CSR PUMPS
Installation, Operation and Maintenance Manual

SAMengineering

Customised Pump Solutions

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SABS ISO 9001

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

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

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

PUMP IDENTIFICATION (NAMEPLATE)

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

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.
The pump nameplate contains the following information:

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

2. MODEL – CSR, followed by SIZE – Composed of three (3) groups of number.
   EXAMPLE: 4 x 3 x 11 – First number (4) is the ASA suction flange size in inches, second number (3) is the ASA discharge flange size in inches, the third number (11) is the nominal maximum impeller diameter in inches.

3. IMPELLER DIAMETER – This number is the impeller diameter in millimetres as supplied by the factory.
   EXAMPLE: 265

4. FLOW – Design flow rate in cubic metres per hour.

5. HEAD – Design head in metres.

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

7. 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 (if fitted) are in Cast Iron / impeller in Stainless Steel / frame is in Cast Iron / shaft is in EN8

8. RPM – Design speed of pump to achieve design flow and head.

INSTALLATION

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.

Pumps and drivers are normally shipped from the factory, mounted on a baseplate. 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 normal packing procedure is designed to protect the pump during shipping. Upon receipt, store in a covered and 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) 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 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, electrical characteristics should be identical to those shown on motor data plate.

SETTING BASEPLATE/PEDESTAL

The foundation surface will support the pump and driver with shims and plates under the baseplate at the foundation bolts. The foundation should be smooth and level at these points to distribute the load evenly on the shims. A thin metal plate levelled in a puddle of mortar or grout is often the easiest way to achieve this level and smooth surface. Use thick shims wherever possible to reduce the number of shims used.

ALIGNMENT PROCEDURE

The pump and driver have been checked at the factory to determine that field alignment dimensionally can be made. Shims and dowels are packaged separately and shipped with the pump. It is mandatory that the unit be field aligned since any baseplate, regardless of size or style, can be warped in shipment or when installed on a foundation. Generally, any type of coupling can be used if aligned properly.

SUCTION AND DISCHARGE PIPING

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

a) 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 supports.

b) It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of heat from friction.

c) Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45-degree or long-sweep 90-degree fittings to decrease friction losses.

d) Make sure that all piping joints are air-tight.

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

f) Remove burrs and sharp edges when making up joints.

g) Do not "spring" piping when making any connections.

h) Provide for pipe expansion when hot fluids are to be pumped. The use of expansion joints is not recommended.

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

a) 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.

b) To facilitate cleaning, pump liquid passage without dismantling pump, an increasing suction nozzle (available from Allis-Chalmers) should be bolted to the suction flange. 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 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. When reducing the piping to the suction opening diameter use an eccentric reducer with the eccentric side down to avoid air pockets.

Note: 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.

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

a) If the pump is operating under static 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.)

b) When foot valves are used, or where there are other possibilities of "liquid hammer", close the discharge valve before shutting down the pump.

c) 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. Install gate valves with stems horizontally to avoid air pockets. Globe valves should not be used, particularly where NPSH is critical.

d) The pump must never be throttled by the use of a valve on the suction side of the pump. 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 grate valve should be installed in the discharge. The check valve, placed between pump and gate valve, protects the pump from excessive 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 can 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.

EXTERNAL-INJECTION LIQUID-SEAL PIPING

a) A tapped hole is supplied in the stuffing box directly over the seal cage to introduce a clean, clear sealing liquid. 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. The sealing liquid must be left on even when the pump is shut down, unless the casing is isolated from the discharge pressure.

b) 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.

c) We recommend that piping supplying sealing liquid of 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.

d) External sealing liquid should be adjusted to the point where 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 clear liquid drips from the box. If the drippage is corrosive or harmful to personnel, it should be collected and piped away.

e) 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.

STUFFING BOX

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 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.

