IDROCHEMICAL
CENTRIFUGAL PUMPS AND MIXERS

NCB LINE
HORIZONTAL CLOSED COUPLED CENTRIFUGAL PUMPS

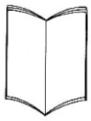
INSTALLATION, USE AND MAINTEINANCE MANUAL

CE

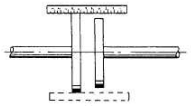
CONTENTS

SAFETY NOTICE

Before starting the pump carry out the following operations

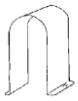


Install and operate the pump according to the instruction indicated in this manual



Make sure that the pump lay on a stable foundation and that the alignment between pump and motor is correct before and after fixing baseplate and piping

Fill the bearing house with the reccomended oil



Make sure that the coupling guard is correctly and safetely installed

Make sure that all the external connections to the pump and to the shaft seal are connected properly

Never operate the pump when dry

1. GENERAL

1.1. GUARANTEE

We undertake to guarantee the construction materials only if the pump is operated according to the conditions of service given in our order confirmation.
The operating and maintenance personnel should study these operating instructions before erecting the pump.
In accordance with our terms of delivery we cannot accept responsibility for damages resulting from the failure to follow these instructions.

1.2. TESTING

Before leaving our works all pumps are subjected to performance test. Only pumps in perfect working order which meet the design performance figures leave our works. By observing the following instructions the pump will give trouble-free operation and meet the specified design performance.

1.3. RATING PLATE

The work and item numbers are stamped on the rating plate. When ordering spare parts, you are required to provide these numbers as well the exact description of the part and its number as listed in the component list.

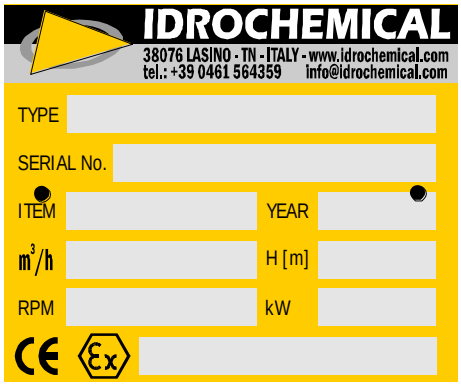


Figure 1 Rating Plate

2. DESCRIPTION

2.1. CONSTRUCTION

The NCB chemical pump is a single stage volute casing pump of process form construction with axial suction and radial discharge nozzles. The one piece volute casing, opening onto the discharge side, which has sturdy integrally cast feet, can remain attached to the piping during maintenance work.
With pump ends conforming to ISO 2858 dimensional and technical standards and to ISO 5199 design criteria, the NCB provides a compact, space-saving arrangement ideal for industrial processes or installations when space is at a premium. NCB pumps are fitted with standard, readily available electric motors so the user can choose an enclosure to suit the application.
The axial thrust is hydraulically balanced by means of back vanes on the impeller. The back vanes are left or trimmed according to suction pressure, so that the pressure on the stuffing box/mechanical seal can be balanced.
The clearance between the impeller and wear ring is determined by the temperature of the fluid and the construction materials.
The impeller is located on the shaft by means of parallel key and retained by a cap nut.
If the pump handles a corrosive liquid, to prevent the medium coming into contact with the shaft, sealing rings of suitable material are fitted between the impeller nut, impeller, shaft sleeve and flinger ring.

2.2. SHAFT SEALING STUFFING BOX

The pump shaft is sealed at the casing back plate by soft stuffing box packing. The stuffing box is normally packed with 4 packing rings and a lantern ring, or 6 packing rings if the lantern is not required.
To repack the stuffing box the lantern ring, gland ring and gland can be removed as the gland is open at the bottom and the lantern and gland rings are split.
Fluid is fed to the lantern ring when:

- The packing must be cooled or lubricated
- The packing must be flushed because the medium contains solids which can damage the packing
- The medium is toxic or pungent so that it does not leak out to the atmosphere
- The medium evaporates at atmospheric pressure

