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भारतीय मानक मसौदा
औद्योगिक अनुप्रयोग के लिए पम्पों के चयन, संस्थापना,
प्रचालन, और अनुरक्षण हेतु रीति सहिता —
भाग 4 अनुरक्षण

[आईएस 10596 (भाग 4) का प्रथम पुनरीक्षण]

DRAFT Indian Standard

CODE OF PRACTICE FOR SELECTION, INSTALLATION, OPERATION,
AND MAINTENANCE OF PUMPS FOR INDUSTRIAL APPLICATIONS —
PART 4 MAINTENANCE

[*First Revision* of IS 10596 (Part 4)]

ICS 23.080

Pumps Sectional Committee,
MED 20

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FOREWORD

(Formal clause to be added later on)

This Indian standard (Part 4) was first published in 1983. This standard lays down the broad guidelines pertaining to operation of pumps for industrial application.

This revision has been taken up to keep pace with the latest technological developments and practices followed in the pump industry. This revision incorporates:

- a) Table **1** and **3** has been modified; and
- b) Other editorial corrections have been done.

The code of practice for selection, installation, operation, and maintenance of pumps for industrial applications is in four parts. This standard covers the guidelines for operation of pump. Other parts in this series under the general title are as follows:

- Part 1 Selection;
- Part 2 Operation; and
- Part 3 Installation.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT Indian Standard

**CODE OF PRACTICE FOR SELECTION, INSTALLATION, OPERATION, AND
MAINTENANCE OF PUMPS FOR INDUSTRIAL APPLICATIONS**

(PART 4 — MAINTENANCE)

(First Revision)

1 SCOPE

This Indian Standard lays down general guidelines for maintenance of pumps for industrial applications. This standard is not applicable to pumps for residential and agricultural applications.

2 MAINTENANCE

2.1A pump cannot give smooth service in the absence of proper maintenance. Hence due attention should be paid to the maintenance of the pumps in operation as well as auxiliary pumps.

2.2 Daily Observation of Pump Operations

For continuous duty pumps, hourly and daily inspection should be made. Whenever any irregularities in the operation of a pump are observed, immediate report of the same, should be made. This particularly applies to changes in the sound of running pump, abrupt changes in bearing temperatures and stuffing box leakage. Recording instruments, if provided, should be checked every day to determine whether the capacity, pressure, current or power consumption indicated are correct or that further inspection is required. Pressure gauges and flow meters, if installed, should be checked frequently. Depending upon the criticality and application parameters, such as head, power, bearing temperature and pump vibrations, should be monitored. The monitoring criteria differ from application to application.

2.3 Annual Inspection

2.3.1 Centrifugal pumps

When general overhauls are carried out the following checks shall be carried out.

2.3.1.1 Radial clearance between impeller and wearing ring, wear of the part of the shaft or sleeve on which the stuffing box is mounted, examination of the wetted parts for corrosion, abrasion or pitting which can cause losses if on the fixed parts and serious unbalancing if on the

moving parts, alignment, and checks on the coupling, replacing of the packing or worn out parts of mechanical seal, check of both radial and axial clearance of the bearings.

2.3.1.2 In case of gland packings it should never be tighten to the fullest extent with the pump at stand still, but the tightening should be regulated gradually and gently with the pump in motion so that the packing can dilate and settle and tightening should be stopped as soon as the leak ceases. Ensure approximately a drop per second leakage is maintained to have sufficient lubrication and cooling for gland packings.

2.3.2 *Reciprocating Pumps (crank end)*

2.3.2.1 *Crank end*

Overhaul involving almost complete dismantling of the pump is carried out by specialized technician at comparatively long intervals and only when inevitable and consist of as follows:

- a) Checking of clearances and the condition of the surface main and big end bearings crosshead sliding block and guides and a complete renovation of normal clearances and conditions b insertion of antifriction metal grinding and scraping or by replacement. When renovating the bearings the instruction of the manufacturer should be observed scrupulously as regard the composition of anti-friction metal and the condition of melting;
- b) A check of the foundation bolts, keys, coupling bolts, etc; and
- c) Complete overhauling of the lubricating pump and accessories and repeated washing of oil circuit including crank case, holes, tubing, etc.