STUFFING BOX OPERATING PRESSURE - The actual stuffing box pressure operating pressure may be obtained by installing a pressure gauge on the box. This should be done with an extra seal cage temporarily replacing the two rings of packing in the bottom of the box to obtain a more accurate gauge reading. Gauge readings should be taken with the pump running under various head and capacity conditions. The pressure of the flushing or lubrication water can then be set at a value 5 to 10 psi above the maximum expected stuffing box operating pressure. Even under the best conditions, a properly packed stuffing box should be watched closely. If pressure conditions change slightly there will be resistant change in packing “seating” which should be compensated by a change in gland adjustment.

FLUSHING AND LUBRICATION WATER – The recommended method to minimise error in regulating flushing water is the “Controlled Pressure System”. Most important is the pressure reducing valve which may be adjusted to a value slightly exceeding the stuffing box operating pressure. A flow indicating device that will serve to indicate a failing of the bottom packing rings allowing leakage into the pump. is advisable eith this arrangement, the packing gland need s to be tightened only against the lowest necessary pressure. The “out” connection from the stuffing box should be closed with this system. Longer packing life and less frequent adjustment are possible with the “controlled pressure system” properly installed and operated.

OPERATION

PRE-START CHECKS

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

1. Check alignment between pump and motor.
2. In the desired direction, check rotation each time motor leads have been disconnected.
3. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency on motor nameplate with line circuit.
4. Check suction and discharge piping and pressure gauges for proper operation.
5. Turn rotating element by hand to assure that it rotates freely.
6. Check impeller clearance.
7. Assure that pump bearings are properly lubricated.
8. Assure that pump is full of liquid.

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 it will prime itself.

STARTING

1. Close drain valves.
2. Fully open all valves in the suction and discharge lines.
3. If pumped fluid is dirty, these lines should always be left open except when using double mechanical seals.)
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. Close the valve after the pump is warmed up.
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, check to see that the check valve has opened up. Check valve must open 5 seconds or less after start-up to prevent damage to pump by operating at zero flow.
8. Adjust the seal water valves to produce the recommended pressure for either the mechanical seal or packed stuffing box.

Note: The valve in the discharge line should always be closed when the pump is started. The excessive current required by the motor to start under full load will in time cause motor trouble.

SHUTDOWN

The following steps 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 "Storage", and "Freeze 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 water valves. (If pumped liquid is dirty, or if in leakage is to be prevented, these lines should always be left open, except when the pump is completely drained.)
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 Maintenance Time Table below.

