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Installation, Operation and Maintenance Manual

Peerless Pump Company manufacturer of
LaBour LPLA/LHLA
Chemical Process Pumps

LPLA/LHLA Horizontal Process Pump IOM

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1.0 Preface

Thank you for purchasing a Peerless Pump Company, manufacturer of LaBour/Taber Chemical Process Pumps. These pumps are an ideal choice for applications involving the transfer of chemicals and industrial applications where long service life or special construction is required. Please READ THIS ENTIRE I.O.M. before attempting to install, operate or repair this pump. Failure to read and comply with installation and operating instructions will void the warranty of the manufacturer and may result in bodily injury as well as property damage. Properly installed, your pump will give you satisfactory, dependable service.

The instructions and recommendations contained in this manual are intended for personnel trained in installation, operation and maintenance of centrifugal pumps. It should be understood that the information enclosed will not relieve the operator from the responsibility of exercising normal good judgment in the care and operation of this equipment.

Peerless Pump Company assumes no responsibility for the design of foundations, piping systems or other manufacturers' equipment. We recommend that a specialist in the design and installation of pumping systems be consulted.

Peerless Pump Company pumps are identified by serial number, model number, type, style, and size. This information can be found stamped on the nameplates located on the pump. Leave the name plate securely attached to the pump for future references. Please reference pump serial number on all correspondence that you make with the factory, sales representative, or our sales department.

This book is intended to be a permanent part of your pump installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled, obtain a new copy from Peerless Pump Company.

2.0 Safety and Storage

The design, material and workmanship incorporated in the construction of Peerless Pump Company. pumps make them capable of giving long, trouble free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by periodic inspection and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and correct methods of installing, operating and maintaining these pumps. Further information can be obtained by contacting the local sales representative or Peerless Pump Company.

!~ SPECIAL WARNING ~!

Peerless Pump Company will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures higher than, nor used with liquids other than stated in the original order acknowledgment without written permission from Peerless Pump Company.

2.1 Check Points on Arrival

Care should be taken when unloading pumps. If shipment is not delivered in good order and in accordance with the Bill-of-Lading, note the damage or shortage on both receipt and freight bills.

Below is a minimum recommendation of items to check:

- Does the nameplate correspond to what you ordered?
- Are all the accessories supplied?
- Have any components been damaged in transit?
- Can the shaft be turned easily by hand? If heavy resistance is felt, or the pump does not turn at all, this may mean that the equipment has been damaged in shipping.

MAKE ANY CLAIMS TO THE TRANSPORTATION COMPANY PROMPTLY. This will reduce potential controversies when

claims are filed with the carrier. No claims will be considered later then thirty (30) days after receipt of shipment.

Instruction sheets on various components as well as the IOM for the pump are included in the shipment. DO NOT DISCARD!

2.2 Safety

A centrifugal pump, like most other high speed or pressure retaining devices, can be dangerous if misused. This danger is greatly increased when the pump is handling corrosive, toxic, or other hazardous liquids. Every caution must be taken against accidents that may endanger life or property.

Handling
Use qualified personnel (riggers) to lift or move the unit at all times. Never lift unit using hooks or slings on shafts. Never place eyebolts in tapped holes except for removal of a part to perform service work. For pump and base assembly, a two cranes and/or a spreader beam may be required to prevent the total included hitch angle from exceeding 60º (see below).

!~ DANGER ~!
Do not use pump or motor eyebolts for lifting pump unit.

Electrical Dangers
Proper consideration must be given to the dangers associated with the presence of electric currents. It is essential that safety devices, such as removable fuses and safety lockouts be used to guard against electrical shock or accidental pump starting.

Pump Application
This pump has been engineered for a particular application and operating point. Before using this pump in another service, Peerless Pump Company must be consulted to make sure that the pump will safely handle the application.

2.3 Storage

Short Term (less than 4 months)
Peerless Pump Company normal domestic shipping and storage preparation is suitable for protecting the pump during shipment in covered trucks. It also provides protection during covered storage at the job site, and for a short period between installation and start-up. It is recommended that the unit be stored in a environment that is relatively free of dirt and has controlled temperature and humidity.

The pump must be drained of any liquids that might have entered or condensed during shipment. This is required to prevent damage due to freezing. Repair any damage to the covers on the flanges and coat machined surfaces and all cast iron or ductile iron components with a corrosion preventive coating, Tectyl 506, Mobilarma 355, or equal.

It is recommended that a weekly inspection of the pump be made. Manually rotate the shaft several times at least once every month. Note the position of the shaft keyway to make sure that the shaft is stopped 180º from the last storage position.

Long Term (greater than 4 months)
Storage Area: Sheltered storage is required to protect the pumps from the effects of the elements. Pumps must be properly protected from moisture, dirt and physical damage during storage. The unit should be stored in a dry level covered area. A concrete floor is desirable. The storage area must be well ventilated.

Pumps: Remove packing from stuffing box (if equipped). Seal packing in a plastic bag and attach to the pump for future reinstallation. For mechanical seals see below (mechanical seal).

The pump must be drained of any liquids that might have entered during shipment. This is required to prevent damage due to freezing.

Exterior surfaces of iron and steel components should be given a heavy coat of rust preventative such as Tectyl 506, Mobilarma 355, or equal.

For pumps with an iron casing, a powdered form of “Volatile Corrosion Inhibitor” such as Shell VPI 260, or Cortec VCI-309, should be placed into the pump through the suction

flange. The suction and discharge flanges must be covered with a sturdy plastic flange cover and taped with waterproof duct tape to seal from the atmosphere.

Pumps of alloy construction should be stored with plastic screens taped over the suction and discharge flanges to allow the pump to “breath” while preventing the entry of debris. The pump must be protected from liquids entering through the screens.

Manually rotate the shaft several times at least once every month. Note the position of the shaft keyway to make sure that the shaft is stopped 180º from the last storage position.

After six months in storage additional oil/grease must be added to the bearings, purging some of the old grease from the cavity. If the pump has been stored more than twelve months, all old oil/grease must be purged from the bearing and replaced by new grease.

Motors: Refer to the motor manufacturer for their recommendations and instructions.

Peerless Pump Company recommends motors be stored in a clean dry area protected from extremes of temperature, moisture, shock and vibration. Storage temperatures of 50º - 120º F with a maximum relative humidity of 60% must be observed.

Motor windings must be protected from excessive moisture absorption. Do not wrap or cover the pump or motor in plastic as this will trap moisture and form condensation causing damage to the insulation of the windings. All motors equipped with heaters are to have the heaters connected and operating.

Machined surfaces should be given a heavy coating of rust preventative (such as Tectyl 506).

Manually rotate the shaft several times at least once every month. Note the position of the shaft keyway to make sure that the shaft is stopped 180º from the last storage position.

All condensate drains must be open and the drain must be at the lowest point of the motor.

After six months in storage additional grease must be added to the bearings, purging some of the old grease from the cavity. If the motor has been stored more than twelve months, all old grease must be purged from the bearing and replaced by new grease.

Motor windings are to be “MEGGED” after the motor is removed from long term storage. The resistance of the stator windings must be at least 1.5 Megohms. If this resistance is not achieved, the motor manufacturer must be consulted before proceeding.

