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Installation, operation, & maintenance procedures for SIHI LEM Series Vacuum Pumps

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INTRODUCTION TO SIHI LEM PUMPS

Print Manual

14 Pages

SIHI's new LEM series, close coupled, multi-service, liquid ring vacuum pumps offer the ultimate in robust simplicity.

SIHI LEM series pumps feature cavitation protection, single North American mechanical seal, single casing drain, continuous solids purge connection, ultimate vacuum approaching 29" Hg. (25 Tort-), and minimum space requirements.

SIHI LEM pumps are close coupled to North American motors of NEMA design. Motors are supplied in compliance with 'UL' and 'CSA' requirements. Being close coupled, the LEM pumps require no baseplate for mounting, no coupling, coupling guard, or on-site alignment of pump and motor.

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THE LIQUID RING PRINCIPLE

The 'liquid ring' pump takes its name from its principle of operation. A cool liquid is introduced into a round casing and, due to centrifugal force, forms a nearly concentric ring around the pump casing.

The impeller is eccentrically mounted in the casing. Hence, at one side, the cells formed by the impeller blades and the boundary of the liquid ring increase in size; and on the other side, they decrease in size.

An optimally sized suction port is positioned in the area where the cell size is increasing. This port ducts the gas from the pump inlet into the lower pressure cells.

The gas introduced into the cells is then compressed by the operating liquid in the area where the cell size is decreasing. A discharge port is then positioned to duct the compressed gas to the pump discharge.

Since the liquid absorbs the heat generated during compression, a small quantity of fresh cooling liquid is continually introduced via the service liquid supply port, and the resulting excess warm liquid discharged with the gas to a downstream gas/liquid separator.

The liquid used as compressant allows the liquid ring pump to perform cool, reliable compression of virtually all gases and condensible vapors while easily handling liquid and soft solid carryover.

APPLICATION

SIHI LEM series pumps are capable of handling many vapors, and gases using service liquids compatible with the metal parts and elastomers of the pumps and mechanical seal. Small quantities of liquid carryover and nonabrasive solids can also be handled.

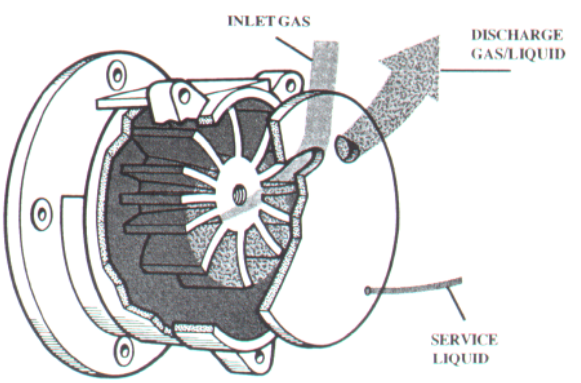


FIGURE 1

SECTION A

INSTALLATION AND OPERATION

TABLE 1 - PRESSURE AND TEMPERATURE LIMITATIONS (STANDARD)

Maximum Gas Temperatures:

Dry Gas:	212”F, 100°C
Saturated Gas:	212”F, 100°C

Casing Pressures:

Casing Design Pressure:	30 PSIG
Casing Test Pressure:	45 PSIG

Service Liquid:

Max. Temperature:	60°C (140°F
Max. Viscosity:	1.15 cts.
Max. Specific Gravity:	1.0
Max. Discharge Pressure:	0.5 PSIG
Max. Dissolved Solids:	200 ppm

NOTE: Viscosity, specific gravity, and discharge pressure limitations are based on standard motors. Should your requirements vary, special motors may be necessary Contact the factorv for information.

Installation

1. Removethepumpunitfromtheshippingcartonor skid and check for mechanical damage. Should damage be observed, report this to the shipping company responsible.

2. Mount the pump on supporting equipment or firm foundation. In most instances, the pump unit is mounted with gas inlet and discharge connections vertically up. However, pump head can be rotated 90” to the right (or left), if desired.

3. Remove plastic shipping plugs, Items 90.98 and 99.99, from the inlet/discharge and service liquid connections.

4. Remove knock-out plug from the motor fan shroud and rotate motor shaft by hand, using a screwdriver inserted through the shroud, and engaging the slotted end of the motor shaft.

   No undue binding or scraping noises should be heard from inside the pump head.

   NOTE: Mechanical seal faces are not lubricated at this time, so some effort may be necessary to rotate the shaft. Do not be concerned unless it is impossible to turn, or if rubbing noises are heard.

5 Connect electrical supply in accordance with the motor label and electrical connection details in the motor terminal box.

   WARNING: Motor connections, wiring, and protective devices should be installed by qualified technicians to all local and national electrical codes.

   NOTE: Should your supply voltages frequency and/or phase vary from those noted on the motor nameplate, please contact the company from whom you purchased the equipment. Do not proceed further.

6. Connect the inlet and discharge piping using line sizes at least equal to the pump connection size. The inlet piping should include a low pressure drop check valve mounted as close to the pump as possible. This is required to prevent service liquid backflow to the system upon shut-down of the pump unit. Check valves recommended by SIHI may be purchased from your local SIHI representative.

   The discharge piping is normally connected to a discharge separator available from SIHI Pumps.

   Be sure to limit maximum vertical rise of piping to twelve (12) inches or less.

7. Connect service liquid supply using suitable gasket compound on all threads.

8. On initial start-up after installation or repair, half fill the pump with service liquid prior to starting.

   Do not run the pump dry or mechanical seal damage may occur.

9. Jog the pump motor and observe the direction of rotation of the motor shaft through the motor fan shroud knock-out. Ensure rotation is in accordance with the arrows on the pumps casing.

IO. Reinstall the motor fan shroud knock-out plug.

11. If this unit is to be used in a new installation, refer to Pages 4 through 8 for normal system requirements and start-up proceduresfor particular types of systems.

SECTION B

GENERAL NOTES CONCERNING SERVICE LIQUID SUPPLY

The operation of the liquid ring pump is dependent upon a continuous supply of cool, clean service liquid, which enters the pump on the suction side and is discharged with the compressed gas. The volume of the liquid ring within the pump should be regulated for optimum performance. The service liquid entering and leaving the pump serves to carry away the heat of compression imparted. The temperature rise across the vacuum pump normally is approximately 4°C (7°F). (NOTE: Actual temperature rises may be higher depending on: 1) point of operation; 2) quantity of service liquid supplied; 3) gas characteristics; and 4) service liquid properties.

