Contents

0. General

Your centrifugal pump will only give you completely troublefree and satisfactory service on condition that it is installed with due care and properly maintained. It is absolutely essential that the instructions contained in this manual be scrupulously observed, and that the pumps are not operated under conditions which differ from those specified under our "Operating Conditions". This operating instructions does not take any account of any safety regulations which may apply to the installation site, and the site manager or site operator is responsible for notifying our erection staff of any such regulations and seeing that they are complied with. The type series, pump size, main operating data and Works serial number are all stamped on the name plate affixed to the pump; please make sure to quote this information every time you write to us in respect of queries, repeat orders, and more particularly when ordering spare parts. When ordering replacement impellers always specify the impeller diameter, as a pump can be fitted with impellers of various diameters.

0.1 Handling

In the case of delivery of a complete pump set, the ropes should be slung under the pump and motor and not threaded through the eyebolt on the motor.

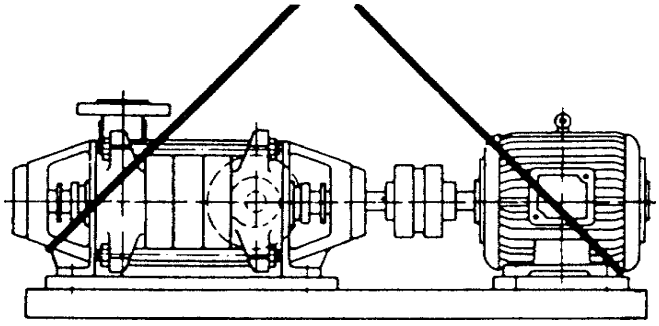


Fig. 1 Pump and driver mounted on a combined baseplate.

In the case of pumps without baseplate, the ropes should be slung as illustrated in Fig. 2.

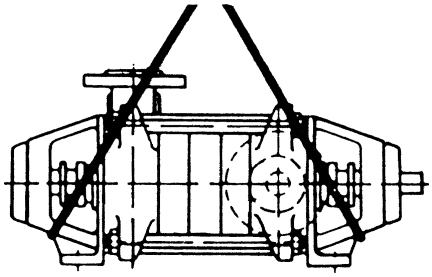


Fig. 2 Pump without baseplate.

Caution : On no account sling the ropes under the shaft.

1. Installation

(Installation on Site)

1.1 Foundation

Make sure that the concrete foundation has set firmly before placing the pumping set on it. The surface of the foundation should be truly horizontal and perfectly flat.

The foundation bolts should be suspended in the baseplate.

1.2 Installation

After placing the pump on the foundation, level it up with the aid of a spirit level placed on the shaft/discharge nozzle. The correct gap between the two coupling halves specified on the installation drawing must be observed. Shims should always be inserted to the left and right of the foundation bolts in close proximity to the bolts themselves, between the baseplate or foundation frame and the foundation itself. If the spacing between adjoining anchor bolt holes exceeds 800 mm, additional shims should be inserted half way between the adjoining holes. All shims must lie perfectly flush.

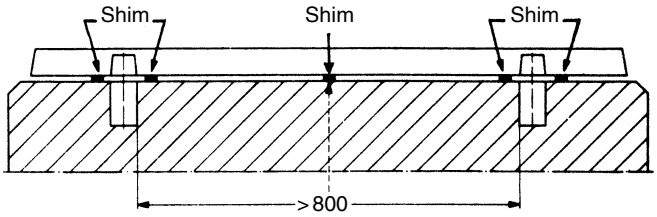


Fig. 3 Provision of necessary shims.

On baseplates with no grouting aperture, only the foundation bolts are to be grouted in.

After Alignment (see section 1.3) grout the baseplates (non-shrinking mortar is highly recommended), ensuring that no cavities remain.

1.3 Mounting of Coupling

If the bare pump is supplied, i.e. the motor or gearbox are not mounted, the flexible coupling should be pre-heated to 100-120^{0}C approx. in an oil bath before mounting on the stub shafts. The flexible elements should be removed before heating.