Mechanical Seal: Refer to the seal manufacturer for their recommendations and instructions.

Peerless Pump Company recommends that as a minimum the seal cavity and gland must be dry before the pump is put into storage.

Plug all openings to the seal cavity and gland. Tape/seal the clearance between the gland and the shaft to prevent dirt and debris from entering the seal cavity.

Turn the shaft several rotations each month.

3.0 Installation and Operation

3.1 Location

Select a location for the pumping unit (pump, base plate, coupling and driver) which will:

(a) Be clean, well ventilated, properly drained and provide accessibility for inspection and maintenance (see outline drawing for dimension). Outdoor installations may require protection from the elements, particularly freezing.

(b) The suction supply system must provide the pump with Net Positive Suction Head (NPSH) equal to or greater than that required by the pump at any capacity over the expected operating range. Ask your representative for assistance if you do not understand how to calculate or measure suction supply system NPSH.

3.1.1 Foundation

Concrete (reinforced as necessary or required) is most widely used for the foundation. In sufficient mass, it provides rigid support, which minimizes deflection and vibration. It may be located on soil, structural steel or building floors, provided the combined weight of the pumping unit and foundation does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from engineering handbooks or local building codes for regional soil types.

3.1.2 Foundation Bolts

Before pouring the foundation, locate the foundation bolts using a template frame and provide anchorage as shown in Figure 1. See the outline drawings furnished with each pump for the exact location of the foundation bolts. When pouring, allow for a grout thickness of 3⁄4 to 1-1⁄2 inches between the top of the foundation and bottom of the base. Roughen the top surface of the foundation to provide a good bond for the grout.

3.1.3 Mounting and Leveling the Unit

!~ CAUTION ~!

Use qualified personnel (riggers) to lift or move unit at any time. Never lift unit using hooks or slings on shafts. Never place eyebolts in tapped holes except for removal of a part to perform service work.

When the unit is received with the pump and the driver mounted on the base plate, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until alignment operations have been completed. The base plate should be supported on rectangular metal blocks and shims or on metal wedges having a small taper. The support pieces should be placed close to the foundation bolts (Figure 2). On large units, small jacks made of cap screws and nuts are very convenient. In each case the supports should be directly under the part of the base plate carrying the greatest weight and spaced evenly to provide uniform support. A spacing of 24 inches is suggested on medium size units. A gap of about 3⁄4 inches to 1-1⁄2 inches should be allowed between the base plate and the foundation for grouting.

Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the coupling faces and the suction and discharge flanges of the pump for horizontal or vertical position by means of a level. The position can be corrected if necessary, by adjusting the supports or wedges under the base plate as required until desired alignments are reached.

!~ CAUTION ~!

Pumps and drivers mounted on a common base plate were accurately aligned before shipment. All base plates are flexible to some extent and, therefore, must not be relied upon to maintain the factory alignment.

Realignment is necessary after the complete unit has been leveled on the foundation and again after the grout has set and foundation bolts have been tightened. The alignment must be checked after the unit is piped and rechecked periodically as outlined in the following paragraphs.

3.1.4 Alignment

Reliable, trouble free and efficient operation of a pumping unit requires correct alignment of pump and driver shafts. Misalignment may be the cause of:

(a) Noisy pump operation

(b) Vibration

(c) Premature seal and bearing failure

(d) Excessive coupling wear

Factors that may change the alignment of the pumping unit are:

(a) Settling of the foundation

(b) Springing of the base plate

(c) Piping strains

(d) Settling of the building

(e) Shifting of pump or driver on the base

3.1.4.1 Alignment Check

The following checking procedure applies to a pumping unit consisting of a pump, flexible coupling and driver mounted on a common base plate. Check alignment as follows:

1. Disconnect the coupling halves.
2. Set the coupling flange gap to the dimension shown in the appendix for TBG Wood's Couplings.
3. The preferred test for parallel and angular alignment may be made with a dial indicator mounted as shown in Figure 3. Proceed as follows:
   a) Scribe the index lines on the coupling halves (as shown) or mark where the indicator point rests.
   b) Set indicator dial to zero.
   c) Slowly turn BOTH coupling halves so that index lines match, or indicator point is always on the mark.
   d) Observe dial reading to determine whether the pump or the driver needs adjustment.
   e) Acceptable parallel and angular alignment is achieved when total indicator reading (complete turn) are within limits specified by the coupling manufacturer. Refer to page 28.
   f) With coupling halves stationary, make trials at four places 90° apart. Perfect alignment occurs when a straight edge is level across the coupling halves and the same gauge slightly enters between the halves, both conditions at all points.

When significant operating temperature differential exists between the pump and driver (i.e. steam turbine drive with pump handling cold liquid), thermal growth will cause the hottest unit to rise. Compensate for this growth by setting the hottest unit 0.003 to 0.005 inch low. When both units are at normal operating temperature, a final check of coupling alignment must be made. Correct the alignment as necessary.

!~ CAUTION ~!

Check for correct electric motor rotation as described in the paragraphs under section 3.1.8 while coupling halves are disconnected.

3.1.4.2 Alignment Adjustment

Since all base plates are flexible, they may be distorted from transportation or handling. Therefore, it may be necessary to correct excessive parallel and angular misalignment by shifting the leveling wedges under the base plate. Tap lightly (in or out) on a wedge with a hammer. Recheck alignment after each adjustment.

(a) In some instances, for factory aligned pumping units, it may be necessary to change the shims under the pump or driver, or even relocate these factory-positioned units on the base plate. Make such changes only after it is certain that alignment cannot be obtained by adjusting of the wedges.

(b) If wedges are shifted or shims changed a substantial amount to obtain proper alignment, recheck piping alignment and the level of the shafts.

!~ CAUTION ~!

Pumping unit shafts must be level, have proper alignment and the piping must mate with the pump flanges without strain. All three conditions must be correct to provide proper performance and long life of the pumping unit.

3.1.4.3 Alignment Recheck

Recheck alignment, and correct as required, after:

1. Mounting
2. The grout has hardened
3. Foundation bolts are tightened
4. Piping is connected
5. Pump, driver, or base plate is moved for any reason

3.1.5 Grouting

!~ NOTE ~!

Unless otherwise specified on the unit outline drawing, the base plate must be completely filled with grout and the leveling wedges grouted in place. The product warranty IS VOID if this instruction is not followed.

When the alignment is correct, the foundation bolts should be tightened evenly, but not too firmly. The unit can then be grouted to the foundation. Foundation bolts should not be fully tightened until the grout is hardened, usually about 48 hours after pouring. Installation without grout completely filling the base plate is acceptable only when recommended by specific notation on the unit outline drawing.

Grouting should completely fill the base plate to ensure minimum vibration levels. Grout compensates for unevenness in the foundation and base plate and distributes the weight of the unit uniformly over the foundation. Grout also prevents the unit from shifting after mounting and alignment. It is essential that the pumping unit be expertly grouted using a non-shrinking grout. The mix required varies with the type of unit to be grouted, location and amount of grout. The instructions included with the non-shrinking grout package will provide the required information for the proper mix for individual applications. Grout the unit as follows:

1. Build a form of plywood or thick planking around the foundation to contain the grout. Support adequately to prevent deformation.
2. Soak the top of the concrete pad thoroughly with water before grouting. Remove all surface water before pouring.
3. Pour the grout through the holes provided in the base plate or through the open ends for steel channel base plates. While pouring, tamp thoroughly in order to fill all cavities and prevent air pockets.

