



# HS90 Series Pumps Installation, Operation and Maintenance Manual

## **SAM**engineering

Customised Pump Solutions



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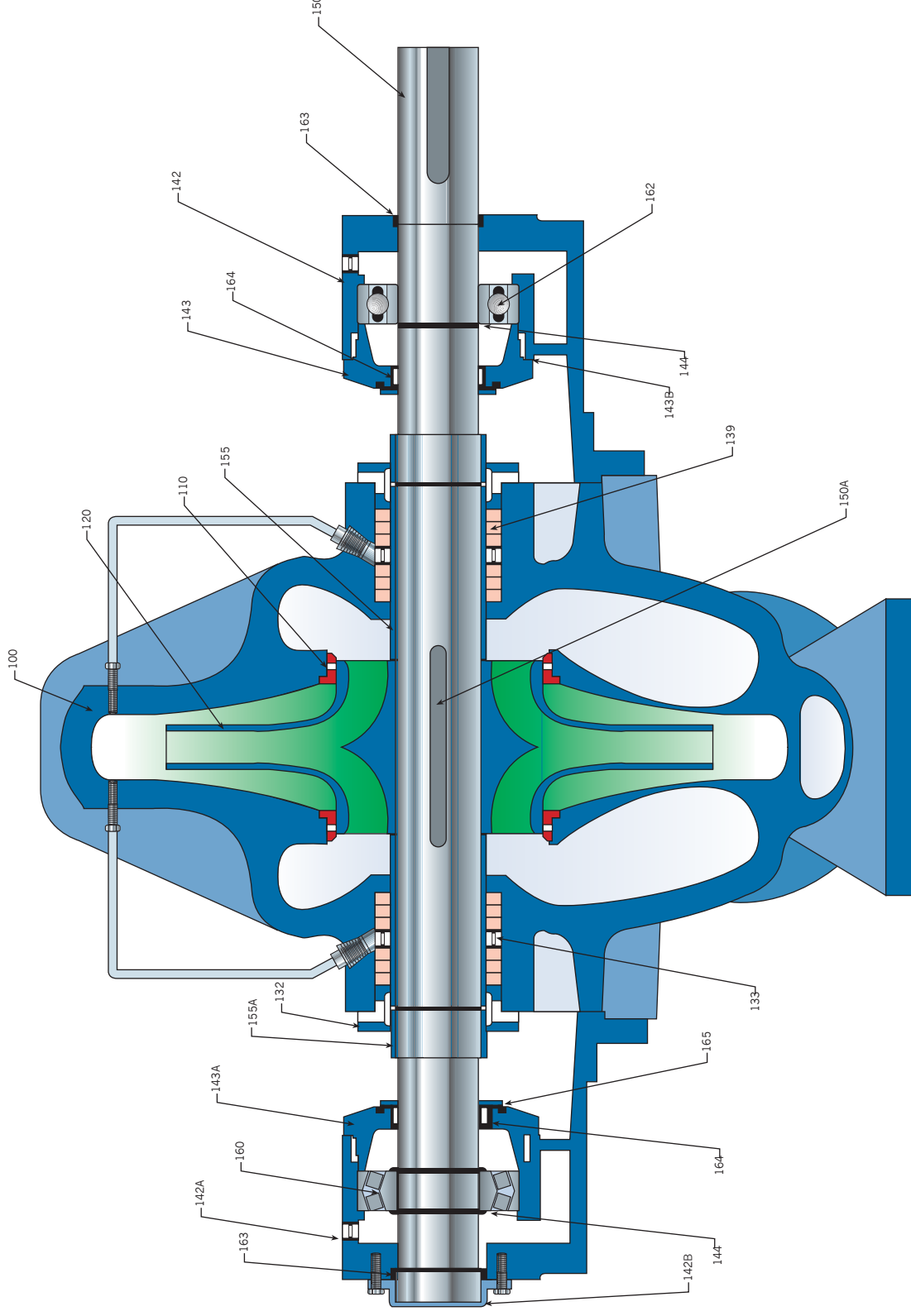
*Alloys to suit all applications*

Proud Manufacturers of SAMCO® Pumps





# Clear Water Applications Axially – Split Case HS90 Series



**PLEASE NOTE:**  
When ordering spare parts,  
indicate model size,  
material of construction  
and / or pump serial number.

Catalog Code	Part Name
100	Casing
110	Casing Wear Ring
120	Impeller
132	Gland
133	Lantern Ring
139	Packing Ring
142	DE Bearing Housing
142A	NDE Bearing Housing
142B	End Cover
143	DE Bearing Cap
143A	NDE Bearing Cap
143B	Bearing Cap Gasket
144	Bearing Circlip
150	Shaft
150A	Key
155	Shaft Sleeve
155A	Shaft Sleeve Nut
160	Non Drive End Bearing
162	Drive End Bearing
163	Bearing Oil Seal
164	Bearing Oil Seal
165	Deflector

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## NOTE:

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted engineering practices in the installation, operation, and maintenance of this equipment.

Any further questions, contact SAM Engineering (Pty) Ltd +27 (0) 11 823-4250.

## INTRODUCTION

This manual is furnished to acquaint you with some of the practical ways to install, operate and maintain this pump. Read it completely before doing any work on your unit and keep it handy for future reference.

Equipment cannot operate well without proper care. To keep this unit at top efficiency, follow the recommended installation and servicing procedures outlined in this manual. The Industrial Pump Division's Customer Service Department is available to expertly guide the installation of the pump for maximum operating life and minimum downtime.

## WARRANTY

Refer to your sales contract for coverage's.

## PUMP IDENTIFICATION

All pumps are designated by a serial number, model number, size and type. This information is stamped on an identification plate which is mounted on the pump. Refer to the pump identification in the specific instruction section of this manual for detailed information.

HS90 Series pumps are designated by serial number, model, size and M.O.C. This information is stamped on an identification plate and affixed to the pump frame or casing.

Permanent records are kept by the factory and filed by serial number.

### PUMP NAMEPLATE

SAMCO PUMPS	
MODEL	SER. NO.
FLOW (m <sup>3</sup> /hr)	HEAD (m)
MAX. DES. PRS. (kPa)	IMP. DIA. (mm)
MOC	RPM
<b>SAM Engineering (Pty) Ltd</b> <b>Tel: +27 11 823-4250</b>	

MODEL = Pump Model and Type

SER. NO. = Serial Number

FLOW (m<sup>3</sup>/hr) = Design Flow Rate

HEAD (m) = Design Head

MAX. DESIGN PRESSURE – This refers to the factory standard hydrostatic test pressure for the hydraulic end of pump.

