SUNDYNE
LMV-806 PUMPS

Instruction and Operation Manual

August 2007

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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.

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INTRODUCTION & SAFETY

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

Note: *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.*

CAUTION

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.

CAUTION

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

CAUTION

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.

CAUTION

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.

CAUTION

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.

CAUTION

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.

CAUTION

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 is required when working on equipment located six feet or higher from the ground.

CAUTION

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

Preventative Machine Guards

Preventative guards must remain in place on all equipment.

CAUTION

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

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

CAUTION

EXPLOSION/FIRE HAZARD

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.

CAUTION

INTRODUCTION

This manual presents installation, servicing, troubleshooting, maintenance and spare parts information for the Sundyne Model LMV-806 centrifugal pump.

If the pump has a bearing box and coupling option, the instructions for these are in a separate manual.

Parenthetical numbers included in the text correspond to item numbers of the illustrated figures. The item number of a part is based on the part's function and the correct spare part can be ordered for any generation pump even if the component parts do not appear the same as presented in this revision of the instruction manual.

Information that may be required regarding performance, alterations, or detailed technical data which is not included herein may be found in the specification sheet and parts list accompanying the unit, or may be obtained from your Sundyne representative.

Custom-made auxiliary equipment cannot be shown in this manual. Refer to the outline drawing for specifics.

WARNING

The pump should not be operated, or maintenance performed, without a thorough understanding of the contents of this manual.

INSTALLATION

1. INSPECTION

Care should be taken when uncrating the pump. If the shipment is not delivered in good order and in accordance with the bill of lading, note the damage or shortage on both the receipt and freight bill. Make any claims to the transportation company immediately.

2. STORAGE

If the equipment is not to be installed immediately, it should be stored in a clean, dry area. Care should be taken to protect from exposure to moisture and dust. Shipping covers installed at the factory for casing flanges and seal ports must be kept securely in place. Storage instructions provided by the driver (motor or turbine) manufacturer should be observed.

If provisions for long term storage (periods in excess of six months) are required and have not been made prior to shipment of the unit, contact your Sundyne representative for recommendations on storage procedures.

3. SUCTION AND DISCHARGE PIPING

A. All piping must be supported independently of the pump. The piping should always line up with the pump flanges. Never draw the piping into place by the use of force at the flanged suction and discharge connections as this may impose dangerous strains on the unit.

B. The piping, both suction and discharge, should be as short and direct as possible. Avoid all unnecessary elbows, bends, and fittings as they increase friction losses in the piping. The size of the pipe and fittings should be selected carefully and be of sufficient size to keep the friction losses as low as practical.

C. If the pump is supported by the base, piping must not be connected to the pump until after pump hold-down bolts have been tightened.

D. The use of elbows near the suction flange should be avoided. When used, elbows should be long radius. A straight pipe run of at least two times the pipe diameter is desirable between an elbow and the suction flange.

E. Suction pipe should never be of smaller diameter than the pump suction inlet. Reducers, if used, should be eccentric and preferably slope up to the pump to avoid creating air pockets in the piping.

F. If reverse flow during shutdown is likely, it is recommended that a check valve be installed in the discharge line to protect the pump from possible reverse rotation.

4. SEAL ENVIRONMENTAL CONTROL SYSTEM

Depending upon the pump seal arrangement and application, a seal environmental control system may be required. The pump seal environment must always be maintained as specified on the specification sheet which accompanies each unit delivery. For many applications a standard kit can be supplied from the factory. Insure that the seal environmental control system specified is properly installed and that ports (refer to Figure 1) are open or plugged as shown.

WARNING

PORT #1 MUST ALWAYS BE OPEN TO A DRAIN.

5. STARTING

Perform the following tasks to start the Sundyne pump:

CAUTION

If 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.

A. Check to affirm that the driver has been serviced per instructions provided by the driver manufacturer.

B. Open the suction valve completely; open the discharge valve about half way.

C. Check for correct shaft rotation. Rotation of the driver must be in the same direction as the arrow on the pump casing.

D. Start the driver. Adjust the discharge control valve to the desired flow and check head and horsepower against requirements on the pump specification sheet.

6. OPERATION

While the application of the pump in any particular system is not within the scope of this instruction manual, the importance of proper application to successful pump operation cannot be ignored. Several factors must always be considered and the experienced operator will be aware of the effects.

7. NPSH - (Net Positive Suction Head and Cavitation)

It is recommended as a safety margin 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 result eventually 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.

8. RECIRCULATION

Centrifugal pumps can experience vibrations from internal flow separations and recirculation at low flow conditions. The operator should be aware of the minimum flow recommendations of the manufacturer. While a pump can operate with some cavitation noise due to recirculation without harm to the pump, 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, especially when a control valve is located well downstream from the pump.

9. PREVENTION

To prevent the pump from operating at points where damage may be sustained from recirculation or cavitation, it is essential that the pump be selected to mate properly with the system head curve. Once properly selected it is essential that it is properly controlled. If variable flows are to be experienced, the Sundyne pump should be controlled by flow control, not pressure control. The relatively flat head capacity curve of Sundyne pumps makes pressure control a very difficult and exacting practice, whereas flow control can be quite precise and effective.

10. TEMPERATURE RISE

If the pump is not operated below minimum flow recommendations, temperature rise within the pump is unlikely to be a problem. However, if operation at low flows becomes mandatory or if the system causes the pump discharge line to be blocked for any period of time, a means of maintaining a minimum flow must be provided. This can be by either a continuous bypass or by a flow controlled bypass. The amount of bypass necessary to prevent boiling liquid in the pump case and at the seal faces can be calculated. Refer to the manufacturer for information if necessary .

11. SUCTION AND DISCHARGE GAGES

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 no way to determine accurately where on its curve the pump is operating.

SERVICING

For long, efficient and trouble-free service, the following items should be serviced at the recommended intervals indicated below. See figure 2.

1. SEAL DRAIN LEAKAGE

Seal drain leakage should be checked after the first 24 hours of operation and each week thereafter. Seals should be replaced if leakage suddenly increases beyond acceptable limits.

2. DRIVER

The driver should receive periodic servicing as recommended by the driver manufacturer.

NOTE

Refer to Instruction Manual for Bearing Box if pump is equipped with option.

3. SERVICING

Directions for Bearing Box and Coupling Information are in the Bearing Box Manual.

PORT	DESCRIPTION
1	SEAL DRAIN (ALWAYS OPEN)
2	SEAL DRAIN (SINGLE SEAL) OR BUFFER FLUID IN (DOUBLE OR TANDEM SEAL)
5	SEAL FLUSH
6	SEAL DRAIN (SINGLE SEAL) OR
7	BUFFER FLUID OUT (DOUBLE OR TANDEM SEAL)