2.3.2.2 *Fluid end* - Overhaul of the items in contact with the fluid, such as valves, stuffing box, pistons and cylinders is carried out at more frequent intervals apart from general overhauls as follows:

- a) Valve seat group should be considered as one indivisible combination and not interchangeable and should be ground as such. As to the stuffing boxes the instructions, which ensure correct assembly and effective maintenance as supplied by the pump manufacturer shall have to be rigorously observed;
- b) Pistons - Only slight scoring or radial wear on the active part up to 0.2 mm allowable. In other cases remetalling and grinding is indispensable, with accurate machining. This is possible in case of stainless steel plungers; and
- c) In case of chromium plated plungers small longitudinal scorings which do not remove chromium plated bright areas are acceptable but deep scoring, any discontinuity or flaking-off of the chromium plating requires extensive repairs. Plungers/pistons which are not plated and cannot be welded require replacement when damaged.

2.4 All instruments and flow-metering devices should be recalibrated, and the pump should be tested to determine whether proper performance is being obtained. If internal repairs are made, the pump should again be tested after completion of the repairs.

2.5 In order to ensure satisfactory operation of these pumps, the following additional maintenance checks are recommended depending upon the application:

- Weekly — Inspection and cleaning of strainers;
- Monthly — Inspection of glands and stuffing boxes;
- Quarterly — Inspection of impellers, sealing rings and casing; and
- Half-yearly — Inspection of bearings and. renewal of lubricants.
Change of strainers, if required.

2.6 Spare and Repair Parts

The minimum number of spare parts which should be carried in stock shall be determined, to a great extent, on the basis of severity of service conditions. In the absence of prior experience, the pump manufacturer should be consulted on this subject. As on insurance against delays, spare parts should be ordered for the complete unit. Depending upon the requirements, certain replacement parts may have to be supplied either oversized or undersize.

When ordering spare parts after a pump has been in service, the manufacturer should always be given the pump serial number and size as stamped on the nameplate. This information is essential in identifying the pump exactly and in furnishing repair parts of correct size and material.

3 INSPECTION AND REPAIR HISTORY CARD

Details of all inspections and repairs should be entered on individual pump maintenance cards, which contain a complete record of the items requiring special attention. These cards should also contain space for comments and observations on the condition of the parts to be repaired or replaced, on the rate and appearance of wear, and the repair methods followed. In many cases it is worthwhile to take photographs of badly worn parts before they are repaired. In all cases complete record of the cost of maintenance and repairs should be kept for each individual pump, together with a record of hits operating hours. A study of these records will generally reveal whether a change in materials or even a minor change in construction may be the most economical course of action.

4 DIAGNOSIS OF PUMP TROUBLES AND REMEDIES

Pump operating troubles may be either of a hydraulic or of a mechanical nature. In the first category, a pump may fail to deliver liquid, it may deliver an insufficient volume rate of flow or develop insufficient pressure, or it may consume excessive power, or symptoms of mechanical troubles may develop at the stuffing boxes or at the bearings, or vibration, noise or breakage of some pump parts may occur.

There is a definite interdependence between some difficulties of both categories. For example, increased wear at the running clearances must be classified as a mechanical trouble, but it will

result in a reduction of the net pump volume rate of flow - a hydraulic symptom - without necessarily causing a mechanical breakdown or even excessive vibration.

A diagnostic analysis along with-remedies is presented in Tables 1 to Table 3.

