Installation, Operation & Maintenance Manual

Sundyne Pumps

Model: LMV-802

SA-07-11-37, Rev Orig.
Jan 2009

Warranty

Sundyne Corporation warrants to Buyer for a period of twelve (12) months from the date of being placed in service (but not to exceed eighteen (18) months after the date of shipment) that the equipment at the time of shipment will be free from defects of design, material and workmanship. If any defects or malperformance occur during the warranty period, Sundyne's sole obligation shall be limited to alteration, repair or replacement at Sundyne's expense, F.O.B. Factory, of parts or equipment, which upon return to Sundyne and upon Sundyne's examination prove to be defective. Equipment and accessories not manufactured by Sundyne are warranted only to the extent of and by the original manufacturers' warranty. Sundyne shall not be liable for damage or wear to equipment caused by abnormal conditions, vibration, failure to properly prime or to operate equipment without flow or caused by corrosives, abrasives or foreign objects. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. In no event shall Sundyne be liable for consequential or incidental damages

Contents

INTRODUCTION & SAFETY

Sundyne Centrifugal Pumps

Sundyne pumps provide high-energy performance and competitive efficiencies in an industrial quality, compact unit that is simple to maintain. Sundyne pumps are single stage that utilize an integral gearbox. Designed to to increase the pressure of a continuous flow of fluid by applying centrifugal action, Sundyne pumps are most commonly used in HPI, CPI, and Boiler Feed applications. Commonly applied in refineries, petrochemical plants, and power generation plants, Sundyne pumps are used in high-head, low-to-medium flow processes.

This manual presents installation, servicing, troubleshooting, maintenance and spare parts information for the latest configuration of Sundyne centrifugal pumps.

***Note**: Parenthetical numbers included in the text correspond to item numbers on the illustrated figures. The correct spare part can be ordered for any generation pump by referencing the item and serial numbers.*

Text Symbols

The following symbols may be found in the text of this manual.

They have the following meanings:

WARNING: Text accompanied by this symbol indicates that failure to follow directions could result in bodily harm or death.

ELECTRICAL HAZARD: Text accompanied by this symbol indicates that failure to follow directions could result in electrical damage to equipment or electrical shock.

RECOMMENDED: Text accompanied by this symbol indicates recommended usage.

REMINDER: Text accompanied by this symbol indicates a reminder to perform an action.

EQUIPMENT USE ALERT: Text accompanied by this symbol indicates that failure to follow directions could result in damage to equipment.

Equipment and Safety Precautions

Sundyne Corporation manufactures centrifugal pumps to exacting International Quality Management System Standards (ISO 9001) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories are specifically designed and tested for use with these products to ensure continued product quality and performance. Sundyne cannot test all parts and accessories sourced from other vendors; incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorized Sundyne pump parts and accessories is considered misuse and damage or failure caused by misuse is not

covered by Sundyne's warranty. Additionally, modification of Sundyne products or removal of original components may impair the safety of these products and their effective operation.

CAUTION

Sundyne pumps may handle hazardous, flammable, and/or toxic fluids. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in accordance with applicable environmental regulations.

***Note**: Safety procedures must be applied prior to any installation, maintenance, or repair of a Sundyne pump. Failure to follow safety precautions may lead to injury!*

Wearing Personal Protective Equipment

To ensure safety, protective equipment must be worn at all times when installing, performing maintenance, or repairing equipment. The following safety recommendations must be adhered to for optimum safety:

- Safety glasses, with the minimum requirement of side shields, must be worn at all times.
- Steel-toed shoes must be worn when lifting equipment greater than 15 pounds (7 kg) or if pallet jacks or forklifts are operated.
- Hearing protection is strongly recommended at all times when noise levels exceed 85 dB during an eight (8.0) hour period.

***Note**: Chemical resistant gloves must be used if chemicals are utilized (refer to Using Chemicals for additional information).*

***Note**: A dust mask respirator must be worn if chemicals have warning labels regarding fumes, dust, or mists.*

When using more than one piece of protective equipment, consider their compatibility. For example, safety glasses will not interfere with hearing protection equipment. Be sure to clean all pieces of personal protective equipment immediately after each use.

Using Forklifts

Any persons operating a forklift must have an active recognized operator license.

***Note**: Before initializing forklift operation, verify that the lift is in a safe operating position.*

Ensuring Electrical Safety

All electrical sources must be powered-off before installation, service, or repair of equipment occurs.

***Note:** Sundyne recommends that a Lock-out/Tag-out program be followed prior to altering the equipment. Locks or tags must be provided to warn employees that equipment is temporarily unavailable.*

Once all work has been completed, the person installing the lock or tag must remove it according to company procedure.

Testing Equipment

Prior to performing a test on newly installed, maintained, or repaired equipment; all personnel in the immediate area must be warned.

***Note**: Follow company procedures prior to equipment testing at all times.*

Using Chemicals

Any chemicals to be used must be accompanied by a relevant material safety data sheet (MSDS), in accordance with government legislation. If applicable, use chemical proof gloves.

***Note**: An eye wash station (or equivalent) should be available in the event of injury. If any hazardous or flammable chemicals pass through the equipment, a complete decontamination of the equipment is required.*

Protection from Falling

Fall protection and associated preventative measures are required when working on equipment located six feet or higher from the ground.

***Note**: Follow company fall prevention procedures prior to working on equipment.*

Preventative Machine Guards

Preventative guards must remain in place on all equipment.

***Note**: Only remove the guards while performing maintenance or repair.*

Replace the guards immediately after working on the equipment and prior to start up.

EXPLOSION/FIRE HAZARD

Note: *Never use an acetylene torch, open flame, or heat to attempt to remove parts that have seized together in Sundyne equipment. Any residual process gas or liquid that is flammable can result in an explosion or fire with potential for serious injury or death.*

Pre-Commission Checklist

Familiarizing Yourself with the Pump

Before servicing and starting up the Sundyne pump, carefully review all information on the product, including:

- Specification sheets
- Outline drawings
- Performance curves
- Instruction and related manuals.
- System P&ID/Process Flow Diagram (Clients equipment).
- Control system and operational philosophy/narrative (client).

Familiarize yourself with the pump configuration before starting and operating the pump.

Driver Instructions

Carefully follow all installation and starting instructions provided by the driver manufacturer. This information is included in the final data package.

Verifying Auxiliaries

Before start up, verify that the following auxiliaries are met:

- Check the utility connections.
- Verify that the auxiliary piping conforms to Sundyne standards, as indicated in the detailed specifications.
- Verify all switch and instrument connections
- Verify that all switch and instrument settings are set to normal operating standards.
- Calibrate all measurement equipment, such as Flow meters, ampere meters, and pressure meters,ect.

Installing a Seal Environmental Control System

Install a system to control the seal environment. Also, verify that port 1 is properly vented.

If required, install drain piping overhead to ensure that the environment operates under normal conditions. For more information, contact Sundyne Corporation.

Checking Driver Rotation

Verify that the direction of the driver rotates in the same direction as the arrow stamped or cast on the pump casing.

*Un-coupled

Piping Connections

Verify that the following bolted or threaded connections are tight:

- ❑ Pump flange bolts
- ❑ Seal environment piping and port connections
- ❑ Cooling water connections to heat exchanger (if applicable)
- ❑ Gearbox oil drain plug
- ❑ Pump case drain plug

Start Up Checklist

Pressurizing the Fluid Loop

Pressurize the double seal buffer loop or external seal flush, if required, prior to admitting fluid into the pump casing.

Servicing the Gearbox

Fill the gearbox with lube oil up to a quarter inch (¼) or 6 mm from the top of the oil level sight glass.

***Note**: Prior to using lube oil, verify that it conforms to acceptable lube oil specification standards. Refer to the SPECIFICATIONS section in this manual for more information.*

Under normal operation, the lube oil level will lower about a quarter inch than when idle. Additionally bubbles will appear at the top of the sight glass.

***Note**: Sundyne recommends that gearbox lube oil be changed at least every six months.*

For requirement information about priming the lube oil system, refer to Starting the Pump in this manual.

Auxiliary Lube Pump

If your pump includes an auxiliary lubrication pump, unlock the electrical circuit and move it to the "hand" position. Check for oil leaks and recheck the oil level.

Setting the Valves

To set the pump to the designated operating point, start the pump with the suction valve in the open position while throttling the discharge valve.

Control Checklist

Process Conditions

Verify the following process conditions against the specifications in this manual:

- Process conditions
- Suction pressure
- Suction temperature
- Discharge pressure

Check with your Sundyne representative if the operation conditions of your pump must run under different parameters than indicated by the specifications in this manual.

Adjusting the Cooling Flow

If your model pump includes an installed heat exchanger for the gearbox, adjust the cooling flow to keep the temperature of the gearbox sump at 140°-180°F (60°-82°C).

Verifying Operating Conditions

Verify the following parameters against the specifications included in this manual:

- Total head
- Flow rate
- Power consumption
- Specific gravity
- Viscosity
- Net Positive Suction Head (NPSH)

The status of these conditions will significantly alter performance of the pump if they are not in accordance with the specification sheet.

INSTALLATION

Inspection

Immediately inspect your Sundyne product upon receipt of the equipment. Check for any damage, which may have occurred during shipment. Notify the carrier and Sundyne immediately if damage is evident.

Note: *The input shaft on the pump may not turn freely due to seal drag and speed increasing gear meshes. If the input shaft does turn freely, and if rotation is "not smooth," damage may have occurred during shipping.*

Suction and Discharge Piping

Please adhere to the following best practices for installing and maintaining suction and discharge piping:

Install a suction strainer (12 mesh - .062" or 1.6mm opening) and clean the suction line prior to starting the pump. This procedure will protect the impeller from damage by mill scale, welding slag, or other foreign particles during initial startup.

Note*: Sundyne Recommends installation of a differential pressure instrument across strainer to indicate strainer condition.*

When installing piping to the pump, ensure that all piping is supported independently from the pump.

All piping must always line up with the pump flanges.

Note*: Never use force to position piping into place at the flanged suction and discharge connection locations. Failure to do so may impose excessive strains on the unit.*

Avoid using elbow fittings near the suction flange. When necessary, use long radius elbow fittings. Sundyne recommends using a straight pipe assembly of at least three times the length of the pipe diameter between an elbow and suction flange.

Note*: Carefully select the size of pipe and fittings to be installed so that friction losses will remain low.*

Never use a suction pipe that is smaller in diameter than the pump suction inlet.

Sundyne recommends installation of a discharge check valve to prevent reverse rotation.

Use block valves (both suction and discharge) when isolating the pump during shutdown. This practice will minimize process leakage and prevent possible reverse rotation from pump back-flow.

Seal Environmental Control System

A seal environmental control system may be required depending upon the pump seal arrangement and application.