Arrangement a) stuffing box without lantern ring

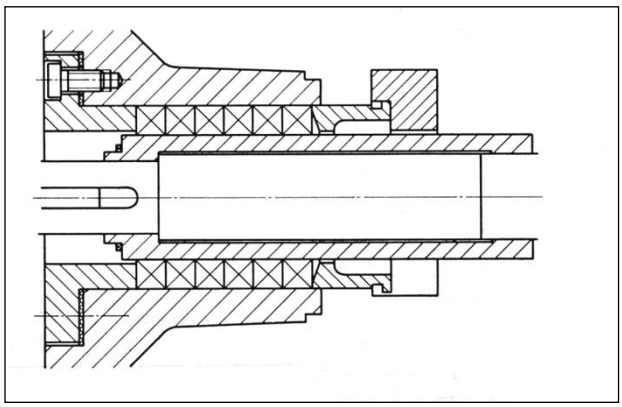


Figure 2 Arrangement a) stuffing box without lantern ring

The medium should be clean and free from impurities and have a good lubricating properties and a moderate temperature.

The suction pressure must be somewhat greater than the atmospheric pressure so that small quantities of the medium are forced out through the stuffing box packing to ensure that the gland is adequately lubricated.

Arrangement b) Stuffing box with lantern ring between 4 packing rings

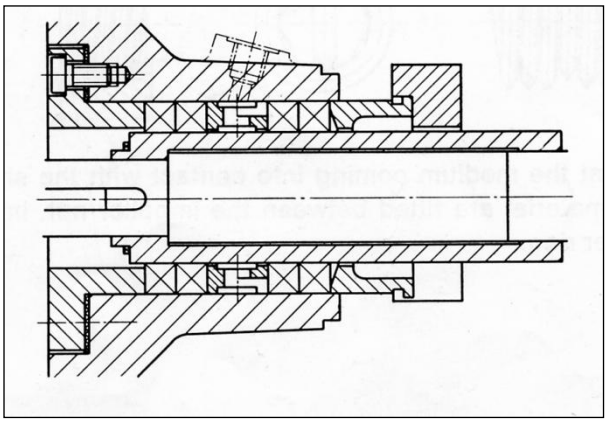


Figure 3 Arrangement b) Stuffing box with lantern ring between 4 packing rings

For fluids with poor lubricating qualities and a high temperature but clean and free from abrasive impurities.

The suction pressure must be less than atmospheric pressure and the sealing fluid must be fed in at a pressure of 1-2 atmospheres greater than the suction pressure. As small quantities can penetrate into the pump, the sealing fluid must be compatible with the pumped fluid.

Arrangement c) Stuffing box with lantern ring at bottom end of stuffing box

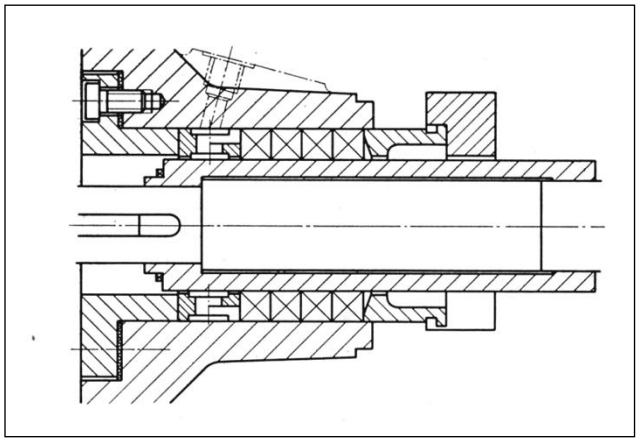


Figure 4 Arrangement c) Stuffing box with lantern ring at bottom end of stuffing box

This arrangement is recommended for fluids with high temperatures that contain abrasive solids or tend to crystallize

2.3. SHAFT SEALING – MECHANICAL SEALS

The advantage of a mechanical seal over a stuffing box is that the seal face which is subjected to wear, is at right angles to the surface of the shaft. Sealing takes place in the radial gap between finely lapped stationary and rotating faces which are forced together by a spring. While the pump is in operation the mechanical seal requires no servicing and seals so that no leakage occurs.
In a short time a film of fluid penetrates between the seals faces which removes the frictional heat by its circulatory effect. The circulating fluid depends on the liquid pumped. It can be the liquid pumped provided it is clean or a compatible fluid introduced from an external source.
The choice of seal depends on the conditions of service.

