CPW and CPX Pumps
Installation, Operation and Maintenance Manual

SAMengineering

Customised Pump Solutions

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SABS ISO 9001

Alloys to suit all applications

Proud Manufacturers of SAMCO® Pumps

SAMCO®

Contents

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 the procedures to install, operate and maintain CPW and CPX pump s. Keep it handy for future reference. Additional information can be obtained from your SAM Engineering Sales Representative. The Standards of the Hydraulic Institute are an excellent source for additional information.

Equipment cannot operate well without proper care. To keep the unit at top efficiency, correct procedures for installation and maintenance must be followed. The SAM Engineering Service Department can assist in the installation of this equipment, so that maximum machine life can be attained with a minimum of downtime.

Your Sales Representative will also help with renewal parts orders and problems requiring special attention.

PUMP IDENTIFICATION

SAMCO PUMPS

MODEL	SER. NO.
FLOW (m^3/hr)	HEAD (m)
MAX. DES. PRS (kpa)	IMP. DIA. (mm)
MOC	RPM

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Compare the name plates on your unit to the nameplates shown in this section to decide whether you have Type I or Type II.

These 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.

(1) SERIAL NUMBER - Composed of certain groups of numbers. All groups are necessary for identification. TYPICAL EXAMPLE: P 2081 / 98.

(2) MODEL – CPW/CPX, followed by SIZE - Composed of three groups of numbers on CSO and two numbers on CP. EXAMPLE: 4 x 3 x 11: first number is the ASA suction flange size in inches, second number is the ASA discharge flange size in inches, third number is the nominal maximum impeller diameter in inches.

(4) IMPELLER DIAMETER - This number is the impeller diameter in millimetres as supplied by the factory. EXAMPLE: 265

(5) FLOW - Design flow rate in cubic metres per hour.

(6) HEAD - Design head in metres.

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

(8) M.O.C. – Material of construction of pump shown in abbreviated form and in four parts. EXAMPLE - CI/SS/CI/EN8 - where casing, stuff box and wear plate (CP) are in Cast Iron / impeller is in Stainless Steel / frame is in Cast Iron / shaft is in EN8.

(9) RPM – Design speed of pump to achieve design flow and head.

GENERAL PUMP INSTRUCTION

1. INTRODUCTION

a. PURPOSE OF MANUAL

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. SAM Engineering's Service or Technical Sales Department is available to expertly guide the installation of the pump for maximum operating life and minimum downtime.

b. SAM ENGINEERING SERVICE

Experienced, factory-trained servicemen offer prompt, efficient service at reasonable rates. These servicemen can find and correct costly errors such as poor grouting, misalignment, pipe stresses transmitted to the pump casing, or improperly cleaned piping. A serviceman may be requested through your nearest SAM Distributor or Sales Representative. Replacement and spare parts, including special attention to your individual problems, may also be obtained through same source.

c. WARRANTY

Refer to your sales contract for coverage.

d. PUMP IDENTIFICATION

All pumps are designated by Serial Number, Model, Size and Construction. This information is stamped on an identification plate which is mounted on the pump casing or frame. Refer to pump identification in specific instruction section of this manual for detailed information.

2. INSTALLATION

a. RECEIVING PUMP

Check pump for shortages and damage immediately upon arrival (an absolute must). 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. 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 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".

b. 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.

NOTE: Oil lubricated pumps are shipped without lubricant. Fill the frame completely full with oil for storage. Oil must be drained to proper level before pump is put into operation. For storage of six months or longer, refer to factory.

c. 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.

Select a dry place above the floor level wherever possible. Take care to prevent 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 motor driven, electrical characteristics should be identical to those shown on motor data plate.

d. FOUNDATION

A substantial foundation and footing should be built to suit local conditions. It should form a rigid support to maintain alignment.

Vertical Pumps — Foundation bolts should be sized and accurately located. Each foundation bolt should be located in a bushing, two diameters larger than the bolt, to allow free movement of the bolt in conforming to the mounting holes in the pedestal. When vertical pumps are used with intermediate shafting, the motor mount baseplate should be securely attached to the floor or support structure.

Horizontal Pumps — The foundation should be poured without interruption to within 12.7 to 38mm of the finished height. The top surface of the foundation should be well scored and grooved before the concrete sets; this provides a bonding surface for the grout. Foundation bolts should be set in concrete. A 4-inch long tube around the bolts at the top of the concrete will allow some flexibility in bolt alignment to match the holes in the baseplate. Allow enough bolt length for grout, shims, lower baseplate flange, nuts and washers. The foundation should be allowed to cure for several days before the baseplate is shimmed and grouted.

e. 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 unit. It must be understood that pump and motor have been mounted and rough aligned at the factory. If motor is to be field mounted, consult factory for recommendations. SAM Engineering cannot assume responsibility for final alignment.

1. Use blocks and shims under base for support at anchor bolts and midway between bolts, to position 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 anchor nuts tight against base, and observe pump and motor shafts or coupling hubs for alignment. (Temporarily remove coupling guard for checking alignment.)

4. If alignment needs improvement, add shims or wedges at appropriate positions under base so that retightening of anchor nuts will shift shafts into closer alignment. Repeat this procedure until a reasonable alignment is reached.

