CSW Pumps
Installation, Operation and Maintenance Manual

SAMengineering

Customised Pump Solutions

SAM Engineering (Pty) Ltd.
24 Duncan Road, Lilianton,
Boksburg, South Africa
Tel: +27 (0) 11 823-4250
Fax: +27 (0) 11 823-4943
Email: pumps@sameng.co.za
www.sameng.co.za

Alloys to suit all applications

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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

PURPOSE OF MANUAL

This manual is furnished to acquaint you with the procedures to install, operate and maintain this pump for reference. Additional information can be obtained from your SAM Engineering Sales Representative.

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

WARRANTY

Refer to your sales contract for coverage's.

PUMP NAMEPLATE

SAMCO PUMPS

MODEL		SER. NO.
FLOW (m^3/hr)		HEAD (m)
MAWP (KPag)	@ °C	IMP. DIA. (mm)
MOC		RPM
SG		HYDRO (kPag)

SAM Engineering (Pty) Ltd
Tel: +27 11 823-4250

MODEL = Pump Model and Type

SER. NO. = Serial Number

FLOW (m^3/hr) = Design Flow Rate

HEAD (m) = Design Head

MAWP = Maximum Allowable Working Pressure @ Temperature in Deg C

IMP. DIA (mm) = Supplied Impeller Diameter

*MOC – Material of Construction

RPM = Operating Revolutions Per Minute

SG = Specific Gravity of Fluid Pumped

HYDRO = Hydro Test Pressure (kPa)

Permanent records are kept by SAM Engineering and filed by serial number.

*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

Check the 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.

Pumps and drivers are normally shipped from the factory mounted on a baseplate while 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 not assembled, 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", "Setting Baseplate", "Grouting Procedure", "Alignment Procedure", and "Doweling".

STORAGE

Short term: (Less than 6 months) SAM Engineering's normal packing procedure is designed to protect the pump during shipping. Upon receipt, store in a covered dry location.

Long Term: (More than 6 months) Preservative treatment of bearings and machined surfaces will be required. Rotate shaft several times every 3 months. Refer to driver, coupling and seal manufacturers for their long-term storage procedures. Store in a covered dry location

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) is provided at pump suction. 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 headroom 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 pump without disturbing the pump inlet and discharge piping.

Select a dry place above the floor level wherever possible.

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

SETTING BASEPLATE/PEDESTAL

Due to flexibility of an ungrouted base and handling in shipment, it should not be assumed that the unit is in alignment when it is placed on the rough foundation.

If these directions are followed, the required alignment should be readily achieved.

Initial or rough alignment must be done before grouting the baseplate. Rough alignment is designated as (0.5mm) 0.020" TIR parallel alignment and (0.2mm) 0.009" TIR per inch of radius angular alignment (See "Alignment Procedure" described below). Use blocks at anchor bolts and the midway between to position the bottom of the base at finished height (See Figure II) with foundation bolts extending through holes in the baseplate. Metal wedges with a small taper may be used in lieu of blocks and shims.

If the unit has a non-flexible coupling, the coupling halves should be disconnected; this is generally not necessary on flexible type couplings.

Tighten up all pump and motor bolts to assure they have not loosened or a "soft foot" has not occurred due to base distortion in shipment.

If the driver is being field installed, it should be centred in its bolt holes with shims added to bring the motor into rough alignment with the pump.

NOTE: Do not exceed six (6) shims; using as thick a shim as possible, otherwise "sponginess" or "soft foot" will result.

Level and plumb the pump shaft, coupling faces and flanges by adding or removing shims between the blocks and the bottom of the base. Hand tighten the anchor bolt nuts at first. Being very careful not to distort the base, snug down the nuts with a wrench. The non-flexible coupling should not be reconnected until the alignment operation have been completed.

NOTE: The baseplate does not have to be level.

After the foundation bolts are lightly torqued, recheck the alignment requirements once more. Follow the requirements outlined at the beginning of this section. If alignment must be corrected, add or remove shims or wedges under the baseplate.