Table 1 Check Chart for Centrifugal Pump Troubles

(Clause 4)

SI No.	Symptoms	Possible Causes	Remedies
(1)	(2)	(3)	(4)
a)	Pump does not deliver water	Pump not primed	Prime or install self-priming device
		Pump or suction pipe not completely filled with liquid	Ensure proper priming
		Suction lift too high	Install the pump at a proper place as per suction limitations
		Insufficient margin between suction and vapour pressure (insufficient available NPSH with respect to required NPSH)	a) Reduce frictional losses in suction pipes b) Reduce the static suction lift c) Increase the pressure in the suction tank if tank is closed d) Control the maximum temperature of the liquid
		Air pockets in suction line	Correct layout of suction piping replace or tighten joints, fitting to avoid air entry.
		Inlet of suction pipe insufficiently submerged	Ensure proper submergence
		Speed too low	a) Check the supply frequency b) Rectify the defect which may be due to clutch or belt slip of faulty prime mover
		Wrong direction of rotation	Change the direction of rotation
	Total head of system higher than design head of pump	Provide larger diameter impeller, if feasible, else change the pump	

			or add suitable head pump in series
		Parallel operation of pumps unsuitable for such operation	Change the delivery pipe size to reduce the friction losses
		Foreign matter in impeller	Clean the impeller provide means for the removal of foreign matter at suction pipe entry.
b)	Insufficient volume rate of flow delivered	Pump or suction pipe, not completely filled with liquid	Ensure proper priming
		Suction lift too high	Install the pump at a proper place as per suction limitations
		Insufficient margin between suction and vapour pressure (insufficient available NPSH with respect to required NPSH)	a) Reduce frictional losses in pipes b) Reduce the static suction lift c) Increase the pressure in the suction tank if tank is closed d) Control the maximum temperature of the liquid
		Excessive amount of air or gas in liquid	Ensure proper venting to allow the air or gas to escape
		Air pocket in suction line	Correct layout of suction piping.
		Air leaks into suction line	Replace or tighten joints fittings.
		Air leaks into pump through stuffing boxes	a) Provide proper sealing to stuffing box b) Tighten the gland
		Foot valve too small	Replace the foot valve with that of proper size
		Foot valve partially clogged	Clean or replace
		Speed too low	Rectify the defect which may be due to clutch or belt slip or faulty prime mover or low supply frequency.
		Total head of system higher than design head of pump	Provide larger diameter impeller, if feasible. Else changes the pump or add suitable head pump in series
		Viscosity of liquid different from that for which designed	Replace the liquid with test or proper viscosity. If not possible replace the pump suitably.

		Parallel operation of pumps unsuitable for such operations	Scrutinize the system resistance curve with characteristics of pumps in parallel and decide to minimum number of pumps to be run to achieve desired pressure
		Foreign matter in impeller	Clean the impeller. Provide means for the removal of foreign matter at suction pipe inlet.
		Wearing rings worn	Replace
		Impeller damaged	Repair or replace
		Casing gaskets defective, permitting internal leakage	Replace
c)	Insufficient pressure developed	Excessive amount of air or gas in the liquid	Ensure proper venting
		Speed too low	a) Check the supply frequency b) Rectify the defect which may be due to clutch or belt slip or faulty prime-mover
		Wrong direction of rotation	Change the direction of rotation
		Total head of system higher than design head of pump	Provide larger diameter impeller, if feasible. Else change the pump or add suitable head pump in series. Consult the manufacturer
		Viscosity of liquid different from that for which designed	Replace the liquid with that of proper viscosity. If not possible, replace the pump suitably
		Parallel operation of pumps unsuitable for such operations	Scrutinize the system resistance curve with characteristics of pumps in parallel and decide the minimum number of pumps to be run to achieve desired pressure
		Wearing rings worn	Replace
		Impeller damaged	Repair or replace
		Casing gaskets defective, permitting internal leakage	Replace
d)	Pump loses	Pump of suction pipe not	Ensure proper priming

