INSTRUCTIONS ON INSTALLATION, OPERATION AND MAINTENANCE FOR SAM TURBO PUMP TYPE “VO”

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APPLICATION

VO Vertically arranged centrifugal pumps, are recommended in all cases where SPACE economy matters.

These pumps are suitable for handling clear liquids, corrosive liquids, slurries, extreme temperature, thermic liquids, hazardous, inflammable and toxic liquids.

The liquid level in these pumps are above the casing level and therefore pumps are self-priming in nature.

CONSTRUCTIONAL FEATURES

Vertical pump mainly consists of
a. Top thrust bearing and bearing bed stool assembly.
b. Intermediate column assembly with line shaft bearings.
c. Pump end bearing, casing assembly and
  delivery pipe assembly.

DESIGN FEATURES

- Self priming.
- Axial adjustment to maintain performance.
- Simple mounting.
- High temperature capability.

PERFORMANCE RANGE

<table>
<thead>
<tr>
<th>PUMP TYPE</th>
<th>CONSTRUCTION</th>
<th>CAPACITY up to m³/hr</th>
<th>HEAD up to mts</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO+CPC, VO+CHC</td>
<td>CLOSED IMPELLER</td>
<td>750</td>
<td>150</td>
</tr>
<tr>
<td>VO+TCH</td>
<td>SEMI OPEN IMPELLER</td>
<td>800</td>
<td>230</td>
</tr>
<tr>
<td>VO+ARS</td>
<td>FOR ABRASIVE SLURRY</td>
<td>300</td>
<td>50</td>
</tr>
<tr>
<td>VO+PS</td>
<td>CLOSED IMPELLER</td>
<td>600</td>
<td>85</td>
</tr>
<tr>
<td>VO+PSW</td>
<td>WIDE PASSAGES FOR SEWAGE</td>
<td>1000</td>
<td>40</td>
</tr>
<tr>
<td>VO+FF</td>
<td>FULLY FREE VORTEX IMPELLER</td>
<td>250</td>
<td>85</td>
</tr>
<tr>
<td>VO+FF+AR</td>
<td>VORTEX IMPELLER FOR ABRASIVE SLURRY</td>
<td>250</td>
<td>85</td>
</tr>
</tbody>
</table>
SECTIONAL DRAWINGS (With Special Features)

BEARING BED ASSEMBLY
- Study bearing bed stool
- Angular contact thrust ball bearing mounted back to back, to take care of vertical loads as thrust of the impeller, shaft weight.
- It contains provisions for Axial Adjustment of the impeller without dismantling the pump.
- For screwed on impeller type of pumps, Non-reversible Ratchet arrangement is provided to ensure the direction of rotation.
- As STANDARD for sealing purpose Gland Packing arrangement provided.
- For GREASE Lubricated type of pumps FELT SEAL arrangement provided.

COLUMN ASSEMBLY & SHAFTS
- This is normally made of ERW/SEAMLESS/CAST PIPE with different materials as per application to guide the rotating shaft with proper supports.
- SHAFTS of more than ample strength and rigidity with proper span between bearings to keep deflection and vibrations to minimum runout.

STARSUPPORT and LINE SHAFT BEARINGS
- Line shaft bearings are precisely machined for positive alignment and secured in starsupport by press fitting. Available in Bronze, Cutless rubber, Carbon and carbon filled teflon.

PUMP END BEARING
- Designed to take radial thrust of Impeller and it is provided as close to the Impeller as possible.
- Bearing construction and bearing material depend upon the pumping liquids.

FLANGE
- Flange drilling details (customer end) are ANSI 150 lbs RF, change of drilling std are optional.

DELIVERY PIPE LINE
- Normally made of similar to column pipe assembly material of construction or change of materials are optional.

LUBRICATION PIPE LINE
- BG - IS318GR2 Bush Bearings with GREASE Lubrication.
- RWE - Cutless Rubber Bush Bearings with External clear water.
- CWI - Carbon/Carbon Filled Teflon with liquid handled.
- CWE - Carbon/Carbon Filled Teflon with External clear water.
- Set lubrication to all Bush Bearings from the discharge pipe line in case of clear pumping liquid.
- External Lubrication for handling liquids containing clogging material un affected by mixing of flushing fluid. Provided with inlet piping connections from the Base Plate.
- Grease Lubrication for sea water, contaminated water at ambient temperature and Provided with inlet piping connections from the Base Plate.