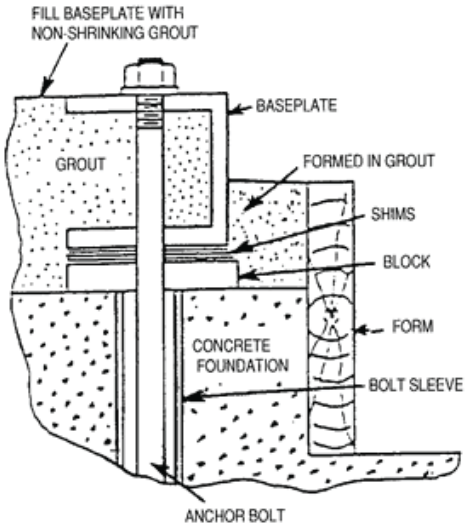


FIGURE II. GROUTING

The unit can then be grouted in (See Figure II).

SUCTION AND DISCHARGE PIPING

Pipe flanges should not impose any strain on the pump. This can be checked by a dial indicator. Any strain must be corrected by adjustments in the piping system.

Suction and discharge piping should be anchored, supported, and restrained near the pump to avoid strain on the pump. When using a rubber expansion joint, follow the recommendations of the Technical Handbook on Rubber Expansion Joints and Flexible Pipe Connectors, published by the Fluid Sealing Association, 2017 Walnut Street, Philadelphia, PA, 19103.

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 the pipe.

Both the suction and discharge piping should be independently anchored 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.

Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45° or long sweep 90° fitting to decrease friction losses.

Make sure that all piping joints are airtight.

Where flanged joints are used, assure that inside diameters match properly.

Remove burrs and sharp edges when making up joints.

Do not "spring" piping when making any connections.

When hot fluids are to be pumped, you should provide for pipe expansion.

STUFFING BOX LUBRICATION

Contaminants in the pumped liquid must not enter the stuffing box. These contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing or mechanical seal 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 or seal. The most important consideration is to establish the optimum flushing pressure that will keep any contaminants from the stuffing box cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing or seal wear may result and extreme heat may develop in the shaft causing higher bearing temperatures. The most desirable condition, therefore, is to use a seal water pressure slightly above the maximum stuffing box pressure.

If the pump system pressure conditions vary during the day, packing adjustment becomes difficult. Consideration should be given to using a mechanical seal. (See "Mechanical Seals".)

Mechanical seals

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 parts may be ordered from your SAM Engineering Pump Sales Representative.

Just as with packing, the mechanical seal chamber must be supplied with a source of clean, clear liquid to flush and lubricate the seal. The most important consideration is to establish the optimum flushing pressure that will keep contaminants from the seal cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive seal wear may result.

OPERATION

PRE-START CHECKS

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

1.1 Check the alignment between the pump and motor.

1.2 Check all connections to motor and starting device against the wiring diagram. Check voltage, phase, and frequency on motor nameplate with the line circuit.

1.3 Check suction and discharge piping and pressure gauges for proper operation.

1.4 Check impeller adjustment

1.5 Turn rotating element by hand to assure that it rotates freely.

1.6 Check the stuffing box adjustment, lubrication, and piping.

1.7 Check driver lubrication.

1.8 Assure that pump bearings are properly lubricated.

1.9 Assure that the coupling is properly lubricated, if required.

1.10 Assure that the pump is full of liquid (see Priming) and that all valves are properly set and operational with the discharge valve and the suction valve open. Purge all air from the top of the casing and from the mechanical seal chamber.

1.11 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.

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.

NOTE: Under either condition, the pump must be completely filled with liquid, before starting. The pump must not be run dry in the hope that it will prime itself.

STARTING

1.1 Close drain valves.

1.2 Completely open all the valves in the suction and discharge lines.

1.3 Turn the seal water on to the stuffing box. (If pumped fluid is dirty, these lines should always be left open, except when using double mechanical seals.)

1.4 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.

1.5 Start the pump driver (turbines and engines may require warming up, consult the manufacturer's instructions).

1.6 When the pump is operating at full speed, check to see that the check valve has opened up. The check valve must open 5 seconds or less after start-up to prevent damage to pump by operating at zero flow.

