FLOWMORE LIMITED

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

FOR

HORIZONTAL SPLIT CASE PUMPS

www.flowmoregroup.com
PREAMBLE

Dear Customer,

Congratulations for becoming a proud owner of a "FLOWMORE" Pump. We have a strong belief in satisfaction of our Valued Customers and your repeat purchases from us will reaffirm your confidence in FLOWMORE.

This is a new set of instructions for the Installation, Operation and Maintenance of Horizontal Split Case (HSC) Pumps manufactured by us and these instructions supersede the previous issue. In this new version, we have tried to cover majority of the technical details, procedures and work instructions pertaining to satisfactory and technically sound practice for Installation, Operation & Maintenance of our pumps. However, if you need any further technical assistance in a specific situation, we will be happy to provide the requisite feedback and make you comfortable in the event of such occurrence. Our team of highly experienced and technically competent field staff constantly endeavors to minimize the equipment down time and to ensure longer trouble free operation of the equipment supplied by us.

We wish to convey our appreciation for your purchase and hope to receive your valuable feedback and suggestions for improvement of our products and services.

With Best Wishes,

Flowmore Limited
# LIST OF CONTENTS

<table>
<thead>
<tr>
<th>ARTICLE NO.</th>
<th>PARTICULARS</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>SAFETY INSTRUCTIONS</td>
<td>1</td>
</tr>
<tr>
<td>2.1</td>
<td>SAFETY SYMBOLS AND EXPLANATIONS</td>
<td>1</td>
</tr>
<tr>
<td>2.2</td>
<td>SAFETY PRECAUTIONS</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>STORAGE</td>
<td>2</td>
</tr>
<tr>
<td>3.1</td>
<td>INSPECTION OF PACKAGE/EQUIPMENT</td>
<td>2</td>
</tr>
<tr>
<td>3.2</td>
<td>STORAGE REQUIREMENTS</td>
<td>2</td>
</tr>
<tr>
<td>3.3</td>
<td>LONG TERM STORAGE</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>BRIEF DESCRIPTION OF HORIZONTAL SPLIT CASE PUMPS</td>
<td>3</td>
</tr>
<tr>
<td>4.1</td>
<td>GENERAL APPLICATIONS</td>
<td>3</td>
</tr>
<tr>
<td>4.2</td>
<td>TYPES OF HORIZONTAL SPLIT CASE PUMPS</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>INSTALLATION</td>
<td>4</td>
</tr>
<tr>
<td>5.1</td>
<td>DRIVER</td>
<td>6</td>
</tr>
<tr>
<td>5.2</td>
<td>COUPLING ALIGNMENT</td>
<td>7</td>
</tr>
<tr>
<td>5.3</td>
<td>GROUTING</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>PIPING</td>
<td>8</td>
</tr>
<tr>
<td>6.1</td>
<td>GENERAL PRECAUTIONS</td>
<td>8</td>
</tr>
<tr>
<td>6.2</td>
<td>SUCTION PIPING</td>
<td>9</td>
</tr>
<tr>
<td>6.3</td>
<td>DISCHARGE PIPING</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>OPERATION OF HSC PUMPS</td>
<td>12</td>
</tr>
<tr>
<td>7.1</td>
<td>PRECOMMISONING CHECKS</td>
<td>12</td>
</tr>
<tr>
<td>7.1.1</td>
<td>LUBRICATION CHECKS</td>
<td>12</td>
</tr>
<tr>
<td>7.1.2</td>
<td>ROTATION CHECK</td>
<td>12</td>
</tr>
<tr>
<td>7.1.3</td>
<td>SUCTION LINE LEAKAGE CHECK</td>
<td>12</td>
</tr>
<tr>
<td>7.2</td>
<td>STARTING INSTRUCTIONS</td>
<td>12</td>
</tr>
<tr>
<td>7.3</td>
<td>OPERATION CHECKS</td>
<td>13</td>
</tr>
<tr>
<td>7.4</td>
<td>STOPPING INSTRUCTIONS</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
<td>MAINTENANCE OF HORIZONTAL SPLIT CASE PUMPS</td>
<td>13</td>
</tr>
<tr>
<td>8.1</td>
<td>PREVENTIVE MAINTENANCE</td>
<td>13</td>
</tr>
<tr>
<td>8.1.1</td>
<td>DAILY INSPECTIONS</td>
<td>14</td>
</tr>
<tr>
<td>8.1.2</td>
<td>QUARTERLY INSPECTIONS</td>
<td>14</td>
</tr>
<tr>
<td>8.1.3</td>
<td>ANNUAL INSPECTION</td>
<td>14</td>
</tr>
<tr>
<td>8.2</td>
<td>BREAKDOWN MAINTENANCE</td>
<td>14</td>
</tr>
<tr>
<td>8.3</td>
<td>REPLACEMENT OF PARTS</td>
<td>14</td>
</tr>
<tr>
<td>8.3.1</td>
<td>DISASSEMBLY PROCEDURE</td>
<td>14</td>
</tr>
<tr>
<td>8.3.2</td>
<td>REASSEMBLY PROCEDURE</td>
<td>16</td>
</tr>
<tr>
<td>8.4</td>
<td>ORDERING REPLACEMENT PARTS</td>
<td>17</td>
</tr>
<tr>
<td>8.5</td>
<td>REPLACEMENT OF SHAFT SEALING ELEMENTS</td>
<td>17</td>
</tr>
<tr>
<td>8.5.1</td>
<td>REMOVING OLD PACKING</td>
<td>17</td>
</tr>
<tr>
<td>8.5.2</td>
<td>REPACKING THE PUMP</td>
<td>17</td>
</tr>
<tr>
<td>8.5.3</td>
<td>REASSEMBLY OF MECHANICAL SEAL</td>
<td>18</td>
</tr>
<tr>
<td>8.6</td>
<td>LUBRICATION</td>
<td>19</td>
</tr>
<tr>
<td>8.6.1</td>
<td>PROCEDURE FOR GREASE RE- LUBRICATION</td>
<td>19</td>
</tr>
<tr>
<td>8.6.2</td>
<td>PROCEDURE FOR OIL RE- LUBRICATION</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>TROUBLESHOOTING</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>LIST OF TYPICAL CROSS SECTIONAL ASSEMBLY DRAWINGS</td>
<td>23</td>
</tr>
<tr>
<td>11</td>
<td>DRAWINGS</td>
<td>24-26</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION:**

The present day version of FLOWMORE Horizontal Split Case (HSC) Pumps is the outcome of extensive research and development, precision machining on sophisticated machine tools, rigorous quality checks at various stages of manufacture and excellent workmanship during assembly, followed by validation of hydraulic performance through comprehensive series of test runs. The typical design feature is ‘shaft through impeller eye’, wherein the impeller is mounted on the pump shaft along a central plane, which in turn is supported between two bearings located at the drive and the non-drive ends of the pump casing. As the nomenclature suggests, the pump casing is split horizontally along the shaft axis of rotation to make it in two parts. This feature permits easy removal of the rotating assembly for maintenance work without disconnecting the suction and discharge pipe lines.