IMP. DIA (mm) = Supplied Impeller Diameter

\*MOC – Material of Construction

RPM = Operating Revolutions Per Minute

\*MOC = Material of Construction of pump shown in abbreviated form and in four parts.

EXAMPLE – CI/SS/CI/EN8 – where casing and stuff box are in Cast Iron, impeller is in Stainless Steel, frame is in Cast Iron and shaft is in EN8.

## INSTALLATION

### RECEIVING PUMP

It is absolutely necessary to check the pump for shortages and damage immediately upon arrival. Prompt reporting to the carrier's agent with notations made on the freight bill will expedite satisfactory adjustment by the carrier.

**WARNING: When unloading horizontal pumps, lift equally at four or more points on the baseplate. Do not lift on the driver or pump. For vertical pumps, use the lifting lugs or eyebolts found on the pump. Do not lift by flanges or by the eyebolts found on the motor. Be very careful not to damage any auxiliary piping or controls when moving pumps.**

Horizontal pumps and drivers are normally shipped from the factory mounted on a baseplate and painted with primer and one finish coat. The couplings may either be completely assembled or have the coupling hubs mounted on the shafts and the connecting members removed. When the connecting members are removed, they will be packaged in a separate container and shipped with the pump or attached to the baseplate.

Shafts are in alignment when the unit is shipped, however, due to shipping, the pumps may arrive misaligned and therefore alignment must be established during installation. SAM Engineering has determined that proper and correct alignment can only be made by accepted assembly practices. Refer to the following paragraphs on "Foundation", "Baseplate Setting", "Grouting Procedure", "Alignment Procedure" and "Doweling".

### TEMPORARY STORAGE

If the pump is not to be installed and operated soon after arrival, store it in a clean, dry place having slow, moderate changes in ambient temperature. Rotate the shaft periodically to coat the bearings with lubricant and to retard oxidation, corrosion, and to reduce the possibility of false brinelling of the bearings.

## LOCATION

The pump should be installed as near the suction supply as possible, with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold.

The pump must be primed before starting. Whenever possible, the pump should be located below the fluid level to facilitate priming and assure a steady flow of liquid. This condition provides a positive suction head on the pump. It is also possible to prime the pump by pressurising the suction vessel.

When installing the pump, consider its location in relation to the system to assure that sufficient Net Positive Suction Head (NPSH) at pump suction is provided. Available NPSH must always equal or exceed the required NPSH of the pump.

The pump should be installed with sufficient accessibility for inspection and maintenance. A clear space with ample head room should be allowed for the use of an overhead crane or hoist sufficiently strong to lift the unit.

**NOTE: Allow sufficient space to be able to dismantle the pump without disturbing the pump inlet and discharge piping.**

When possible, select a dry place above the floor level. Take care to prevent the pump from freezing during cold weather when not in operation. Should the possibility of freezing exist during a shut-down period, the pump should be completely drained and all passages and pockets where liquid might collect should be blown out with compressed air.

Make sure there is a suitable power source available for the pump driver. If the pump is motor driven, the electrical characteristics should be identical to those shown on the motor data plate.

## BASEPLATE SETTING (Before Piping)

**NOTE:** This procedure assumes that a concrete foundation has been prepared with an anchor or hold-down bolts extending up, ready to receive the unit. It must be understood that the pump and motor have been mounted and rough aligned at the factory. If the motor is to be field mounted, consult factory for recommendations. SAM Engineering cannot assume responsibility for final alignment.

1. Use blocks and shims under the base for support at the anchor bolts and midway between bolts, to position the base approximately 25.4mm above the concrete foundation with studs extending through holes in the baseplate.
2. By adding or removing shims under the base, level and plumb the pump shaft and flanges. The base plate does not have to be level.
3. Draw the anchor nuts tight against the base, and observe the pump and motor shafts or coupling hubs for alignment. (Temporarily remove the coupling guard for checking alignment.)
4. If the alignment needs improvement, add shims or wedges at appropriate positions under the base so that retightening of the anchor nuts will shift the shafts into a closer alignment. Repeat this procedure until a reasonable alignment is reached.

**NOTE:** A reasonable alignment is defined as that which the pump contractor and the accepting facility (final operator) mutually agreed upon. Final alignment procedures are covered under "Alignment Procedure".

5. Check to make sure the piping can be aligned to the pump flanges without placing pipe strain on either flange.
6. Grout the baseplate completely (see "Grouting Procedure") and allow grout to dry thoroughly before attaching piping to the pump. (24 hours is sufficient time with the approved grouting procedure.)

## ALIGNMENT PROCEDURE

**NOTE:** A flexible coupling will only compensate for small amounts of misalignment. Permissible misalignment will vary with the make of coupling. Consult the coupling manufacturer's data when in doubt.

Allowances are to be made for thermal expansion during cold alignment so that the coupling will be aligned at operating temperature. In all cases, a coupling must be in alignment for continuous operation. Even though the coupling may be lubricated, misalignment causes excessive wear, vibration and bearing loads that result in premature bearing failure and ultimate seizing of the pump. Misalignment can be angular, parallel, or a combination of these, and in the horizontal and vertical planes. Final alignment should be made by moving and shimming the motor on the baseplate until the coupling hubs are within the recommended tolerances measured in total run-out. All measurements should be taken with the pump and motor foot bolts tightened. The shaft of the sleeve-bearing motors should be in the centre of its mechanical float.

**NOTE:** Proper alignment is essential for correct pump operation. This should be performed after the baseplate has been properly set and grout has dried thoroughly according to instructions. Final alignment should be made by shimming the driver only. Alignment should be made at operating temperatures.

The following alignment procedure is recommended where precise alignment is necessary or desirable:

- a. Make sure each hub is secured to its respective shaft and that all connecting and/or spacing elements are removed at this time.
- b. The gap between the coupling hubs is set by the mfg. before the units are shipped. However, this dimension should be checked.
- c. Scribe index lines on the coupling halves as shown in Fig. III.
- d. Mount the dial indicator on one hub for parallel alignment and set the dial to zero.

- e. Turn both coupling halves so that the index lines remain matched. Observe the dial reading to see whether the driver needs to be adjusted.
- f. Mount the dial indicator on one hub for angular alignment and set dial to zero.
- g. Turn both coupling halves so that index lines remain matched. Observe the dial reading to see whether the driver needs adjustment.
- h. Assemble the coupling and tighten all bolts and set screw(s). It may be necessary to repeat steps 3 through 6 for a final check.
- i. I.) For single element couplings, a satisfactory parallel misalignment is 0.1mm T.I.R., while a satisfactory angular misalignment is 0.1mm T.I.R. per inch of radius R.  
II.) For double element couplings, a satisfactory parallel misalignment is .008" T.I.R., while a satisfactory angular misalignment is 0.05mm T.I.R. per inch of radius R.  
III.) For universal joint couplings, angular misalignment between the driver and driven shaft should be held at  $\pm 1^\circ$ , shafts should be offset 3mm to 4.7mm per foot of spacer.