Caution :

Never drive the half coupling onto the shaft by hammer blows. Always use a pusher device to mount it on the shaft.
(see Fig. 3.1)

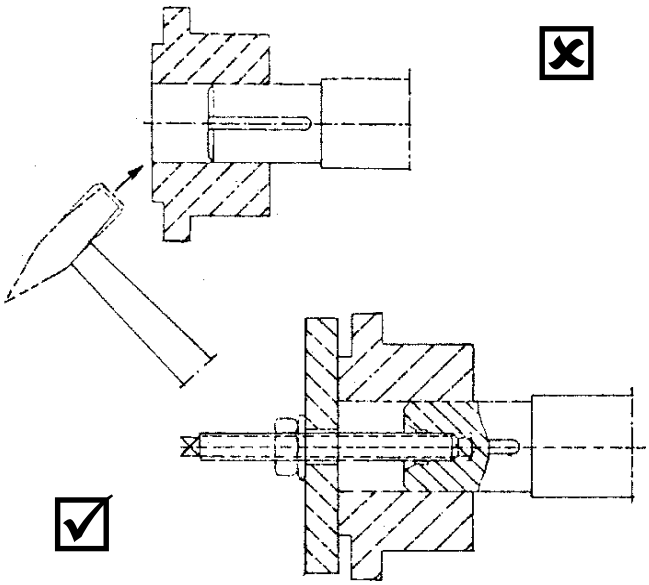


Fig. 3.1 Mounting the coupling

1.3.1 Alignment of Pump & Driver

In order to align the shaft, the pump and driver should be pushed towards each other until the two coupling halves are separated by the axial gap specified in the general arrangement drawing.

The preliminary alignment of the coupling is effected by means of a short straight edge and feeler gauge.

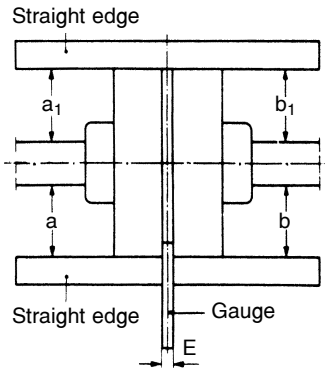


Fig. 4 Aligning the coupling by means of a straight edge and gauge.

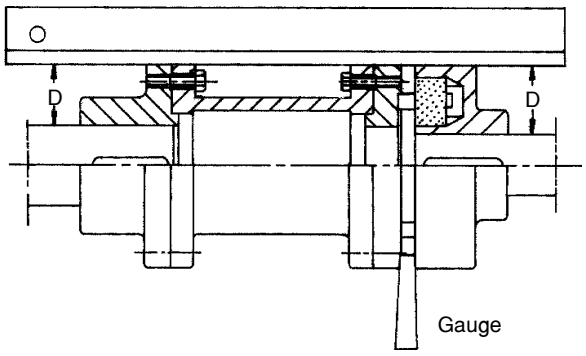


Fig. 4.1 Aligning the spacer-type coupling by means of a straight edge and gauge.

Check the axial gap 'E' at various points around the periphery, with the aid of a feeler gauge, and place a short straight edge across the outer diameter of the two coupling halves, forming a bridge. If the gap 'E' remains constant around the periphery, and if the straight edge lies flush at all points, the preliminary alignment can be considered satisfactory (see Fig. 4 & 4.1).

The accurate coupling alignment requires a coupling alignment jig. This can be made from 20 x 20 flat bar steel or similar, the jig should be attached to the shafts (see Fig. 5 & 5.1).