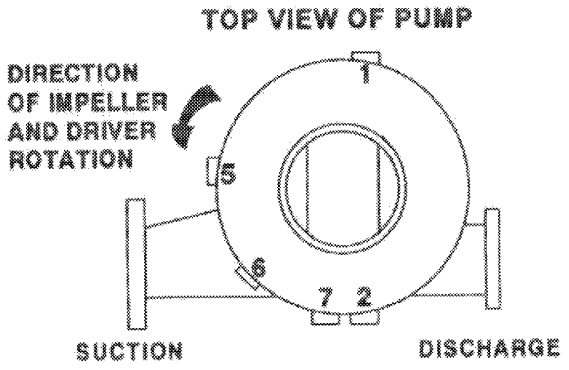


Figure 1. Seal Port Identification

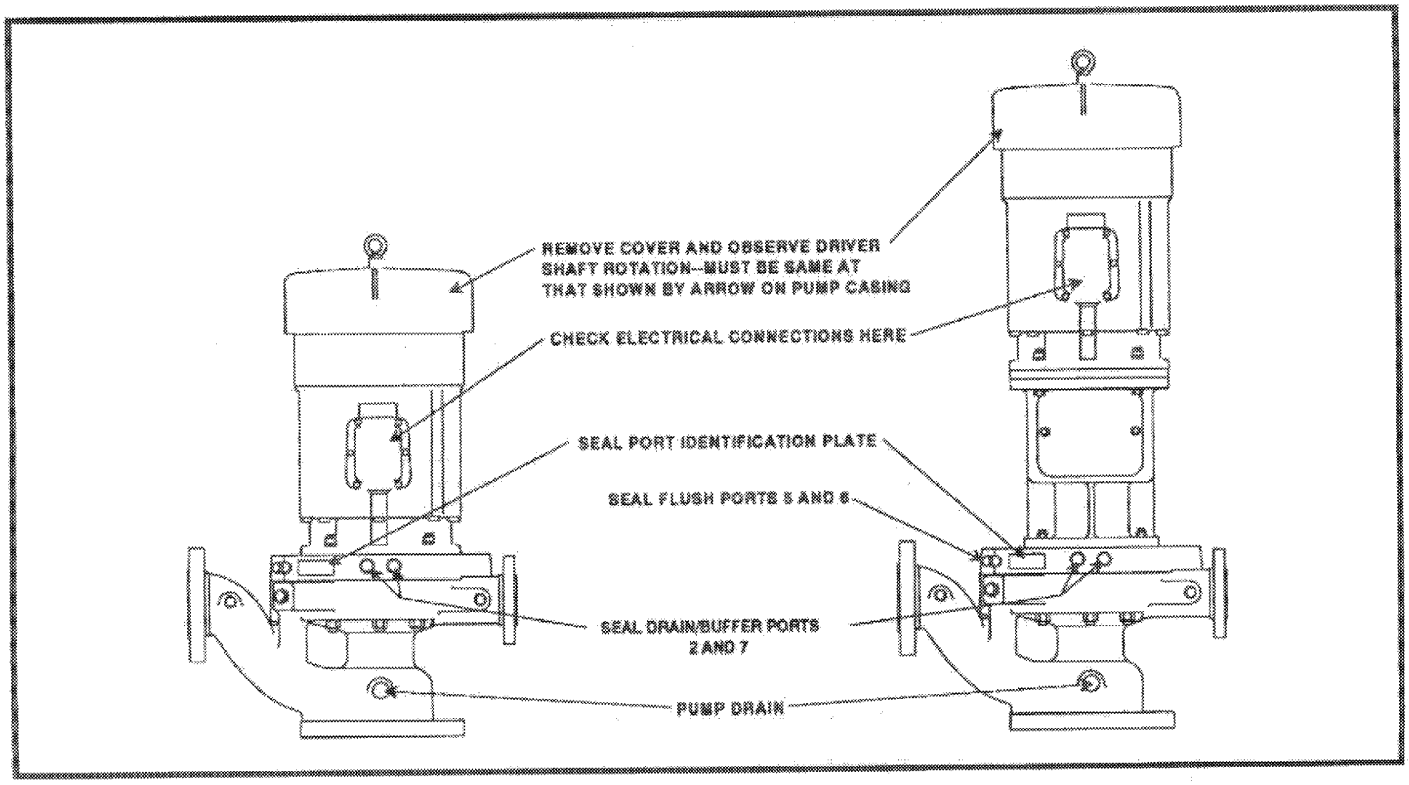


Figure 2. Service Check Points

TROUBLESHOOTING

1. PUMP

Pump performance characteristics are shown on the specification sheet and performance curve. Table 1 presents information which is useful in the analysis of pump performance problems. Repair procedures for the pump and mechanical seals are listed in the MAINTENANCE section of this manual.

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.
	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".

Table 1. Pump Troubleshooting

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Insufficient flow or head rise. (Continued)	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 separator orifice worn.
	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 centipoises 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 flowmeters 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.

Table 1. Pump Troubleshooting (Continued)

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Driver overloaded (Continued)	Mechanical damage to diffuser throat. Material build-up 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 build-up or surface degadation. Clean these areas of all obstruction and restore surfaces to a smooth polished finish (use emery cloth or machined skin cuts).
	Diffuser throat eroded due to discharge cavitation resulting from excessive flow rate.	Edge of diffuser throat must be sharp. If damage is more 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.

Table 1. Pump Troubleshooting (Continued)

2. PUMP MECHANICAL SEALS

Table 2 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.

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.

Table 2. Mechanical Seal Troubleshooting

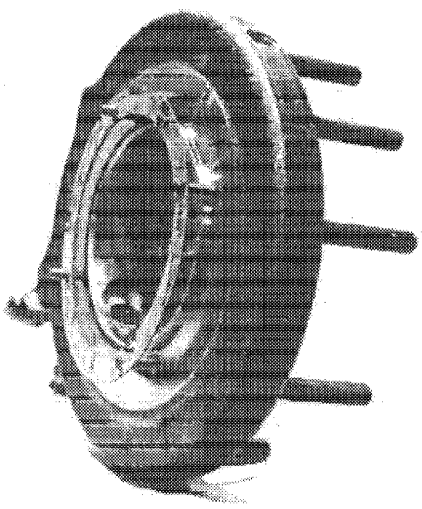
TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Sudden increase in seal leakage. (Continued)	Loss of suction or severe cavitation due to low NPSH causing seal damage from lack of lubrication.	Install a double seal if loss of suction cannot be prevented.
		Correct low NPSH condition. The installation 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.
		Install double seal.
		Insure buffer fluid always present during operation.
	Chemical attack of seal faces, seal parts or "O"rings.	Investigate fluid properties and determine suitable materials for replacement.

Table 2. Mechanical Seal Troubleshooting (Continued)

MAINTENANCE

The following procedures apply to all configurations of the Sundyne LMV-806 process pump. Refer to the 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 included in the text correspond to item numbers in the parts list section.

1 . Procedure for Assembling a LMV-806 Pump



STEP 1

Position the thermal barrier gasket (87A), on the seal housing.

NOTE:

The gasket thickness is critical in establishing the proper seal stack-up.

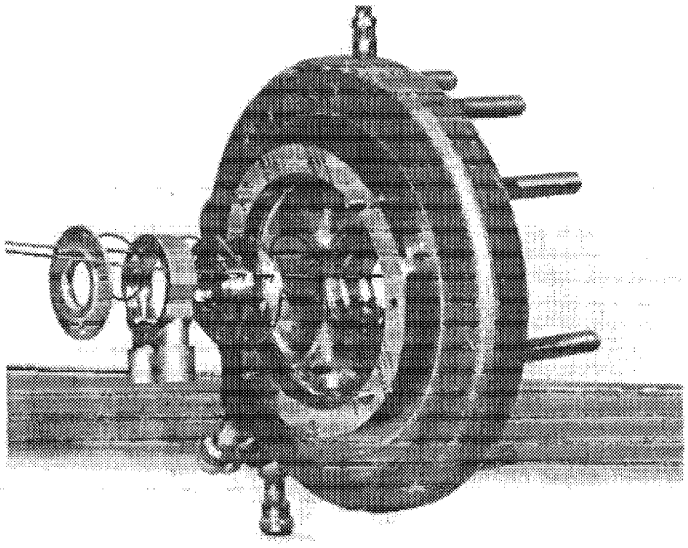
STEP 2

Install gasket (87 A)

Caution: observe correct thickness of gasket 87 A (1/16" or 1.5mm) in order to maintain normal impeller clearances.

1 - single seal:
Install respectively o-ring (936 H), seal spacer (52), mechanical seal (60 A), o-ring (936 H), seal retainer spacer (19 A), o-ring (936 H), and throttle bushing(21 B) in seal housing (30).

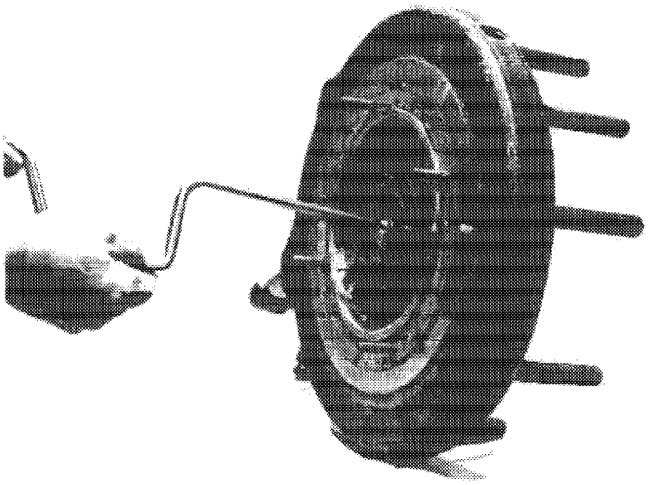
2 - double seal:
Install respectively o-ring (936 H), mechanical seal (60 A), seal spacer (52), o-ring (936 H), seal retainer spacer (19 A), seal rotating face (51C), o-ring (936 H), and mechanical seal (60 B) in seal housing (30).



3 - tandem seal:
Install respectively o-ring (936H), seal spacer (52), mechanical seal (60A), o-ring (936H), seal retainer spacer (19A), seal rotating face (51B), o-ring (936H) and mechanical seal (60B) in seal housing (30).

NOTE:

Picture refers to a single seal with throttle bushing.