## FINAL ALIGNMENT

Final alignment cannot be accomplished until the pump has been operated initially for a sufficient length of time to attain operating temperature. When normal operating temperature has been attained, secure the pump to re-check alignment and compensate for temperature accordingly. See Alignment Section.

After final alignment, it is necessary to dowel the driver feet and pump to the baseplate. Drill and ream diagonal feet of both for dowels. See Doweling.

**NOTE: The pump may have been doweled to the base at the factory.**

## SUCTION AND DISCHARGE PIPING

When installing the pump piping, be sure to observe the following precautions:

- Piping should always be run to the pump.
- Do not move the pump to a pipe. This could make final alignment impossible.

## STUFFING BOX

Contaminants in the pumped liquid must never enter the packing space as these contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing deterioration. They can even plug the stuffing box flushing and lubrication system. The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. The most important consideration is to establish the optimum flushing pressure that will eliminate contaminants from the packing. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing wear will result and extreme heat may develop in the shaft causing higher bearing temperatures. The most desirable condition is therefore to use the lowest possible flushing pressure that the operating conditions will permit. If the pump system pressure conditions vary during the day, the packing problem becomes difficult. Consideration should be given to using a mechanical seal. (See "Mechanical Seals".)

## PACKING LUBRICATION

### Internal Liquid Lubricant

Pumped liquid may be used to lubricate the packing when the following conditions prevail:

1. Liquid is clean, free from sediment and chemical precipitation, and is compatible with seal materials.
2. The temperature is above 0°C and below 71°C.
3. Suction pressure is below 5 bar g.
4. The liquid has lubricating qualities.
5. The liquid is non-toxic and non-volatile.
6. Liquid is non-toxic and non-volatile.



## External Liquid Lubricant

When the liquid being pumped contains solids or is otherwise not compatible with the packing materials, an outside supply of seal liquid should be furnished. In general, external-injection liquid (from an outside source) is required when the following conditions prevail:

1. The liquid being pumped contains dirt, grit, or other impurities.
2. Temperature of the pumped liquid is below 0°C or above 71°C.
3. The liquid being pumped has non-lubricating properties.
4. The liquid is toxic or volatile.
5. Suction pressure is above 5 bar g, vacuum, or high lift.

## STUFFING BOX OPERATING PRESSURE

The actual stuffing box operating pressure may be obtained by installing a pressure gauge on the box. This is done with an extra seal cage temporarily replacing the two rings of packing in the bottom of the box to obtain accurate gauge readings. Take gauge readings with the pump running under various head and capacity conditions. Then set the pressure of flushing or lubrication liquid at a value of 5 to 10 psi above the maximum expected stuffing box operating pressure.

Even under the best conditions, a properly packed stuffing box should be watched closely. If pressure conditions change slightly, there will be a resultant change in the packing "seating" which should be compensated for by a change in gland adjustment. Consideration should also be given to the lubrication pressure. A wide variation indicates a need to use a mechanical seal.

## MECHANICAL SEALS

Mechanical seals are preferred over packing on some applications because of better sealing qualities and longer serviceability. Leakage is eliminated when a seal is properly installed, and normal life is much greater than that of packing on similar applications. A mechanical shaft seal is supplied in place of a packed stuffing box when specifically requested. The change from packing to an alternate arrangement may be made in the field by competent service personnel. Conversion kits may be ordered from your SAM Engineering Sales Representative.

## OPERATION

### 1. PRE-START CHECKS

Before initial start of the pump, the following inspections should be made:

- a. Check alignment between the pump and motor.
- b. Check all connections to the motor and starting device with a wiring diagram. Check voltage, phase, and frequency on the motor nameplate with the line circuit.
- c. Check the suction and discharge piping and pressure gauges for proper operation.
- d. Check the impeller adjustment. See the specific section for proper adjustment.
- e. Turn the rotating element by hand to assure that it rotates freely.
- f. Check stuffing box adjustment, lubrication, and piping.
- g. Check driver lubrication.
- h. Assure that pump bearings are properly lubricated.
- i. Assure that the coupling is properly lubricated, if required.
- j. Assure that the pump is full of liquid (see Priming) and all valves are properly set and operational with the discharge valve closed and the suction valve open.
- k. Check rotation. Be sure that the driver operates in the direction indicated by the arrow on the pump casing as serious damage can result if the pump is operated with incorrect rotation. Check rotation each time the motor leads have been disconnected.

**CAUTION:** Rotation should be checked with coupling disconnected on coupled units.

## 2. PRIMING

If the pump is installed with a positive head on the suction, it can be primed by opening the suction and vent valve, and allowing the liquid to enter the casing.

If the pump is installed with a suction lift, priming must be done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

**CAUTION:** Under either of the above conditions, the pump must be completely filled with liquid before starting. The pump must not be run dry in the hope it will prime itself. Serious damage to the pump may result if it is started dry.

## 3. STARTING

1. Close the drain valves and valve in the discharge line.
2. Completely open all valves in the suction line.
3. Turn on the seal water to the stuffing box. (If pumped fluid is dirty or if leakage of air is to be prevented, these lines should be always left open.)
4. Prime the pump.

**NOTE:** If the pump does not prime properly, or loses prime during start-up, it should be shut down and the condition corrected before the procedure is repeated.

5. (Pumps moving high temperature liquids.) Open the warm-up valve to circulate liquid for preheating. Consult the instructions that cover such specially designed heating system.
6. Start the pump driver (turbines and engines may require warming up. Consult the manufacturer's instructions).
7. When the pump is operating at full speed, open the discharge valve slowly. This should be done promptly after start-up to prevent damage to the pump by operating at zero flow.
8. Adjust the liquid seal valves to produce the recommended pressure for either the mechanical seal or packed stuffing box.

## 4. OPERATING CHECKS

1. Check the pump and piping to assure that there are no leaks.
2. Check and record the pressure gauge readings for future reference.
3. Check and record voltage, amperage per phase, and kW, if an indicating wattmeter is available.
4. Check the bearings for lubrication and temperature. Normal temperature should be 180° maximum.
5. Check and adjust stuffing box for correct operation.
6. Check sealing water lines and valves.