	prime after starting	completely filled with liquid	
		Suction lift too high	Install the pump at a proper place according to suction limitation
		Excessive amount of air or gas in liquid	Ensure proper venting
		Air pocket in suction line	Correct layout of suction piping
		Air leaks into suction line	Air leaks into suction line
		Air leaks into pump through stuffing boxes	a) Provide proper sealing to stuffing box b) Tighten the gland
		Inlet of suction pipe insufficiently submerged	Ensure proper submergence of suction pipe
		Water-seal pipe plugged	Clean or replace
		Seal cage (lantern ring) improperly located in stuffing box, preventing sealing fluid from entering space to form the seal	Locate seal cage properly so that sealing fluid can fill up the space to form seal
e)	Pump requires excessive power	Speed too high	Suitably reduce the speed
		Total head of system higher than design head of pump	Correct the nature of power curve: a) If it is rising towards rated conditions, check for mechanical friction, speed and specific gravity of liquid b) If it is rising towards shutoff, trim down the impeller suitably if necessary
		Total head of system lower than design head of pump	a) Trim down the impeller suitably, if necessary b) Also check mechanical friction
		Specific gravity of liquid different from design	Replace the fluid by that of correct specific gravity
		Viscosity of liquid different from that for which designed	Replace the fluid by that of correct viscosity
		Foreign matter in impeller	Clean the impeller. Provide means for the removal of foreign matter at suction pipe inlet.

		Misalignment	Realign properly
		Shaft bent	Replace
		Rotating part rubbing on stationary part	Prevent it by suitable adjustments
		Wearing rings worn	Replace
		Packings improperly installed	Replace, if necessary, and re-install properly
		Incorrect type of stuffing box packing for operating condition	Replace with packing suited to the existing working conditions
		Gland too tight, resulting in no flow liquid of lubricate packing	Loosen the gland to ensure proper lubrication of packing
f)	Stuffing box leaks excessively	Seal cage improperly located in stuffing box, preventing sealing liquid from entering space to form the seal	Locate seal cage properly so that sealing fluid can fill up the space to form seal
		Misalignment	Realign properly
		Shaft bent	Replace
		Shaft or shaft sleeves worn or scored at the packing	a) Replace the shaft and/or b) Replace the shaft sleeves, if worn out
		Packing improperly installed	Properly install the packing
		Incorrect type of packing for operating conditions	Replace existing one by that of correct type suitable for the purpose
		Shaft running off centre because of worn bearings or misalignment	Replace bearings, if worn out or realign properly, as the case may be
		Rotor out of balance causing vibration	Balance the rotor
		Failure to provide cooling liquid to water cooled stuffing boxes	Ensure proper circulation of cooling liquid
		Excessive clearance at the bottom of stuffing box between shaft and casing, causing packing to be forced into pump interior	Replace the casing or fit a close clearance bush
		Dirt or grit in sealing liquid,	Use clean liquid

		leading to scoring of shaft or shaft sleeve	
g)	Packing has short life	Water-seal plugged/clogged	Clean
		Seal cage improperly located in stuffing box, preventing sealing liquid from entering space to form seal	Locate seal cage properly so that sealing liquid can fill up the space to form seal
		Misalignment	Realign properly
		Shaft bent	Replace
		Wearing rings worn	Replace
		Shaft or shaft sleeves worn or scored at the packing	a) correct the shaft and or b) Replace the shaft sleeves, if worn out
		Packing improperly installed	Install the packing properly
		Incorrect type of packing for operating conditions	Remove old packing and put new packing suited to operating conditions
		Shaft running off centre because of worn bearings or misalignment	Replace worn out bearings by new one or realign properly, whichever is applicable
		Rotor out of balance, causing vibration	Balance the rotor
		Gland too tight, resulting in no flow of liquid to lubricate packing	Suitably loosen the gland to ensure proper lubrication
		Failure to provide cooling liquid to water-cooled stuffing boxes	Ensure proper circulation of cooling liquid
		Excessive clearance at bottom of stuffing box between shaft casing, causing packing to be forced into pump interior	Replace the casing or fit a close clearance bush
		Dirt or grit in sealing liquid, leading to scoring of shaft or shaft sleeve	Use clean liquid
h)	Pumps vibrates or	Pump or suction pipe not completely filled with liquid	Ensure proper priming

