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GENERAL

It is neceessary that this Operating Instruction Manual is carefully read and understood by the person, who will be working on this pump set.Procedure laid down in this Manual should be strictly adhered so that risk of personal injury or damage to the equipment (particularly pump) is avoided.

We recommend that the erection and commissioning of the pump set is either done by KSB's Service Engineer, or at least under the supervision of our Service Engineer. When the erection and commissioning is done by our Service Engineer we guarantee the satisfactory performance and safety of the installed pump set.

YOU MUST CONFIRM TO ALL SAFETY REGULATIONS RELATED TO

- handling large pump set during transport, installation, assembly and dismantling.

PAY PARTICULAR ATTENTION TO THE CENTER OF GRAVITY

- operating this pump set high pressure, speed and temperature.

FAILURE TO COMPLY WITH THESE REGULATIONS CAN RESULT IN PERSONAL INJURY AND DAMAGE TO THE EQUIPMENT.

Centrifugal pumps will give satisfactory service if they are carefully installed and maintained.

The instructions in this Manual refer to the particular pump supplied under the order. The Manual does not cover all design details or possible eventualities which might occur during installation, operation or maintenance, nor local safety regulations.

The type series, size, main operating data and serial number are shown on the nameplate on the pump. For any information or instruction not given in this Manual, contact your nearest KSB office.

The pump should not be opened during the guarantee period unless a specific written authorisation is obtained in advance from KSB. If repairs do become necessary please contact KSB and request the visit of one of our Service Engineer.

ALL MEASURING INSTRUMENTS SUPPLIED WITH THE PUMP, SHOULD BE CALIBRATED BEFORE COMMISSIONING OF THE PUMP SET.

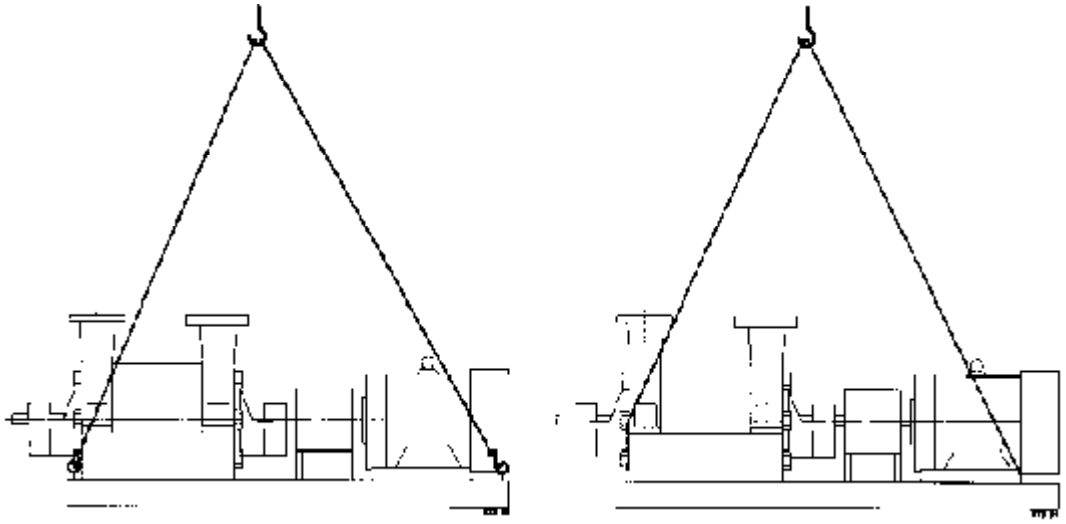
CAUTION

The pumps equipped with plain bearings and ring oil lubrication, should under no circumstances be kept running (e.g. idling speed for turbine drive) below 800 rpm. At lower speeds, lubricating ring will be ineffective to supply the oil to bearings, resulting into damages to bearings.

Set points, wherever conveyed through OPERATING INSTRUCTION MANUAL, of the instruments are only as guide line, and final values are to be set on the site as per observations and requirements.

Handling

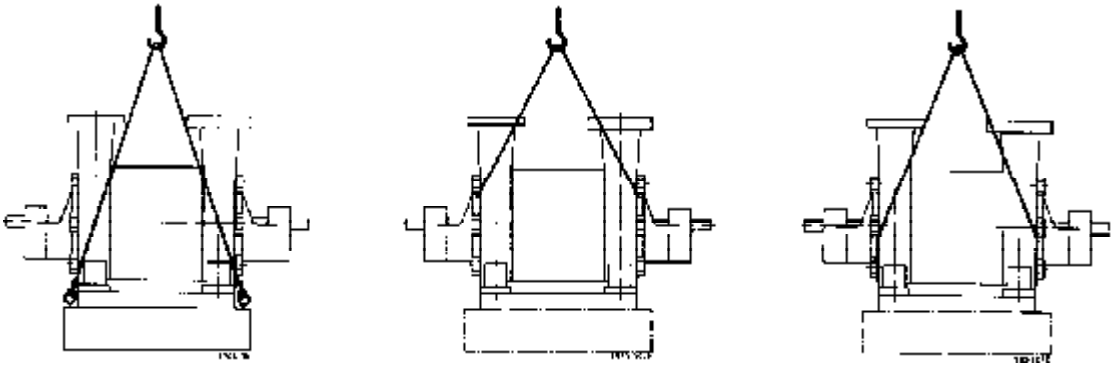
If the pumping set is supplied as a complete unit bolted onto a combined baseplate, the hoisiting ropes should be slung as illustrated in Fig. (and not through the eyebolt of the driver).



Pump and driver mounted on combined baseplate

In case of bare pumps or pumps mounted on a short baseplate, the hoisting ropes should be attached as illustrated in Fig.

Caution :
Do not sling the ropes under the shaft stub ends or under the bearing housings of the pump.



Pump mounted on short baseplate

PROCEDURE FOR LEVELLING & GROUTING OF BASE FRAME AT SITE
(FOR HDA / HDB / HG / CHT PUMPS ONLY)

PURPOSE :

High speed rotory equipment needs to be installed with maximum contact area between base frame and the foundation. To achieve this conventionally, blue matching procedure is adopted between packer plates and foundation. This calls for skilled millwright fitters to work on and consumes lot of time. Despite this, the contact area achieved is nowhere near 100%.

Therefore, the following procedure is recommended which ensures :

1. Nearly 100% contact area between the foundation, the packer plates and the base frame.
2. Considerable saving in time and manpower.

PREPARATION :

The following preparation is followed, in case the base frame and the packer plates (equal to the number of foundation bolts) are in scope of KSB. Otherwise, the user is requested to follow the preparation as under :

- The base frame is provided with the pads, which are welded at the bottom, machined in one setting and drilled to 15 mm. Dia. (Ref. Fig. 1).
- Machined packer plates, having 0.02 mm. face parallality, and of the dimensions equal to the welded pads at the bottom of the base frame, are required with tapping of M 10. These packer plates are to be bolted with pads at the bottom of the base frame, using M10 bolts (Ref. Fig. 2 & 3).

PROCEDURE :

01. Bolt the pump on the base frame.
02. Bolt the packer plates on the bottom pads of the base frame.
03. Place the unit on the foundation.
04. Suspend foundation bolts into the pockets provided on the foundation blocks.
05. Level the pump on the delivery flange or feet, within 0.04 mm. per meter, using jacking bolts pro vided at the corners of the base frame.
06. Grout the foundation bolts and the packer plates by using quick setting non-shrink cement, ACC make ‘Shrinkkomp’ or Forsoc make ‘Cobextra-GP2’ or equivalent (Ref. Fig. 4).
07. Allow curing time of 24 to 72 hours depending upon the grout used.
08. Remove M 10 bolts, which are holding packer plates with the base frame.
09. Carry out final levelling by inserting shims (SS shims preferred) between packer plates and the base frame.
10. Tighten the foundation bolts and recheck the levelling. Correct it, if necessary.
11. Grout the complete base frame, including the hollow portion, if any, using conventional grouting mix, i.e., portland cement, sand and aggregate in proportion 1 : 2 : 2 and gravel size not to exceed 20 mm.
12. Plaster the foundation and apply suitable oil resistant paint.

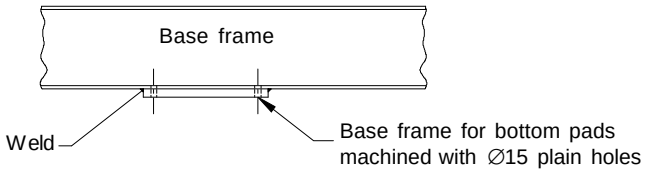


Fig. 1 : Base frame bottom pad

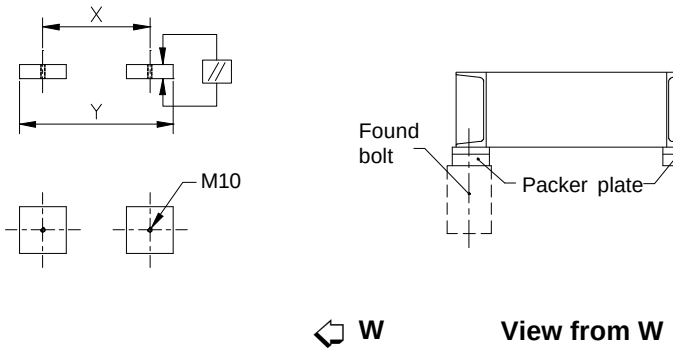


Fig. 2 : Packer plates in pairs, machined for for base frame with channel

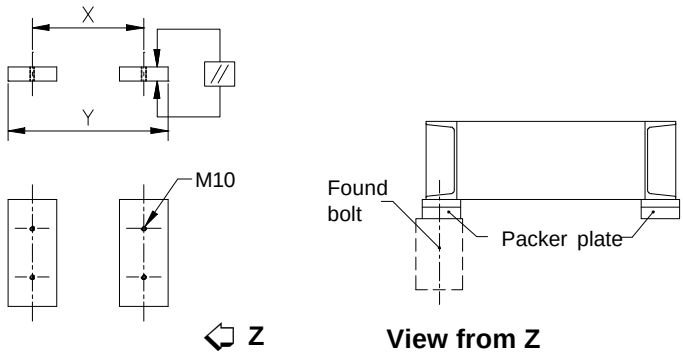


Fig. 2A : Packer plates in pairs, machined for base frame with double channel / I beam

