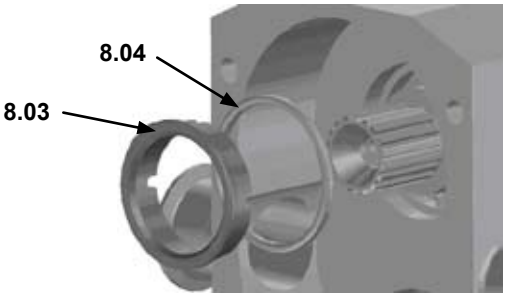


FIGURE 93

- Install the I-cup (8.01) and the rotary face (8.02) into the rotor (2.01)

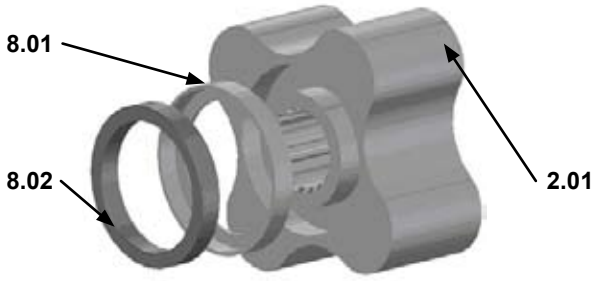


FIGURE 94

The seals are now assembled.

For rotor and head installation see pump assembly section

5.3 SINGLE FLUSH SLG

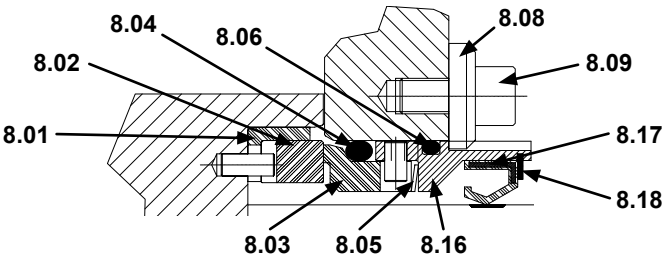


FIGURE 95

FIGURE 96

- Install the seal washers (8.08) and the seal screws (8.09)

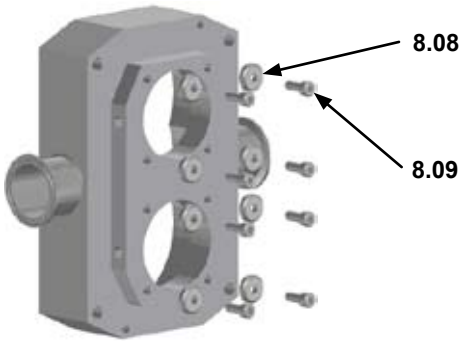


FIGURE 97

The washers overlap the seal bore – this locates and provides drive to the seal.

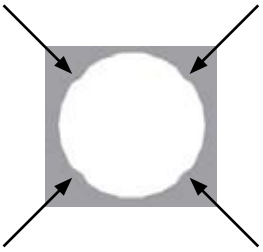


FIGURE 98

- Install the slinger (5.15)

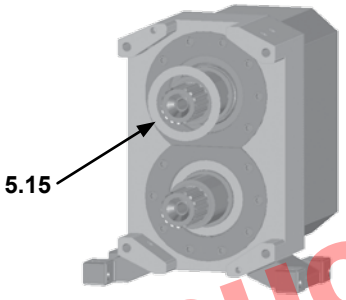


FIGURE 99

NOTE: the slinger has raised sections on the internal diameter, which press onto the shaft

- Install the guard (7.03) onto the rear of the casing (3.01)

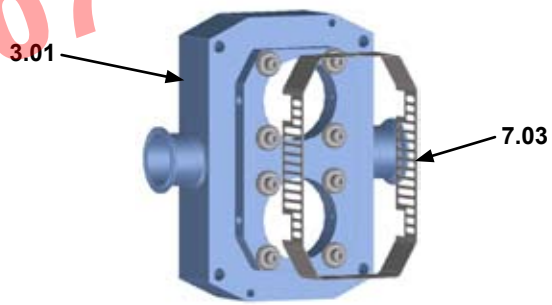


FIGURE 100

- Install the casing (3.01) and secure with screws (4.07) (See section 6.2 for torque settings)

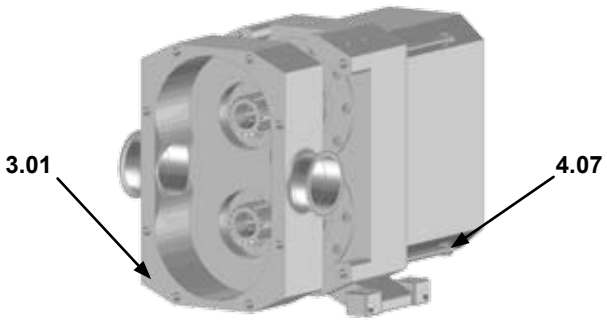


FIGURE 101

- Install the O-ring (8.06), lip-seal (8.17) and the cir-clip (8.18) into the seal housing and then install the seal housing (8.16) into the casing

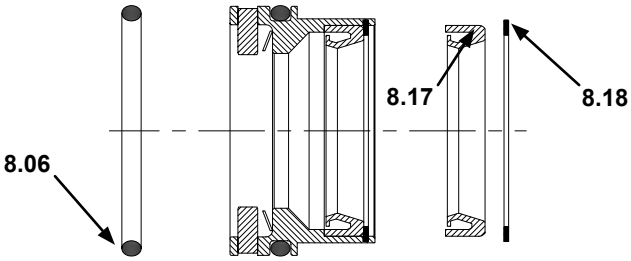


FIGURE 102

NOTE: On the SLG only the lipseal runs directly on the pump shaft and not a sleeve

- Install the O-ring (8.04) onto the static seal (8.03) and then install the static seal into the casing – ensure that the location slots line up with the pins in the seal housing