	is noisy	Suction left too high	Install the pump at proper place according to suction limitations
		Insufficient margin between suction and vapour pressure (insufficient available NPSH with respect to required NPSH)	a) Reduce frictional losses in pipes b) Reduce the static suction lift c) Increase the pressure in the suction tank if tank is closed d) Control the maximum temperature of the liquid
		Foot valve too small	Replace existing one with that of proper size
		foot valve partially clogged	Clean or replace
		Inlet of suction pipe insufficiently submerged	Ensure proper submergence
		Operation at very low volume rate of flow	Run at high volume rate of flow with a proper by pass arrangement
		Foreign matter in impeller	Clean and provide means to remove foreign matter
		Misalignment	Realign properly
		Foundations not rigid	Provide rigid foundation
		Shaft bent	Replace
		Rotating part rubbing with stationary part	Prevent it by suitable adjustments
		Bearing worn	Replace
		Impellers damaged	Repair or replace
		Shaft running off-centre because of worn bearings or misalignment	Replace worn out bearings or realign properly, as the case may be
		Rotor out of balance causing vibration	Balance the rotor
Excessive thrust caused by a mechanical failure inside the pump or by the failure of the hydraulic balancing device, if any	Find out the exact cause and suitably rectify		
Excessive grease or oil in anti-friction bearing housing or lack, of cooling, causing excessive temperature	Remove excessive grease or oil and improve cooling, if necessary		

		Lack of lubrication	Improve lubrication
		Improper installation of anti-friction bearings (damaged during assembly, incorrect assembly of stack bearings, use of unmatched bearing as pair, etc)	Properly install correct bearings
		Dirt in bearing	Clear the bearings and lubricate properly
		Rusting of bearings from water in housing	Replace bearing. Provide a water slinger or water guard on the pump shaft between the stuffing box and bearing housing
		Excessive cooling of water cooled bearing, resulting in condensation of moisture from the atmosphere in the bearing	Reduce circulation of cooling of liquid
j)	Bearings have short life	Misalignment	Realign properly
		Shaft bent	Replace
		Rotating part rubbing against stationary part	Prevent it by suitable adjustments
		Bearings worn	Replace
		Shaft running off centre because of worn bearings or misalignment	Replace worn out bearings or realign properly, as the case may be
		Rotor out of balance causing vibration	Balance the rotor
		Excessive thrust caused by mechanical failures inside the pump or by the failure of the hydraulic balancing device, if any	Find out the exact cause and suitably repair it
		Excessive grease or oil in anti-friction bearing housing or lack of cooling, causing excessive bearing temperature	Remove excessive grease or oil and improve cooling, if required
		Lack of lubrication	Properly install correct bearings

		Improper installation of anti-friction bearings (damaged-during assembly, incorrect assembly of stack bearings, use of unmatched pair of bearings, etc)	Properly install correct bearings
		Dirt in bearings	Clean and relubricate
		Rusting of bearings from water getting in housing	Replace bearing. Provide a water slinger or water guard on the pump shaft between the stuffing box and bearing housing
		Excessive cooling of water cooled bearings, resulting in condensation of moisture from the atmosphere in the bearing housing	Decrease the flow rate of cooling water to prevent over-cooling
k)	Pump overheats and seizes	Pump not primed	Prime the pump
		Insufficient margin between suction pressure and vapour pressure	a) Reduce frictional losses in pipes b) Reduce the static suction lift c) Increase the pressure in the suction tank if tank is closed d) Control the maximum temperature of the liquid
		Operation at very low volume rate below minimum safe flow	Run the pump at higher volume rate of flow with a provision of by-pass flow
		Parallel operation of pumps suitable for such operation	Consult manufacturer
		Misalignment	Realign properly
		Rotating part rubbing on station any part	Prevent it by suitable adjustments
		Bearings worn	Replace worn out bearings
		Shaft running off centre because of worn bearings of misalignment.	Replace worn out bearings or realign properly as the case may be
		Rotor out of balance causing vibration	Balance the rotor
		Excessive thrust caused by a me	Find out the cause -and take