**CAUTION:** Make all pump output adjustments with the discharge valve. Do not throttle the suction line to adjust the pump output.

## 5. SHUTDOWN

The following steps of procedure will take care of most normal shutdowns of the pump. Make any further adjustments of process piping, valves, etc., as required. If the pump is to be removed from service for an extended period of time, refer to "Temporary Storage" and "Freezing Protection."

- a. Close the discharge valve slowly.

**NOTE:** When stopping the pump, always close discharge valve first.

- b. Shut down the driver (Consult manufacturer's instructions for special operations).
- c. Close the seal liquid valves. (If pumped liquid is dirty or if in-leakage is to be prevented, these lines should always be left open).
- d. Open the drain valves as required.

No liquid delivered	
CAUSES	CURES
1. Lack of prime	Fill pump and suction pipe completely with liquid.
2. Loss of prime	Check for leaks in suction pipe joints and fittings; vent casing to remove accumulated air.
3. Suction lift too high	If no obstruction at inlet, check for pipe friction losses. However, static lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, liquid to be pumped must be raised or pump lowered.
4. Discharge system head too high	Check pipe friction losses. Larger discharge piping may correct condition. Check that valves are wide open.
5. Speed too low	Check whether motor is directly across-the-line and receiving full voltage. Alternatively, frequency may be too low; motor may have an open phase.
6. Wrong direction of rotation	Check motor rotation with directional arrow on pump casing. Wrong rotation will cause pump damage.
7. Impeller completely plugged	Dismantle pump or use piping hand hole to clean impeller.

**Not enough liquid delivered**

**CAUSES**

**CURES**

8. Air leaks in suction piping	If liquid pumped is water or other non-explosive material, and explosive gas or dust is not present, test flanges for leakage with a flame or match. For such liquids as gasoline, suction line can be tested by shutting off or plugging inlet and putting line under pressure. A gauge will indicate a leak with a drop of pressure.
9. Air leaks in stuffing box	Increase seal lubricant pressure to above atmosphere.
10. Speed too low	See item 5.
11. Discharge system head too high	See item 4.
12. Suction lift too high	See item 3.
13. Impeller partially plugged	See item 7.
14. Cavitation; insufficient NPSH (depending on installation)	<ul style="list-style-type: none"> <li>a. Increase positive suction head on pump by lowering pump or increasing suction pipe size or raising fluid level.</li> <li>b. Sub-cool suction piping at inlet to lower entering liquid temperature.</li> <li>c. Pressurise suction vessel.</li> </ul>
15. Defective impeller	Inspect impeller. Replace if damaged or vane sections badly eroded.
16. Defective packing	Replace packing and sleeves if badly worn.
17. Foot valve too small or partially obstructed	Area through ports of valve should be at least as large as area of suction pipe, preferably 1½ times. If strainer is used, net clear area should be 3 to 4 times area of suction pipe.
18. Suction inlet not immersed deep enough	If inlet cannot be lowered, or if eddies through which air is sucked persist when it is lowered, chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
19. Wrong direction of rotation	Compare rotation of motor with directional arrow on pump casing. Wrong rotation will cause pump damage.
20. Too small impeller diameter (probable cause if none of the above)	Check with factory to see if a larger impeller can be used; otherwise, cut pipe losses or increase speed, or both, as needed. Be careful not to seriously overload drive.

**Not enough pressure**

<b>CAUSES</b>	<b>CURES</b>
21. Speed too low	See item 5.
22. Air leaks in suction piping	See item 8.
23. Mechanical defects	See items 15, 16, and 17.
24. Obstruction in liquid passages	Dismantle pump and inspect passages of impeller and casing. Remove obstruction.
25. Air or gases in liquid (Test in laboratory, reducing pressure on liquid to pressure in suction line. Watch for bubble formation.)	May be possible to overrate pump to the point where it will provide adequate pressure despite condition. It is better to provide gas separation chamber on suction line near pump, and periodically exhaust accumulated gas. See item 14.
26. Excessive impeller clearance	Adjust impeller clearance.
27. Too small impeller diameter (probable cause if none of the above.)	See item 20.

**Pump operates for a short time, then stops**

<b>CAUSES</b>	<b>CURES</b>
28. Incomplete priming	Free pump, piping and valves of all air. If high points in suction line prevent this, they need correcting. See page 5.
29. Suction lift too high	See item 3.
30. Air leaks in suction piping	See item 8.
31. Air leaks in stuffing box	See item 9.
32. Air or gases in liquid	See item 25.

**Pump takes too much power**

**CAUSES**

**CURES**

33. Head lower than rating; thereby pumping too much liquid

Machine impeller's OD to size advised by factory.

34. Cavitation

See item 14.

35. Mechanical defects

See items 15, 16, and 17.

36. Suction inlet not immersed enough

See item 18.

37. Liquid heavier (in either viscosity or specific gravity) than allowed for

Use larger driver. Consult factory for recommended size. Test liquid for viscosity and specific gravity. See item 6.

38. Wrong direction of rotation

Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing. If packing is wearing too quickly, replace scored shaft sleeves and keep liquid seeping for lubrication.

39. Stuffing box too tight (Packing)

Check alignment. Examine pump for friction between impeller and casing. Replace damaged parts. Check for pipe strain.

40. Casing distorted by excessive strains from suction or discharge piping

Check alignment. Examine pump for friction between impeller and casing. Replace damaged parts. Check for pipe strain.

41. Shaft bent due to damage - through shipment, operation, or overhaul

Dismantle pump and inspect shaft.

42. Mechanical failure of critical pump parts

Check bearings and impeller for damage. Any

43. Misalignment

irregularities in these parts will cause a drag on the shaft. Realign pump and driver.

44. Speed may be too high (brake hp of pump varies as the cube of the speed; therefore any increase in speed means considerable increase in power demand)

Check voltage on motor.

45. Electrical defects

The voltage and frequency of the electrical current may be lower than that for which the motor was built: or there may be defects in the motor. The motor may not be ventilated properly due to a poor location.

46. Mechanical defects in turbine, engine, or other type of drive exclusive of motor

If trouble cannot be located, consult factory.

## GENERAL MAINTENANCE

Operating conditions vary so widely that to recommend one schedule of preventative maintenance for all centrifugal pumps is not possible. Yet some sort of regular inspection must be planned and followed. We suggest a permanent record be kept of the periodic inspections and maintenance performed on your pump. This recognition of a maintenance procedure will keep your pump in good working condition, and prevent costly breakdowns.

