*भारतीय मानक*

**औद्योगिक अनुप्रयोग के लिए पम्पों के चयन, संस्थापना,**

**प्रचालन, और अनुरक्षण हेतु रीति सहिता —**

**भाग 4 अनुरक्षण**

(*प्रथम पुनरीक्षण* )

*Indian Standard*

**Code of Practice for Selection, Installation, Operation, and Maintenance of Pumps for Industrial Applications —**

**Part 4 Maintenance**

( *First Revision* )

ICS 23.080

BIS 2024

भारतीय मानक ब्यूरो

**B U R E A U O F I N D I A N S T A N D A R D S**

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Pumps Sectional Committee, MED 20

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Pump Sectional Committee had been approved by the Mechanical Engineering Division Council.

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:

1. Table **1** and **3** has been modified; and
2. 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.

The composition of the committee responsible for the formulation of this standard is given in Annex A.

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 (s*econd 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.

*Indian Standard*

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

**2.1** A 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 ahead, 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:

1. 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;
2. A check of the foundation bolts, keys, coupling bolts, etc; and
3. 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:

1. 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;
2. Pistons - Only slight scoring or radial wear on the active part up to 0.2 mm allowable. In other cases remetalling and grinding is indispensible, with accurate machining. This is possible in case of stainless steel plungers; and
3. 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.

**2.6Spare 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)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Symptoms** | **Possible Causes** | **Remedies** |
| (1) | (2) | (3) | (4) |
|  | Pump does not deliever 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 pipesb) 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 frequencyb) 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. |
|  | 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 pipesb) 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 |
|   |   |
|  | Insufficient pressure developed          | Excessive amount of air or gas in the liquid  | Ensure proper venting |
| Speed too low  | a) Check the supply frequencyb) 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 |
|   |   |
|  | Pump loses prime after starting         | Pump of suction pipe not completely filled with liquid | Ensure proper priming |
| 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  |
|  | 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 necessaryb) 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 |
|   |   |
|  | 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 bearing s 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, leading to scoring of shaft or shaft sleeve | Use clean liquid |
|  | Packing has short life               | Water-seal pipe 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 orb) 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  |
|   |   |
|  | Pumps vibrates or is noisy                        | Pump or suction pipe not completely filled with liquid | Ensure proper priming |
| 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 pipesb) Reduce the static suction liftc) 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 me chanical 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 pipesb) 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 chanical failure inside the pump or by the failure of the hydraulic balancing device, if anyGland too tight resulting in no flow of liquid to lubricate packingLiquid temperature too high | Find out the cause -and take suitable corrective actionSuitably loose the gland to ensure proper lubrication and cooling of packingControl the temperature of the liquid as per specification |

**Table 2 Check Chart for Rotary Pump Troubles**

(*Clause* 4)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Symptoms** | **Possible Causes** | **Remedies** |
| (1) | (2) | (3) | (4) |
|  | Pump fails to discharge | Not properly primed | Ensure proper priming |
| Suction pipe not submerged | Ensure proper submergence |
| Strainer clogged | Clean or replace |
| Leaking foot valve | Repair 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 and fitting |
| Wrong direction of rotation | Change the direction of rotation |
| Low speed | Find out the exact cause and remove it |
| Pump worn | Repair or replace |
| Valves closed or an obstruction in suction or discharge pipe | Open all valves and remove obstructions |
| Foot valves stuck | See that the foot valve flap open fully |
| Relief valve stuck and/or by-pass valve open | Closed the by-pass valve if open and ensure relief valve properly sitting in position |
|  | Pump is noisy | Air leaks in suction | Replace or tighten joints and fittings |
| Insufficient liquid | Ensure proper supply of liquid |
| Excessive pressure | Provide suitable relief valve |
| Bent drive shaft | Replace |
| 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 |
|  | 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 |
|  | 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 |
|  | 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 suction line | Reduce suction lift |
| Air or gas pockets in pumping system | Remove pockets by changing pie layout as necessary |
|  | 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 |
|  | 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)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Symptoms** | **Possible Causes** | **Remedies** |
| (1) | (2) | (3) | (4) |
|  | 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  |
|  | 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  |
|  | 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  |
|  | Water in crank case  | Condensation | Remove oil, dry the crank case, flush it with oil and fill fresh oil  |
|  | Oil in crank case | Worn seals | Replace  |
| Oil level too high | Remove excess oil |
|  | Rapid plunger or packing wear  | Dirty liquid  | Use clean liquid  |
| 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  |
|  | Pitted valves or seats | 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 |
|  | Valves hanging up | Broken valve spring | Replace |
| j) | Leak at cylinder valve hole plugs  | Over-pressure or overspeed | Rectify it |
| Water hammer  | Avoid abrupt changes |
| Loose cylinder plug  | Tighten or replace  |
| Damaged O-ring seal  | Replace |
| k) | Loss of prime | Insufficient suction pressure  | \*Provide positive flooded suction  |
| Lift too high  | Install the pump at a proper place according to suction and discharge requirements  |
| Leaking suction at foot valve Air leak at packing | Repair or replace Replace packing |
| Acceleration head too highIncreased temperature of liquid increasing vapour pressure which reduces the available NPSH | 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 pipingControl the temperature of the liquid as per specification for which pump is selected |
|  |  |  |