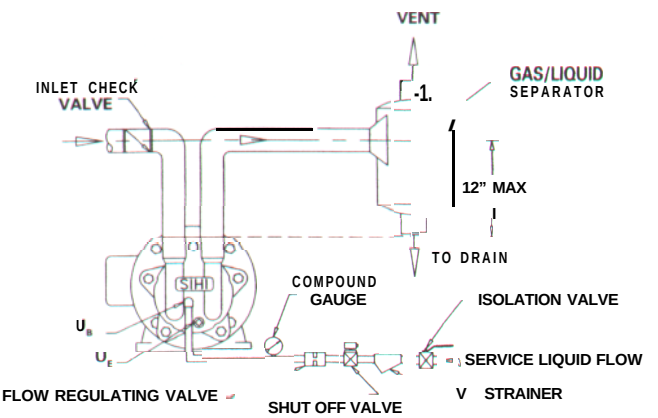
Service supply systems, Figures 2,3, and 4, show typical systems for supply of service liquid. In each system, different accessory items are recommended. These items may be obtained from SIHI, or if desired, a complete factory assembled system may also be purchased from SIHI.

DESCRIPTION OF SUPPLY SYSTEMS

System 1 - Once Through

Once through service liquid supply requires liquid to be available at some posltlve pressure to the liquid supply accessories prior to the pump.

Normal accessories in this mode of operation are: compound gauge,flow regulating orifice (orflowcontrol valve), normally closed solenoid valve, 'Y' pattern strainer, and manual isolating valve.



Once Through System

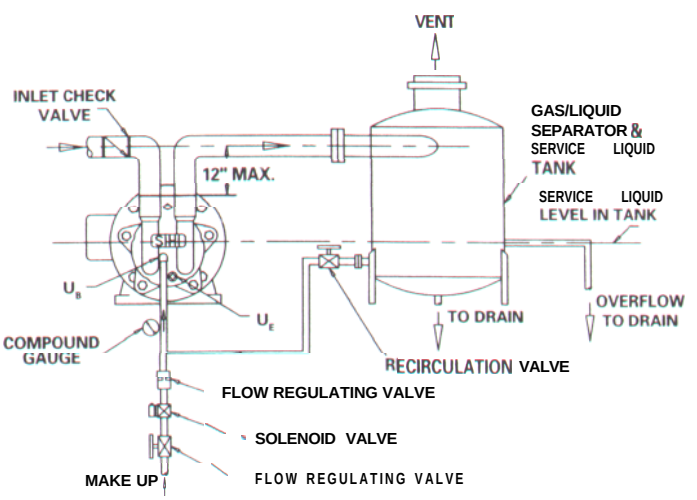
FIGURE 2

System 2 - Partial Recirculation

Figure 3 details a partial recirculation system employed to reduce the quantity of fresh (new) liquid needed. Partial recirculationcan beemployedin instanceswhere a make-up liquid is available at a temperature lower than the service liquid design temperature. Service liquid enters the pump and is discharged at a slightly higher temperature to the separator. Heat is lost due to radiation and convection, and a portion of the liquid (still at higherthan the design temperature) is returned to the pump. The returned liquid is cooled to the design temperature by mixing with a suitable quantity of cool fresh liquid (make up) at a lower temperature.

The quantity of make up required is dependent on the difference In temperatures between the design service liquid temperature, the temperature rise across the pump, the pump required operating pressure and capacity, the actual pump capacity, and the normal required liquid flow. In many instances, it is possible to reduce the fresh liquid flow to 50% of the normal flow or less. The excess liquid so introduced is drained from the separator to maintain the same liquid level in the separator.

Partial recirculation requires a SIHI XBa type separator (or similar liquid reservoir), inlet check valve, plus flow control valve (or regulating orifice), normally closed solenoid valve, 'Y'strainer, and shut-off valve, as shown In Figure 3.



Partial Recirc System

FIGURE 3

System 3 - Complete Recirculation

Figure4detailsthenormalinstallationofaself-contained service liquid supply system. This arrangement is normallyusedwhere,duetocost,availability,ordisposal limitations, it is desired to eliminate or minimize service liquid make-up and drain needs.

Service liquids chosen under these conditions can be water, solvents, oils, or other liquids as compatiblewith pump materials, performance requirements, and the process.

CAUTION: Where it is desired to use liquids other than water, please contact your local SIHI representative or the factory with details of the proposed application, prior to selection or operation of the equipment.

In this arrangement, liquid used is discharged to a separator and returned to the pump via a sealed cooling device such as a liquid to liquid cooler or an airto liquid cooler. NOTE: If the pump is small and will operate for lessthanlOminutesperhour,acoolermaybedispensed with, depending on the system design and operating requirements. Contact the factory for information in these instances.

Accessories required are: recirculation separator/ container fitted with some form of level monitoring device(s), isolating valve for the heat exchanger, 'Y' pattern strainer, flow control valve, compound gauge, and the cooler.

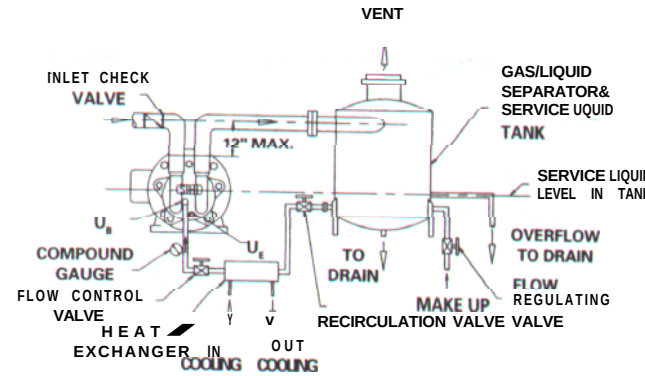
Other accessorieswhich may be requiredcould include: gas demister, and/or filters on the vents, gas coolers/ condensers, and various other accessories to make the system fit the requirements of the user.

In the event the pump will be required to operate for an extended time below 10" Hg. vacuum, an orifice should be installed in the pump suction of the size noted in Table 2, or a recirculation pump should be employed to positively supply liquid.