!~ NOTE ~!

During pouring and tamping, the grout may trap air in some places. Drill small vent holes through the base surface as needed.

4. After the grout has thoroughly hardened, tighten the foundation bolts and connect the piping.
5. Be certain piping does not strain pump flanges.
6. Check the alignment after the piping is connected and the foundation bolts are tightened.
7. Connect the coupling halves.
8. After the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

!~ CAUTION ~!

It is very important to support and secure both the suction and discharge pipes near the pump to avoid application of the forces and moments to the pump casing. Failure to support the piping properly can cause excessive pipe strain on the casing which can affect alignment, cause vibration, and promote rapid wear of seals and bearings. Damage caused by pipe strain will void the warranty.

3.1.6 Suction Piping - General

Improperly installed suction piping is a potential source of faulty operation. To achieve best performance, provide for the following:

1. Suction pipe should be same size as the suction flange. This will reduce priming time.
2. For suction lift applications, the suction piping must be as short as possible. Long lengths of horizontal piping may cause priming problems.
3. Minimize the number of flange fittings and joints to avoid potential leak areas. When practical, welded joints are preferred to reduce emissions or leaks.
4. The suction pipe should be hydrostatically tested for leaks at initial installation, and every twelve months thereafter. Air leaks on the suction side of the pump may prevent the pump from holding prime and could result in damage to the pump.
5. When possible a suction side valve should be avoided. When a valve can not be avoided, it must be installed in a horizontal position or facing downward in order to prevent accumulation of air. Be sure to keep the valve fully open when the pump is running and during priming.
6. Make bend sections as gentle as possible and keep the number to a minimum.
7. Arrange pipe so that there is an upward incline to the suction side of the pump (approximately 1/50 slope) in order to prevent air collecting in the piping.
8. When the supply source is feeding more than one pump, separate suction lines are required.

3.1.7 Discharge Piping

Discharge piping must allow for the free exhausting of air and vapors during the priming cycle.

1. Do not undersize the diameter of the discharge piping. Provide air vent valves where necessary since accumulation of air has an adverse effect when it occurs on the discharge side of the pump.
2. When the discharge piping has a vertical leg, it is best to install a check valve to prevent reverse rotation during pump shutdown and to avoid water hammer. Since there is no means for air to escape during operation, air vents below the check valves are required.
3. If the discharge piping has a vertical leg followed by a dropping of the pipe to form a siphon, the highest part of the discharge pipe must not exceed the shutoff head of the pump.

3.1.8 Electric Motor Driven Units

For electric motor drives, connect power supply to conform with national and local codes. Line voltage and wire capacity must match the ratings stamped on the motor nameplate.

To check motor rotation it is recommended to:

1. With the coupling halves disconnected, momentarily energize the motor to check that rotation is in the same direction as the arrow on the pump.
2. If the motor is a three phase type, reverse rotation (if required) by interchanging any two of the three power leads. The rotation of most single phase motors is fixed by internal wiring and cannot be easily changed.

3.1.9 Stuffing Box

Packing: Stuffing box packing is installed at the factory. Gland bolt nuts should be installed finger tight only. Packing cannot run dry, it must be lubricated. If the pumpage is clean, cool fluid, it may be used through a bypass connection off the discharge to the lantern ring to lubricate the packing. If the pumpage is dirty or hot, it is not suitable to lubricate the packing and an external source must be utilized unless the bypass is equipped with proper separator, filter, and/or cooling system. This must also be piped into the lantern ring connection (refer to packing recommendations) for lubrication.

Mechanical Seals: When mechanical seals are supplied, they are installed and adjusted at the factory. They must not run dry or come into

contact with abrasives in the pumpage. Connect recirculation, flush, and/or cooling lines as required, following instructions on the seal drawing supplied. On the cartridge type seals installed at the factory, the centering clips are removed. Follow instructions on the seal drawing supplied.

3.1.9.1 Packing Recommendations

1. Chemical and Solvent Packing – This is a PTFE-Graphite packing. It is used for severe chemical and solvent applications. It has a PH range of 0 to 14 and a maximum operating temperature of 550 degrees F. This packing is similar to Sepco ML4002 or Crane type C1065 or equal.
2. High Pressure and Temperature Packing – Often called Graphoil, it is used in clean high pressure and temperature applications. It has a PH range of 0 to 14 and a maximum operating temperature of 750 degrees F.

3.2 Operation

3.2.1 Start-up Check List

3.2.1.1 Checking Shaft Rotations

1. With power off and locked out, remove spacer between coupling hubs.
2. Restore power, and momentarily energize motor to determine rotation. Motor shaft must rotate in the direction of arrow on the pump bearing frame or casing. See Section 3.1.8 on changing rotation.
3. Shut off power and lock out.
4. Impeller clearance is set at the factory. Do not rely on factory setting, which could be affected by piping connections, or if high temperature liquids are to be pumped, the impeller setting must be adjusted. See Section 4.1.3 for adjustment procedures.
5. Reinstall coupling spacer. Make sure coupling hubs are secured to the shafts. Lubricate coupling as required per manufacturer's instructions. RECHECK ALIGNMENT.
6. Install coupling guard.

3.2.1.2 Bearing Lubrication

Oil Lubrication: PUMPS ARE NOT SHIPPED FROM THE FACTORY WITH OIL.

Pure Oil Mist Lubrication: When ordered, power frames are drilled and tapped with connections for oil mist systems. The connections are located on the top of the bearing frame. Follow instructions from the manufacturer of the oil mist generator system. If you are using flood oil lubrication, instructions for converting to oil mist can be obtained from the factory.

Grease Lubrication: Pumps shipped from factory contain some grease but it is not sufficient for placing the pump into continuous service. Refer to page 14.

Greased for Life Bearings: These bearings are greased and permanently sealed by the bearing manufacturer.

See page 14 for recommended lubrication schedules.

3.2.1.3 Shaft Sealing - Refer to section 3.1.9.

!~ WARNING ~!

Never allow pump to run dry, or operate pump without liquid in the seal chamber. Seal faces must always be lubricated. Operating a pump without liquid in the casing or seal chamber, even for a brief period, can cause seal failure, pump damage and or personal injury.

3.2.1.4 Priming

1. Add priming charge to pump through the trap cover. The priming charge liquid must be compatible with the process and the liquid being pumped.

!~ CAUTION ~!

The pump must be filled with a liquid before it is started or close-clearance rotating parts and seal will be damaged from running dry. Double or tandem seals, must be flushed with clean pressurized fluid in the seal cavity.

2. After the initial priming charge has been added, the pump will retain enough liquid for subsequent starts.
3. Rotate the motor by hand in both directions to make sure that all air has been expelled from the seal chamber. Start external seal flush (if required for single seal, mandatory for double and tandem seals).