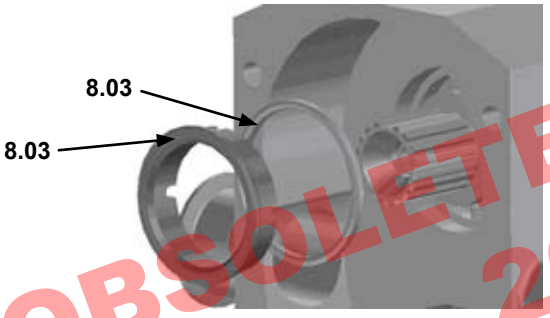


FIGURE 103

- Install the L-cup (8.01) and the rotary face (8.02) into the rotor (2.01)

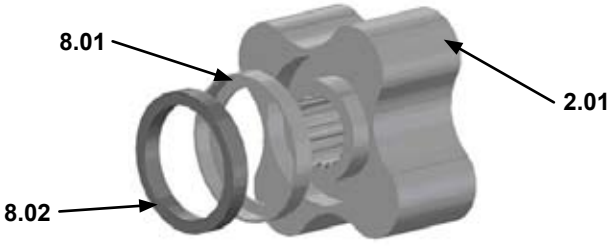


FIGURE 104

The seals are now assembled.

For rotor and head installation see pump assembly section.

5.4 DOUBLE SEAL - SLA, SLB, SLC

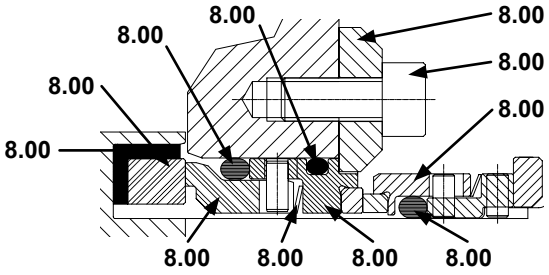


FIGURE 105

FIGURE 106

- Install the seal washers (8.08) and the seal screws (8.09)

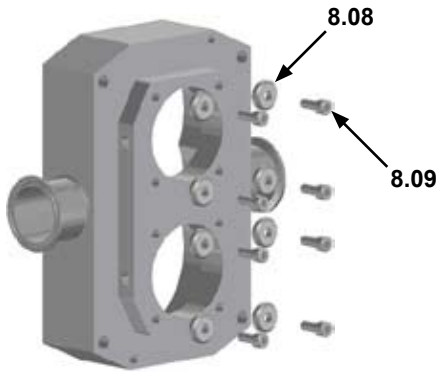


FIGURE 107

The washers overlap the seal bore – This locates and provides drive to the seal.

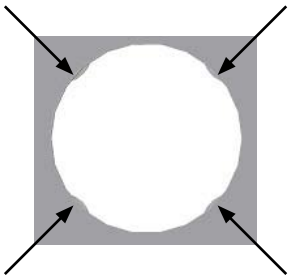


FIGURE 108

- Install the slinger (5.15)

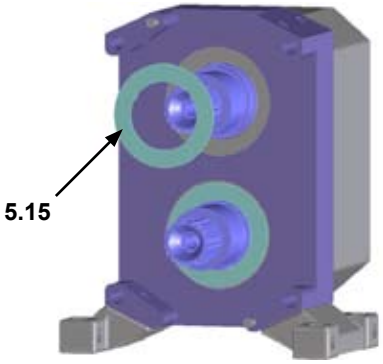


FIGURE 109

NOTE: the slinger has raised sections on the internal diameter, which press onto the shaft.

- Install the O-ring (8.19) into the sleeve (8.11) and then install the assembly onto the shaft.

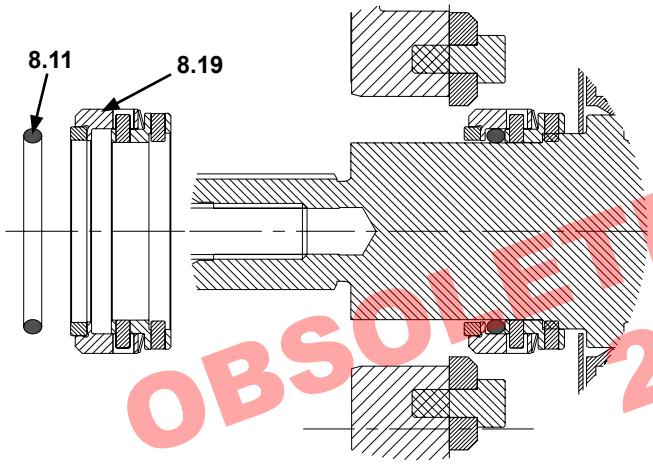


FIGURE 110

NOTE: There are two drive slots in the shaft which must be lined up with the drive pins on the sleeve.

NOTE: The SLA utilizes four grub screws instead of the drive pins to locate the housing onto the shaft

- Install the guard (7.03) and casing (3.01) and secure with screws (4.07) (See section 6.2 for torque settings)

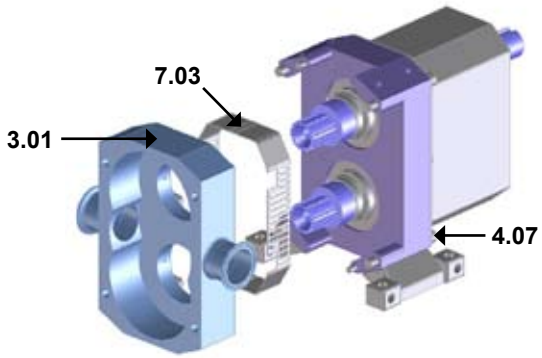


FIGURE 111

- Install the O-ring (8.06) into the seal housing and then install the seal housing (8.10) into the casing
- Making sure that the location recesses line up with the seal washers (8.08) see Figure 47 and Figure 44