TABLE 2 - INLET GAS LINE ORIFICE SIZES

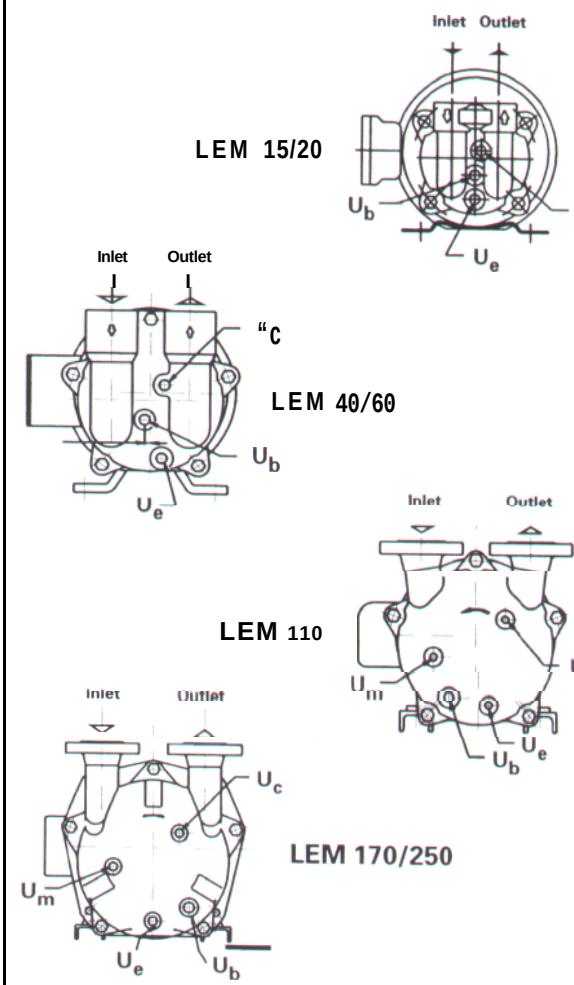
LEM 15	3/8 inch
LEM 20	7/16 inch
LEM 40	1/2 inch
LEM 60	9/16 inch
LEM 110	11/16 inch
LEM 170	7/8 inch
LEM 250	I-318 inch

(Standard drill sizes)



Total Recirc System
FIGURE 4

Piping Connections



Ub is Service Liquid
Uc is Anti-Cavitation
Ue is Drain
Um is Gauge

FIGURE 5

SECTION C

TYPICAL OPERATING SEQUENCES FOR LEM PUMPS IN THE VARIOUS SERVICE LIQUID SUPPLY MODES

SYSTEM 1 - ONCE THROUGH SERVICE LIQUID SUPPLY NORMAL OPERATION

The normally closed solenoid valve should be wired to open in conjunction with motor start.

If the pump is new or repaired, or the system was worked on, perform the checks noted in Section A, Item 1 through Item 11, prior to doing the following.

Jog the pumpwhile observing thecompound gauge. A variation in the pressure should occur if the solenoid valve is opening. If no variation occurs, check the solenoid and the line for closed valves or plugs.

Start the pump and let the unit run down to the normal operating pressure. Ifthe pump is fitted with automatic flow orifice, monitor the operation and ensure pump operates satisfactorily.

If flow regulating orifice is not supplied: monitor the service liquid pressure on the compound gauge with pump operating in the normal operating range, and adjustthe liquid flow using a manual valve. Approximate settingonthecompoundgaugeshould be zero, however, the optimal setting occurswith valvesetatthe minimum opening possible, where pump runs smoothly at the minimum operating pressure (or maximum vacuum level) and discharge temperatures are satisfactory.

Aftersetting the flow, mark the reading onthecompound gauge. Monitor the service liquid pressure routinely to ensurevariationsare notoccurring and pumpoperation is satisfactory.

If in the course of normal operation it is necessary to shut the unit off, stop the pump and check that the solenoid closes. If pressure is Indicated on the gauge, the solenoid valve is not closing and pump may be flooded. Repair solenoid and drain pump to shaft center line before restarting.

CAUTION: Starting liquid ring pumps with excessive water in the casing can lead to motor overload and possible damage.

SYSTEM 2 · PARTIAL RECIRCULATION

The normally closed solenoid valve on the make-up (fresh liquid) line should be wired to open in conjunction with the motor start.

If the pump is new or repaired, or the system has been worked on, perform the checks noted in Section A, Item 1 through Item 11, prior to proceeding.

Continues in right column

Jog the pump while observing the compound gauge. If the solenoid valve is opening, a variation in pressure should occur. If no variation occurs, check the solenoid and all liquid lines for closed valves or plugs.

Operation With Automatic Control Orifice

If a make-up (fresh liquid) orifice is installed, start the pump unit and monitor operation. When the system is operating under normal conditions, check to ensure that pump runs smoothly and that pump temperature stabilizes. If pump operating temperature does not stabilize, liquid make-up rate is unsatisfactory. Check again for plugs in the fresh liquid supply. Do not continue to operate the unit if temperature continues to rise.

Ooeration Without Automatic Orifice

Partial recirculation always requires introduction of some cool liquid. However, the actual quantity required varies, depending on the system conditions.

Optimum make-up rate is the minimum flow rate required to maintain a stable service liquid supply temperature at the lowest operating pressure (highest vacuum), while maintaining smooth, quiet operation. NOTE: SIHI recommends a minimum of 10% fresh make-up in most instances, since the separators used have relatively small liquid volumes. Leakage or evaporation could quickly result in failure, due to dry running. Should it be desired to reduce make-up rates further, consultthe factory, or consider installing a SIHI complete recirculation system.

Start the pump with the make-up line manual flow control valve open approximately halfway.

Monitor the system inlet pressure until pump operates at the normal design, maximum vacuum, conditions. Reduce the liquid make-up setting, until the pump is just capable of maintaining system vacuum with a stable service liquid temperature.

Monitor the system in operation for a period of time to ensure temperatures are stable and pump operates smoothly. Remove flow control valve handle and wire to the line to prevent loss and ensure availability.

Monitor pump operation from time to time to ensure all remains normal during the operating cycle. If in the course of operation it is necessary to shut the unit off, stop the pump and check that the solenoid valve closes.

CAUTION: Starting liquid ring pumps with excessive water in the casing can lead to motor overload and possible pump damage.

SYSTEM 3 -COMPLETE RECIRCULATION

Liquid to liquid cooler system: prior to operation of the pump unit, ensure coolant is available to the heat exchanger.

Fill the separator/liquid reservoir to the normal operating level. In most systems, the maximum normal operating level will be the pump shaft center line, and an overflow will be located at this level. NOTE: If separator runs under positive pressure, a drain trap system must be employed on the overflow. Connect the overflow to vented drain.