NOTE: Reasonable alignment is defined as that which 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 baseplate in completely and allow grout to dry thoroughly before attaching piping to pump (24 hours is sufficient time with approved grouting procedure.)

f. ALIGNMENT PROCEDURE

NOTE: A flexible coupling will only compensate for small amounts of misalignment. Permissible misalignment will vary with the make of coupling. Consult 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 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 baseplate has been properly set and grout has dried thoroughly according to instructions. Final alignment should be made by shimming driver only. Alignment should be made at operating temperatures.

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

1. Make sure each hub is secured to its respective shaft and that all connecting and/or spacing elements are removed at this time.
2. The gap between the coupling hubs is set by the mfr. before the units are shipped. However, this dimension should be checked. (Refer to the coupling mfr's specifications supplied with the unit).
3. Scribe index lines on coupling halves.
4. Mount dial indicator on one hub as shown for parallel alignment. Set dial to zero.
5. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment. (See paragraph 9 below.)
6. Mount dial indicator on one hub as shown for angular alignment. Set dial to zero.
7. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment. (See paragraph 9 below.)
8. Assemble coupling. Tighten all bolts and set screw(s). It may be necessary to repeat steps 3 through 6 for a final check.
9. a) For single element couplings, a satisfactory parallel misalignment is 0.10mm T.I.R., while a satisfactory angular misalignment is 0.10mm T.I.R. per 25.4mm of radius R.

   b) For double element couplings, a satisfactory parallel misalignment is 0.2mm T.I.R., while a satisfactory angular misalignment is 0.05mm T.I.R. per 25.4mm of radius R.

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 driver feet and pump to the baseplate. Drill and ream diagonal feet of both for dowels. See Doweling.

NOTE: Pump may have been doweled to base at factory.

g. SUCTION AND DISCHARGE PIPING

General

1. When installing the pump piping, be sure to observe the following precautions:
2. Piping should always be run to the pump.
3. Do not move pump to pipe. This could make final alignment impossible.
4. Both the suction and discharge piping should be independently supported near the pump and properly aligned so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at necessary intervals to provide support. When expansion joints are used in the piping system they must be installed beyond the piping supports closest to the pump. Tie bolts should be used with expansion joints to prevent pipe strain. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes. It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction.
5. Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long sweep 90° fitting to decrease friction losses.
6. Make sure that all piping joints are air-tight.
7. Where flanged joints are used, assure that inside diameters match properly.
8. Remove burrs and sharp edges when making up joints.
9. Do not "spring" piping when making any connections.
10. Provide for pipe expansion when hot fluids are to be pumped.

Suction Piping

When installing the suction piping, observe the following precautions.

1. The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimised and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be directly attributed to improper suction piping systems.

2. Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening. If the suction pipe is short, the pipe diameter can be the same size as the suction opening. If longer suction pipe is required, pipes should be one or two sizes larger than the opening depending on piping length.

3. Suction piping for horizontal double suction pumps should not be installed with an elbow close to the suction flange of the pump except when the suction elbow is in the vertical plane. A suction pipe of the same size as the suction nozzle approaching at any angle other than straight up or straight down must have the elbow located 10 pipe diameters from the suction flange of the pump. Vertical mounted pumps and other space limitations require special piping.

4. There is always an uneven turbulent flow around an elbow and when it is in a position other than the vertical it causes more liquid to enter one side of the impeller than the other. This results in high unequalised thrust loads that will overheat the bearings and cause rapid wear in addition to affecting hydraulic performance.

5. When operating on a suction lift, the suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe will become filled with air and thus prevent proper operation of the pump.

6. When reducing the piping to the suction opening diameter use an eccentric reducer with the eccentric side down to avoid air pockets.

NOTE: When operating on suction lift never use a straight taper reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe.

7. To facilitate cleaning pump liquid passage without dismantling pump, an increasing suction nozzle should be bolted to the suction flange. If this is not done, a short section of pipe (Dutchman or spool piece) so designed that it can be readily dropped out of the line can be installed adjacent to the suction flange. With this arrangement, any matter clogging the impeller is accessible by removing the nozzle (or pipe section).

Valves in Suction Piping

When installing valves in the suction piping, observe the following precautions:

1. If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type, rather than the multiple spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line. See “Valves in Discharge Piping” below.)

2. When foot valves are used, or where there are other possibilities of “water hammer”, close the discharge valve slowly before shutting down the pump.

3. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets. Globe valves should not be used, particularly where NPSH is critical.

4. The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump for maintenance purposes, and should always be installed in positions to avoid air pockets.

Discharge Piping

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain as even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

Valves in Discharge Piping

A check valve and gate valve should be installed in the discharge. The check valve, placed between pump and gate valve, protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure. The gate valve is used in priming and starting, and when shutting the pump down.

Pressure Gauges

Properly sized pressure gauges should be installed in both the suction and discharge nozzles in the gauge taps (which are provided on request). The gauges will enable the operator to easily observe the operation of the pump, and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapour binding, or other unstable operation should occur, widely fluctuating discharge pressure will be noted.

h. STUFFING BOX

Contaminants in the pumped liquid must not enter the packing space. 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, therefore, is to use the lowest possible flushing pressure which 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”.)

i. PACKING

SAM Engineering are not normally packed before shipment. If the pump is packed (arrangements at quote/order) and installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, inspect the packing before the pump is started.

j. 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. Temperature is above 0°C and below 70°C.
3. Suction pressure is below 5 bar g.
4. Liquid has lubricating qualities.
5. Liquid is non-toxic and non-volatile.