**ANNEX B**

(*Foreword*)

**COMMITTEE COMPOSITION**

Pump Sectional Committee, Med 20

|  |  |
| --- | --- |
| *Organization(s)* | *Representative(s)* |
| In Individual Capacity(*B-184, Sarita Vihar, New Delhi – 110076*) | Shri A.K. Nijhawan (***Chairperson***) |
| Aquasub Engineering, Coimbatore | Shri C. Murugesasn SHRI P. Ramesh (*Alternate*) Shri G. Prasath (*Young Professional*) |
| Best Engineers Pumps Private Limited, Coimbatore | Shrimati C. G. Sripriya Shri T. Parthiban (*Alternate*) |
| Bharat Heavy Electrical Limited, New Delhi | Shri Anuj Jain Shri Hardeep Singh Dogra (*Alternate*) |
| Bharat Petroleum Corporation Limited, Mumbai | Shri D. P. Chandramore Shri Santosh N. Kale (*Alternate*)  |
| Bureau of Energy Efficiency, New Delhi | Ms Pravatanalini Samal Shri Mukhe K Sai Satvik (*Alternate* I) Shri Kamran Shaikh (*Alternate* II) |
| Central Water and Power Research Station (CWPRS), Pune  | Shri Abdul Rahiman  |
| Crompton Greaves Consumer Electricals Limited, Ahmednagar  | Shri Parvin Garje  Shri Parvin Murdekar (*Alternate* I) Shri Rohit Bhadane (*Alternate* II) |
| Electrical Research and Development Association (ERDA), Vadodara | Shri Ravi Prakash Singh Shri Jitendra Tahilwani (*Alternate*) |
| Engineers India Limited, New Delhi  | Shri Mahesh Gupta Ms. Rima Singh (*Alternate* I) Shri Abhay Kumar (*Alternate* II) |
| GAIL (India) Limited, New Delhi | Shri Shashi Ranjan Shri Rakesh Kumar Singh (*Alternate* I) |
| Grundfos Pumps India Private Limited, Chennai | Shri Sanjeev Choudhary Shri Amitrup Dutta (*Alternate*) |
| Havells India Limited, Noida | Shri Anil Sukumar Akole |
| Hindustan Petroleum Corporation Limited, Mumbai | Shri Sourabh Sharma Shri Akash Raj (*Alternate*) |
| Indian Pump Manufacturers Association, Ahemdabad | Shri Lalit Kumar Patel |
| International Copper Association India, Mumbai | ShriK N Hemanth Kumar Shri Sanjay Namdeo (*Alternate*) |
| KSB Pumps Limited, Pune | Shri Rajesh B. Gote Shri Dattatray Katkar (*Alternate*) |
| Kirloskar Brothers Limited, Pune | Shri Ravindra Birajdar Shri Sudhir Mali (*Alternate*) |
| National Bank for Agriculture and Rural Development, Mumbai | Shri Sukanta K. Sahoo Shri D. Elangovan (*Alternate* I) Shri A. K. Sinha (*Alternate* II) |
| North India Pump Manufacture Association, Jalandhar | Shri C. L. Garg  |
| Punjab Agricultural University, Ludhiana | Shri Sunil GargShri Sanjay Satpute (*Alternate*) |
| *Organization(s)* | *Representative(s)* |
| Rajkot Engineering Association, Rajkot | Shri Vinod Asodariya Shri Sunny R. Marvania (*Alternate*) |
| Scientific and Industrial Testing and Research Centre, Coimbatore | Shri Mohan SendilkumarShri Ulaganathan (*Alternate*) Shri R. Manikandan (*Young Professional*) |
| Southern India Engineering Manufacturers Association, Coimbatore | Shri K.V. Karthik Shri D. Vignesh (*Alternate*) |
| WPIL Limited, Ghaziabad | Shri Lokesh Jayal Shri Sanjay Ray (*Alternate* I) Shri Debajyoti Das (*Alternate* II) |
| Waterman Industries Private Limited, Ahmedabad | Shri Utkarsh. A. Chhaya Shri Dipak Darji (*Alternate*) |
| Wilo Mather and Platt Pumps Private Limited, Pune | Shri Kishor A. Dumbre Shri Vinod Gabru Chougule (*Alternate*) |
| In Personal Capacity | Shri A. K. Jain |
| In Personal Capacity, Mumbai | Shri S. L. Abhyankar |
| BIS Directorate General | Shri K. V. Rao,Scientist ‘F’/Senior Director and Head (Mechanical Engineering) [Representing General (Ex-Officio)] |

*Member Secretary*

Shri Aman Dhanawat

Scientist ‘C’/Deputy Director

 (Mechanical Engineering), BIS