WARNING: If toxic or hazardous gases are handled, safety precautions must be followed.

Open all isolating valves in the service liquid lines between the separator and the pump, and allow service liquid to fill the lines. Refill the separator as necessary to the normal level.

Check that the pump is half full of liquid. If not, fill to the pump shaft center line.

CAUTION: Do not operate the vacuum pump dry, or premature failure of mechanical seal may occur. In addition, do not start the pump unit completely filled with liquid, or high motor shaft loads leading to motor overload may result.

If the system is fitted with a recirculation pump, half close the flow control valve before starting. In this instance, the recirculation pump motor should be wired to start with the start of the vacuum pump.

Jog the vacuum pump motor and ensure coolant automatic valves (if applicable) open, and recirculation pump motor (if applicable) energizes (and de energizes) with vacuum pump motor. Ensure all motors rotate in the correct direction.

Start the system and check the inlet pressure and service liquid compound gauge for pressure variation. If pressure does not decrease, stop the unit and check the service liquid lines for plugs, closed valves, and the like.

Restart the unit and monitor operation. Check to ensure pump operates smoothly and quietly, and that temperature of all water lines and pumps are suitable.

Ensure all pipe connections are tight and leak free. Routinely monitor operation from time to time to check for proper service liquid levels, leakage, and smooth pump operation.

Should you have any concerns, contact your local SIHI representatlve or the factory at your discretion.

CAVITATION PROTECTION

SIHI LEM pumps are fitted with provisions for a cavltation reduclng air bleed Should it be necessary to utilize this feature, check the pump drawing and remove plug denoted as Uc. Connect a bleed line with manual regulating valve to the connection, and to the separator vent piping.

CAUTION: Do not open plug Uc to atmosphere, since in some operating conditions, water and/or gas may be vented from the Uc connection.

Operate the pump at the design conditions and open the bleed valve until the cavitation noise subsides. Leave the air bleed open at this setting.

DIRT DRAINS

SIHI LEM pumps are fitted with a central drain for the impeller cavity (Ue). If solids are carried over from the system evacuated, this drain should be opened from time to time with the pump idle to drain solids trapped in the pumpcasing. Frequency required will depend on the quantity of foreign matter carryover experienced.

In extreme cases, the drain connection in the pump casing can be piped via a manual or orifice type flow valvetocontinuouslydraincarriedoversolids. However, in these instances, service liquid flows or make-up flows must be increased by the liquid quantity dralned.

CAUTION: If continuous drain is utilized, drain piping should be piped from the connection up to approximately the midpoint of the casing, and then down to drain, to prevent complete casing drain when the pump is idle.

For complete recirculation systems, the continuous drain should be piped to the discharge separator, not to an open drain, unless make-up is continuously used

DESCALING

WARNING: Liquid ring pumps used in areas where water has a high level of calcium carbonate or iron scale, may become fouled, leading to seize-up, high motor loads, and possible mechanical seal leakage.

In these instances, pumpshould be periodically flushed with a descalent as frequently as necessary to ensure scale build-up is removed. Recommended descalent is "Rydlyme". Please call SIHI for Information.

TABLE 3 - TROUBLESHOOTING TABLE

PROBLEM:	Motor Speed Low	High Disch. Press.	High Svc. Water Temp.	Too Much Liquid	Too Little Liquid	Worn Mech. Seal
REDUCED CAPACITY	■	■	■	■	■	
EXCESSIVE NOISE		■	■	■	■	
HIGH POWER CONSUMPTION		■		■		
OVERHEATING	■		■		■	
VIBRATION	■			■	■	
SEAL LEAKAGE		■				■

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SERVICE LIQUID RATES

PUMP MODEL- **LEM 15**

Pump Speed	12" Hg. V. 455 Torr			16" Hg. V. 354 Torr			20" Hg. V. 252 Torr			24" Hg. V. 150 Torr			28" Hg. V. 49 Torr		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
3500	0.75	0.20	0.10	0.75	0.20	0.10	0.75	0.20	0.10	0.75	0.20	0.10	0.75	0.20	0.10
2900		–	–		–	–		–	–		–	–		–	–

PUMP MODEL- **LEM 110**

Pump Speed	12" Hg. v. 455 Torr			16" Hg. V. 354 Torr			20" Hg. v. 252 Torr			24" Hg. v 150 Torr			28" Hg v 49 Torr		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1750	1.8	11	07	2.3	12	08	3.1	15	10	3.5	15	10	3.9	13	0t
1450		–	–		–	–		–	–		–	–		–	–

PUMP MODEL- **LEM 20**

3500	10	0.34	0.20	10	034	020	10	034	320	10	134	020	10	0.28	0.16
2900		075	001		026	015		027	016		027	016		020	011

PUMP MODEL- **LEM 170**

1750	3.1	17	12	3.8	1.9	13	3.8	20	13	44	20	13	4	18	11
1450		14	09		1.6	1.0		17	11		17	11		14	08

PUMP MODEL- **LEM 40**

3500	1.5	0.5	0.3	1.5	0.5	0.3	1.5	0.5	0.3	1.5	0.5	0.3	1.5	0.4	0.2
2900		–	–		–	–		–	–		–	–		–	–

PUMP MODEL- **LEM 250**

1750	26	1.7	1.3	32	20	14	3.9	2.2	1.5	45	2.4	1.6	52	2.2	1.4
1450		10	06		17	11		19	12		2.0	1.2		1.7	1.0

PUMP MODEL- **LEM 60**

3500	15	07	05	15	0.8	0.5	15	08	05	1.5	0.7	0.5	15	07	04
2900		06	04		06	04		06	04		0.6	0.4		0.6	0.3

TABLE 4

Column 'A' is the flow in USGPM required - once through.

Column 'B' is the make-up flow required when make-up liquid is 5°C (9°F) cooler than service water.