External Liquid Lubricant

When the liquid being pumped contains solids or is otherwise not compatible with 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. Liquid being pumped contains dirt, grit, or other impurities.
2. Temperature of the pumped liquid is below 0°C or above 70°C.
3. Liquid being pumped has non-lubricating properties.
4. Liquid is toxic or volatile.
5. Suction pressure is above 5 bar g, vacuum, or high lift.

k. 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 35 to 70kpa 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 packing “seating” which should be compensated 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.

I. 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.

Single Mechanical Seal

Pumps containing single mechanical seals normally utilise the pumped liquid to lubricate the seal faces. This method is preferred when the pumped liquid is neither abrasive nor corrosive. If the liquid being pumped is not suitable, an external flush should be provided. (See "External Liquid Lubricant".)

Double Mechanical Seal

A double mechanical seal consists of two single seals mounted back-to-back and a suitable sealing liquid which is introduced into the seal chamber. The sealing liquid (preferably clear water) is injected into the box at a higher pressure than that which exists at the entrance to the seal cavity on the pump side. The pressure differential isolates the sealing faces from the pumped liquid. Double mechanical seals are normally preferred in pumps handling sewage, slurries, or any other solids suspended in the pumped liquid.

Lubrication for the double seal is provided by the sealing liquid which is introduced through the tap in the seal cavity. The sealing liquid pressure must always be higher than the pressure on the seal closer to the suction side. If sufficient sealing pressure is not maintained, the pressure within the pump can force open the lower seal and allow the pumped liquid to enter the box which can damage the seals.

Two methods are used to provide sealing liquid to the stuffing box:

1. A common method utilises a pressure line that is installed from a tap on the discharge nozzle to the tap in the stuffing box cartridge. A filter is installed in the line to trap the solid particles. The filter must be capable of screening out all particles above 25 microns in size.

   Since the liquid is bypassed from the high pressure (discharge) side of the pump, and dead-ended in the stuffing box cartridge, there are no problems in maintaining a sufficient pressure differential provided the filter is not clogged.

2. Clear, clean water can be supplied from an external source in some installations. City water can be used if there is an air break between the water supply and the water being provided to the pump. Various municipal ordinances require this break to prevent contamination of the city water supply.

3. OPERATION

a. PRE-START CHECKS

Before initial start of the pump, make the following inspections:

1. Check alignment between pump and motor.
2. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency on motor nameplate with line circuit.
3. Check suction and discharge piping and pressure gauges for proper operation.
4. Check impeller adjustment; see specific section for proper adjustment.
5. Turn rotating element by hand to assure that it rotates freely.
6. Check stuffing box adjustment, lubrication, and piping.
7. Check driver lubrication.
8. Assure that pump bearings are properly lubricated.
9. Assure that coupling is properly lubricated, if required.
10. Assure that 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.
11. 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.

b. 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 CONDITION, 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.

c. STARTING

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

d. OPERATING CHECKS

1. Check the pump and piping to assure that there are no leaks.
2. Check and record pressure gauge readings for future reference.
3. Check and record voltage, amperage per phase, and kW if an indicating wattmeter is available.
4. Check bearings for lubrication and temperature. Normal temperature is 82°C 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.

e. SHUTDOWN

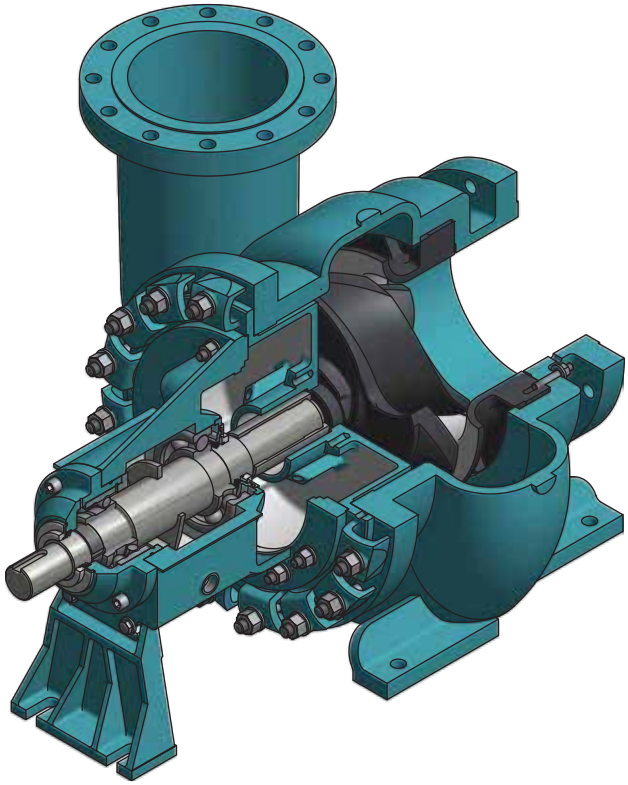
The following steps of procedure will take care of most normal shutdowns of the pump. Make any further adjustments of process piping, valves, etc., as required. If the pump is to be removed from service for an extended period of time, refer to "Temporary Storage" and "Freezing Protection."