One of the best rules to follow in the proper maintenance of your centrifugal pump is to keep a record of actual operating hours. Then, after a predetermined period of operation has elapsed, the pump should be given a thorough inspection. The length of this operating period will vary with different applications and can only be determined from experience. New equipment, however, should be examined after a relatively short period of operation. The next inspection period can be lengthened somewhat. This system can be followed until a maximum period of operation is reached which should be considered the operating schedule between inspections.

## CHANGING ROTATION

The HS90 Series centrifugal pumps can be operated clockwise or counter clockwise when viewed from the coupling end of the pump. If you wish to reverse the suction and discharge nozzles, this can be accomplished with the same pump as follows:

1. Remove the impeller from the shaft, turn it 180° and replace it on the shaft.
2. With the rotating element out of the casing, remove the casing from the bedplate and turn 180°.
3. Set the rotating element back in the casing and reassemble the pump.

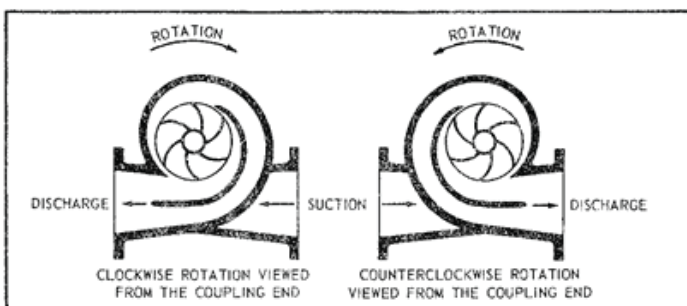


Fig. 3. — Correct Relationship of Impeller and Casing

**NOTE:** The impeller and casing are in the same relationship to each other as they were originally. The shaft and motor are also in the same relationship to each other as they were originally.

4. Reassemble the pump and realign the coupling as called for in the alignment instructions.
5. The rotation of the motor must be changed by switching the motor leads.

**NOTE:** Unless the motor rotation is reversed, the impeller will run backward.

## DISASSEMBLY AND REASSEMBLY PROCEDURES

The procedures outlined in this section provide the step-by-step requirements for dismantling and then re-assembling of HS90 Series pumps with either packing or mechanical seals.

When working on the pump, use accepted mechanical practices to avoid unnecessary damage to parts. Check clearances and condition of parts when the pump is dismantled and replace if necessary. Steps should usually be taken to restore the impeller and casing ring clearance when it exceeds twice the original clearance of 0.010-0.012 inclusive.

## DISMANTLING

1. Drain the pump by opening the vent plug and removing drain plugs on the suction and discharge nozzle.
2. Remove seal lines (1-939-1).
3. Pumps with Packing

Remove the gland bolts (1-904-9), gland (1-014-2), packing (1-924-1), and seal cage (1-013-2) from each stuffing box.

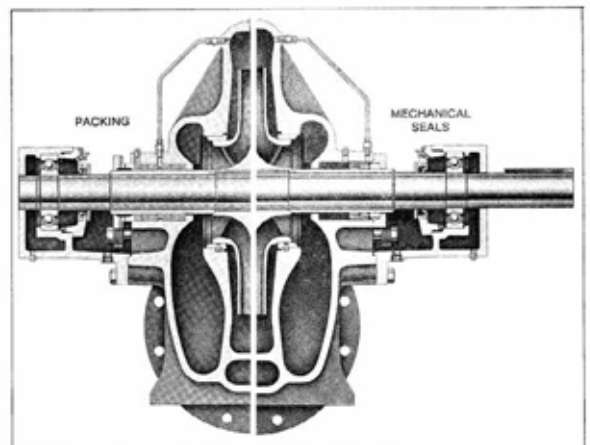


Fig. 5 — Assembly Section

## 4. Pumps with Mechanical Seals

Remove the gland bolts (1-904-9) and slide one piece gland (3-014-2) away from the casing.

- a. Remove all casing main joint-cap screws (2-904-1) and dowels (2-916-2). Use the slot in the casing main joint to break the joint. Lift the upper half casing (2-001-7) by cast lugs.
- b. Remove cap screws (1-904-7) from each bearing housing (3-025-2) and lift rotating element out of the lower casing (2-001-8).
- c. Pull the coupling half and key (3-911-2) off the shaft (3-007-0).

**NOTE:** A spare rotating element can be installed at this point. (See Figure 6)

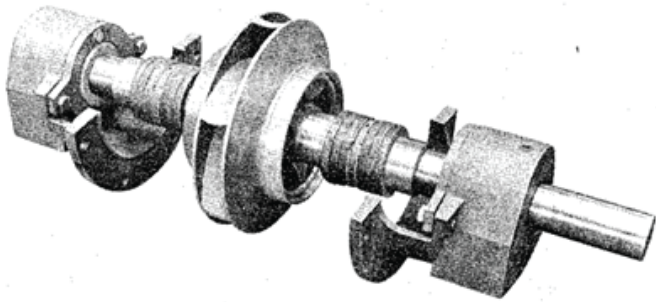


Fig. 6 — Complete Rotating Element, Consisting of Impeller, Shaft, Seals and Bearings. (Pump with Packing)

- d. Remove cap screws (3-904-6) from the bearing covers (3-018-3,-4).
  - e. Remove bearing housings (3-025-2) and snap rings (3-915-4-2). Mount the bearing puller and remove bearings (3-026-2). (See Figure 7)
- CAUTION:** Do not reuse the ball bearings.
- f. Remove bearing covers (3-018-3,-4) and push oil seals (3-177-2) out of the bearing covers. Pull deflectors (3-136-2) off the shaft.

**NOTE:** On some sizes, a snap ring must be removed before the bearing cover can be removed.

## 5. Pumps with Mechanical Seals

Remove the one piece glands (3-014-2). Loosen set screws and remove the mechanical seal head assembly (3-402-0). Press mechanical seal seats (3-401-0) from the one piece glands.

- a. Remove casing rings (3-003-9) from the impeller (4-002-0).
- b. Remove the snap rings, (3-915-2) shims, (3-942-3) sleeves (3-009-9), and impeller (4-002-0).

**NOTE:** Apply heat uniformly to the shaft sleeve to loosen the sealant between the shaft and sleeve. Do not heat above 150°C. To further assist in removing the sleeve, hold the shaft vertically and drop it on a block of wood. The impeller weight should force both the impeller and sleeve from the shaft.

- c. Refer to page 8 if the pump is equipped with adjustable rings.

**NOTE:** For impellers with replaceable rings, remove the rings (4-004-9) by cutting the rings with a cold chisel.

(See Figure 10)

## ASSEMBLY

All bearings, O-rings, seals and gaskets should be replaced with new parts during assembly. All reusable parts should be cleaned of foreign matter before reassembling. The main casing joint gasket should be made using the lower half as a template. Lay the gasket material on the casing joint and mark it by pressing it against the edges of the casing. Trim the gasket so that it is flush with the inside edges of the casing.