Column 'C' is the make-up flow when make-up liquid is 10°C (18°F) cooler than service liquid

Effect of Service Water Temperature on the Capacity of Single Stage Liquid Ring Vacuum Pumps

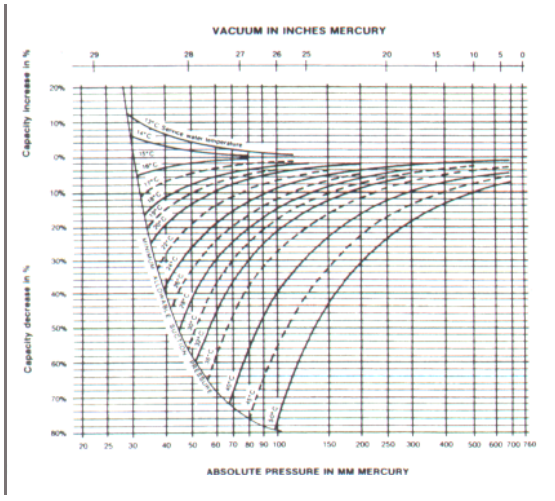

FIGURE 6

NOTES: SERVICE LIQUID TEMPERATURES

Service liquid temperatures effect pump performance. Increasing temperatures result in higher vapor pressures and reduction in effective pump performance.

SIHI standard capacity data is based on water @ 15°C/59°F. Corrections for higher temperatures are obtained from the curve at left.

If liquids with vapor pressures different than water are used, effects are obtained by finding the temperature at which water has the same vapor pressure as the liquid used and applying the water correction factor for that temperature.

SECTION D

ASSEMBLY AND DISASSEMBLY INSTRUCTIONS

Important Notes

These general assembly instructions apply to the standard LEM pump range.

The LEM 15 & 20 are covered first, the LEM 40 through LEM 250 next.

The standard mechanical seals for all units are John Crane #21 or Sealol#43. These seals can be supplied in various material configurations, however, Kalrez or Teflon elastomers require the use of special seals. These special seals are covered by notes in each applicable section. Please note the pump description and pay attention to any special notes applicable.

TABLE 5 · MECHANICAL SEALS

Type	Seal Type	Model Number
Standard	J. Crane Type #21 or Sealol #43	LEM ___ AZ 83X.Xx
Special Single Seals	J. Crane Type #8	LEM AZ IIX.XX.O

Where a deviation occurs beside the number applicable, you will see the following note: Special Seals · "SS"

Section A - General

1. Item numbers in brackets ( ) refer to section drawing and parts list numbers.
2. When ordering spare parts, refer to pump model, serial number, and Item number.
3. All parts (especially sealing areas) are to be handled with care, and if stored, should be protected from mechanical damage and corrosion.
4. When assembling, all machined surfaces should be cleaned and degreased prior to use.
5. Uselrquidcompoundgasket material on all machined mating faces internal to the pump casing. (Not to be used on flanged gasket faces.)

6. Important Data

Motors: Motors, though of NEMA design, have special tolerances and construction for SIHI LEM pump usage. Replacement motors, should they ever be required, should be ordered from your local SIHI representative.

Use of other than SIHI supplied motors may result in premature pump failure.

TABLE 6 - FLANGE GASKETS FOR INLET AND DISCHARGE

LEM 20 through LEM 60	N/A
LEM 1 110/170	I-1/2"
LEM 250	2"

NOTE: Solid gaskets are recommended (fiber reinforced gasketscommonly result in leakage across the fibers).

7. Axial Pump Clearances

Clearances are set during assembly. In all instances, axial clearances are measured between the outer face of the impeller and the intermediate. The rear face clearance is for the most part insignificant.

TABLE 7 · AS ASSEMBLED AXIAL CLEARANCES

Pump Model	Clearance
LEM 15	0.003 to 0.004 inches
LEM 20	0.003 to 0.004 inches
LEM 40	0.004 to 0.006 inches
LEM 60	0.004 to 0.006 inches
LEM 110	0.005 to 0.008 inches
LEM 170	0.005 to 0.008 inches
LEM 250	0.005 to 0.008 inches

Refer to Figures 7 & 10

SECTION E

LEM 15 & 20 ASSEMBLY AND DISASSEMBLY

PART I - Disassembly

Preparation for Disassembly

1. Remove drain plug (lowest plug on the cover) and drain the pump completely.

   DANGER: If liquid or gases handled are toxic, be certaintofollowacceptedprocedureswhendraining or disassembling equipment. Safety regulations must take precedence over any procedure noted in this manual.

2. Remove pump from the installation.

   NOTE: It is possible to service the unit without removing the motor. However, in most instances, it will be more convenient to remove pump and motor unit from the system.

3. Remove four bolts (90.10), then carefully remove cover assembly (IO.IO), complete with intermediate (13.70). from center body (10.90).

   NOTE: To break the gasket seal between the intermediate and center body, use a screwdriver blade inserted between the intermediate and the center body as a lever.

4. Remove and store knock-out plug in the motor fan shroud, and use a large screwdriver to hold the motor shaft. Then remove impeller (23.50) from shaft. Save shims (52.50) on the rear of the impeller. **NOTE:** The two diametrically opposite 3/16" holes In the impeller face can be used to aid in removing the impeller.

   SS 4a. If special seal with Teflon/Kalrez is used, loosen set screw and remove rotary seal faces, then proceed with Item 5.

5. Inspect center body (10.90). If wear is not seen, do not remove, unless it is necessary to replace the mechanical seal seat (43.30), or it is necessary to service the motor.

   If removal IS necessary and the same center body is to be returned to the same motor, carefully remove mounting bolts (90.22) and note locations of shims (52.50).

6. Remove center body (10.90) from motor (80.00) and store shims carefully marked as to proper location.

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7. Press mechanical seal stationary (43.30) from the center body.

8. Carefully pry intermediate(13.70)from cover(10.10) and remove orifice balls (75.40).

Refurbishment

1. It is suggested that if the pump is completely disassembled, that orifice balls (75.40) and mechanical seal (43.30) be replaced.

2. Carefully clean orifice ball seats and guide holes to remove corrosion, using fine emery cloth.

3. Inspect intermediate (13.70) for wear on the flat (impeller) side. If the plate is not deeply grooved, refurbish by cleaning corrosion from the face by rubbing on a piece of fine emery cloth mounted on a flat surface.

   Inspect the mechanical seal surface of the motor shaft If care is taken, wear on the motor shaft should not be significant, especially if John Crane type #21 or Sealol#43 are used.

   If shaft is damaged, motor rework or replacement will be necessary to prevent leakage. Contact the factory for information.

   SIHI LEM pumps are precision pieces of equipment. **Use only SIHI supplied replacement parts.**

PART II · Reassembly

1. If center body was not removed, proceed with Item 5 below. Otherwise, proceed with Steps 2,3, and 4.

2. Install center body (10.90) using bolts (90.11).

3. Mount a dial gauge on the motor (80.00) shaft with probe riding on the inside rear machined surface of the center body (10.90). then rotate about motor face. Set the dial gauge to zero at the highest point. Rotate the shaft and record the shim sizes needed in the area of bolts (90.11).

