PUMPIRAN

WATER.OIL. ENERGY

MD Series

High Pressure Pumps

Contents

1 General

Centrifugal pumps will give trouble-free, satisfactory service if they are properly installed and maintained. Follow the instructions in this manual carefully. Do not run the pumps under operating conditions which may differ from those specified by us.
This manual does not take into account any site safety regulations which may apply. The site manager or site operator is responsible for notifying our erection staff of any such regulations and ensuring they are complied with.
The type series, pump size, main operating data, product no. and serial no. are all stamped on the nameplate attached to the pump.
Please quote this information whenever you have queries or repeat orders and in particular when ordering spare parts.

	**WARNING**
	Do not operate this pumpset above the limit values for capacity, speed, pressure and temperature etc. shown on the nameplate.

Ensure that operation is in accordance with the instructions contained in this manual (contract documentation). It is essential that the electrical connection values are as specified and that the instructions on installation and maintenance are followed.
Failure to do so can result in personal injury and damage to equipment.

N.B.
The instructions and descriptions in this manual refer to the standard pump model. This manual does not cover all design details or eventualities which might occur during installation, operation or maintenance. The pumpset must only be handled by skilled, trained personnel.
For any information and instructions not contained in this manual, please contact pumpiran.
The manufacturer accepts no liability for the pumpset if the instructions in this manual are not complied with

2 Handling

When handling the complete pumpset attach ropes to the pump and motor as shown (not through the motor eyebolt).

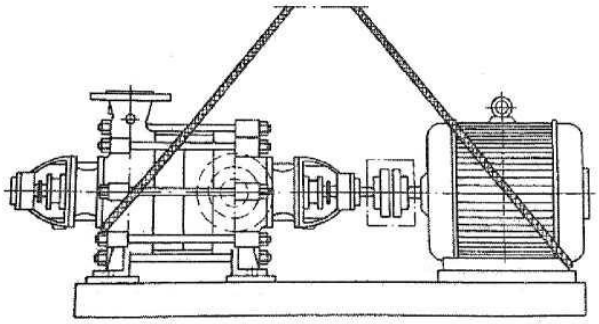


Fig. 1 Pump and motor on a common baseplate

Always handle the pumpset with the shaft in a horizontal position.
When preparing to install the pumpset ensure it cannot tip over through being top heavy.

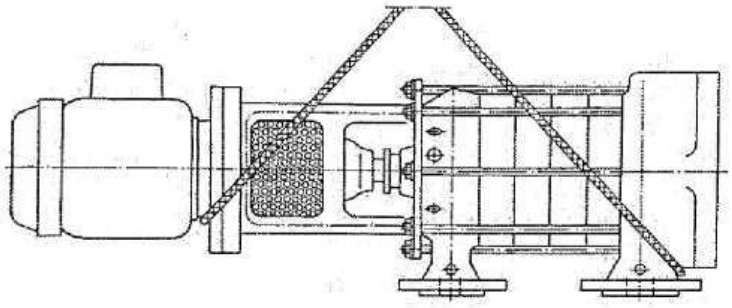


Fig. 2 Pump and motor

When handling a pump without its motor remove the coupling guard from the motor stool and attach the ropes as shown in Fig. 3.

	**WARNING**
	Do not attach ropes to the pump shaft.

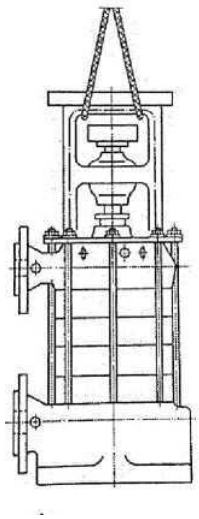


Fig. 3 Pump without motor

3 Installation

(Mounting / Installation at Site)

3.1 Foundation

Make sure that the concrete foundation has set hard before mounting the pumpset. The surface of the foundation must be

completely level and perfectly smooth.

3.2 Mounting

Position the pumpset on the foundation and align using a precision spirit level (on the shaft/discharge nozzle). Ensure that the gap between the two coupling halves is as given on the general arrangement drawing. Shims should always be fitted to the left and right of the bolts in close proximity to the bolts, between the baseplate/baseframe and foundation. If the bolts are more than 800 mm apart, position extra shims equidistant between them. All shims must seat perfectly flush.