1. Close the discharge valve slowly.

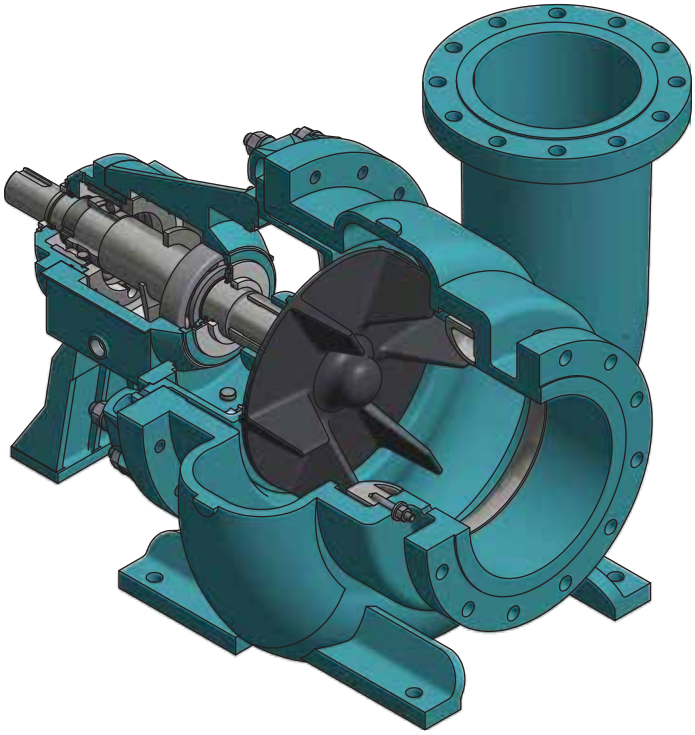
NOTE: When stopping pump, always close discharge valve first.

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

CPW SERIES



CPX SERIES



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	
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)	a. Increase positive suction head on pump by lowering pump or increasing suction pipe size or raising fluid level. b. Sub-cool suction piping at inlet to lower entering liquid temperature. c. Pressurise suction vessel.
15. Defective impeller	Inspect impeller. Replace if damaged or vane sections badly eroded.
16. Defective packing	Replace packing and sleeves if badly worn.

Not enough liquid delivered	
CAUSES	**CURES**
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	
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	
28. Incomplete priming	Free pump, piping and valves of all air. If high points in suction line prevent this, they need correcting.
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 irregularities in these parts will cause a drag on the shaft.
43. Misalignment	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.

MAINTENANCE

a. GENERAL

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 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.

b. 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 pumping units. First, dismantle the bearings; clean and inspect them for any rusted or badly worn surfaces. If bearings 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 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.

c. BEARING LUBRICATION

Grease

Grease lubricated ball bearings are packed with grease at the factory and ordinarily will 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 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-emphasised. 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 be used. It is always best if 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 which 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. Do 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 82°C. Should the temperature of the bearing frame rise above 82°C, the pump should be shut down to determine the cause.

Grease lubricated bearings should not be used where temperature of the pumped liquid exceeds 180°C.

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

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 midway in the sight glass.

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.

(1) Saybolt viscosity at 38°C	150-200 SSU
(2) Saybolt viscosity at 99°C	43 SSU
(3) Viscosity index, minimum	95
(4) API gravity	28 - 33
(5) Pour point, maximum	+93°C
(6) Flash point, minimum	200°
(7) Additives:	Rust and Oxidation inhibitors

NOTE: Oils from different suppliers should not be mixed.

The oil should be well refined, good grade, straight cut, 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 38°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 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; THIS CAUSES THE BEARINGS TO RUN HOT. THE MAXIMUM DESIRABLE OPERATING TEMPERATURE FOR BALL BEARINGS IS 82°C. SHOULD THE TEMPERATURE OF THE BEARING FRAME EXCEED 82°C (MEASURED BY THERMOMETER), SHUT DOWN PUMP TO DETERMINE THE CAUSE.

d. STUFFING BOX

The standard stuffing box consists of rings of packing, (See assembly section for number of rings) a seal cage, and a gland. A shaft sleeve that extends through the box and under the gland is normally provided to protect the shaft.

A tapped hole is supplied in the stuffing box directly over the seal cage to introduce a clean, clear sealing medium. The stuffing box must at all times be supplied with sealing liquid at a high enough pressure to keep the box free from foreign matter, which would quickly destroy the packing and score the shaft sleeve.

Water Lubrication

Only a sufficient volume of sealing liquid to create a definite direction of flow from the stuffing box inward to the pump casing is required, but the pressure is important. Apply seal water at a rate of 2-4 l/m, at 35-70 kPa above stuffing box operating pressure.

We recommend that piping supplying sealing liquid to stuffing box be sized to supply a sufficient volume of water at the required pressure, based on the location of the pump (or pumps) with respect to the liquid source. A small pipe can be utilised for the connection to the stuffing box. A valve should be installed to adjust and regulate sealing liquid and a gauge installed to check pressure to the box.

External sealing liquid should be adjusted to the point where the packing runs only slightly warm, with a very slow drip from the stuffing box. Excess pressure from an external source can be very destructive to packing. More pressure is required, however, for abrasive slurries than for clear liquids. Examination of the leakage will indicate whether to increase or decrease external pressure. If slurry is present in the leakage, increase the pressure until only clear liquid drips from the box. If the drippage is corrosive or harmful to personnel, it should be collected and piped away.

A common error is to open the external piping valve wide and then control the drippage by tightening the packing gland. Actually, a combination of both adjustments is essential to arrive at the optimum condition. The life of packing and sleeve depends on this careful control more than any other factor.

Grease Lubrication

Pump stuffing boxes are also suitable for grease lubrication. Several types of grease lubricators are available. When using a grease lubricator, grease pressure to the stuffing box should be equal to the pump discharge pressure.