4. Loosen center body bolts (90.11) and install shims as necessary.

5. **CAREFULLY** insert mechanlcal seal stationary (43.30) over shaft and press into position in center body (10.90).

Determining Thickness of Clearance Shims (52.511

GENERAL: It is possible to determine clearance by measuring impeller, center body depth, and shaft shoulder to center body length. However, in order to ease field assembly, this procedure is simplified by installing a measured, oversized shim set (52.51), then measuring the clearance between the impeller front face and outside mounting face of the center body (10.90). The required actual shim thickness necessary is then obtained by adding the face clearance figures measured to the normal clearance obtained from Table 7, and then subtracting this result from the known trial shim thickness.

Procedurefor Establishing Impeller Shim Thickness

1. Using a micrometer, measure the complete set of shims as supplied and record. This set should exceed 0.030".

2. Lubricate shim washer stock lightly with grease (to hold in place) and place carefully in the recess of impeller (23.50).

3. Carefully install impeller (23.50) on motor shaft and tighten. Do not tighten using impeller blades, or damage may occur.

4. Place a straight edge across the impeller and measure the clearance between the straight edge and machined mounting face of center body (10.50) using feeler gauges (refer to Figure 7). Record this dimension.

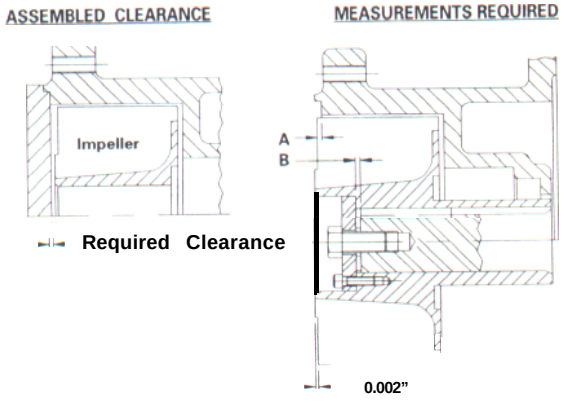


FIGURE 7

5. Total the required clearance per Table 7 and trial clearance measured in Point 4. NOTE: Straight edge must be across impeller hubs, since blade tips are recessed 0.002". per Figure 7.

6. Subtract measurement determined in Point 5 from total trial shim set measured in Point 1. The resulting figure is the final shim thickness necessary.

Continuing Assembly

7. Remove impeller (23.50) which was trial installed in Point 3.

8. Place rotating seal assembly (43.30) over shaft and into position against stationary seat.

SS *8a. If set screw type seal (John Crane type 8-1) is used, measure the locating dimension per auxiliary Figure 9, and scribe a line on the shaft at this point for LEM 15 & 20.

SS *8b. Carefully push rotating seal assembly over shaft into position and tighten, securing set screws. Be careful to tighten set screws evenly to avoid "cocking" of the seal on the shaft.

9. Lightly grease shims (52.50) determined in Point 6 and place in position in impeller locating bore.

10. Screw impeller onto shaft and tighten to 30 ft/lb.

11. Final check clearance between impeller face and center body (10.50) with straight edge and feeler gauges. Clearance should be per Table 7.

12. Place orifice balls (75.40) and locating pins (56.21) in their locating holes in cover (10.10).

13. Apply liquid gasket compound to all sealing faces of cover (lO.lO), then mount Intermediate (13.70) to cover, ensuring locating pins engage In holes In the intermediate.

14. Insert cover bolts (90.10) and tighten to 10 ft/lb.

PART Ill · Reinstallation

1. Final check for impeller binding by rotating motor shaft using large screwdriver inserted in motor shaft through knock-out plug In the rear of the motor.

2. Reinstall pump and motor.

3. Use suitable thread sealant and reinstall threaded inlet and discharge pipes. Do not overtighten, and ensure no pipe stress is applied to casing!

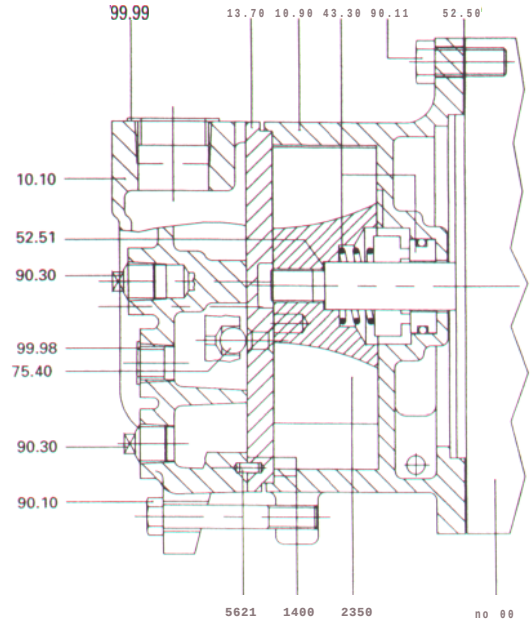
4. Reinstall service liquid supply line at the Ub connection, continuous drain Ue, and anti-cavitation piping at Uc, as applicable.

5 Perform the start up procedures as outlined in the Installation and Operattons Manual, Pages 4 through 8.

SS *For set screw mounted seals only.