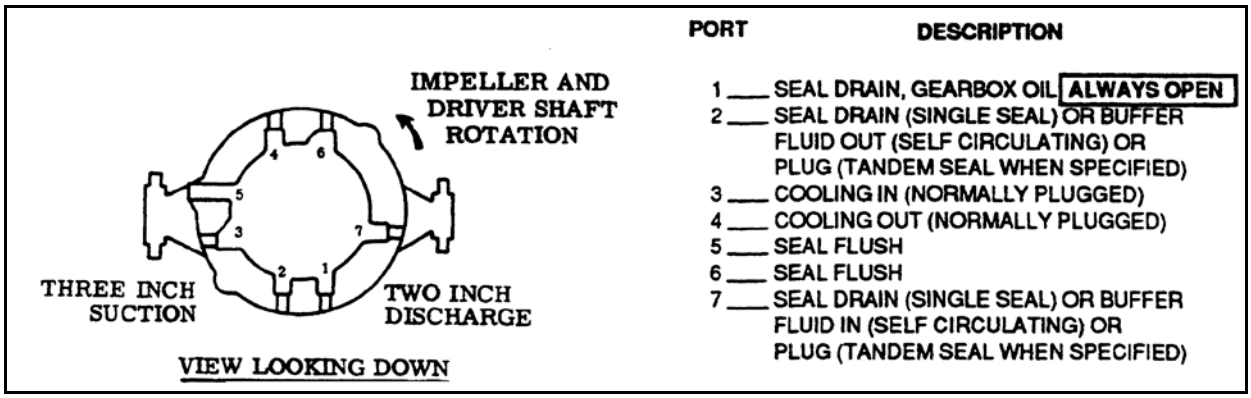
Always maintain the pump seal environment as detailed on the specification sheet that accompanies each unit.

***Note**: For most applications, a standard control system can be obtained from the factory.*

Ensure that the specified seal environmental control system is properly installed and that the ports are open (or plugged) as indicated in Figure 1 below.

***Note**: Port 1 must always be open so that it is free to drain.*

Figure 1 Seal Housing Port Identification



START UP

Starting the LMV–802

To start the pump perform the following tasks:

- Check to ensure that the driver has been serviced in accordance with the instructions provided by the driver manufacturer.
- Open the suction valve completely; open the discharge valve about half way.
- Check to ensure correct shaft rotation. Rotation of the driver must be in the same direction as the arrow on the pump casing.
- Start the driver. Adjust the discharge control valve to the desired flow and check head and horsepower against requirements on the pump specification sheet.

***Note**: A buffer fluid or external seal flush auxiliary system is required, this system should be pressurized prior to admitting process fluid into the pump. If port 6 is not used for a seal flush, it is recommended that a hand bleed valve be installed at this location. Bleed air and vapor before starting.*

Controlling the Pump During Startup

To ensure control of the pump during start up, follow the start up procedures for your desired configuration.

Single Operation

Start the pump with the suction valve open while throttling the discharge valve. This will ensure that the pump will reach the design flow operating point.

If the process fluid is near its vapor press, open the supply vessel seal cavity vent so that the pump is filled with liquid.

Parallel Operation

To prevent back-flow, place the check valves in the discharge piping of each pump.

***Note**: Sundyne recommends installing separate bypass loops around each pump for additional operational flexibility.*

1. Start the first unit as described in the Single Operation instructions.
2. Start the second unit with the bypass valve set to maintain the flow above minimum flow.
3. Open the discharge valve on the second unit so that the design flow of both units is maintained.

***Note**: Do not operate the pumps at their peak head capability.*

Sundyne recommends that separate flow controls be used on each pump to provide a lower minimum flow range than is achieved by pressure control.

NPSH - (Net Positive Suction Head and Cavitation)

In order to protect the pump, it is recommended that NPSH available be at least two-feet greater than NPSH required. If the pump is operated beyond the design capacity the increase in required NPSH with the increase in capacity will eventually result in cavitation. This is usually identifiable as a loud rumble, sometimes described as sounding like gravel is being pumped. Continuous operation in a state of cavitation may cause serious damage to the impeller. Vibration can result in more extensive damage to the pump.

Recirculation

Centrifugal pumps can experience vibrations from internal flow separations and recirculation at low flow conditions. The operator must be aware of the minimum flow recommendations of the manufacturer. It is possible for a pump to operate with some cavitation noise due to recirculation without harm to the pump. However, excessive noise and vibration are signs that the pump may be subject to damage if operation is continuous. Noise and vibration may be accentuated by resonance in the discharge line. This is especially true when a control valve is located well downstream from the pump.

Prevention

It is essential that the pump be selected to mate properly with the system head curve to prevent the pump from operating on its curve where damage may be sustained from recirculation or cavitation. It is also essential that once it is selected that it is properly controlled. Use of flow control should be used in place of pressure control if variable flows are to be experienced. Pressure control is a very difficult and exacting practice due to the relatively flat head capacity curve of Sundyne pumps. Flow control, on the other hand, can be quite precise and effective

Temperature Rise

Temperature rise within the pump is unlikely to become of problem as long as the pump is not operated below minimum flow recommendations. If operation at low flows does become mandatory or if the system causes the pump discharge line to be blocked for any period of time, a means of maintaining minimum flow must be provided. Using either a continuous bypass or a flow-controlled bypass can accomplish this. The operator can calculate the amount of bypass necessary to prevent boiling liquid in the pump case and at the seal faces. Please refer to the manufacturer for information if this becomes necessary.

Suction and Discharge Gauges

It is recommended that suction and discharge pressure gages be installed on any pump that is not flow controlled. If no flow-measuring device is installed there is not a way to determine accurately where on its curve the pump is operating.

OPERATION & CONTROL

Operation of Sundyne Pumps

Under normal operation, several factors must be taken into consideration to ensure successful pump operation. Experienced pump operators will be aware of jeopardizing factors and their effects.

Suction Conditions

Improper flow of liquid into the impeller is the most common operational abuse of centrifugal pumps. Two conditions must exist to prevent turbulence at the eye of the impeller.

- See suction piping section.
- Liquid reaching the impeller eye must have enough vapor pressure to prevent the fluid from flashing to a gas in the impeller. If this condition occurs, it will cause cavitation, which can damage the impeller and inducer. When centrifugal pumps cavitate the noise sounds like the pump is “pumping gravel”. In high speed, single stage pumps, this sound may not be discernable. Cavitation can be prevented by maintaining suction pressure at a high enough level and suction temperatures low enough to maintain Net Positive Suction Head (NPSH) available greater than Net Positive Suction Head (NPSH) required by the pumps.

Minimum Flow Conditions

Vibration and noise will occur during operation of centrifugal pumps if either of two conditions exist:

- Internal flow separations
- Recirculation at low flow conditions.

If the operator is noticing excessive noise or vibration, operation must be suspended until the cause is determined and corrected. Continued use may cause damage to the pump. Resonance in the discharge line can accentuate noise, vibration, and damage to the pump, primarily when a control valve is located an excessive distance downstream from the pump.

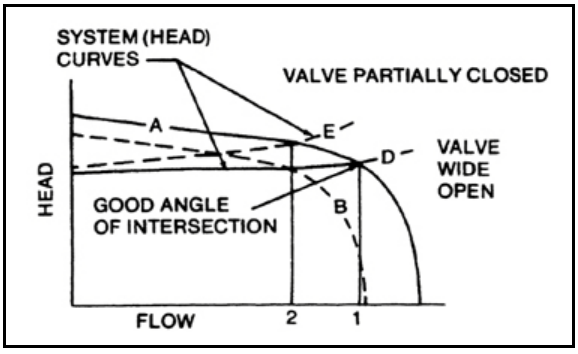
Entrained Gases

The head and capacity of centrifugal pumps will be reduced by gas that is drawn in with the liquid. Under normal operating conditions, centrifugal pumps can tolerate up to 2% of gas (by volume). Entrained gases can cause damage to mechanical seals with the exception of double seals. If you have entrained gas, contact Sundyne for further instruction.

System Head Curve

The point of intersection between the system curve and the pump characteristic curve determines the flow or operation for the centrifugal pump. For steady flow to occur, the system curve must intersect the pump characteristic curve at a significant angle. The following diagram gives examples of satisfactory and unsatisfactory angles of intersection.

Figure 2. Typical Operation



Note: *The curve for pump A has a significant angle of intersection with system curves D and E. The system curve D could represent a system with the control valve wide open while system E could represent the same system but with the throttle valve closed to reduce flow from flow 1 to flow 2. Pump curve B, on the other hand, will provide only flow 2, even with the control valve wide open (curve D). When the control valve is partially closed to create system curve E, the curve E and lower pump curve B are practically parallel. The lack of a significant angle of intersection means*

that the pump flow is likely to drift aimlessly and not respond to control valve position.

Parallel Operation

Maximizing control is critical when operating centrifugal pumps in parallel. One pump can overpower the other in regards to head at a lower total flow. If a simple, unrestricted manifold connects two pumps at the discharge head, the discharge head of one pump is imposed on the other. All pumps will see the same discharge head at a given time. This is demonstrated on the following curves:

The characteristic curves of two pumps designated A and B are demonstrated in the Parallel Operation figure.

Since no two pumps will have exactly the same performance, it is assumed that pump A produces a slight amount more head than pump B. The pumps are arranged with a common manifold as shown in Parallel Units Common Valve figure.

Figure 3. Parallel Operation

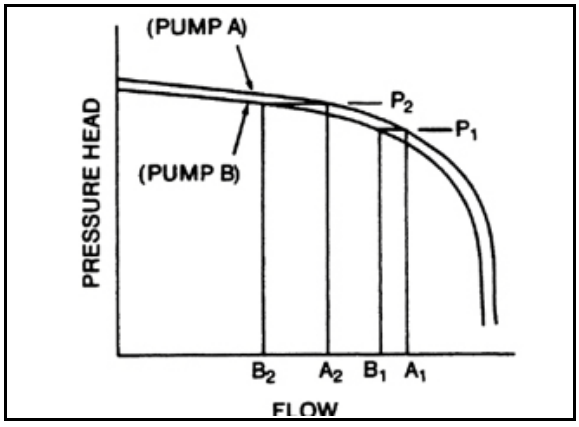
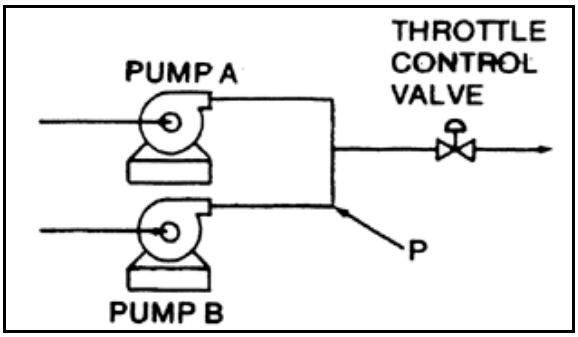


Figure 4. Parallel Units Common Valve



The pressure in the manifold is set at P_1; the flow through pump A indicated as A_1 on the preceding curve. At the same time, the flow through pump B is indicated as B_1. However, if the throttle valve is closed to cause the manifold pressure P to rise to P_2, then flows through pump A and B are A_2 and B_2 respectively. If the throttle valve were closed even further, then pump B would cease to flow entirely. Since pump B would effectively be deadheaded, the fluid in it would heat up and boil. During internal boiling, it could encounter liquid slugging and probable damage to the pump. Proper selection of a control system can prevent this situation.