1.7 Adjust the seal water valves to produce the recommended pressure for either the mechanical seal or packed stuffing box.

SHUTDOWN

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

1.1 Shut down the driver. (Consult manufacturer's instructions for special operations.)

1.2 Close suction and discharge valves.

1.3 Close seal water valves. (If pumped liquid is dirty, or if leakage is to be prevented, these lines should always be left open, except when the pump is completely drained.)

1.4 Open drain valves as required.

MAINTENANCE

GENERAL MAINTENANCE AND PERIODIC INSPECTION

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 conditions 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. See the Maintenance Time Table.

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 observed in the first hour or so after the pump has been started to see that they are operating properly.

In greasing anti-friction bearings, the use of high pressure equipment is not only unnecessary, but is actually undesirable unless used with great care. High pressure may damage the bearings or seals, cause unnecessary loss of grease, create a danger of overheating due to over-greasing, and produce unsightly conditions around the bearing.

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

Adequate lubrication is assured if the level of grease is maintained at about 1/2 the capacity of the bearing and bearing housing space. Any greater amount will, as a rule, be discharged by the seal or vent and be wasted.

The importance of proper lubrication cannot be over-emphasised. It is difficult to say how often a bearing should be greased, since this depends on the conditions of operation. It is recommended that one ounce of grease is added at regular intervals, however, it is equally important to avoid adding too much grease. For average operating conditions, it is recommended that one ounce of grease be added at intervals of three to six months, using only clean grease. It is advised that the unit is stopped while grease is added to avoid overloading.

A lithium based NLGI - 2 grade grease should be used for lubricating bearings where the ambient temperature is above -6°C. Grease lubricated bearings are packed at the factory with Mobilux EP No.2 grease. Other recommended greases are Texaco Multifak EP-2 and Shell Alvania EP-2.

Greases made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Do not use graphite.

Refilling grease after cleaning

When cleaning the bearings during a major overhaul, use a bearing cleaning solvent, industrial cleaning solvent, or kerosene. In case of badly oxidised grease, soak bearings in hot, light oil (93° to 115°C). Do not use gasoline. Use lint free cloths. Do not use waste rags.

Hand pack clean bearings (not the housing) completely full with fresh grease while the pump is disassembled. Add additional grease to the bearing housing. The resulting total level of grease should be about 1/2 the capacity of the bearing and bearing housing space. On vertical pumps, place some grease on the frame ledge above the inboard (lower) bearing. Remove the vent plug to allow any excess grease to be expelled during the first 24 hours of operation. Then replace all vent plugs.

Periodic addition of grease

Grease lubricated ball bearings are packed with grease at the factory. Store the pump in a clean, dry place prior to its first operation.

If you are uncertain about the amount of grease in a bearing at re-lubrication intervals, the safe rule is to add grease slowly (one ounce at a time) as the bearing operates (if this is safe). Remember, a ball or roller bearing in most applications is assured of adequate lubrication if the level of grease is maintained at about 1/2 the capacity of the bearing and bearing housing space. Any greater amount will, as a rule, be discharged by the seals or vent and be wasted.

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

Remove vent plugs for the first 24 hours of operation after re-greasing.

Bearing temperature

Normally, the maximum desirable operating temperature for ball bearings is 80°C as measured on the bearing housing. Special designs may have higher limits. Should the temperature of the bearing frame rise above the limit, the pump should be shut down to determine the cause. 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

Oil lubrication on sewage pumps is considered special. Oil lubricated pumps may have an oil ring in which the oil is picked up from the reservoir by a rotating the oil ring, and deposited on the shaft and bearings inside the bearing housing. They may also have an oil slinger which creates a mist of fine droplets over the entire interior of the bearing cavity.

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

A Mobil DTE Medium turbine oil or equivalent, meeting the following specification will provide satisfactory lubrication. The oils can be furnished by all major oil companies. It is the responsibility of the oil vendor to supply a suitable lubricant.