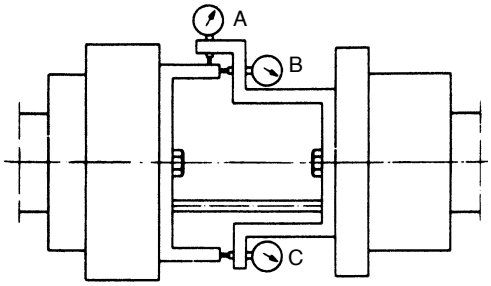


Fig. 5 Spacer type coupling

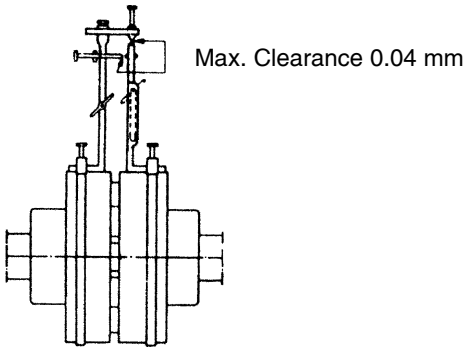


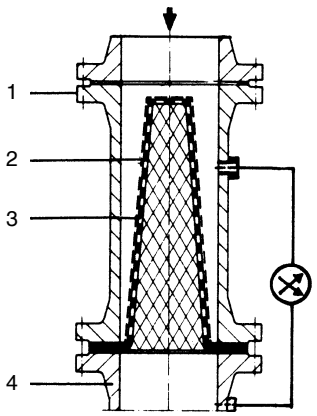
Fig. 5.1 Coupling alignment jig

The coupling can be considered correctly aligned with the aid of the jigs illustrated if the difference measured does not exceed 0.04 mm. both in the radial and axial directions, measurements being taken in 4 planes at 90^0 intervals. The coupling alignment checking should be repeated after the piping has been connected to the pump.

1.4 Connecting the Piping

Never use the pump itself as an anchorage point for the piping. Suction lift lines should be laid with a rising slope towards the pump, and suction head lines with a downward slope towards the pump. The pipelines should be anchored in close proximity to the pump and should be connected to the latter without transmitting any stresses or strains, nor should the weight of the piping be loaded onto the pump. The nominal sizes of the pipelines should be at least equal to the nominal sizes of the pump nozzles. We recommend the incorporation of check valves or non-return valves and isolating valves in the system, depending on the type of installation and pump.

Any thermal expansion of the piping (due to high temperatures) must be compensated by suitable means, to as not to impose any additional load on the pump. Prior to commissioning of a new plant, all the vessels, piping and connections must be thoroughly cleaned, flushed through and blown through. If often happens that welding beads, pipe scale and other dirt only become detached from inside the piping after a considerable period of operation. They must, therefore, be prevented from penetrating inside the pump by the incorporation of a strainer in the suction line. The free passage cross-section of this strainer must be at least equal to three times the cross-sectional area of the suction pipe, in order to avoid an excessive pressure drop as a result of the accumulation of foreign matter in the strainer. Conical strainers with a woven wire of 1.0 mm width and 0.5 mm wire diameter made of corrosion-resistant material should be used. (see Fig. 6).



1. Strainer holder
2. Fine strainer
3. Perforated sheet
4. Pump suction nozzle

Fig. 6 conical strainer in the suction line.

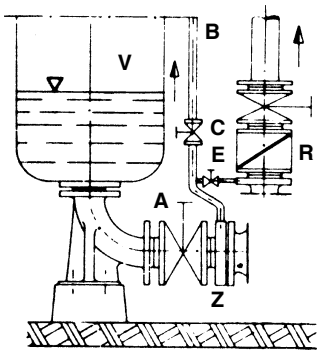
1.4.1 Auxiliary Connections

The auxiliary connections required for your pump (sealing liquid, leakage evacuation) are indicated on the installation drawing and on the piping diagram in respect of size and location.

1.4.2 Vacuum Balance Line

If the pump has to pump a liquid out of a vessel under vacuum, it is advisable to install a vacuum balance line. This line should have a nominal size of 25 mm at least. It should be arranged to lead back into the vacuum vessel at a point above the highest permissible liquid level.

An additional pipeline equipped with a shutoff valve, connecting the pump discharge nozzle to the vacuum balance line, facilitates venting of the pump prior to start-up.



A Main isolating valve
B Vacuum balance line
C Isolating valve
E Vacuum-tight isolating valve
V Vessel under vacuum
Z Intermediate flange
R Check valve

Fig. 7 Suction line and vacuum balance line

1.4.3 Minimum Flow

If the nature of the installation includes the likelihood of operation against a closed discharge valve, it will be necessary to provide a manually-actuated bypass or a permanent bypass, or alternatively an automatic recirculation valve.

1.5 Coupling Guard

In compliance with the accident prevention regulations, the pump may only be operated if it is fitted with a coupling guard. If the customer states specifically that this coupling guard is not to be supplied by us, it must be provided by the pump operator.

1.6 Final Check

All connections should be checked in respect of correct functioning and correct connection.

2. Commissioning, Start up and Shut Down

2.1 Preparations prior to Commissioning

2.1.1 Lubricants

Grease-lubricated bearings are pre-packed with grease at our Works before despatch of the pump.

2.1.2 Shaft Seal

Check the shaft seal (see section 4.2.1).