MAINTENANCE

Disassembling the LMV-802

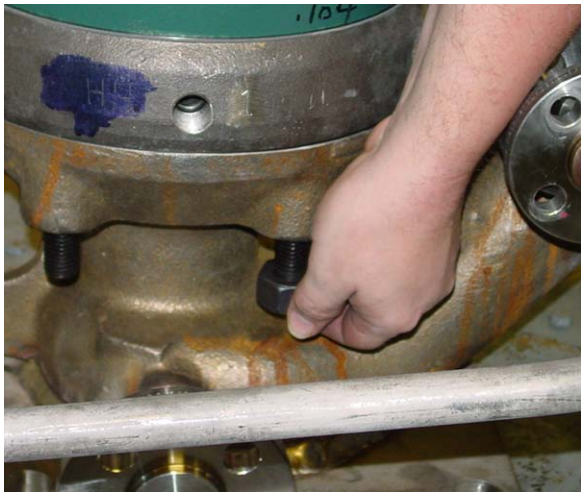
The following procedures apply to all configurations of the LMV-802 process pump. Refer to he specification sheet to determine your specific pump configuration and optional equipment included. Disassembly should be done only to the extent necessary for repair. Parenthetical numbers in the text correspond to item numbers in the parts list section.

***Note**: The following replacement parts will be required as a result of pump disassembly and seal housing removal:*

PART	ITEM NO.	QTY.
Impeller Tab washer	5	1
O-Ring Repair Kit	--	1
Thermal Barrier Gasket	87A	1

STEP 1

Remove nuts (914A) from the pump casing studs.



STEP 2

Remove the driver and seal housing from the pump casing (1).

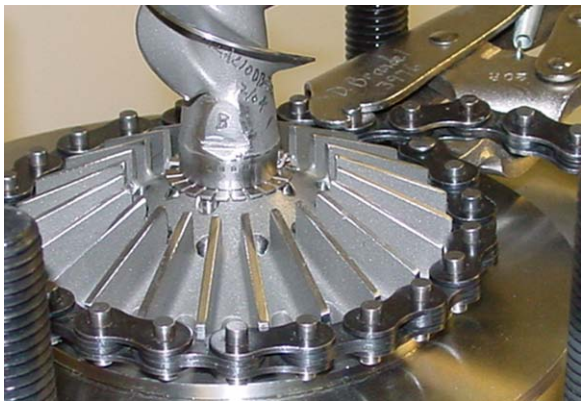
***Note**: Exercise care not to damage the inducer (9) if one is installed.*

***Note**: Use hoist and hooks to prevent personal injury.*

STEP 3

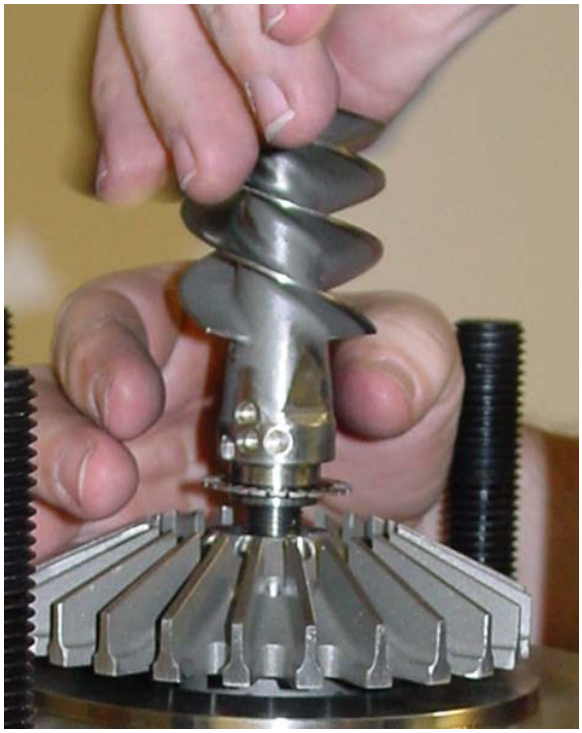
Prevent Impeller from moving using a strap or chain wrench, loosen the inducer or impeller nut.

Note: *Left hand thread.*



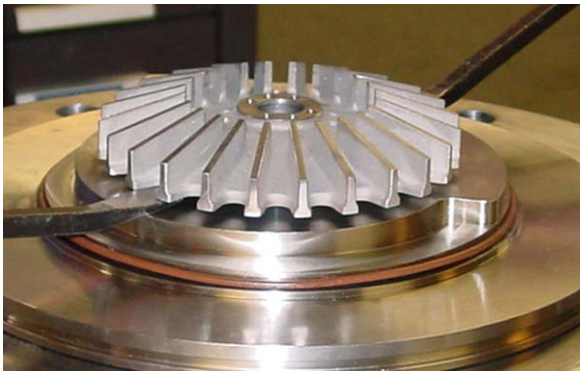
STEP 3 continued

Remove the inducer (9).



STEP 4

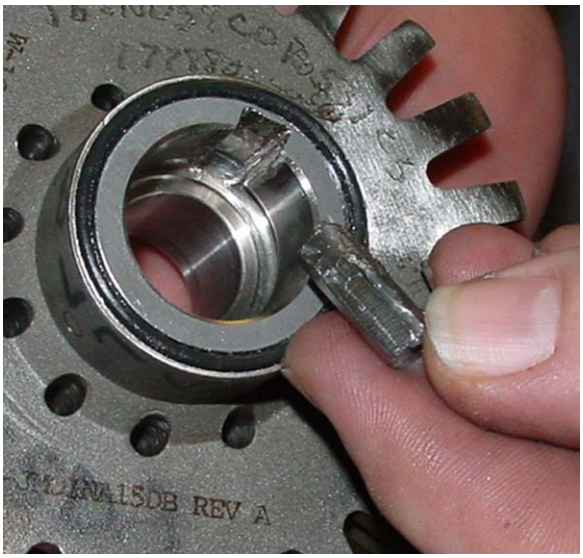
Pry the impeller (2) from the drive shaft.



Note*: The impeller is dynamically balancedand should be replaced if it shows any sign of damage.*

STEP 5

Remove the impeller key (4).



STEP 6

Mark the position of the seal housing to the driver. These marks will ensure the seal housing will be in the correct position when reassembled.

STEP 7

Remove the seal rotating face (51A).

STEP 8

Remove seal housing (30) from the driver by removing hex head bolts.

STEP 9

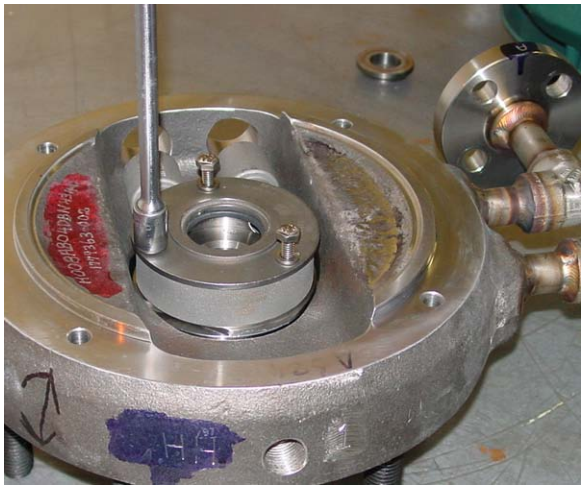
Remove seal housing gasket (87A).

STEP 10

Remove lower mechanical seal mating ring.

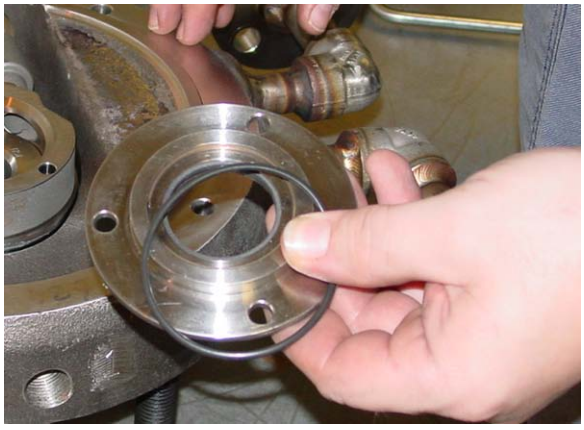
STEP 11

Turn the seal housing over and remove the three hex head cap screws.



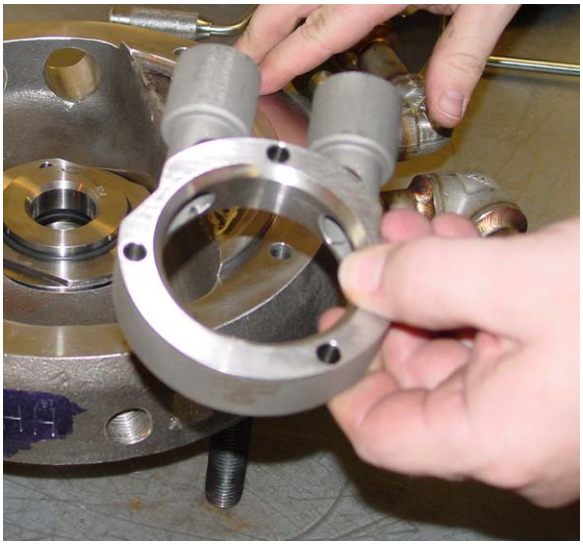
STEP 12

Remove the throttle bushing (21B) and the throttle bushing “O” ring (936H).



STEP 13

Remove seal retainer spacer (19A).



STEP 14

Remove lower mechanical seal (60A) and the front and back mechanical seal “O” rings.

STEP 15

Remove the seal spacer from the lower mechanical seal.

***Note**: STEPS 12-15 will vary depending on the seal arrangement on your pump. The following procedures are for all seal arrangements.*

SINGLE SEAL

Remove the throttle bushing (21B), seal retaining spacer (19A), mechanical seal (60A), and seal spacer (52).

DOUBLE SEAL

Remove the upper mechanical seal (60B), seal retaining spacer (19A), seal rotating face (51C), seal spacer (52), and lower mechanical seal (60A).

TANDEM SEAL

Remove the upper mechanical seal (60B), seal retaining spacer (19A), seal rotating face (51B), lower mechanical seal (60A), seal spacer (60A) and lower shaft sleeve.

Reassembling the LMV-802

The following procedures apply to the LMV-802 process pump. Refer to the specification sheet to determine you specific pump configuration and optional equipment included. Parenthetical numbers included in the text correspond to item numbers in the parts list section.

STEP 1

Install seal spacer on the lower mechanical seal.

***Note**: Chamfer must be towards the lower seal.*

Before installing spacer inspect the seal and sealing surfaces for

- Abrasive particles on the fluid and leakage sides of the mechanical seal.
- Excessive seal face wear.
- Binding action of the seal face washer.

Replace or rebuild faulty mechanical seals. A seal may be rebuilt by replacing the following parts:

- Seal face washer.
- Wedge ring or “O” ring.
- Retaining ring.
- Springs.