FLOWMORE Horizontal Split Case Pumps, when properly installed and operated with reasonable care and maintenance will operate satisfactorily for a long period of service. Subsequent paragraphs explain the general principles which should be followed to ensure trouble free operation of the supplied unit.

Additional information for special pump designs/applications and situations which are not covered in this manual, can be furnished on request for specific requirements. While seeking technical information for such cases, make sure that correct information about Pump Serial No., Pump Figure and Size is furnished and these inputs can be easily taken from the name plate of the pump.

2. **SAFETY INSTRUCTIONS:**

Centrifugal Pumps manufactured and supplied by Flowmore are designed with a thought of Safety for Men and Material in mind. Where hazards cannot be eliminated, the risks are minimized by the use of guards and other design features. In case any of the hazards cannot be guarded, the personnel involved must take full responsibility to use safe working practices as per prevalent industry norms governed by the law of the land.

2.1. **SAFETY SYMBOLS AND EXPLANATIONS:**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>LEGEND</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>CAUTION</td>
<td>A hazardous situation that may cause minor or moderate injury, if not avoided.</td>
</tr>
<tr>
<td>!</td>
<td>WARNING</td>
<td>A hazardous situation that may cause serious personal injury or even death, if adequate care is not taken.</td>
</tr>
<tr>
<td>!</td>
<td>DANGER</td>
<td>A hazardous situation that will cause death or serious injury, if cautions are ignored.</td>
</tr>
<tr>
<td>?</td>
<td>ELECTRICAL HAZARD</td>
<td>There may be a possible risk of electricity related hazards, if precautionary measures are not followed properly.</td>
</tr>
</tbody>
</table>

2.2. **SAFETY PRECAUTIONS:**

<table>
<thead>
<tr>
<th>GENERAL PRECAUTIONS</th>
<th>CAUTION</th>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read this manual carefully before installing and using the Pump Unit. Improper installation and unintended use of the pump can cause personal injury and damage to property, and may void the warranties.</td>
<td>If the agreed conditions of service are proposed to be changed, user must seek FLOWMORE’s written approval before start-up of the pump.</td>
<td>Use fasteners of the designated size and property grade to avoid any catastrophic failure of items during normal pump operation.</td>
</tr>
</tbody>
</table>
Clear and easy access to all controls, gauges and dials etc. must be maintained at all times.

Hazardous or flammable materials must be stored in safe areas or racks in pilfer proof and spill proof containers.

Do not wear loose or frayed clothing or jewellery that could get entangled with the controls/knobs/handles or get trapped in rotating equipment.

**DANGER**

Do not operate the pump without coupling guard and other safety precautions.

Following Personal Protective Equipment (PPE’s) should be used as a minimum requisite, while working on the pump,

- Hand gloves
- Safety glasses
- Safety shoes
- Helmets
- Ear Plugs

Due care should be taken during hoisting and placement of heavy equipment.

**ELECTRICAL HAZARD**

All electrical connections should be properly insulated and covered.

Before beginning any alignment procedure, ensure driver power is disconnected from the source of power supply.

---

### 3. STORAGE:

#### 3.1. INSPECTION OF PACKAGE/EQUIPMENT:

i. Inspect the physical condition of the packages/items immediately on receipt. In case the packing cases are found damaged, same should be opened in presence of the transporter’s representative.

ii. Inspect all the items for any physical damage/short supply as per the packing list. As a visual check, the main things to be looked for are;

   a. Broken or cracked feet of the pump base
   b. Broken or cracked suction and discharge flanges
   c. Broken or cracked adaptors
   d. For drive motor, check for the broken fan cover/shield, bent eye bolts, broken or cracked feet and damaged terminal box.

iii. In case of any mismatch in Quantity/Quality of items received, take immediate steps to inform the nearest FLOWMORE representative, Transport Company responsible for delivery of the equipment and Insurance Company.

iv. In case the supplied equipment is to be used at a later date, ensure proper storage of the items as described in the following paragraphs entitled "STORAGE REQUIREMENTS".

#### 3.2. STORAGE REQUIREMENTS:

Storage requirements vary depending on the length of storage, the climatic conditions and the equipment. For storage periods of three months or longer, contact FLOWMORE for specific instructions. Improper storage may lead to invalid warranties.

Consider a unit in STORAGE when:

i. It has been delivered to the job site and is awaiting installation.

ii. It has been installed but operation is delayed due to incomplete plant construction.

iii. There is long, 30 days or more, period between operation cycles.
iv. The plant or department is under shut down.

Following instructions should be followed to avoid any damage to the pump components under storage.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor storage</td>
<td>FLOWMORE suggests that the storage area should be clean, dry and well ventilated with platforms/pallets for stacking of the pump components.</td>
</tr>
<tr>
<td>Outdoor storage</td>
<td>In this case, apart from the conditions as stated for indoor storage, components must be covered from all sides with weather proof black PVC/Plastic sheets or tarpaulins. Ingress of dust must be prevented to enter the covered areas to protect the stored items from the effect of corrosion.</td>
</tr>
<tr>
<td>Uncovered storage facilities such as uneven temperatures, higher humidity, and/or dusty conditions</td>
<td>Check and clean the pump/components periodically to ensure that the pump is free to rotate by hand and that all components are free from dust, rust and corrosion.</td>
</tr>
</tbody>
</table>
| Pump Rotation                     | Rotate the pump shaft several rotations by hand every fortnight (two weeks). This will ensure  
  a) Adequate coating of bearings with lubricant  
  b) Retarding of oxidation/corrosion  
  c) Prevention of possible false brinelling. |
| Oil Lubricated Bearings           | Fill the bearing housing completely with suitable grade of lubricating oil for storage. This oil must be replaced with new oil at the time of its start up. Ensure periodic shaft rotation as above. |

3.3. **LONG TERM STORAGE:**

Ensure that any rust prone surface must be coated either with anti rust oil or a thin layer of grease. Actual condition of surface finish should be checked from time to time and requisite preventive measures should be taken to ensure due care of the delivered item/s. In addition, nearest FLOWMORE representative should be consulted for any specific instructions/guidelines for long term storage.

4. **BRIEF DESCRIPTION OF HORIZONTAL SPLIT CASE PUMPS:**

4.1. **GENERAL APPLICATIONS:**

FLOWMORE Horizontal Split Case Pumps are recommended for a wide spectrum of water and mild liquids pumping requirements of city municipalities, power and industrial sectors. More precisely, these pumps are ideally suited for applications like Domestic and Fresh Water Supply; Pressure Boosting; Cooling Water, Boiler Feed and Condensate pumping. FLOWMORE HSC Pumps are in regular use, giving excellent service for various applications in Power Plants, Steel Plants, Rolling Mills, Sugar Plants, Paper and Textile Mills, Fertilizer, Chemical, Refinery and Petrochemical Units. Other noteworthy applications for HSC Pumps are in HVAC and Fire Protection.
4.2. TYPES OF HORIZONTAL SPLIT CASE PUMPS

FLOWMORE manufactures Horizontal Split Case Pumps in the following three configurations:

1. **Double Suction Single Impeller**: In general, a horizontal split case pump is identified as, and referred to, this type of construction with bulging suction chambers on both sides of the pump casing and in-line Suction and Discharge nozzles. The pumps are primarily designed to handle large flow rates for low to high head applications. (Refer Drawing No. CSD-HSC-HP-001-00)

2. **Single Suction Double Impeller**: This is a two stage version of HSC pumps. The typical constructional and design features of the pump casing ensures that the two impellers, though individually mounted on the same shaft, receive and handle flow in series, thus developing much higher discharge pressures. Suction and Discharge nozzles are staggered and not in-line with each other. All FLOWMORE HSC Pumps designated as Fig. 5900 conform to the above design features. (Refer Drawing No. CSD-HSC-HP-002-00).