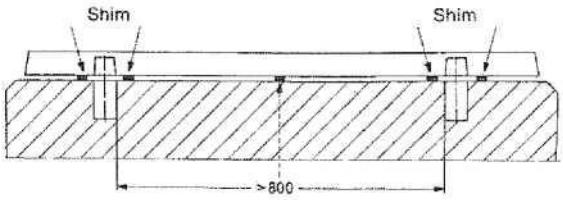


Fig. 4 Fitting shims

Uniformly tighten up the bolts.

Grout in the baseplate (non-shrinking mortar is highly recommended), ensuring no cavities remain.

If the pump and motor are supplied separately, position the pump without the motor on the foundation and align it using a precision spirit level placed on the upper thrust bearing lantern flange. Bolt the pump into place. For alignment fit shims always to the left and right of the anchor bolts near to the bolts between the pump foot and foundation. All shims must seat perfectly flush.

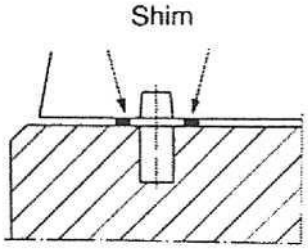


Fig. 5 Fitting shims Uniformly tighten up the bolts.

⚠	WARNING
	If the pump has two or more anchorage points (refer to the installation plan or the complete drawing) ensure that it is not subjected to axial or radial stressing.

3.3 Aligning the Pump and Motor

After the baseplate has been fixed in position carefully check the coupling and, if necessary, realign the pumpset.
Prior to the aligning check, or aligning itself, the pump feet should be loosened and tightened again free of tension.
The coupling must also be checked and the pumpset realigned even if the pump and motor are supplied ready mounted on a common baseplate.

The pumpset can be considered correctly aligned when the gap (a or b, see Fig. 6) between each shaft and a straight edge placed axially over both coupling halves is the same at all points on the circumference. Furthermore, the gap between the two coupling halves must be the same at all points on the circumference. This can be measured with calipers or a feeler gauge (see Fig. 6).

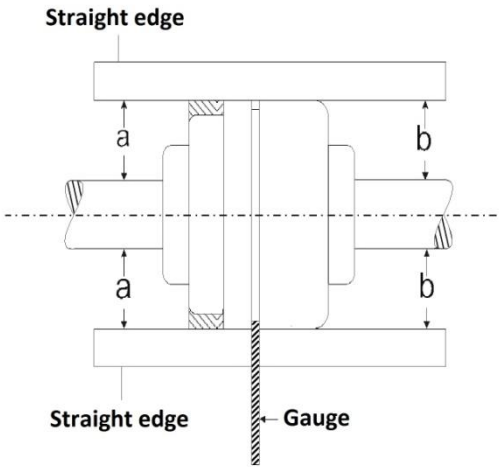


Fig.6 aligning a non-spacer type flexible coupling

The axial and radial deviation between the two coupling haves must not exceed 0.1 mm

3.4 Connecting the Piping

Never use the pump as an anchorage point for the piping.
The suction line should be run with a rising slope towards the pump, under inflow conditions with a downward slope towards the pump.
The pipes should be supported very near to 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 diameters of short pipe lines shall correspond at least to those of the pump connections; for long pipe lines the most economic nominal diameters shall be determined depending on the respective requirements.
We recommend installing non-return devices and shut-off valves, depending on the type of installation and pump.
The thermal expansion of the pipework should be accommodated by suitable means so as not to impose any extra load on the pump.
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 to prevent these from entering the pump. The total cross-section of the holes in the strainer should be three times the cross-section of the piping in order to avoid excessive pressure loss across the strainer due to clogging. The conical strainer consists of a coarse strainer fronted by a fine strainer with a 2,Omm mesh and 0,5 mm diameter wire, made of corrosion-resistant material, see DIN 41 81.

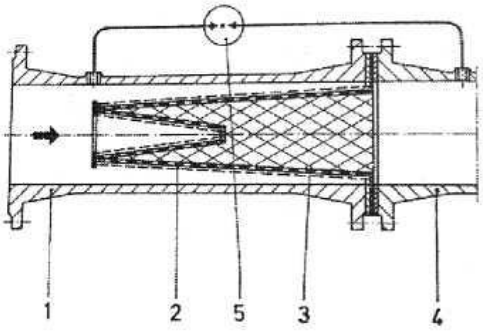


Fig. 7 Conical strainer for suction line

1.Strainer holder
2.Fine strainer
3.Coarse strainer
4.Pump suction nozzle
5.Differential pressure gauge

3.4.1 Auxiliary Connections

The size and location of all auxiliary connections for sealing, circulation, balance and leakage liquids are shown in the installation plan or piping diagram.