		<p>chanical failure inside the pump or by the failure of the hydraulic balancing device, if any</p> <p>Gland too tight resulting in no flow of liquid to lubricate packing</p> <p>Liquid temperature too high</p>	<p>suitable corrective action</p> <p>Suitably loose the gland to ensure proper lubrication and cooling of packing</p> <p>Control the temperature of the liquid as per specification</p>
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Table 2 Check Chart for Rotary Pump Troubles
(Clause 4)

Sl No. (1)	Symptoms (2)	Possible Causes (3)	Remedies (4)
a)	Pump fails to discharge	<p>Not properly primed</p> <p>Suction pipe not submerged</p> <p>Strainer clogged</p> <p>Leaking foot valve</p> <p>Suction lift too high</p> <p>Air leaks in suction</p> <p>Wrong direction of rotation</p> <p>Low speed</p> <p>Pump worn</p> <p>Valves closed or an obstruction in suction or discharge pipe</p> <p>Foot valves stuck</p> <p>Relief valve stuck and/or by-pass valve open</p>	<p>Ensure proper priming</p> <p>Ensure proper submergence</p> <p>Clean or replace</p> <p>Repair or replace</p> <p>Install the pump at a proper place according to suction limitations</p> <p>Replace or tighten joints and fitting</p> <p>Change the direction of rotation</p> <p>Find out the exact cause and remove it</p> <p>Repair or replace</p> <p>Open all valves and remove obstructions</p> <p>See that the foot valve flap open fully</p> <p>Closed the by-pass valve if open and ensure relief valve properly sitting in position</p>
b)	Pump is noisy	<p>Air leaks in suction</p> <p>Insufficient liquid</p> <p>Excessive pressure</p> <p>Bent drive shaft</p>	<p>Replace or tighten joints and fittings</p> <p>Ensure proper supply of liquid</p> <p>Provide suitable relief valve</p> <p>Replace</p>

	coupling out of balance or misalignment	Find out the exact cause and take corrective action, that is, either balance the coupling or realign properly
	Relief valve chatter	Repair or replace
	High spots on rotating elements	File or scrap high spots
c) Pump wears rapidly	Excessive pressure	Provide suitable relief valve
	Grit or dirt in liquid	Provide means to clear off dirt and grit from the liquid to be handled
	Pump runs dry	Take every precaution to prevent dry running of the pump
	Pipe strain on pump casing	Provide proper support to piping especially bear the pump casing
	Corrosion	Replace the affected components with new components of compatible metallurgy to suit the liquid being pumped
d) Pump not up to rated volume rate of flow	Strainer clogged	Clean or replace
	Suction lift too high	Install the pump at a proper place according to suction limitations
	Air leaks in suction	Replace or tighten joints
	Suction pipe too small	Fit larger diameter pipe
	Low speed	Rectify the defect which may be due to clutch or belt slip or faulty prime mover
	Pump worn	Repair or replace
	Air leak at packing	Replace packing
	Relief valves improperly seated or hand by-pass partly open	Rectify by regrinding the valve on its seating as necessary and by-pass valve properly closed
e) Pump starts, then loses its suction	Not properly primed	Ensure proper priming
	Suction pipe not submerged	Ensure proper submergence
	Air leaks in suction	Replace or tighten joints and fittings
	suction pipe too small	Fit larger diameter pipe
	Insufficient liquid supply	Ensure proper supply of liquid
	Liquid vaporizes in the	Reduce suction lift

		suction line	
		Air or gas pockets in pumping system	Remove pockets by changing pie layout as necessary
f)	Pump takes excessive power	Viscosity higher than specified	Replace the fluid with one of correct quality or heat the liquid to reduce its viscosity
		Obstruction in discharge line	Remove the obstruction
		Bent drive shaft	Replace
		Pipe strain on pump casing	Provide proper support to piping especially rear the pump casing
		Packing too tight	Loosen the packing suitably
		Pump out of alignment with its driver	Realign properly
g)	Pump not developing required pressure	Relief valve not set correctly	Use pressure gauge and reset valve to specified pressure
		Relief valve leaking	Check relief valve seat for score marks. Reseat by grinding, or replace
		Broken relief valve spring	Replace spring, reset relief valve
		Flow of liquid to tank is unrestricted	Check for control valve in "Neutral" or for open return line
		Internal leakage in control valve or power cylinder	Repair or replace leaking valve or cylinder