3. **Single Suction Single Impeller**: These pumps, identified as Fig. 5823 and 5824 upto 80mm discharge sizes, are designed for moderate flow with middle to high discharge head requirements. Like Single suction double impeller design, the Suction and discharge nozzles are not in line with each other. (Refer Drawing No. CSD-HSC-HP-003-00).

Majority of these pumps are Electric Motor Driven, and as such, standard direction of rotation is counter clockwise, when viewed from the coupling end. However, the pumps can also be manufactured and supplied suitable for opposite direction of rotation, i.e., for clockwise rotation, which is mandatory for Diesel Engine Driven Pumps.

![Direction of Rotation of HSC Pumps](image)

**FIGURE-1 : DIRECTION OF ROTATION OF HSC PUMPS**

5. INSTALLATION:

It is recommended that the services of a competent and experienced erection/commissioning engineer should be employed for installation and commissioning of the equipment. However any experienced contractor can install this equipment if the recommendations and instructions described herein are strictly adhered to.

i. The pump should have easy access for its inspection and maintenance. Adequate head room should be available for installing an overhead crane or a travelling chain pulley block, just in case it becomes necessary to hoist the equipment during installation/ maintenance.

ii. The pump should be located as near to the liquid being handled, as practical, so that a short and direct suction pipe may be used. For a stipulated value of required NPSH, the total suction lift should not exceed 4.5 meters,
when pumping the rated capacity at sea level; at a temperature not exceeding 30°C. Reduction in suction lift for change in altitude is approximately 300mm for every 305m above sea level.

iii. The foundation of the pump should be sufficiently substantial to absorb any vibration and to form permanent rigid support. Foundation bolts of proper size should be located and embedded in the concrete as per the Approved General Arrangement Drawing or a template to match the drawing dimensions. Foundation pipe sleeves of diameter about 2.5 times larger than the foundation bolt, should preferably be used to allow final positioning of the foundation bolts wherever required, particularly for larger pump sizes. It is recommended that the top of the foundation be finished reasonably smooth and the height be made 30 mm to 40 mm less than the desired finish level to allow for grouting.

![Diagram](image)

1. Base plate
2. Shims or wedges
3. Grout
4. Foundation
5. Dam
6. Bolt
7. Sleeve

(a)-Without Foundation Sleeve  (b)-With Foundation Sleeve

**FIGURE-2: A TYPICAL PUMP FOUNDATION**

iv. Before commencing installation, pump dimensions should be checked and compared with certified factory plans/ pump building dimensions to ensure that the unit will fit into the space provided for it.

v. If the pump had been in storage, it will be necessary to remove all the grease/oil from the bearings/bearing housings. The bearings/ bearing housings should then be flushed with a suitable compound, and re-greased/ re-oiled. The proper procedure for performing this operation is outlined in Instructions for Lubrication under "Maintenance of HSC Pumps".

vi. Thoroughly clean the suction and discharge flange surfaces. Using a solvent, remove the protective coating from the pump shaft.

vii. In such cases, where the driver unit is not in the scope of supply of FLOWMORE, The pump is positioned on the base frame in the factory itself but the locating holes for motor feet are left blank to be made at site as per the actual motor to be installed. It is a normal practice to dowel the pump- motor units at site with base frame after their final alignment.
Following is the set of step wise instructions to be followed for Pump-Motor-Base frame mounted units on their respective foundations,

i. Lift the Pump, Motor and Base Frame Assembly with the help of slings of adequate strength suitably fastened at appropriate locations marked on the base frame (see Figure-3).

![FIGURE-3: HOISTING OF PUMPING UNIT](image)

ii. Now lower it on to the place provided on the foundation suitably.

iii. Using wedges, placed as close to the foundation bolts as possible, raise the pump to the desired elevation.

![FIGURE-4: PLACEMENT OF WEDGES FOR LEVELING](image)

iv. Using a spirit level, adjust the wedges so that the suction and discharge flanges are vertical.

v. Align the coupling as mentioned in the instructions for COUPLING ALIGNMENT.

vi. Grouting of Pump-Motor Base should be carried out as per the guidelines provided under “GROUTING” to complete the installation.

5.1. **DRIVER:**

In most cases, HSC Pumps are driven by an Electric Motor. Installation and commissioning procedure for these motors should be carried out as per motor manufacturer’s recommendations and procedures listed in the installation manual furnished along with the motor.

Like motor driven units, in case of diesel engine driven pumps, separate manual of installation and commissioning instructions for diesel engine is provided by the engine manufacturer and is supplied along with the Pumping Unit.
5.2. COUPLING ALIGNMENT:
In case of Pump and Driver mounted on common base, the Pump and Driver units are factory aligned before dispatch within the accuracy of 0.05mm. This alignment may get disturbed due to extreme change in temperature surrounding the pump unit, mishandling during transit or installation, piping strain on the pump flanges, shifting of the building structure, inefficient grout setting or wear of bearing races etc.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment of the Pump – Driver Unit should be checked at various stages as indicated below to get a fool proof installation and to ensure a trouble free operation of the unit:</td>
</tr>
<tr>
<td>i. During leveling of the unit on the foundation</td>
</tr>
<tr>
<td>ii. After the grout is set and foundation bolts are tightened</td>
</tr>
<tr>
<td>iii. After the piping connection have been done</td>
</tr>
<tr>
<td>iv. Periodically as a routine check</td>
</tr>
</tbody>
</table>

To carry out these alignment checks, it is necessary to remove the flexible member(s) such as Pin & Bush, Spider and Tyre from the flexible coupling. Using a Straight Edge and Taper or Feeler Gauge, check the coupling for angular and parallel alignments. These checks should be done at four equally spaced positions around the coupling.

To check parallel misalignment of Pump-Motor Coupling, use a straight edge or a dial indicator. The correction is carried out by suitably shifting the pump or driver on their respective base frames.

Angular misalignment of the coupling may be checked with the help of taper or feeler gauge. The angular misalignment should be corrected by placing shims of adequate thickness at strategic locations under the driver feet only to safeguard the pump-motor alignment. Shimming below the pump feet is not recommended.

When dial indicators are used to check the final alignment, the pump and drive unit are considered to be correctly aligned when total indicator run out value is within a maximum of 0.05 mm.