3.2.2 Starting the Pump

Turn the pump shaft by hand to ensure that the rotating element is free. If the rotating element rubs or binds, check for any abnormal piping strain or other loads on the pump causing misalignment. A slight drag from the mechanical seal is normal.

1. Check that the voltage and frequency on the motor nameplate match the current supply. Be sure the motor is wired for correct voltage. Check that all thermal overload relays are of the proper size and "set" for operation.
2. Be sure the valve in the suction line is open. Never use the suction line valve to control flow. The discharge valve should be open. See that all pipe connections are tight. Make sure all flushing and cooling lines are open.
3. Restore power supply and start the pump motor/driver. As soon as pump reaches full speed, slowly adjust the discharge valve.

!~ WARNING ~!

Do not operate the pump below minimum rated flow levels or against a closed discharge valve for prolonged periods of time. This can cause increased vibration levels which will affect seal and bearing life. It can also cause cavitation damage to the internal surfaces of the pump.

!~ CAUTION ~!

If the pump fails to prime after FOUR minutes of operation, the pump must be shut down & the cause of the priming problem fixed. This must be done to prevent pump damage from over heating of the priming charge.

4. Listen for rubbing or binding which may have been caused by piping strains. If present, shut down the pump immediately. Investigate and correct the cause before restarting the pump.
5. Check the packing/mechanical seal for proper operation. Packing should have a leakage rate between 10 to 30 drops per minute. Never force the packing into a leakproof position since this will create excessive friction and premature damage to the packing and shaft or shaft sleeve. If leakage is excessive, tighten the gland bolts evenly, about 1/4 turn at a time. Allow the packing to seat in its new position. Packing must be "run-in" and this could take several hours or days to achieve the desired results.

   Mechanical seals are installed and adjusted at the factory. No further adjustment is required.
6. After the pump has been operating for a sufficient length of time to bring it up to operating temperatures, the final alignment should be checked. Once the pump has reached operating temperature, stop the pump, lock out the power source, and immediately remove coupling guard. Disconnect coupling and check the alignment. Make any necessary adjustments at this time. Reconnect coupling and replace coupling guard.

!~ WARNING ~!

NEVER run pump without the coupling guard. disregard of this warning can result in serious personal injury or death.

3.2.3 Noise Check

Entrainment of air or solids from the suction source often gives rise to abnormal noise and vibration. Loud shrillness usually indicates component failure requiring the pump to be shutdown immediately. Unusual noises should be investigated immediately for cause and corrective action.

3.2.4 Vibration Check

Precautions are required in the case of vibration caused by cavitation, or poor installation. Adjust the flow rate as needed with the discharge valve only. The discharge valve must remain open during normal operation.

Typical and normal level vibration for a new installation should be below 0.10 in/sec with an upper limit of 0.15 in/sec. In no case should operational levels be in excess of 0.20 in/sec, unless emergency conditions exist requiring operation. Operation with vibration at excessive levels severely reduces pump service life and damages a greater number of pump components.

3.2.5 Performance Check

Discharge pressure and flow should be monitored at regular intervals and recorded. Over time performance will decrease with respect to pump wear. Pumping of abrasive solids will degrade performance at a much higher rate. Bearing and process temperatures can also add valuable input to a predictive maintenance program.

3.2.6 Stopping the Pump

Under normal conditions, the discharge valve must be closed before stopping operation of the pump. Pump operation with the discharge valve closed, must be limited to no more than one minute. Lock out motor power supply to prevent accidental restart when performing inspection or routine maintenance.

When operating under pressurized suction conditions, close the discharge valve first and stop operation of the pump. This is an unusual situation and care must be exercised as the pump cannot be isolated from the pressure and can pose a personnel hazard if maintenance is performed with the tank pressurized.

When the pump stops due to a power failure, first turn off the power switch and close the discharge valve manually. When power is restored refer to “Start-up” above to return to operation.

3.2.7 Freeze Damage

Special care is required during the cold season since retained liquid will freeze, upon which it will expand, causing cracks and other serious damage to pumps and piping systems.

3.2.8 Other Precautions

Installed spare pumps should not be left unused for long periods of time, but utilized periodically to confirm that they are ready for use when needed.

Operation must be restricted within the limits shown on the performance curve or as specified by Peerless Pump Company. Do not use with an insufficient or excessive flow rate.

4.0 Preventive and Corrective Maintenance

A planned program of routine inspection and preventive maintenance can increase the service life of your pump. Maintenance records should be kept for each pump in a data base which will be beneficial in developing long term maintenance planning. Regular check ups of the following items will help keep your pump running trouble free and keep costly downtime to a minimum.

4.1 Daily/Weekly Routine Inspection and Maintenance

1. Observe oil level and condition through sight glass or Trico oiler if provided. Oil level should be visible and at the level indicated on the sight glass. Slight foaming under operation is normal. Contaminated oil should be changed immediately.
2. Grease lubricated bearings should be re-greased at start-up and approximately every 2000 hours of operation. Refer to page 14 for recommended grease manufactures.
3. Check mechanical seal chamber for leaks. Mechanical seals should not leak. Visible signs of leakage should be investigated immediately.
4. Visually inspect pump and piping for leaks. Inspect all tapped and plugged connections. Check for unusual noise or

vibrations. Check for high bearing temperatures.

5. Periodically, check foundation bolts, pipe supports and pump to motor alignment.
6. If performance deteriorates, refer to troubleshooting, Appendix 8.1.

4.1.1 Oil Lubricated Bearings

!~ CAUTION ~!

Pumps are not shipped from the factory with oil. Responsibility for filling the bearing frame with the proper type and amount of oil is the responsibility of the user.

A high quality turbine oil with rust and oxidation inhibitors should be used. Under normal operating conditions, an oil of 300 SSU viscosity at 100° F should be used where pumping temperatures do not exceed 350° F (177°C).

Change oil after 200 hours of operation for new bearings, then every 2000 hours or three months whichever occurs first.

RECOMMENDED OIL MANUFACTURERS

Atlantic Richfield	**Duro 68**
Chevron	**Chevron Turbine Oil GST 68**
Exxon	**Teresstic 68**
Texaco Inc.	**Regal R&O 68**
Mobil	**DTE Heavy-Medium**
Amoco Oil	**Amoco Industrial Oil #68**

4.1.1.1 Oiler Installation

1. Remove the plastic thread protector on the on the oiler mounting nipple. The oiler is packaged separately and is included in an accessory box fastened to pump shipping skid. The oiler manufacturers installation instructions are included with the oiler.
2. The bearing housing has been pre-drilled and tapped at the factory to the correct dimension and no further machining or adjusting is required.
3. Remove oiler from box, loosen (3) set screws holding upper casting to lower casting and remove upper casting with plastic reservoir intact.
4. Remove plastic thread protector from pipe nipple installed in bearing housing and seal threads with Teflon tape or a suitable thread sealing compound.
5. Thread lower oiler casting onto bearing housing pipe nipple by hand.

!~ CAUTION ~!

DO NOT OVER-TIGHTEN Castings on oiler are zinc and over-tightening can result in thread damage and oil leakage.