STEP 3

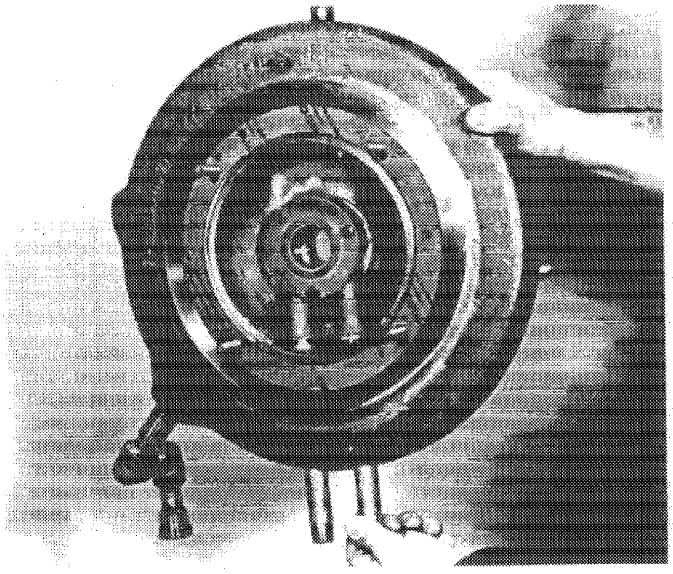
Tighten the hex head cap screws (905 F) to the correct torque as given in table 3 on page 14.

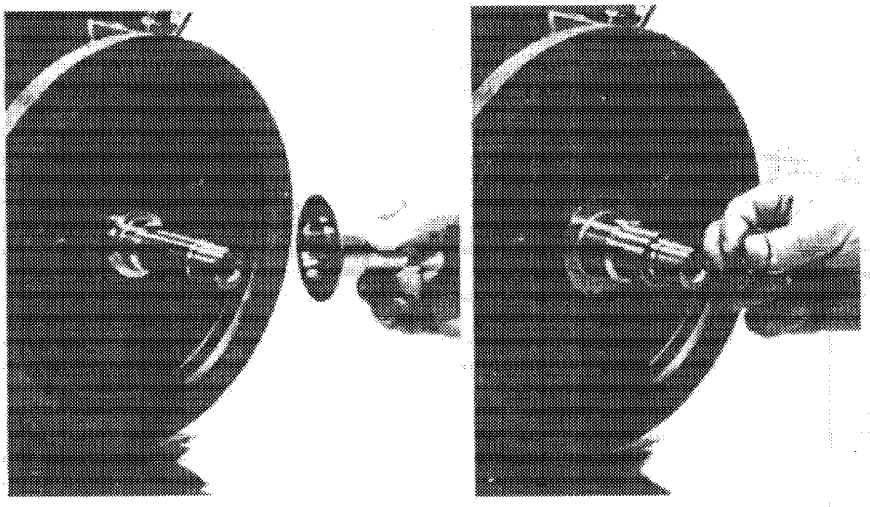
STEP 4

Install the two nipples (951W)

NOTE

For units with a bearing housing, refer to assembly procedure on page 25 for oil lubricated bearings, or page 31 for grease packed bearings before proceeding.





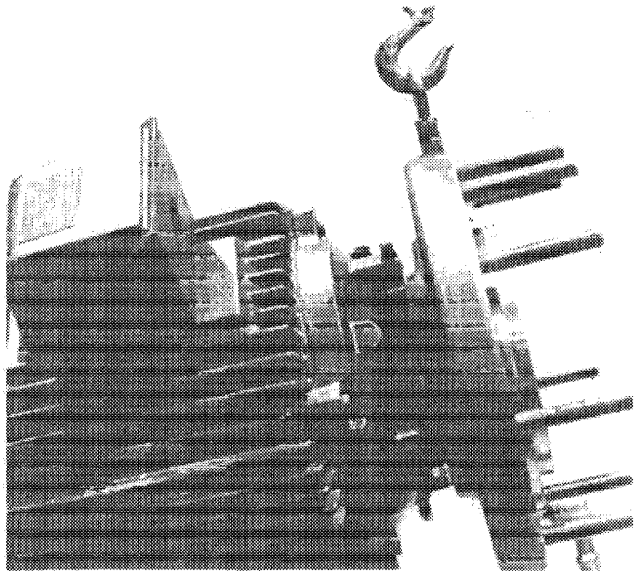
STEP 5

1 - single seal:
Install shaft sleeve (50) on the drive shaft.

2 - double and tandem seals:
Install shaft sleeve (50 B) and o-ring (936 J) on the drive shaft

Note

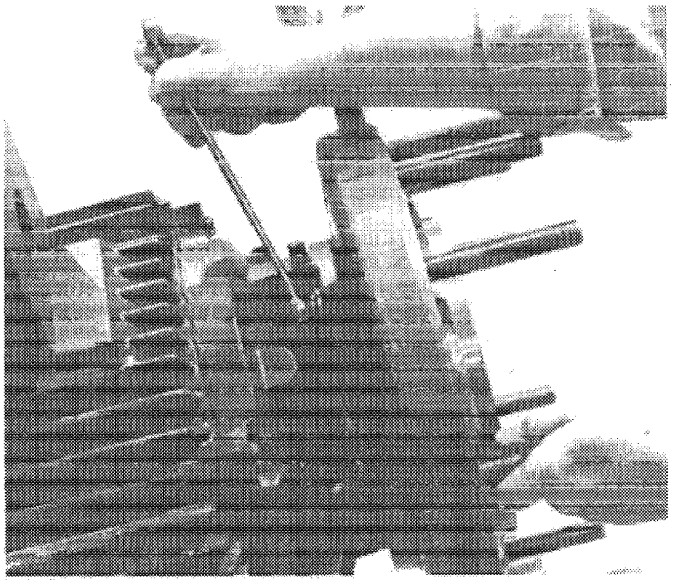
Drive shaft is motor shaft for direct drives, or the drive shaft (503) for the units with bearing housing.

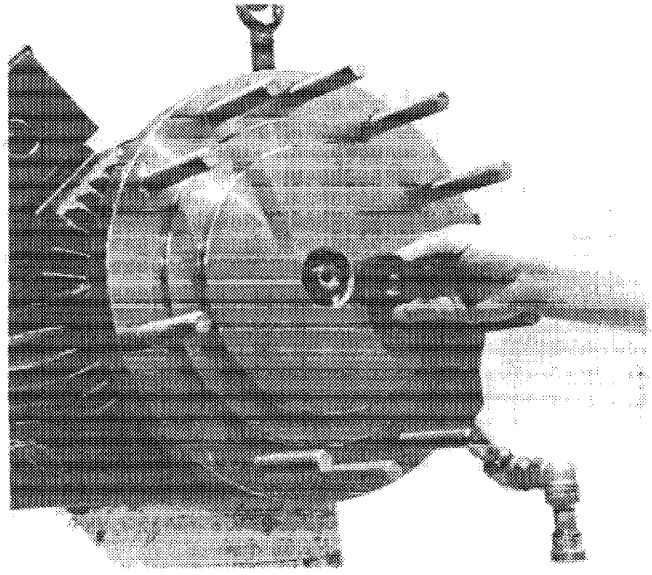


STEP 6

Position the seal housing (30) in front of the drive shaft. . .

and tighten the nuts to the specified torque value in table 3 page 14.



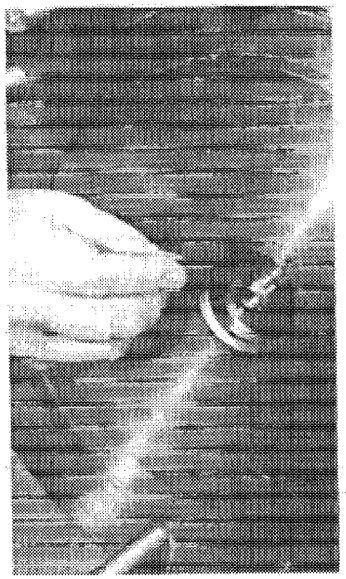


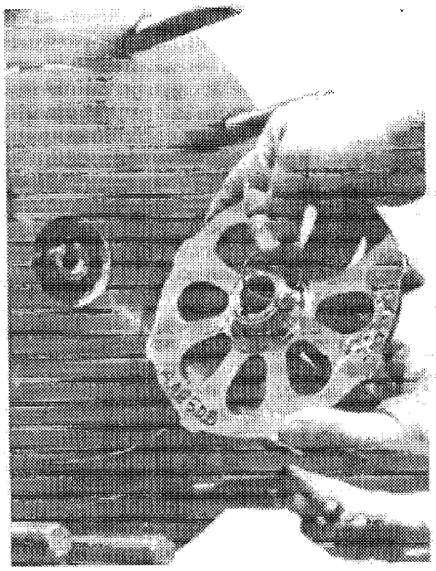
STEP 7

1 - single seal:
Install o-ring (936J) and seal rotating face (51A) on the drive shaft.