3.4.2 Vacuum Balance Line

If the pump has to pump liquid out of a vessel undervacuum it is advisable to fit a vacuum balance line. This pine should have a minimum nominal diameter of 25 mm and should be arranged to lead into the vacuum vessel at a point above the highest permissible liquid level.
An additional line which can be closed - the discharge nozzle balance line - facilitates pump venting prior to stars-up.

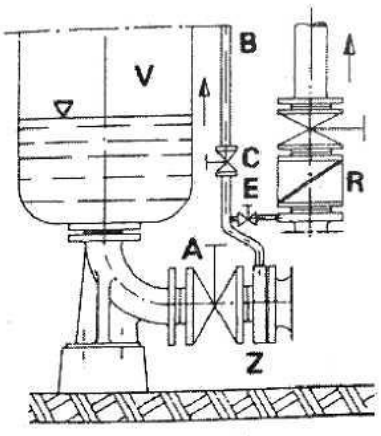


Fig. 8 Suction line and vacuum balance line

A. Main shut-off valve
B. Vacuum balance line
C. Shut-off valve
E. Vacuum-tight shut-off valve
R. Non-return valve
V. Vacuum vessel
Z. Intermediate flange

3.4.3 Minimum Flow

If the possibility is given that the pump operates against a closed shut-off valve, a minimum flow reduction at

t -10up to +100° C ~15%of Q_{opt}

t > 100 up to +140° C ~ 20%of Q_{opt}

has to be considered.

Should an exact calculation be essential in any particular case, it will be necessary to refer to pumpiran.

3.5 Direction of Rotation

The rotational direction must correspond to the arrow on the pump. Check this by switching the pump on and then off again immediately.

3.6 Coupling Guard / Thrust Bearing Lantern

Safety regulations specify that the pump must be fitted with a coupling guard / thrust bearing lantern guard. If the purchaser stipulates that lie does not want us to supply a guard then this must be provided by the operator.

3.7 Final Check

Re-check alignment as described in 1.3. It must be possible to rotate the coupling easily by hand.
Check if all connections are correct and function properly.

4 Start-up/ Commissioning, Shutdown

4.1 Preparations

4.1.1 Lubricant

The grease- lubricated bearings have already been packed with grease.

4.1.2 Shaft Seal

Check the shaft seal (see 4.4.2)

4.1.3 Priming the Pump and Associated Checks

Vent and prime the pump and suction line before start-up.
The shut-off valve in the suction line must be fully open.
Fully open all auxiliary connections and check the flow. Open the shut-off valve in the vacuum balance line (if fitted) and close the vacuum-tight shut-off valve "E" (Fig. 8).

4.2 Start-up

Start the setup only if the shut-off valve in the discharge line is closed. Slowly open the shut-off valve to obtain the required duty point after the pump has reached full speed.

	WARNING
	After the pump has reached its working temperature and / or if the pump leaks, tighten the tiebolts with the set disconnected

4.3 Shutdown

Close the shut-off valve in the discharge line. Incorporate a non-return valve, provided there is back pressure. Switch off the motor, making sure the pucopset runs smoothly and evenly down to a standstill.
If the pumpset is to remain out of service for long periods, close the shut-off valve in the suction line. Close off the auxiliary connections.
On pumps supplied with product under vacuum, sealing liquid must be supplied to the shaft seal even during standstill.
If there is a danger of freezing and / or if the pump is to be out of service for long periods, drain the pump or otherwise protect against freezing.

5 Maintenance and Lubrication

5.1 Supervision of Operation

The pump must run quietly and evenly at all times.
Max. ambient temperature 40°C.
The bearing temperature may exceed ambient temperature by 50°C but must not rise above 90°C (measured externally on the bearing housing).
Never allow the pump to run dry.
Do not run the pump for a long period against a closed shut-off valve.
The shut-off valves in the auxiliary lines must remain open while the pump is running.
If the pump has gland packing this should leak slightly during operation. The gland cover should only be lightly tightened.
If the pump has a mechanical seal this experiences only minor leakage or no visible leakage (vapour) during operation. It is maintenance-free.
Any standby pump should be started and up then shut down immediately at least once a week, to ensure they are in constant readiness for operation. Check if the auxiliary connections function properly.
The flexible coupling elements should be regularly checked and replaced as soon as they show signs of wear.