2.1.3 Priming the Pump and Checks to be carried out

The pump and suction lift line must be vented and primed with the fluid pumped before start-up. The isolating valve in the suction lift line must be fully open. All auxiliary connections provided on your pump (sealing liquid) must be opened fully and the unimpeded flow of the fluid through these lines must be verified. Open the isolating valve in the vacuum balance line (if applicable to your installation) and close the vacuum-tight isolating valve “E” (Fig. 7).

Caution :

Avoid dry running of pump at all cost !

2.1.4 Check the Direction of Rotation

The direction of rotation must correspond to the arrow on the pump. This can be checked by switching on the pump for a short instant and switching it off again immediately. Mount the coupling guard.

2.2 Switching On

Always make sure that the isolating valve in the discharge line is closed when the pump is switched on. Only after the pump has attained full operating speed should the discharge valve be opened gradually and the operating point conditions adjusted by means of this valve.

2.3 Switching Off

Close isolating valve in discharge line.

If a non-return valve or check valve has been incorporated in the discharge line, the isolating valve can remain open in so far as there is a back pressure present in the line.

Switch off the driver. Observe the pumping set running down smoothly and quietly to a standstill.

In the event of a prolonged shutdown, the isolating valve in the suction lift line should be closed.

Close the auxiliary connections.

The stuffing box of pumps which are connected to a supply vessel under vacuum must be fed with sealing liquid even when the pump is switched off. In the event of frost and/or of prolonged shutdowns, the pump must be drained or otherwise protected against freezing.

3. Maintenance and Lubrication

3.1 Supervision of Operation

The pump should run quietly and free from vibration at all times. Avoid prolonged running against a closed discharge valve. The bearing temperature may be allowed to attain upto 50^0C above room temperature, but should not exceed $+80^0$C. The isolating valves in the auxiliary feed lines must always remain open while the pump is running.

The soft-packed stuffing box (if your pump is of gland packed design) should drip slightly during operation (approx. 60 drops/ min). The stuffing box gland only be tightened lightly.

The mechanical seal (if your pump is with mech seal) should leak only slightly or not at all during operation. It is maintenance-free.

Any standby pumps in the pumping installation should be operated once a week for a short instant, by switching on and switching off again so as to maintain them in good condition for instant start-up in an emergency. The correct functioning of the auxiliary connections should be kept under observation.

The flexible coupling elements should be regularly checked and replaced if they show signs of wear.

3.2 Lubrication and Lubricant Changes

3.2.1 Lubrication

The antifrication bearings are grease-lubricated.

3.2.2 Grease Changes

The initial fill (grease packing) of grease-lubricated antifriction bearings should last for 3000 operating hours approx., but should be renewed at least once every 2 years of after every 3000 hours of operation.

Grease quality :

Use a good quality ball and roller bearing grease with a lithium soap base, free of resin and acid, not liable to crumble, and possessing good rust-preventive characteristics. The grease should have a penetration number situated between 2 and 3, corresponding to a worked penetration situated between 220 and 295 mm/10 lts Drop point should not be less than 175^{0}C.

4. Special Instructions and Recommendations

4.1 Basic Instructions and Recommendations

Caution :

Before commencing dismantling, make sure that the pump cannot be accidentally switched on, by disconnecting it from the mains supply. The shut off valves in the positive suction head line or suction lift line and in the discharge line must be closed. The pump casing must have cooled down to ambient temperature. The pump casing must be drained and pressureless.

4.2 Dismantling

1. Disconnect and remove the auxiliary connections on your pump.
2. Remove the coupling guard.
3. Disconnect the pump from the driver at the coupling, and disconnect the pump from the baseplate.
4. Unscrew the socket head cap screw in the coupling hub, and pull the coupling half off the pump shaft with the aid of an extractor device, and remove key (940.3).

It can happen after a prolonged period of operation that certain components can only be pulled off the shaft with difficulty. In this event, use one of the better known brands of rust solvent, and also make use of suitable puller devices as far as possible.

On no account use force to remove the components.

5. The pump should always be dismantled starting from the discharge end, in the sequence below :

Bearing end cover	361
Circlip	932.2
Spacer ring	504.1

The stage casings (108) should be underpinned before proceeding with further dismantling, to prevent them falling down when the bearing housing (350) is removed.

Bearing housing (350) together with deep groove ball bearing (321).

Splash ring	507.1
Gland	452
Circlip	932.1
Spacer ring	504.1
Gland packing	461

Shaft protection sleeve (524.2) together with O-ring (412.2) Nuts (920.1) and tie rods (905).