1. Place both shaft sleeve keys (3-911-3) and the impeller key (3-911-1) in the shaft (3-007-0).
2. Check the impeller (4-002-0) and casing to determine the correct impeller rotation (See Figure 3) and locate the impeller on the shaft.

**NOTE:** For impellers with replaceable rings, heat each new ring (4-004-9) and slide it onto the impeller. Hold rings against the impeller shoulder until they are cool. (See Figure 10)



3. Apply Loctite pipe sealant or equivalent uniformly about the sleeve diameter, covering an area of about  $\frac{1}{2}$ " from the sleeve and near the impeller. Also, apply Loctite about the shaft diameter directly behind the key-way, covering a width of  $\frac{1}{2}$ ". (See Figure 8).
4. Slide the sleeves (3-009-9) onto the shaft, rotating the sleeves to evenly distribute the sealant applied in step 3. Assemble snap ring retainers (3-915-2) (See Figure 9).

**NOTE:** Install shims (3-942-3) as required between shaft sleeve (3-009-2) and snap ring (3-915-2) on one side only. No gap must exist.

5. Assemble casing rings. (3-003-9)
6. For pumps with Mechanical Seals (Steps 6 & 7), install stationary seats (3-401-0) into the glands (3-014-2). Do not scratch or damage the seal faces during assembly. The stationary seat must bottom squarely in the gland.
7. Apply a light coat of oil to the seal faces and shaft sleeve and slide the seal head assembly (3-402-0) over the sleeve. If the seal is a John Crane Type 8, set it to dimensions shown in Figure 11 and tighten the setscrews. Next install O-rings (3-914-2) onto the one piece glands (3-014-2) and install the glands on the shaft.

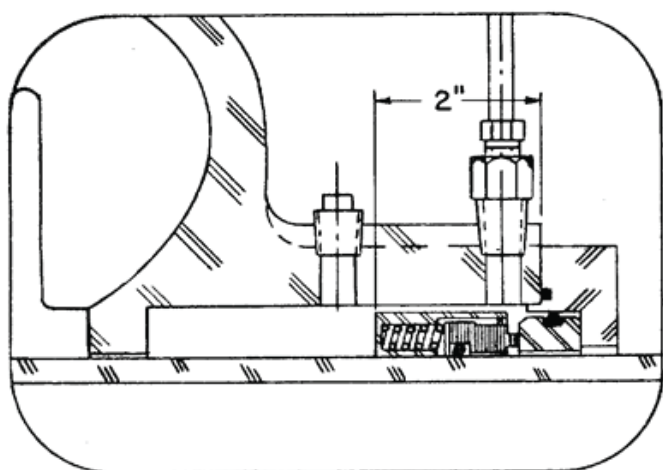


Fig. 11 — Mechanical Seal Locating Dimension

8. Start heating the bearings (3-026-2) so that they will be ready when called for in Step 11. Use dry heat from induction heat lamps or an electric furnace. Do not exceed 135°C.

**CAUTION:** These are precision, high quality bearings. Exercise care at all times to keep them clean and free from foreign matter.

9. Assemble oil seals (3-177-9) in each bearing cover.

**NOTE:** The seal lip or pressure side must point away from the bearing.

10. Slide the deflectors (3-136-2) and bearing covers (3-018-3-4) on the shaft. On all sizes, except for the 18 x 14 x 23 and 18 x 14 x 28, install a snap ring (3-915-0) on the outboard end.

**NOTE:** The coupling side bearing cover is approximately  $\frac{1}{4}$ " less in width than the outside bearing cover. This is the only dimensional difference.

11. Press the heated bearing (3-026-2) on the shaft against the shaft shoulder or snap ring. Install the bearing retaining ring on the outboard end. (See Figure 6).
12. Pumps with Grease Lubrication Cool the bearings to room temperature and coat with 2 or 3 ounces of a recommended grease.
13. Slide bearing housings (3-025-2) over the bearings (3-026-2).
14. Assemble the bearing cover to bearing housing with two cap screws (1-904-7).
15. Replace the pump coupling half and key (3-911-2).
16. Assemble the rotating element in lower half casing (2-001-8). Correctly locate the casing ring pins (3-943-9) in the casing main joint slot.

**NOTE:** Sliding the coupling bearing housing toward the coupling, prior to assembling the rotating element in the casing, will ease assembly.

17. Bolt the outboard bearing housing in place. Be sure that both housings are seated in the lower half casing.
18. Bolt the inboard bearing housing in place.
19. Install a new 0.4mm thick gasket (2-123-5-6) (thick oil paper or graphite asbestos service sheet) with a light coat of commercial cup grease on both gasket surfaces. Align the gasket edge with the casing bore and end face.
20. Lower the upper half casing (2-001-7) into place. (See Figure 12)

21. Insert taper dowels (2-916-2) and drive it into the casing joint. Replace the casing main joint bolts (2-904-1) and tighten them. Recheck dowels and drive them home.
22. Slide deflectors (3-136-2) toward the bearing covers and allow rotating clearance.
23. Rotate the shaft by hand to assure that it turns smoothly and is free from rubbing or binding.
24. For pumps with mechanical seals, bolt one piece glands (3.014.2) to the casing with gland bolts (1-904-9).

## Pumps with Packing

Cut full rings of 5/8" square packing so that the ends butt, leaving no gap between the packing and casing. Install three rings of packing and tap fully to the bottom of both stuffing boxes (See Figure 13). Stagger the joints of each ring of packing at least 90°. Install a lantern ring and be sure that it will line up with the seal water inlet when the packing is compressed. Install the remaining three rings of the packing with joints staggered. Assemble glands square with the stuffing box and pull up tight. Then loosen the gland bolts to permit packing to expand and retighten them finger tight. Final adjustment of the gland bolts must be done when the pump is running. Allow 30 minutes between adjustments.

25. Assemble seal water lines (0-939-1) to the stuffing box and casing.

## Pumps with Packing

Seal water lines go to inside holes.

## Pumps with Mechanical Seals

Seal water lines go to outside holes.

26. Check coupling alignment and re-dowel if necessary.

## ADJUSTABLE RINGS

Adjustable rings are an assembly of two threaded stainless steel rings. The outer, stationary ring is held in the casing by a tongue and groove and a locating pin in the lower half main joint. The inner, adjustable ring can be moved axially, in either direction, by rotating it. The ring is held in position by a stainless steel locking pin.