Packing

Pumps are not packed before shipment, unless otherwise requested. If packed, packing used is quality branded standard material. Before pump is put into operation, check the condition of the packing. If pump is installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication. If pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, we recommend an inspection of the packing before pump is started.

Fibre Packing

The standard packing is a soft, square asbestos, impregnated with oil and graphite. A soft well-lubricated packing reduces stuffing box resistance, and prevents excessive wear on the shaft or shaft sleeve. Many brands of packing on the market have the desired qualities. For specific recommendations, consult the factory.

When a pump with fibre packing is first started, it is advisable to have the packing slightly loose without causing an air leak. As pump runs in, gradually tighten the gland bolts evenly. The gland should never be drawn to the point where packing is compressed too tightly, and no leakage occurs. This will cause the packing to burn, score the shaft or shaft sleeve, and prevent liquid from circulating through the stuffing box, cooling the packing. The stuffing box is improperly packed or adjusted if friction in the box prevents turning the rotating element by hand. A properly operated packed stuffing box should run lukewarm with a slow drip of sealing liquid. After the pump has been in operation for some time and the packing has been completely run-in, drippage from the stuffing box should be at least 40 to 60 drops per minute. This will indicate proper packing and shaft sleeve lubrication and cooling.

NOTE: Eccentric operation of the shaft, or sleeve, through the packing could result in excess leakage that cannot be compensated for. Correction of this defect is very important.

Packing should be checked frequently and replaced as service indicates. Six months might be a reasonable expected life, depending on operating conditions. It is impossible to give any exact predictions. A packing tool may be used to remove all old packing from the stuffing box. Never reuse old and lifeless packing or merely add some new rings. Make sure that the stuffing box is thoroughly cleaned before new packing is installed. Also check the condition of the shaft or sleeve for possible scoring or eccentricity, making replacements where necessary.

New packing should be placed carefully into the stuffing box. If moulded rings are used, the rings should be opened sideways, and the joints pushed into the stuffing box first. The rings are installed one at a time, each ring seated firmly, and the joints staggered so they are not in line. The joints should be kept toward the upper side of the shaft and should be at about a 90° angle from each preceding joint.

If coil packing is used, cut one ring to accurate size with either a butt or mitered joint. An accurately cut butt joint is superior to a poor fitting mitered joint. Fit the ring over the shaft to assure proper length. Then remove and cut all other rings to the first sample. When the rings are placed around the shaft, a tight joint should be formed. Place the first ring in the bottom of the stuffing box. Then install each succeeding ring, staggering the joints as described above, making sure each ring is firmly seated.

Make sure the seal cage is properly located in the stuffing box under the sealing water inlet. The function of the seal cage is to establish a liquid seal around the shaft, prevent leakage of air through the stuffing box, and lubricate the packing. If it is not properly located, it serves no purpose.

e. MECHANICAL SHAFT SEALS

General

A mechanical shaft seal is supplied in place of a packed stuffing box where specifically requested. 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 normally the life of the seal is much greater than that of packing on similar applications.

General instructions for operation of the various mechanical sealing arrangements are included below. It is not feasible to include detailed instructions for all mechanical seals in this booklet because of the almost unlimited number of possible combinations and arrangements. Instead, seal manufacturer's instructions will be included as a separate supplement to this book where required.

1. Mechanical seals are precision products and should be treated with care. Use special care when handling seals. Clean oil and clean parts are essential to prevent scratching the finely lapped sealing faces. Even light scratches on these faces could result in leaky seals.

2. Normally, mechanical seals require no adjustment or maintenance, except routine replacement of worn, or broken parts.

3. A mechanical seal which has been used should not be put back into service until the sealing faces have been replaced or relapped. (Relapping is generally economical only in seals two inches in size and above.)

Four important rules which should always be followed for optimum seal life are:

1. Keep the seal faces as clean as possible.

2. Keep the seal as cool as possible.

3. Assure that the seal always has proper lubrication.

4. If seal is lubricated with filtered fluid, clean filter frequently.

f. CLEANING WITHOUT DISMANTLING PUMP

We recommend that an increasing suction nozzle, bolted to the suction flange, be used. (If this is not done, a short section of pipe so designed that it can be readily dropped out of the line can be installed adjacent to the suction flange.) With this arrangement, any matter clogging the impeller is accessible by removing the nozzle (or pipe section).

The suction nozzle should be equipped with a hand hole with removable cover, and a pipe tap for injecting high-pressure clean out water into the pump. This high-pressure water (up to 5.5 bar) can be injected to flush out any matter clogging the impeller or water passages. The water should be applied only with the suction valve closed.

Other cleaning methods include running an auger into the pump through the clean out hole in the suction nozzle, or through the casing hand hole. This should free any clogging in the impeller eye.

If the pump cannot be freed of clogging after the above methods have been tried, dismantle the unit as previously described to locate the trouble.

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	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. Check shaft or shaft sleeve for scoring. Scoring accelerates packing wear. 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.
Every year	Remove the rotating element. Inspect thoroughly for wear, and order replacement parts if necessary. Check wearing clearances·clearance between impeller inlet and suction cover or between impeller wear ring and suction wear plate... Remove any deposit or scaling. Clean out stuffing box piping. 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.

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.