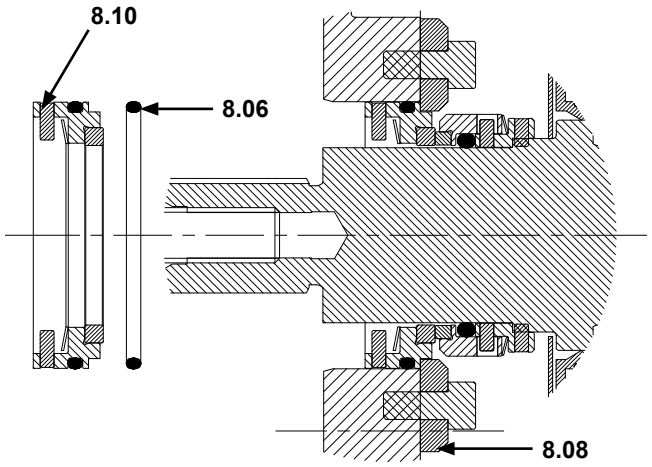


FIGURE 112

- Install the O-ring (8.04) onto the static seal (8.03) and then install the static seal into the casing – Make sure that the location slots line up with the pins in the seal housing

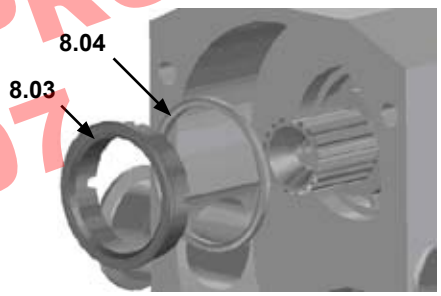


FIGURE 113

- Install the L-cup (8.01) and the rotary face (8.02) into the rotor (2.01)

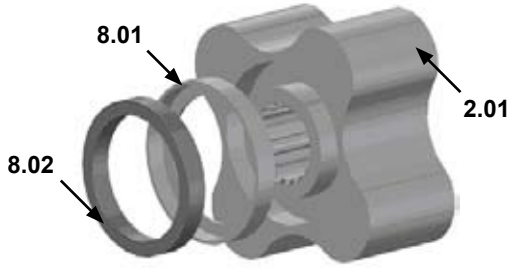


FIGURE 114

The seals are now assembled.

For rotor and head installation see pump assembly section.

5.5 DOUBLE SEAL SLD – SLG

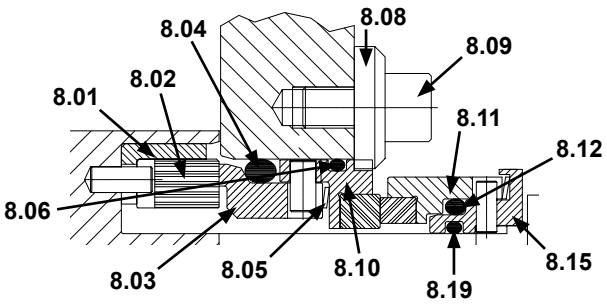


FIGURE 115

FIGURE 116

- Install the seal washers (8.08) and the seal screws (8.09)

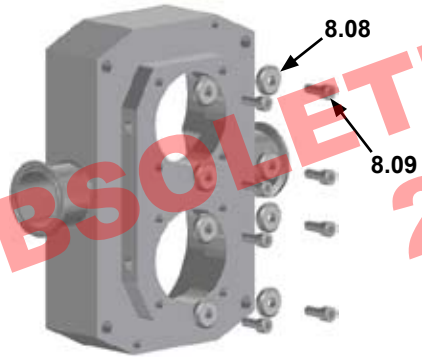


FIGURE 117

The washers overlap the seal bore – this locates and provides drive to the seal.

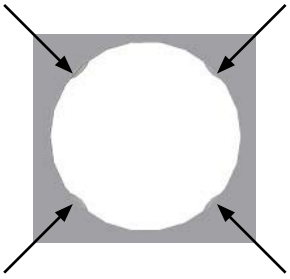


FIGURE 118

- Install the slinger (5.15)

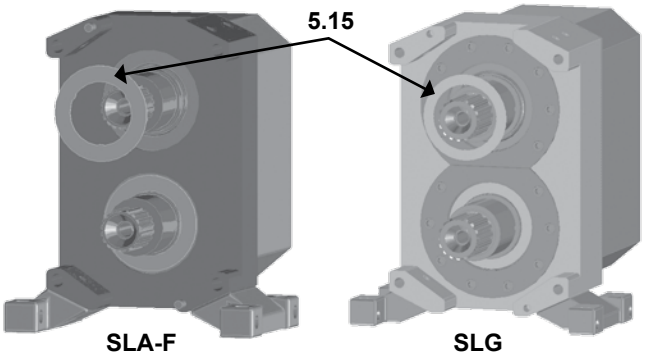


FIGURE 119

NOTE: the slinger has raised sections on the internal diameter, which press onto the shaft

- Install the O-rings (8.12)(8.19) and the wave spring (8.13) into the sleeve (8.15) and then install the housing (8.10) onto the sleeve, Install the assembly onto the shaft

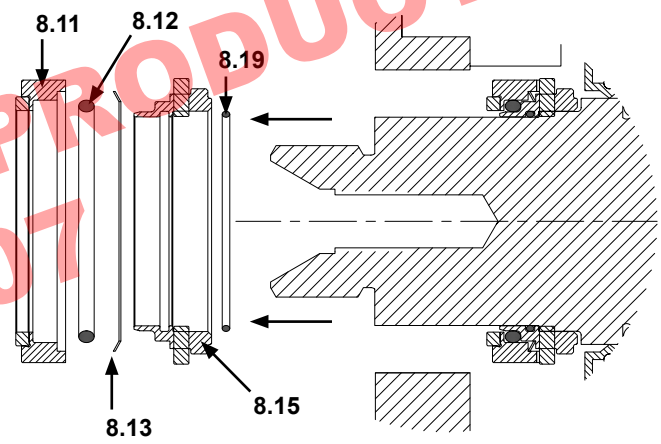


FIGURE 120

NOTE: There are two drive slots in the shaft which must be lined up with the drive pins on the sleeve.