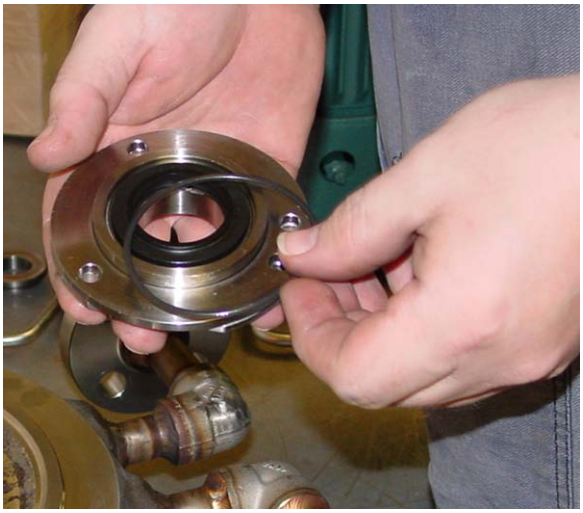
Seal repair kits are available for most seals. See specific information on seals contained in the data package that accompanied this pump.

Replace the seal rotating face if the wear track is rough or is worn to a depth greater the 0.0002 inch (0.005mm).

A combined total of 0.010 inch (0.25mm) may be removed by lapping the surfaces of the pump seal. The flatness must be maintained to within two helium bands.

STEP 2

Install the lower mechanical “O” rings.



Installing the “O” ring around the mechanical seal and over the seal spacer.

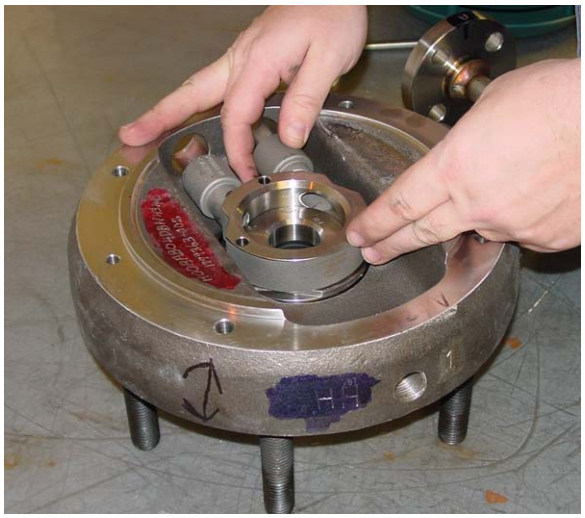
STEP 3

Install the lower seal into the seal housing.

Mechanical seal and spacer installed in bottom of the seal housing.

STEP 4

Install seal retainer spacer.



Installing the seal retainer spacer over mechanical seal and seal spacer.

STEP 5

Install the throttle bushing "O" ring onto the throttle bushing.

STEP 6

Install throttle bushing onto the seal retainer spacer.

STEP 7

Install the 3 throttle bushing hex head screws.

***Note**: Torque to 100 In.-Lbs..*

By installing these three screws all the parts installed to this point will be fastened to the seal housing.

STEP 8

Install the thermal barrier gasket onto the driver.

STEP 9

Install shaft sleeve onto the driver shaft.

STEP 10

Install the shaft sleeve “O” ring.

STEP 11

Lower the seal housing onto the driver.

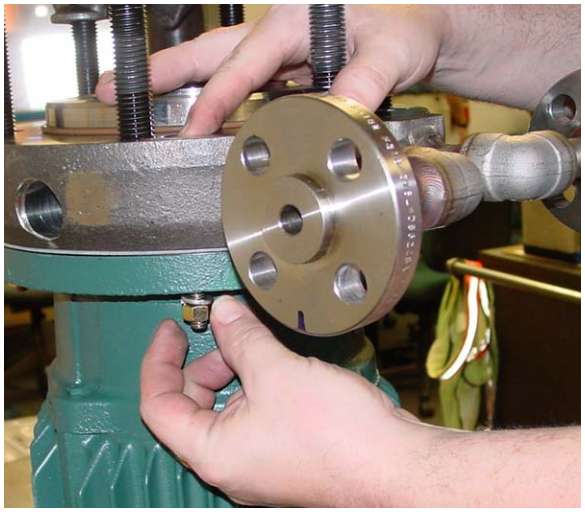
***Note**: Use hoist if possible to avoid personal injury.*

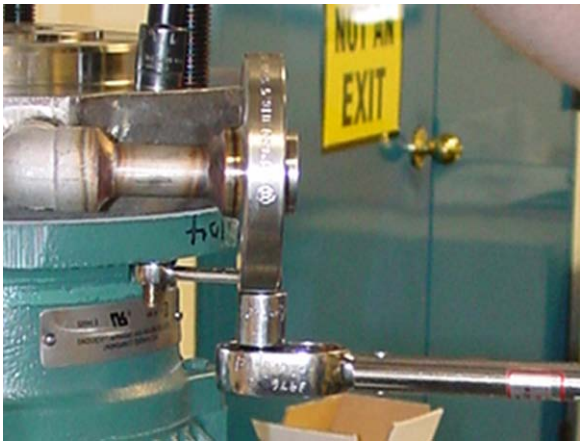
Use of a hoist also will help prevent damage to the thermal barrier gasket due to rough handling.

STEP 12

Install seal housing onto the driver using hex head bolts.

***Note**: Torque to 40 Ft.-Lbs.*





STEP 13

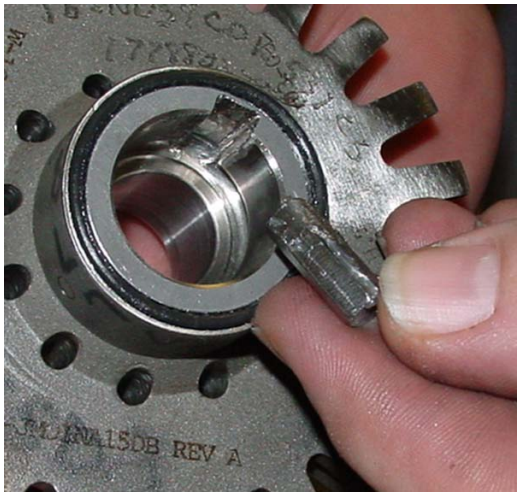
Install lower seal mating ring into the bottom of the seal housing.

STEP 14

Install the “O” ring and key into the impeller.

Sliding the “O” ring onto the impeller.

STEP 14 continued



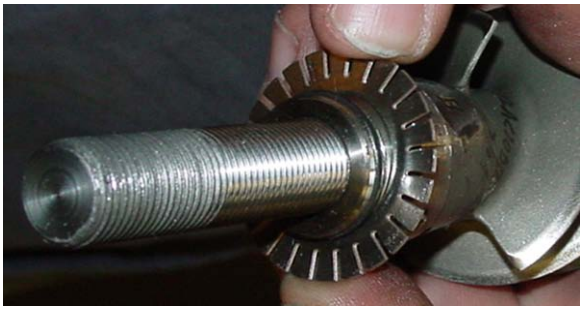
Inserting the impeller key into the impeller.

STEP 15

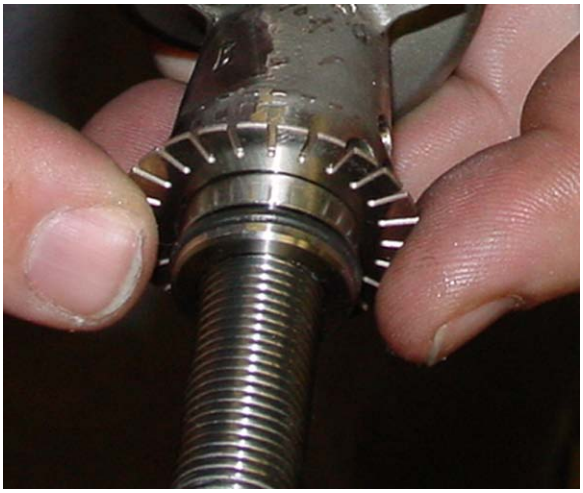
Install the impeller onto the driver shaft.

STEP 16

Install inducer tab washer and inducer "O" ring onto the inducer..



Installing the inducer tab washer.

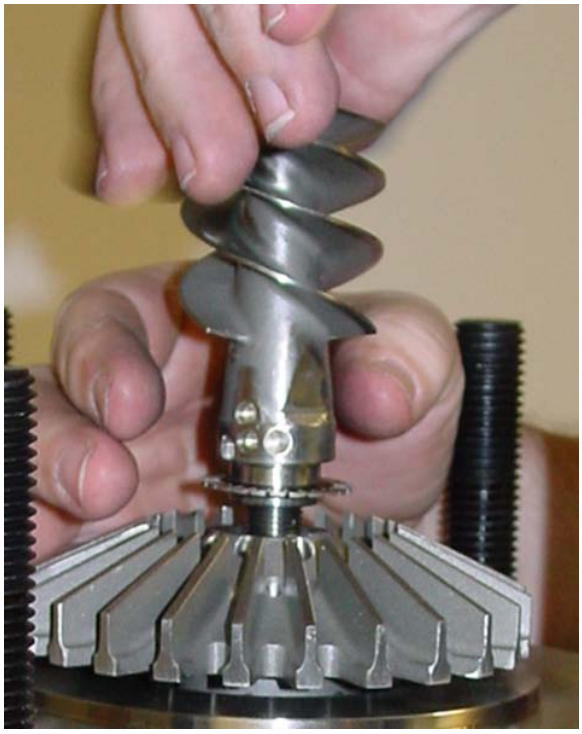


Installing the inducer "O" ring.

STEP 17

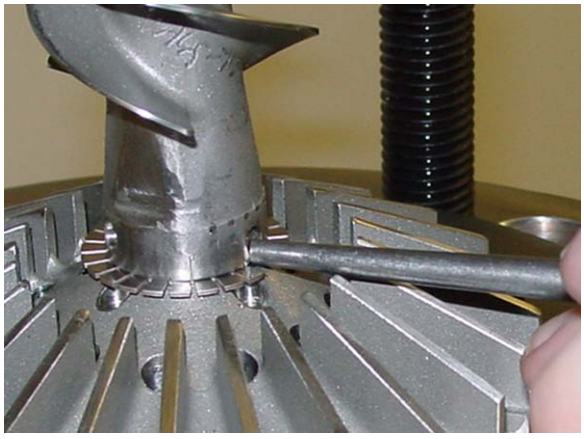
Install the inducer into the motor shaft.

***Note**: Left hand thread.*



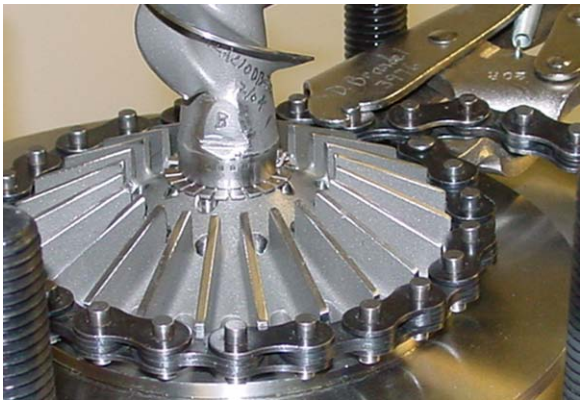
STEP 18

Punch a tab into the inducer slot.