VO+PC/V+CHC
- This construction is provided with closed impeller arrangement and hence suitable for handling pure or slightly contaminated liquids, with suitable material of construction. The same models can be utilised for handling acids, dyes, hydrocarbons, in the petro-chemical and chemical industries.

This pump has the provision of open impeller construction, with the result, it will be able to handle liquids containing solid particles. But, of course, the size of solids is limited.

The impeller of this construction works on the vortex principle. This is meant for handling large solids and the passages are fully free and hence suitable for such liquids.

MATERIAL EXECUTION CHART

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
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</thead>
<tbody>
<tr>
<td>BEARING BED ASSY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLUMN, DELIVERY PIPES</td>
<td>M.S</td>
<td>M.S</td>
<td>SS-304</td>
<td>SS-316</td>
<td>ALLOY-20</td>
<td>CD4MCu</td>
</tr>
<tr>
<td>STAR SUPPORTS</td>
<td>CJ</td>
<td>CJ</td>
<td>SS-310</td>
<td>SS-316</td>
<td>SS-304</td>
<td>SS-316</td>
</tr>
<tr>
<td>COUPLING SLEEVE SET</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHAFT ASSY</td>
<td>EN.8/SS-410</td>
<td>SS-304</td>
<td>SS-316</td>
<td>ALLOY-20</td>
<td>CD4MCu</td>
<td></td>
</tr>
<tr>
<td>BUSH BEARINGS</td>
<td>BRONZE/CUTLESS RUBBER/CF8/CD4MCu/ALLOY-20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>FASTENERS</td>
<td></td>
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<tr>
<td>COOLING PIPE LINE ASSY</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASING ASSY</td>
<td>CJ/MS/SS-304/SS-316/ALLOY-20/CD4MCu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STRAINER / BELLMOUTH</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C.I. - IS 210 FG 200
M.S. - IS 2062 C15/ERW MS
SS-304 - AISI - 304
SS-316 - AISI - 316
En 8 - BS 970 En 8
CF8 - ASTM A743 CFB
CF8M - ASTM A743 CFBM
CD4MCu - ASTM A743 CD4MCu
ALLOY-20 - ASTM A743 CN7M

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GENERAL ARRANGEMENT

Fig No: 800-101

NOTE: (a) - LENGTH OF SUCTION SPOOL IS LIMITED TO MAXIMUM 1.0 to 1.2M.
FOREWORD AND GUARANTEE:

This erection and operation manual should be read in all cases by the fitters before erection and start up.

We are not liable for the damage incurred due to failure to observe the instructions for erection and operation.

During the period of guarantee, repair work should be done by our fitters only or should get our approval in writing before attending to the complaint themselves.

Contrary to our acknowledgement of order if you use the pumps for a different service please get our concurrence. Otherwise, the guarantee for the pump will not apply.

TYPES OF PUMPS:
“VO & VR”, is the Vertical version of Sam’s standard Horizontal pumps CHC, CH.FF, FF+AR, AR,PS and PSW.
VO: Pump shaft supported in sleeve type bearing for wet pit installation with liquid Lubrication.
VR: Pump Shaft supported in metallic Ball & Roller bearings with grease lubrication for dry pit only.

FOUR CHOICES OF LUBRICATION ARRANGEMENT
Four choices of sleeve type Bearings and lubrication arrangement offered to meet duty requirements depending on the liquid in case of “VO” type pumps and they are designated as:-

a. VO + BG : Bronze Bush Bearings with Grease lubrication arrangement.
b. VO + C/TW: Carbon / Teflon Bush bearing arrangement with external water/ steam lubrication.
c. VO + C/ Tld: Carbon / Teflon Bush bearing arrangement with lubrication by the liquid handled.
d. VO + RW : Rubber bush bearing arrangement with lubrications of external water under pressure.

Check up from name plate of the pump model received by you and its lubrication arrangement. This is very important.