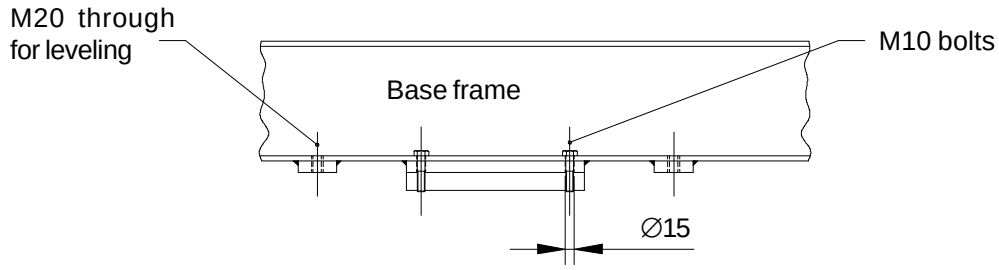


Fig. 3 : Clamping of packer plate and bottom pads with M10 bolts

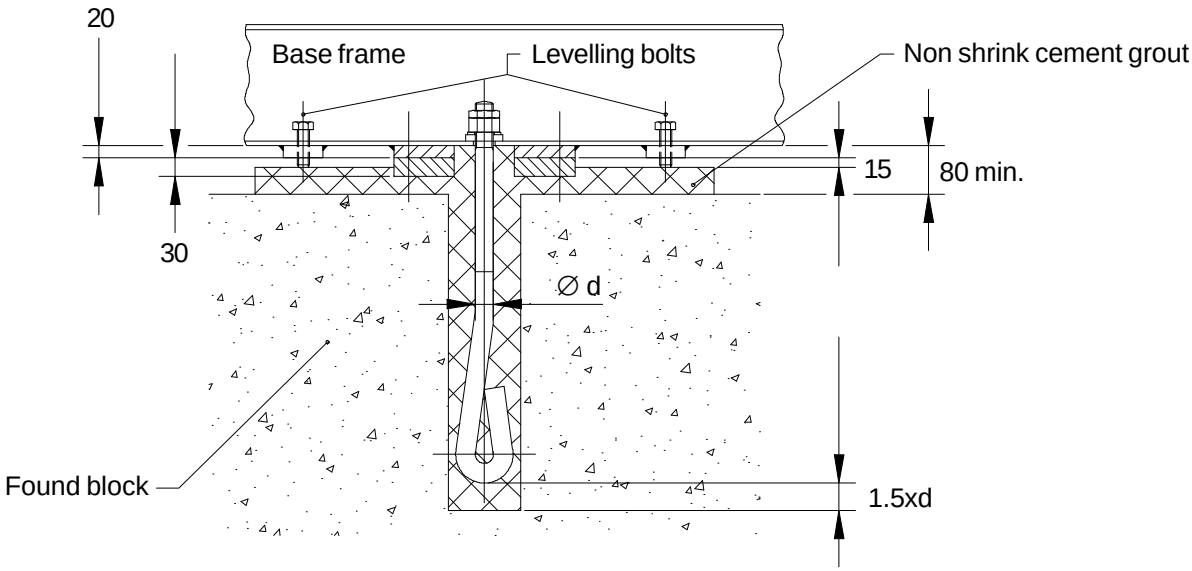


Fig. 4 : Grouting of packer plate

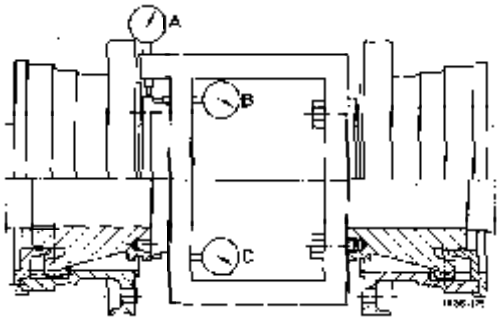
Note : The foundation to be made of concrete on solid ground. Foundation bolts and packer plates to be grouted with non shrink grout only. Balance hollow portion of base frame to be grouted with portland cement sand and aggreegate in preparation 1:2.2 Gravel size should be < 20 mm. After final grouting all surface should be finished with fine plaster and apply oil resistent paint.

Alignment the Pump and Driver

The pumpset can be considered correctly aligned when the gap between each shaft and a straight edge placed axially over the two half couplings is the same at all points on the circumference. Check this using a dial indicator (See fig.).

Caution !

When mounting and aligning the pumpset make allowance for any level misalignment resulting from the driver warming up.



Aligning a spacer coupling using a dial indicator (example)

The axial and radial deviation between the two half couplings must not exceed 0.04 mm.

Checking the Direction of Rotation of the Driver with a non-primed pump

Prior to starting up the pump, check the driver's direction of rotation. If no rotary field indicator is available, disconnect the driver from the pump and check the direction of rotation.

Checking the Direction of Rotation

- Warning :
- Ensure that the motor cannot be inadvertently switched on (risk of accident).
- Dismantle spacer sleeve of the coupling.
- Startup the motor, run it briefly, shut it down.
- Check the direction of rotation; if it is wrong, have the terminals changed over by an electrician and then re-check the direction of rotation.
- Note : Suitably mark the connections in the terminal box.
- Warning :

  Until startup, ensure that the motor cannot be inadvertently switched on (risk of accident).
- Carry out final alignment of the coupling and connect it up.
- Fit coupling guard resp. cladding.

Connecting the Piping

Never use the pump as an anchorage point for the piping.

The suction line should be run with a dropping slope towards the pump. The pipes should be supported very near the pump and should be connected to the pump without transmitting any stresses and strains to it. The pump must not bear the weight of the piping. The nominal bores of the pipes should be the same as or greater than those of the pump nozzles.

We recommend installing non-return valves and shut-off valves, according to the type of installation. Thermal expansion of the pipework should be accommodated by suitable means so as not to impose any extra load on the pump.

Forces and Moments

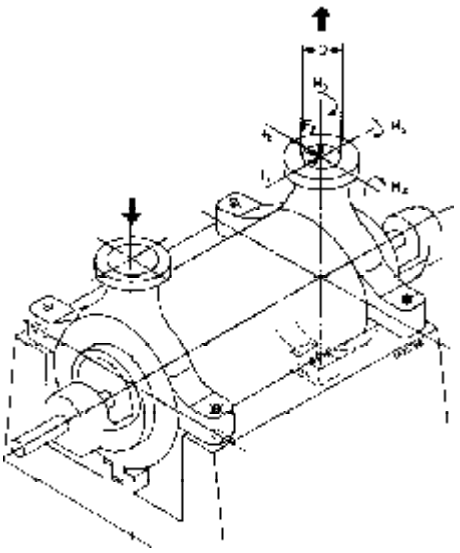
The piping forces and moments do not generally reach levels where the pump would be subjected to excessive mechanical loads.

Recalculation is not necessary provided the piping forces and moments lie within the values given in the appendix.

Dimensions : F in N
M in Nm
DN in mm

Forces and moments can simultaneously affect discharge and suction nozzles.

The suction and discharge nozzles are to be considered separately.



Fx, Fy and Fz indicate the directions in which the forces act, as follows :
Fx = horizontal parallel to the pump axis
Fy = horizontal at right angles to the pump axis
Fz = vertical to the pump axis

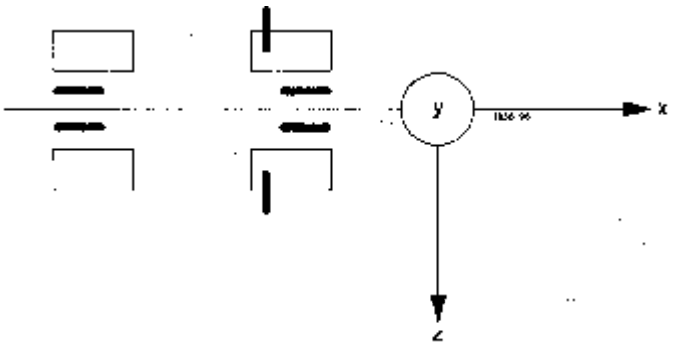
Mx, My and Mz indicate the directions in which the moments act, as follows :
Mx = around a horizontal axis paralel to the pump axis
My = around a horizontal axis at right angles to the pump axis
Mz = around the vertical nozzle axis

DN = normal diameter of the suction/discharge nozzle

Dowelling the Pump

In order to ensure that the alignment of the pumping set will not be altered unduly after the pipelines have been connected and have warmed up, which might cause the pump to run rough and might lead to excessive wear of the pump and coupling, the pump should be dowelled on the baseplate as shown in the following figure. The pump should be dowelled a new after every dismantling operation.

The maximal admissible forces and moments at the pump nozzles as shown in the Technical Appendix must not be exceeded by the dowelling operation.



Dowelling the pump on the baseplate

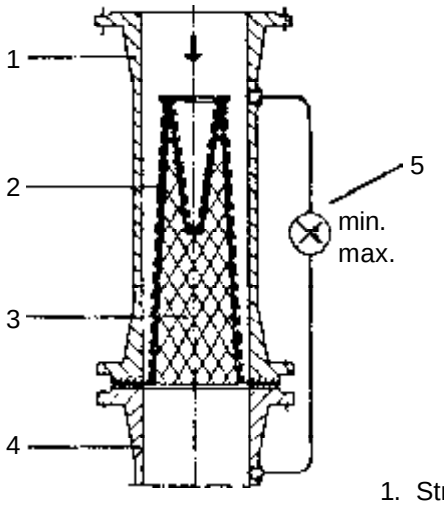
Strainer in the Suction Line

Before commissioning a new installation, thoroughly clean, flush and blow through all vessels, piping and connections. As welding beads, scale and other impurities frequently only become dislodged after a certain period of time, it is necessary to fit a strainer in the suction line, as close as possible to the suction nozzle, to stop these entering the pump. The total cross-section of the holes in the strainer should be three times the cross-section of the piping to prevent excessive pressure loss across the strainer caused by clogging. The pressure drop in the line must not exceed 3 m. We recommend the provision of Differential Pressure Gauge / Differential Pressure Switch, to monitor this pressure drop.

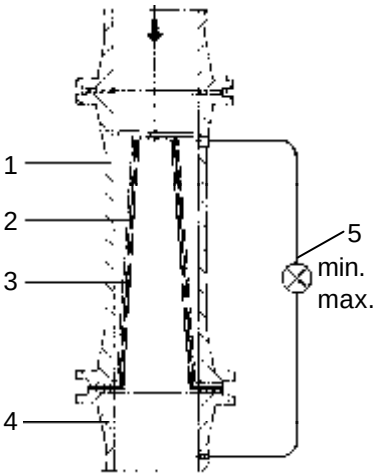
The conical strainer consists of a coarse strainer fronted by a fine strainer made of corrosion resistant material to DIN 4189 for :

Mesh width 0.5 mm
Wire diameter 0.25 mm

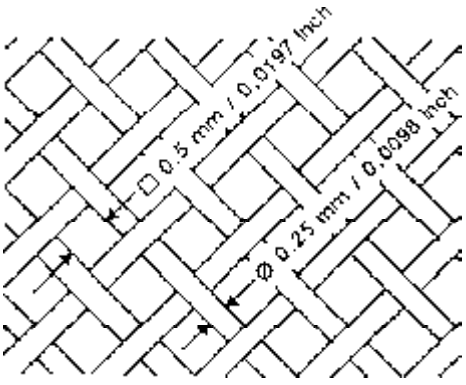
Above DN100



Upto DN100



1. Strainer holder
2. fine strainer
3. Coarse strainer
4. Pump suction nozzle
5. Differential pressure gauge (△ p - gauge)



Conical strainer with pressure monitoring (example)

Auxiliary Connections

The size and location of all auxiliary connections (e.g. cooling liquid, balance liquid etc.) are shown in the installation plan.

Minimum Flow Qmin

Minimum flow circulation by means of an automatic recirculation valve. If this is provided to your pump see seperate Operating Instructions.

Balance Liquid

The flow velocity in the balance liquid line should on no account exceed 5 m/s. If the balance liquid is led back into the suction vessel, the pressure of the balance liquid must be at least 0.5 bar higher than the suction pressure at the pump inlet, and the permissible damping pressure must not exceed 2.5 % max. of the pump discharge pressure.

If the balance liquid is led back into the suction vessel and the length of the balance liquid line exceeds 10 m, the return line should be sized one nominal size larger.