PARTS LISTS/SECTIONAL DRAWINGS FOR LEM PUMPS

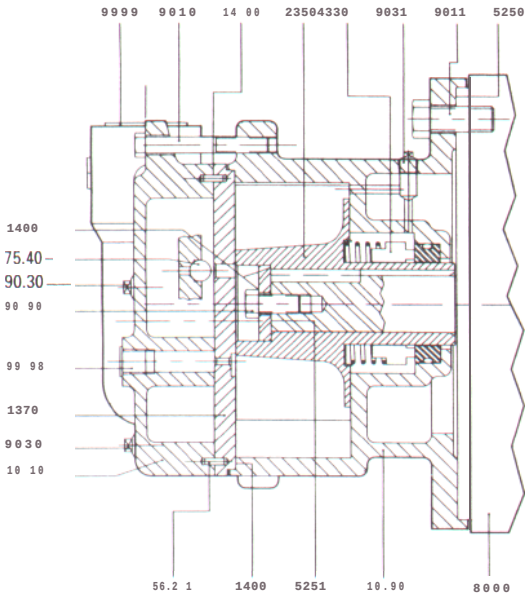
LEM 15120



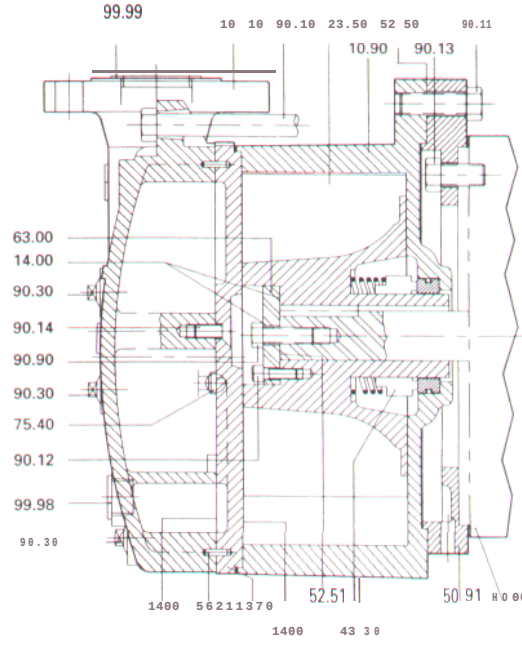
ITEM DESCRIPTION

10.10	COVER
10.90	CENTER BODY
13.70	INTERMEDIATE
14.00	GASKET-LIQUID
23.50	IMPELLER
43.30	MECHANICAL SEAL
52.50	SHIM SET
52.51	SHIM
56.21	LOCATING PIN
75.40	ORIFICE BALL
80.00	MOTOR/TEFC
90.10	BOLT
90.11	BOLT
90.30	PLUG
99.98	PLUG-PLASTIC
99.99	PLUG-PLASTIC

LEM 40/60



LEM 11 O/l 701250



ADDED PARTS FOR LEM 40/60

ITEM DESCRIPTION

63.00	IMPELLER PLATE
90.90	BOLT

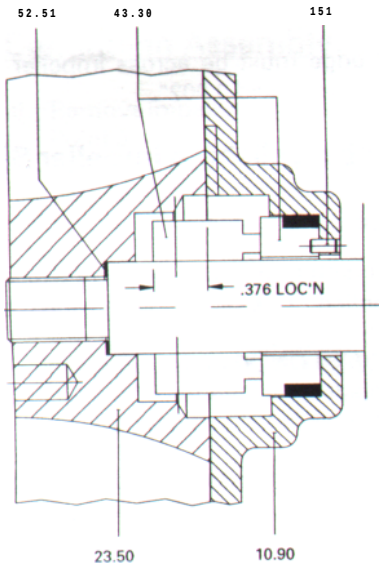
ADDED PARTS FOR LEM 110/170/250

ITEM DESCRIPTION

50.91	MOUNTING SPACER
63.00	IMPELLER PLATE
90.12	CYLINDER SCREW
90.13	BOLT
90.14	MACHINE SCREW
90.90	BOLT

FIGURE 8

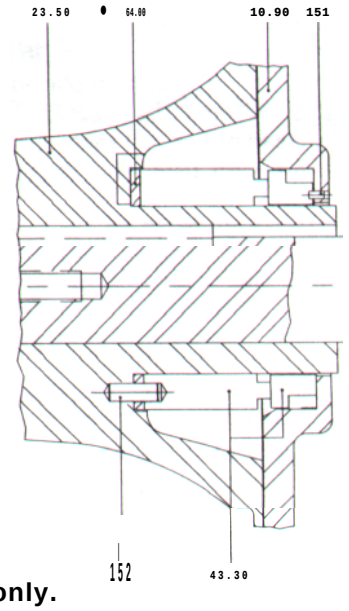
LEM 15/20



ITEMS DESCRIPTION

10.90 CENTER BODY
23.50 IMPELLER
43.30 MECHANICAL SEAL
"64.00 SPACER
151 PIN
152 DRIVE PIN

LEM 40/60/1 1 O/l 70/250



"Item 64.00 applies to LEM 110 only.

FIGURE 9

ASSEMBLY & DISASSEMBLY · LEM 40, 60,110,170 & 250

PART I - Disassembly

Preparation for Disassembly

1. **Remove drain** plug (lowest plug on the cover) and drain the pump completely.

   DANGER: If liquid or gases handled are toxic, be certain to follow accepted procedures when draining or disassembling equipment. Safety reaulations must take precedence over any procedure noted in this manual.

2. Remove pump from the installation.

   NOTE: It is possible to service the unit without removing the motor. However, in most instances, it will be more convenient to remove pump and motor unit from the system.

3. Remove five bolts (90.10), then carefully remove cover assembly (10.10), complete with intermediate (13.70), from center body (10.90).

   NOTE: To break the gasket seal between the intermediate and center body, use a screwdriver blade inserted between the intermediate and the center body.

4. (LEM 40/60 ONLY) - Remove impeller mounting bolt (90.90).

4. (LEM 110/170/250 ONLY) - Remove the four plate securing bolts (90.12) and impeller mounting bolt (90.90). Remove impeller mounting plate (63.00) and shims (52.51) from impeller.

5. Slide impeller (23.50) from the motor shaft.

6. Inspect center body (10.90). If wear is not seen or may be cleaned with the aid of emery cloth, do not remove unless it is necessary to replace the mechanical seal seat (43.30), or it is necessary to service the motor.

   If removal is necessary and the same center body is to be returned to the same motor, carefully remove mounting bolts (90.11) and note of shims (52.50).

7. Remove center body (10.90) from mounting flange (50.91) and store shims carefully marked as to proper location.

continued/ next page

8. Press mechanical seal stationary (43.30) from the center body.

9. Remove screw (90.14) from intermediate, pry intermediate (13.70) from cover (10.101, and then remove orifice balls (75.40).

Refurbishment

1. It is suggested that if the pump is completely disassembled, that orifice balls (75.40) and mechanical seal (43.30) be replaced.

2. Carefully clean orifice bail seats and guide holes to remove corrosion, using fine emery cloth.

3. Inspect intermediate (13.70) for wear on the flat (impeller) side. If the plate is not deeply grooved, refurbish by cleaning corrosion from the face by rubbing on a piece of fine emery cloth mounted on a flat surface.

   Inspect the mechanical seal surface of the impeller hub. If care is taken, wear on the hub should not be significant, especially if John Crane type #21 or Sealol #43 are used.