1. DESCRIPTION OF ARRANGEMENT: (Ref.Fig.No.810- M5. Page 19)

**VO + BG:** In case of sleeve type Bronze Bearings individual pipe lines are provided for supply Grease to each sleeve type Bearings support from the top of sole plate itself.

**NOTE:** For pump above setting height of 5M, a Grease Pump driven by the main pump is supplied along with the pump which feeds small quantity of grease for all the Bearing through individual pipe lines.

**MAINTENANCE OF GREASE PUMP:**
Ensure that the Grease Reservoir is filled up always with sufficient quantity. In the case of Reservoir is empty, the pump will fail. The quantity of grease feeding in the grease pump. It is normally factory set.
However, the feeding of Grease should be carefully watched and ensure no bearing starve due to lack of grease.

**VO+C/TW:**
In this design arrangement, individual pipe lines are provided and they are brought above the sole plate. Provide external flushing liquid (mostly water) as the lubricating liquid for the sleeves pumps. In case of crystallizing liquids use of Carbon Bushes are recommended with steam as lubrication medium. Refer pressure and quantity of liquid requirement.

**VO+ V/TLd:**
If in the event of internal liquid lubrication arrangement, all such connection are provided in the pump itself. No additional arrangement is required at the site.

**VO + RW:**
These pumps are supplied with cutless rubber bushed lubricated by external water. There are two types of arrangement. If the liquid is not very abrasive, individual pipe lines are provided for every sleeve type rubber bush and they are to be lubricated by low pressure flushing water from external source. In the second arrangement, which are provided for handling highly abrasive slurry the entire column pipe containing all Rubber Bushes is to be supplied with water under pressure. By this procedure we completely eliminate the entry of highly abrasive slurry in to the Bush Bearing Region. For this purpose water under pressure and capacity as mentioned in the name plate shall be fed through the single pipe lines entry provided above the sole plate for the purpose. A steady flow of capacity 1.5 to 3 M³/hr. of fresh water is thus to be maintained as an inward flow into the pump. To ensure this install sight gauge and flow indicator in the pipe line above the sole plate. Also connect a pressure gauge of appropriate size to check at regular intervals to find out satisfactory performance of sealing water requirements. It is also advisable to inter connect the sealing water pump with the main pump so that main pump is not run on any occasion without the sealing water supply. It is also important to note that before starting the main pump, the sealing water pumps shall be started and run for 10 minutes to clear the slurry deposited if any from the sleeve bushes. After this only main pump shall be started.

**MAIN BEARINGS CARRYING THE PUMP SHAFT AND IMPELLER:**
In VO and as well as in VR, the main Bearings are 2 Nos.angular contact Bearings of 73 series mounted back to back as per recommendations of API 610. These bearings are Grease Lubricated. Provide proper Grease as per general instructions. The mounting of AC bearings in Back to Back fashion shall be done in a very careful manner.

**DIRECTION OF ROTATION:**
Clock -wise, when pump is viewed from driven end.

**2. INSTALLATION AND ERECTIONS OF SET (VO):**
A crane of adequate capacity must be available which permits lo, jerk-free, raising and lowering of the set. For the minimum lift required please refer to the arrangement drawing.
The eye bolts of the driving unit must by no means be used for lifting the complete set, since they are rated for the weight of the driver only.
The pump is submerged directly into the pit. Down to certain installation depths it can be suspended free, beyond these depths a lateral guidance of the pump is required (provision of a pump guide piece at the bottom of the pit), see acknowledgment of order and / or arrangement drawing.
The suspension pipes are bolted to the sole plate. Thus the support for the sole plate (on beam or foundation) has to be designed for the total weight of the set.
Provision so a suction Bell will considerably reduce the required min. submergence.

In the standard design of the pump the delivery pipe is carried upwards through the sole plate. As a variant the set can also be supplied without delivery pipe (and with a smaller sole plate).

Drive of pump is effected via a shaft assembly (Pump shaft intermediate shaft- top shaft, rigidly connected by sleeve couplings) running in the centre of the suspension pipes.
The shaft assembly is guided in sleeve bearings, lubrication is depending on the operating conditions. Lubrication is either by grease, or by external water or by the liquid handled.

**VR + BG:**

Dry fit vertical pump is always provided with Grease Lubrication Arrangement only as standard. Individual Bearings are provided with Grease Nipple and at regular intervals indicated in the Name Plate fresh grease has to be injected.