STEP 19

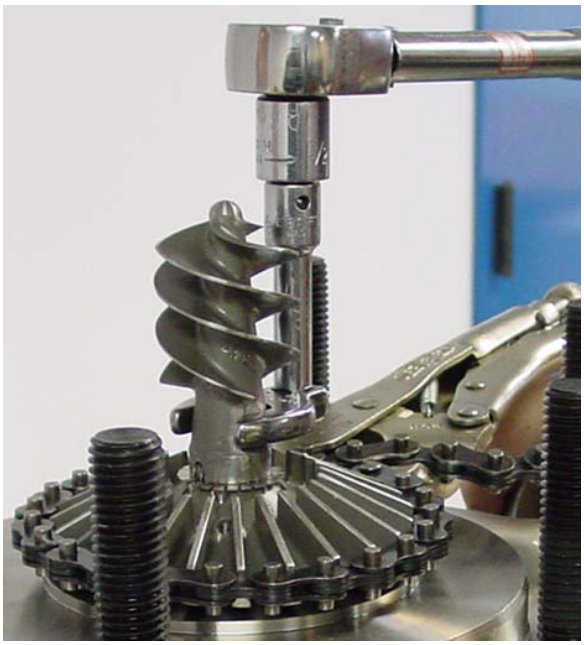
Prevent impeller from moving using a chain or strap wrench.



STEP 20

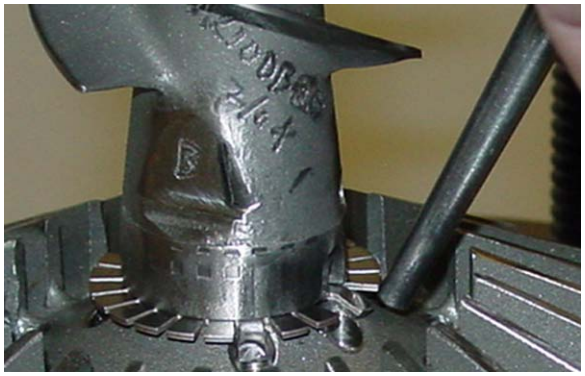
Tighten the inducer.

***Note**: Torque to 36-40 Ft.-Lbs.*



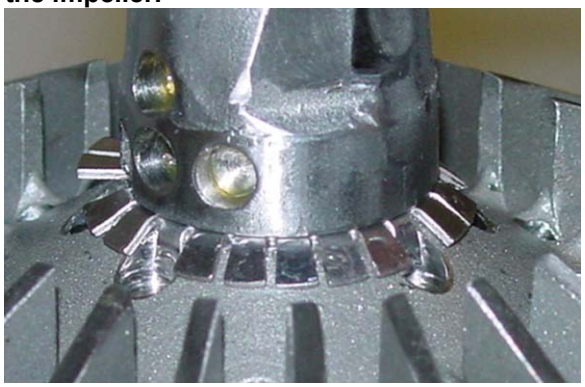
STEP 21

Bend tabs on tab washer into impeller holes.



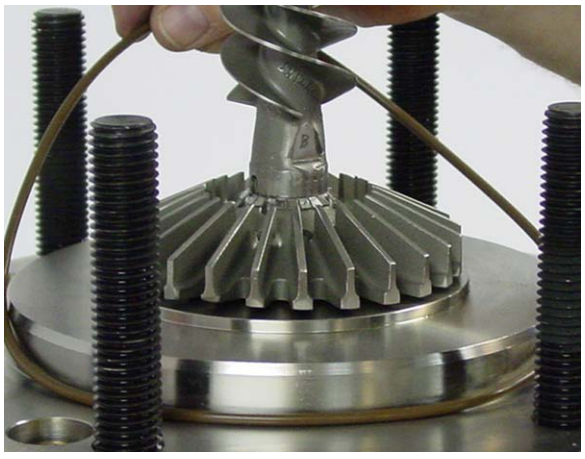
STEP 22

Flatten all the remaining tabs until flush with the impeller.



STEP 23

Install case "O" ring onto seal housing.



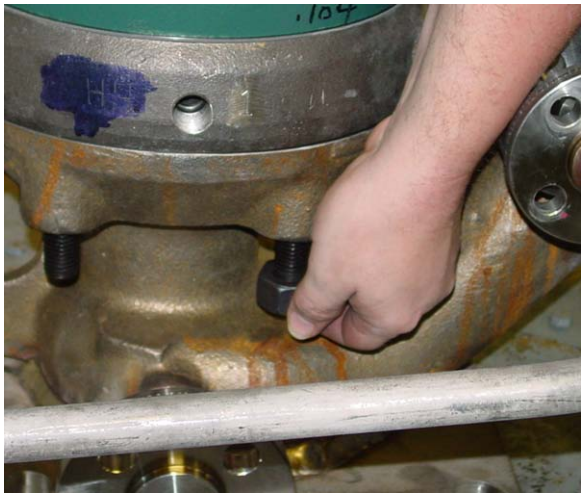
STEP 24

Lower the driver assembly onto the pump case.

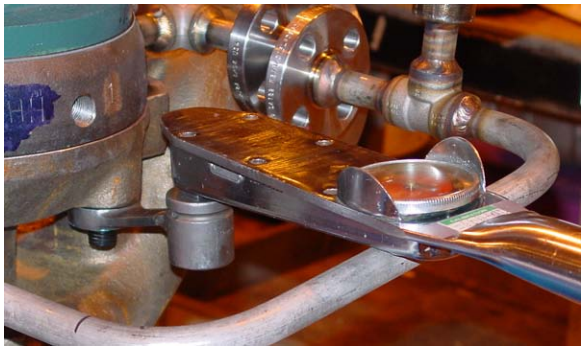
***Note**: Use hoist to prevent personal injury or possible damage to the pump.*

STEP 25

Install case nuts to fasten driver assembly to the pump casing.



***Note**: Torque to 250 Ft.-Lbs.*



TROUBLESHOOTING

Troubleshooting the Sundyne LMV-802 PUMP

Performance characteristics for this pump can be found on the Specification sheet and the performance curve. Information found in Table 1 can be useful in the analysis of pump performance problems. Procedures for repairing the pump and mechanical seals are listed in the MAINTENANCE section of this manual.

Table 1. Pump Troubleshooting

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
No flow, no pressure at startup.	Pump not completely filled with liquid.	Bleed all vapor or air from port 6. Allow more cool-down time if pumping low temperature fluid. Check suction line for air leak if suction pressure is lower than atmosphere.
	NPSH actually lower than NPSH requirement listed on specification sheet.	Suction line blocked - check suction screen and valve. Excessive pressure drop through suction piping. Flow restricted by vapor pockets in high points of suction line. Suction tank level or pressure too low. Entrained air or vapor in pumped fluid. NPSH reduced by presence of more volatile fluid in process fluid.
	Failure of driver component such as shaft or impeller key, or item missing from assembly.	Disassemble and inspect.
	Reverse direction of rotation (if pump has inducer).	Direction of driver shaft rotation must be as shown by arrow on pump casing. Note: Pump and driver rotate in the same direction.
Insufficient flow or head rise	Flow too high.	Check head rise and flow rate against performance curve. Adjust system conditions to design head-flow specified on performance curve.
	Wrong direction of driver shaft rotation. It is possible for the pump to develop greater than 50% of its design head rise in this condition.	Direction of driver shaft rotation must be as shown by arrow on pump casing. Note: Pump and driver rotate in the same direction
	NPSH actually lower than NPSH requirement listed on specification sheet	Refer to solutions listed under “No flow, no pressure at startup”.
	Flow too low, causing internal boiling or unstable pump operation.	Increase through-flow rate. Bypass part of pump discharge to supply tank Use seal cavity bypass to increase inlet flow rate.
	Diffuser discharge throat partially plugged or impeller damaged by passage of a solid particle.	Disassemble and inspect. Replace damaged parts.
	Corrosion pitting of pump casing and cover plate surfaces adjacent to impeller blades.	Clean these areas of all obstructions and restore surfaces to a smooth finish free of all corrosion pitting (use emery cloth). Edge of diffuser throat must be sharp. If damage is more severe, replace the damaged part.
	Excessive recirculation from discharge to inlet.	Check flow through external piping.
		Integral centrifugal orifice worn.

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Insufficient flow or head rise. (Continued)	Process fluid specific gravity or viscosity different from values shown on specification sheet.	Check actual viscosity and specific gravity at operating temperature. Viscosity higher than five centipoise will cause reduced head and flow and increased power consumption.
	Driver speed too low.	Check speed against value listed on specification sheet.
	Pressure gages or flow meters in error.	Calibrate instrumentation.
Driver overloaded	Fluid specific gravity or viscosity higher than values listed on specification sheet.	Check actual viscosity and specific gravity against value listed on specification sheet.
	Electrical failure in electric driver.	Check circuit breaker heater size and setting.
		Check voltage
		Current for each phase should be balanced within three percent.
	Mechanical failure in driver or pump.	Remove driver and check for freedom of rotation of driver and pump.
	Mechanical damage to diffuser throat. Material buildup or corrosion of diffuser bowl area or seal housing surface behind impeller.	Disassemble and inspect. Check diffuser bowl, throat and seal housing area behind impeller for material buildup. Clean these areas of all obstruction and restore surfaces to a smooth polished finish (use emery cloth).
	Diffuser throat eroded due to discharge cavitation resulting from excessive flow rate.	Edge of diffuser throat must be sharp. If damage is severe (i.e. impeller is deformed or more than a small amount of material removed due to contact with diffuser or seal housing) replace the damaged parts.
Excessive discharge pressure pulsations.	Flow rate too low.	Increase flow rate through pump. Add bypass to suction tank if necessary.
	Insufficient NPSH.	Refer to solution for insufficient NPSH under “No flow, no pressure at startup”.
	Defective flow control valve.	Check control valve.
	Flow rate too low for control by back pressure control valve, or too low for parallel pump operation.	Increase pressure drop between pump and control valve.
		Increase flow rate.

Pump Mechanical Seals

The following table contains troubleshooting procedures for units equipped with a single seal. The information also is applicable to single seal with throttle bushing, double and tandem seal units. Repair procedures for mechanical seals are listed in the maintenance section of this manual.

Table 2. Pump Mechanical Seals

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Sudden increase in seal leakage.	Internal boiling or instability due to pump operation below minimum flow for smooth operation, causing vibration and bouncing of seal face.	Increase flow rate.
		Provide a cool seal flush.
		Bleed vapor in seal cavity through port 6. A bypass from port 6 back to the supply tank may be required.
	Loss of suction or severe cavitation due to low NPSH, causing seal damage from lack of lubrication.	Install a double seal if loss of suction cannot be prevented.
		Correct low NPSH condition. The installation of an inducer may be required.
	Seal icing on low temperature pumps or icing when handling fluids which vaporize at a temperature of less than 32°F. at atmospheric pressure.	Inject Iso-Hexane, Methanol or Acetone (or a similar compatible fluid which will not freeze at pump temperature) above single seal drain port 2 or 7 to prevent ice formation on atmospheric side of seal during startup.
		Use single seal with throttle bushing and purge of dry nitrogen gas.
		Install double or tandem seal if ice is caused by water in process fluid, or supply external seal flush of compatible fluid which does not contain water.
	Worn or damaged seal.	Disassemble seal and rebuild or replace per instructions in maintenance section.
	Solid particles in seal cavity or seal spring area (seal faces usually have rough scratched appearance).	Inspect for clogged integral centrifugal separator orifice. Clean orifice if necessary.
		Supply external clean seal flush or double seal if particles cannot be removed by separator.
	Seal stationary face spring action is rough and sticky.	If parts are corroded, replace with parts made from compatible materials.
		If formation of solids causes sticky seal, analyze fluid properties. Use external seal flush, a double or tandem seal arrangement, or apply an inert gas purge.
	Wear pattern on seal rotating faces not uniform.	Lightly lap surfaces of shaft sleeve and impeller hub which contact rotating seal face to remove high spots. Install new seal faces.
	Wear pattern on stationary face smooth but not uniform.	Replace seal.
	Seal rotating face cracked or broken. May be caused by damage at assembly or thermal shock caused by (1) seal running dry, or (2) rotating face spinning on shaft, or (3) loss and recovery of buffer fluid	Prevent loss of pump suction or supply continuous external seal flush.