Discharge casing (107) together with final stage diffuser (171). Impeller (230), (make sequence when dismantling) stage casing (108).

The individual stages are then successively dismantled upto and including the last impeller.

4.2.1 Shaft Seal

4.2.1.1 Soft-packed Stuffing Box

Insert the packing supplied loose with the pump into the stuffing boxes (unless the pump was supplied with its stuffing boxes already packed).

Fig. 8 Packing ring cut to length

The gland cover should be tightened lightly and uniformly. The rotor must be easy to turn.

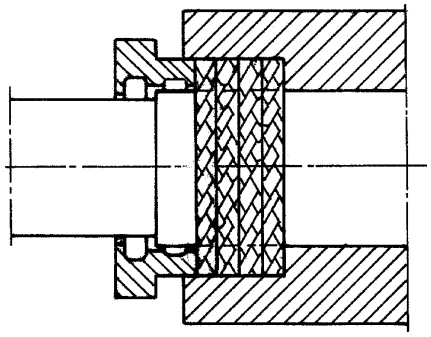
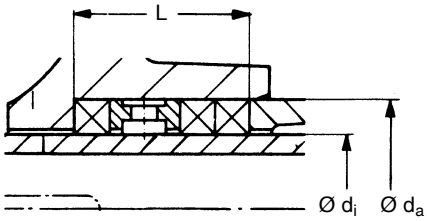


Fig. 9 Packing rings inserted into the stuffing box with their butt joints offset 90^0 in relation to the butt joint of the preceding packing ring.

Dimensions of packing compartment / Number of packing rings.



Dimensions in mm

Pump size	Stuffing Box Compartment		Suct/Disch.
	Ø di	Ø da	L
40	39	55	52/36

4 packing rings each of 8 x 8 mm Total length 600 mm.

Fig. 10 Dimensions of stuffing box Compartment.

Rate of flow of sealing liquid from an outside source (only in the case of operation under vaccum), 1 litre/minute approx; sealing liquid pressure : 0.5 bar + positive suction pressure (Pz) bar, but at least 0.1 bar above atmospheric pressure. The sealing liquid must be compatible with the fluid pumped.

4.3 Bearing Arrangement

Antifriction bearings in accordance with DIN 625, bearing clearance class C3.

WKL 40		Bearing size	
Normal (both ends)		6306	Grease Servogem-2 of Indian oil or equivalent
HWD	Suction	NU207K	
	Discharge	6306	

As regards bearing lubrication, clean off all remnants of the old grease and pack the bearings with fresh grease (approx. 10 grammes per bearing).

4.4 Reassembly

4.4.1 Impellers

It is essential to proceed with the reassembly work in the specified sequence.

4.4.2 Pump

The pump should be reassembled in accordance with the rules of sound engineering practice.

The fits of the individual components should be coated with graphite or another suitable lubricant before assembly, and the same applies to the screw threads of screwed connections.

O-rings and radial seal rings should be examined for signs of damage and replaced by new ones where necessary. Put silicon grease on 'O' rings. Gaskets should, in principle, be replaced by new ones, taking care to ensure that the thickness of the new gasket is exactly the same as that of the old one.

The individual components should be mounted in the following sequence :

1. Mount shaft protection sleeve (525.1) together with 'O' ring (412.2) on the shaft, from suction side. Mount spacer sleeve (525.1) and assemble the circlip (932.1) to avoid it's horizontal movement towards suction.
2. Slip first stage impeller on key no. 1 untill it abutts with shaft protection sleeve.
3. Insert this assembly in suction casing (106). Place flat gasket (400.1).
4. In first stage casing (108), fit diffuser (171.1) properly. Mount this casing on suction casing.
5. Mount the remaining impellers, stage casings with diffusers, gaskets in sequence.
6. Mount shaft protection sleeve (524.2) with 'O' ring (412.2), on shaft untill it abutts last stage impeller. Mount spacer sleeve (525.2), spacer ring (504.2) and circlip (932.2).
7. Place flat gasket (400.1) on last stage casing.
8. Fit last stage diffuser (171.2), with 'O' ring (412.1) in discharge casing (107). Mount the discharge casing on last stage casing from non drive end.
9. Insert tie rods (905). Tighten the nuts of tie rods for a torque of 10 Kgm.
10. Slip lantern ring (458) (if applicable), gland (452) and splash ring (507) on discharge side.
11. Adjust the rotor position and complete the assembly of the pump as per following procedure :-

The Suction, discharge and Stage casings are clamped together by means of tie rods. Discharge side stuffing box housing, stuffing box gland, splash ring and bearing housing are mounted.