For connections 14A and 14E refer to the sectional drawing in the appendix.

Coupling Guard / Coupling Cladding

Safety regulations stipulate that the pump must be fitted with a coupling guard or a coupling cladding.

Commissioning, Shutdown

Preparations for Commissioning

Alignment

Re-check alignment. It must be possible to turn the rotor by hand at the coupling. If there are no deviations in alignment dowel the driver using cylindrical pins.

Lubrication

Check bearing and coupling lubrication and apply the required quantities of lubricant as stipulated. See Technical Appendix for details of lubricant grade and fill.

Shaft Seal

Check shaft seal. In case of gland packed pump, the gland packings are sent separately. The stuffing box / seal casing must be filled with these gland packings, in ring forms.

Priming the Pump and associated Checks

Vent and prime the pump and suction line before startup. The shut-off valve in the suction line must be fully open. Fully open also all auxiliary lines and check the flow.

Checking the Direction of Rotation with the Pump primed

The direction of rotation must match the arrow on the pump. Check this by switching the pump on and then off again immediately.

Warning : Prevent any contact of the non-guarded shaft stub by personal.

Fit coupling guard.

Precommissioning Checks

If commissioning takes place more than 5 months after the installation, the following checks must be repeated.

1. Ensure that the couplings are in perfect alignment.
2. The coupling casings of toothed couplings must be able to slide effortlessly in the axial direction.
3. Check the main piping is connected stress-free.
4. Check shaft seal.
5. Check operation of the measuring the monitoring equipment.
6. If the driver is an electric motor, check the direction of rotation with the pump primed by switching the pump on and then off again immediately. The direction must match the arrow on the pump.

   Warning : Present any untensional contact of the non-guarded shaft stub by personal.
7. Turbine drive : Follow start up instructions for the turbine, from Operating Instruction Manual of Turbine manufacturer.

Startup

Follow startup instructions of the driver !

a) Initial startup

Open the shut-off valve in the minimum flow line. Switch on the pump (motor) only if the discharge valve is closed.

Slowly open the discharge valve to obtain the required duty point after the pump has reached full speed. Check the pressure loss in the suction line by differential pressure measurements; this should not exceed 3 m.

b) Normal Operation

Switch on pump (motor).
Check the pressure loss in the suction line by differential pressure measurements; this loss must not exceed 3 m.

Shutdown

a) Normal operation

Switch off the driver checking that it runs down smoothly to a standstill.
It is essential that a non-return valve is fitted in the discharge line and that sufficient back pressure is available.

b) For overhaul

Close the shut-off valve in the discharge line.
Switch off the driver, checking that it runs down smoothly to a standstill.
Close the shut-off valves in the suction, minimum flow and supply lines.
Allow the pump cooling down, make it pressure-less and drain it.
In case of frost and/or of prolonged shutdown periods, the pump must be drained or otherwise suitably safeguarded against freezing.

MAINTENANCE

Supervision of Operation

The pump must run smoothly and evenly at all times.

The pump must never run dry.

Prolonged operation against a closed discharge valve (> 250 hours per year) must be avoided even if the Automatic Recirculation valve is installed. (Part-load cavitation, wear to the Recirculation valve internals).

Check the quality and quantity of the bearing and coupling lubrication as per details in Technical Appendix.

The temperature of the bearing housing may exceed ambient temperature by 50^0C, but should not exceed 80^0C.

The shut-off valves in the supply lines must remain open during operation.

For details of Shaft Seal monitoring see section Shaft Seal.

Check the suction pressure and temperature, the pump discharge pressure and temperature.

The suction and discharge nozzles of each pump should be equipped with a pressure gauge and thermometer having a suitable range for the pressure/temperature involved, plus a pressure gauge cock or valve.

Check cooling liquid flow and temperature.
The max. permissible diff. between inlet and outlet temperature is 10^0C.

We recommend recording this information in a logbook.

Standby pumps should be started up then immediately shut down once a week to keep them operational. Also check the integrity of the auxiliary connections.

Descriptions

Rotor position indicator

The axial position of the rotor, correspondingly the wear out of the balancing device is indicated by the rotor position indicator mounted on the discharge side of pump.

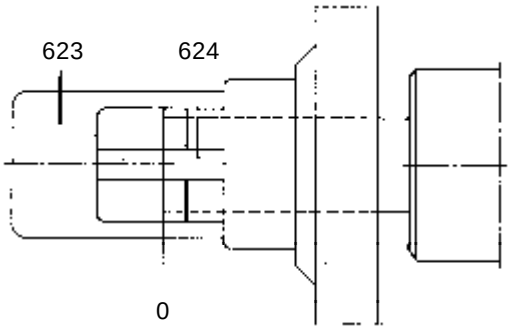
Rotor position indicator consists of the indicator bush (623.1) screwed on the bearing end cover, which is the stationary part, and the indicator (624) which is screwed in the shaft discharge end, which is the rotory part.

The bush has two scriber mark, at right angles to the shaft axis, which are 1.5 mm apart. The outer mark of this bush is aligned with the normal running position of the rotor, in the initial assembled condition.

During the running of the pump, as the balancing device wears out, the rotor begins to shift towards the suction side, which is indicated by the indicator shifting with respect to the outer mark on the indicator bush.

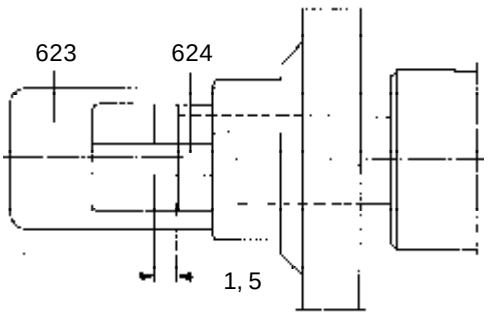
The spacing of 1.5 mm between the two marks on the indicator bush, corresponds to the maximum permissible wear out of the balancing device. As such, when the indicator indicates that the rotor is shifted by 1.5 mm towards the suction side, the pump should be stopped and the balancing device should be renewed.

Pump running normally



Rotor position indicator

Time to shut down the pump



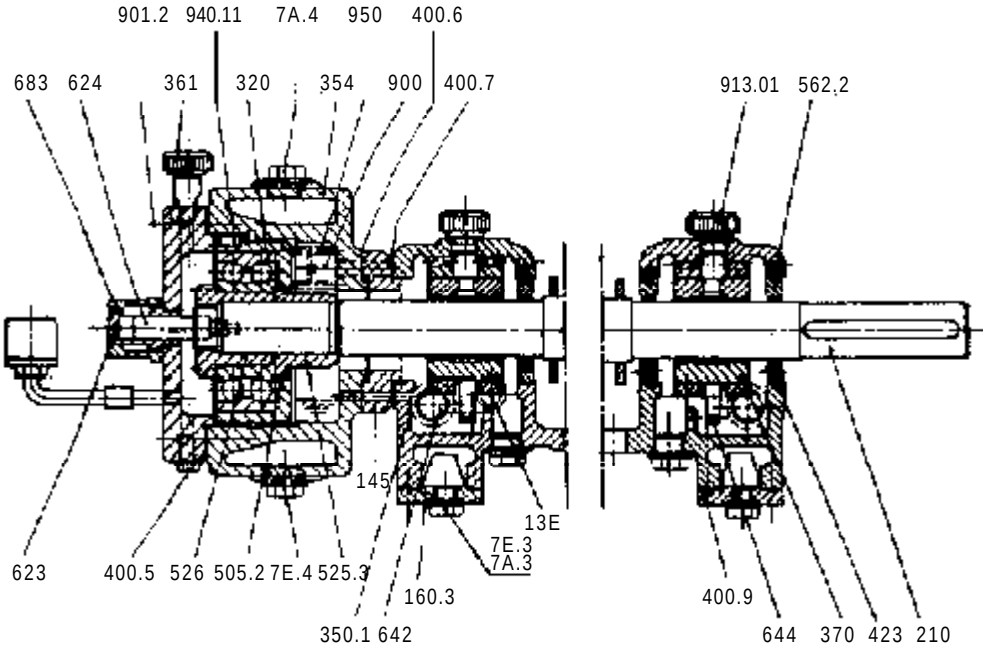
Rotor position indicator

Descriptions

Bearings

The shaft (210) is radially guided in two plain bearings (370). There is no need to take up the axial thrust because this is accomodated by the balance device (601 and 602). A lift-off device at the discharge end reliably disconnects the balancing disc from the counter balancing disc during low speeds, e.g. during startup or shutdown operation. Labyringh rings (423) prevent leakage liquid entering the bearing housings (350.01).

For bearing sizes refer to Technical Appendix.



Part No.	Part designation	Part No.	Part designation
145	Adaptor	562.2	Cylindrical pin
160.3	Cover	623	Indicator bush
210	Shaft	624	Indicator
320	Angular contact ball brg.	642	Oil level sight glass
350.1	Brg. Hsg.	644	Lubricating ring
354	Thrust Brg. Hsg.	683	Hood
361	Brg. end cover	900	Screw
370	Brg. shell	901.2	Hex. bolt
400.5	Flat gasket	913.01	Vent Plug
400.6	Flat gasket	940.11	Fitting Key
400.7	Flat gasket	950	Spring
400.9	Gasket	7A.3	Brg. Hsg. cooling liquid outlet
423	Labyrmth ring	7E.3	Brg. Hsg. cooling liquid inlet
505.2	Retainer ring	7A.4	Lift off device cooling liquid outlet
525.3	Spacer sleeve	7E.4	Lift off device cooling liquid inlet
526	Centering sleeve	13E	Pr. oil inlet

Lubrication

Plain bearings :

Ring oil lubrication. For oil requirement see Technical Appendix / Lubrication Chart.

Oil specification : Heavy duty grade oils acc. to ISO class VG 46, L-TD acc. to DIN 51 515 or similar qualities.

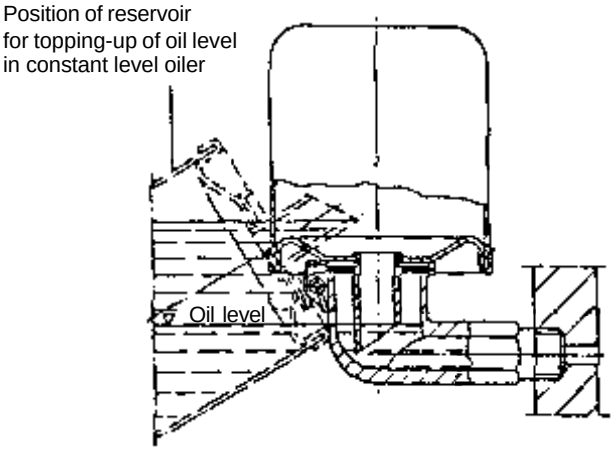
Lubrication Schedules and Oil Change : First oil change after about 300 hours of operation. Oil change after every further 8,000 hours or one year, whichever is the sooner.

Check of oil fill is via constant level oiler (638).

Lubrication

The bearings are ring-lubricated by oil. The lubricating ring (644) is immersed to a sufficient depth in the oil fill to ensure correct and adequate lubrication.

The necessary oil level in the bearing housing (350) is automatically attained by a constant level oiler (638). A labyringh ring (423) prevents any oil leakage between shaft and bearing housing. The bearing housing is to be vented by unscrewing the vent plug (913.01).