NOTE: Oils from different suppliers should not be mixed. Engine oils are not recommended.

The oil should be a non-foaming, well-refined, good-grade, straight-cut, filtered mineral oil. It must be free from water, sediment, resin, soaps, acid, and fillers of any kind.

In installations with moderate temperature changes, low humidity, and a clean atmosphere, the oil should be changed after approximately 1000 hours of operation. The oil should be inspected at this time to determine the operating period before the next oil change. Oil change periods may be increased up to 4000 hours based on an 8000 hour year. Check the oil frequently for moisture, dirt, or signs of breakdown, especially during the first 1000 hours.

NOTE: Do not over oil as this causes the bearings to run hot. The maximum desirable bearing housing operating temperature for all ball bearings is 180°F. Should the temperature of the bearing frame exceed 80°C (measured by thermometer), shut down the pump to determine the cause.

CLEANING WITHOUT DISMANTLING THE 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 designed to 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.

CAUTION: Do not open hand hole cover unless driver has been locked out and the pump drained of fluid. Failure to follow these instructions may result in serious injury, death, or property damage.

PERIOD	INSPECTION
Every month	Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 82°C), 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 identified 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 the shaft or shaft sleeve for scoring. Scoring accelerates packing wear. Check alignment of the 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. 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 also reflect in the 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.

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)	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.
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	
CAUSES	**CURES**
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	
CAUSES	**CURES**
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 dis-charge 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.

SERVICING GENERAL MAINTENANCE NOTES

When assembling and disassembling the pump frame, it is easier to work in the vertical position. Place the pump frame, minus the impeller, on a flat table or support with a hole in the centre for the shaft to pass through. Use a hoist to handle larger pumps. If the pump bearings or seals are to be removed, it is recommended they be replaced rather than reusing old parts. If they fail in service as a result of damage sustained during disassembly, the cost of replacing them again will be much greater than the cost of new parts in the first place.

DISASSEMBLY

(Refer to parts list and assembly sections.)

Wet end

a. Close the discharge and suction valves.

b. Lock out power to the driver.

c. Disconnect the power source from the driver, following proper safety precautions.

d. Turn off packing or seal liquid supply and disconnect all piping to the stuffing box.

e. Open drain plugs and drain casing.

f. Disconnect the coupling.

   i. Pump with standard flexible coupling: Disconnect the driver half cou-pling and remove the driver. Shims and dowels under the driver feet should be marked so they can be replaced in the proper location when the driver is reinstalled.

   ii. Pump with spacer type coupling: Remove spacer portion of coupling. The driver half coupling may be left assembled and the driver need not be moved.

Note: The pump half coupling is only removed if the pump is to be completely dismantled.

   iii. Pump with V-Belt drive: Remove belts and pump sleeve.

g. Rotating Element Removal: Unbolt and remove the foot support from frame.

h. Remove bolts that secure the rotating element to the casing and pull the entire rotating element from the casing. The casing may be left connected to the piping unless it or the suction cover is to be replaced or repaired. Remove casing joint gasket.

i. Impeller Removal: Unlock and remove the impeller nut set-screw and impeller nut. The nut has right hand threads for both clockwise and counter clockwise directions of impeller rotation. The impeller nut set-screw has been locked in place with a retaining compound. Application of heat from a small propane torch may be necessary to remove the set screw.

j. Remove impeller and impeller key from the tapered shaft. Wedges may be used to remove the impeller, but they should be placed directly behind the vanes to avoid damaging the impeller. The impeller can also be removed by using a simple puller.

k. If the impeller is equipped with a wear ring (optional) and if the wear ring is to be replaced, pry it off using a screwdriver or small pry bar. The wear ring is held in place using a retaining compound, so the application of heat from a small propane torch will be helpful.

l. The suction cover is equipped with a wear plate and if the wear plate is to be replaced, pry it off using a screwdriver or small pry bar. The wear plate is held in place with a retaining compound, so the application of heat from a small propane torch will be helpful.