**DRY PIT INSTALLATION (VR):** (Ref.Fig.No.810-M2. Page No:15)
The pump is installed in a dry pit or a pump seller approximately at the height of the adjacent feed tank (collection tank). Down to certain installation depths it can be suspended free, beyond these depths a guidance of the pump is required (use of a support bend attached to the bottom of the pit, which is not allowed to absorb weight forces).
The suspension pipes are bolted to the sole plate. Thus the support for the sole plate (on beam or foundation) has to be designed for the total weight of the set.
As a rule, the feed line up to the feed tank including the bend and the delivery line are not part of the ‘Pump” supply. Shaft sealing of the pump is effected by means of a packed stuffing box. In the case of the standard design a lantern ring is subjected to the pressure of the liquid handled in order to positively avoid the intake of air during operation. The supply of clean external liquid for sealing (necessary in the case of handling contaminated liquids) is possible as a variant. Drive of the pump is effected via shaft assembly (pump shaft intermediate shaft, top shaft, rigidly connected by sleeve couplings), running in the centre of the suspension pipes.
The shaft assembly is guided in grease lubricated rolling contact bearings.
An amply sized grease lubricated pair of angular ball bearings in the motor pedestal carries the weight of the rotor and the residual axial thrust.
Every bearing point is provided with grease nipple for individual grease lubrication.

The motor pedestal, designed to accommodate the driving unit, is bolted to the sale plate. Motor shaft and top shaft are connected by a flexible coupling.

Check by means of a spirit level whether the pump is suspended vertically. For pumps suspended free the admissible deviation from the vertical (Pump without guide piece and/or foot bend and piping) is 5 mm per meter installation depth.

After installation the rotor must rotate freely by hand. Should this not be the case, the set must by no means be put into operation.

**ASSEMBLY OF PUMP AT THE SITE:**

In many cases (pump of large setting heights that is above 1.5 meter setting height) pumps will be dispatched in dismantled condition. The final assembly, be done at the site only. For this purpose the components will be supplied in the following assemblies:

1. Bearing Bed\Assembly \with sole plate and with all accessories.
2. Shafts.
3. Column Pipe.
4. Wetted parts Assembly.
5. Delivery pipe assembly.

Prior to assembly clean the fitting surface and seats of all parts. To facilitate the assembly easy, wet all fittings and sliding surfaces by oil or grease.

**BEARING BED ASSEMBLY:**

1. Insert the bearing (Part no.8) on bearing collar (part no.5) and fasten by lock nut & Lock washer (part no.9) for positive locking.
2. Insert the bearing collar with bearing, into the bearing Housing (Part 00.7)
3. Insert the Drive Shaft (part no.16) into the bearing housing a assembly, was already Circlip and key provided.
   Circlip provided for locking the bearing collar with Drive Shaft. Key provided to give Positive drive to bearing collar with Drive shaft.
4. Arrest the bearing collar with Drive shaft by means of lock nut and lock washer (part no.2 &3 )
v. Assemble the bearing cap (Cum Ratchet) (part no. 6) through the drive shaft and tighten the bearing cap with bearing Housing. Such that the outer Race' of the bearing sits on the bearing housing.

vi. Insert the Hatchet collar (part no. 4A) into the Drive 'shaft which was already ratchet pin and Hatchet plate fixed. (part no. 4). In Drive Shaft a key is to be provided to give for ratchet plate & coupling.

vii. Fit the Gland housing assembly (part no.10-13)/Felt Seal cover with the bearing bed (part no.1A) and the bearing bed fitted to the sole plate by means of screws.

viii. With the bearing assembly unit; a deflector (part no.14B) to be provided on the Drive shaft, just after the circlip (part no.14A.) and inserted through Gland Housing Assembly.

ix. Before fixing the bearing housing to the bearing bed, the Metallic shims (part no.14) are to be provided. Normally the shims packed to 3-4 mm with 0.5mm MS/Copper sheets. Apart that adjusting screws with lock nuts (part no.7A) was also provided in bearing housing. (To adjust t the shaft assembly with Impeller).

x. Insert the Pump coupling to the Drive shaft (Drive end) and lock it by means of washer and locking screw.