Constant level oiler

Procedure :

Unscrew vent plug (913.01). Turn down the constant level oiler (638). Pour in oil through the vent plug aperture after having hinged down the reservoir of the constant level oiler until oil appears in the vertical portion of the connection elbow of the constant level oiler (see fig.). Then fill the reservoir of the constant level oiler with oil and snap it back smartly into operating position. Screw vent plug in again. After a short time has elapsed, check whether the oil level in the reservoir has sunk. The reservior should always remain filled.

Caution :

The oil level should always be situated below the level of the vent slot arranged at the top edge of the connection elbow, and this slot should always be perfectly dry.

SHAFT SEAL

(Please refer cross sectional drawing of Mechanical seal for appropriate part numbers)

Mechanical seal :

In a mechanical seal, the sealing action takes place in the narrow axial clearance gap between the rotating seal ring and the stationary seal ring. The rotation of shaft generates a thin film of fluid between the rubbing faces of these two seal rings. The presence of this fluid film is vital for the length of life and operation reliability of the shaft seal. The film itself is influenced by the lubricating characteristics of the fluid pumped and by the effective removal of the frictional heat generated.

Mechanical seals of Burgman / Flowserve Sanmar / Eagle Poonawala can be provided. These seals are single acting, balanced. The sizes and the range of applications will be as follows.

Pump Type	**Size**	**Sizes of Mechanical Seal**		
		Burgman	**Flowerve Sanmar**	**Eagle Poonawala**
HDA/HDB	40, 50 65, 80 100	40 58 65	1.5/8” 2.1/2” 2.5/8”	-26 -40 -42
HDA	125	70	3”	-48
HDB	125	80	3.3/8”	-54

Range of Application		
Operating Temperature in ^{0}C	Recommended Seal Burgman / Flowserve Sanmar / Eagle Poonawala	Remarks
Up to 69	H75 Q1A VGG PTO EM5 – VV P13 NFAB Normal seat	Flushing by pumping medium w/o heat exchanger. API plan 11
70 – 130	H75 AQ12 VGG PTO EM5 – VV P13 NFAB Cooled seat	W/o circulation with seat cooling API plan 02
131 - 160	H75 Q1A VGG PTO EM5 – VV P13 NFABAPI plan 21 Normal seat	Flushing by pumping medium with heat exchanger (one per stuffing box)

The exact make / type of Mech. Seal and details of flushing plan are specified in Tech. Appendix.

In specific cases the seals in cartridge arrangement are offered

General Instructions and Notices

Warning !
Before commencing dismantling, make sure that the pump is disconnected from the power supply and cannot be switched on accidentally.

The isolating valves in the suction line and in the discharge line respectively must be closed. The pump casing must have cooled down to ambient temperature. The pump casing must be drained and pressureless.

Cooling liquid and oil pipes must be closed if the relevant pump components must be handled. The bearings and the oil supply lines upto the oil supply plant must also to be drained.

Remove coupling guard resp. coupling cladding. Disconnect the coupling and remove the spacer sleeve.

Dismantle the auxiliary piping as far as necessary.

Remove gland packing, if the pump is gland packed.

Check pump alignment at the coupling, and make a written note of the readings (see section ‘Alignment’).

Always refer to the relevant sectional drawing during dismantling and reassembly.

DISMANTLING

Dismantling the Pump (mark all parts)

Pump with Plain bearings

At Suction side

1. Pull coupling hub off the shaft using proper device.

At Discharge side

2. Unscrew and remove indicator bush from End bearing cover.
3. Loosen hex bolts (901.2) and remove End bearing cover (361).
4. Unscrew the bearing sleeve (526). Pull out the angular contact ball bearing (320) and retainer ring (505.2).
5. Remove spacer sleeve (525.3) and springs (950).
6. Remove screw (900.3) and take off thrust bearing housing (354), as well as adaptor (145).

At Suction & Discharge sides

7. Unscrew and remove nuts fixing the upper bearing housing (350.1).
8. Remove upper bearing housings (350.1).
9. Remove top bearing sheels (370), Lubricating rings (644) and bottom labgrinth rings (423).
10. Remove bottom bearing shells (370).
11. Unscrew nuts (920.2) of studs (902.1) on suction / discharge casings, and remove lower bearing housings (350.1).
12. Take off the splash rings (507.1).

Inspect the rubbing pattern in the bore and, if necessary remove any light pressure marks with scraper. Check the fits of the bearing shells (370) in bearing housings (350.1). When mounted in position the bearing shell should not be able to move in its seat. If the seat is too loose (i.e. if it is possible to move the bearing shell), the two joint faces of the bearing housing must be touched up evenly until the bearing shell can once more be clamped absoluting tight in its seat.

If new bearing shells are fitted, their seats should in principle be fitted in the manner described above.

SHAFT SEAL

Mechanical Seal

[Refer cross sectional drawing of Mechanical Seal, for appropriate Part Nos. & description]

1. Unscrew and remove allen head screws (914.3) and dismantle the seal cover (471.1/2) together with stationary seat ring.

Sizes 40 - 125

2. Pull out the complete rotating assembly of the mechanical seat parts.

Sizes 40 and 50

3. Unscrew and pull off shaft sleeves (523.1/2). Remember the right-hand and left-hand screw threads respectively.

Sizes 65 to 125

3. Remove circlip (932.3) and pull sleeve (520) and shaft protection sleeves (523.1/2) off the shaft.

4. Pull off spacer sleeve (525.1) on the suction side.

Sizes 40 to 125

5. Force and remove stuffing box housing (451) together with cooling cover.

Damaged shaft sleeves (523.1/2) and mechanical seal components should be replaced by new ones. In the event of relatively light score marks on the rubbing faces, the rotating seal ring and stationary seat ring can be sent back to the seal manufacturer for lapping.

CAUTION :

Never allow O'rings of EPR material (ethylene propylene rubber) to come into contact with oil or grease.

BALANCING DEVICE

Sizes 40 and 50

Pull balancing disc (601) off the shaft with the aid of an extractor.

Sizes 65 - 125

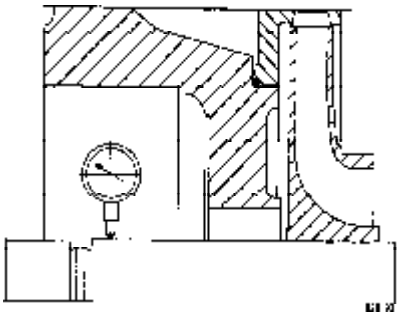
1. Pull off retainer ring (505.1) and remove split ring (501).
2. Pull off spacer ring (504.1).
3. Pull off balancing disc (601) with the aid of an extractor.
4. If necessary unscrew the fixing screws of counter balancing disc (602) and pull it out of the discharge casing (107), with the aid of an extractor.

Sizes 40 to 125

5. Pull spacer sleeve (525.2) on discharge side off the shaft.

NOTE :

If you do not intend to dismantle the body of the pump, measure the approximate total radial play. For this purpose, attach a dial indicator to a fixed support (e.g. flange or discharge nozzle) and place its tip against the seat of the balancing disc (See fig.). Carefully raise the shaft to its upper dead centre, ensuring that there is no additional sagging of shaft, as this could give an incorrect measurement. The measured clearance must not exceed 0.8 mm.; if it does, the pump must be dismantled and overhauled. The accurate rotor measurement is possible only if the pump is dismantled.



Determining the rotor clearance

Balance Device

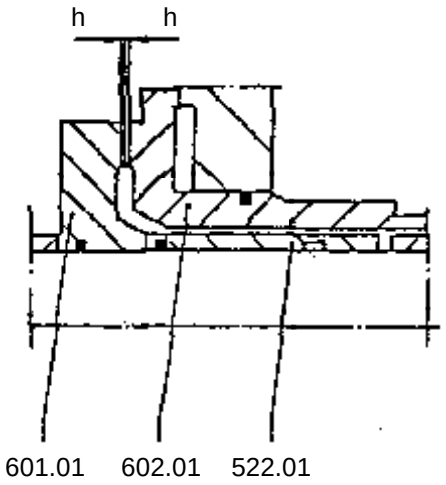
Check the balance disc (601.01), the counter balance disc (602.01) and the spacer sleeve (522.02) for damages.

If the balance disc (601.02) has touched the counter balance disc (602.01) remachine the faces on the lathe with mandrel, this ensures the contact faces are then sufficiently true in relation to the bores. (Max. remachining 2 h = 2 mm, see fig.). Individual grooves can be allowed to remain.

Remachining the balance device.

If remachining causes 2 h to be exceeded you must fit a new balance device (601.01, 602.01). The total thickness of metal removed from the balancing disc (601.01) and from the counter balancing disc (602.01) must also be machined off the spacer sleeve (525.02) in order to maintain the previous rotor position in relation to the pump casing. When doing so make absolutely sure that the plane parallelism of the two end faces of spacer sleeve (525.02) is not impaired. The bottom of the remachined balance disc (601.01) should not press against the key.

When eliminating fouling in the radial gap between the counter balance disc (602.01) and balancing disc (601.01) by machining, apply the clearance specified in the Technical Appendix.



Remachining the balance device

Pump Body

1. Loosen the nuts (920.01) on the discharge-side tie-rods (905.01) cross-wise until they are only slightly pretensioned.

2. Loosen holding down bolts on pump feet and lift the pump off the baseplate onto erection trestles.

2a. Remove the clading (680).

Note : Do not sling ropes under the pump shaft. Do not damage the sealing faces on the nozzles.

3. Unscrew nuts (920.01) on the discharge end of the pump and withdraw the tie rods (905.01).

4. Under pin the stage casings (108) with blocks of wood or a stand so that the next components are accessible.

5. Press discharge casing (107) together with diffuser (171) from the stage casing (108). Do not damage the seal faces.

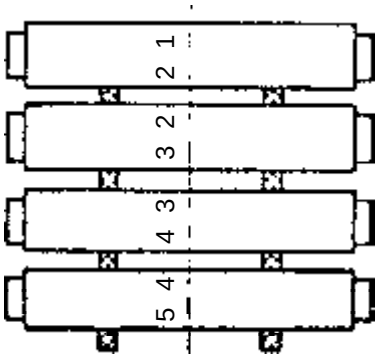
6. Pull last stage impeller (230) off the shaft.

Note : Before dismantling, match-mark the stage casings (108) so they can be reasembled in the same order and position (see fig.).

7. Remove the stage casings (108) together with the diffusers (171), stage sleeves (521) and impellers (230) of the following stages. The impellers (230) and stage sleeves are secured against twisting by a common key on the shaft (210) and are stamped with matching numbers.

8. After the first (suction side) stage casing (108) has been dismantled, draw the shaft (210) with first stage impeller (230) out of the suction casing (106). Then pull the impeller (230) off the shaft (210).

9. Stack the stage casings (108) carefully so that the seal faces cannot be damaged (see fig.)



Stacking the stage casings

Shaft (210)

Check true running between centres on a lathe. Max. permissible shaft whip : 0.03 mm. The shaft should neve be straightened either warm or cold. If the maximum permissible shaft whip is exceeded, fit a new shaft.