2 - double seal:
Install o-ring (936J) and lower shaft sleeve (50A) on the drive shaft

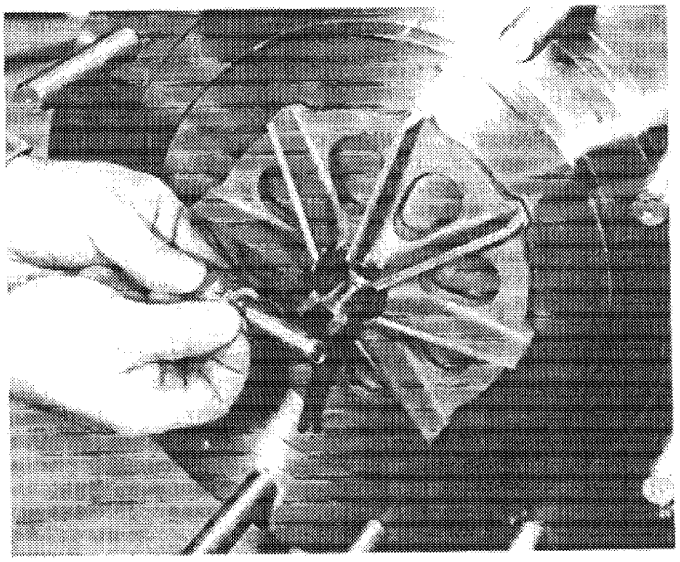
3 - tandem seal:
Install o-ring (936J), rotating face (51B), o-ring (936J), upper shaft sleeve (50A), O-ring (936J) and seal rotating face (51A) on the drive shaft.





STEP 8

Install impeller key (4) and impeller (2), with o-ring (936G), on the drive shaft.

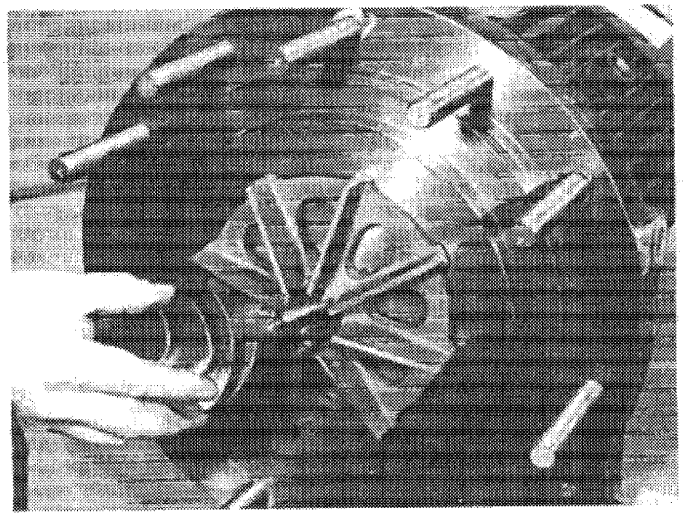


STEP 9

Only for units with impeller bolt (**no inducer**) install the impeller tab washer(5) and o-ring (936F) on the impeller bolt assembly (3) and screw the stud into the shaft.

Caution

Impeller bolt has a left hand thread.



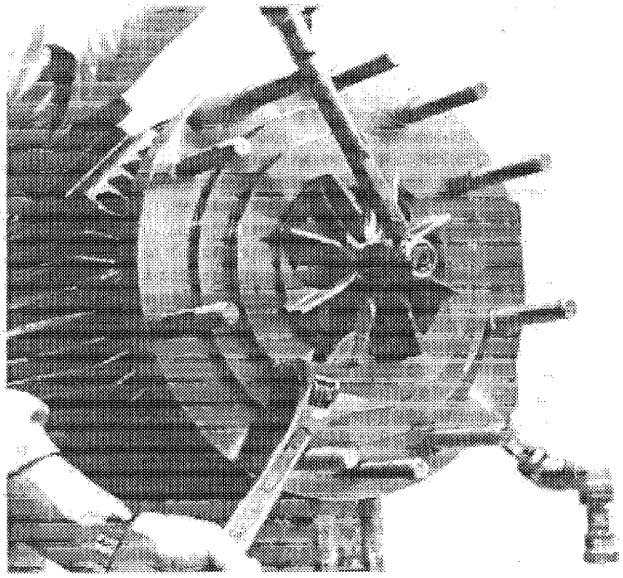
STEP 10

Only for units **with inducer.**

Install the impeller tab washer (5) and o-ring (936F) on the inducer (9) and screw the inducer stud (10) into the inducer. Then screw the complete assembly into the shaft.

Caution

Inducer stud has a left hand thread



STEP 11

By using adequate tools, tighten the impeller bolt (3) or inducer (9) to the required torque value as described in table 3 on page 14.

Remark 1:

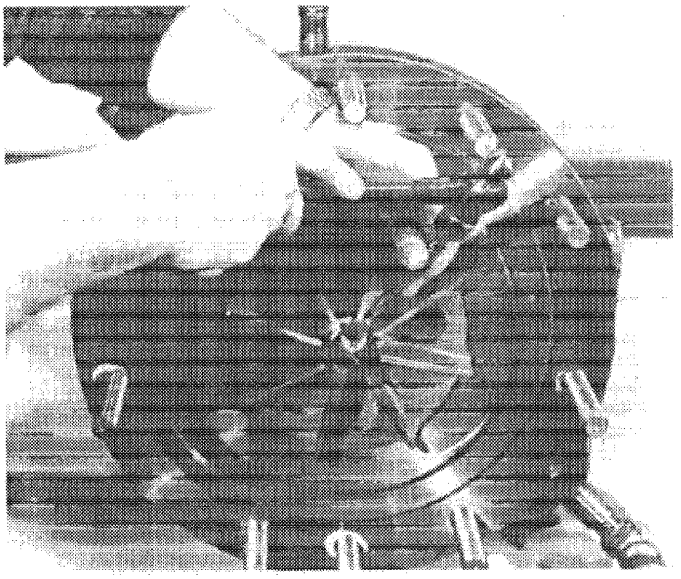
Eventually remove 2 or more studs to prevent damage of the inducer vanes during the tightening procedure.

Remark 2:

The impeller can also be prevented from turning by fixing an adjustable spanner on one of the impeller blades.

STEP 12

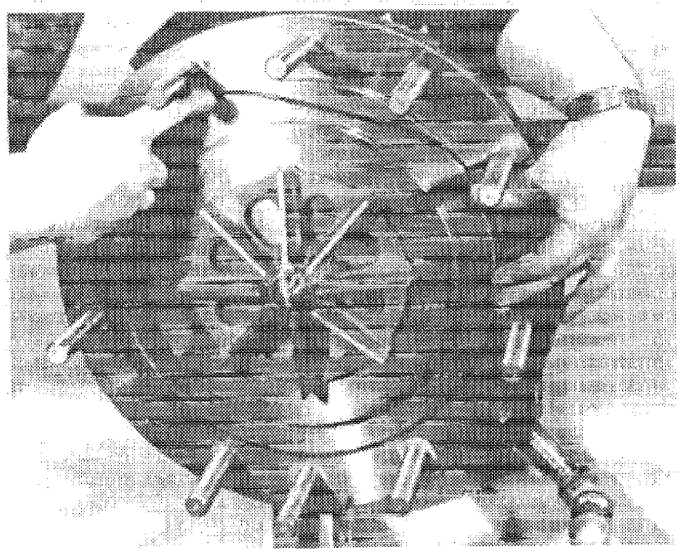
Fit the tabs of the impeller that washer in the slots of the impeller bolt or inducer.



NOTE:

For units with internal centrifugal separator:

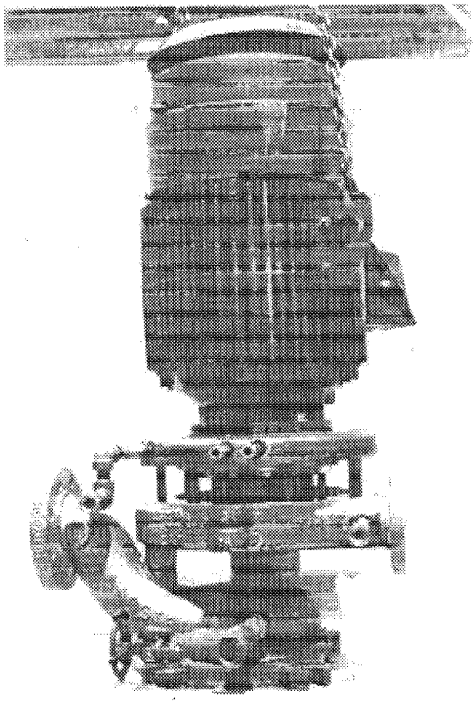
Install o-rings (936V) and (936Z) on separator fitting (91) and install separator orifice (90) with o-ring (936U) into the pump casing.