5.2 Lubrication and Grease Change
5.2.1 Lubrication

MD: grease lubrication cylindrical roller bearing

See 4.3 for details of grease fill.

5.2.2 Grease Grade / Grease Change

The bearings are lubricated by a high quality lithium soap grease. Under normal operating conditions the initial grease fill will last for 15,000 operating hours or 2 years. Under arduous operating conditions e.g. high ambient temperature, high humidity, dust-laden air or an aggressive industrial atmosphere etc. check the bearings sooner, clean them if necessary and repack with grease.
Use a lithium soap grease, resin and acid-free which is not liable to crumble and which possesses good rust-preventive properties. It should have a penetration number of between 2 and 3 corresponding to a worked penetration of 220-295 mm/10. Its drop point must be above 175 °C. Do not fill the bearings more than half with grease.
If necessary, greases on a different soap-base may be used to lubricate the bearings, however, as greases should not be mixed, it is necessary to thoroughly wash out the bearings before applying a new grease. Adapt the lubrication intervals to the new grease.

6 Dismantling and Assembly

6.1 General

⚠	WARNING
	Before dismantling, make sure the pump is disconnected from the power supply and cannot be switched on accidentally

The suction and discharge shut-off valves must be closed.
Ensure that the pump casing has cooled down to ambient temperature and that it is empty and not under pressure.

6.2 dismantling

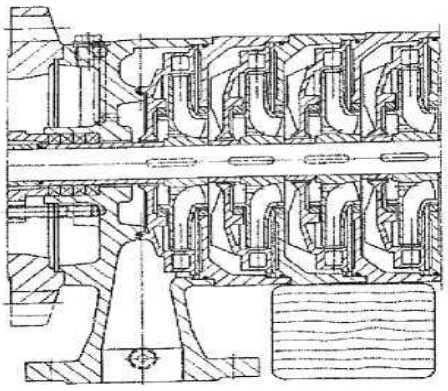
1. Detach all auxiliary supply lines
2. Remove coupling guard
3. Disconnect the pump from the motor and detach from base plate.
4. Unscrew socket head cap screw in the coupling hub and detach the coupling half from the shaft using a pull-off device.
   Remove the key 940.1.

Never use force!

2. Number and match-mark the stage casings 108 consecutively, so that the suction casing 106, stage casing 108 and the discharge casing 107 will be re-assembled in the correct sequence and position.

3. Support the stage casings 108 so that they do not collapse when the bearing housing 350 is removed (see Fig, 10).
4. Dismantle the pump from the discharge end in the sequence shown in the exploded views on pages 10 and 11
5. Remove all stages up to and including the last impeller.

6. Detach the pump from the foundation. Continue dismantling from the suction end with the shaft horizontal in the sequence shown in the exploded view on page 12.
7. Support the stage casings 108 so that they do not collapse when the discharge casing 107 is removed (see Fig.9).



(Wedge or frame)
Fig. 9 Chocking up the pump during horizontal dismantling

8. Remove all the stages up to and including the last impeller.

6.2.1 Mechanical Seal

Pull the mechanical seal 433... off the shaft by hand.Before reassembly, clean the shaft sleeves 523... touching up any grooves or scratches with a polishing cloth. If the score marks still remain visible, fit a new shaft sleeve. Clean the stationary seal ring in the seal cover 471.

6.3 Bearings

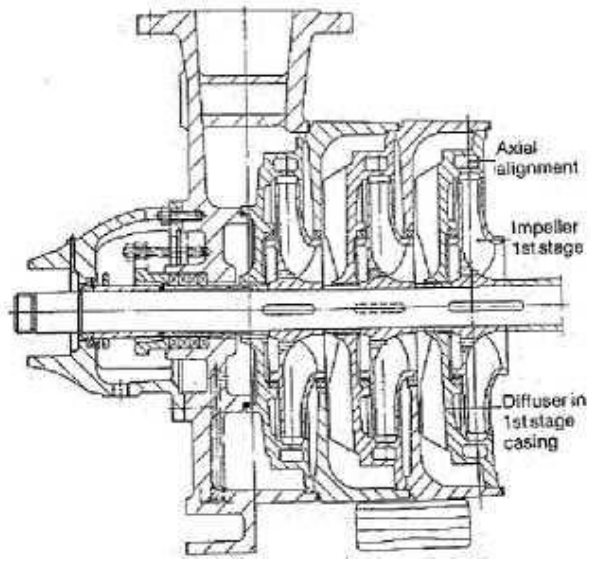
Pump Type	Cylindrical roller bearing DIN 5412
MD 50-50	NU 310 EG
MD 65-50	NU 310 EG
MD 80-50	NU 312 EG
MD 100-67	NU 315 E
MD 150-67	NU 315 E