**COLUMN PIPE ASSEMBLY**

i. Insert the split off coupling Rings (part no.18) with coupling nut (part 00.22) to the Drive shaft (pump end) (part no.16)

ii. Slip the coupling sleeve (part no.19) with key on the shaft. Tighten the coupling nut Over the sleeve and lock the group screws. Place the Drive column pipe (part no.17) with bearing bed (Gasket to be provided between bearing, bed/ column pipe &. column pipe/star support) and bolt the star support (part no:.21) with intermediate bush bearing (part 00.20) which will slide on the coupling sleeve (part no.19).

iii. Slide the Line shaft (part no.24) into the coupling sleeve with coupling ring and coupling nut.

iv. Tighten the coupling nut and coupling ring with grob screws.

v. Place the line column pipe (part no.23) Over the star support with Gasket and tighten the bolts.

vi. Repeat this procedure according to the numbers of line shafts. For short setting heights, the drive shaft must already be installed instead of Line shaft.

vi. Place the pump shaft (part no.28) and pump column pipe (part no. 27)
i. Place the shaft sleeve (part 00.31) on the pump shaft (part no.28) with key.

ii. Place the side casing (Part no.33) with bush bearing (part no.32) over the Pump column Pipe (part no.27)

iii. Place the casing Cover (part no.34) and Impeller (part no.36) and tighten the Impeller nut (part no.37) with Gaskets between sleeve/Impeller, Impeller/Impeller nut (part no.39,40)

iv. By the adjustment of the adjusting screws in the bearing housing the rotor assembly can be moved up and down. With this aid keep the clearance between casing cover and Impeller (normally 2 to 3mm)

v. Mount the casing (part no. 35) over the casing cover with a Gasket (part no.41)

Care should be taken so that orientation of the delivery of the casing should suit the sole plate. Then check up the Free rotation of the rotor assembly. Tight the lock nut (part no.7A) provided in Adjuster screw.

vi. It is important to position the Impeller correctly in relation to the casing. No rubbing can be allowed with side walls or front walls of the casing. This can be avoided by the adjusting the screws in bearing housing

Laying the connecting piping:

GENERAL:
The diameters of the piping are not determined by those of the pump branches. On short delivery pipe runs the diameter should be such that the pipe resistance constitutes but a small portion of the delivery head, for long pipe runs the most economic pipe diameter must be assessed in each particular case.

Abrupt changes in pipe cross sections and sharp bends should be avoided.

Once the flange bolts have been loosened. The flanges must not yield more than the amount corresponding to the gasket thickness nor must they be out of the parallel nor bear against each other under stress. See that the flange gaskets do not extend into the bore of the piping. Clean carefully all pipe parts and fittings prior to assembly.

As the pump branches should not absorb pipe forces and moments, the pump must not be used as a locating point of the pipe work.

Caution: After connecting up the piping, the pump alignment must be re-checked, as the set may have been distorted. It must be possible to turn the rotor easily by hand. In Case of inadequate alignment, bearings, coupling, shaft seal (in the case of VR. design) and wear rings may get damaged prematurely.

FEED LINE: (FOR VR Design ONLY)
The isolating valves in the feed line must remain fully open during operation and must NEVER be used for regulating.
DELIVERY LINE

Install a gate valve or an output control valve in the delivery line as close to the pump branch as possible. As a matter of principle, it is recommended to place a non-return valve between the pump branch and regulating valve, thus protecting the pump branch and regulating valve, thus protecting the pump against reverse rotation and water hammer which may occur in case of sudden shut-down.

STARTING-UP AND STOPPING:

PRECAUTIONS TO BE TAKEN BEFORE OPERATION

Packing of the stuffing Box (For YO + RW) design only. The pumps are delivered by us with the stuffing box unpacked. Cut the individual packing rings from the packing plait supplied to suitable length using a gauging plug of the same diameter as the shaft protecting sleeve. The cut pieces must not be too long.

A gap of 1 mm between the joints after fitting will, in any case, prove less detrimental than squeezing too long pieces together. When installing the packing rings the joints of two consecutive rings must be staggered.

Sequence of installation of the packing rings and lantern ring:

1. packing ring - lantern ring - 3. packing rings.