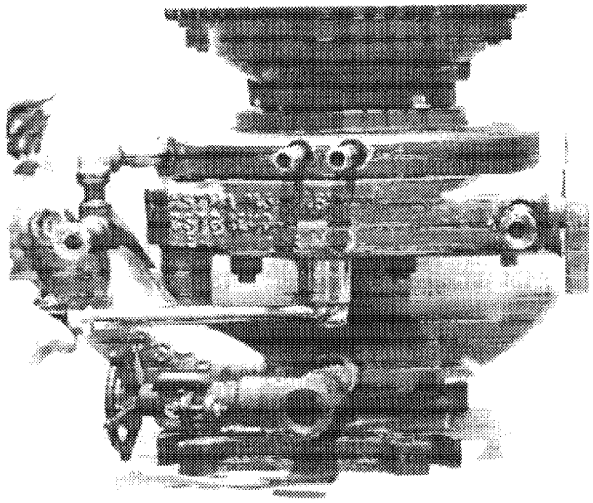


STEP 13

Install o-ring (936 A) on the seal housing...

and carefully lower the seal housing and driver bearing housing into the pump casing. Exercise care not to damage the inducer if one is installed.





STEP 14

Tighten the nuts (914A) to the required value as given in table 3 page 14.

Table 3. 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	9 5- 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	47 - 54 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.				

MINIMUM REQUIRED PARTS AS A RESULT OF PUMP DISASSEMBLY

ITEM NO.	**PART NAME**	**QTY.**		
87A	Thermal Barrier	1		
5	Impeller Tab Washer	1		
936A	"O" Ring	1		
936F	"O" Ring	1		
936G	"O" Ring	1		
936H	"O" Ring	1		
		(Seal Arrangement)		
		Single	Double	Tandem
936J	"O" Ring	1	2	3

PARTS LIST

1. GENERAL

Assemblies, subassemblies and components of the Sundyne LMV-806 process pump are illustrated in the following views and show the basic features of a standard LMV-806 pump. Refer to your Sundyne specification sheet for those options applicable to your pump. The corresponding parts list, keyed to each part by item number, identify detail parts by name, quantity and location.

2. RECOMMENDED SPARES

A recommended spare parts list is included on page 22. There are 3 classes of recommended spares. Each class requires various types and quantities of spares based on the support of one pump unit. The recommended spares are classified depending upon equipment location, type of service and operating conditions. An available supply of spares provides immediate replacement parts without costly downtime and keeps inventory requirements to a minimum. You can obtain assistance for planning an adequate supply of recommended spare parts from your Sundyne representative.

3. REPAIR KITS

Seal and o-ring repair kits are not illustrated herein, but may be purchased directly from Sundyne Corporation. The use of these kits reduces maintenance time, prevents assembly mistakes, simplifies stocking and inventory and reduces delivery time.

4. ORDERING REPLACEMENT PARTS

When ordering replacement parts, give the pump serial number and list each part by part number as shown on the Parts List which is supplied with each pump. This is the preferred method. Otherwise, list each part by item number (as listed in the illustrations) and part name, with pump model and serial number. Specify quantities desired.

Order parts from your Sundyne representative or directly from Sundyne Corporation at the address on the back cover.

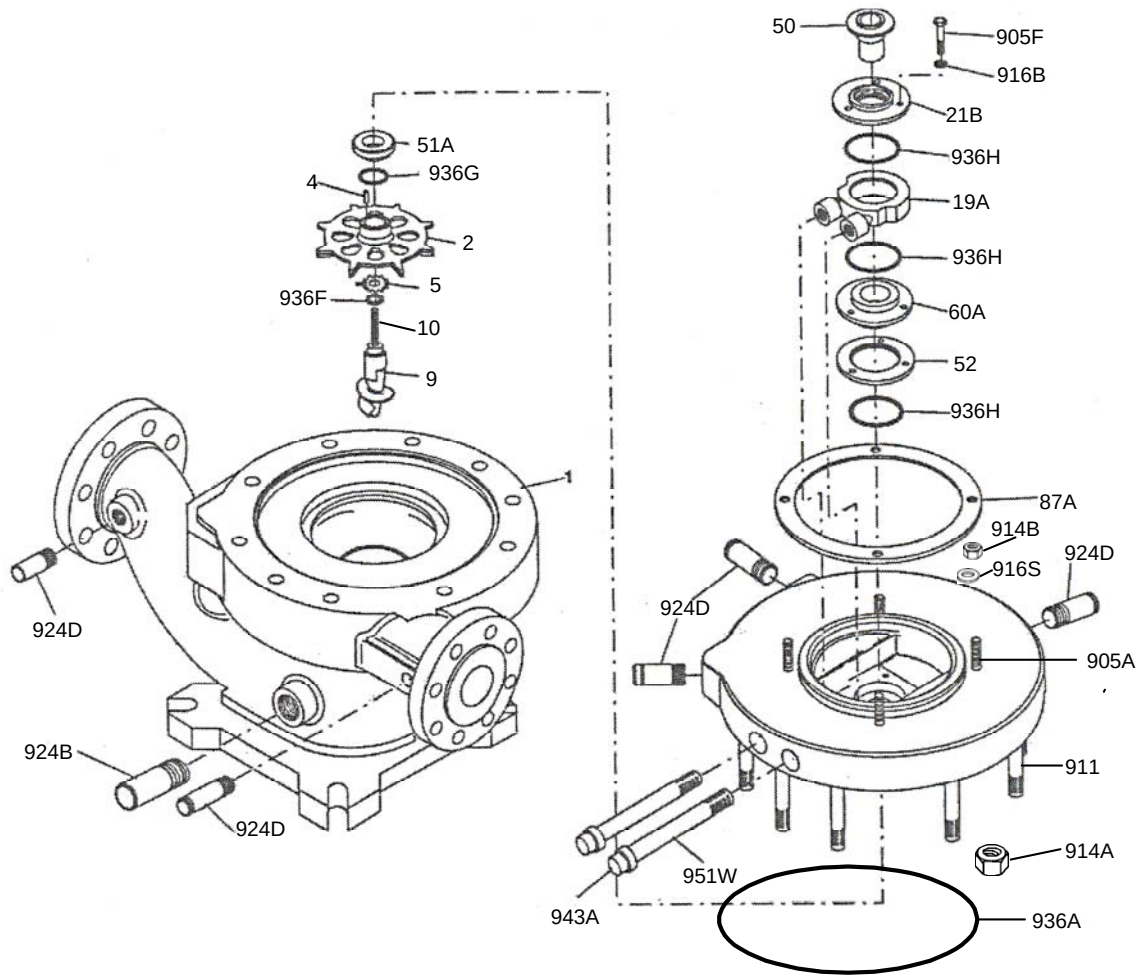


Figure 3. Exploded View of LMV-806 (Single Seal)

ITEM NO.	PART NAME	QTY.	ITEM NO.	PART NAME	QTY.
1	Pump Casing	2	905A	Stud Driver	4
2	Impeller	1	905F	Hex Head Cap Screw	3
4	Impeller Key	1	911	Stud Casing	10
5	Impeller Tab Washer	1	914A	Nut, Casing	10
9	Inducer	1	914B	Nut, Driver	4
10	Inducer Stud	1	916B	Washer	3
19A	Seal Retainer Spacer	1	916S	Washer, Driver	4
21B	Throttle Bushing	1	924B	Bull Plug	2
30	Seal Housing	1	924D	Bull Plug	5
50	Shaft Sleeve with Slinger	1	936A	O-Ring	1
51A	Seal Rotating Face	1	936F	O-Ring	1
52	Seal Spacer	1	936G	O-Ring	1
60A	Mechanical Seal, Lower	1	936H	O-Ring	3
87A	Thermal Barrier	1	943A	Cap	2
			951W	Nipple	2