- Install the guard (7.03) and casing (3.01) and secure with screws (4.07) (See section 6.2 for torque settings)

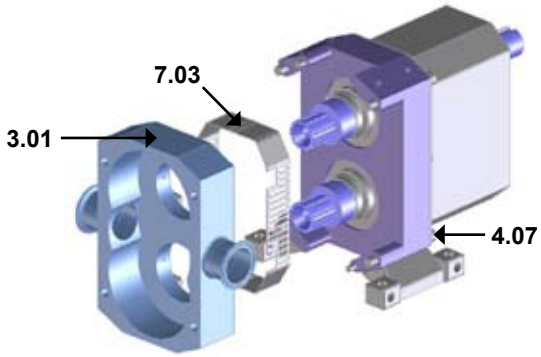


FIGURE 121

- Install the O-ring (8.06) into the seal housing and then install the seal housing (8.10) into the casing
- making sure that the location recesses line up with the seal washers (8.08) (See Figure 47 and Figure 44)

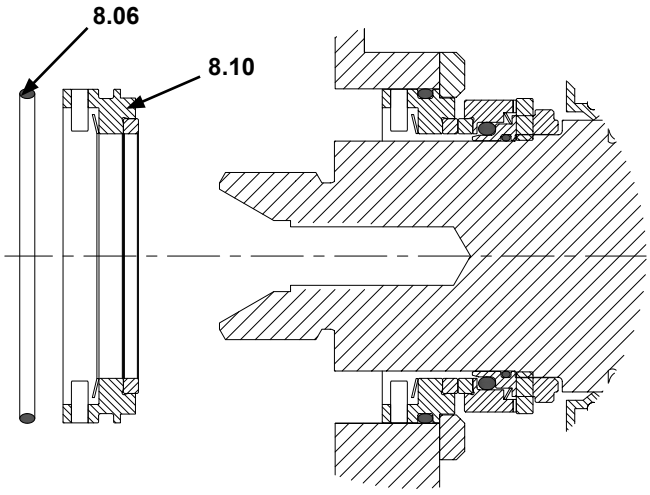


FIGURE 122

- Install the O-ring (8.04) onto the static seal (8.03) and then install the static seal into the casing – make sure that the location slots line up with the pins in the seal housing

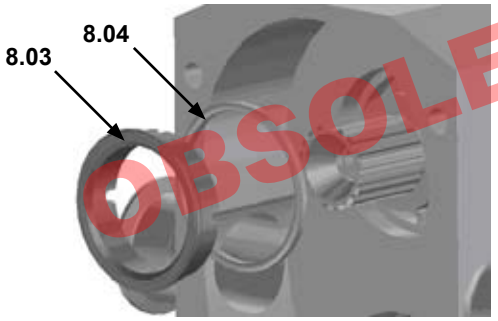


FIGURE 123

- Install the L-cup (8.01) and the rotary face (8.02) into the rotor (2.01)

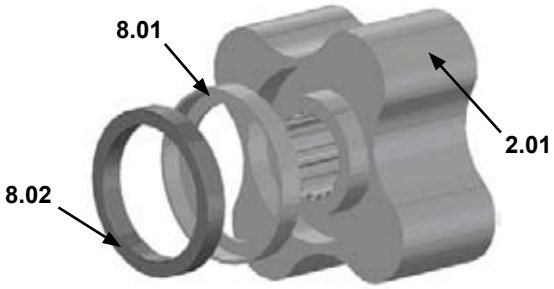


FIGURE 124

The seals are now assembled.

For rotor and head installation see pump assembly section.

5.6 ROTARY SEAL REMOVAL

- To remove the seal face in the rotor use the seal face removal tool
- The tool locates on the rubber L-cup and when pressed in the seal face will extrude up into the tool allowing ease of the seal face removal (A press tool may be required)

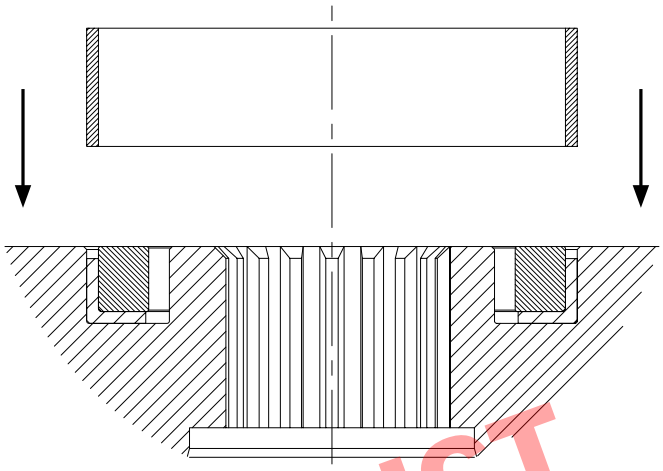


FIGURE 125

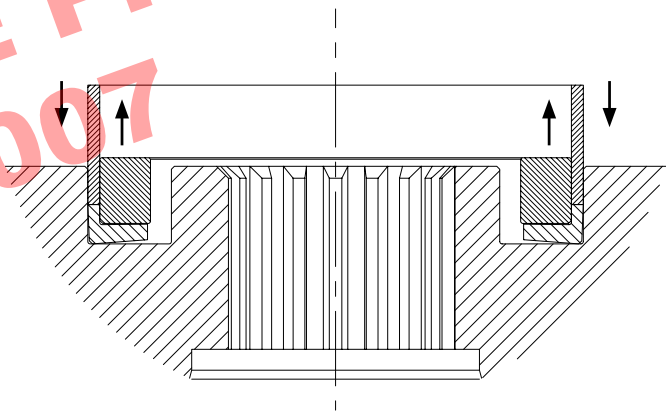
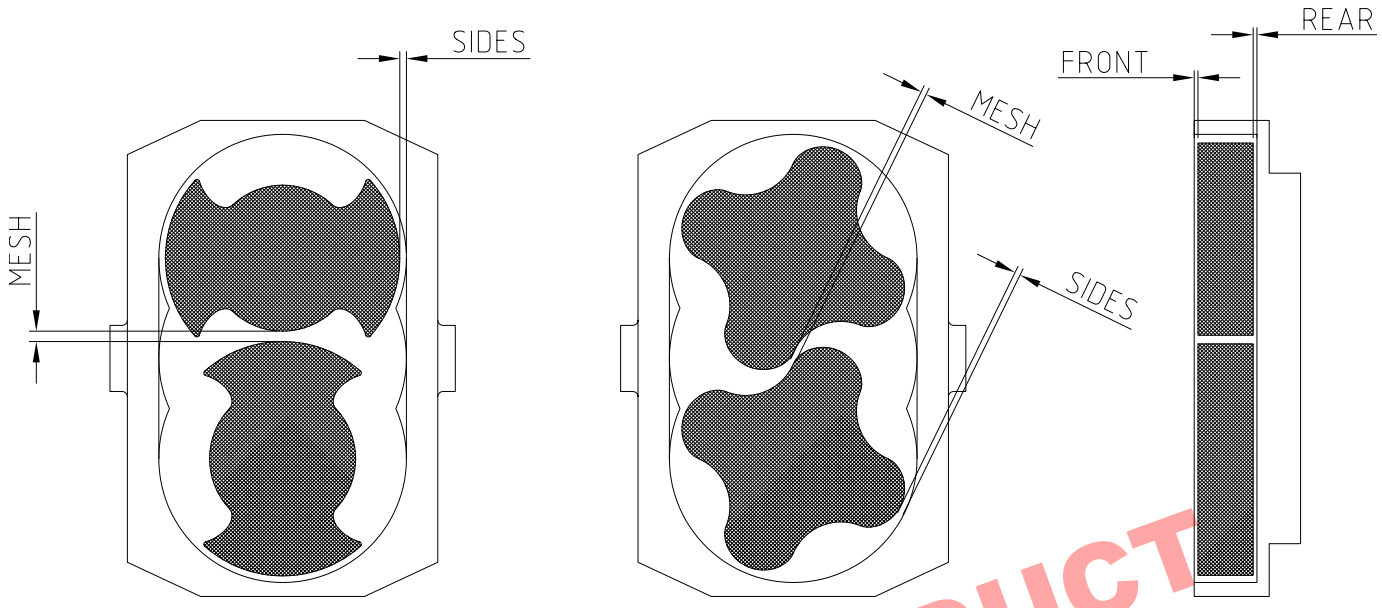