Pumps with packing

a. Loosen the packing gland.

b. Remove the two screws that secure the stuffing box cover to frame. Remove the stuffing box cover with packing arrangement.

c. Dismantle the stuffing box cover by removing gland, packing, lantern ring, and packing base ring.

d. Remove the set screw from sleeve and slide the shaft sleeve off the shaft.

e. Remove the O-ring from the shaft.

Pumps with standard double mechanical seal

NOTE: Use care when performing the following steps so as not to damage or scratch the seal parts.

a. Remove the two screws that secure stuffing box cover to frame.

b. Remove the set screw from the sleeve.

c. Remove the screws holding the mechanical seal gland. Use care since the seal faces are spring loaded.

d. Carefully pull the stuffing box cover with the stationary seat off the shaft.

e. Slide the shaft sleeve with mechanical seal parts off the shaft.

f. Slide the gland with the stationary seat off the shaft.

g. Remove mechanical seal parts from the sleeve and stationary seats from the stuffing box and gland.

h. Remove the O-ring from the shaft.

Frame

Remove the pump half coupling and coupling key if these parts have been left on the shaft.

a. Remove the deflectors from both ends of the frame.

b. Remove the four cap screws securing the outboard bearing housing to the frame.

c. Pull out the adjusting shims.

NOTE: Do not discard shims. They will be needed to re-adjust clearance when the pump is reassembled. Two of the screws removed in Step b can be used as jacking screws on most frames.

d. Pull the complete shaft and bearing assembly out of the outboard end of the frame.

e. Press the bearing cover out of the inboard end of the frame.

h. Remove the bearing housing from the outboard end of the shaft.

i. Press out the outboard bearing seal from the outboard bearing housing.

j. Bend the locking tabs on the bearing lock washer out of the slots on the bearing locknut and remove the nut using either a spanner wrench or a drift pin and hammer.

k. Remove the outboard bearing from the shaft.

NOTE: When removing bearings, do not apply pressure to the outer race. Apply pressure to the inner race only. This will avoid any possible damage to the bearings.

l. Remove grease retainer and bearing housing snap ring from shaft.

m. Remove the inboard bearing from the shaft.

PART INSPECTION

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

Casing

All machined surfaces should be cleaned. Remove rust, burrs, or raised surfaces from the main casing joint. Check for evidence of extreme wear or corrosion, especially at threaded taps and gasket joints.

Suction cover

Check and clean machined surfaces and gasket joint. Inspect for wear. Check suction wear plate.

Stuffing box cover

Check and clean machined surfaces and the gasket joint. Make sure the stuffing box cavity is clean. Inspect and clean seal water inlet.

Stuffing box parts

a. Pumps with packing:
Inspect gland and lantern ring. Replace packing.

b. Pumps with mechanical seal:
Inspect for wear, deterioration of bellows, broken spring, broken or scratched seal seats.

Impeller

Check the impeller vanes, impeller bore, and keyway for signs of wear, breakage, or corrosion. Inspect the impeller hub and impeller back vanes on rear of impeller. (Some impellers do not have back vanes. Check the impeller wear ring or inlet face for wear.

Shaft sleeve

Inspect the shaft sleeve for nicks, burrs, grooves, or other damage. Repair if possible; if not, replace. If the shaft sleeve for packing is grooved or worn in excess of 3/64" on the diameter, replace.

Shaft

Check the bearing and impeller fits, lip seal surfaces, and keyways for signs of wear, breakage, corrosion, nicks, or burrs. Repair these surfaces if it is damaged or replace the shaft. Check to see if shaft is straight. It must be within 0.002 TIR straightness.

Bearings

Clean the bearings using an approved bearing cleaning solvent, or other non-flammable industrial solvent. Inspect the bearings, replacing them if they are noisy or rough when rotated, or if there are signs of wear or pitting in the bearing race-ways.

WARNING: Under no condition should a combusti-ble solvent such as gasoline be used to clean the bearings or any other part of the pump. The use of such solvents could lead to fire or explosion. Failure to follow all instructions may result in serious injury, death, or property damage

GREASE SEALS – REPLACE

Frame

Check the machined bores for evidence of corrosion or wear and clean old grease from the frame interior.