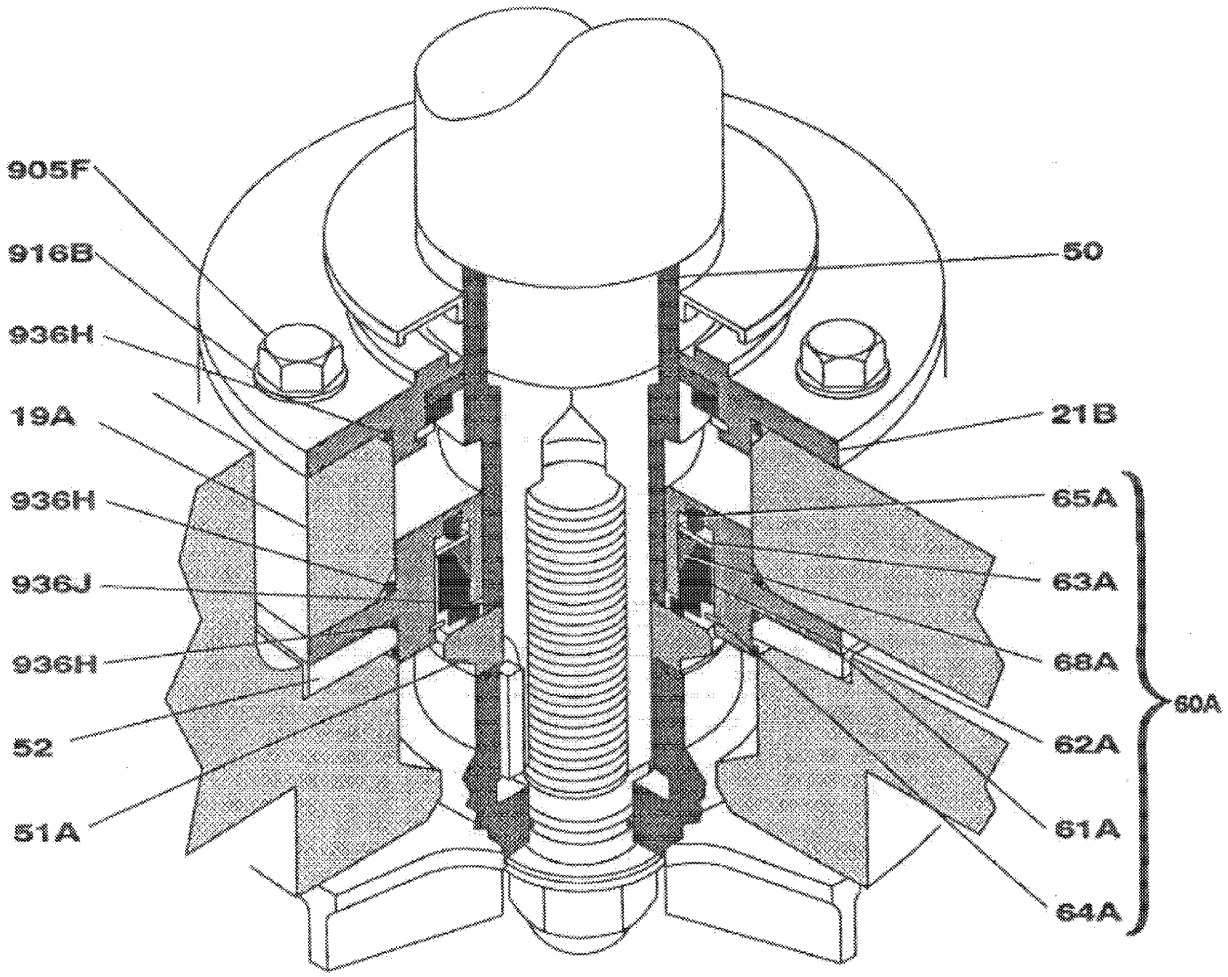


Figure 4. Single Seal Arrangement

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 & Drive Sleeve Assy	1	936H	"O" Ring Packing	4*
62A	• Seal Face Washer	1**	936J	"O" Ring Packing	1*

* Recommended Spare Parts
**Recommended Seal Spare Component Parts
***Specific to Type 9AB Seal Design

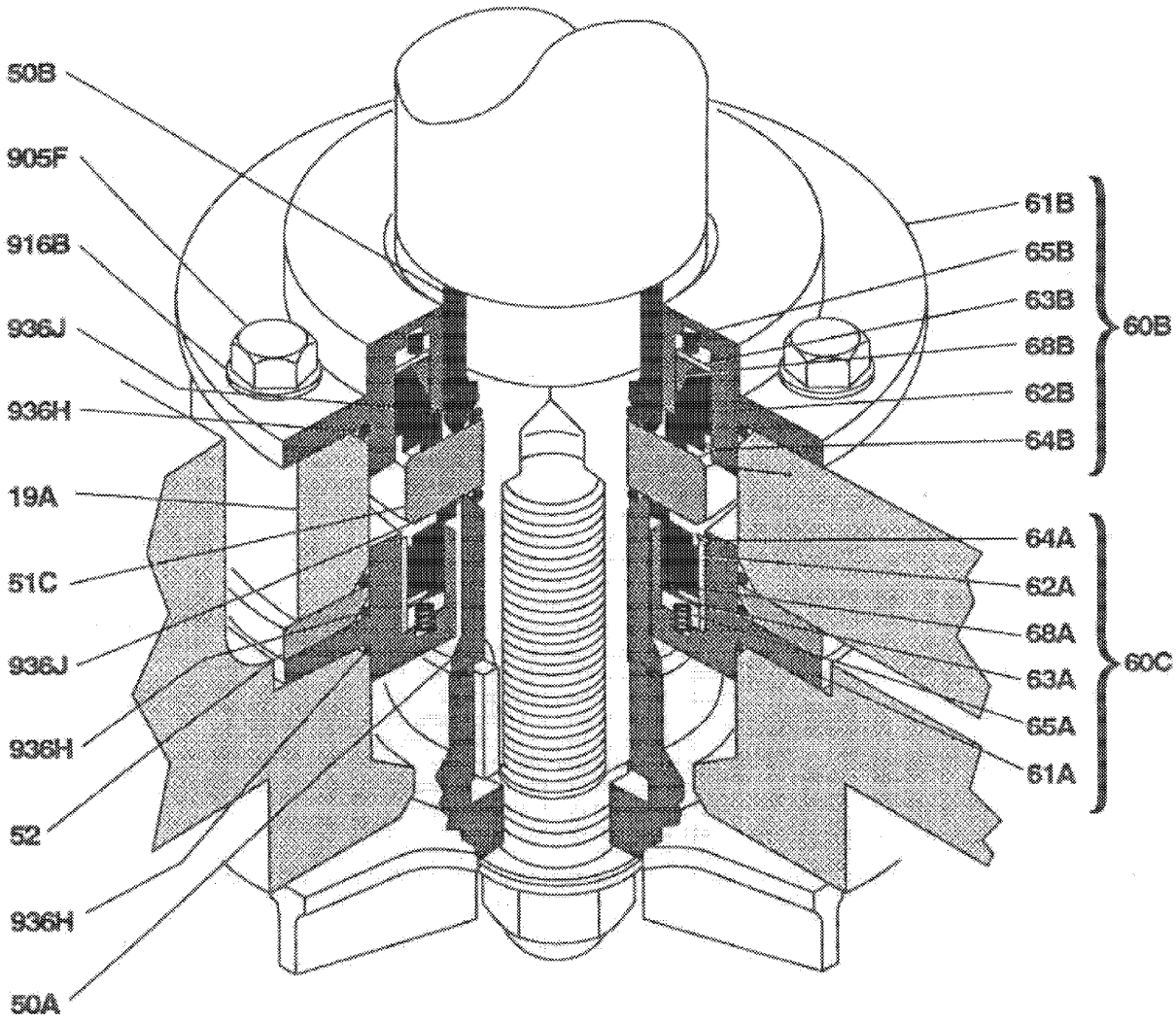


Figure 5. Double Seal Arrangement

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 Assy	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 Assy	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
***Specific to Type 9AB Seal Design