Remove all the old grease before repacking. Lube quantity approx. 10 to 20 g per bearing.

6.4 Assembly
6.4.1 Pump

Follow standard engineering practice when assembling the pump.
Coat the fits of the various components and the screw connections with graphite or similar before assembly. Check the O-rings for damage and replace them if necessary. Fit new gaskets throughout, ensuring that they are of the same thickness as the old ones.
Reassemble in the reverse order to dismantling. It is essential that the components are fitted in the correct sequence.

If new parts are fitted, realign the first stage impeller 230 axially in relation to the diffuser.
After mounting the first stage diffuser 171.1 align the shaft and impeller so that the centre of the impeller (outlet) corresponds to the centre of the diffuser (inlet) (see Fig. 10).



(Wedge or frame)
Fig. 10 Axial alignment of rotor

Then make a reference groove (see Fig. 11) on the shaft in line with the outer edge of the bearing housing 350.1. Remove the diffuser fitted for alignment.

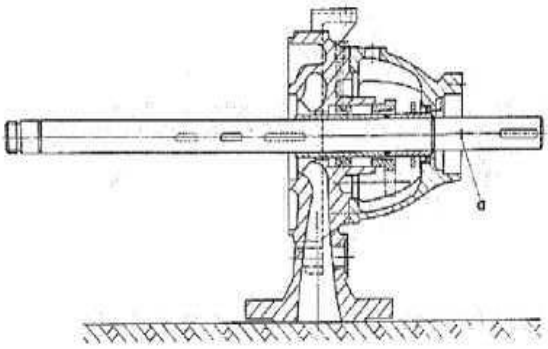


Fig . 11 a=reference groove
When the bearing 320 is in position, the reference groove must be in its original position.

Make up for difference by fitting spacer ring 504 (required size = y - x = length of spacer ring, see fig. 12).

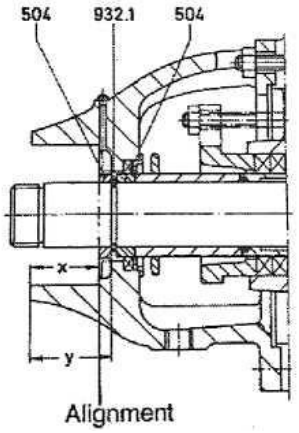


Fig. 12 correctly sized spacer ring

It must be possible to easily rotate the shaft by hand.

6. 4.2 Shaft Seal

6. 4.2.1 Stuffing box compartment

Thoroughly clean the packing compartment and shaft sleeve before packing the gland.

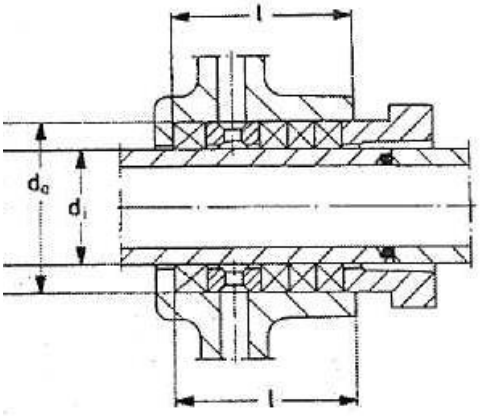


Fig. 13 MD stuffing box compartment

Discharge & Suction side

mm

MD	50-50			65-50			80-50			100-67			150-67		
	d_i	d_a	l	d_i	d_a	l	d_i	d_a	l	d_i	d_a	l	d_i	d_a	l
packing compartment															
Suction side	55	75	75.5	55	75	74	65	90	86	75	107	109	75	107	112
Discharge side	55	75	74	55	75	74	65	90	86	75	107	108	75	107	108
No. of rings															
Suction side	5 packing ring , 1 lantern ring														
Discharge side	5 packing ring , 1 lantern ring														
Required packing															
Suction side	10 x 10			10 x 10			12 x 12			16 x 16			16 x 16		
Discharge side	10 x 10			10 x 10			12 x 12			16 x 16			16 x 16		

6. 4.2.2 Packing ring

Fig. 14 packing ring cut to size

Insert the first packing ring and push it home using the gland cover.