2.3.1. single unbalanced mechanical seal

This seal can only be employed when the fluid pumped is free from solids and does not crystallise. The maximum permissible stuffing box pressure varies depending on the seal manufacture. The circulating fluid is introduced at the seal faces by means of a recirculation harness from the discharge nozzle to the sealing cover plate and drawn back into the suction side of the pump by means of the impeller back vanes. The required flow of the recirculating fluid depends on the fluid pumped and its temperature and can be regulated by an orifice or a valve in such a way that the temperature at the sealing cover plate is not appreciably higher than elsewhere in the pump.

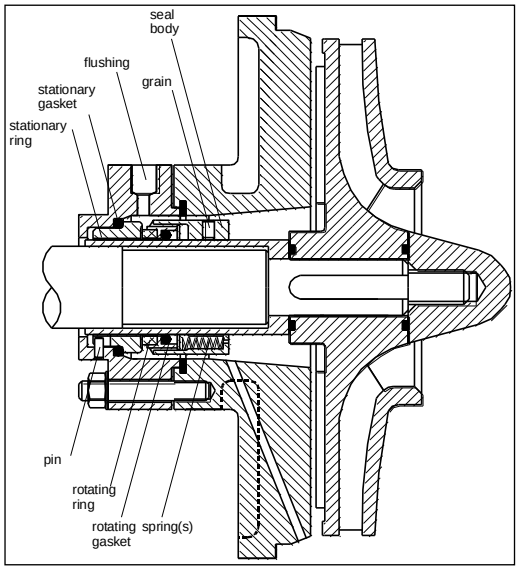


Figure 5 Single unbalanced mechanical seal

The flushing liquid inlet pressure is generally given by the following equation:

$$P_i = P_a + \frac{\Delta P}{2} + 1$$

where P_i is the inlet pressure in bar, P_a the maximum pump suction pressure in bar and ΔP the pump head in bar.

2.3.2. Single mechanical seal with quench

The quench is recommendable when medium forms solid deposits or crystalizes when it comes in contact with the atmosphere or low temperature. Quench is normally applied conveying steam or clean liquid at a pressure not exceeding 1 bar. Quench is helpful to recover occasional leakages, or, in case of under vacuum, to avoid dry- running.

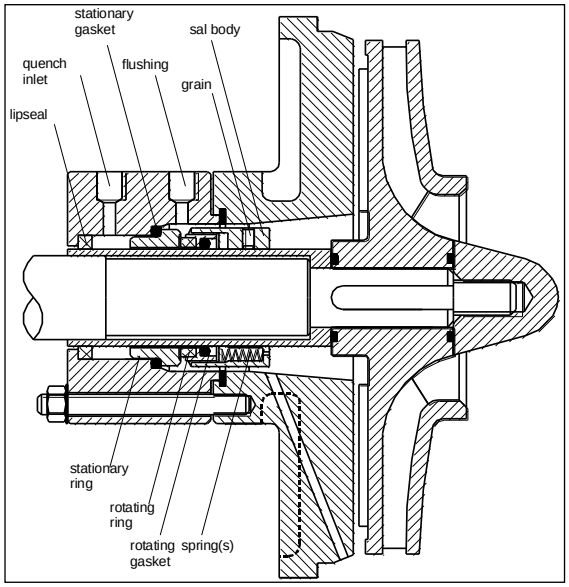


Figure 6 Quench

2.3.3. External mechanical seal

The media is inside the seal. The outer seal is generally used to handle corrosive or toxic liquids. Springs and all the metallic parts are not in contact with the pumped fluid.