<table>
<thead>
<tr>
<th>WARNING:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft Alignment Procedures must be followed to prevent failure of rotating components like shafts, couplings and bearings.</td>
</tr>
</tbody>
</table>

Always re-check alignment after each correction, as adjustment in one direction may disturb adjustments made in another direction.

5.3. GROUTING:
   i. Clean all the surfaces of the base frame, pump and motor pedestals that will come into contact with the grout.
   ii. Build a dam around the foundation.
   iii. Use a good quality Non Shrink Grout Mixture.
   iv. Thoroughly wet the foundation that will come into contact with the grout using rich cement slurry.
   v. Pour grout through the grout hole into the base plate up to the level of the dam. Adequate care should be taken, while pouring the grout, to avoid formation of air bubbles. This can be achieved either by stirring of the grout by a vibrator or directly pumping of the grout into place.
   vi. Allow the grout to set for at least 48 hours before full tightening of the foundation bolts.
   vii. It is a good practice to fill the remainder of base plate with grout as shown in the schematic diagram to minimize possibilities of vibrations.
6. PIPING:

6.1. GENERAL PRECAUTIONS

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

- **CAUTION:**
  Before connecting station piping to the pump nozzles, take an inventory of tools and materials used during installation of the pump. The suction and discharge nozzles of the pump make a very convenient, though totally undesirable, place to lay hand tools and other small items. Invariably, the erection personnel tend to forget to remove these tools. When the pump is first started, these items usually are sucked into the pump and cause damage to the impeller and casing. If any doubt exists, as to the freedom of pump and piping from tools, rags, bolts, nuts, welding slag etc, a lot of time and expense may be saved by rechecking over this point and flushing the pipelines before connecting to the pump.

  i. Piping should always run up to the pump. Do not move pump to pipe as this may make final alignment impossible.

  ii. Both the suction and discharge piping should be properly aligned and supported independently near the pump, so that no strain is transmitted to the pump when the flange bolts are tightened.

  iii. Install piping as straight as possible, avoiding unnecessary bends, Where ever necessary, use long radius 45-degree or 90-degree bends to decrease friction losses.

**FIGURE-5: GROUTING OF BASE FRAME**

(a)-Grouting of base frame without sleeve

(b)-Grouting of base frame with sleeve

viii. Tighten the foundation bolts fully.
iv. Remove burrs and sharp edges when making up the pipe joints.

v. Make sure that all piping joints are air-tight.

6.2. SUCTION PIPING

When installing the suction piping, observe the following precautions:

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

ii. Friction losses caused by undersized suction piping can increase the fluid’s velocity into the pump. As recommended by the Hydraulic Institute Standard, Suction pipe velocity should not exceed the velocity in the pump suction nozzle. In some situations pipe velocity may need to be further reduced to satisfy pump NPSH requirements and to control suction line losses. Pipe friction can be reduced by using pipes that are one to two sizes larger than the pump suction nozzle in order to maintain pipe velocities less than 5 feet/second (1.5 m/s).

iii. Suction piping should be as short as possible in length, as direct as possible and NEVER SMALLER IN DIAMETER than the pump suction opening.

iv. When operating on suction lift never use a straight taper reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe. Also 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 on the pump. When reducing the piping to the suction opening diameter use an eccentric reducer with the eccentric side down to avoid air pockets.

v. A suction pipe of the same size as the suction nozzle approaching at any angle other than straight up or straight down must have the elbow located 10 pipe diameters from the suction flange of the pump.

vi. Suction piping for horizontal double suction pumps should not be installed with an elbow close to the suction flange of the pump, except when the suction elbow is in the vertical plane, as it results in unequal distribution of flow to the two suction chambers (see Figure 10). Such an orientation of the bend results in high unbalanced thrust loads that will overheat the bearings and cause rapid wear in addition to affecting hydraulic performance. Vertical mounted pumps and other space limitations may require special piping layouts.

vii. To facilitate cleaning pump liquid passage without dismantling pump, 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).

viii. Typical suction pipes layouts, "Correct" and "Incorrect", are shown in figures 6 to 10 below:
FIGURE 7

FIGURE 8

FIGURE 9
ix. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on suction side of all the pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets.

x. The pump must never be throttled by the use of a valve on the suction side. Suction valves should be used only to isolate the pump for maintenance purposes.

6.3. **DISCHARGE PIPING:**

If the discharge piping is short, the pipe diameter can be same as the size of pump discharge nozzle. However, in case the piping runs longer, pipe diameter should be one or two sizes larger than the pump discharge size. Avoid high spots, such as loops or bends to form air pockets which result in throttling the discharge system or lead to erratic pumping.

   i. Horizontal Split Casing Pumps are equipped with pipe nipples to collect stuffing box leakage from either side. These drain pipes/nipples must be connected to ensure clean work area around the pump.

   ii. A check valve and a gate valve should be installed in discharge line. The check valve, placed between the pump and gate valve, will protect the pump from excessive back pressure and prevent water flowing back through the pump resulting in reverse rotation, that may cause damage to the pump. The gate valve is used for priming before initial starting and when the pump is in shut down. If increasers (expanders) are used on pump discharge side to increase the size of discharge piping, these should always be placed between the check valve and the pump.

   iii. Pressure gauges should be installed in gauge taps provided on both suction and discharge nozzles.

   iv. After all the piping is complete, recheck the pump and driver alignment.
7. **OPERATION OF HORIZONTAL SPLIT CASE PUMPS:**

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Do not operate the pump without priming or in dry condition.</td>
</tr>
<tr>
<td>ii. Do not operate the pump with closed suction and discharge valves.</td>
</tr>
</tbody>
</table>

In order to ensure satisfactory operation of these pumps, review carefully and perform all the operations outlined as below:

7.1. **PRECOMMISSIONING CHECKS:**

7.1.1. **LUBRICATION CHECKS:**

i. Check that the pump bearings are filled with sufficient of amount of lubricant.

ii. In addition to the above, it is advisable to check the motor bearings for lubrication. This should be done in accordance manufacturer’s recommendations as listed in the motor installation manual.

7.1.2. **ROTATION CHECK:**

The electrical motors are usually of poly-phase design and can be operated in either direction of rotation by merely interchanging any two of the phase connections at motor terminal box. It is extremely important that the motor rotates in the correct direction of rotation to match the pump rotation. Standard direction of rotation of these pumps is **CCW** (Counter Clock-wise) when viewed from the coupling end. The direction of rotation is indicated by an arrow cast integral with the casing. Prior to switching on the electric supply for checking direction of rotation of motor, disengage the flexible coupling between the pump and its motor by removing the pins and rubber cushions from the flexible coupling. Check the rotation. Correct if required and complete the final electrical connections. Reassemble the flexible member between the two coupling halves.

7.1.3. **SUCTION LINE LEAKAGE CHECK:**

Fill the suction line with liquid and check for leakage of joints. Tighten the leaking joints or replace gaskets where ever necessary.