Fit each subsequent ring separately with its joint offset by 90 to the preceding one pushing it home with the gland cover.

Tighten the gland cover lightly and evenly. It must be possible to rotate the rotor without difficulty.

6. 4.2.3 Mechanical Seal

Reassemble in the reverse order to dismantling.
When fitting the mechanical seal, bear the following points in mind:
Maximum care and maximum cleanliness are mandatory.
Do not remove the guard on the seal faces until just before fitting.
The seal faces and O-rings must not be damaged.
Clean or carefully remove any deposits from the shaft and stationary seal ring seat in the bearing housing.
The shaft sleeve 523 may be oiled to reduce friction when mounting the seal.

⚠	WARNING
	Epoxy rubber O-rings must not come into contact with oil or grease. Use water

Push the stationary seal ring into the seal plate by hand, applying pressure evenly to all sides.
When fitting double Teflon-sheathed O-rings, ensure that the ridge of the sheath faces away from the direction of insertion.

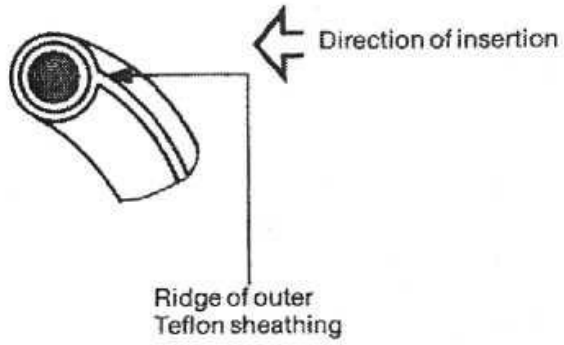


Fig.15 Teflon-sheathed O-ring

6.4.3 Tightening Torques for the Tie bolts

MD	50-50	65-50	80-50	100-67	150-67
Torque N.m	200	250	300	350	400

6.4.4 External Source Sealing Liquid (vacuum operation)

Flow rate of external source liquid (vacuum operation only) approx 1 l/min, sealing liquid pressure: 0.5 bar+ inlet pressure (p_z) at least 0.1 bar above atmospheric. The sealing liquid must be compatible with the product pumped.