6. Fill the bearing housing by pouring oil into the removable breather until level is just visible in the lower casting (for recommended oil see oil lubrication guide). Use the oiler reservoir to fill beyond this point to prevent over filling.
7. Tip reservoir so that beveled stem is facing upward and fill with oil. Place thumb over reservoir spout, invert and slide reservoir and upper casting over lower casting until it seats as low as possible. The oil level is determined by the setting of the reservoir so it is important to make sure that the reservoir seats as low as possible. Several fillings of the oiler reservoir may be required before the final oil level is reached. When no more oil will run out of the reservoir bottle the oil level should be in the middle of the oil level sight glass.
8. Tighten the three setscrews to secure upper casting to lower casting. From this point on only a periodical filling of the lubricator's reservoir is required.
9. It is extremely important that the proper oil level is maintained. Too low an oil level will result in rapid bearing failure. Too high of an oil level will cause foaming and heating of the bearings and degradation of the oil and premature bearing failure will occur. The proper oil level range will be +/-0.050"

from the centerline of the oil level sight glass.

4.1.2 Grease Lubricated Bearings

!~ CAUTION ~!

Grease lubricated ball bearings are optional on the LPLA/LHLA series. These units can be identified by grease fittings located on the bearing frame (see figure b). Pumps ordered with regreaseable bearings from the factory will contain some grease, but not a sufficient amount for placing the pump into continuous service. It is necessary to completely grease the bearings as described below before placing the pump on line. Failure to do this may result in repairs not covered by the product warranty.

Clean any dirt or foreign matter from the grease fittings. Remove grease relief plugs from bottom of frame. Pump grease through the fittings and into each bearing cavity until fresh grease comes out of the relief ports. REGREASE BEARINGS EVERY 2000 HOURS OF OPERATION OR 3 MONTHS, WHICHEVER OCCURS FIRST. For pumping temperatures less than 350° F, use a lithium based mineral oil grease of NLGI consistency equal to NO. 2. NEVER MIX GREASES OF DIFFERENT CONSISTENCIES OR OF DIFFERENT TYPES. WHEN CHANGING FROM ONE TYPE OF GREASE OR CONSISTENCY TO ANOTHER, ALWAYS REMOVE THE BEARINGS AND CLEAN OUT ALL THE OLD GREASE.

ACCEPTABLE GREASE MANUFACTURERS

NGLI Grade 2	(350 Deg F. Max)
Mobil	Mobilux EP2
Exxon	Unirex N2
Sunco	Multippurpose EP
SKF	LGMT2

NGLI Grade 3	(500 Deg F. Max)
Exxon	Unirex 3
SKF	LGMT3

4.1.3 Impeller Clearance Adjustment LPLA/LHLA Pumps

If a gradual loss in head and/or capacity occurs, adjusting the impeller clearance may restore performance. If performance cannot be restored by adjustment, the pump should be disassembled and impeller and casing inspected for wear. Impeller clearance is the measurement between the edge of the impeller vanes and the surface of the casing. The following table should be used as a guide for setting the impeller clearance under various operating temperatures.

Temperature	Impeller Clearance
up to 200 F (93 C)	0.015 in (0.39mm)
201 to 250 F (121 C)	0.017 in (0.43mm)
251 to 350 F (149 C)	0.019 in (0.48mm)
351 to 499 F (177 C)	0.021 in (0.53mm)
401 to 450 F (218 C)	0.023 in (0.58mm)
451 to 500 F (246 C)	0.025 in (0.54mm)

4.1.3.1 Dial Indicator Adjustment of Impeller Clearance

1. LOCK OUT POWER SUPPLY TO MOTOR.
2. Remove coupling guard and coupling.
3. Place a dial indicator with a magnetic mounting base on the surface of the pump baseplate. Position indicator against face of pump shaft. SEE FIGURE D.

Figure D.

4. Loosen jacking bolts (370D) and jam nuts (423) and remove shim packs. Tighten bearing housing bolts (370C) evenly, while slowly rotating the shaft until the impeller

just starts to rub on the casing. Set dial indicator to zero.

5. Tighten the jacking bolts (370D) evenly, until they contact the bearing frame. Continue to tighten the jacking bolts evenly, about one flat at a time, drawing the bearing housing away from the frame until the dial indicator shows the proper clearance, from .015 inch to .025 inch (See 4.1.3 for recommend setting)
6. Reinstall the correct amount of shims between the bearing cartridge and the rear face of the bearing housing. Each of the four shim packs must be uniform to within 0.002" of each other.
7. Tighten bearing housing bolts (370C) evenly, then tighten jacking bolts (370D) evenly. Make sure dial indicator reading does not move from the proper setting. Rotate shaft to make sure that it turns freely.
8. Reinstall coupling and coupling guard.

4.2 Vibration & Predictive Maintenance

Vibration monitoring should be part of a structured predictive failure analysis program. Early detection of pump problems is desirable, when damage is minor, so equipment is analyzed on line for diagnosis. Mechanical problems are determined before catastrophic failure; therefore, maintenance can be scheduled at a time that is convenient. The result of a good predictive maintenance program is reduced downtime, reduced maintenance cost, prevention of secondary damage and improved plant safety.

A predictive maintenance program is specifically tailored to the user's needs; as a result, programs and monitoring equipment vary from user to user. Therefore, we can only offer simple guidelines for vibration monitoring. Ultimately, the success of the program relies on the expertise of the user.

4.2.1 Monitoring Schedules

Pumps should be monitored in accordance with a prescribed schedule where vibration levels are recorded on an equipment data sheet to establish a history of the unit's condition. A trend of increasing vibration level is a sign of developing mechanical problems. These increases are compared to a baseline reading and maintenance is schedule at a predetermined vibration increase. A graph showing vibration trend vs monitoring date is a very useful analysis tool.

The baseline vibration level is the vibration of the unit while it is operating in good condition, without cavitation, with good coupling alignment, without undo pipe strains, and with straight suction piping to the casing for uniform flow. If previous vibration history is unavailable, a baseline reading can be determined from a similar unit in operation in good condition, or the factory can be consulted for a baseline value taken when the pump was tested before shipment.

Monitoring schedules are predetermined by the program administrator and will vary by application and useful failure detection period. This period is based on the time between confirmation of a machine problem and catastrophic failure.

Pumps that are in a very critical or hazardous service should be considered for a continuous monitoring system that will shut down or alarm when the predetermined vibration levels increase.

4.2.2 Scheduled Maintenance

Maintenance should be scheduled at a predetermined vibration level increase above the baseline value. This level is determined by the user and will vary depending on the application.

As a general rule, maintenance should be scheduled when:

- Vibration exceeds twice the baseline value.
- Vibration level exceeds 0.20 in/sec.

4.2.3 Measuring Procedure

1. Connect the pickup (accelerometer). The pickup should be placed on a rigid part of the pump where it can be securely held,

typically in a horizontal/radial position on the bearing housing. The pickup must be connected at the same location each time the pump is monitored. This location should be illustrated on the data sheet an/or physically marked on the pump.