7.2. **STARTING INSTRUCTIONS:**

i. **PRIME THE PUMP AFTER CLOSING THE GATE VALVE IN DISCHARGE LINE.**

With the exception of Horizontal Split Casing Pump under positive suction condition, HSC Pumps working under suction lift must be primed. This may be done by one of the following methods, as best suited to local site conditions.

a. **PRIMING BY EJECTOR:**

Where steam or compressed air is available, this is a very convenient method of priming. Attach an ejector at the high point of the casing and make the necessary air or steam connections. Valves should be provided between the ejector and the pump which may be closed after the pump is primed and started. The time span required for priming will vary depending upon the conditions in each installation.

b. **PRIMING BY VACUUM PUMP**

When steam or compressed air is not available, a hand or power operated vacuum pump may be used to evacuate the air filled in the suction line and pump casing. Statements made into preceding paragraph for cut off valve and priming time will be applicable in this case also.
c. **PRIMING BY WATER SUPPLY**
When it is feasible to place a foot valve on the suction pipe and a separate external water supply is available, the pump priming can be very conveniently achieved. The water supply can be connected to the pump casing at any convenient point and priming is accomplished by allowing the suction pipe and casing to fill. An air vent must be provided at the highest point of pump casing.

ii. **START THE DRIVER** - This should be done as per the recommendations of the motor and its control/switch gear manufacturers.

iii. **OPEN THE DISCHARGE VALVE** -
After the pump has attained full speed, open the discharge valve. This should be done slowly in order to bring a gradual load on the driver, and to prevent development of water hammer in the distribution system. This is especially important, as water hammer can cause serious damage to the piping and other equipment in the installation. Water hammer is caused by a sudden build up of pressure, resulting in setting up of pressure waves moving to and fro in the piping system. This pressure is composed of the pressure built up by the pump and by the weight and velocity of the liquid being handled. In many cases, this pressure can exceed the bursting pressure of the pipes, fittings and pipe joints.

7.3. **OPERATION CHECKS:**
When the pump is first started, and during normal operation it is advisable to periodically observe the pump behavior for symptoms of trouble and to follow remedial measures as listed under **TROUBLE SHOOTING**.

7.4. **STOPPING INSTRUCTIONS:**
   i. Slowly close the discharge valve, again to prevent water hammer in the distribution system.
   ii. Disconnect the power from the drive.
   iii. Drain the pump

For shut down periods, stuffing box should be flushed clean and moderately re-lubricated. Re-grease the pump and motor bearings. Also, it is advisable to provide the pump and motor with a protective covering to prevent moisture damage to the bearings and motor windings.

8. **MAINTENANCE OF HORIZONTAL SPLIT CASE PUMPS:**

These pumps, like any other machine, require maintenance under two situations, namely Preventive maintenance and Breakdown maintenance.

While preventive maintenance involves routine periodic checks to avoid breakdowns and to ensure trouble free operation, the breakdown maintenance is an emergency situation to locate, identify and rectify the fault in the shortest possible time.

8.1. **PREVENTIVE MAINTENANCE:**
Routine maintenance checks under preventive maintenance are recommended to be carried out at regular intervals as listed below:
8.1.1. DAILY INSPECTIONS:
Perform following daily checks during routine maintenance activity:

i. Check and record pump operating parameters like discharge pressure gauge readings, bearing temperature, noise and vibrations. In case of increasing trend in vibration values, analyze cause and take corrective steps.

ii. Check for dripping of lubricant from pump bearings and take requisite corrective action.

iii. Check the pump and piping for leaks and rectify as necessary.

iv. Check for adequate leakage of liquid from the stuffing box. Excessive leakage needs to be arrested.

8.1.2. QUARTERLY INSPECTIONS:
Following checks during tri monthly maintenance activities are recommended:

i. Check that the foundation bolts and the hold-down bolts are tight.

ii. Check the shaft alignment, and realign as required.

iii. Change the lubricant every six months or after 2000 operating hours whichever is less.

iv. Change the lubricant more often if the pumps are operating under adverse atmospheric or other conditions that might contaminate the lubricant.

v. Under special situations, it may be necessary to partly dismantle the pump for attending to an adverse observation during any of the above inspection schedules.

8.1.3. ANNUAL INSPECTION:
Excessive drop in pump performance and rising trend or persistent high levels of sound and vibrations are reasons enough to go for detailed investigations under annual inspection. Such an inspection will normally amount to complete dismantling of pump to look for internal wear tear and damage to pump components. This also covers an eventuality of rectification of a defect observed under daily and quarterly inspections but could not be attended due to system requirement. Extent of dismantling needs to be carefully assessed based on work involved for tackling the identified problem. Before taking a decision for dismantling the pump, check and record the pump operating parameters as listed under daily inspection.

8.2. BREAKDOWN MAINTENANCE:
Guidelines listed under ANNUAL INSPECTION AND REPLACEMENT OF PARTS should be meticulously followed to address problems of equipment breakdown.

8.3. REPLACEMENT OF PARTS:
Except in cases involving breakage or extreme wear on the casing, normally there is no need to disturb piping in order to inspect and replace parts in these pumps. Following procedure is given as a guide to ensure ease of disassembly and easy identification of faulty components.

8.3.1. DISASSEMBLY PROCEDURE:
It is normally advisable to disassemble the pump and check the wearing surfaces for wear after its satisfactory working of approx 1000 hours, as excessive wearing ring clearances will lower the overall efficiency of the pump. In the event of replacement of any worn out component necessitating disassembly of the pump, the procedure given below should be adhered to:

A. DISASSEMBLY OF DRIVER AND COUPLING

i. Disconnect the power supply from the drive motor and tag the pump for maintenance.

ii. Close gate valves of suction and delivery pipelines.
iii. Remove the coupling guard and pins/ flexible member from the coupling, thus disconnecting the pump and driver.

B. DISASSEMBLY OF THE PUMP
i. Put match-marks on bearing housing caps and bearing housings.
ii. For units equipped with gland packings, loosen and remove the gland halves.
iii. In case of Mechanical Seal Fitted Pumps, remove seal cover plate of the mechanical seal.

| CAUTION | When removing these seal cover plates, allow the seal to slowly expand as pressure applied against the rings may tend to expand the compressed mechanical seal instantly and thus causing damage to the seal faces. |

iv. Remove the dowel pins and hex head screws holding together the upper and lower casing halves.
v. Remove the upper half of pump casing.
vi. Remove the bearing housing cap screws and bearing caps.

vii. Lift the entire rotating assembly from the lower casing.

viii. Check the casing wearing rings for wear and running clearances between the casing wearing rings and impeller. It should not be more than twice the clearance given in the table appended below.

<table>
<thead>
<tr>
<th>SPLIT CASE PUMP WEARING RING DIAMETRICAL CLEARANCE (NOMINAL) IN MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP SIZE IN INCHES</td>
</tr>
<tr>
<td>FIG.</td>
</tr>
<tr>
<td>5821</td>
</tr>
<tr>
<td>5822</td>
</tr>
<tr>
<td>5823</td>
</tr>
<tr>
<td>5824</td>
</tr>
<tr>
<td>5825</td>
</tr>
<tr>
<td>5826</td>
</tr>
<tr>
<td>5922 &amp; 5972</td>
</tr>
</tbody>
</table>

ix. If the Inter ring clearance is more than the above recommendations, the casing wearing rings must be replaced with the new ones.

x. If the bearings or impeller require replacement proceed to the next step.