The gland must not be tightened too firmly because otherwise the packing and the shaft sleeve may get damaged. Make sure that the gland is not tightened unevenly and does not rub on the shaft sleeve. The shaft must turn easily by hand.

Lubrication of bearings by external water (fresh water) (for VO + RW design with external water lubrication only)

The sleeve bearings of the shaft assembly and the sleeve bearing in the pump must not run dry. Thus the external water lubrication must be switched on before starting the set.

CHECK OF DIRECTION OF ROTATION

The direction of rotation must correspond to the direction arrow to the sole plate. For checking the direction of rotation the motor may be started for a moment only. It is always better to remove the motor separately from the pump and check the direction of rotation.

STARTING-UP:

The regulating valve in the delivery line should be closed or, in the case of automatic operation, the full back pressure should be on the non-return valve.

Once the pump has run up to working speed, open the regulating valve in the delivery line slowly until the required service data of the pump are reached. Prolonged operation against closed regulating valve in the delivery line may lead to destruction of the internal pump parts and must therefore be avoided.

For YO (wet pit installation) see that the lowest admissible liquid level in the pit (minimum submergence) is maintained during starting-up as well as during operation. The required minimum submergence prevents vibration and thus damage to the set - which may occur: due to the formation of air entraining vortices which may extend as far as the interior of the pump.
In case of VR (dry pit installation) tighten gland at first only slightly for running-in even if the leakage is greater than what is normal. After a certain running-in period the gland should be tightened evenly until there is only slight leakage from the stuffing box.

An alteration of the service data of the pump which might become necessary may be effected only, with the aid of the regulating valve in the delivery line.

Particular care should be taken that:

a. The driver does not get overloaded if the specific weight of the liquid handled is greater than that originally provided.

When starting-up automatically operated plants, all isolating valves, hence the delivery gate valve too, must be kept open.

STOPPING:

If there is no back-flow preventer (a 'swing' type or 'lift' type or other check valve) close the regulating valve in the delivery line. Do not switch off driver until then.

Close isolating valve in the feed line only if necessary.

RE-STARTING:

Before re-starting the set, take care that pump shaft does not rotate back rotating in opposite direction may lead to wards. Starting with the shaft damage.

NON-REVERSE RATCHET:

All vertical pumps are provided with Non-Reverse Ratchet arrangements. This prevents wrong directions of rotation.

SUPERVISION AND MAINTENANCE OF THE INDIVIDUALLY LUBRICATION ROLLING CONTACT BEARINGS:

Bearings in the motor pedestal (for all, variants) Intermediate bearings for variant VRT (dry pit Installation).

BEARING TEMPERATURE.

The Bearing temperature must not exceed 80°C.

RE-GREASING (INTERVALS).

Re-greasing, using a grease gun, through the grease nipples. During regreasing there is always the risk of dirt entering the bearing space. Care should be taken that grease container and greasing devices are clean and that the lubricant will not be contaminated when transferred into another container.

Lubricating intervals at pump speed:

<table>
<thead>
<tr>
<th>Speed</th>
<th>Operating Hours</th>
<th>Operating Hours</th>
<th>Operating Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 l/min.</td>
<td>Every 2500</td>
<td>1800 l/min.</td>
<td>Every 2000</td>
</tr>
<tr>
<td>1800 l/min.</td>
<td>Operating</td>
<td></td>
<td>Operating</td>
</tr>
<tr>
<td>3000 l/min.</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Lubricating quantities – Lubricants:

When installing the rolling contact bearings with a fresh grease charge, the
Hollow spaces of the-rolling contact bearings shall always be completely filled with grease the housing space on both sides, however, only be filled one third.

If the bearings are over greased (too much grease in' the bearing) there is the danger of hot running.

As lubricating grease a lithium soap high quality bearing grease shall be used which is free from resins and acids and which shall have, a rust inhibiting effect.

Grease properties

<table>
<thead>
<tr>
<th>Consistency No.</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work penetration</td>
<td>(265-295)</td>
</tr>
<tr>
<td>Usable temperature</td>
<td>upto 100°C</td>
</tr>
<tr>
<td>Dropping point not below</td>
<td>160°C</td>
</tr>
</tbody>
</table>

**SUPERVISION AND MAINTENANCE OF THE PACKED STUFFING BOX:**

**FOR VRT DESIGN ONLY:**

In order to dissipate the friction heat on the sealing surface a packed stuffing box must always drip slightly. Should, however, the leakage increase too much and should it not diminish when evenly tightening the gland, the packing must be renewed.