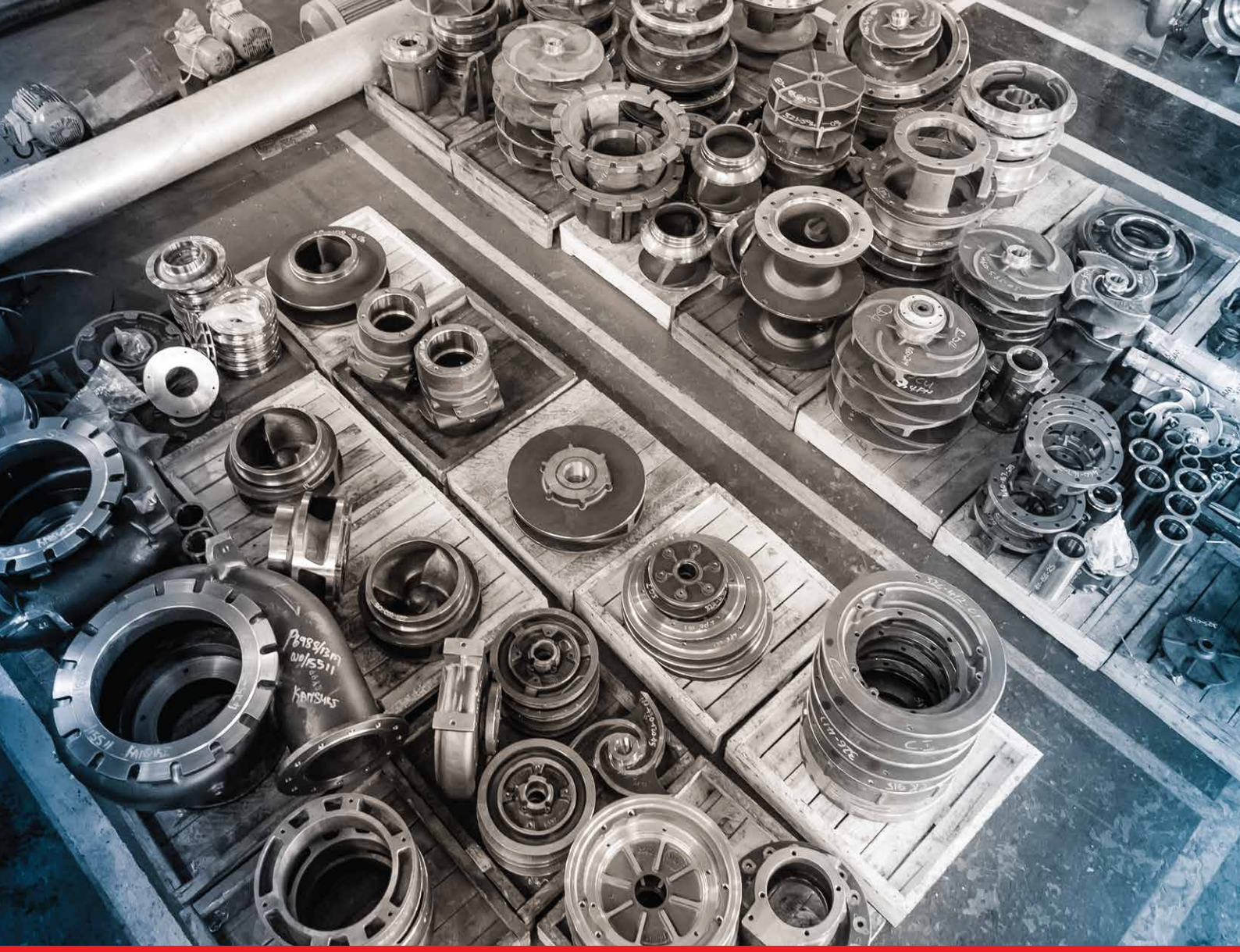
PERIOD	INSPECTION
Every month	Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 180°), it may be the result of too much lubricant. If changing the lubricant does not correct the condition, disassemble and inspect the bearings.
Every 3 months	Check grease lubricated 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 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 also reflect 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.

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. See page 5.
29. Suction lift too high	See item 3.
30. Air leaks in suction piping	See item 8.
31. Air leaks in stuffing box	See item 9.
32. Air or gases in liquid	See item 25.

Pump takes too much power	
CAUSES	**CURES**
33. Head lower than rating; thereby pumping too much liquid	Machine impeller's OD to size advised by factory.
34. Cavitation	See item 14.
35. Mechanical defects	See items 15, 16, and 17.
36. Suction inlet not immersed enough	See item 18.
37. Liquid heavier (in either viscosity or specific gravity) than allowed for	Use larger driver. Consult factory for recommended size. Test liquid for viscosity and specific gravity. See item 6.
38. Wrong direction of rotation	Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing. If packing is wearing too quickly, replace scored shaft sleeves and keep liquid seeping for lubrication.
39. Stuffing box too tight (Packing)	Check alignment. Examine pump for friction between impeller and casing. Replace damaged parts. Check for pipe strain.
40. Casing distorted by excessive strains from suction or discharge piping	Check alignment. Examine pump for friction between impeller and casing. Replace damaged parts. Check for pipe strain.
41. Shaft bent due to damage - through shipment, operation, or overhaul	Dismantle pump and inspect shaft.
42. Mechanical failure of critical pump parts	Check bearings and impeller for damage. Any 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.



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