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Sudden increase in seal leakage. (Continued)	Seal rotating face cracked or broken. May be caused by damage at assembly or thermal shock caused by (1) seal running dry, or (2) rotating face spinning on shaft, or (3) loss and recovery of buffer fluid (continued)	Install double seal.
		Ensure that buffer fluid is always present during operation.
	Chemical attack of seal faces, seal parts or o-rings.	Investigate fluid properties and determine suitable materials for replacement.

SPECIFICATIONS

Table 3. Gearbox and Pump Torque Values

Gearbox ***Sundyne Standard Steel Screws & Bolts and NACE Compliant Steel Screws/Bolts (BG Material)***				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
905H	Oil Filter Manifold	3/8 - 16 x 1/2	22 - 25 ft-lbs	30 - 34 N-m
905L	Gearbox Seal	1/4 - 20 x 1/2	75 - 80 in-lbs	8.5 - 9.0 N-m
905M, N	Journal Bearings	#10 - 24 x 1	35 - 40 in-lbs	4.0 - 4.5 N-m
905T	Chemical Barrier Gasket	1/4 - 20 x 5/8	75 - 80 in-lbs	8.5 - 9.0 N-m
909B	Gearbox Halves	1/2 - 13 x4	60 - 65 ft-lbs	81 - 88 N-m
909C	Gearbox Halves, Alignment	5/8 - 18 x 4 17/64	60 - 65 ft lbs	81 - 88 N-m
906B	Sight Glass	#8 - 32 x 1/2	10 - 12 in-lbs	1.0 - 1.4 N-m
Pumps & Compressors* ***Sundyne Standard Steel Screws and Bolts***				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
3	Impeller Bolt/Inducer:			
	LMV/BMP-801, 802, 806, 322, 311, 331	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
	LMV/BMP-341, 346	1/2 - 20	65 - 70 ft-lbs	88 - 95 N-m
	LMV-313, 343, BMP-338, 348 (High Flow)	3/4 - 10	85 - 90 ft-lbs	115-122 N-m
	LMC/BMC 3X1P, 3X1F, 3X3, 3X6P, 3X7	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
906D	Diffuser Attaching Screws	1/4 - 20	95 - 102 in-lbs	11 - 11.5 N-m
905E	Mechanical Seal No. Spacer	1/4 - 20 x 12	95 - 102 in-lbs	11 - 11.5 N-m
905F	Throttle Bushing/Mechanical Seal	1/4 - 20 x 12	95- 102 in-lbs	11 - 11.5 N-m
905G	Double Seal with Spacer	1/4 - 20 x 3/4	95 - 102 in-lbs	11 - 11.5 N-m
914A	Case Nuts	3/4 - 10	250 - 275 ft-lbs	340 - 375 N-m
914A	Case Nuts	7/8 - 9	300 - 330 ft-lbs	405 - 445 N-m
905A	Seal Housing to Gearbox	3/8 - 16 x 1 3/4	35 - 40 ft-lbs	47 - 54 N-m
905P	Separator	1/4 - 20 x 5/8	95 - 102 in-lbs	11 - 11.5 N-m
Pumps & Compressors ***NACE Compliant Steel Screws / Bolts (BG Material)***				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
3	Impeller Bolt/Inducer:			
	LMV/BMP-801, 802, 806, 322, 311, 331	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
	LMV/BMP-341, 346	1/2 - 20	65 - 70 ft-lbs	88 - 95 N-m
	LMV-313, 343, BMP-338, 348 (High Flow)	3/4 - 10	85- 90 ft-lbs	115 - 122 N-m
	LMC/BMC 3X1P, 3X1F, 3X3, 3X6P, 3X7	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
906D	Diffuser Attaching Screws	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905E	Mechanical Seal No. Spacer	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905F	Throttle Bushing/Mechanical Seal	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905G	Double Seal with Spacer	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
914A	Case Nuts	3/4 - 10	160 - 200 ft-lbs	217 - 270 N-m
914A	Case Nuts	7/8 - 9	225 - 245 ft-lbs	305 - 332 N-m
905A	Seal Housing to Gearbox	3/8 - 16 x 1 3/4	27 - 30 ft-lbs	37 - 40 N-m
905P	Separator	1/4 - 20 x 5/8	70 - 75 in-lbs	8.0 - 8.5 N-m

* When using Teflon® o-rings, allow 15 minutes between torquing for the Teflon® to cold flow. Repeat torquing until there is no change in torque.

Pump Spare Parts List

Figure 5. Pump Cross Section

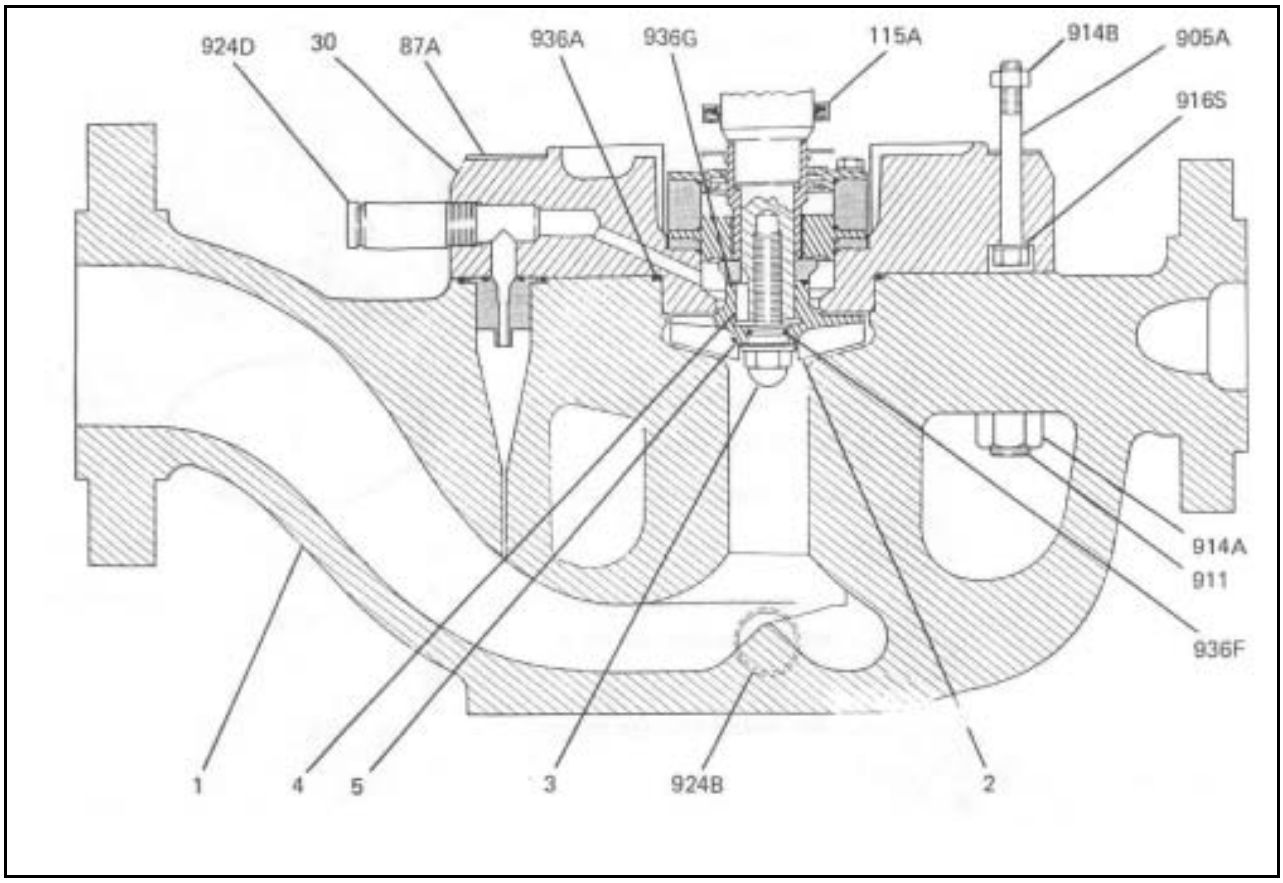
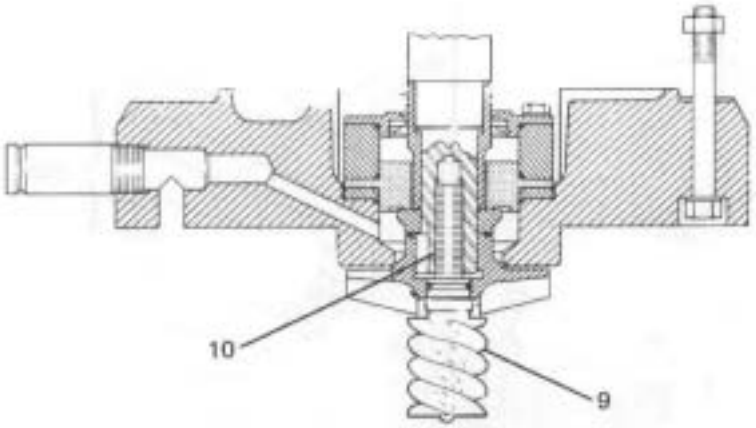


Table 4. Pump Spare Parts List

ITEM NO.	PART NAME	QTY	ITEM NO.	PART NAME	QTY
1	Pump Casing	1	911	Stud	6
2	Impeller	1	914A	Nut	6
3	Impeller Bolt	1*	914B	Nut	4
4	Impeller Key	1*	916S	Washer	4
5	Impeller Tab Washer	1*	924B	Bull Plug	2
30	Seal Housing	1	924D	Bull Plug	1
87A	Gasket	1	936A	O-Ring Packing	1*
115A	Shaft Seal (Driver)	1*	936F	O-Ring Packing	1*
905A	Hex Head Cap Screw	4	936G	O-Ring Packing	1*
*Recommended Spare Parts					

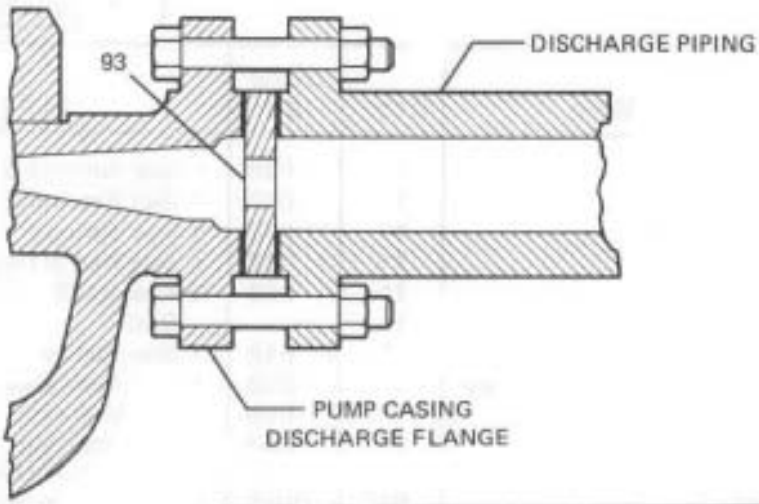
Inducer and Stud

Figure 6. Inducer and Inducer Stud



ITEM NO.	PART NAME	QTY.
9	Inducer	1
10	Inducer Stud	1

Figure 7. Discharge Orifice



NOTE: The failure to install this orifice will alter the pump's curve shape and could result in it,s operation at a higher than intended flow rate.