2. Check the operation conditions. The pump vibration will vary at different points along the pump performance curve, so the pump head and capacity should be at the design or baseline condition each time the unit is monitored.
3. Take a reading. Turn the vibration analyzer to the velocity (in/sec) setting and set to an appropriate scale (the lowest setting that will read full amplitude). Make a spectrum plot and mark the maximum velocity on the pump data sheet.
4. Check results. Compare vibration reading to the baseline reading and previous readings. It is useful to have a trend chart that shows changes in vibration level with respect to monitoring dates.

5.0 Disassembly

The following is the recommended step by step procedure for dismantling the pump for inspection and repair. The numbers ( ) referred to in this procedure are the same as those shown on the Sectional Drawing included in the appendix.

Before unbolting any flanges, match mark in order to ease the re-assembly and insure proper realignment.

5.1 Removing Pump Assembly

1. Lock out motor electrical breaker to prevent accidental starting of motor.
2. Remove the coupling guard. Loosen Coupling hub set screw to remove coupling spacer.
3. Drain any oil from the bearing housing (223), noting if any metallic particles are present. Remove the oiler assembly.

!~ CAUTION ~!

The pump must be drained of any hazardous liquids before it is removed. Since small pockets of liquid will always be contained in various pump cavities, care must be taken to protect people working on the pump!

4. Since the LHLA/LPLA series of centrifugal pumps are a back pull out design, most normal repairs and inspections can be carried out without removing the pump casing from the baseplate or removal from the suction and discharge piping. If this situation is thought to be the case, skip this section and go to item 6. If it is determined that major pump components must be repaired or replaced, then the entire pump assembly should be removed from its baseplate.
5. Use an overhead crane to carry the weight of pump while it is being lifted off of the baseplate. Using choke slings around the bearing housing and the suction flange is the best way to hitch the pump and to provide for a safe captive vertical lift. Move the pump to a maintenance area for further dismantling.
6. Remove nuts fastening the Adapter (218) to the Casing (200). Use an overhead crane to carry the weight of rotating element while it is being pulled out of the casing. Move rotating element to a workbench for further dismantling.
7. Use an adjustable wrench to hold shaft from turning (coupling hubs are normally furnished with flats for this purpose). Use a rubber mallet to loosen the Impeller (206), turning in a counter-clockwise direction. Remove impeller.
8. Remove the Gland Nuts and loosen the Gland (212).
9. Remove the two Capscrews (211) fastening the Stuffing Box Cover (210) to the Adapter (218). Remove the Stuffing Box Cover. No further dismantling of pump is required to repair or replace the Mechanical Seal.

10. The Rotating Element is now dismantled. Inspection of all normal wear components can be carried out in this state.
11. Remove the Gland (212) and Mechanical Seal from the Shaft.
12. Remove the Adapter (218) (LPLA's only) from Bearing Frame
13. Loosen Cap Screws in the Bearing Housing and remove Shims. Using the two Jack Screw, remove the Shaft Assy and Bearing Housing from Bearing Frame
14. Remove the Bearing Retaining Snap Ring (SR) and press off the Cartridge.
15. Remove the Thrust Bearing Locknut (229) and Lockwasher (230). Press the Oil Lip Seal (224 & 228) off the Shaft (226). Press the Oil Lip Seals (224 & 235) out of the Adapter (218) and the Bearing Cover (232).
16. Never re-use Lip Seals, always replace with new Lip Seals to ensure proper sealing.

6.0 Ordering Spare/Replacement Parts

When ordering spare or replacement parts please include the following information on your order:

- Pump model, size of pump and serial number. (These can be obtained from the nameplate on the pump).
- Write plainly the name, part number (from Bill of Material), item number (from sectional drawings in appendix) and material of each part required.
- Give quantity of parts required.
- Give complete shipping instructions.

Repair orders will be handled with a minimum of delay. To ensure against possible long and costly downtime periods, especially on critical services, it is advisable to have spare parts on hand. See below for a list of recommend spare parts.

Start Up

Shaft/Sleeve, Packing/Mechanical Seal, Radial Bearing, Thrust Bearing, Bearing Lock Nut, Bearing Lock Washer, O-Ring and Gaskets

First Year of Operation

Impeller, Shaft/Sleeve, Packing/Mechanical Seal, Radial Bearing, Thrust Bearing, Bearing Lock Nut, Bearing Lock Washer, O-Ring and Gaskets

7.0 Assembly

The number () referred to in this procedure are the same as those show on the Sectional Drawing enclosed.

Make sure that the flange match marks are properly aligned when the components are reassembled.

All components must be thoroughly cleaned before they are assembled. Carefully inspect all gasket surfaces to make sure that they are free of any nicks or scratches that might impair their sealing.

Replace all gaskets, lip seals, o-rings, etc., when reassembling the pump.

7.1 Bearing Housing Assembly

1. Insure all parts, the work bench area, and all required tools are clean and free of grit, rust, dirt, and any other debris.
2. Install new labyrinth or lip seals, gaskets or o-rings in any adapters, bearing covers or bearing cartridges. The lip of any oil seals must be pointing toward the bearing (any garter springs must face towards the bearing). Lubricate oil lip seals and o-rings with grease or a light oil.
3. Blow air through any grease or oil passages to assure that they are free of debris. Install grease fittings where required and pump with grease until all passages are filled with clean grease. Cover components to keep clean.
4. Install oil finger (as required for oil lubrication) at the position shown on the assembly drawing.

5. Clean any required locknuts and washers. Apply oil to threads and trial assembles to the shaft.
6. Bearing Assembly: Do not remove the bearings from their original packing until the shaft and all other required components are ready for assembly. It is not necessary to remove the light coating of preservative, which is on the bearing to prevent corrosion in storage.
7. Inspect the bearings and compare to the assembly drawings and any notes on the bill of material to determine the proper mounting position and location of any shield or seals.
8. ANGULAR CONTACT-Only specially match ground bearings are suitable for mounting in pairs. The bearing markings must match the bill of material. The outboard thrust bearing (228) must be installed “BACK TO BACK” (as a set of two bearings with large portion of the outer race on one bearing facing the large portion of the outer race on the other bearing).
9. Heat new anti-friction Bearings (225 & 228) to 180 F (note-bearings with integral lip seals can not be heated above 150 F or the seal may be damaged). While bearings are hot, install on the Shaft (226) and secure with the new lock washer (230) and Locknut (229) hand tight. Completely wrap the bearings with oil paper to keep clean.
10. When bearings and shaft are cool, tighten the bearing locknut until lower bearing race is solid against the shaft shoulder. While the locknut must be tight, excessive tightening may damage the bearing race or the retaining shoulder on the shaft. Hand tightening with a spanner wrench is the best method available. Bend a locking tab of the lockwasher into a slot on the locknut with which it aligns. Completely cover the bearings to keep them clean.
11. Pumpac Bearings: Install on shaft (in the same manor as normal angular contact bearings) making sure that the “V” marked on the outer races of the set of two bearings aligns and points toward the impeller end of the shaft. Wrap the bearings with oil paper to keep clean.
12. Oil Lubricated Pumps: Press the bearing/shaft assembly into the Bearing Cartridge (232) and assemble the bearing Snap Ring (SR) to locate the thrust bearings. Assemble the bearing/shaft/bearing cartridge sub-assembly into the bearing house (223).
13. Assembly of covers, plugs, adapters, etc., must be completed quickly to prevent contamination of bearings with dirt and debris. See instructions in the I.O.M. manual for type of oil, installation of oilers and filling procedures.
14. Grease Lubrication: The bearings are to be hand packed lubricated with Magnalube G (Carleton-Stuart Corporation, Long Island City, NY) grease or equal. Accrolube is equivalent grease. Enough grease must be worked past the balls and the cage such that at least 90% of all air space within the bearing has been filled with clean grease.
15. Press the bearing/shaft assembly into the Bearing Cartridge (232) and assemble the bearing Snap Ring (SR), with gap of the Snap Ring straddling the oil return groove in the Bearing Cartridge, to locate the thrust bearings. Assemble the bearing/shaft/bearing cartridge sub-assembly into the bearing housing (223).
16. Assembly of covers, plugs, adapters, etc., must be completed quickly to prevent contamination of bearings with dirt and debris.
17. Before starting, several strokes of grease should be added through the grease fittings.