ASSEMBLY

Pump and frame parts are reassembled in the reverse order of dismantling, with special notes as outlined below. Follow all installation precautions covered in this manual. Always replace all old gaskets, O-rings, and packing. We also recommend replacing bearings if they have been removed from the shaft, and lip seals whenever new bearings are installed.

Frame

1. Place the bearing housing snap ring and the bearing grease retainer, in that order, on the outboard end of the pump shaft. The grease retainer has an offset surface near the inside diameter which must face away from the bearing. The flat side of the snap ring faces toward the coupling end of the shaft. These parts are placed on the shaft to be used in a later assembly step.

2. Heat the inboard and outboard bearings to 110°C using a clean oil bath or a dry oven.

WARNING: Use insulated gloves when handling hot bearings. Failure to follow all instructions may result in serious injury, death, or property damage.

The inboard bearing is a single row bearing and fits on the impeller side of the shaft. The outboard bearing is a double row angular contact bearing and fits onto the coupling side of the shaft.

Slide both bearings onto their respective bearing fits on the shaft, being sure the bearings press firmly against the bearing fit shoulder.

Install the bearing lock washer on the coupling end of the shaft, with the lock-ing tabs facing away from the bearing. There is a tab on the LD. of the lock washer which must fit into the groove in the pump shaft.

Install the bearing locknut with the bevelled edge facing the bearing. Tighten the locknut using either a spanner wrench or a drift pin and hammer. Tapping the spanner wrench with a hammer will insure the nut is tight. Make sure that the nut comes to rest in a position where a slot on the nut lines up with a tab on the lock washer. Bend one of the lock washer tabs into a matching slot on the bearing locknut.

3. Thoroughly pack both bearings with an approved lubricant. Note that the space between the bearing and bearing lip seal should be no more than one-half to one-third full of grease to prevent overheating.

4. Press the outboard bearing seal into the outboard bearing housing.

Note: Use proper tool for assembly so the lip seal does not cock.

The bearing seal must be positioned with the lip facing outward. The bearing seal is positioned in this fashion to exclude contaminant so some grease leak-age may occur. Pre-lubricate the lip seal with a thin film of grease.

5. Slide the outboard bearing housing over the shaft and outboard bearing. Place the bearing grease retainer against the outer race of the outboard bearing and place the snap ring into the snap ring groove in the outboard bearing housing. Be sure the snap ring is firmly seated in the groove by tapping it with a soft steel punch. The bevel on the snap ring must face away from the outboard bearing.

6. Press the inboard bearing seal into the inboard bearing cover with the lip pointing away from the bearing. Press the bearing cover into the inboard end of the frame. The bearing seal is positioned in this fashion to exclude contaminants. Some grease leakage may occur. Pre-lubricate the lip seal with a thin film of grease.

7. Slide the shaft assembly, impeller end first, into the outboard end of the frame. This may be best performed vertically. Be careful so the inboard bearing seal does not get damaged.

8. Assemble bolts to hold the bearing housing to the frame. Do not tighten the bolts fully until the rotating element is placed into the casing and the impeller clearance is adjusted.

9. Assemble deflectors and on both ends of frame.

10. Insert coupling key onto shaft.

WET END

Pumps with packing

1. Insert the packing base ring, two rings of packing, lantern ring, and the three additional rings of packing in the stuffing box using the shaft sleeve as a guide. Next, remove the shaft sleeve from the stuffing box. Make sure the lantern ring lines up with the stuffing box lubrication hole. The last ring of the packing may not fit into the stuffing box until the packing gets compressed in service.

2. Install the O-ring in the shaft O-ring groove.

3. Slide the shaft sleeve over the shaft. Position the set screw hole in the shaft sleeve directly over the dimple in the pump shaft. Place the set screw through the sleeve and into the pump shaft using a retaining compound, such as Loctite 271, to lock set screw. Do not over-tighten the set screw.

4. Place the stuffing box cover onto frame and secure with two bolts. This may best be performed vertically.

5. Slide the packing gland into position. Tighten gland nuts until they are "finger tight". Two nuts are provided on each side for locking purposes.