C. DISASSEMBLY OF ROTOR ASSEMBLY

| CAUTION | 1. Do not apply unwarranted heat to disassemble any components of pump during the process of disassembly. It can alter the metallurgy of the component thereby affecting its useful life. |
| | 2. Great care must be exercised to prevent any damage to the bearings and mechanical seal while removing them from the pump shaft. |

i. Loosen the bearing cover from the bearing housing and slide the bearing cover and Neoprene water flinger/ water thrower as far towards the impeller as possible.
ii. Remove the bearing housing by gently knocking it towards the end of the shaft with the help of a mallet.

iii. Gently pull the bearing from the shaft using a bearing puller.

iv. Mark the ends of shaft sleeves and impeller hubs at appropriate locations adjacent to the impeller hub by etching suitable match marks. These match marks will prove useful for identification of sleeves of either sides of impeller during reassembly.

v. Remove the bearing housing covers and neoprene flingers. Loosen and remove sleeve nuts, gland plates, rotating unit of mechanical seals, stuffing box washers, casing wearing rings and shaft sleeves from the shaft.

vi. Check the shaft/shaft sleeve for excessive wear and replace, if necessary, with the new components.

vii. Remove the impeller from the shaft using a hydraulic/ power press.

8.3.2. REASSEMBLY PROCEDURE

A. REASSEMBLY OF THE ROTATING ASSEMBLY:

i. Assemble the sleeve gasket and sleeve from the thrust end (NDE) side of the shaft, ensuring that the match-marked end goes in first. Hold the sleeve in its inner most position.

ii. Place and hold the impeller key in its slot on the shaft, simultaneously locking the above sleeve in its position, and press the impeller over the shaft from the coupling end (DE) side till it reaches its mid position on the shaft and sits on the impeller key.

CAUTION:-
Prior to assembling the impeller, make sure that it is positioned for the correct direction of rotation.

iii. Assemble the sleeve gasket and sleeve from the other, i.e., DE side of the shaft, with sleeve reaching its inner most position, touching the impeller hub face and simultaneously locking itself on to the impeller key.

iv. Assemble and slide over all other small components, such as, rotating unit of mechanical seals, stuffing box washers, casing wearing rings, seal plates, sleeve nuts, neoprene water flingers and bearing housing covers from either side of the pump shaft. If the unit is equipped with gland packings, install the stuffing box bushing snap rings and stuffing box bushing in place of the mechanical seals and snap rings.

CAUTION:-
Ensure that all the above components are assembled in correct orientation to match the direction of impeller rotation.

v. With the help of sleeves on both sides, locate the impeller on its original position and lock the shaft-impeller- sleeve assembly in this position by tightening sleeve nuts from both sides.

vi. Remove all rust, dirt and slivers from the shaft sections that receive the mechanical seals.

vii. Slide and fit the bearings on the shaft and secure the thrust bearing with its shaft snap ring.

viii. Place bearing housings on the bearings and secure the thrust bearing housing by installing the bearing snap ring.

ix. Position the bearing housing covers in the bearing housings and firmly press into place and position the Neoprene flingers in their proper location.

B. REPLACING ROTATING ASSEMBLY INTO CASING:

i. Slide the mechanical seals down the shaft toward the bearings as far as possible.

ii. Place the rotating assembly into the lower casing.
iii. Look for the match marks and reassemble the bearing housing caps in their original position and tighten securely.
iv. Replace the casing gasket, making certain that the gasket extends flush upto the edge of the stuffing box bore. Seal leakage is likely to occur if this is not ensured.
v. Place the upper casing into position, install taper/ dowel pins, cap screws and tighten.
vi. On units equipped with mechanical seals, place a light coat of oil on the shaft area receiving the seal to assist in seal assembly. After coating the shaft with oil, immediately slide seals into the stuffing boxes and compress until the snap ring will fit in the groove provided.
vii. On units equipped with gland packings, install the stuffing box snap ring and stuffing box washer.
viii. Install the packings as outlined under ‘REPACKING THE PUMP’ and tighten the glands.

8.4. ORDERING REPLACEMENT PARTS:
When ordering the repair parts, furnish details about type, figure and size of the pump. In addition, ALWAYS GIVE PUMP SERIAL NUMBER WHICH IS STAMPED ON THE NAME PLATE. When ordering an impeller, provide impeller diameter across the blade tips. The order for replacement parts should specify part name, part number, and quantity required.
In view of continuous improvement of the FLOWMORE products, the company reserves the right to furnish parts for repairs as per improved design, provided such parts are interchangeable. A part that is received and is not identical in appearance or has a different symbol from the original part, May still be interchangeable with the worn out part. As such, the parts of improved version should not be returned to the factory without proper confirmation from FLOWMORE.

8.5. REPLACEMENT OF SHAFT SEALING ELEMENTS:
8.5.1. REMOVING OLD PACKING:
It’s time to replace the packing when there is no more adjustment left in the packing gland and there is too much leakage from the stuffing box. When it occurs, complete set of packing rings must be replaced. Adding an additional ring or just replacing one or two rings will only lead to premature packing failure and damage to the shaft and sleeve.
i. Tag the pump in the “OFF” position and lock it out so that it can’t be accidentally restarted.
ii. Isolate the pump by closing the suction and discharge valves.
iii. Drain the pump by opening the drain cock or removing the drain plug in the bottom of the volute.
iv. Remove the gland half by unscrewing relevant hardwires.
v. Remove the packing rings with a packing puller with due care so that shaft should not be scored.
vi. Remove the water seal ring & remaining packing rings.
vii. Clean the stuffing box & shaft/sleeve.
viii. Disconnect, inspect and clean the seal water line and seal water port, if provided.
ix. Inspect the shaft or shaft sleeve. If it is scored or grooved, the pump should be dismantled and the shaft/shaft sleeve should be dressed or replaced.

8.5.2. REPACKING THE PUMP:
The correct packing size can be determined using the following procedure:
i. Measure the inside diameter of the stuffing box and the outside diameter of the shaft/ sleeve.
ii. Subtract the shaft diameter from the stuffing box diameter.
iii. Divide the difference by two to arrive at the correct packing size.
The correct number of rings can be determined using the following procedure:

i. Measure the depth of the stuffing box.

ii. Divide the depth of the stuffing box by the size of the packing as calculated above to get the total number of rings.

iii. Subtract one from this total if a lantern ring is used in the stuffing box.