(a) Insert the spacer ring (504.1) on the shaft.
(b) Push the rotor towards suction end of the pump and measure distance 'A' from bearing bracker (350.0) end face to the spacer ring (504.1) face, as shown in the figure.
(c) Pull the rotor towards dhscharge end of the pump and measure distance 'B' from bearing bracket (350.0) end face to the spacer rign (504.1) face, as shown in the figure.
(d) '(A-B)' is the total axial play *(minimum required is 3.5 mm).*
(e) Measure depth 'C' of the bearing resting face of the bearing bracket (350.0) from its end face as shown in the figure.
(f) Reduce the thickness of the spacer ring (504.1) by

$$C - \left[B + \frac{(A - B)}{2} \right]$$

(g) Fit deep groove ball bearing (321.0) on the shaft and tighten the shaft nut (920.4).
(h) Pack the bearing with grease and fit bearing end cover (361.0) alongwith flat gasket (400.3) by hexagonal bolt (901.1).
(i) Mount suction side stuffing box housing, splash ring and bearing bracket.
(j) Fit drive end side bearing (cylindrical roller bearing with adaptor sleeve for HWD execution / deep groove ball bearing for N execution).
(k) Pack the bearing with grease and fit bearing end cover (360.0) along with flat gasket (400.3) by hexagonal bolt (901.1).

12. It must now be possible to rotate the shaft by hand without effort.

13. Before packing the stuffing boxes (see sections 4.2.1.1, and 4.2) thoroughly clean the packing compartments and the shaft protection sleeves.

Attach the piping to the pump **without trasnmitting any stresses or strains onto the latter,** then check again that the shaft is able to rotate without effort by hand.

4.5 Spare Parts

Please quote the following information when ordering spare parts :

Type : Pump size / Number of stages
Product No. :
Serial No. :
This data is stamped on the name plate.

4.5.1 Recommended stock of spare parts for two years of operation in accordance with VDMA 24 296

Part No.	Part designation	Number of pumps (incl. standby pumps)						
		2	3	4	5	6	8	10 and more
		Number of spare parts						
201	Shaft with keys	1	1	2	2	2	3	30%
230	Impeller	S	S	S	S2	S2	S3	30%
321/322	Deep groove ball bearing / Roller bearing	1+1	1+1	2+2	2+2	3+3	4+4	50% + 50%
400.1/2	Gaskets (sets)	4	6	8	8	9	12	150%
461	Gland packing (set)	4	4	6	6	6	8	40%
524.1/2	Shaft protection sleeve	2	2	2	3	3	4	50%