Table 3 Check Chart for Reciprocating Pump Troubles
(Clause 4)

SI No.	Symptoms	Possible Causes	Remedies
(1)	(2)	(3)	(4)
a)	Liquid discharge not up to capacity	Insufficient suction pressure	Repair, tighten or replace suction joints and fittings
		System shocks	
		Poorly supported piping, abrupt turns in piping. pipe size too small, piping misaligned	Find out exact cause and take corrective action
		Air in liquid	Ensure proper venting
		Overpressure or overspeed	Find out the cause and correct it
		Broken or badly worn valves	Replace
		Packing worn	Replace
		Obstruction under valve	Remove the obstruction and clean the valve

b)	Power and noise	Loose main bearings	Tighten or replace with proper bearings
		Worn bearings	Replace
		Low oil level	Pour more oil
		Loose plunger	Tighten or replace the plunger
c)	Overheated power end	Overpressure or overspeed	Misalignment of the teeth of gear and pinion
		Low oil level	Pour more oil
		Tight main bearings	Loose suitably or change
		Belts too tight	Loose suitably
		Prime mover misaligned	Realign the prime mover properly
		Inadequate ventilation	Ensure proper ventilation
		Misalignment of the teeth of gear and pinion	Reset the alignment properly and ensure constant supply of lubricating oil at the point of meshing of the teeth of the gear and pinion
d)	Water in crank case	Condensation	Remove oil, dry the crank case, flush it with oil and fill fresh oil
e)	Oil in crank case	Worn seals	Replace
f)	Rapid plunger or packing wear	Oil level too high	Remove excess oil
		Dirty liquid	Use clean liquid
g)	Pitted valves or seats	Dirty environment	Flush the plunger and keep the pump house clean
		Pump not set level and rigid	Find out the exact cause and take corrective action
		Loose packing	Tighten or replace packing
		Cavitation	
		Various possible reasons responsible to cause cavitation may be:	
		a) Suction strainer clogged	Clean or replace
		b) Diameter of suction line too small	Fit larger diameter pipe
		c) Too many bends in suction line	Modify the design or fit a larger diameter pipe
		d) Local restrictions in suction line partly closed valve, heavy non-return valve spring damaged, pipe or hose collapsed.	Open or modify valves, repair or replace pipe or hose
		Fluid too cold	Heat fluid to recommended temperature
Incorrect viscosity of the liquid	Replace the liquid by that of correct viscosity		
Vapour formation	Reduce working temperature to correct level		

	Failure of boost system	Repair or replace the damaged parts
	Pump running too fast	Reduce speed to normal level
	Sealed reservoir	Fit a breather and air cleaner
	Dirty liquid	Use clean liquid
	Corrosion	Use proper corrosion resistant material parts suited to the working conditions
h)	Valves hanging up	Replace
j)	Leak at cylinder valve hole	Rectify it
	plugs	Avoid abrupt changes
		Tighten or replace
		Replace
k)	Loss of prime	*Provide positive flooded suction
		Install the pump at a proper place according to suction and discharge requirements
	Insufficient suction pressure	Repair or replace
	Lift too high	Replace packing
	Leaking suction at foot valve	Increase suction pipe size, replace elbow with long bend to reduce the pipe velocity Suction size of the pump should be properly designed based on the flow to be handled to avoid sharp taper pieces in suction piping
	Air leak at packing	Control the temperature of the liquid as per specification for which pump is selected
	Acceleration head too high	
	Increased temperature of liquid increasing vapour pressure which reduces the available NPSH	