Caution :

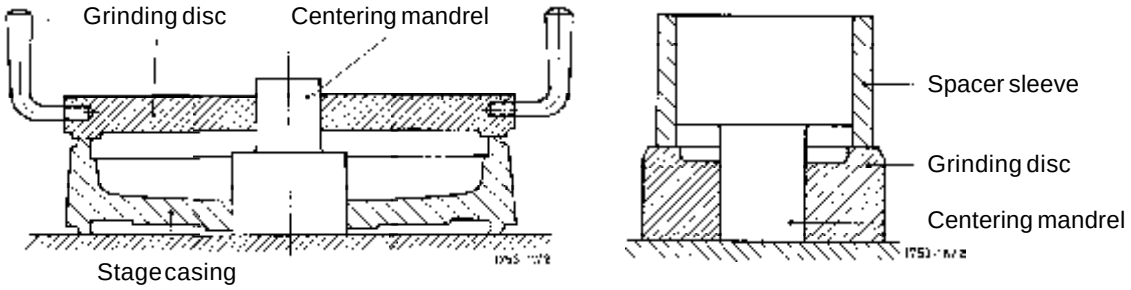
Make sure the shaft is accurately centred on the lathe as otherwise the readings will be inaccurate.

Suction (106), Discharge (107) and Stage Casings (108), Impellers (230.02), Spacer Sleeves (525.01/.02), Casing Wear Rings (502).

Check all seal faces are in perfect condition. Check the plane parallelism of the sealing faces at four points with a micrometer. The deviation should not exceed 0.02 mm. Touch up any damaged surfaces, preferably on a lathe. The surface roughness should not exceed 0.8 µm (superfinish turning). If damaged faces cannot be touched up on a lathe they may be reground.

The pump casing has been adapted to match the sag of the shaft. The mating sealing faces on two adjoining stage casings are machined in such a way that the gap between the sealing faces at the top is narrower by a given amount that the gap at the bottom. These stage casings are marked with the word ‘‘TOP’’ at the top end of the periphery, and with the identification number of the stage casing concerned. When touching up the sealing faces of these stage casings, this difference in dimensions between top and bottom must be maintained at all costs.

The grinding equipment consists of a grinding disc and centering mandrel. Always use a very fine grinding compound.



Grinding the sealing faces

Never regrind a sealing face by using its mating face on the next stage casing as a grinding block, as this would open out the centring spigot.

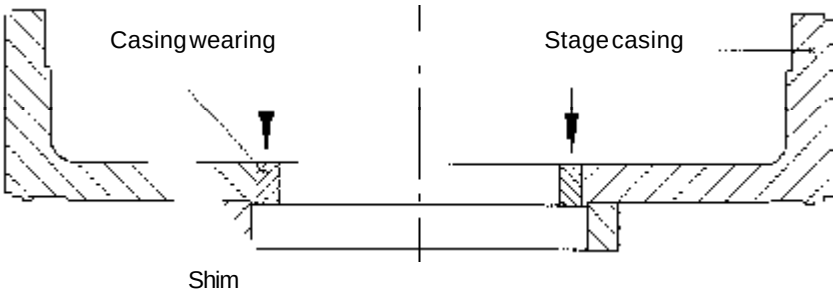
The stage casings (108) are equipped with renewable casing wear rings (502.02). Examine the wearing parts for signs of wear and check the rotor clearances as per Technical Appendix.

The wearing parts must only be remachined in situ within the max. permissible clearance limits. The increase in clearance caused by machining must also be adjusted at all the wear points in the pumps.

If the rotor clearances exceed the max. values given in the Technical Appendix new wear part must be fitted to re-establish ''as-new'' clearances.

Example : Renewing the casing wear rings (502).

1. Push the casing wear rings out of their seats taking care not to damage the seats (see fig.).
2. Press the new oversized wear rings into the bore (cooling the rings makes this easier).
3. Smooth down all impellers (230) in the region of the suction throttle section to a common diameter, basing this on the most heavily scored section. Individual deep grooves can be left untouched.
4. Calculate the average actual diameter of all smoothed down impeller wear rings. Adding this to the ''as new'' clearance as per Technical Appendix gives to bore diameter for the casing wear rings, tolerance + 0.04 mm.
5. Align the stage casing (108) and suction casing (106) with fitted casing wear ring to the outer fit and machine the wear ring in one machine tool setting.



Pushing out the casing wear rings

BALANCING THE ROTOR

Fitting new rotor components or remachining exisiting ones, means rotor has to be dynamically balanced.

Maximum permissible residual unbalance is 5 microns.

Assembly of rotor for dynamic balancing

Assembly from the suction side of the shaft.

Sizes 40 and 50

1. Insert key for first stage, and spacer sleeve (525.1) onto the shaft.

1.1 Screw shaft prot. sleeve (524.1) onto the shaft without O rings.

Sizes 65 to 100

1. Slip spacer sleeve (525.1) onto the shaft, insert key, slip shaft prot. sleeve (524.1) onto the shaft and fix it by means of circlip (932.3).

Size 125

1. Inset key, shaft sleeve (524.1) onto the shaft, and secure it with the circlip (932.3).

Sizes 40 and 125

2. Insert key for coupling hub in shaft (210) and mount coupling hub onto the shaft with the air of a pusher device.

Further Assembly from discharge side of the shaft.

Sizes 65 to 125

3. Insert key for first stage impeller (230/231) in shaft (210).

Sizes 40 to 125

4. Slip the impellers and stage sleeves of the following stages onto the shaft in their correct sequence. Then slip on spacer sleeve (525.2) and balancing disc (601) without O rings.

Sizes 40 and 50

5. Screw the shaft sleeve (524.2) onto the shaft and tighten it. Check that the axial clearance on the suction side [between first stage impeller (230) and spacer sleeve (525.1); alternately between spacer sleeve (525.1) and shaft prot. sleeve (524.1)] is 0.3 mm. If necessary, obtain this clearance by touching up spacer sleeve (525.1).

Sizes 65 to 125

5. Slip spacer ring (504.1) onto the shaft, insert split ring (501) into the shaft groove and secure it against falling out by means of retainer ring (505.1). Check that the axial clearance between impeller (230) and spacer sleeve is 0.3 mm. for sizes 65 to 100 & 1.0 mm for size 125.

5.1 Insert key in shaft (210), mount shaft prot. sleeve (524.2) without O ring and fix it by means of circlip (932.3).

NOTE :

In case the pumps are with segmental pads Lift off device, slip spacer sleeve (525.3) onto the shaft. Then insert key, slip thrust bearing plate (384) and spacer sleeve (525.4) onto the shaft, and tighten them with the bearing nut (920.8).

Sizes 40 to 125

6. Before dynamic balancing the rotor should be checked for run out at the impellers, stage sleeves, balancing disc and bearing seats. The maximum permissible run out 0.03 mm.

7. The rotor components are to be dismantled in the reverse order, prior to the assembly of the pump.

Assembly

Assembling the Pump

Assemble the pump in accordance with standard engineering practice. Coat the fits of the individual components with graphite or similar before assembly, and the same applies to the threads of screwed connections. Check all O-rings and oil seals for damage and renew if necessary.

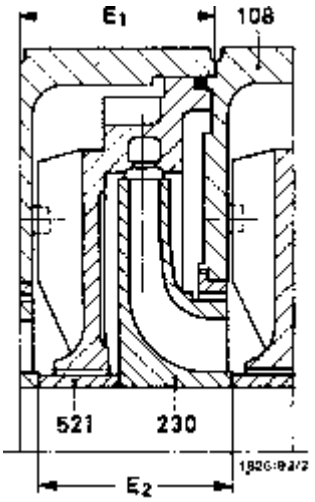
Note :

Always moisten O-rings before final assembly with silicon fulid or, if not available, with soapy water. Never fit dry O-rings.

Preparations

Prior to assembly, measure the axial length ''E'' of the stage casing (108) and the associated impeller (230) and stage sleeve (521). Any differences in length must be compensated for solely by machining the stage sleeve (521) so that $E_1 = E_2$ (see fig.).

If remachining is necessary, reduce the length of the stage sleeve at both end faces in a single machine tool setting. The permissible deviation from absolute plane parallelism is 0.05 mm.

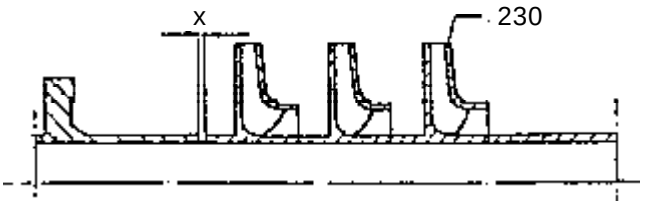


Measuring the stages

Check the axial clearance of the rotor components (x) before mounting the rotor (see fig.).

x = 0.3 mm for HDA 40-100 and 1.0 mm for HDA 125.

Value of 'x' to be ensured as above by machining (if required) the spacer sleeve (525.1), in case of size 40 and 50.



Axial rotor clearance

ASSEMBLING THE PUMP

1. Coat shaft (210) with molybdenum disulphide or a similar approved liquid.

Sizes 40 and 50

1. Insert key for first stage Impeller, slip spacer sleeve (525.1) onto the shaft, tighten the shaft sleeve (524.1) together with O ring (412.5) onto the drive end of the shaft. Remember right hand / left hand screw threads.

Sizes 65 to 100

1. Slip spacer sleeve (525.1) from the suction side of the shaft, insert key, slip shaft prot. sleeve (524.1) and fasten it with the aid of circlip (932.3). Check the axial clearance between the shaft shoulder and spacer sleeve (525.1), which should be 0.3 mm., if necessary, it should be established by machining the spacer sleeves.

Size 125

1. Place key on the suction side of the shaft, slip the shaft prot. sleeve (524.1) and fasten it by means of circlip (932.3). Check that the axial clearance between shaft prot. sleeve (524.1) and the shaft shoulder, which should be 1.00 mm.

Sizes 40 and 50

2. Slip the first stage impeller and stage sleeve (521) onto the shaft from the discharge side, and insert the shaft into suction casing (106).

Sizes 65 to 125

2. Insert key for first stage impeller, slip impeller (230/231) and stage sleeve (521) onto the shaft from discharge side, and insert the shaft into suction casing (106).

Sizes 40 to 125

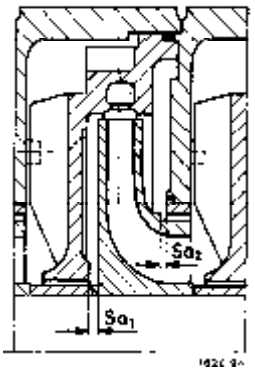
3. Insert diffuser (171.1) into stage casing (108), insert O ring (412.1) {HDA 125 will be without O ring}.

   Assemble the pre-assembled stage casing onto suction casing (106).

4. Assemble the subsequent stages, in their correct sequence, in the manner explained above. Each stage consists of the impeller, stage sleeve and stage casing, together with O ring.

   Underpin each stage casing in succession after assembly.

5. After assembly of each stage, check the total axial play $Sa_1 + Sa_2$, of the rotor, which should be min. 5 mm.



Total axial play

6. Insert final stage diffuser (171.2) into discharge casing (107).

7. Assemble discharge casing [with diffuser (171.2) and wear ring (512)] onto the stage casing last stage. {HDA 125 is without wear ring}.

8. Slip the washer (550.1) onto the suction end tie rod (905), screw the hex nut (920.1) upto the medium position on suction side threading of tie rod, and inset the tie rods into the casings from suction side.

9. On the discharge side, coat the threads and washers with molybdenum disulphide and tighten the nuts (920.1) by hand using standard short open-ended spanner to ensure metal-to-metal contact of the stage casings (108).