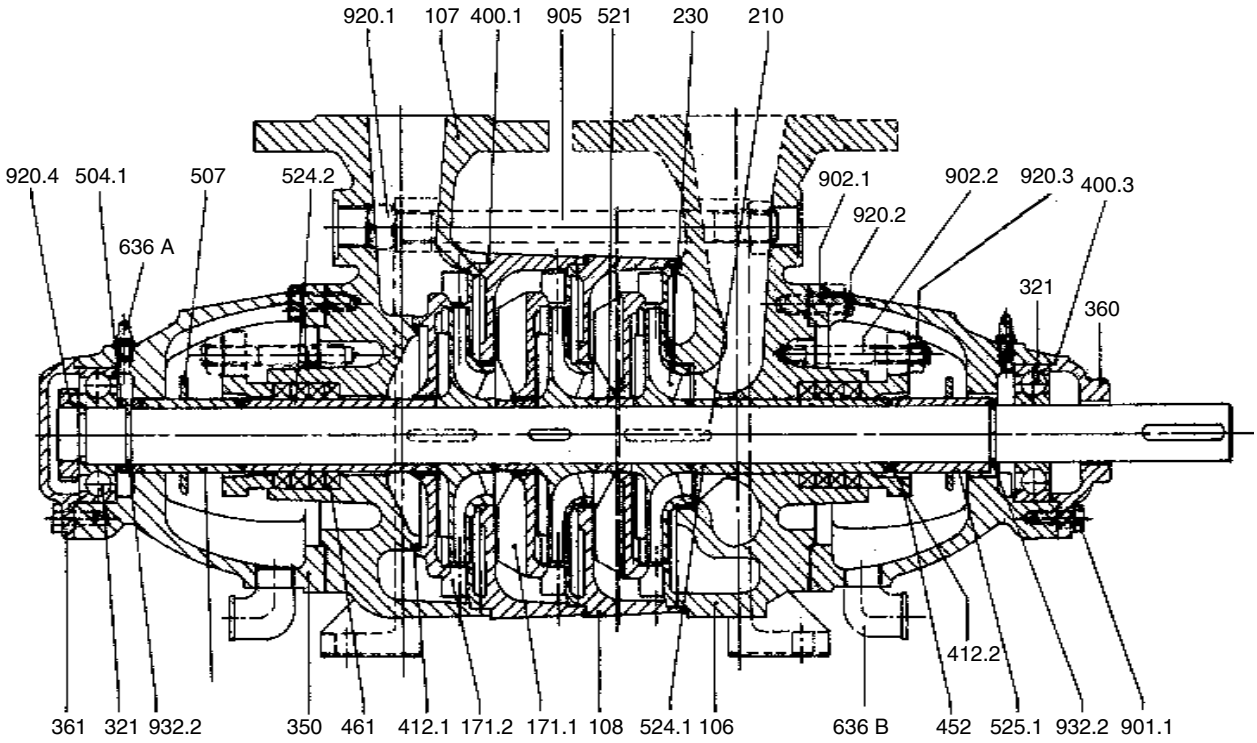
S = 1 x number of stages.

4.5.2 Storage of complete Rotor

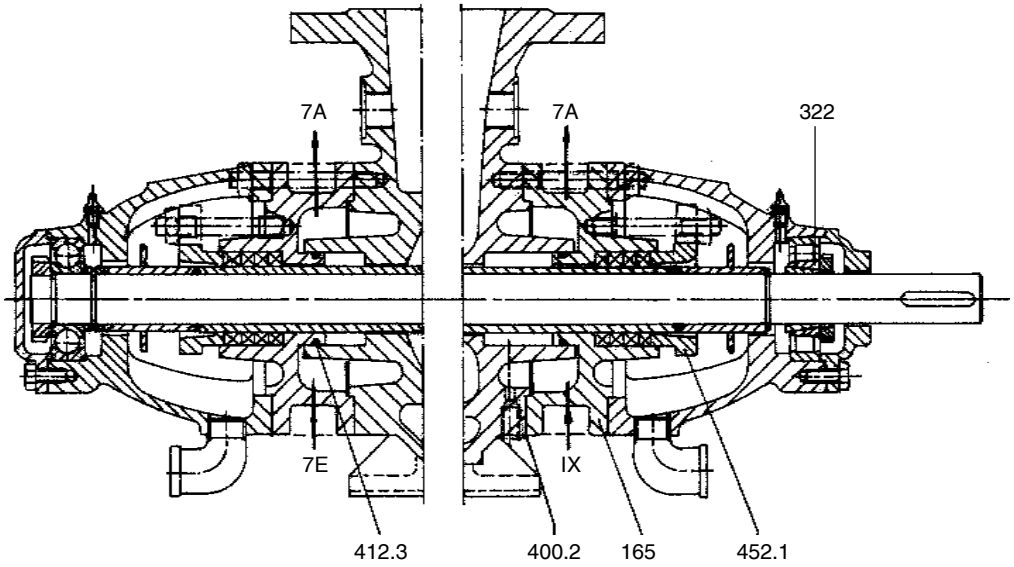
Alternatively, a complete rotor should be kept in stock, consisting of :-

1 Shaft with keys	Part No. 210
1 Set impellers	Part No. 230
2 Spacer sleeve	Part No. 525
2 Shaft protection sleeves	Part No. 524
2 O-rings	Part No. 412.2
2 Circlips	Part No. 932.1/2

4.6 Sectional Drawing and list of components.



HOT WATER DESIGN



Part No.	Description
106	Suction casing
107	Discharge casing
108	Stage casing
171.1	Diffuser
171.2	Diffuser last stage
210	Shaft
230	Impeller
321	Deep groove ball bearing
350	Bearing Housing
360	Bearing cover
361	Bearing end cover
400.1	Flat gasket
400.2	Flat gasket
412.1	'O' Ring
412.2	'O' Ring