FIGURE 126

6.0 SPECIFICATIONS

6.1 CLEARANCE CHART



Metric Clearances (x 0.1 mm)							
Pump Model	Sides		Front		Back		Mesh
	Min	Max	Min	Max	Min	Max	Nominal
SLAS	1.0	1.8	1.0	1.3	0.8	1.6	1.5
SLAL	1.0	1.8	1.1	1.4	1.1	1.9	1.5
SLBS	1.4	2.2	1.1	1.4	0.9	1.8	1.8
SLBL	1.6	2.4	1.4	1.7	1.3	2.2	1.8
SLCS	1.5	2.5	1.4	1.7	1.2	2.0	2.2
SLCL	1.7	2.7	1.6	1.9	1.4	2.2	2.2
SLDS	2.0	3.0	1.8	2.2	1.2	2.2	2.5
SLDL	2.2	3.2	2.1	2.5	2.0	3.0	2.5
SLES	1.8	3.2	2.0	2.5	2.1	3.1	3.0
SLEL	1.8	3.0	2.1	2.6	2.2	3.2	3.0
SLFS	2.4	3.5	2.8	3.3	2.7	3.7	4.0
SLFL	3.0	4.0	2.9	3.6	2.9	3.8	4.0
SLGS	10.0	12.2	4.0	6.0	3.0	5.5	4.0
SLGL	10.0	12.0	4.5	6.5	3.5	6.0	11.0

Imperial Clearances (x 0.01 in)							
Pump Model	Sides		Front		Back		Mesh
	Min	Max	Min	Max	Min	Max	Nominal
SLAS	0.39	0.71	0.39	0.51	0.31	0.63	0.59
SLAL	0.39	0.71	0.43	0.55	0.43	0.75	0.59
SLBS	0.55	0.87	0.43	0.55	0.35	0.71	0.71
SLBL	0.63	0.94	0.55	0.67	0.51	0.87	0.71
SLCS	0.59	0.98	0.55	0.67	0.47	0.79	0.87
SLCL	0.67	1.06	0.63	0.75	0.55	0.87	0.87
SLDS	0.79	1.18	0.71	0.87	0.47	0.87	0.98
SLDL	0.87	1.26	0.83	0.98	0.79	1.18	0.98
SLES	0.71	1.26	0.79	0.98	0.83	1.22	1.18
SLEL	0.71	1.18	0.83	1.02	0.87	1.26	1.18
SLFS	0.94	1.38	1.10	1.30	1.06	1.46	1.57
SLFL	1.18	1.57	1.14	1.42	1.14	1.50	1.57
SLGS	3.94	4.80	1.57	2.36	1.18	2.17	1.57
SLGL	3.94	4.72	1.77	2.56	1.38	2.36	4.33