7.2 Mechanical Shaft Seal Installation

1. Installation of a mechanical shaft seal requires special care to keep parts extremely clean and to prevent damaging brittle sealing surfaces. A drawing showing the assembly methods and setting dimensions is required before the seal can

be installed. The drawing must be for the particular seal being installed!

2. Install seal, gland and stuffing box cover in accordance with the seal drawing.

7.3 Pump Rotor Element Assembly

1. Fasten the stuffing box to the adapter using Capscrews (211) as shown on the sectional drawing.
2. Replace the impeller Gasket (209) and screw the impeller into the end of the shaft. Lock the coupling end of the shaft to prevent the shaft from turning and use a rubber mallet to firmly tighten the impeller. Recheck clearance between impeller and stuff box (should be 0.015”-0.025”) with feeler gauges.
3. Setting Impeller Clearance (new Parts): Replacement of the Stuff Box Cover (210), Bearing Housing (223), Adapter (218), Shaft (226) and or Outboard Bearing (228) may necessitate readjustment of the running clearance (0.015”-0.025”) between the impeller blades and Stuffing Box Cover.
4. Resetting of the Impeller clearance can be done with the drive unit disassembled from the casing. Gently tap the shaft assembly forward until the bearing cartridge touches the face of the bearing housing. Measure the protrusion of the shaft beyond the Stuffing Box Cover (0.000”-1.000” depth micrometer is preferred measurement tool). Whatever amount this measurement exceeds 0.020” will be the total amount of shims to be installed between the bearing cartridge and the rear face of the bearing housing.,
5. Move shaft assembly back toward coupling end. Install proper thickness of shims (each of the four shims must be uniform to within 0.002” each other). Tighten the bolts locating the shim. Measure and record the protrusion of the shaft assembly beyond the stuffing box cover (should be 0.015”-0.025”). (see Section 4.1.3 for how to set the impeller clearance with the pump in place).
6. Bearing Cartridge Shims: Shims are the recommended way to set the impeller position (each of the four shim packs must be uniform to within 0.002” of each other). When shims are not readily available, it is possible to use the two jackscrews supplied with the bearing cartridge in order to set the impeller position. Care must be taken to make sure that the each jackscrew is equally loaded to prevent “cocking” of the cartridge. A lock nut should be added to the jackscrew to prevent loosening.
7. Final Pump Assembly: Place Casing Gasket (204) onto the Stuffing Box cover (210). Assemble rotor into the pump Casing (200) being careful not to pinch the gasket.
8. Uniformly torque casing studs and nuts (205) in a cross-flange pattern. Increase the torque value in increments of about 5.0 lb-ft until reaching a SAE Grade 2 dry bolt torque (torque valves listed in appendix).
9. Recheck coupling alignment (see coupling information in appendix)
10. Install oiler and fill bearing housing using oiler. For detailed instructions for installation of oiler and acceptable grades refer to paragraph 4.1.
11. The pump is now assembled. Please review all items discussed in Section 3.2 before starting pump.

8.1 - Trouble Shooting

Problem	Probable Cause	Remedy
Pump is noisy or vibrates.	Improper Pump/driver alignment	Align shafts.
	Partly clogged Impeller causing imbalance.	Back-flush pump to clean Impeller.
	Broken or bent impeller or shaft	Replace as required Tighten hold down bolts of pump and motor or adjust stilts.
	Foundation not rigid Worn bearings Suction or discharge piping not anchored or properly supported. Pump is cavitating.	Replace. Anchor per Hydraulic Institute Standards Manual recommendations System problem.
Pump not producing rated flow or head.	Air leak through gasket.	Replace gasket.
	Air leak through stuffing box.	Replace or readjust packing/mechanical seal.
	Impeller partly clogged.	Back-flush pump to clean impeller.
	Insufficient suction head.	Ensure that suction line shutoff valve is fully open and line unobstructed.
	Worn or broken impeller.	Inspect and replace if necessary
Pump starts, then stops pumping.	Sump empty	Stop pump, check level
	Air leak in suction line.	Repair (plug) leak.
No liquid delivered.	Pump not primed.	Reprime pump, check that trap is full of liquid.
	Suction line clogged.	Remove obstructions.
	Impeller clogged with foreign material.	Back-flush pump to clean impeller.
	Wrong direction of rotation.	Change rotation to concur with direction indicated by arrow on bearing housing or pump casing.
	Suction pipe opening not submerged enough.	Consult factory for proper depth. Use baffle to eliminate vortices.
	Suction lift to high.	Shorten Suction Pipe
Excessive leakage from stuffing box.	Packing gland improperly adjusted.	Tighten gland nuts.
	Stuffing box improperly packed.	Check packing and repack box.
	Worn Mechanical seal parts.	Replace worn parts.
	Overheating mechanical seals.	Check lubrication and cooling lines.
	Shaft / sleeves scored.	Re-machine or replace as required.
Bearings run hot.	Improper alignment	Re-align pump and driver.
	Improper lubrication.	Check lubricant for stability and level.
	Lube cooling.	Check cooling system.

8.1 - Trouble Shooting ~ cont. ~

Problem	Probable Cause	Remedy
Motor requires excessive power.	Head lower than rating. Pumps too much liquid.	Consult factory. Install throttle valve, cut impeller.
	Liquid heavier than expected.	Check specific gravity and viscosity.
	Stuffing packing too tight.	Readjust packing. Replace if worn.
	Rotating parts bind.	Check internal wearing parts for proper clearance.
Pump Fails to Prime.	Lack of priming charge.	Fill pump with initial priming charge.
	Leak in suction line.	Check bolting in flanges and tighten.
	Packing allowing air into stuffing box.	Check to see if packing is suitable for vacuum. Replace if required.
	Shaft rotation incorrect.	Check motor leads.