Pumps with standard double mechanical seal

1. Install an O-ring in the shaft O-ring groove.

2. Take the stuff box cover and place on a flat surface with the seal cavity facing up.

3. Install the inboard mechanical seal seat with O-ring into the bottom of the stuffing box.

4. Install the outboard mechanical seal seat with an O-ring into the gland.

5. Grease the gasket and place on the gasket face of the gland.

6. Coat the sleeve with a thin film of 10 weight silicon oil to provide a lubricant for assembly. Also coat seal faces for initial start-up. On a clean workbench, set the shaft sleeve (with the set screw hole toward the open end of the stuffing box) in the centre of the stuffing box. Install the rotary parts of the seal over the sleeve. Care must be taken not to damage the seal face.

NOTE: When performing this step, make sure to carefully inspect the rotary parts and sleeve.

7. Bolt the gland to the stuffing box cover using caution not to damage the seal. Use screws and washers.

8. Place the sleeve, mechanical seal, and stuffing box assembly onto the shaft. Position the set screw hole directly over the dimple in the shaft. Insert the set screw into the sleeve using the dimple in the shaft as a locking point. Use a retaining compound, such as Loctite 271, to lock the set screw. Do not over-tighten the set screw.

9. Using screws, bolt the stuffing box assembly to the frame.

10. Apply water under pressure (40 psi to 60 psi) to the seal chamber and rotate shaft slowly to check for leaks. If there is no sign of leakage, continue with assembly. Should leakage occur, the seal bellows may need to be repositioned on the shaft sleeve. This is accomplished by sliding the bellows toward the stationary seal where leakage appeared. If the pump is not to be placed in service immediately, be sure the stuffing box is completely dry to prevent any rust formation.

    You must continue with all assembly steps through and including the impeller clearance adjustment. The seal bellows will seize against the sleeve after a short time and the impeller adjustment after that point can result in mechanical seal leakage.

11. If the wear plate is to be replaced, apply a retaining compound, such as Loctite 222, to the wear plate and press it into the suction cover. Be sure the wear plate sits firmly against the machined surface. The chamfered edge must face down.

12. If the wear ring (optional) is to be replaced, apply a retaining compound, such as Loctite 222, to the wear ring and press it in place on the impeller. Be sure wear ring sits firmly against the machined surface.

13. Place the impeller key in the shaft keyway and slide the impeller on the shaft taper.

14. Assemble the impeller nut and tighten.

Caution: The dog point of the set screw must sit in the drilled hole. If this is not done, the impeller nut can loosen. Failure to do so may result in equipment and/or property damage. Do not over-tighten the set screw.

15. Place a new casing joint gasket onto the gasket surface of the stuffing box using a thin film of grease around the gasket.

16. Reassemble the complete rotating element of the pump into the casing. Be careful not to pinch the gasket. Insert bolts and washer that secure frame to the casing.

NOTE: When performing this step, be sure the bearing housing bolts that are installed are loose, and remain loose during assembly. Failure to do so may result in damage to the pump bearing housing.

Pull the casing bolts down evenly finger tight, making sure the frame is not "cocked" in the casing. Then start "snugging" bolts. Do not completely tighten each bolt before tightening the next. It is recommended the first bolt be turned 1/2 turn, then tighten the bolt 180° opposite the first, now move to two bolts at the 90° and 270° points and tighten 1/2 turn.

17. Follow this alternating procedure until all bolts are tightened.

18. Check the impeller clearance and adjust the number of shims to obtain the proper axial clearance between the impeller and wear plate.