FIGURE 127

6.2 FASTENERS & TORQUE SETTINGS

Item	Description	Position		Pump Model						
				SLA	SLB	SLC	SLD	SLE	SLF	SLG
6.02	Socket Head Cap Screw	Foot / Bearing Housing	Quantity / Pump	4	4	4	4	4	4	4
			Size	M8 x 16	M8 x 16	M10 x 16	M10 x 16	M12 x 25	M12 x 25	M12 x 25
			Torque N/m	25	25	51	51	88	88	88
			Torque ft. lbf	18.4	18.4	37.6	37.6	64.9	64.9	64.9
4.08	Socket Head Cap Screw	Bearing Housing / Casing	Quantity / Pump	4	4	4	4	4	4	4
			Size	M8 x 65	M8 x 100	M10 x 100	M12 x 110	M16 x 130	M16 x 130	M16 x 200
			Torque N/m	25	25	51	51	180	180	180
			Torque ft. lbf	18.4	18.4	37.6	37.6	132.8	132.8	132.8
5.09 5.16	Lock Nuts	Gear / Shaft	Quantity / Pump	2	2	2	2	2	2	4 / 2
			Size	M17	M25	M30	M45	M55	M60	M90 / M70
			Torque N/m	25	40	40	40	50	50	60
			Torque ft. lbf	18.4	29.5	29.5	29.5	36.9	36.9	44.3
4.09	Socket Head Cap Screw	Gearbox / Gearbox Cover	Quantity / Pump	4	4	4	6	6	8	8
			Size	M6 x 12	M6 x 12	M6 x 12	M6 x 12	M8 x 16	M8 x 16	M8 x 16
			Torque N/m	10	10	10	10	25	25	25
			Torque ft. lbf	7.4	7.4	7.4	7.4	18.4	18.4	18.4
-	Rolling Torque	Bearing / Shaft	Quantity / Pump	2	2	2	2	2	2	2
			Torque N/m	0.5 - 1	1.5 - 2	2- 2.5	3 - 3.5	4 - 4.5	5 - 5.5	9 - 12
			Torque ft. lbf	0.36	1.1 - 1.48	1.48	2.21	2.95	3.69	6.64
2.02	Retainer	Rotor / Shaft	Quantity / Pump	2	2	2	2	2	2	2
			Torque N/m	24	24	30	40	50	60	60
			Torque ft. lbf	17.7	17.7	22.1	29.5	36.9	44.3	44.3
1.03	Dome Nut (Acorn)	Front Cover / Casing	Quantity / Pump	4	4	4	4	8	8	8
			Size	M8	M10	M10	M12	M12	M16	M16
			Torque N/m	25	51	51	88	88	180	180
			Torque ft. lbf	18.4	37.6	37.6	64.9	64.9	132.8	132.8
1.04	Stud	Front Cover / Casing	Quantity / Pump	4	4	4	4	8	8	8
			Size	M8 x 35	M10 x 35	M10 x 35	M12 x 45	M12 x 49	M16 x 55	M16 x 55
			Torque N/m	25	51	51	88	88	180	180
			Torque ft. lbf	18.4	37.6	37.6	64.9	64.9	132.8	132.8
7.02	Hammer Drive Screw	Nameplate / Gearbox	Quantity / Pump	4	4	4	4	4	4	4
9.09	Socket Head Cap Screw	RV Cylinder / Head	Quantity / Pump	6	6	6	6	6	8	
			Size	M6 x 35	M6 x 35	M8 x 40	M10 x 40	M10 x 40	M16 x 50	-
			Torque N/m	10	10	25	51	51	180	
			Torque ft. lbf	7.4	7.4	18.4	37.6	37.6		
9.07	Socket Head Cap Screw	RV Cylinder / Nut	Quantity / Pump	1	1	1	1	1	1	
			Size	M63	M63	M80	M125	M125	M140	-
			Torque N/m	-	-	-	-	-	-	
			Torque ft. lbf	-	-	-	-	-	-	
9.16	Socket Head Cap Screw	RV Cylinder / Head	Quantity / Pump	-	-	-	-	-	10	-
			Size						M10 x 25	
			Torque N/m						51	
			Torque ft. lbf						37.6	

6.3 LIP-SEAL SETTING DISTANCES

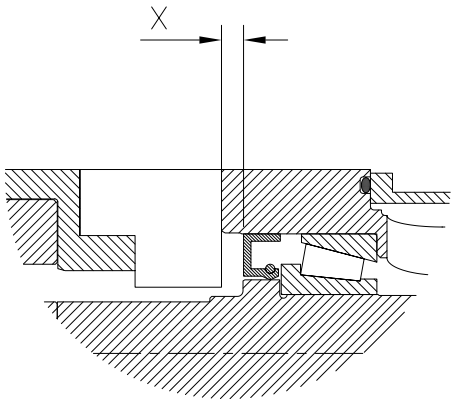


FIGURE 128

Pump Model	Dimension "X" (mm)	Dimension "X" (inch)
SLAS	4	0.16
SLBL	6	0.24
SLCS	5	0.20
SLDL	6	0.24
SLES	3	0.12
SLFL	8	0.31
SLGS	7	0.28

6.4 LUBRICANTS

The recommended lubricant for use in the SL Series is an EP00 grade, lithium based, extreme pressure grease intended for 'sealed for life' units. Suitable for operating temperatures between –30°C and 120°C (-22°F to 266°F) and a base viscosity in the region of 200 cSt at 40°C (104°F).

The unit is shipped as standard with the recommended grade listed above. Refer to manufacturers recommended operating conditions concerning limitations, servicing and application. In case of doubt, please consult the factory for details.

SLA = 0.25 Liters ..... (0.066 US gallons)
SLB = 0.7 Liters ..... (0.184 US gallons)
SLC = 1.1 Liters ..... (0.29 US gallons)
SLD = 2.2 Liters ..... (0.58 US gallons)
SLE = 4.6 Liters ..... (1.21 US gallons)
SLF = 8.2 Liters ..... (2.16 US gallons)
SLG = 12 Liters ..... (3.16 US gallons)

During the filling operation, lubricant should be directed at the front bearings to ensure good circulation and coverage in this area.

Care should be taken not to overfill the gearbox.

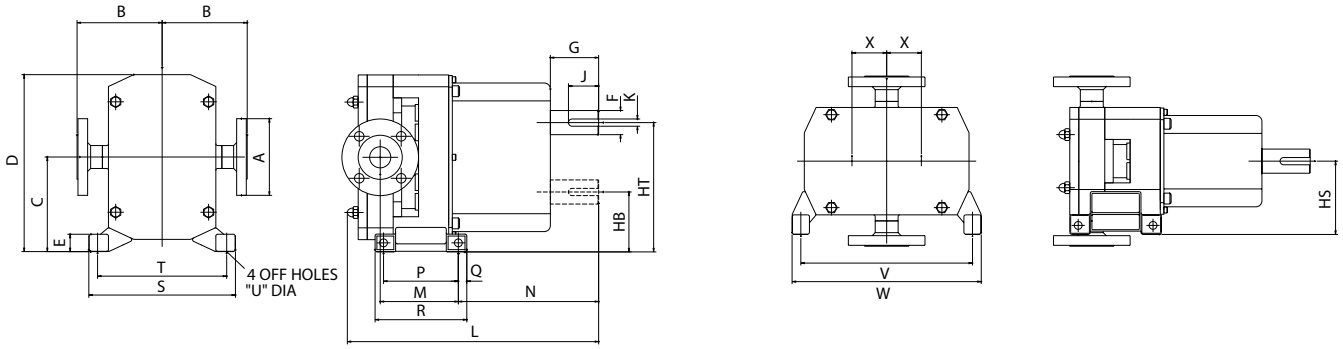
6.5 MATERIAL SPECIFICATION

Rotors ..... 316L Stainless Steel
Casing ..... 316L Stainless Steel
Shafts ..... 316L Stainless Steel
Head ..... 316L Stainless Steel
Rotor Retainer ..... 316L Stainless Steel
Bearing Housing ..... Grade 220 Grey Cast Iron, Coated