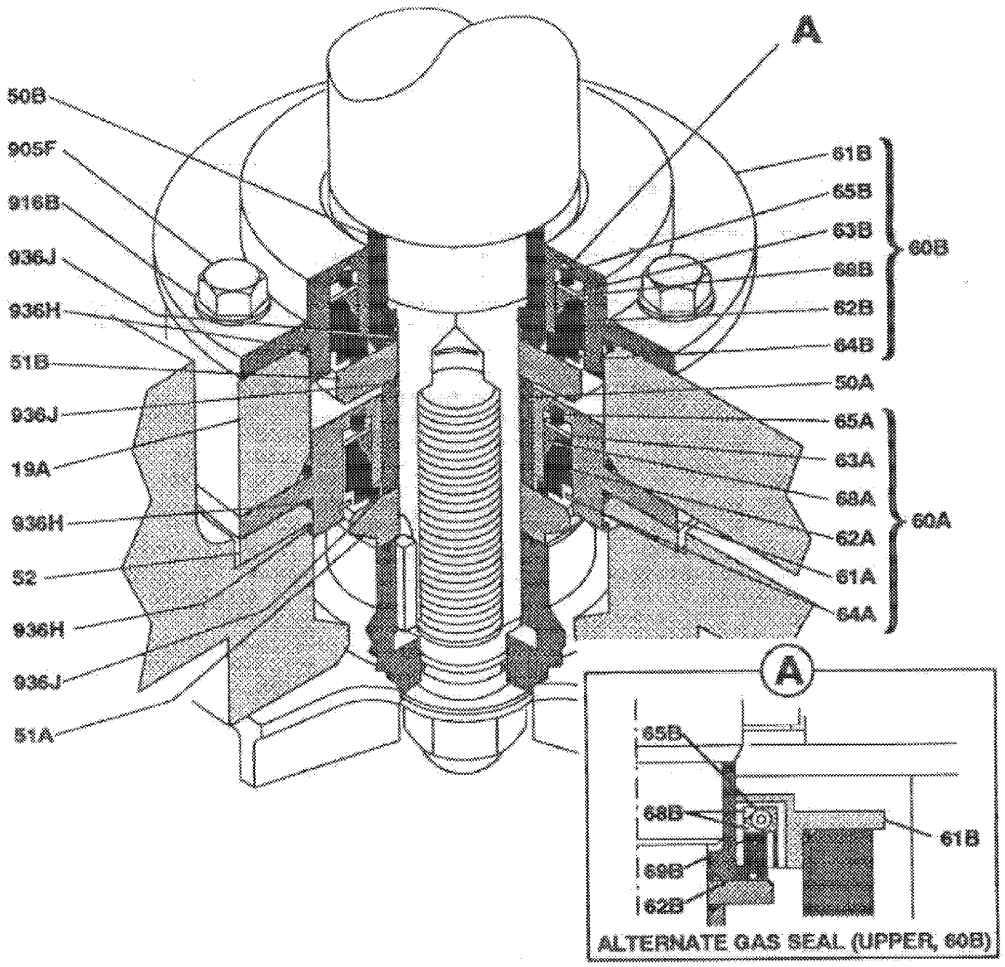
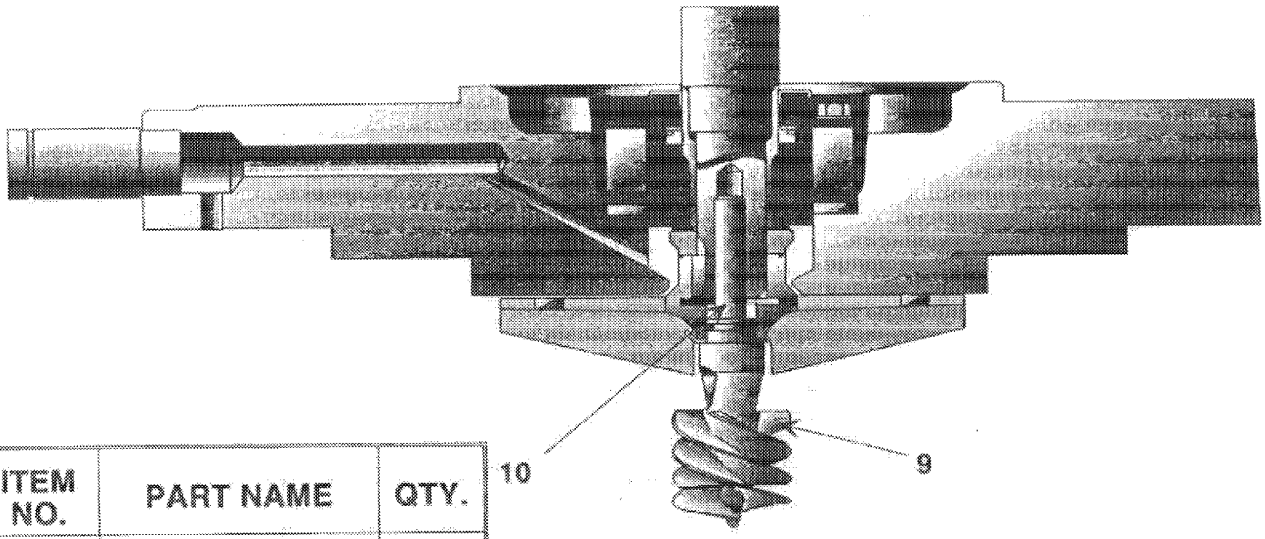


Figure 6. Tandem Seal Arrangement

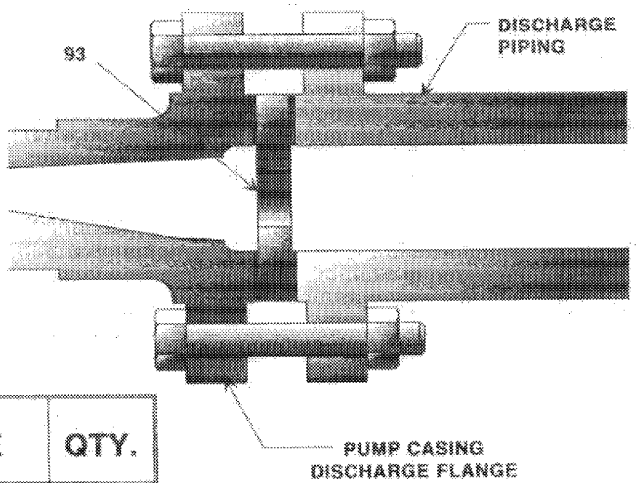
ITEM NO.	PART NAME	QTY.	ITEM NO.	PART NAME	QTY
19A	Seal Retaining Spacer	1	63B	- Seal Spring Back Up Disc	1**
50A	Shaft Sleeve (Lower)	1	64B	- Seal Retaining Ring	1**
50B	Shaft Sleeve (Upper)	1	65B	- Seal Spring	6**
51A	Seal Rotating Face	1*	68B	- Seal Wedge Ring***	1**
51B	Seal Rotating Face	1*	60B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

* Recommended Spare Parts
**Recommended Seal Spare Component Parts
***Specific to Type 9AB Seal Design



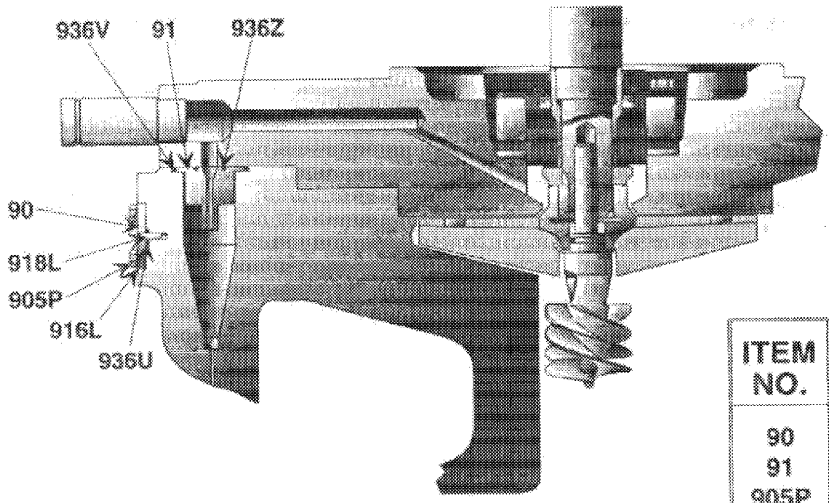
ITEM NO.	PART NAME	QTY.
9	Inducer	1
10	Inducer Stud	1

Figure 7. Inducer and Inducer Stud



ITEM NO.	PART NAME	QTY.
93	Discharge Orifice	1

Figure 8. Discharge Orifice



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
936V	"O" Ring Packing	1*
936Z	"O" Ring Packing	1*

Figure 9. Centrifugal Separator

NOTES

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
		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

NOTES: 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 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

1. OPERATION OF SUNDYNE PUMPS

While the application of the pump in any particular system is not within the scope of this instruction manual, the importance of proper application to successful pump operation cannot be ignored. Several factors must always be considered. The experienced operator will be aware of the effects.

A. SUCTION CONDITIONS

The most common reasons for improper centrifugal pump operation are those relating to proper flow of liquid into the impeller. To avoid turbulence at the eye of the impeller, the suction pipe should be straight for at least three pipe diameters beyond the suction flange. Another rule of thumb is that suction piping should be at least one pipe size larger than the pump suction flange.