10. Place the pump on its baseplate, ensuring the pump feet flush on the base plate.

11. Tighten the nuts (920.1) on the discharge side of the tie rods (905) by number of divisions stamped on the top of the bearing housings designated as ''SKT''. Unscrew them again until loose and subsequently retighten them by hand using a short standard spanner. Mark the starting point on each nut and tie rod. Finally retighten the nuts by the amount indicated on the top of bearing housing.

MOUNTING THE BALANCING DEVICE

Sizes 40 to 125

1. Insert Gasket (400.1), O ring (412.8) into the groove of the counter balancing disc, insert counter balancing disc (602) into discharge casing (107) and firmly tighten allen head screws (914.1).

Sizes 40 and 50

2. Slip spacer sleeve (525.2) onto the shaft until it abuts.

3. Insert key and push balancing disc (601) onto the shaft until it abuts against spacer sleeve (525.2).

4. Screw shaft sleeve (524.2) together with O ring (412.5) onto the shaft (210) and tighten it. Remember the right-hand or left-hand screw threads respectively.

Sizes 65 to 125

2. Insert O ring (412.3), slip spacer sleeve (525.2) onto the shaft until it abuts against the impeller. The key of the final stage must engage in the keyway of spacer sleeve (525.2).

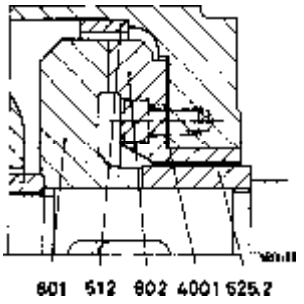
3. Insert O ring (412.3) in the groove of balancing disc (601). Insert the key in the shaft key way and slip balancing disc onto the shaft until it abuts against spacer sleeve (525.2).

   Measure and shorten spacer ring (504.1) in accordance with section ‘‘Adjustment of Rotor position’’.

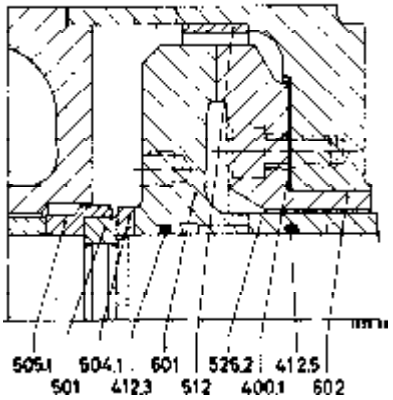
4. Slip spacer ring (504.1) onto the shaft, insert split ring (501) into the shaft groove, and slip retainer ring (505.1) over it.

CAUTION :

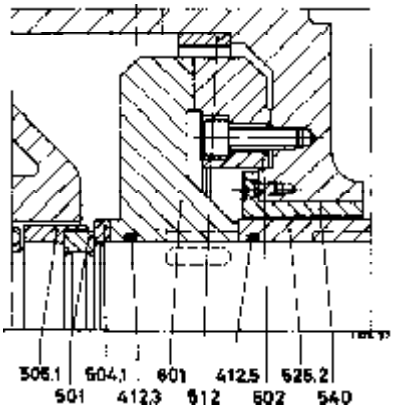
Follow the instructions of section ‘‘Checking the balancing device with bluing ink’’.



Pump sizes 40 and 50 Sizes



Pump sizes 65 to 100 Sizes



Pump sizes 125 and 150

Checking the Balance Device with Bluing Ink

After remachining the balance device or fitting new components (601.01, 602.01) carry out a check with bluing ink.

Coat the axial contact face of the balance disc (601.01) thinly with bluing ink.

Thoroughly clean the axial contact face of the counter balancing disc (602.01).

Assemble the balance device, shaft protecting sleeve, seal casing and bearings as described.

Note !

Do not fit the O-rings.

Slowly rotate the rotor pushing it towards the suction side.

Then pull the rotor back towards the discharge end of the pump and dismantle all components up to the balance counter disc (602.01).

The contact face of the counter balancing disc should bear an even impression of the bluing ink over its entire area or at least over the outer 3/4 of this area.

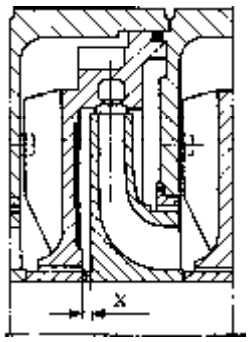
If not, the counter balancing disc (602.01) must be remachined and the ink test repeated.

ADJUSTING THE ROTOR

The suction, discharge and stage casings are clamped together by means of Tie rods, and counter balancing disc (602), together with O-ring (412.8) is mounted in discharge casing (107) with gasket (400.1).

First shift the rotor towards discharge end of the pump, until it abuts against the casing, then shift it back towards the suction end. (See Fig.)

CAUTION : This rotor position must not be alfered during the whole course of the measurements which follows :



Rotor position at start of measurements

Pump Size	With Lift off device dimension x in mm.	Without Lift off device dimension x in mm.
40 to 100	2.0	2.5
125	3.0	3.5

Rotor Adjustment

Measure distance ‘‘a’’ from wear face of counter balancing disc (602) to hub face of Last stage Impeller. (See Fig.)

Then measure the distance ‘‘b’’ from the wear face of balancing disc (601) {in dismantled condition} to the end face of spacer sleeve (525.2).

Machine Spacer sleeve (525.2) so that distances a = b.

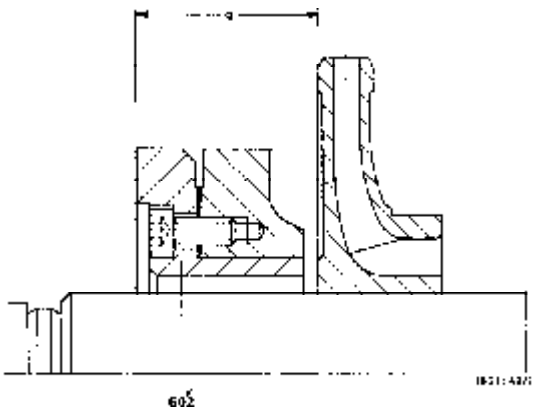
Sizes 40 and 50

Follow the instructions on page 26 ‘Preparations’.

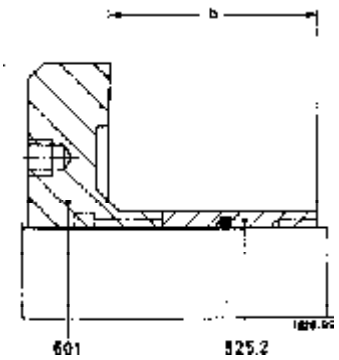
Sizes 65 to 125

Machine spacer ring (504.1), taking care not to impair the plain parallelism of its end faces, by an ammount which will provide on axial clearance of 0.3 mm, on pump sizes 65-100 & 1.0 mm for size 125, between split ring (501) and spacer ring (504.1).

The deviation from absolute plane parallalison of the end faces must not exceed 0.02 mm. Refer ‘‘Mounting the Balancing Device’’.



Rotor adjustment, distance ‘‘a’’



Rotor adjustment, distance ‘‘b’’

Fitting the Shaft Seal (Mechanical Seal)

Sizes 40 and 50

1. Insert key and screw shaft sleeve (523.1/2) including O'ring (412.5) until abutment on shaft. Take care of right-hand or left-hand threads.

Sizes 65 to 125

1. Mount stuffing box housing (451) including gasket (400.3) [For size 125 it is O'ring (412.9) in place of gasket].

Sizes 40 to 125

2. Shift the rotor until balancing disc (601) touches the counter balancing disc (602).
3. Check the control dimension 'a' [See Fig.] between stuffing box housing (451) and shaft sleeve (523.1/2). Distance 'a' is to be corrected either by machining pump end of shaft sleeve, or by fitting a gasket (400.4) of appropriate thickness, to observe the specified dimension of 'a'.
4. Slip the rotory components of mechanical seat onto shaft sleeve.

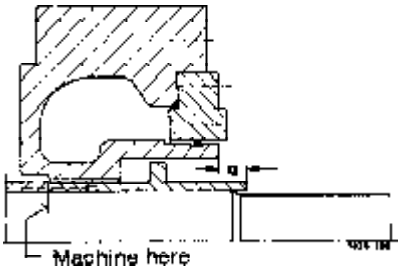
Sizes 65 - 125

4a. Slip sleeve (520) onto the shaft and secure it by means of circlip (932.3).

Check that the axial clearance between sleeve (520) and shaft sleeve is 1.00 mm; and establish it, if necessary, by machining the sleeve (520).

Sizes 40 - 125

5. Mount the stationary component of mechanical seal into the seal cover (471), and mount the subassembly onto the stuffing box housing. While tightening allen head screws (914.3) slowly rotate the pump rotor, to avoid skewing of seal components.
6. Slip splash ring (507.1) onto the shaft.



Assembly check measurement 'a' for new mechanical seals.

MOUNTING THE BEARINGS

[Pump with plain bearings, Lift off device with Antifriction bearings]

1. Mount the bottom half of bearing housing (350.01)

2. Twist in the bearing shells (370) between shaft (210) and bearing housing.
   Mount the coupling hub with the aid of the pusher device.

3. Raise the rotor (see section ''Raising the Rotor'')

4. Mount top bearing shell (370), labyrinth ring (423), front end bearing cover (361) and top half of bearing housing.

5. On discharge side mount adaptor (145) and flat gasket (400.7) onto the bearing housing (350.2).

6. Mount thrust bearing housing (354) together with gasket (400.6) onto adaptor. The springs are to be inserted only after the complete measurement & necessary machining.

7. Slip spacer sleeve (525.3) onto the shaft (210) until it abuts.

8. Insert bearing (320) in the retainer ring (505.2) with the filling groove on outside, Heat both the components in an oil bath or oven upto approx. 80^0C and slip both of them onto centering sleeve (526).

9. Carry out the measurement of the spring insertion length - required as 30 ± 1 mm - with the balancing/counter balancing discs in contact.

9.1. Measure dimension ''a'', the depth of thrust bearing housing (354) from the outer face to spring seat.

9.2. Measure dimensions ''b'', the total length of retainer ring.

9.3. Twist the subassembly of centering sleeve with bearing and retainer ring, together with key (940.11) onto the shaft, until it abuts against the spacer sleeve (525.3).
The freeness or of retainer ring subassembly has to be ensured, within the thrust bearing housing.

9.4. Measure dimension ''C'' from the face of thrust bearing housing to retainer ring.

9.5. From these measurement the spring length will be = a - (b + c); which should be equal to 30 ± 1.0 mm. In case it is different either the back face (''A'') of the retainer ring or the front face (''B'') of the spacer sleeve should be machined.

10. Lift off dimension ''X''
    This should be 1.0 ± 0.1 mm.
    Dimension ''d'' on the bearing end cover (361) plus thickness of gasket must be equal to ''c'' - (1.0 ± 0.1 mm). In case it is different, the bearing end cover must be machined accordingly.

11. Dismantle centering sleeve, together with bearing subassembly. Insert springs (950) and tighten the subassembly of bearing sleeves with bearing, onto the shaft, till it abuts against spacer sleeve. Insert key (940.11).

12. Mount rotor position indicator, consisting of indicator (623.1) and indicator bush (624); onto the bearing end cover.