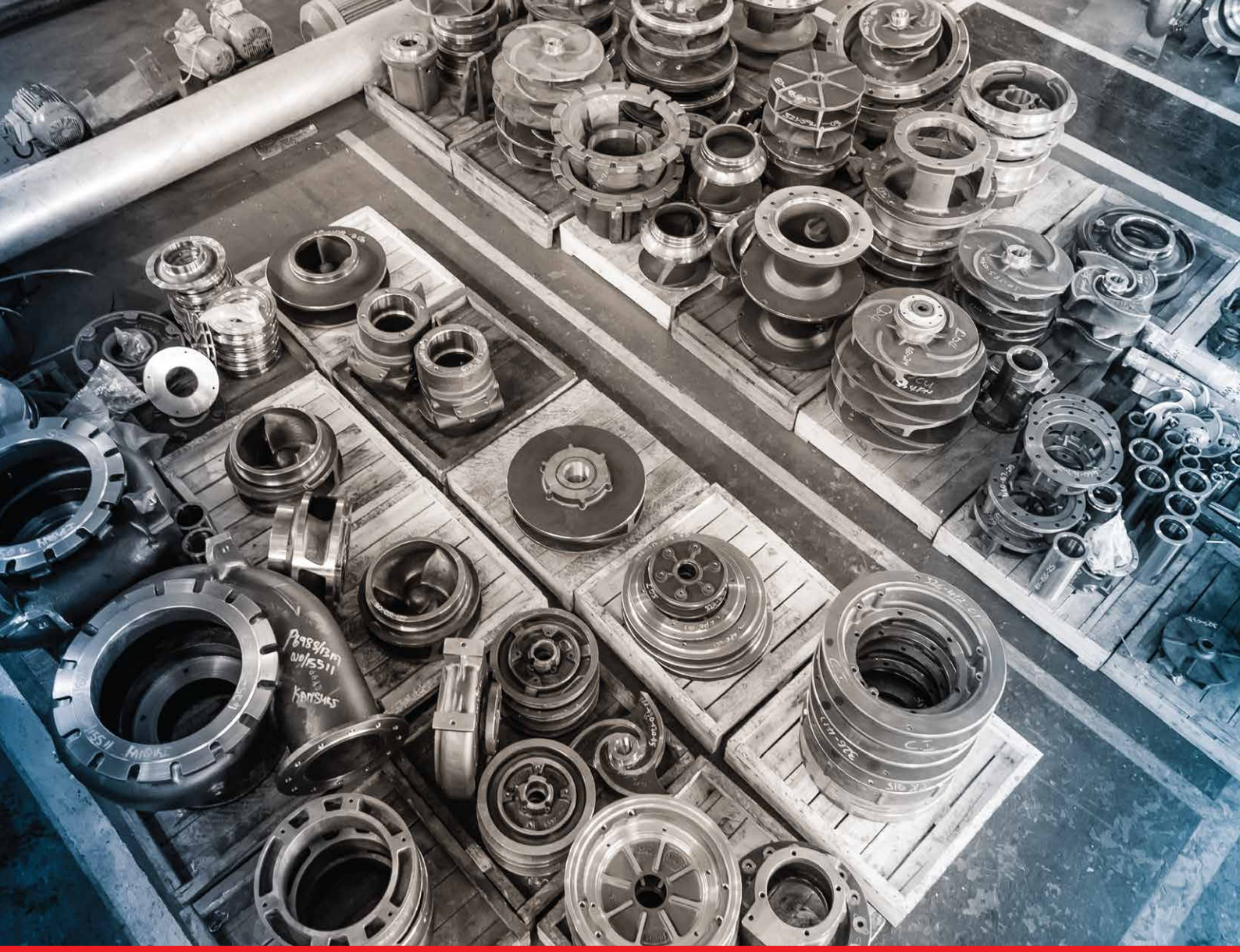
19. Replace the driver and align to the pump as per the “Alignment Procedure”. Replace any shims or dowels.

20. Reconnect the power source and check for proper rotation of the motor.

21. Reconnect the coupling between the pump and driver and recheck alignment.

22. Connect the piping to the stuffing box and turn on sealing liquid.

23. Open the valves. Make sure the unit is primed before starting.



SAMengineering

Customised Pump Solutions

SAM Engineering (Pty) Ltd.
24 Duncan Road, Lilianton, Boksburg, South Africa
Tel: +27 (0) 11 823-4250 | Fax: +27 (0) 11 823-4943
Email: pumps@sameng.co.za
www.sameng.co.za