The installation of the new packing 1-sto be done 'with special attention to the following points:

a. The surface of the shaft protecting sleeve must be in perfect condition, otherwise the shaft ‘protecting’, sleeve must be changed.

b. The old packing must be completely' removed as otherwise' the running faces of the shaft protecting sleeve 'will get damaged within short ti me in spite of the new packing.

c. The quality of the packing material used must suit the operating conditions.

**DISMANTLING AND ASSEMBLING**

If the set has been maintained and serviced carefully, breakdowns which necessary date the dis mantling should not occur.

If, however faults occur, the cause should be located before dismantling, if possible.

If technical persons are not available, we recommend that you request the service of an erection engineer or dispatch the set to, our works for checking.'

If the set is being stripped by yourselves, all parts must be handled with greatest care, avoiding blows and shocks

All parts must be carefully cleaned, tested for wear and, if necessary, reconditioned or replaced with new parts.

When assembling the pump take into account the pump section drawing. After assembly, the rotor must turn easily by hand. Otherwise the bearings coupling, shaft' seal and wear rings opposite the impeller may get damaged prematurely.
<table>
<thead>
<tr>
<th>SL.NO</th>
<th>TROUBLE</th>
<th>CAUSE - REMEDY NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pump does not deliver</td>
<td>1 7 8 10 11 15 16 17 18 19 20 24 26 68 69 70</td>
</tr>
<tr>
<td>2</td>
<td>Pump delivers at reduced capacity</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 68 69 70</td>
</tr>
<tr>
<td>3</td>
<td>Delivery performance reduced</td>
<td>1 3 7 9 10 11 12 14 15 20 21 22 23 24 59 65 69</td>
</tr>
<tr>
<td>4</td>
<td>Pump delivers too much</td>
<td>17 68 69 70</td>
</tr>
<tr>
<td>5</td>
<td>Delivery is interrupted</td>
<td>1 3 6 7 8 9 10 11 12 13 14 15 16 17 20 23 24 26 27 68 69 70</td>
</tr>
<tr>
<td>6</td>
<td>Pump runs in reverse direction</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>Very noisy</td>
<td>1 2 5 6 7 8 11 12 14 16 20 21 23 66 67 68 69</td>
</tr>
<tr>
<td>8</td>
<td>Unsteady running of pump</td>
<td>20 21 23 33 34 35 38 39 41 42 43 47 48 49 50 51 52 53 54 55 56 57 58 63 66 67 70 76 77</td>
</tr>
<tr>
<td>9</td>
<td>Pump casing not leak-proof</td>
<td>52 54 59</td>
</tr>
<tr>
<td>10</td>
<td>Excessive leakage _from /Stuffing Box</td>
<td>21 25 28 29 30 32 33 52 55 56 57 65</td>
</tr>
<tr>
<td>11</td>
<td>Pump rotor blocked in standstill position</td>
<td>23 49 52 53 54 58</td>
</tr>
<tr>
<td>12</td>
<td>Pump is heating up and seizing,</td>
<td>23 24 25 26 27 28 29 30 32 43 49 52 53 54 55 56 57 58</td>
</tr>
<tr>
<td>13</td>
<td>Bearing temperature increase</td>
<td>20 21 22 23 33 34 35 37 38 39 41 42 43 47 48 49 51 52 53 54 55 56 57 63 66 67 70</td>
</tr>
<tr>
<td>14</td>
<td>Lubricating water pressure drops/increases</td>
<td>33</td>
</tr>
<tr>
<td>15</td>
<td>Motor will not start</td>
<td>15 23 72</td>
</tr>
<tr>
<td>16</td>
<td>Motor is difficult to start</td>
<td>15 17 23 28 29 49 51 52 53 54 58 70 71 72</td>
</tr>
<tr>
<td>17</td>
<td>Motor is running hot or burning out</td>
<td>15 17 23 28 29 58 67 68 70 71 72 73</td>
</tr>
</tbody>
</table>
CAUSE - REMEDY