## ADJUSTMENT

When the clearance between the impeller shroud and the adjustable wearing ring becomes excessive, remove the upper half casing and pull the locking pin.

Rotate the inner ring to restore 0.005"-0.010" clearance, greater than the shaft end, float between the ring and the impeller. Drill a new hole in the inner ring for the locking pin. This is a blind hole - do not drill through. Replace the locking pin and upper half casing.

## DISASSEMBLY AND ASSEMBLY

Adjustable rings are removed in the same manner as regular casing rings. They can be separated for cleaning. Adjustable rings are installed in the pump with stationary and adjustable members assembled, but not pinned. Turn the adjustable member to provide a maximum impeller clearance and slide it over the shaft ends. Each pair of rings will have one right hand and one left hand set. They are installed so that movement in direction of rotation increases the impeller clearance. With the rotating element in the pump and bearings installed, the rings can be adjusted. Be sure that the stationary member has its flange flush against the casing lower half. Move the rotating element toward outboard end as far as bearings permit, and screw the outboard end adjustable ring toward the impeller to obtain a 0.005" impeller clearance. Drill through the stationary ring hole into the adjustable ring and insert locking pin. Move the rotating element towards the coupling and set the coupling end ring in the same manner.

## OIL LUBRICATED BEARING

The oil ring is placed in the inverted (upside down) bearing housing which is assembled over the bearing in this position. The bearing housing is then rotated to its normal position. The position of the oil ring must be checked by viewing through the oil cap. The oil ring must be resting on the shaft for correct operation. A screwdriver can be used to correct the oil ring position, if required. The housing is filled with oil through the oil cap until the oil level reaches the indicator line on the window.

Rotate the inner ring to restore 0.13mm-0.25mm clearance greater than the shaft end float between the ring and the impeller. Drill a new hole in the inner ring for the locking pin. This is a blind hole - do not drill through. Replace the locking pin and upper half casing.

## DISASSEMBLY AND ASSEMBLY

Adjustable rings are removed in the same manner as regular casing rings. They can be separated for cleaning. Adjustable rings are installed in the pump with stationary and adjustable members assembled, but not pinned. Turn the adjustable member to provide a maximum impeller clearance and slide it over the shaft ends. Each pair of rings will have one right hand and one left hand set. They are installed so that movement in direction of rotation increases the impeller clearance. With the rotating element in the pump and bearings installed, the rings can be adjusted. Be sure that the stationary member has its flange flush against the casing lower half. Move the rotating element toward outboard end as far as bearings permit, and screw the outboard end adjustable ring toward the impeller to obtain a 0.005" impeller clearance. Drill through the stationary ring hole into the adjustable ring and insert locking pin. Move the rotating element towards the coupling and set the coupling end ring in the same manner.

## MAINTENANCE OF PUMP DUE TO FLOOD DAMAGE

The servicing of centrifugal pumps after a flooded condition is a comparatively simple matter under normal conditions.

Bearings are a primary concern on the pumping units. First, dismantle the bearings and clean and inspect them for any rusted or badly worn surfaces. If they are free from rust and wear, reassemble and re-lubricate them with one of the recommended pump lubricants. Depending on the length of time the pump has remained in the flooded area, it is unlikely that a bearing replacement is necessary, however, in the event that rust or worn surfaces appear, it may be necessary to replace the bearings.

Next, inspect the stuffing box and clean out any foreign matter that might clog the box. Packing that appears to be worn, or no longer regulates leakage properly, should be replaced. Mechanical seals should be cleaned and thoroughly flushed.

Couplings should be dismantled and thoroughly cleaned. Lubricate the coupling with one of the coupling manufacturer's recommended lubricants where required.

Any pump that is properly sealed at all joints and connected to both the suction and discharge should exclude outside liquid. Therefore, it should not be necessary to go beyond the bearings, stuffing box and coupling when servicing the pump.

## BEARING LUBRICATION - GREASE

Grease lubricated ball bearings are packed with grease at the factory and will ordinarily require no attention before starting, provided the pump has been stored in a clean, dry place prior to its first operation. The bearings should be watched during the first hour or so after the pump has been started to see that they are operating properly.

The importance of proper lubrication cannot be over emphasized. It is difficult to say how often a bearing should be greased since that depends on the conditions of operation. It is well to add one ounce of grease at regular intervals, but it is equally important to avoid adding too much grease. For average operating conditions, it is recommended that 1 ounce of grease be added at intervals of three to six months, and only clean grease should be used. It is always best if the unit can be stopped while grease is added to avoid overloading.

**NOTE: Excess grease is the most common cause of overheating.**

The bearing frame should be kept clean, since any contamination of foreign matter that gets into the housing will destroy bearings in a short time. When cleaning bearings, use a bearing cleaning solvent, or an industrial cleaning solvent. Do not use gasoline. Use lint free cloths, not use waste rags.

A regular ball bearing grease should be used, but a standard commercial Vaseline can be substituted if necessary.

Do not use graphite. A No.1 or 2 grease is generally satisfactory for operation at ordinary temperatures, the lighter grease for operation at high speed or low room temperature.

Mineral greases with a soda soap base are recommended. Grease made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Most of the leading oil companies have special bearing greases that are satisfactory. For specific recommendations, consult the factory.

The maximum desirable operating temperature for ball bearings is 180°F. Should the temperature of the bearing frame rise above 180°F, the pump should be shut down to determine the cause.

Grease lubricated bearings should not be used where temperature of the pumped liquid exceeds 176.7°C.

**NOTE:** A bearing frame that feels hot to the touch of the hand is not necessarily running hot. Check with an accurate temperature measuring device to be sure.

## BEARING LUBRICATION – OIL

The oil-lubricated pumps may have an oiling ring, in which the oil is picked up from the reservoir by a rotating oil ring and deposited on the shaft and bearings inside the bearing housing, or they may have an oil slinger, which creates a shower of fine droplets over the entire interior of the bearing cavity.

After the pump has been installed, flush the bearing housing to remove dirt, grit and other impurities that may have entered the bearing housing during shipment or assembly. Then refill the bearing housing with proper lubricant. The oil level to be maintained is shown by a line in the sight glass or oil level indicator.

Experience shows that oils meeting the following specifications will provide satisfactory lubrication. These oils can be furnished by all major oil companies. It is the responsibility of the oil vendor to supply a suitable lubricant.