   If sealing surface is damaged, impeller rework or replacement will be necessary to prevent leakage. Contact the factory for information.

   SIHI LEM pumps are precision pieces of equipment. Use only SIHI supplied replacement parts.

PART II · Reassembly

1. If center body was not removed, proceed with Item 4 below. Otherwise, proceed with Steps 2 and 3.

2. Install center body (10.90) using bolts (90.11).

3. Mount a dial gauge on the motor shaft with probe riding on the inside rear machined face of the center body (10.90). then rotate about motor face. Set the dial gauge to zero at the highest point, rotate motor shaft and read the shim sizes needed in the area of bolts (90.11).

4. Loosen center body bolts (90.11) and install shims as necessary.

5. CAREFULLY insert mechanical seal stationary (43.30) over shaft and press into position in center body (10.90).

Determining Thickness of Clearance Shims (52.51)

GENERAL: It is possible to determine clearance by measuring impeller, center body depth, and shaft shoulder to center body length. However, in order to ease field assembly, this procedure is simplified by installing a measured, oversized shim set (52.511, then measuring the clearance between the impeller front face and outside mounting face of the center body (10.90). The required actual shim thickness necessary is then obtained by adding the face clearance figures measured to the normal clearance obtained from Table 7, and then subtracting this result from the known trial shim thickness.

NOTE: Straight edge must be across impeller hub, since blade tips are recessed 0.002".

Procedure for Establishing Impeller Shim Thickness

1. Using a micrometer, measure the complete set of shims as supplied. This set should exceed 0.030".

2. (LEM 110/170/250 ONLY) - Install impeller mounting plate (63.00) onto impeller (23.50) using sockethead screws (90.12).

   NOTE: Impeller mounting plate is an integral piece on the LEM 40 and 60, and should not need removal or replacement.

3. Insert impeller securing bolt (90.90) through mounting plate (63.00), then place measured shim set over bolt.

4. Slide impeller onto motor shaft then tighten, securing bolt (90.90).

5. Place a straight edge across the impeller hub and measure the clearance between the straight edge and machined mounting face of center body (10.50) using feeler gauges (refer to Figure IO). Record this dimension.

steps 6 and 7 on next page

ASSEMBLED CLEARANCE MEASUREMENTS REQUIRED

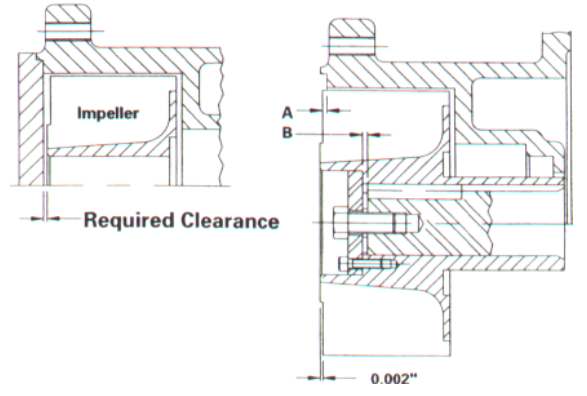


FIGURE 10

continued on next column

6. Total the required clearance per Table 7 and trial clearance measured in Point 4. NOTE: Straight edge must be across the impeller hub, since blade tip is recessed 0.002".

7. Subtract measurement determined in Point 6 from total trial shim set measured in Point 1. The resulting figure is the final shim thickness necessary (B).

Continuing Assembly

8. Remove impeller (23.50) which was trial installed in Point 3.

   SS *8a. (LEM 110 ONLY) - Reinstall drive pin (152) and spacer (64.00), then proceed with Item 9.

9. Place rotating seal assembly (43.30) over impeller.

   SS *9a. If special seal (John Crane type 8-l) is used, carefully push rotating seal assembly over shaft into position and locate drive pin in drive hole of rotating assembly.

10. Reinstall key in motor shaft.

11. Place shims determined in Point 7 into position and reinstall impeller.

12. Tighten impeller securing bolt (90.90) to 30 ft/lb.

13. Final check clearance between impeller face and center body (10.50) with straight edge and feeler gauges. Clearance should be per Table 7.

14. Place orifice balls (75.40) and locating pins (56.21) in their locating holes in cover (10.10).

15. Apply liquid gasket compound to all sealing faces of cover(IO.IO), then mount intermediate (13.7O) to cover, ensuring locating pins engage in holes in the intermediate (on LEM 110/170/250, install machine screw (90.14)).

16. Insert cover bolts (90.10) and tighten: LEM 40/60 10 ft/lb; LEM 110/170/250 30 ft/lb.

PART - Reinstallation

1. Final check for impeller binding by rotating motor shaft using large screwdriver through knock-out plug in the rear of the motor.

2. Reinstall pump and motor.

3. Reinstall service liquid supply line at the Ub connection, continuousdrain Ue, and anti-cavitation piping at Uc, as applicable.

4. Perform the start-up procedures as outlined in the Installation and Operations Manual, Pages 4 through 8.

SS * If pin drive seal (John Crane #8-1 is used.

SECTION F

PUMP ROUTINE MAINTENANCE

No special routine maintenance is required on the pump head, except to visually inspect for leakage.

WARNING: Do not attempt to operate pump unit if leakage is observed between pump and motor.

SECTION G

MOTOR ROUTINE MAINTENANCE

Lubrication

This is a ball bearing motor. No lubrication need be added before start-up. The bearings have been lubricated at the factory.

Relubrication Intervals

The following internals are suggested as a guide:

Hours of Service per Year	H.P. Range	Suggested Relube Interval
6,000	I/8 to 7 I/2	6 years
Continuous Normal Applications	10 to 15	1 year
Seasonal Service Motor IS Idle for 6 Months or More	All	1 year (beglnning of season)
Continuous High Ambients, Dirty or Moist Locations, High Vibrations, or Where Shaft End IS Hot (Pumps Fans)	1/8 to 40	6 months

Insulation Class	Consistency	TYPE	Typical Grease
A/B/F & H	Medium	Polyurea	Shell Dolium R

Procedure

If motor is equipped with Alomite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215 frame and smaller. On motors having drain plugs, remove grease drain plug and operate motor for 20 minutes before replacing drain

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215 frame and smaller. On motors having grease drain plugs, remove plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep grease clean. Lubricate motors at standstill. Remove and replace drain plugs at standstill. Do not mix petroleum grease and silicone grease in motor bearings.