6.5 Spare Parts

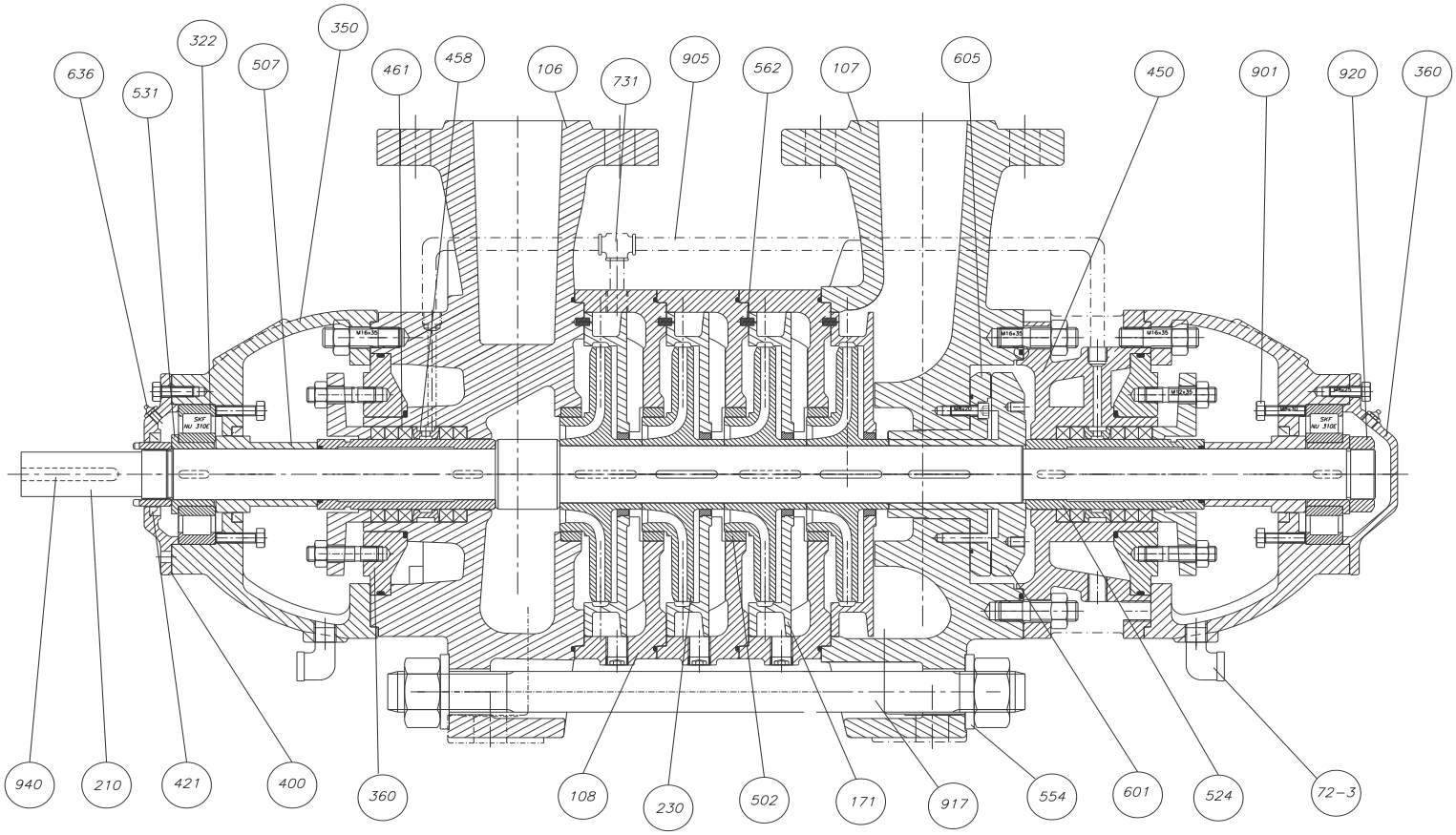
6.5.1 Ordering Spare Parts

When ordering spare parts please always indicate the following information which may be taken from the nameplate of the pump.

6.5.2 Recommended List of Spare Parts for 2 Years' Continuous Operation

Part no.	Part designation		No. of pumps (including standby pumps)							Alternatively stocking a complete rotor, comprising:
			2	3	4	5	6,7	8,9	10 and above	
			Quantity of spare parts							
On pumps with a gland packing										
210	Shaft with nut with two flats 920.4, circlips 932.1 /.2 and keys940.1 /.3/A /.5/.6		1	1	2	2	2	3	30%	1 off
230	Impeller (set = S)		1	1	1	2	2	3	30%	1 set
320	Angular contact ball bearing		1	1	2	2	3	4	50%	
322	Cylindrical roller bearing with clamping sleeve 531		1	1	2	2	3	4	50%	
412.1/.2	O-ring (set)		4	6	8	8	9	12	150%	1 set (412.2 only)
412.4	O-ring (set = S)		4	8	8	8	9	12	150%	
461	Gland packing (set).		4	6	8	8	9	12	150%	
502	Casing wear ring (set=Sx2)		2	2	2	3	3	4	50%	
521	Stage sleeve (set=S-1)		2	2	2	3	3	4	50%	1 set
524.1/.2	Shaft protecting sleeves (set=suction and discharge side)		2	2	2	3	3	4	50%	1 set
525.1/.2	Spacer sleeves(set=suction and discharge side)		2	2	2	3	3	4	50%	1 set
525.3	Spacer sleeve (only onsize150suctionside)		2	2	2	3	3	4	50%	
On pumps with mechanical seal										
400.5	Gasket	Replace part nos. 461 and 524.1/.2	4	6	8	8	9	12	150%	
433	Compl. Mechanical seal		2	3	4	5	6	7	90%	
523.1/.2	Shaft sleeves (set)		2	2	2	3	3	4	50%	1 set