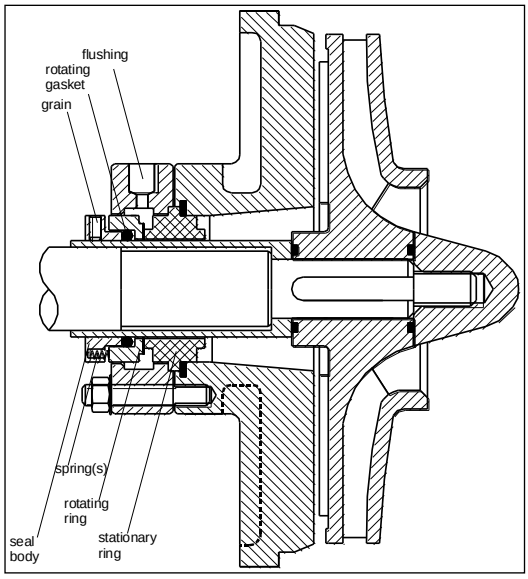


Figure 7 External mechanical seal

2.4. DOUBLE MECHANICAL SEAL

This arrangement is employed when the liquid contains solids, gels or crystallises when cooled, is toxic or is near saturation and the danger of evaporation exists.
A compatible sealing fluid must be chosen as small quantities penetrate into the pump. The sealing fluid is externally introduced into the seal housing through the casing backplate and emerges through a connection in the sealing cover plate. The pressure of the sealing fluid must be 1—2 bars above the internal pressure at the in-board seal face but should not exceed a certain given design pressure. The flow of the sealing fluid can be regulated by an orifice or a valve in such a way that the temperature at the sealing cover plate is not appreciably higher than elsewhere in the pump.

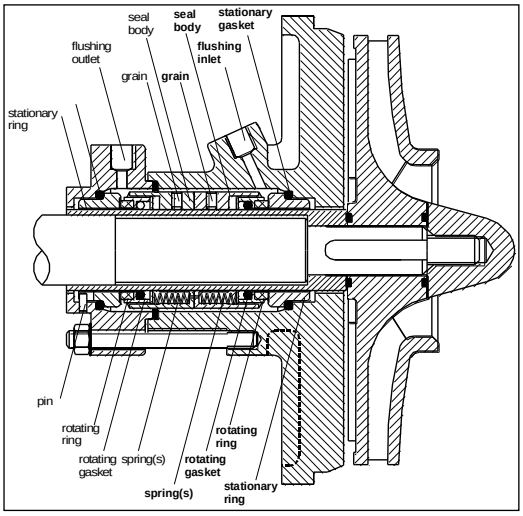


Figure 8 Double mechanical seal (back to back)

2.4.1. Double tandem Mechanical seal

The inner seal works like a single seal while the secondary seal is set up for safety to prevent leakages induced from a damage of the principal one.