8.2 - Sectional Drawings

LHLA Pumps

8.2 - Sectional Drawings ~ cont. ~

LPLA Pumps

8.3 - Parts & Materials List

Item No.	Part Name	Ductile Iron	304SS	316SS	Elc. K	R-55	Nickel	Y-17	Y-30	Alloy 48
200	Casing	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
*206	Impeller	316SS	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
210	Stuffing Box	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
*226	Shaft (Wet End)	316SS	304SS	316SS	20SS	Hast G30	Ni	Hast C22	Hast B	20SS
212	Gland	316SS	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
244	Trap	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
245	Trap Cover	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
246	Strainer	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
247	Separator	D. Iron	304SS	316SS	Elc K	R-55	Ni	Y-17	Y-30	A48
249	Clamp, Cover	304SS								
*204	Gaskets - Casing	Sepco 6234 (Optional: Teflon, Gylon, Grafoil, and Flexitallic)								
*209	Gaskets - Impeller	Teflon								
*249	Gaskets - Trap Cover	Sepco 6234 (Optional: Teflon, Gylon, Grafoil, and Flexitallic)								
*250	Gaskets - Trap	Sepco 6234 (Optional: Teflon, Gylon, Grafoil, and Flexitallic)								
*251	Gaskets - Separator	Sepco 6234 (Optional: Teflon, Gylon, Grafoil, and Flexitallic)								
*215	Packing, Stuffing Box	Sepco ML4002 (Optional: Die-Formed Grafoil Rings, Graphite, metallic Foil & Teflon)								
*214	Lantern Ring	Teflon								
205	Casing Studs & Nuts	Steel	18-8 Stainless Steel							
213	Gland Stud & Nut	18-8 Stainless Steel								
218	Adapter	D. Iron								
219	Adapter Gasket	Buna N								

		LHLA	LPLA
218	Adapter	N/A	D. Iron
223	Bearing Frame	D. Iron	C. Iron
224	Inboard Oil Seal	137-283-12	187-262-12
225	Inboard Bearing	Steel (307-W)	Steel (6310)
228	Outboard Bearing	Steel (7307 PW)	Steel (7310-BEAYG)
235	Outboard Oil Seal	087-162-12	125-200-12
229	Bearing Locknut	Steel (N07)	Steel (N10)
230	Bearing Lockwasher	Steel (W07)	Steel (W10)
233	O-Ring, Bearing Hsg.	Buna N	Buna N
SR	Snap Ring	N-5002-316	N5002-433
FC	Front Cover	Steel	N/A
GFC	Gasket, Front Cover	Vellumoid	N/A
SS	Shim Set	300 Stainless	300 Stainless
232	Bearing Cartridge	D. Iron	D. Iron

8.4 - Stuffing Box Seal Chamber Options

Dim	TOL	Shaft Dia. +/- 0.001		
		∅1.125	**∅1.375**	**∅1.875**
A	**Nominal**	3/8-16	3/8-16	½-13
B	+/- 0.03	∅3.25	∅4.00	∅5.19
B1	+/- 0.03	∅3.75	∅4.50	∅5.00
C	+/- 0.02	2.44	2.44	2.87
C1	+/- 0.02	2.00	2.00	2.50
D	+/- 0.03	1.75	1.75	2.93
D1	+/- 0.03	2.19	2.13	3.31
D2	+/- 0.03	2.12	3.00	3.88
F	+/- 0.02	∅1.750	∅2.000	∅2.625
G	+/- 0.02	∅2.000	∅2.625	∅3.375
G1	+/- 0.02	∅2.625	∅2.875	∅3.625
H	+/- 0.02	∅2.375	∅3.125	∅4.000
H1	+/- 0.02	∅3.125	∅3.597	∅4.125
J	+/- 0.02	2.19	2.62	3.00
J1	+/- 0.02	1.75	1.72	2.13
K	+/- 0.02	2.19	2.19	2.63
L	+/- 0.02	0.69	0.78	0.91
M	+/- 0.02	1.56	2.09	2.66

8.5 - Fastener Tightening Torque Table
Non-Lube Values

Fastener Size	Torque (Lb-Ft)
5/16-18	11
3/8-10	20
7/16-14	30
1/2-13	50
9/16-12	65
5/8-11	90
3/4-10	160
7/8-9	140
1-8	220
1 1/8-7	300
1 1/4-7	420
1 3/8-6	560
1 1/2-6	740

8.6 - TBG WOODS Coupling Alignment

Wood's Sure-Flex® Spacer Coupling flanges (outer metallic parts) and sleeves (inner elastometric members) come in many sizes and types. All rubber sleeves (EPDM) and Neoprene) have the same ratings for a given size and may be used interchangeably. Hytrel sleeves, however, has completely different ratings. Rubber sleeves must not be substituted for Hytrel, or Hytrel for rubber. First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.)

1. Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shaft
2. Slide one coupling flange onto each shaft, using snug-fitting keys.
3. Position the flanges on the shafts so that each shaft extends into each flange a minimum length equal to the shaft diameter. Tighten one flange in its final position. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth, as shown.

1.

4. Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange. Tighten all fasteners to the values given in Table 2. Different coupling sleeves require different degrees of alignment precision. Locate the earing failure (D) Excessive coupling wear
5. Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling. DO NOT rotate the coupling. If the maximum offset exceeds the figure shown under "Parallel" in Table 3, realign the coupling.
6. Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions. DO NOT rotate the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 3. If a correction is necessary, be sure to recheck the parallel alignment. (Note: For maximum life, keep misalignment values as near to zero as possible.)

Table 2	Fastener Torque Values (ft-lbs)			
Coupling Size	Type J	Type S	Type SC	
3	3	--	--	--
4	3	--	5.5	13
5	7	13	4	13
6	13	13	9	13
7	13	13	9	13
8	23	23	18	23
9	--	23	31	23
10	--	23	50	50
11	--	23	75	50
12	--	50	150	100
13	--	100	150	165
14	--	100	150	165
16	--	100	150	165

NOTE: Periodically check elastomeric coupling sleeves for any visible evidence of deterioration. If deterioration is apparent, the coupling sleeve must be replaced.

8.7 - TBG WOODS Coupling Alignment ~cont.~

Table 3	Maximum Allowable Misalignment				
Coupling Size	G Dimension	Types JES, JNS, E & N		Type H & HS*	
		Parallel	Angular	Parallel	Angular
3	3/8”	0.010	0.035	-	-
4	5/8”	0.010	0.043	-	-
5	3/4"	0.015	0.056	-	-
6	7/8”	0.015	0.070	0.010	0.016
7	1”	0.020	0.081	0.012	0.020
8	1-1/8”	0.020	0.094	0.015	0.025
9	1-7/16”	0.025	0.109	0.017	0.028
10	1-5/8”	0.025	0.128	0.020	0.032
11	1-7/8”	0.032	0.151	0.022	0.037
12	2-5/16”	0.032	0.175	0.025	0.042
13	2-11/16”	0.040	0.195	0.030	0.050
14	3-1/4”	0.045	0.242	0.035	0.060
16	4-3/4”	0.062	0.330	-	-

Note: Values shown above apply if the actual torque transmitted is more than ¼ the coupling rating. For lesser torque, reduce the above values by ½. *Type H sleeves (orange) should not be used as direct replacements for EPDM or Neoprene sleeve (black) or with J or B flanges.

7. If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

8. Check safety codes and install protective guards or shields as required.

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