6.6 TROUBLE SHOOTING

No Flow	Irregular Flow	Under Capacity	Pump Overheats	Motor Overheats	Excessive Rotor Wear	Excessive Seal Wear	Noise / Vibration	Seizure	Pump Stalls on Startup	Causes	Action
■										Incorrect Direction of Rotation	Reverse Motor
■										Pump Not Primed	Expel Gas From Suction Line / Pump Chamber & Prime
■	■	■					■			Insufficient NPSH Available	Increase Suction Line & Static Suction Head Diameter. Simplify Suction Line & Reduce Length. Reduce Pump Speed & Product Temperature
	■	■					■			Product Vaporizing in Suction Line	
	■	■					■			Air Entering Suction Line	Remake Pipework Joints
■	■	■					■			Gas in Suction Line	Expel Gas From Suction Line / Pump Chamber
	■	■					■			Insufficient Static Suction Head	Raise Product Level to Increase Static Suction Head
			■	■			■		■	Product Viscosity Too High	Decrease Pump Speed / Increase Product Temperature
		■								Product Viscosity Too Low	Increase Pump Speed / Increase Product Temperature
		■	■		■		■		■	Product Temperature Too High	Cool Product / Pumping Chamber
				■					■	Product Temperature Too Low	Heat Product / Pumping Chamber
					■	■	■	■		Unexpected Solids in Product	Clean System / Fit Strainer on Suction Side of Pump
		■	■	■	■		■	■	■	Discharge Pressure Too High	Check for Blockages / Simplify Discharge Line
			■	■	■		■	■		Casing Strained by Pipework	Check Pipe Alignment / Support Pipework
				■			■			Pump Speed Too High	Decrease Pump Speed
		■								Pump Speed Too Low	Increase Pump Speed
			■	■	■	■	■	■		Seal Flush Inadequate	Increase Seal Flush to Required Pressure / Flow
			■	■	■	■	■	■	■	Bearing / Timing Gear Wear	Replace Worn Components

6.7 SL SERIES FOUNDATION DIMENSIONS



Model		A	B1	B2	B3	B4	B5	C	D	E	② F	G	HB	HS	HT
SLAS	IN	3/4	2.72	3.27	N/A	3.82	3.82	3.44	6.22	0.87	-	1.00	2.38	2.93	4.55
	MM	-	69	83	N/A	97	97	87.5	158	22	14	25.5	60.5	74.5	115.5
SLAL	IN	1	3.27	3.27	N/A	3.82	3.82	3.44	6.22	0.87	-	1.00	2.38	2.93	4.55
	MM	-	83	83	N/A	97	97	87.5	158	22	14	25.5	60.5	74.5	115.5
SLBS	IN	1	3.98	3.98	4.53	4.53	4.53	3.98	7.28	0.87	-	1.40	2.66	3.35	5.33
	MM	-	101	101	115	115	115	101	185	22	20	35.5	67.5	85	135.5
SLBL	IN	1 1/2	3.98	4.84	4.53	4.53	4.53	3.98	7.28	0.87	-	1.40	2.66	3.35	5.33
	MM	-	101	123	115	115	115	101	185	22	20	35.5	67.5	85	135.5
SLCS	IN	1 1/2	4.21	5.08	4.76	4.76	4.76	5.08	9.17	1.18	-	1.81	3.41	4.00	6.75
	MM	-	107	129	121	121	121	129	233	30	24	46	86.5	101.5	171.5
SLCL	IN	2	4.21	5.08	4.76	4.76	5.08	5.08	9.17	1.18	-	1.81	3.41	4.00	6.75
	MM	-	107	129	121	121	129	129	233	30	24	46	86.5	101.5	171.5
SLDS	IN	1 1/2	5.00	5.47	5.16	5.16	5.16	6.16	11.57	1.14	-	3.15	3.90	4.78	8.43
	MM	-	127	139	131	131	131	156.5	294	29	40	80	99	121.5	214
SLDL	IN	2	5.00	5.47	5.16	5.16	5.47	6.16	11.57	1.14	-	3.15	3.90	4.78	8.43
	MM	-	127	139	131	131	139	156.5	294	29	40	80	99	121.5	214
SLES	IN	2	6.22	6.57	6.26	6.26	6.57	7.56	10.24	1.69	-	3.15	4.80	7.09	10.32
	MM	-	158	167	159	159	167	192	260	43	48	80	122	180	262
SLEL	IN	3	6.22	6.57	6.26	6.57	6.77	7.56	14.17	1.69	-	3.15	4.80	7.09	10.32
	MM	-	158	167	159	167	172	192	360	43	48	80	122	180	262
SLFS	IN	3	6.81	8.07	7.36	7.68	7.87	8.50	16.10	1.69	-	3.15	5.35	7.52	11.65
	MM	-	173	205	187	195	200	216	409	43	50	80	136	191	296
SLFL	IN	4	6.97	8.66	7.36	7.68	7.87	8.50	16.10	1.69	-	3.15	5.35	7.52	11.65
	MM	-	177	220	187	195	200	216	409	43	50	80	136	191	296
SLGS	IN	4	7.64	9.33	8.03	8.35	8.54	9.88	18.90	1.69	-	4.25	6.14	7.95	13.62
	MM	-	194	237	204	212	217	251	480	43	60	108	156	202	346
SLGL	IN	6	7.64	9.33	8.03	8.35	8.54	9.88	18.90	1.69	-	4.25	6.14	7.95	13.62
	MM	-	194	237	204	212	217	251	480	43	60	108	156	202	346