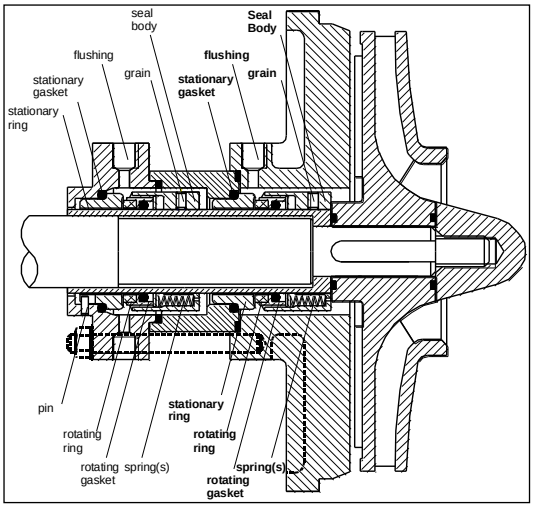


Figure 9 Double tandem mechanical seal

3. ERECTION OF THE PUMP

3.1. INSTALLATION

Lift and transport the pump-motor units, as indicated in figure 10

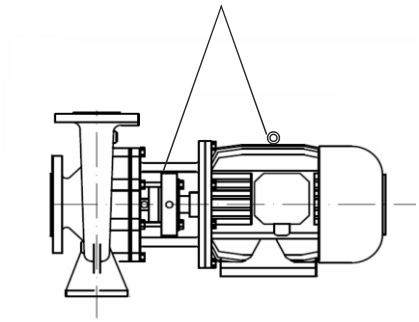


Figure 10

The suction pipe, whose internal diameter should never be smaller than the suction port, should be arranged in accordance with the suction conditions and consider product and temperature's characteristics. Make sure that connections in the suction pipe are perfectly airtight. Moreover, the suction pipe, in the horizontal sections must have a positive slope towards the pump to avoid that air pockets occur inside the pipeline. Should the pump run with a positive slope, pipe is descendant towards the pump. Should the pump run with a negative slope in the suction pump, install a foot valve at the end of the pipe, to allow and keep priming of the pump. Fit a check-valve in the delivery pipe to protect the pump from too high counterpressures or reverse rotation (after each stop).

Suction and delivery pipes have to be supported aside from the pump but as close to it as possible. Be sure that the pipes are installed to allow the perfect mating of flanges and counterflanges, avoiding stress transmission to the pump. A compensation bellows is also necessary to absorb expansions caused by hot liquids.

Electrical connection must be carried out by a qualified electrician in accordance with local regulation. Make sure that the supply voltage corresponds to the voltage on the motor plate. It will be the local responsible' s task to make sure earthing is carried out first and all the installation operations are performed in compliance with the applicable regulation. Provide a device to disconnect each phase from the supply with a break of 3mm between the contacts in the open position. Regarding motor protection, install a switch or a thermal relay for the current indicated on the motor plate, plus 5%.

3.2. CONTROL

After the pump has been erected the pump and driver should be examined to see if they are standing true. A quiet running coupling prevents premature wear on the bearings. The complete set should be easily turned by hand at the coupling.
The direction of rotation of the driver must be the same as that of the pump —see arrow on the bearing house or casing. To check this the uncoupled motor should be switched on for a short period.
The direction of rotation can be altered by changing the poles of two phases.

For a constant and efficient check, install a gauge on the discharge pipe and a vacuum gauge on the suction pipe.

3.3. PIPING

The bore of the piping should not be smaller than the respective pump nozzles and free from scale, welding beads and other foreign bodies. The piping should be so laid that it transmits no stress to the flanges and nozzles when connected.

The piping bore at the discharge side should be so sized that a flow velocity not greater than 2,5—3,0 m/sec. results so as to minimize friction loss in the piping. A control valve should be incorporated into the discharge line as close to the pump discharge nozzle as possible so that the flow and head can be regulated. Sharp bends, abrupt cross-sections etc. should be avoided.

The suction line should be so arranged that air locks cannot form.
Eccentric reducers should be used to bridge the difference between piping of larger bore and the suction and discharge nozzles. A stop valve should be incorporated in the suction line which should be fully opened when the pump is operating and not used as a regulating valve to control the flow.
The flow velocity in the suction line should not, if possible, exceed 2,5 m/sec. The flow velocity can be calculated using the following equation:

$$v\left[\frac{m}{s}\right] = Q\left[\frac{m^3}{h}\right] \cdot \frac{1}{3600} \cdot \frac{1}{A\left[m^2\right]}$$

Where v is the flow velocity, Q the capacity and A the pipe cross section.

4. OPERATION OF THE PUMP

4.1. STARTING UP

Turn on the sealing/flushing fluid supply and check its flow.

When the pump has the double back to back mechanical seal the pressure in the seal chamber must be always higher then the pressure in the pump (see Section 2.4).

Open the stop valve in the suction line and close the valve in the discharge line. Start the driver and slowly open the valve in the discharge line until the pump has attained the required discharge head.

4.2. SHUTDOWN

First close the discharge valve, then switch off the driver, close the valve in the suction line and finally turn off the sealing/flushing fluid.