1. Suction filter, foot valve clogged
2. Nominal diameter of suction line too small
3. Inlet casing does not reach far enough into the delivery liquid
4. Ground clearance of inlet casing too narrow
5. Too many bends in the suction line
6. Shut-off valve in the feed line in unfavorable position
7. Incorrect layout of suction line (formation of air pockets)
8. Valve(s) in the suction and/or feed line not fully open
9. Screwed joints or flanges in the suction line not leak-proof
10. Ingress of air via leaking valves and fittings in the suction line (Stuffing box, etc.)
11. Suction lift too great, water level in pit too low
12. Available NPSH too low (difference between pressure at suction branch and vapor pressure too low)
13. Cut-out level for starter too low (in automatic plants)
14. Delivery liquid containing too much gas and/or air
15. Delivery liquid too viscous
16. Insufficient venting.
17. Speed too high (number of revolutions of driver higher than nominal number of revolution of pump)
18. 'Speed too low (number of revolutions of driver higher than nominal number of revolution of pump)
19. Incorrect direction of rotation (electric motor incorrectly connected, leads on the no mina( board inter changed)
20. Impeller clogged
21. Impeller damaged
22. Wear rings worn.
23. Separation of crystals from the delivery liquid (falling below the temperature limit/equilibrium temperature.
24. Sealing liquid line/ circulation line clogged
25. Sealing liquid contaminated.
26. Lantern ring in the stuffing box is not positioned below the sealing liquid Inlet.
27. Sealing liquid omitted.
28. Packing incorrectly fitted
29. Gland tightened too much/slanted
30. Packing material not suitable for operating conditions
31. Shaft sleeve/shaft worn in the region of the packing
32. Bearing worn out
34. Insufficient lubrication of bearings (also in case of automatic lubrication)
35. Grease lubricating 'line' broken
37. Rolling contact bearings over greased
38. Grease quality unsuitable
39. Rolling contact bearings incorrectly fitted.
41. Bearings dirty
42. Bearings rusty (corroded)
43. Axial thrust too great because of worn wear rings and/or back vanes, obstructed relief holes.
47. Alignment of coupling faulty or coupling loose
48. Elastic elements of coupling worn
49. Foundation incorrectly petrol med
51. Motor pedestal incorrectly aligned
52. Pump casing under stress
53. Insufficient alignment of the support pipe
54. Pipe work under stress.
55. Shaft runs untrue
56. Shaft bent
57. Rotor insufficiently balanced.
58. Rotor parts touching the casing
59. Unsuitable casing seal
63. Vibration of pipe work
64. Non-return valve sticks
65. Contaminated delivery liquid.
66. Delivery flow too small
67. Delivery flow too great
68. Pump unsuitable for parallel operation
69. Type of pump unsuitable.
70. Pumps incorrectly rated.
71. Voltage too low / power supply over loaded.
72. Short circuit in the motor.
73. Setting of circuit –breaker for motor too high.
76. Causes attributable to driver.
77. Structure has not been properly investigated in respect of statics and vibrations.
<table>
<thead>
<tr>
<th>Component Name</th>
<th>Part No.</th>
<th>COMPONENT INSTALLED IN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VO+ TCH</td>
</tr>
<tr>
<td>Impeller</td>
<td>24</td>
<td>x</td>
</tr>
<tr>
<td>Gasket</td>
<td>39</td>
<td>x</td>
</tr>
<tr>
<td>“O” Rings</td>
<td>35,36,37,40&amp;41</td>
<td>x</td>
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<tr>
<td>Packing/Felt seal</td>
<td>43</td>
<td>x</td>
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<tr>
<td>Wear Ring</td>
<td>38</td>
<td>-</td>
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<tr>
<td>Shaft Sleeve</td>
<td>13</td>
<td>x</td>
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<tr>
<td>Wear Plate Sleeve</td>
<td>21</td>
<td>x</td>
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<tr>
<td>Bush Bearing</td>
<td>12</td>
<td>x</td>
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<tr>
<td>Wear Plate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction Side</td>
<td>30</td>
<td>-</td>
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<tr>
<td>Delivery side</td>
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</table>