Model		J	② K	L	M	N	P	Q	R	S	T	U	V	W	X
SLAS	IN	-	-	9.25	3.31	4.67	2.44	0.43	3.31	5.87	5.04	0.35	6.14	6.93	1.08
	MM	20	5	235	84	118.5	62	11	84	149	128	9	156	176	27.5
SLAL	IN	-	-	9.61	3.39	4.67	2.44	0.43	3.31	5.87	5.04	0.35	6.14	6.93	1.08
	MM	20	5	244	86	118.5	62	11	84	149	128	9	156	176	27.5
SLBS	IN	-	-	11.81	3.35	6.85	2.44	0.43	3.31	6.69	5.87	0.35	7.17	7.95	1.34
	MM	35	6	300	85	174	62	11	84	170	149	9	182	202	34
SLBL	IN	-	-	12.24	3.54	6.85	2.44	0.43	3.31	6.69	5.87	0.35	7.17	7.95	1.34
	MM	35	6	311	90	174	62	11	84	170	149	9	182	202	34
SLCS	IN	-	-	13.07	4.84	6.40	4.88	0.55	5.98	7.99	6.81	0.51	8.98	10.12	1.67
	MM	30	8	332	123	162.5	124	14	152	203	173	13	228	257	42.5
SLCL	IN	-	-	13.62	5.16	6.40	4.88	0.55	5.98	7.99	6.81	0.51	8.98	10.12	1.67
	MM	30	8	346	131	162.5	124	14	152	203	173	13	228	257	42.5
SLDS	IN	-	-	16.42	5.10	9.15	4.88	0.55	5.98	9.57	8.43	0.51	11.20	12.34	2.26
	MM	50	12	417	129.5	232.5	124	14	152	243	214	13	284.5	313.5	57.5
SLDL	IN	-	-	17.17	5.49	9.15	4.88	0.55	5.98	9.57	8.43	0.51	11.20	12.34	2.26
	MM	50	12	436	139.5	232.5	124	14	152	243	214	13	284.5	313.5	57.5
SLES	IN	-	-	19.45	6.10	10.81	6.69	0.63	7.95	14.17	12.60	0.71	13.94	15.12	2.76
	MM	60	14	494	155	274.5	170	16	202	360	320	18	354	384	70
SLEL	IN	-	-	20.43	6.57	10.81	6.69	0.63	7.95	14.17	12.60	0.71	13.94	15.12	2.76
	MM	60	14	519	167	274.5	170	16	202	360	320	18	354	384	70
SLFS	IN	-	-	22.91	6.99	12.40	6.69	0.63	7.95	15.04	13.46	0.71	15.83	17.01	3.15
	MM	65	16	582	177.5	315	170	16	202	382	342	18	402	432	80
SLFL	IN	-	-	24.25	7.58	12.40	6.69	0.63	7.95	15.04	13.46	0.71	15.83	17.01	3.15
	MM	65	16	616	192.5	315	170	16	202	382	342	18	402	432	80
SLGS	IN	-	-	29.21	8.31	16.50	6.69	0.63	7.95	15.94	14.37	0.71	18.58	19.76	3.74
	MM	90	18	742	211	419	170	16	202	405	365	18	472	502	95
SLGL	IN	-	-	31.30	9.33	16.50	6.69	0.63	7.95	15.94	14.37	0.71	18.58	19.76	3.74
	MM	90	18	795	237	419	170	16	202	405	365	18	472	502	95

① External NPT ports standard on sizes SALS - SLES, ANSI 150# flange standard on sizes SLEL - SLHS.
② Metric shaft coupling and key required. Related dimensions (F, J, and K) are shown in metric only.

FIGURE 129

6.8 TOOL LIST

Listed below are tools required for the maintenance of the SL Series pump.

Type	Size or Range	SLA	SLB	SLC	SLD	SLE	SLF	SLG
Combination Spanner	13 mm	✓						
	17 mm		✓	✓				
	19 mm				✓	✓		
	24 mm						✓	✓
Hexagon (Allen) Key	5 mm	✓	✓	✓	✓	✓	✓	✓
	6 mm	✓	✓	✓	✓	✓	✓	✓
	8 mm			✓	✓	✓	✓	✓
	10 mm				✓	✓	✓	✓
Hexagon (Allen) Key Socket Driven	5 mm	✓	✓	✓	✓	✓	✓	✓
	6 mm	✓	✓	✓	✓	✓	✓	✓
	8 mm			✓	✓	✓	✓	✓
	10 mm				✓	✓	✓	✓
Torque Wrench	0 - 75	✓	✓					
	0 - 150			✓	✓			
	0 - 300					✓	✓	✓
Depth Micrometer	0 - 25 mm	✓	✓	✓	✓	✓	✓	✓
Feeler Gauge Set		✓	✓	✓	✓	✓	✓	✓
Rolling Torque Meter	0 - 5 NM	✓	✓	✓	✓			
Rolling Torque Meter	0 - 10 NM					✓	✓	✓
Socket For Rotor Retainers	Supplied With Pump	✓	✓	✓	✓	✓	✓	✓
Seal Removal Tool	Supplied With Pump	✓	✓	✓	✓	✓	✓	✓
Rotor Lock Tool	Supplied With Pump	✓	✓	✓	✓	✓	✓	✓
C - Spanner	To Suit M17 Nut	✓						
	To Suit M25 Nut		✓					
	To Suit M30 Nut			✓				
	To Suit M45 Nut				✓			
	To Suit M55 Nut					✓		
	To Suit M60 Nut						✓	
	To Suit M70 Nut							✓
Soft Face Mallet		✓	✓	✓	✓	✓	✓	✓
Pin Punch		✓	✓	✓	✓	✓	✓	✓
Steel Hammer		✓	✓	✓	✓	✓	✓	✓
For Pumps With Relief Valve								
Tommy Bar	Diameter 8 - 200 Long	✓	✓					
	Diameter 13 - 400 Long			✓				
	Diameter 16 - 600 Long				✓	✓		
Pin Spanner		✓	✓	✓	✓	✓		

VIKING PUMP

IDEX CORPORATION

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. If, during said warranty period, any products sold by Viking prove to be defective in workmanship or material under normal use and service, and if such products are returned to Viking's factory at Cedar Falls, Iowa, transportation charges prepaid, and if the products are found by Viking to be defective in workmanship or material, they will be replaced or repaired free of charge, FOB, Cedar Falls, Iowa.

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