4.3. SUPERVISION AND MAINTENANCE

The chemical centrifugal pump requires little supervision after it has been run-in. The following points should, however, be observed:

- Stuffing box

If pump is provided with stuffing box read the following instructions.
During operation the stuffing box should weep slightly.
Initially the stuffing box should only be very lightly tightened and then evenly tightened up over a prolonged period after running in.
Trouble free sealing depends upon the choice of the packing material and the careful supervision of the stuffing box.
Before fitting new packing the stuffing box housing and gland should be carefully cleaned. If the shaft sleeve is worn it should be replaced. When inserting the packing rings care should be taken to ensure that the lantern ring is correctly placed under the sealing fluid inlet. See sectional drawing of the pump.

4.4. OPERATING TROUBLES AND THEIR POSSIBLE CAUSES

If the capacity of the pump drops it may traced to one of the following causes:

1. Driver speed too low

2. Increase in the discharge pressure resulting in a smaller capacity. This can be deviated by increasing the speed of the pump or fitting a larger impeller.

3. Cavitation of the pump sets in. This can be caused by a drop in the pressure in the suction line or by too low a discharge pressure. This can be remedied by throttling the discharge or raising the suction pressure.

4. Excessive wear of wear ring and impeller boss:

a) By pumps with shrouded impellers fit new wear ring and if necessary refurbish impeller

b) By pumps with open impellers adjust clearance between impeller and wear plate. Renew worn parts

5. Ingress of air into the stuffing box when the pump is operating under suction lift conditions. Provide sealing fluid to the stuffing box.

6. If the mechanical seal leaks:

The seal faces have been worn by normal use, or damaged by running dry or by solids in the fluid.

The seal faces should be replaced or a new mechanical seal fitted.

5. INSPECTION AND RENEWAL OF WEAR PARTS

5.1. GENERAL

When dismantling the pump all parts should be handled with care and knocks and blows be avoided.

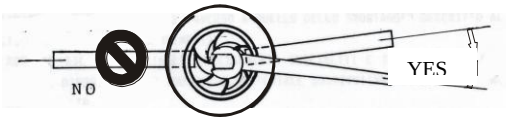
5.2. DISMANTLING THE PUMP

With the help of the cross-sectional drawing in the Appendix A the pump can be dismantled as follows:

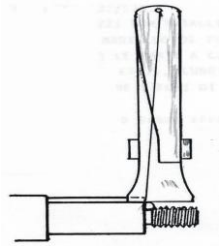
1. close discharge valve
2. close suction valve
3. avoid the possibility off turning on the pump
4. drain pump by opening drain plug (POS. 263)
5. undo auxiliary piping for cooling/flushing fluid.
6. dismantle the coupling guard
7. undo Nuts (POS: 472) on casing.
8. extract rotating assembly from casing.
9. remove the casing gasket (POS. 700)
10. check wearing rings if provided (POS. 180) and remove them if damaged
11. bring rotating parts in a clean place

If mechanical seal arrangement is double continue to point 15 otherwise skip to point 20

12. loose the 4 nuts of mechanical flange (POS. 473). Remove very carefully the seal flange (POS: 210) using two levers
13. loose impeller nut (POS. 430) by means of two lever as shown in the following picture:



14. remove the gasket (POS 720), and remove the impeller by means of an extractor positioning the jaws on impeller blades
15. remove the impeller key (POS. 500) as shown in the following picture



16. remove the gasket (POS. 710)

17. In case of single mechanical seal arrangement without mechanical seal flange (POS. 210), remove carefully the stuffing box (POS. 120) and the mechanical seal by means of 2 levers. If the mechanical seal is double the stuffing box in independent from mechanical seal. Remove then the mechanical seal, the shaft sleeve and the mechanical seal flange.

5.3. REASSEMBLY OF THE PUMP

The reassembly of the pump is carried out in the reverse order. To ensure trouble free running the pump should be reassembled with the greatest of care.

The following points should be carefully observed.