S = no. of stages



Part No.	Part Designation	Part No.	Part Designation
106	Suction Casing	531	Ball Bearing Sleeve
107	Discharge Casing	636	Grease Nipple
210	Pump Shaft	920	Hex. Nut
230	Impeller	940	Key
360	Stuffing Box Housing Cover	421	Radial Shaft Seal Ring
920	Hex. Nut	360	Bearing Cover
901	Hex. Head Bolt	400	Flat Gasket
450	Stuffing Box Housing	322	Single Row Cylindrical Roller Bearing
605	Balancing Bush	108	Stage Casing
562	Cylindrical Pin	502	Wear Ring
905	Pipe (Unsteam)	171	Diffuser
731	Pipe Union	917	Tie Bolt
458	Lantern Ring	554	Washer
461	Stuffing Box Packing	601	Balancing Piston
350	Bearing Housing	524	Shaft Protecting Sleeve
507	Thrower	72-3	Angle

7 Faults

Pump delivers insufficient liquid	Motor over loaded	Excessively high discharge pressure	Bearings overheating	Pump leaks	Excessive shaft seal leakage	Pump runs noisily and roughly	Excessively temperature increase in the pump	Cause	Remedy [1]
X								Pump generates an excessively high	Re-set the duty point
X								Excessively high back pressure	Check installation for contamination Fit larger impeller(S) [2] Increase speed(of turbine or combustion engine)
X						X	X	Pump and / or piping inadequately vented or primed	Vent or prime
X								Suction line or impeller(s) clogged	Remove deposits in the pump and / or piping
X								Formation of air pockets in the piping	Alter the piping layout Fit a vent valve
X						X	X	Suction head too high/ $NPSH_{plant}$ too low	Correct the liquid level Fully open the suction side shut-off valve Modify the suction line if the piping losses are excessive Check the suction strainers/suction aperture Ensure that the permissible rate of pressure decrease is not exceeded
X								Ingress of air at the shaft seal	Clean out the sealing liquid passage, possibly in troduce an external source sealing liquid or increase the pressure Fit a new shall seal.
X								Reverse rotation	Change over two phases of the power supply
X								Speed too low [2]	Increase the speed
X						X		Excessive wear to pump internals	Replace the worn components
	X					X		Pump back pressure is lower than specified in order	Re-set the duty point correctly In the case of persistent overloading, consider trimming the impeller(s) [2]
	X							Specific gravity or viscosity of the product pumped is higher than specified in the order [2]	

1) The pump should be made pressureless before attempting to remedy faults in parts under pressure
2) Please contact Pumpiran

Pump delivers insufficient liquid	Motor over loaded	Excessively high discharge pressure	Bearings overheating	Pump leaks	Excessive shaft seal leakage	Pump runs noisily and roughly	Excessively temperature increase in the pump	Cause	Remedy [1]
	X				X			Gland cover is too tight or tightened askew	Rectify
	X	X						Speed too high	Reduce the speed [2]
				X				Tie bolts / gaskets	Tighten up the tie bolts Fit new gaskets
					X			Worn shaft seal	Fit a new shaft seal Check the pressure of the flushing/sealing liquid
					X			Surface of the shaft protecting sleeve/shaft sleeve is scored or rough	Fit a new shaft protecting sleeve/shaft sleeve Fit a new shaft seal
					X			Uneven running of pump	Rectify the suction conditions Re-align the pump Rebalance the rotor Increase the pressure at the suction nozzle
			X		X	X		Pumpset misaligned	Re-align
			X		X	X		The pump is warped or there are resonance vibrations in the piping	Check the piping connections and the pump holding bolts,if necessary,reduce the gap between the pipe clamps Fix pipings over vibration absorbing material
			X					Excessive axial thrust[2]	Clean out the balance holes in the impeller
			X			X		Excessive, insufficient or unsuitable lubricant	Reduce or increase the lubricant quantity or change the lubricant
			X			X		Specified coupling gap not respected	Correct the coupling gap as per installation plan
X	X							Motor runs on two phases	Replace the defective fuse Check the electrical connections
						X		Rotor unbalanced	Rebalance the rotor
						X		Bearings defective	Fit new bearings
						X	X	Inadequate flow	Increase the minimum flow
					X			Faults in the circulation liquid supply	Increase the cross-section of the line supply

1) The pump should be made pressureless before attempting to remedy faults in parts under pressure
2) Please contact Pumpiran

PUMPIRAN

WATER.OIL.ENERGY

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