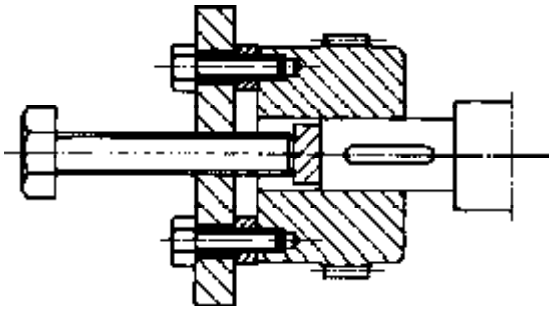
13. Check the marking of the indicator (623.1) with the balancing disc (601) abutting against the counter balancing disc (602); if necessary, scribe a new marking on the indicator (see ''Rotor Position Indicator'').

Coupling :

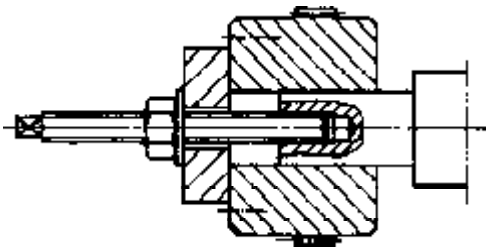
A geared coupling with spacer sleeve is used to connect the pump and drives (See fig.).

Whereever possible, use a special device to fit and pull off the couplings (See fig.).

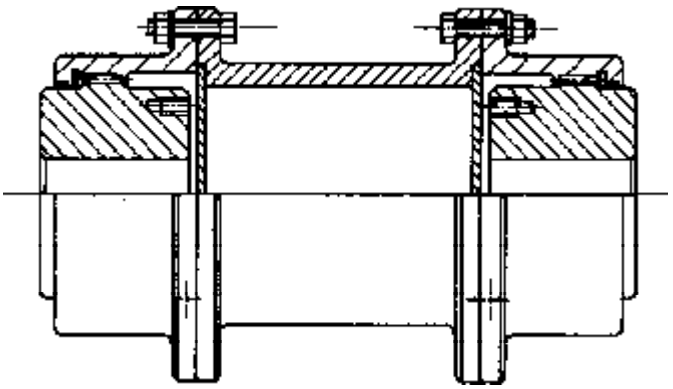
To mount the coupling hubs when warm, heat them in an oil bath or an electric hotplate to between 80 and 100^{0}C.



Pulling off the coupling hub.



Mounting the coupling hub.



Gear coupling with spacer sleeve

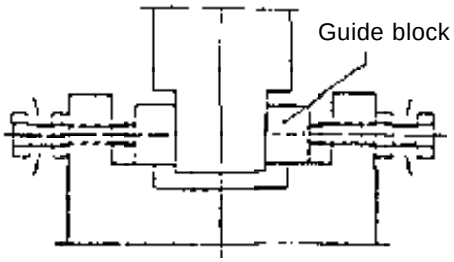
Caution :

It must be possible to manually slide the coupling hubs axially without effort, when the pump is stopped. In case of couplings with retainer rings, the axial freeness is to be checked with the retainer rings removed.

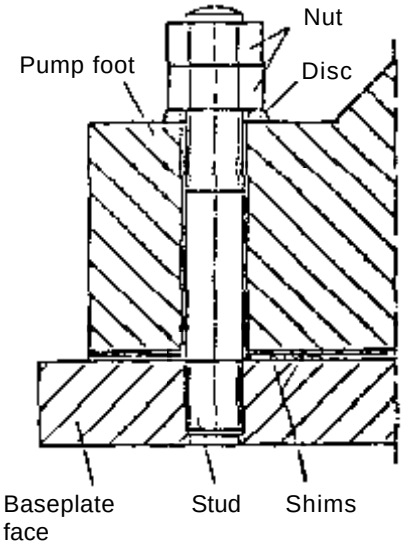
Fill grease before start up. For grease fill, grease quality, lubrication schedules and grease change refer manufacturers manual.

Alignment after Overhaul

After completion of overhaul and installation work, align the pump and driver at the coupling with dial indicators as per section ‘Aligning the Pump and Driver’. Correct any differences in level by inserting shims between the pump feet and baseplate.



Lateral adjustment of pump (example)



Arrangement of the shims

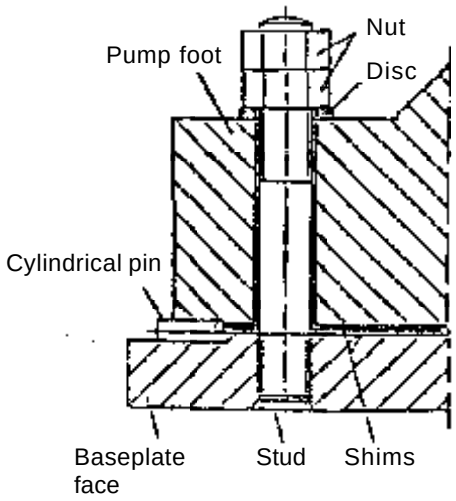
After connecting all the pipework and checking the driver’s direction of rotation (with the pump disconnected) re-check alignment. Enter the final measurements in the installation record pad graph.

Tightening the pump feet fastening bolts

Discharge end
Tighten up the first nut so that the disc can only be moved by tapping it lightly with a hammer. Tighten up the second nut completely (lock), ensuring that the first one does not move at all.

Suction end
Tighten up the first nut against the disc and then tighten the lock nut. The feet of the stage casing 1st stage are dowelled vertically to the baseplate by cylindrical pins.

After completing alignment, fit the coupling spacer.



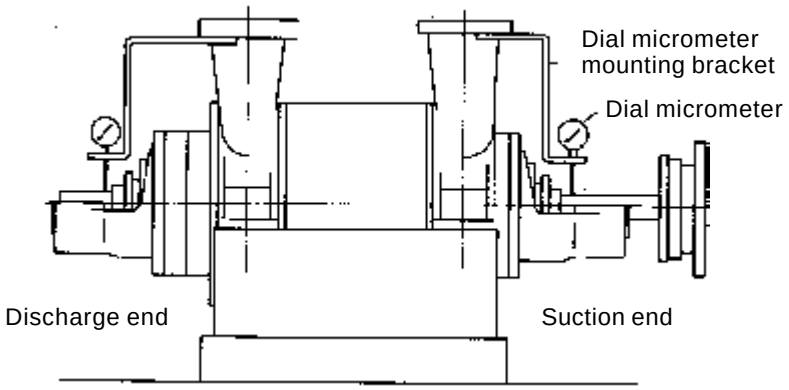
Dowelling the pump feet (suction end)

Raising the Rotor (Pump with plain bearings)

This check must only be carried out on the pump after it has cooled down & with the coupling hub mounted on the shaft. The temperature measured at the pump nozzle should not exceed 50°C.

Note :

Rotor raising values are stamped on the top valves of the bearing housings and designated by the word 'Lift-Up'. If any increases in clearances between pump rotor and pump casing, within the permissible limits, have been ascertained during the checking process, then the value for rotor raising stamped on the top half of the bearing housing must be increased by half the amount of the increase in radial clearance.



Placing the micrometers for raising the rotor

Place dial micrometers on shaft (210) at the suction and discharge end with the rotor in 'zero' position (the 'zero' position of the rotor means its position when both radial bearings and labyrinth rings have been removed. The rotor raising value is related to this 'zero' position). Then insert the bottom bearing shells (370) at the suction and discharge ends of the pump, and read off the vertical alteration in the rotor position on the dial micrometers and compare with the values for motor raising stamped on the bearing housing. Correct any deviation by adjusting the bearing housings. To do this loosen bolts at bearing housings and carry out the precision adjustment using the fitted adjusting screws.

These measured values should be checked a second time by renewed removal and renewed reinsertion of the bottom bearing shells (370). The initial measurement reading must again be obtained during this renewed check. The bearing shells can be inserted more easily if the shaft is raised with the aid of a wooden slat. A written record should be made of the rotor raising values measured. Accurate sideways alignment of the bearing housings is to be carried out by the adjustment screws arranged on bearing housing flanges in the horizontal plane. Accurate sideways alignment can be considered to have been achieved when it is possible to twist the bottom bearing shell from either end without effort in its seat between shaft (210) and bottom half of bearing housing.

Re-tighten adjustment screws and nuts after rotor raising procedure has been carried out.

Re-check the rotor raising values.

SPARE PARTS

When ordering spare parts, always quote the part number and works serial number. The serial number is shown on the front page of this manual and on the pump name plate. When ordering spare parts for number of same pumps on one site, please refer VDMA 24296.

Following table gives complete list of recommended spares. For applicability of the same, please refer Cross Sectional Drawing and List Component for the particular order.

S = No. of stages

Part No.	Part Description	Quantity	Remarks
210	Shaft with Keys	1	
230	Impeller	S	
320	Ang. Cont. ball brg.	1 Set	
322	Cyl. Roller Brg. with Adapt. Sleeve	2	Pump with Antt. Fr. Brg.
370	Bearing Shell	2	Pump with Plain Brgs.
400	Gasket	1 Set	
412	O Ring	1 Set	
433	Mech. Seal complete	2	Pump with Mech. Seal
461	Gland Packing	2 Sets	Pump with gland pack
501	Split Ring	1	For sizes 65 - 125
502	Wearing Ring	S	
503	Impeller Ring	S	If provided
504.1	Spacer Ring	1	For sizes 65 - 125
505.1	Retainer Ring	1	For sizes 65 - 125
505.2	Retainer Ring	1	
520	Sleeve	1	For sizes 65 - 125
521	Stage Sleeve	S-1	
524.1/2	Shaft Prot. Sleeve	2	Pump with Gland Pack
523.1/2	Shaft Sleeve	2	Pump with Mech. Seal
525.1	Spacer Sleeve	1	For sizes 40 - 100
525.2	Spacer Sleeve	1	
525.3	Spacer Sleeve	1	
541	Stage Bush	S-1	If provided
601	Balancing Disc	1	
602	Counter Bol. Disc.	1	
932.3	Circlip	2	Fir sizes 65 - 100
950	Spring	1 Set	

FAULTS

Fault	Reference number Cause - Remedy
Pump delivers insufficient liquid	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 28
Driver overloaded	11, 12, 13, 14, 15, 23, 27, 28
Excessively high pump discharge pressure	15
Bearings overheating	22, 23, 24, 25, 26
Pump leaks	16, 29
Excessive shaft seal leakage	17, 18, 19, 20, 21, 22, 23
Rough pump running	3, 6, 11, 12, 22, 23, 25, 30, 31, 32
Excessive temperature rise inside the pump	3, 6, 32
Pressure quantity of balance liquid varies	3, 6, 11, 24, 34

Cause - Remedy [1)]