ITEM NO.	PART NAME	QTY.
93	Discharge Orifice	1

Figure 8. Centrifugal Separator

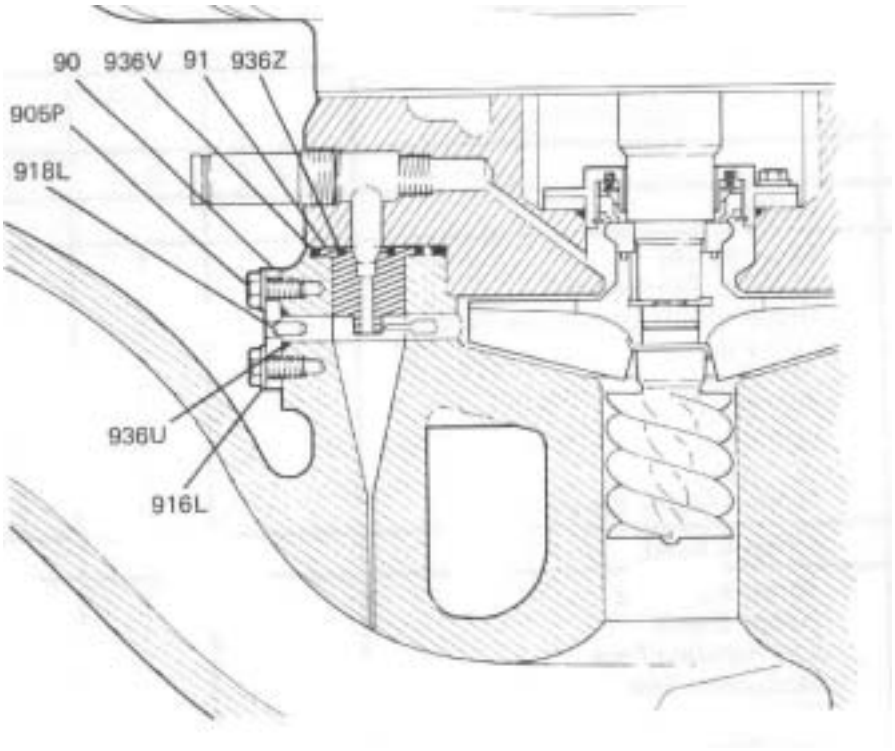


Table 5. Centrifugal Separator Parts List

ITEM NO.	PART NAME	QTY
90	Separator Orifice	1
91	Separator Fitting	1
905P	Hex Head Cap Screw	2
916L	Washer	2
918L	Pin (Alignment)	1
936U	“O” Ring Packing	1*
936Z	“O” Ring Packing	1*
*Recommended Spare Parts		

Table 6. Recommended Pump and Seal Spare Parts List

ITEM NO.	PAGE NO.	DESCRIPTION	CLASS 1 QTY	CLASS 2 QTY	CLASS 3 QTY
		PUMP			
4		Impeller Key	1	1	1
5		Impeller Tab Washer	1	1	2
3 (or 10)		Impeller Bolt (or Inducer Stud)		1	1
936A		O-Ring	1	2	2
936F		O-Ring	1	2	2
936G		O-Ring	1	2	2
936V		O-Ring	1	2	2
936Z		O-Ring	1	2	2
87A		Thermal Barrier Gasket	1	2	2
		SINGLE SEAL			
21B		Throttle Bushing		1	1
50		Slinger Sleeve		1	1
51A		Seal Rotating Face	1	1	2
60A		Mechanical Seal	1	1	2
936H		O-Ring	4	8	8
936J		O-Ring	1	2	2
		DOUBLE SEAL			
50A		Shaft Sleeve (Lower)		1	1
50B		Shaft Sleeve (Upper)		1	1
51C		Seal Rotating Face	1	1	2
60A		Mechanical Seal (Lower)	1	1	2
60B		Mechanical Seal (Upper)	1	1	2
936H		O-Ring	4	8	8
936J		O-Ring	2	4	4
		TANDEM SEALS			
50A		Shaft Sleeve (Lower)		1	1
50B		Shaft Sleeve (Upper)		1	1
51A		Seal Rotating Face	1	1	2
60A		Mechanical Seal (Lower)	1	1	2
60B		Mechanical Seal (Upper)	1	1	2
60B		Mechanical Seal (Upper Gas)	1	1	2
51B		Seal Rotating Face	1	1	2
936H		O-Ring	4	8	8
936J		O-Ring	3	6	6

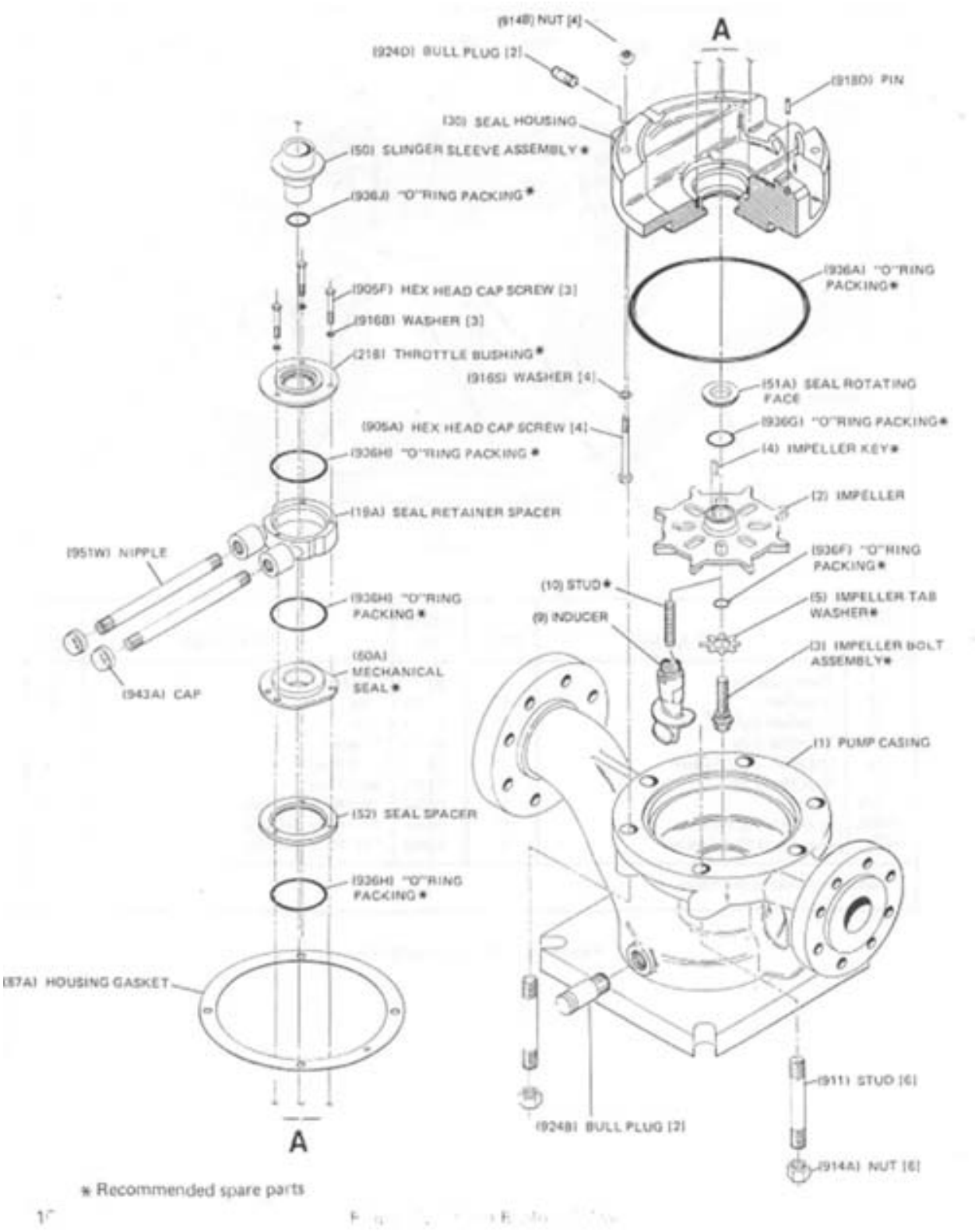
***Note**: Seal repair kits for standard seals are available. O-Rings for standard units are available as a package O-Ring Kit. Each kit includes all the above O-Rings.*

Class 1: Minimum recommended spare parts necessary to perform a startup, and inspection of a new unit.

Class 2: Minimum recommended spare parts necessary to cover 1-2 years of normal operation.

Class 3: Minimum recommended spare parts stock necessary for critical services or units that will be installed in remote locations.