Saybolt viscosity at 100°F	150 SSU - 200 SSU
Saybolt viscosity at 210°F	43 SSU
Viscosity index, minimum	95
Aplgravity	28-33
Pour point, maximum	-6.7°C
Flash point, minimum	199°C
Additives:	Rust and Oxidation inhibitors

**NOTE:** Oils from different suppliers should not be mixed.

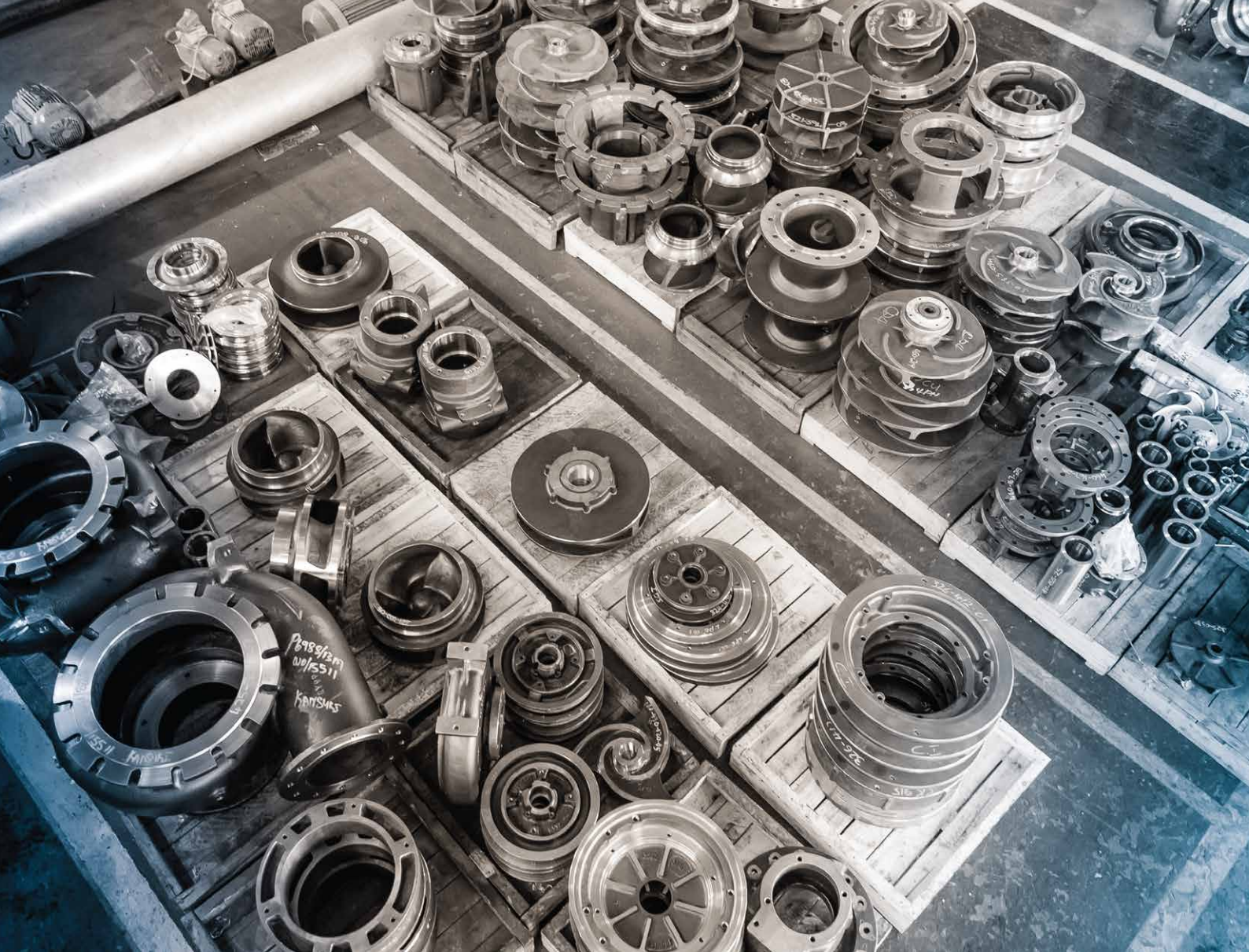
The oil should be well refined, good grade, straight cut, and filtered mineral oil. It must be free from water, sediment, resin, soaps, acid and fillers of any kind. It should also be non-foaming with a viscosity of about 150-200 SSU at 37.8°C (approximately SAE-20).

In installations with moderate temperature changes, humidity and dirt, the oil should be changed after approximately 160 hours of operation. The oil should be inspected during this time to determine the operating period before the next oil change. Oil change periods may be increased up to 2000-4000 hours, based on an 8000-hour year. Check the oil frequently for moisture, dirt or signs of breakdown.

**CAUTION:** Do not over oil as this causes the bearings to run hot. The maximum desirable operating temperature for ball bearings is 180°F. Should the temperature of the bearing frame exceed 180°F (measured by thermometer), shut down the pump to determine the cause.

PERIOD	INSPECTION
Every month	Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 180°), it may be the result of too much lubricant. If changing the lubricant does not correct the condition, disassemble and inspect the bearings.
Every 3 months	Check grease lubricated bearings for saponification. This condition is usually incurred by the infiltration of water or other fluid past the bearing shaft seals and can be noticed immediately upon inspection, since it gives the grease a whitish colour. Wash out the bearings with a clean industrial solvent and replace the grease with the proper type as recommended.
Every 6 months	<p>Check the packing and replace if necessary. Use the grade recommended. Be sure the seal cages are centred in the stuffing box at the entrance of the stuffing box piping connection.</p> <p>Check shaft or shaft sleeve for scoring. Scoring accelerates packing wear.</p> <p>Check alignment of pump and motor. Shim up units if necessary. If misalignment recurs frequently, inspect the entire piping system. Unbolt piping at suction and discharge flanges to see if it springs away, thereby indicating strain on the casing. Inspect all piping supports for soundness and effective support of load.</p>
Every year	<p>Remove the rotating element. Inspect thoroughly for wear, and order replacement parts if necessary.</p> <p>Check wearing clearances.</p> <p>Remove any deposit or scaling. Clean out stuffing box piping.</p> <p>Measure total dynamic suction and discharge head as a test of pipe connection. Record the figures and compare them with the figures of the last test. This is important especially where the fluid being pumped tends to form a deposit on internal surfaces. Inspect foot valves and check valves, especially the check valve which safeguards against water hammer when the pump stops. A faulty foot or check valve will reflect also in poor performance of the pump while in operation.</p>

**NOTE: The above time table is based on the assumption that after start up, the unit had been regularly monitored and such a schedule was found to be consistent with operation, as shown by stable readings. Extreme or unusual applications or conditions should be taken into consideration and may require shorter maintenance intervals.**



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