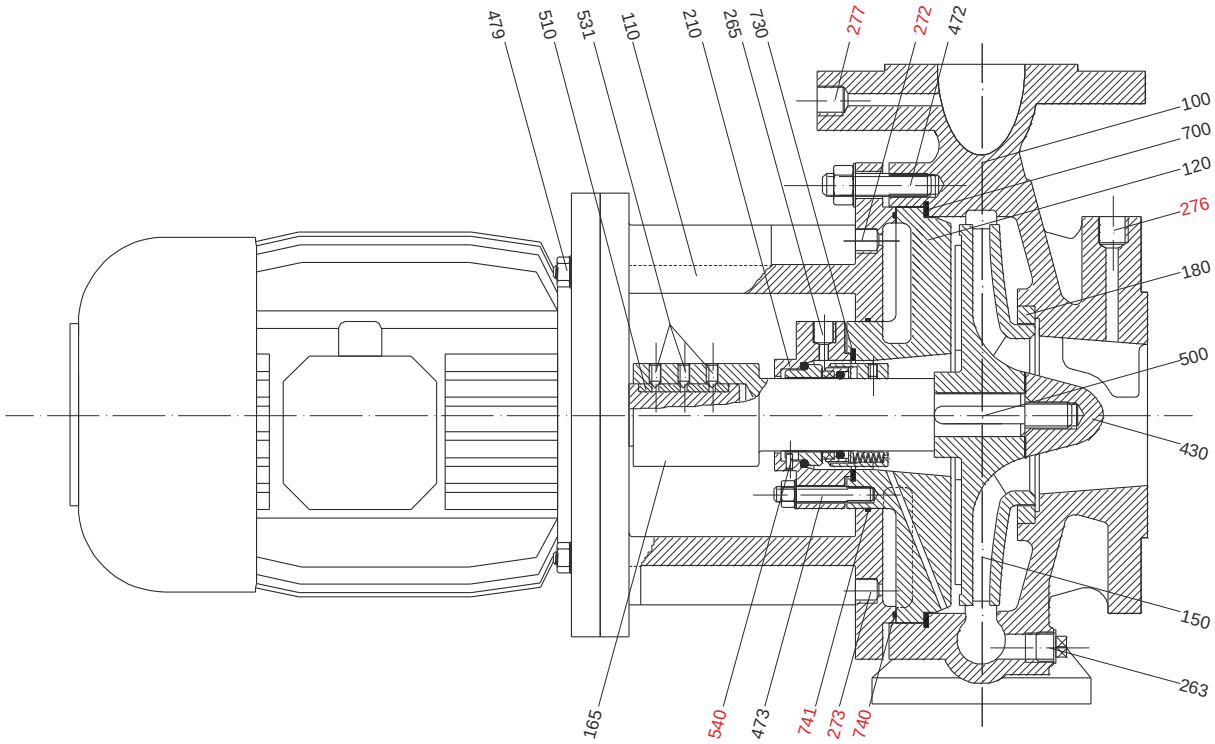
a) Take care not to damage the mechanical seal when fitting.

b) The shaft sleeve of soft packed pumps should be free from wear grooves and remnants of old packing.

c) Carefully fit keys and shaft sealing rings, making sure that the gaskets and sealing faces are clean.

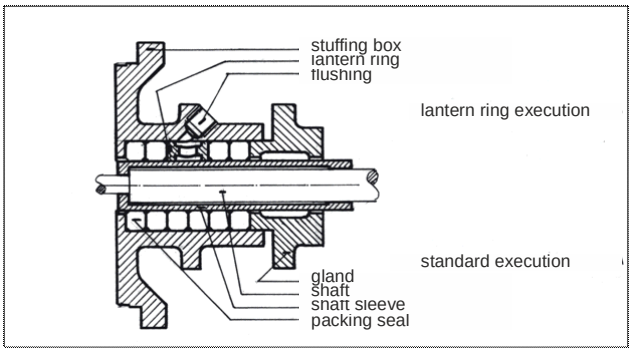
d) By pumps with open impellers the clearance between the impeller and wear plate must be adjusted to approx. 1 mm by means of screws