5. DISASSEMBLY INSTRUCTIONS

a. REMOVAL OF ROTATING ELEMENT FROM CASING

a) Lock off all electrical power to motor. Disconnect all piping to stuffing box, and other special piping. Casing (2-001-0) (001) may be left in process line assembled to suction and discharge piping if repair or replacement is not required. Drain all liquid from casing if necessary.

b) Remove spacer portion of coupling. If pump is to be completely dismantled, remove pump half coupling, key, and spacer portion. Motor half coupling may be left assembled. See manufacturers' coupling instructions. If pump is V-Belt driven, remove driven sheave and belt.

c) Support the rotating element with a hook and sling under the frame top web and shaft at the coupling end.

For F8 frame, loosen and remove the attaching parts, screw (2-904-2), washer (2-909-2).
For F9 frame, loosen and remove the attaching parts, screw (2-904-2) and washer (2-909-1).

d) Separate the rotating element from the casing with a pry bar (F9) or jacking screws (F8). Remove the casing gasket(s).

e) To remove the front side from the casing, take out the attaching parts, screw and washer. Remove the gasket.

b. IMPELLER REMOVAL (Note: Impeller is threaded to shaft)

a) To remove impeller, hold the shaft stationary. Turn the impeller in a counter clockwise direction, using a wrench on the hex head provided at the impeller inlet. A slight even pressure exerted on the impeller in this manner will loosen it sufficiently, allowing it to be turned off by hand (See Fig. 4). O-ring can be removed from impeller hub.

CRADLE THE LOOSENED IMPELLER IN A SLING AND REMOVE IT BY ROTATING THE SHAFT COUNTER-CLOCKWISE (FROM THE COUPLING END).

WARNING: Never apply heat to impeller to aid in removal. Heat may cause an explosion.

c. STUFFING BOX REMOVAL

a) Packed Stuffing Box

Loosen and remove the two nuts securing the gland. Pull gland and gland base ring, if applicable, free of stuffing box. Next, loosen and remove the screws securing the stuffing box cover to the frame. Pull packing and remove seal cage and packing base ring. Remove shaft sleeve.

NOTE: To replace packing only, remove the gland and the packing. See assembly procedures to replace packing.

b) Mechanical Seal Stuffing Box

1. Loosen and remove the four nuts holding the mechanical seal gland plate to the stuffing box. Pull back the gland plate. Next remove the screws securing the stuffing box cover to the frame. Pull stuffing box cover from frame, being careful not to damage mechanical seal in any way. Seal rotating element and sleeve may be removed from shaft as an assembly. To remove mechanical seal from sleeve, loosen the two set screws in the locking collar with an Allen wrench. Remove the seal gland plate. Then remove stationary seat from gland. Use care not to damage the seal faces.

c) Dynamic Seal Arrangement

For frames sizes F8L1, F8M1, F9L1 &F9M1

1. Remove the back side plate by removing the cap screws. Remove casing back cover.
2. Remove spacer sleeve, if necessary, and O-ring, if necessary. Remove first stage expeller and O-ring.
3. For two stage units, remove intermediate expellers and intermediate plates, the spacer sleeve and the O-ring.
4. Remove dynamic seal housing.
5. Remove shaft sleeve.

d. FRAME DISASSEMBLY

1. Remove bottom drain plug to remove all oil from frame.

2. Remove the deflectors (5-024-3 & 5-024-4) (122 & 123) from both ends of the frame. Newer designs have O-rings and grub screws. Each may be easily pulled from the shaft.

3. To remove the plastic adjusting shims, loosen and remove the four cap screws securing the bearing housing (5-025-0) to frame. Pull out plastic adjusting shims. Use jacking screws located in bearing housing if necessary.

4. Next, pull out the complete shaft assembly, including shaft (5-007-0) (121), bearing housing (5-025-0) (124), ball bearings (5-026-3 & 5-026-4) (123 & 130), and oil slinger(s), (5-485-0) (129). Outboard bearing (5-026-4) (123) is held in housing by snap ring (5-068-4) (126).

5. To remove bearing housing first take out the snap ring (5-068-4) (126) using a pair of snap ring pliers. Then, slide bearing housing free of the bearing and shaft. The O-ring (5-914-4) (127) can be removed from the bearing housing.

6. Oil seal (5-177-3&4) (119) pressed into bearing housing, is removed next. Bearing cover (5-018-3) (112) with seal (5-177-3) (113) can also be removed from inboard end of the frame if desired.

7. Depending on the design, the outboard bearing may be secured to shaft by a snap ring or a bearing locknut. To remove bearing:

   a. If snap ring is used, first remove snap ring at outboard bearing with snap ring pliers.

   b. If bearing locknut is used, bend tab(s) up on lock washer (5-517-4) and remove locknut (5-516-4) and lock washer by turning nut counter clockwise.

8. A standard bearing puller can then be used to remove bearings from both ends of the shaft.

9. Spring type oil slinger (5-485-0) (129) may be removed from shaft by pulling extended tabs in opposing directions. Frame F8 has cast type slingers. There are two (2) set screws in each tap.

e. PARTS INSPECTION

When pump is dismantled for any reason, we recommend that all parts be inspected for wear or damage. Check the following, and replace parts where necessary.

1. Casing — All machined surfaces should be cleaned. The main casing joint should be free of all rust, burrs, or raised surfaces. Check for evidence of extreme wear or corrosion.

2. Impeller — Check impeller vanes for signs of wear, breakage, or corrosion.

3. Stuffing Box Cover — Clean machined surfaces and gasket joint. Make sure that stuffing box cavity is clean.

*4. Mechanical Seal — Check sealing faces and gaskets. Sealing faces must show no evidence of wear. Any cracked or chipped seal face must be replaced. Refer to specific seal manufacturer's instructions.