1. The pump generates an excessively high differential pressure
   - Open discharge valve further until the duty point conditions have been attained
2. Excessively high back pressure
   - Fit larger impeller(s) [2)]
   - Check installation for contaminations
3. The pump and/or piping are incompletely vented or primed
   - Vent or prime the pump and piping completely
4. Suction line or impeller(s) clogged
   - Remove deposits in the pump and / or piping
5. Formation of air pockets in the piping
   - Alter piping layout
   - If necessary, fit a vent valve
6. NPSH available is too low (on positive suction head installations)
   - Check liquid level in suction vessel
   - Open isolating valve in suction line fully
   - Alter suction line if necessary, if the friction losses in the suction line are excessive
   - Check suction line strainers
   - Make sure that the permissible rate of pressure decrease is not exceeded
7. Excessively high suction lift
   - Clean out suction strainer basket and suction piping
   - Check liquid level in the pit, correct if necessary
   - Alter the suction line
8. Ingress of air through the stuffing box
   - Fit a new shaft seal
9. Reverse rotation
   - Change over two phases of the power supply cable
10. Rotational speed is too low [2) 3)]
    - Increase speed
    - Increase voltage
11. Excessive wear of the pump internals
    - Replace worn components by new ones
12. Pump back pressure is lower than specified in the purchase order
    - Adjust duty point accurately by means of the isolating valve in the discharge line
    - In case of persistent overloading, trim the impeller(s) if necessary [2)]
13. Specific gravity or viscosity of the fluid pumped is higher than that specified in the purchase order
    - [2)]
14. Gland cover too tight or tightened askew
    - Correct
15. Excessive rotational speed
    - [2) 3)]
16. Defective seal
    - Renew seal between cooling chamber/sealing cover plate and stuffing box housing
17. Worn shaft seal
    - Check condition of shaft seal and renew it if necessary
18. Grooving, score marks or roughness on shaft sleeve surface
    - Fit new shaft protecting sleeve
19. Lack of cooling liquid or fouled and clogged cooling liquid compartment
    - Increase the flow of cooling liquid
    - Clean out the cooling compartment
    - Clean the cooling liquid itself

20. Gland cover, end cover or seal coverplate incorrectly tightened, wrong packing material
    - Remedy the fault
21. The pump runs noisily
    - Correct the suction conditions
    - Check alignment of pump set and realign if necessary
    - Re-balance the pump rotor
    - Increate the suction pressure at pump suction nozzle.
22. Pump set misaligned
    - Check alignment at coupling and realign the set if necessary
23. The pump is warped
    - Check piping connections and pump fixing bolts
24. Excessive axial thrust 2)
    - Clean out balance holes in impeller
    - Fit new casing wear rings
25. Too much, too little, or unsuitable lubricant
    - Reduce quantity of or top up lubricant, or change lubricant quality
26. The specified coupling gap has not been maintained
    - restore correct coupling gap in accordance with the data on the installation plan
27. Operating voltage is too low
28. The motor is running on two phases only
    - Replace the defective fuse
    - Check electrical connections
29. The connecting bolts are slack
    - Tighten the bolts
    - Fit new gaskets
30. The rotor is out of balance
    - Clean the rotor
    - Rebalance the rotor dynamically
31. Defective bearings
    - Fit new bearings
32. Insufficient rate of flow
    - Increase the minimum rate of flow
33. Check balance liquid line for changes in cross-section, excessive pressure drops, combination of several lines too close to the pump, leaching out of balance counter disc, abrasive wear of balance device
    - Check mode of running of the pump
    - Check return line
    - Check pump pressures
    - Check rotor clearances and balancing device

1) The pump should be made pressureless before attempting to remedy faults in parts under pressure.
2) Please contact KSB
3) This fault can also be overcome by modifying the impeller diameter.

LONG TIME STORAGE

1.0 STORAGE

Adequate measures are taken at KSB works to safeguard the pump for short term storage between 3-4 months. However, following precautions are to be taken while storing the pump at site stores.

1.1.1 The pump should be stored in an enclosed room, which is, equipped with fire protection, free from roof leakage, water splashes or seepage from the floor. The pump should be protected from rain, sun hest, sand storms etc. Sufficient insurance cover may also be given.

1.1.2 In case if the pump is stored in the same packing box, as packed and supplied, from our works, the box should rest on anti-termite wooden beams or similar supporting structure at least 6" above the ground.

1.1.3 In case if the pump is stored in unpacked condition, it should be covered with atleast 6 mil (0.15 mm) thick clear polyethylene sheet which should be fixed to resist winds; and should be with sufficient ventilation underneath.

1.1.4 The suction, discharge and other connections are blanked while dispatching the pump from works. Do not remove the blanks. Close open connections, if any, by metallic blanks.

1.2 For storage beyond 3-4 months, at stores or in installed condition, following measures in addition to above are required to be taken.

1.2.1 The packing box must be opened, if not opened earlier, and fill bearing housings of the pump with vapour phase inhibiting oil upto half of the bearing cavity, to avoid rusting of bearings and other components.

1.2.2 Lube oil, flushing and mech. seal piping, if provided, must be checked for rusting, clean if required, and fill with rust preventive oil.

1.2.3 The pump nozzles which are blanked with plugs or metallic blinds are to be opened and approx. 1/2" kg of vapour phase inhibiting crystals (e.g. Silica Gel), packed in a cloth bag are to be suspended in the pump nozzles and metallic blinds are to be placed back. (We recommend metallic blinds, bolted to the flange).

1.2.4 Following periodic checks are required to be performed.

ITEM	PERIODICITY	CHECKS
Vapour phase inhibiting crystals	Every 3 months	Checking of bags in nozzles and replenishment.
Shaft	Every 3 months	Rotation through 180 degrees.
Bearing housing	At the end of first six months	Drain Bearing Housing and refill to half the level with vapour phase inhibiting preservative oil. Internal surfaces should be checked and recoated.
Internal surface of the pump	At the end of first six months	Checking through the nozzle openings and recoating the accessible area, except for stainless steel.
Coupling	At the end of first six months	Checking and recoating
External surfaces of the pump	At the end of the six months	Checking for the surface not painted, and recoating of them.
Mechanical seal	Every 6 months after completion of first year	The preservating oil should be injected into the seal faces through the flushing piping.
Soft packed stuffing box	Every 6 months after completion of first year	Cleanliness and dryness of accessible seal parts should be checked.

2.0 PREPARATIONS BEFORE INSTALLATION / COMMISSIONING

Remove all coats applied during dispatching the pump from our works or during storage at site. Check the pump thoroughly. In case if you need assistance, please contact Customer Service Department of KSB.

2.1 While making use of petroleum products for cleaning, heat / sparks / flames etc., should be avoided.

2.2 Preservative grease should be washed off from the external surfaces, using some petroleum product (Kerosene / Diesel / Thinner).

2.3 All the auxiliary piping, as well as Bearing Housing, should be drained for the preservative oil.

2.4 Auxilliary piping and Bearing Housings should be flushed with a petroleum product, and the Bearing Housings should be cleaned and dried.

2.5 All the bearings should be removed before the flushing of bearing housing.

2.6 All the bearings should be cleaned, checked for acceptance for the use, and then only should be fitted in the bearing housing.

3.0 STORAGE OF ACCESSORIES

3.1 ACCESSORIES

For major accessories, like driver/coupling/gear box / panels / main valves etc., basically manufacturer's recommendations are to be followed.
The smaller accessories covering piping/instrumentation/valves in piping/mountings etc., are generally mounted on the pumping unit, in their respective position, and as such will be taken care along with the precautions of the pump itself. However, if these are supplied loose, the same should be treated as if spares.

3.2 SPARES

While dispatching the spares whether project or subsequent these are properly packed, and treated before packing. These packings as long as they are not tampered can be directly stored in proper racks, for desired long time storage, however these racks must be located in such a position that they fulfill the conditions stipulated for pumps. Exception is to be made for the items which have their own shelf life such as rubber components, gaskets etc.

3.3 PUMP CARTRIDGE

Barrel type of pumps are many times supplied with a pump cartridge (which comprises a complete pump except the barrel), which is supplied in the assembled condition, clamped together with the clamping device.
The storage of this pump cartridge must fulfill all the conditions stipulated for the pump.

3.4 TOOLS

All the pumps are supplied with necessary Tools and Tackles for Dismantling / Assembly of pumps components. Though these do not demand any specific requirements for long time storage, these should be stored in such a manner that these are easily and readily accessible in emergencies.

LOG SHEET

	PUMP TYPE		**SERIAL NO.**					
	CUSTOMER ITEM NO.							
NO.		**DESCRIPTION**	**UNIT**	**READING**				
		PRESSURE AT						
1		Suction nozzle	kg/cm2					
2		Differential across suction strainer	kg/cm2					
3		Discharge nozzle	kg/cm2					
4		Balancing line	kg/cm2					
5		**Oil inlet** to bearing (forced oil lubrication)						
	5.1	Suction side bearing	kg/cm2					
	5.2	Discharge side bearing	kg/cm2					
	5.3	Lift off / Thrust bearing	kg/cm2					
		TEMPERATURE AT						
6		Suction nozzle	Deg C					
7		Discharge nozzle	Deg C					
8		Balancing line	Deg C					
9		**Bearings**						
	9.1	Suction side	Deg C					
	9.2	Discharge side	Deg C					
	9.3	Lift off / Thrust	Deg C					
10		**Oil inlet** to bearing (forced oil lubrication)						
	10.1	Suction side	Deg C					
	10.2	Discharge side	Deg C					
	10.3	Lift off / Thrust	Deg C					
11		**Flushing liquid**						
	11.1	Shaft seal - Suction	Deg C					
	11.2	Shaft seal - Discharge	Deg C					
		Cooling Water Inlet / outlet						
	11.3	Suction	Deg C					
	11.4	Discharge	Deg C					
	11.4	Lift off / Thrust	Deg C					
12		**ROTOR POSITION**						
13			Amplitude			RMS Velocity		
		VIBRATIONS AT	microns (peak to peak)			mm / s		
			H	V	A	H	V	A
	13.1	Suction side bearing housing						
	13.2	Discharge side bearing housing						
	13.3	Lift off / Thrust bearing housing						
	13.4	Suction flange						
	13.5	Discharge flange						
	13.6	Suction side support foot						
	13.7	Discharge side support foot						
	13.8	Base Frame						
			H = Horizontal ;		V = Vertical ;		A = Axial.	

	DATE / TIME	SIGNATURE OF OPERATOR

KSB

PUMP MAINTENANCE PLAN

Maintenance Activity ➠ **Maintenance point –** (Whichever applicable)	OIL CHANGE First	 Next	BEARING CONDITION	LUBRICATION	CHECK
Pump Bearing Housing	300 h	8000 h however at least once in a year	✪		
Pump Gland Packing					✝ *
Pump Mechanical Seal					✝ *
Coupling				@	Alignment * #

* = Only during stand still ✝ = In case of excessive leakage through shaft seal

@ = Refer Manufacturer's Manual

= In case of (i) higher vibrations; (ii) Restarting after long interval; (iii) Restarting after replacement of bearings; (iv) After overhaul

✪ = In case of (i) higher vibrations; (ii) higher bearing temperature; (iii) indication of misalignment

PUMP SUPERVISION PLAN

Type of Control ➠ **Control Area**	Proper Condition	Damage	Leakage	Tightness	Noise	Smooth Running	Oil Level	Temperature	Pressure	Gland Packing Leakage @	Rotor Position	Oil / Water flow	Differential Pressure	Vibrations
Pump	W	W	S *	S *	S	S					W			
Suction Nozzle								S	S					
Discharge Nozzle								S	S					
Suction Strainer													S	
Min Flow Bypass									S					
Balancing Leak off									S			S		
Shaft Seal	R	R								S				
Bearing Housing	R	R			S		S	S	S					W
Flushing Inlet								S	S			S		
Lube oil Inlet								S	S			S		
Cooling Inlet								S	S			S		
Coupling	R	R												

* All threaded joints @ Applicable only in case of Gland packed pump

S = Once a Shift; W = Once a Week; M = Once a Month;

R = Inspection at stand still