Part No.	Description
452	Stuffing box gland
461	Gland packing
504.1	Spacer ring
507	Splash ring
521	Stage sleeve
524.1	Shaft protection sleeve
524.2	Shaft protection sleeve
525.1	Spacer sleeve
525.2	Spacer sleeve
636 A	Grease nipple
636 B	Elbow male female
901.1	Hex bolt.
902.1	Stud
902.2	Stud
905	Tie Rod

Part No.	Description
920.1	Hex nut
920.2	Hex nut
920.3	Hex nut
920.4	Key nut
932.1	Circlip
932.2	Circlip

Hot Water Design

165	Cooling cover
322	Cylindrical Roller bearing
412.3	'O' Ring
452.1	Stuffing box gland
7 A	Cooling liquid/outlet
7 E	Cooling liquid/inlet

5. Faults

Faults	Code number, Cause-remedy
Pump delivers insufficient liquid	1,2,3,4,5,6,7,8,9,10, 11,28
Driver is overloaded	12,13,14,15,20,27,28
Excessively high pump discharge pressure	15
Excessively high bearing temperature	22,23,24,25,26
Leakage at the pump	16,29
Excessive leakage at shaft seal	17,18,19,20,21,22,23, 33
The pump runs rough	3,6,11,12,22,23,25,30, 31,32
Excessive temperature rise inside the pump	3,6,32

Numbers omitted do not apply to this type series.

Cause - Remedy [1)]

1. The pump delivers against an excessively high discharge pressure.
   - Open discharge valve further until the duty point conditions have been attained (adjusted).
2. Excessively high back pressure
   - Check plant for impurities
   - Fit an oversize impeller[2)]
   - Increase rotational speed (applies to turbine or I.C. engine driven pumps)
3. The pump and/or piping are incompletely vented or primed.
   - Vent or prime the pump and system completely
4. Suction line or impeller 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
   - Install a different suction line if necessary, if the friction losses in the suction line are excessive
   - Check suction line strainer
7. Excessively high suction lift
   - Clean out suction strainer basket and suction piping
   - Check liquid level in the pit
   - Alter the suction line
8. Entrainment of air through the stuffing box
   - Sealing liquid passages are clogged; clean them out. If necessary, arrange a sealing liquid supply from an outside source, or increase sealing liquid pressure.
   - Fit a new shaft seal
9. Reverse rotation
   - Change over two of the phase leads of the power supply cable.
10. Rotational speed is tool low[2)]
    - Increase rotational speed
    - Increase voltage of power supply
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 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 tightened excessively or askew
    - Adjust the gland as required.
15. Excessive rotational speed
    - Reduce speed (applies to turbine or I.C. engine driven pump)
    - [2) 3)]
16. Defective joint
    - Renew joint between cooling cover and stuffing box housing.
17. Worn shaft seal
    - Check condition of shaft seal and renew it if necessary.
    - Check flushing liquid or sealing liquid pressure.
18. Grooving, score marks or roughness on shaft protection sleeve surface.
    - Fit a new shaft protection 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 cover plate incorrectly tightened, wrong type of packing material used
    - Remedy the fault
21. The pump runs rough
    - Correct the suction conditions
    - Check alignment of pumping set and realign if necessary.
    - Rebalance the pump rotor dynamically.
    - Increase the suction pressure at pump suction nozzle.
22. Pumping 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 or too little lubricant, or unsuitable lubricant quality
    - Top up lubricant, reduce quantity of lubricant, or change lubricant quality.
26. The prescribed coupling gap has not been maintained
    - Restore correct coupling gap in accordance with the data on the foundation drawing.
27. Operating voltage is too low.

28. The motor is running on two phases only
    - Replace the defective fuses
    - Check the cable connections.
29. The connecting bolts are slack
    - Tighten the bolts.
    - Fit new gaskets.
30. The rotor is out of balance
    - Clean the rotor
    - Re-balance the rotor dynamically
31. Defective bearings
    - Fit new bearings.
32. Insufficient rate of flow
    - Increase the minimum rate of flow
33. Faults in the circulation liquid supply
    - Increase the cross-section of the circulation liquid line.

1) The pump should be made pressureless before attempting to remedy faults concerning parts exposed to pressure.
2) Please refer to KSB.
3) This fault can also be remedied by altering the impeller diameter.

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