*5. Shaft sleeve must be smooth. If grooved, it should be replaced.

6. Shaft — Check all rotating close-clearance surfaces such as bearing fits for wear. Check to see if shaft is straight, within (0.02mm).001 T.I.R.

*7. Bearings — Clean if dirty. Replace if noisy or rough when rotated. There should be no signs of rust or pitting.

*8. Shaft Seals — Replace if worn or damaged.

9. Frame — Check machined bores, clean interior of oil reservoir. Replace oil sight gauge if damaged.

*10. Replace all gaskets and O-rings.

It is recommended that all items indicated "*" should be replaced anytime the pump is disassembled.

f. FRAME ASSEMBLY

Refer to Proper Assembly Section

1. Slip the oil slingers over the shaft so that the bevelled side of the slingers face each other. Adjust the spacing "A" and "B" in and tighten slinger locking screws. It is necessary to hang the snap ring on the shaft before mounting the bearings.THE TAPERED FACE OF SNAP RING MUST ALWAYS FACE AWAY FROM THE BEARING.

NOTE: Each slinger has two (2) set screws per tap.

2. Assemble ball bearings at both ends of shaft. If an arbour press is not available, the bearings may be heated and quickly slipped on the shaft. (Do not heat above 135°C).

Assemble and securely tighten the lock nut (5-516-4) and lock washer (5-517-4) at the outboard bearing. BEND TAB(S) ON LOCK WASHER. If the frame assembly has a snap ring instead of a lock nut, assemble the snap ring making sure the tapered face is away from the bearing.

3. Press outboard seal into bearing housing so that seal lip is directed away from housing. Install bearing housing over bearing and lock in place with loose ring.

4. Press inboard seal into bearing cover so that seal lip is directed away from housing. Press inboard bearing cover into frame.

5. Insert O-ring in groove of bearing housing, then carefully insert shaft assembly into frame. Do not install shims at this time, since the proper shim thickness will be determined after reassembly of the complete rotating element. Temporarily attach bearing housing to frame.

NOTE: The word "top" which is cast on the bearing housing, should be in the uppermost position. This locates the oil return passage in the proper position.

6. Insert shaft key.

g. STUFFING BOX ASSEMBLY

a) Packed Stuffing Box

1. Place stuffing box cover on table or workbench with the stuffing box opening up.

2. Assemble packing base ring. In bottom of stuff box insert three (3) rings of packing, seal cage, two (2) rings of packing, and gland with the shaft sleeve packed in the stuffing box. Packing joints should be staggered to prevent excessive leakage. Pull gland retaining nuts to finger tightness.

3. The entire stuffing box assembly, including the sleeve, may then be placed into position over the shaft and bolted to the frame.

b) Mechanical Seal Stuffing Box

(Single inside mechanical seals with clamped in seat and O-ring seat are both illustrated.)

1. Assemble mechanical seal stationary seat into gland plate. Slide gland plate assembly with gasket and seal rotating assembly on shaft in order mentioned. Position rotating assembly on shaft using seal manufacturer's instruction sheet.

2. Tighten all set screws. Slide stuffing box cover over shaft. Assemble and tighten the retaining screws which secure the stuffing box cover to the frame. Move gland plate forward to check seal adjustment. Tighten gland screws after final impeller adjustment.

For all Frame Sizes

1. Assemble the gasket into the casing cover onto the previously assembled unit.

2. Assemble the rear side plate and the gasket onto the casing cover using cap screws. For ease of assembly, place studs in two of the mounting holes for initial alignment.

3. Adjust the rotating element as far forward as possible (towards the pump suction). Do not attempt to turn shaft until the impeller is assembled.

For F8 frame use the jacking screws (5-904-9).
For F9 frames use the adjusting screw (5-904-0).

h. IMPELLER ASSEMBLY

1. Place O-ring into the impeller O-ring groove and screw the impeller onto the shaft.

2. Apply a coat of anti-seize compound to shaft threads.

3. TO THREAD THE IMPELLER ON THE SAFT, CRADLE IT IN A SLING, AND ROTATE THE SHAFT CLOCKWISE FROM THE COUPLING END.

4. To secure the impeller, hold the shaft in affixed position and place a block of wood against an impeller vane. Carefully tap with a mallet to tighten the impeller.

5. Adjust the gap between the impeller and the stuff box to .015".

For an F8 frame use the jacking screws on the outboard bearing housing.

For an F9 frame use the adjusting screw. The frame clamping screws should be snug to hold the frame liner in proper alignment with the frame, but without preventing axial adjustment.

6. Rotate the shaft to be certain that it rotates freely.

i. CASING ASSEMBLY

1. Assemble the gasket to the casing. Place studs in two of the front side plate holes to guide the front side plate into the casing. Assemble cap screws and washers.

NOTE: Before installing the rotating element into the pump casing, the total internal clearance of the casing must be established. Use steps two (2) through six (6) to determine this clearance.

2. Utilise the jacking screws in the bearing housing. Alternately loosen the attachment screws while tightening the jacking screws until the impeller is against the stuffing box cover (there will be no clearance between the impeller and the cover). When making the screw adjustments, be sure that the space between the bearing housing and the frame is held equal at all four attachment screws when the adjusting screws are snug.

3. Using a combination square, measure distance "C" between the stuff box cover flange and the straight part of the impeller vane.