Pump Exploded View



Single Seal Arrangement

Figure 9. Single Seal Arrangement

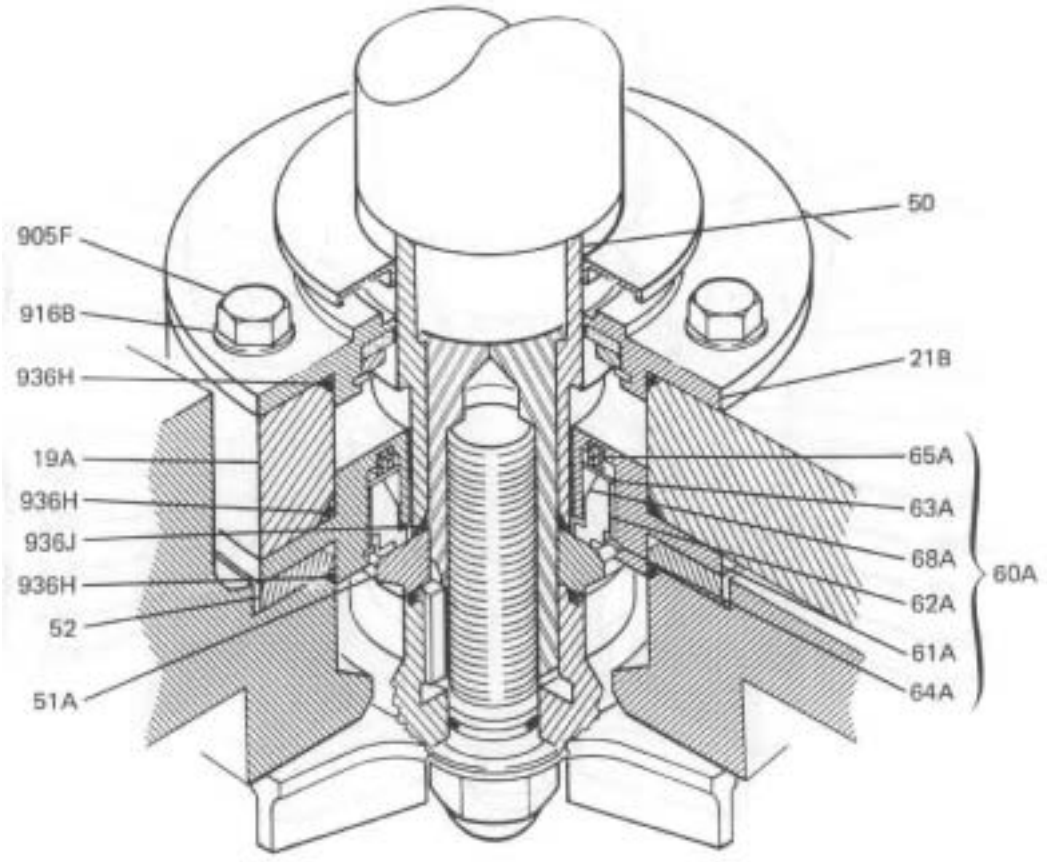


Table 7. Single Seal Arrangement

Item No.	PART NAME	QTY	ITEM NO.	PART NAME	QTY
19A	Seal retaining spacer	1	63A	-Seal Spring Back Up Disc	1**
21B	Throttle Bushing	1	64A	-Seal Retaining Ring	1**
50	Slinger Sleeve	1*	65A	-Seal Spring	6**
51A	Seal Rotating Face	1*	68A	-Seal Wedge Ring	1**
52	Seal Spacer	1	905F	Hex Head Cap Screw	3
60A	Mechanical Seal	1*	916B	Washer	3
61A	-Retainer and Drive Sleeve Assembly	1	936H	“O” Ring Packing	4*
62A	-Seal Face Washer	1**	936J	“O” Ring Packing	1*

*Recommended Spare Parts
**Recommended Seal Spare Component Parts

Double Seal Arrangement

Figure 10. Double Seal Arrangement

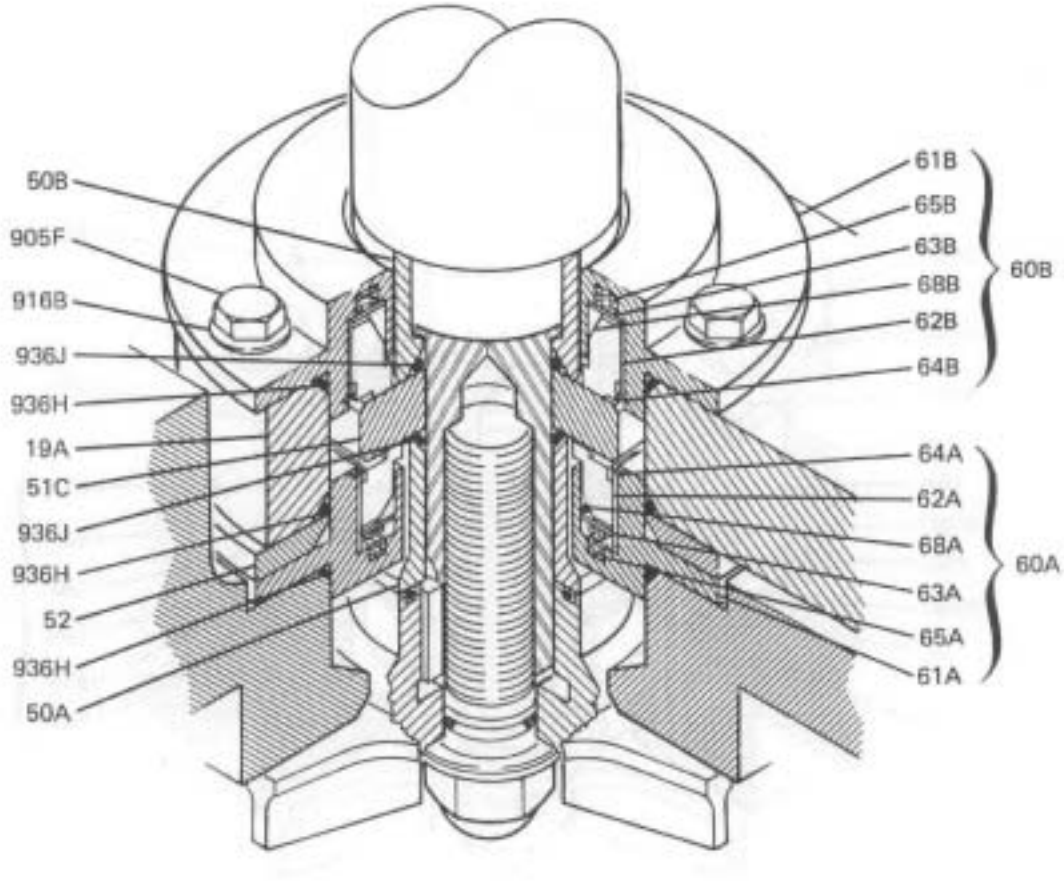


Table 8. Double Seal Arrangement

ITEM NO.	PART NAME	QTY	ITEM NO.	Part Name	QTY
19A	Seal Retaining Spacer	1	60B	Mechanical Seal (Upper)	1*
50A	Shaft Sleeve (Lower)	1*	61B	-Retainer & Drive Sleeve Assembly	1
50B	Shaft Sleeve (Upper)	1*	62B	-Seal Face Washer	1**
51C	Seal Rotating Face	1*	63B	-Seal Spring Back Up Disc	1**
52	Seal Spacer	1	64B	-Seal Retaining Ring	1**
60A	Mechanical Seal (Lower)	1*	65B	-Seal Spring	6**
61A	-Retainer & Drive Sleeve Assembly	1	68B	-Seal Wedge Ring	1**
62A	-Seal Face Washer	1**	905F	Hex Head Cap Screw	3
63A	-Seal Spring Back Up Disc	1**	916B	Washer	3
64A	-Seal Retaining Ring	1**	936H	“O” Ring Packing	4*
65A	-Seal Spring	6**	936J	“O” Ring Packing	2*
68A	_Seal Wedge Ring	1**			

* Recommended Spare Parts
** Recommended Seal Spare Component Parts

Tandem Seal Arrangement

Figure 11. Tandem Seal Arrangement

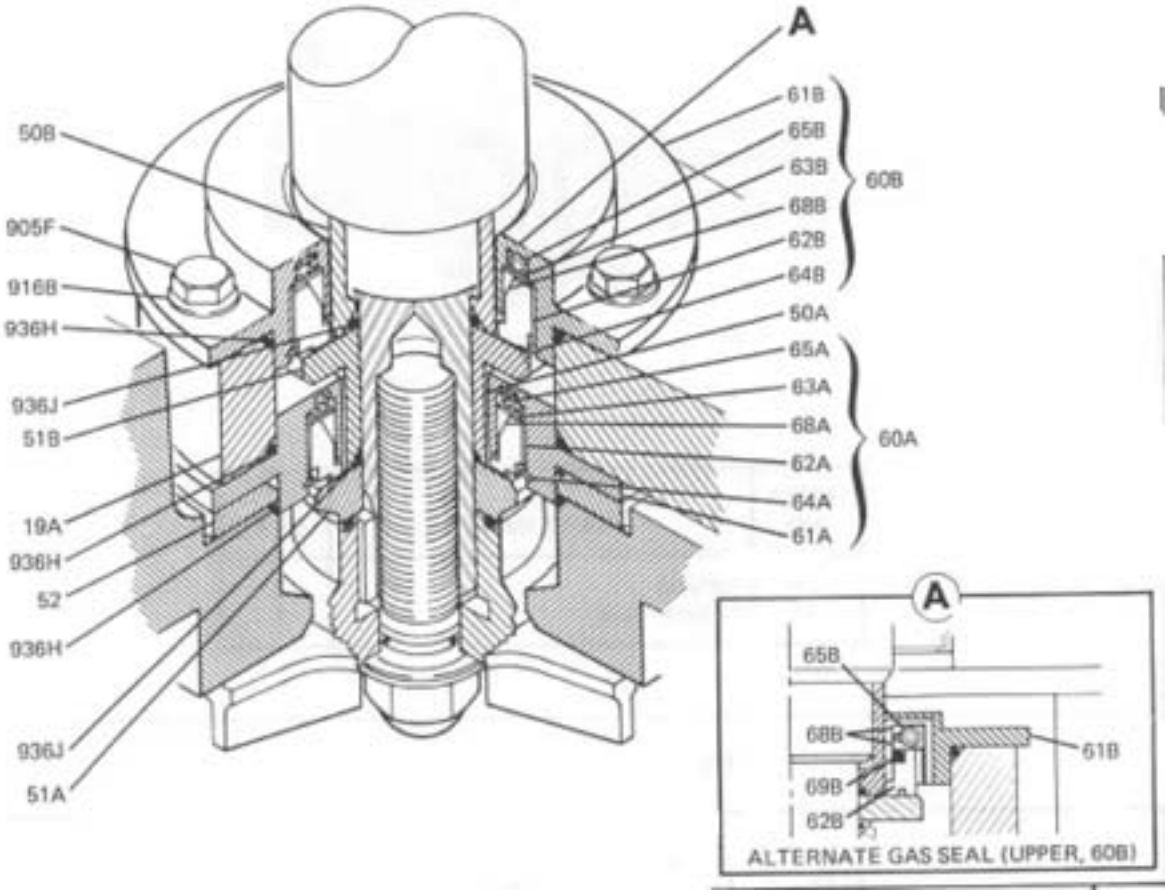


Table 9. Tandem Seal Arrangement

ITEM NO.	PART NAME	QTY	ITEM NO.	PART NAME	QTY
19A	Seal Retaining Spacer	1	63B	-Seal Spring Back Up Disc	1**
50A	Shaft Sleeve (Lower)	1	64B	-Seal Retaining Ring	1**
50B	Shaft Sleeve (Upper)	1	65B	-Seal Spring	6**
51A	Seal Rotating Face	1*	68B	-Seal Wedge Ring	1**
51B	Seal Rotating Face	1*	60B	Mechanical Seal (Upper Alternate Gas)	1*
52	Seal Spacer	1	61B	-Seal Retainer	1**
60A	Mechanical Seal (Lower)	1*	62B	-Seal Face Washer	1**
61A	-Retaining and Drive Sleeve Assembly	1	65B	-Garter Spring	1**
62A	-Seal Face Washer	1**	68B	-Backing Ring	2**
63A	-Seal Spring Backup Disc	1**	69B	“O” Ring Packing or Tec Seal	1**
64A	-Seal Retaining Ring	1**	905F	Hex Head Cap Screw	3
65A	-Seal Spring	6**	916B	Washer	3
68A	-Seal Wedge Ring	1**	936H	“O” Ring Packing	4*
60B	Mechanical Seal (Upper)	1*	936J	“O” Ring Packing	3*
61B	-Retainer and Drive Sleeve Assembly	1**			
62B	-Seal Face Washer	1**			

*Recommended Spare Parts
**Recommended Seal Spare Component Parts

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