Installation procedure for gland packings may be followed as explained hereunder:

i. Always use a good grade of soft packing because inferior grades may allow excessive leakage and early wear tear of the shaft/sleeve. Great care should be taken to keep the packing material clean and free from dirt. The two most important aspects of cutting packing rings involve cutting them of right length and cutting them in a manner that the ends will butt together squarely.

ii. Wrap each ring of packing around the shaft and seat it in the stuffing box completely before adding the next ring. Open the packing ring by twisting instead of pulling the ends apart. A light coat of grease on the outside of the ring will make it much easier to push in to the stuffing box. Stagger the joint so the rings so that they are 90 degrees apart. Never install a lantern ring at the bottom most position in a stuffing box. Make sure that the lantern ring, when installed, lines up with the seal water port provided in the stuffing box.

iii. Install the packing gland. Make sure the gland is tightened down evenly. It is usually made out of cast material and will break easily if it gets in a bind.

853 REASSEMBLY OF MECHANICAL SEAL:

Operating length given in the seal drawing or dim 'C' shown in figure 11, identifies the compressed or operating length of mechanical seal necessary to prevent leakage from the seal faces. The distance 'E', as shown in figure 11, is known as the "location dimension". It will allow the locking collar to be positioned at a point on the shaft to ensure that the seal has proper compression when the gland ring is installed.

![Diagram of mechanical seal](image)

**FIGURE 11- FINDING SEAL INSTALLATION DIMENSIONS FROM STUFFING BOX FACE**

Location dimension is the combination of two dimensions, one is dimension 'B' i.e. the projection or depression of the stationary seal or insert face from the seal plate & Dimension 'C' i.e. the operating or compression length of the mechanical seal. Once the location dimension has been determined and the shaft and stuffing box have been dressed, the following procedure should be followed to properly install the seal:

i. Scribe a reference mark (also called the witness mark) on the shaft that will line up with the stuffing box face.

ii. Remove the frame assembly along with shaft and scribe another mark, the location mark, on the shaft that is the same distance from the reference mark as the location dimension.
iii. Lubricate the shaft with soap solution.
iv. Mount the insert in the gland plate. Lightly lubricate the insert mounting o-ring and position it in the gland plate. Gently press the insert into the gland plate and seat it. Always try to avoid direct contact with the seal face. In case it is necessary to apply pressure directly to the seal face to seat it, the same should be done with clean hands after covering the seal face with a clean cloth. take care that this step is to be taken care in calculation of location dimension too.
v. Install the rotary unit parts on the shaft in the proper order. Lubricate the shaft packing o-ring and take care not to roll or pinch it as it slides into place. Again, try to avoid contact with the seal face.
vi. Set the back of the locking collar on the location mark and tighten the set screws firmly and evenly.
vii. Reassemble the pump, making sure to clean and flush the stuffing box.
viii. Seat the gland ring/plate and ring gasket to the stuffing box face by tightening the gland nuts/bolts evenly and firmly. Check manufacturer’s specs for proper torque.

8.6. LUBRICATION:
The pumps are sufficiently lubricated for an average service of six months before dispatch from the factory. Although each pump bearing is furnished with Grease inlet fitting and Grease pressure relief fitting, adding additional lubricant to the pump bearings will seldom be necessary. Good judgment and care should be exercised while adding grease to a bearing.

Never try to replace the original factory fitted grease fittings with pressure gun fittings. Such fittings will only tempt the maintenance personnel to add the lubricant to the bearings, thereby causing more damage to the bearings due to excessive lubrication.

8.6.1. PROCEDURE FOR GREASE RE-LUBRICATION:
i. Remove the drain plug from the bearing housing located at middle & side face of the bearing housing.
ii. Run the pump for 5-10 minutes prior to adding new grease. Stop the pump, lock and tag it for maintenance.
iii. Waste the first shot of grease from the grease gun to remove contaminated grease from the tip. Add new grease - MP2 OF HINDUSTAN PETROLIUM OR EQUIVALENT- to force the old grease out through the drain. Continue until new grease comes out of the drain.
iv. Restart the pump and allow it to run for 5-10 minutes while excess grease is expelled from the housing.
v. When no more grease comes out of the drain, stop the pump, re-tag it and tighten the drain plug.
vi. Start the pump and allow it to run for 10-15 minutes. Check the bearing temperature. If it is too hot, remove the drain plug and allow the excess grease to be expelled till the bearing temperatures reduces to desirable limits.

8.6.2. PROCEDURE FOR OIL RE-LUBRICATION:
i. Remove vent plug located at top of the bearing frame.
ii. Remove the drain plug from the oil sump located at its bottom/ side face. Collect all waste oil in a suitable pan. Replace drain plug after draining of waste oil is complete.
iii. Fill HINDUSTAN PETROLIUM MAKE MULTIGRADE MOBIL OIL 20W40 OR EQUIVALENT up to the level indicated on sight glass. Excess oil will result in over heating of the bearing
iv. Tighten all the plugs & Restart the pump.

Immediately after re-lubrication, bearing temperatures may rise above normal operating temperature. It usually gets stabilized within 4 to 6 hours of operation. The frequency of re-lubrication will depend upon actual operating conditions.
CAUTION
Ensure that the bearings are periodically lubricated with designated lubricants only.
Do not re-lubricate a pump while it is running.