4. Install the rotating element in the casing.

F8 Frame

Secure the frame assembly to the casing with attaching parts, clamp lugs, screw and washer.

j. IMPELLER ADJUSTMENT

NOTE: The impeller must always be adjusted against the back side plate before the rotating element is assembled to the casing.

1. Place a dial indicator against the coupling end of the shaft and move the rotating element forward until the impeller contacts the front side plate.

NOTE: The internal clearance from the dial indicator should read between 0.7mm and 1.5mm.

2. If it reads more or less, remove or add casing gaskets to obtain the proper clearance.

3. Repeat step 1 for final clearance check.

CAUTION: Shim material is a special plastic. Ordinary plastic should not be substituted.

a) Loosen the four (4) cap screws and back off bearing housing with jacking screws for easy insertion of shim packs.

b) Insert the proper shims at both the top and bottom of the gap.

c) Place all cap screws into the tightening position and draw them up against the shims.

d) Turn the shaft by hand to make sure the unit rotates freely.

4. For mechanical seal stuffing box pump, tighten the four (4) screws which secure the gland to the stuffing box.

REPLACEMENT PARTS

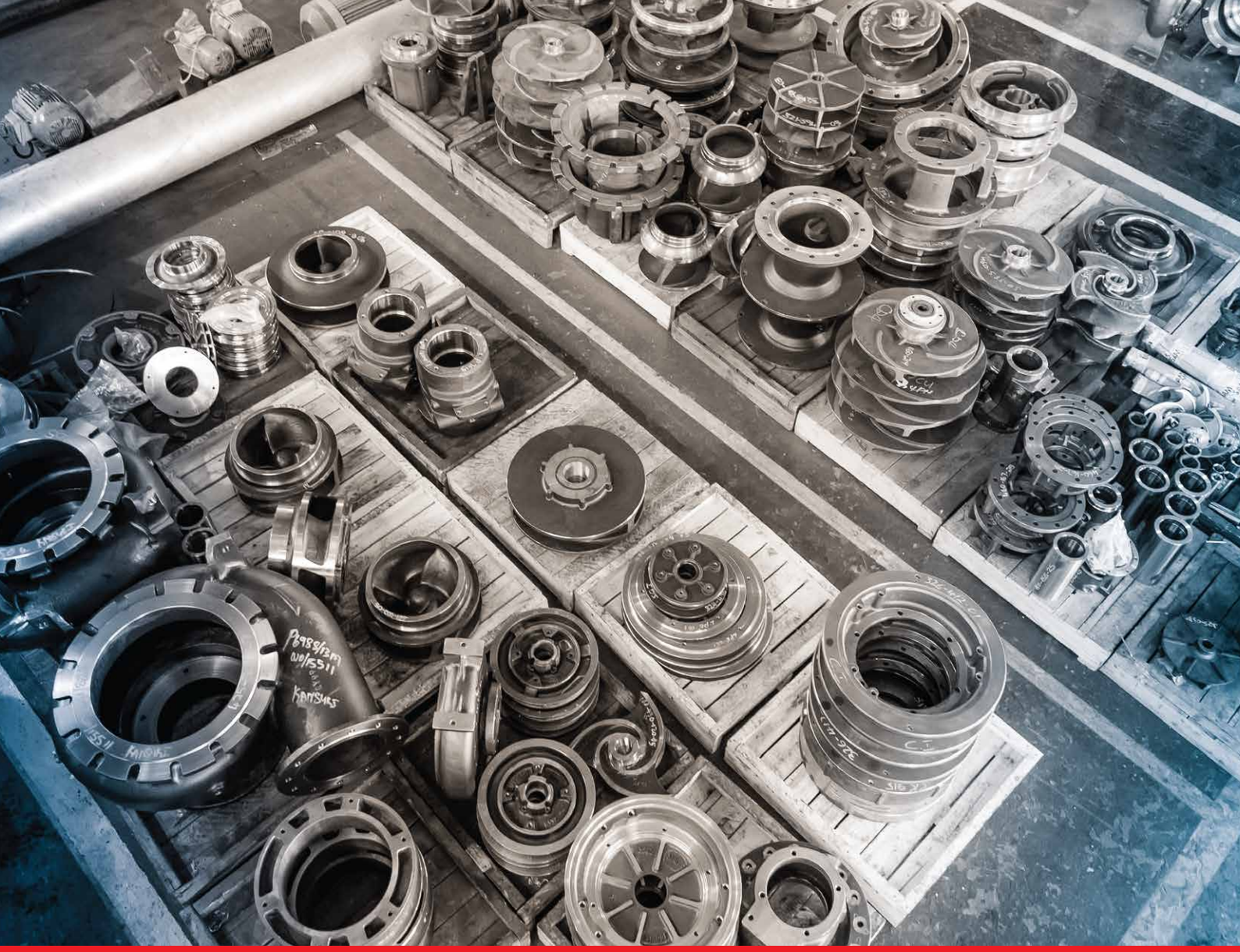
Pumps are designed and built with all wearing parts replaceable. A recommended inventory of spare parts is dependent on the installation and the importance of continued operation.

Parts should be ordered as far in advance as possible since circumstances beyond the control of SAM Engineering may reduce existing stock. Not all parts are stocked; some must be manufactured for each order.

When ordering spare parts, always include the following:

1. Pump Serial Number
2. Pump Model and Size
3. Catalogue Number of Part
4. Name of Part
5. Quantity of each Part
6. Material Desired (if different than original material)

NOTE: Parts will be furnished in original materials unless specified as a material change. All material substitutions should be discussed with the factory.



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