APPENDIX A – SECTIONAL DRAWING – standard execution



ITEM	DESCRIPTION
100	casing
110	lantern
120	seal housing
150	impeller
165	conter-shaft
180	wear ring
210	mechanical seal flange
263	casing drain
265	flushing
272	connection
273	connection
276	connection
277	connection
430	impeller nut
470	screw
472	screw
473	screw
479	screw
500	impeller key
510	key
540	pin
700	casing gasket
710	gasket
730	gasket
741	gasket

Packing Gland Execution



APPENDIX E – RECOMMENDED SPARE PARTS

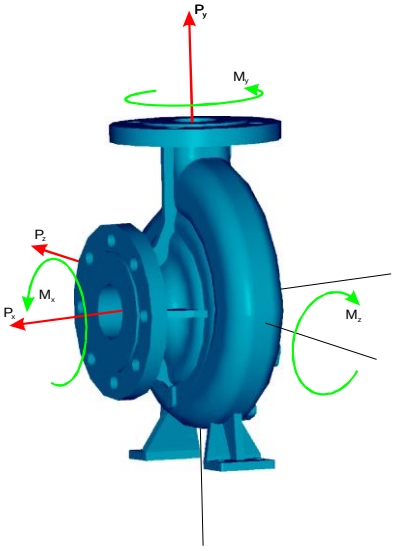
RECOMMENDED SPARE PARTS FOR 2 YEARS WORKING									
POS.	DESCRIPTION	No. OF PUMPS							
		1	2	3	4	5/6	7/8	9	10 (+)
150	**IMPELLER**	**0**	**1**	**1**	**2**	**2**	**2**	**3**	**30%**
180-190	**WEARING RINGS (IF PROVIDED)**	**1**	**2**	**2**	**2**	**2**	**3**	**4**	**50%**
170	**SHAFT SLEEVE (IF PROVIDED)**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**20%**
700-710-720-730	**GASKET SET**	**2**	**5**	**7**	**9**	**10**	**10**	**12**	**120%**
-	**MECHANICAL SEAL**	**1**	**2**	**3**	**4**	**5**	**7**	**9**	**100%**

APPENDIX F – ALLOWABLE FORCES AND MOMENTS

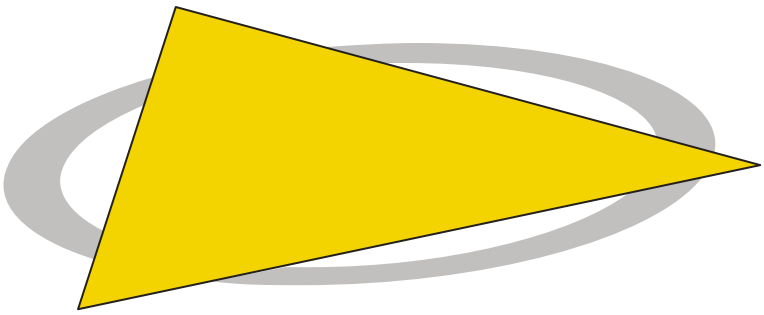
Forces and moments acting on the pump flanges due to pipe loads may induce misalignment of pump and driver shafts, deformation and over stressing of pump casing, or over stressing of the fixing bolts between pump and baseplate.
Following table value are referred to steel construction, for different materials than steel the corrective factor is given by:

$$K = \frac{E_m(T)}{200}$$

where $E_m(T)$ is Young modulus of the material in GPa at the considered temperature



pump type	forces [N]			moments [Nm]		
	P_x	P_y	P_z	M_x	M_y	M_z
32-13 32-16 32-20 32-26	920	1150	750	620	420	320
40-13 40-16 40-20 40-26 40-32	1140	1450	920	750	500	380
50-13 50-16 50-20 50-26 50-32	1420	1800	1150	820	550	420
65-13 65-16 65-20 65-26 65-32	1860	2350	1500	1000	680	500
80-16 80-20 80-26 80-32	2300	2860	1850	1180	780	600
100-20 100-26 100-32 100-40	2850	3600	2320	1480	1000	740
125-26 125-32 125-40	3580	4450	2920	1700	1150	860



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