It is essential that liquid reaching the impeller eye has a high enough vapor pressure to prevent it flashing to a gas in the impeller. The result of the liquid flashing is cavitation, a phenomenon which can cause damage to the impeller and inducer. Cavitation is sometimes noticeable as a"pumping gravel" noise in centrifugal pumps. In high-speed single-stage pumps, this sound may not be discernible. The way to prevent cavitation is to maintain suction pressure at a high enough level and suction temperatures low enough to maintain Net positive suction Head available ($NPSH_a$) greater than Net Positive Suction Head required ($NPSH_r$) by the pumps.

B. MINIMUM FLOW CONDITIONS

Centrifugal pumps can also experience vibrations from internal flow separations and recirculation at low flow conditions The operator should be aware of the minimum flow recommendations of the manufacturer. While a pump can operate with some noise due to recirculation without harm to the pump, 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, especially when a control valve is located well downstream from the pump.

C. ENTRAINED GASES

Entrained gases in the fluid will reduce the head and capacity of a centrifugal pump. Normally it is considered that two to three percent entrainment is limiting. The pump has been found to operate very well under adverse conditions of gas entrainment. However, the operator should expect a reduction in performance.

D. SYSTEM HEAD CURVE

The flow at which a centrifugal pump operates depends upon the point of intersection of the system (head) curve with the pump characteristic (head versus flow) curve. In order for control to be steady, the system curve must intersect the pump characteristic curve at a significant angle. Examples of satisfactory and unsatisfactory angles of intersection are shown on the following diagram.

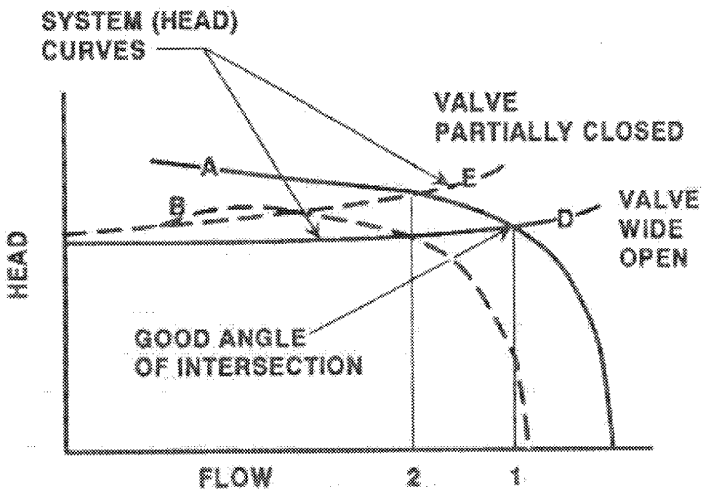


Figure 10. Typical Operation

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.

E. PARALLEL OPERATION

When centrifugal pumps are operated in parallel, their control becomes more critical because one pump may tend to"overpower" another in terms of head at lower total flows. If pumps are connected together at their discharge head by a simple and unrestricted manifold, the discharge head of one pump is imposed upon another and all pumps see the same discharge head at any given moment in time. This situation is shown on the following curves.

Figure 9 shows the characteristics curves of two pumps designated A and B. Since no two pumps will have exactly the same performance, it is assumed that pump A produces a very slight amount more head than pump B. The pumps are arranged with a common manifold as shown in Figure 10.

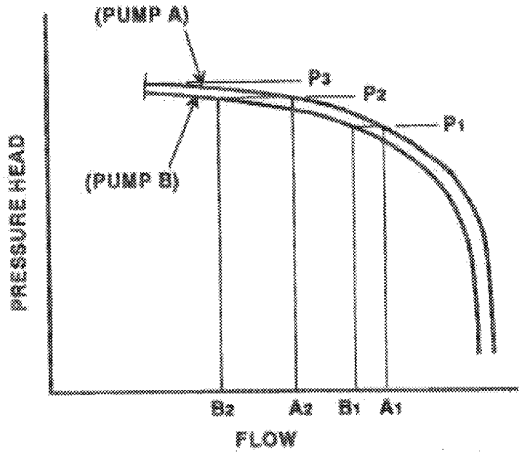


Figure 11. Parallel Operation

The pressure in the manifold is set at P_1; the flow through pump A is indicated as A_1 in Figure 9. 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, e.g. P3, 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 damage to the pump. This situation can be avoided by proper selection of the control system.

2. CONTROL OF SUNDYNE PUMPS

The proper operation of any centrifugal pump requires that the pump be operated in a range where(1) the system head curve and pump performance curve intersect at a significant angle, (2) the pump does not operate below the minimum flow recommended, and (3) the pump does not operate beyond the maximum capacity (recommended Rule of thumb would establish this at 20% beyond the best efficiency point as long as horsepower and NPSH requirements are not exceeded).

It is recommended that **flow control** rather than pressure control be used with the LMV-806. Pressure and flow controls both operate by throttling the discharge flow. However, flow control devices are much more sensitive to the changes in the point of intersection of the performance curve with the system head curve.

Minimum flow is determined by the larger of either (1) the amount of flow necessary to prevent damaging low

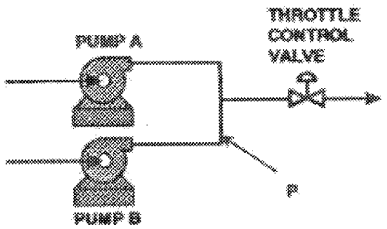


Figure 12. Parallel Units Common Value

flow recirculation, (2) the amount of flow necessary to prevent excessive temperature rise in the pump casing due to low flow recirculation, or (3) in the case of pumps operated in parallel, the minimum flow that will prevent one from deadheading the other.

The minimum flow necessary to prevent excessive vibrations caused by low flow recirculation has been found to be largely a function of the system design. It has been found through experience that the greater the distance the control valve is located from the pump discharge flange, the more severe the effect of this vibration becomes.

If the pump is not operated below minimum flow recommendations, temperature rise within the pump is unlikely to be a problem. However, if operation at low flows becomes mandatory, or if the system causes the pump discharge line to be blocked for any period of time, a means of maintaining a minimum flow must be provided. This can be accomplished by use of either a continuous bypass or by a flow controlled bypass. Any bypass arrangements must return liquid to the suction tank or to a location with similar heat sink capability.

In the case of two or more pumps operating in parallel, it is essential that flow be controlled so that one pump will not deadhead the other and so that they share the work equally. The best way to accomplish this is to provide a separate control valve for each pump. Other systems can be used but must be designed with careful consideration of the system head and pump performance curves (See figure 11).

Various safety devices to protect the pump and system are available. Devices that monitor vibration, temperature or pressure changes can be installed. Consult the manufacturer for recommendations.

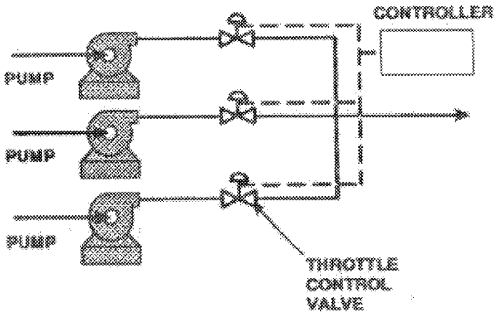


Figure 13. Parallel Units with Discharge Throttling

CRITICAL - STARTUP CHECKLIST

KNOW YOUR MACHINE

Prior to start-up of the Sundyne LMV-806 pump, carefully review the specification sheet, outline drawing, performance curves, and instruction manual. It is important that you become familiar with the pump configutation befor starting and operating the pump.

DRIVER INSTRUCTIONS

Follow installation and starting instruction of the driver manufacturer.
Follow installation and starting instructions for bearing box if used.

ENVIRONMENTAL CONTROL SYSTEM

Install seal environmental control system, if required, and overhead drain piping.

PRESSURIZE FLUID LOOP

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

PRIME PUMP

Pressurize the suction line with liquid and bleed all air and vapor from seal flush port 6.

CHECK DRIVE ROTATION

Rotation must be CCW looking at fan end of motor.

START PUMP

With suction line valve completely open and the discharge valve 40-50 percent open, adjust discharge valve to obtain the required head flow.

CHECK

Be sure that process conditions conform to values listed on the specification sheet. Check head rise, flow rate, and power consumption against pump specification sheet. Check that specific gravity, viscosity and NPSH are in accordance with the specification sheet. These conditions will significantly alter performance of the pump and could damage the pump if different than values listed on the specification sheet.

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