9. TROUBLESHOOTING:

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Causes</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No discharge</td>
<td>Pump is not primed (For Horizontal Non Clog pump only)</td>
<td>Re prime the pump and check that the pump casing and suction line are full of liquid.</td>
</tr>
<tr>
<td></td>
<td>Pump suction/line is clogged</td>
<td>Remove the obstructions from the suction/line.</td>
</tr>
<tr>
<td></td>
<td>Impeller is clogged</td>
<td>Back-flush the pump in order to clean the impeller</td>
</tr>
<tr>
<td></td>
<td>Pump is not primed (operating under suction lift)</td>
<td>Re prime the pump and ensure that the pump casing and suction line are full of liquid.</td>
</tr>
<tr>
<td></td>
<td>Pump is rotating in wrong direction</td>
<td>Correct the direction of rotation by interchanging any two of the face connections at motor terminal box.</td>
</tr>
<tr>
<td></td>
<td>The suction lift is higher than that for which the pump is designed</td>
<td>Check suction pipe friction losses. Rectify/ modify suction line as necessary.</td>
</tr>
<tr>
<td></td>
<td>Speed is too slow</td>
<td>Check that motor is properly connected across the supply line and that it receives full supply voltage.</td>
</tr>
<tr>
<td></td>
<td>Discharge head is too high</td>
<td>Check pipe friction losses. Rectify as necessary.</td>
</tr>
<tr>
<td>Insufficient discharge</td>
<td>Air leaks in suction line</td>
<td>Check leaking joints in the suction line. Rectify as necessary.</td>
</tr>
<tr>
<td></td>
<td>Air leaks in Stuffing box</td>
<td>Replace gland packing if necessary. Readjust packing gland.</td>
</tr>
<tr>
<td></td>
<td>Speed is too low</td>
<td>Check that motor is properly connected across the supply line and that it receives full supply voltage.</td>
</tr>
<tr>
<td></td>
<td>The impeller is partially clogged</td>
<td>Back flush the pump in order to clean the impeller</td>
</tr>
<tr>
<td></td>
<td>Running clearance between the impeller and casing wear rings is excessive</td>
<td>Replace the worn out wear rings.</td>
</tr>
<tr>
<td></td>
<td>Discharge head higher than anticipated</td>
<td>Check pipe friction losses. Rectify as necessary.</td>
</tr>
<tr>
<td>Issue</td>
<td>Description</td>
<td>Possible Solution</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------------------</td>
</tr>
<tr>
<td>The suction lift is higher than that for which the pump is designed</td>
<td>Check suction pipe friction losses. Rectify/ modify suction line as necessary.</td>
<td></td>
</tr>
<tr>
<td>The impeller is worn out or broken</td>
<td>Inspect and replace the impeller</td>
<td></td>
</tr>
<tr>
<td>Foot valve too small</td>
<td>Replace with adequately sized foot valve</td>
<td></td>
</tr>
<tr>
<td>Foot valve or suction opening not submerged fully</td>
<td>Increase the length of suction pipe to achieve sufficient submergence.</td>
<td></td>
</tr>
<tr>
<td>Pump is rotating in wrong direction</td>
<td>Correct the direction of rotation by interchanging any two of the face connections at motor terminal box.</td>
<td></td>
</tr>
<tr>
<td>Speed too low</td>
<td>Check that motor is properly connected across the supply line and that it receives full supply voltage.</td>
<td></td>
</tr>
<tr>
<td>Dissolved air/gasses in the liquid being pumped</td>
<td>Follow specific degasification procedure in consultation with FLOWMORE</td>
<td></td>
</tr>
<tr>
<td>Impeller is worn out or broken</td>
<td>Inspect and replace the impeller</td>
<td></td>
</tr>
<tr>
<td>Pump is rotating in wrong direction</td>
<td>Correct the direction of rotation by interchanging any two of the face connections at motor terminal box.</td>
<td></td>
</tr>
<tr>
<td>The pump is not primed</td>
<td>Re-prime the pump and check that the pump and suction lines are full of liquid</td>
<td></td>
</tr>
<tr>
<td>The suction line has air or vapor pockets</td>
<td>Rearrange the piping in order to eliminate air pockets</td>
<td></td>
</tr>
<tr>
<td>The suction line has an air leak</td>
<td>Check leaking joints in the suction line. Rectify as necessary.</td>
<td></td>
</tr>
<tr>
<td>Defective casing gasket/O’ ring</td>
<td>Replace the gasket/ O’ ring</td>
<td></td>
</tr>
<tr>
<td>Dissolved air/gasses in the liquid being pumped</td>
<td>Follow specific degasification procedure in consultation with FLOWMORE</td>
<td></td>
</tr>
<tr>
<td>Suction lift is too high</td>
<td>Check suction pipe friction losses. Rectify/ modify suction line as necessary.</td>
<td></td>
</tr>
<tr>
<td>Water seal ring clogged</td>
<td>Clear the obstruction to resume cooling/flushing water supply into the stuffing box.</td>
<td></td>
</tr>
<tr>
<td>Insufficient gland pressure</td>
<td>Tighten gland nuts</td>
<td></td>
</tr>
<tr>
<td>Insufficient packings in the stuffing box</td>
<td>Check quantity and size of gland packings and repack the pump</td>
<td></td>
</tr>
<tr>
<td>Worn out shaft/shaft sleeve</td>
<td>Replace the worn out parts</td>
<td></td>
</tr>
<tr>
<td>Pump operating at low discharge head, hence delivering excess quantity of liquid.</td>
<td>Throttle the discharge valve to achieve rated head. If it does not help trim the impeller diameter in consultation with FLOWMORE representative.</td>
<td></td>
</tr>
<tr>
<td>Specific gravity and/or viscosity of the liquid pumped are too high.</td>
<td>Replace drive motor with motor of higher rating. Alternatively trim the</td>
<td></td>
</tr>
</tbody>
</table>
### Excessive vibrations and noise

**Rotating parts are rubbing against each other**
Check the parts, identify cause of rubbing and rectify as necessary.

**Speed is too high**
Check the motor for its rated speed and the supply voltage being fed to the motor.

**Mechanical defects:**
1. Bent shaft
2. Packing gland too tight.
3. Insufficient impeller running clearance
4. Rotating element binds
   - 1. Replace the defective parts
   - 2. Loosen the gland nuts
   - 3. Replace casing and impeller wear rings.
   - 4. Check the rubbing parts for adequate running clearance.

**Misalignment between pump and driver**
Realign the pump and driver

**Foreign object stuck in the impeller eye/ vanes.**
Back flush the pump or physically dislodge the foreign object.

**Foundation bolts and hold-down bolts are loose**
Tighten foundation bolts and the hold-down bolts of pump and motor

**Pump operating at low discharge head, hence delivering excess quantity of liquid.**
Throttle the discharge valve to achieve rated head. If it does not help, consult with FLOWMORE representative.

**Suction and/or discharge pipes inadequately supported**
Ensure proper supports below suction and discharge pipes.

**Excessive strain on suction and discharge nozzles due to misaligned suction and discharge pipes**
Align the suction and discharge pipes with respect to pump nozzles.

**Pump is cavitating**
Locate and correct the system problem and ensure pump operating at design point.

**Mechanical defects :**
1. Bent shaft
2. Broken impeller
3. Rotating element binds
4. Packing gland too tight
5. Worn out bearings.
   - i. Replace the defective part
   - ii. Replace the defective part
   - iii. Check the rubbing parts for adequate running clearance.
   - iv. Loosen the gland nuts
   - v. Replace with new bearings.

**Pump overheats**

**A. Bearings :**
1. Misalignment between pump and driver.
2. Excessive / insufficient grease/oil lubrication
3. Bent shaft
4. Rotating element binds

**B. Stuffing box :**

**A**
1. Realign the pump and driver
2. Check the lubricant for its suitability and quantity.
3. Replace the defective part
4. Check the rubbing parts for adequate running clearances

**B**
i. Excessive packing gland pressure
ii. Water seal connection plugged
iii. Inferior grade of packings used.

i. Loosen the gland nuts
ii. Disconnect seal water connection and remove the obstruction.
iii. Use good quality packings with adequate lubricating properties.

10. LIST OF TYPICAL CROSS SECTIONAL ASSEMBLY DRAWINGS:

<table>
<thead>
<tr>
<th>SR. NO</th>
<th>DRAWING NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSD-HSC-HP-001-00</td>
<td>TYPICAL CROSS SECTIONAL DRAWING FOR DOUBLE SUCTION SINGLE IMPELLER PUMP</td>
</tr>
<tr>
<td>2</td>
<td>CSD-HSC-HP-002-00</td>
<td>TYPICAL CROSS SECTIONAL DRAWING FOR SINGLE SUCTION DOUBLE IMPELLER PUMP</td>
</tr>
<tr>
<td>3</td>
<td>CSD-HSC-HP-003-00</td>
<td>TYPICAL CROSS SECTIONAL DRAWING FOR SINGLE SUCTION SINGLE IMPELLER PUMP</td>
</tr>
</tbody>
</table>