IDROCHEMICAL

CENTRIFUGAL PUMPS AND MIXERS

NCM LINE
HORIZONTAL CENTRIFUGAL PUMPS

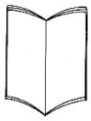
INSTALLATION, USE AND MAINTEINANCE MANUAL

CE

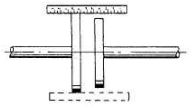
CONTENTS

SAFETY NOTICE

Before starting the pump carry out the following operations

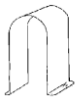


Install and operate the pump according to the instruction indicated in this manual



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.

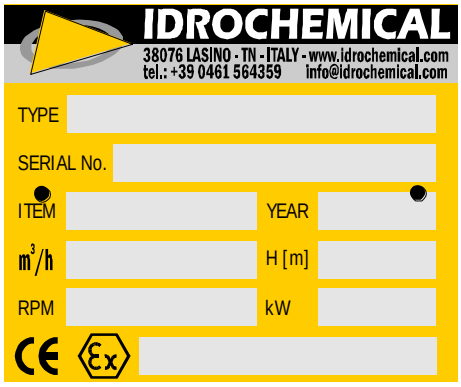


Figure 1 Rating Plate

2. DESCRIPTION

2.1. CONSTRUCTION

The NCM 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.
If a spacer type coupling is used the driver can also remain attached to the baseplate
The volute casing is sealed on the discharge side by means of a casing back plate. The impeller is mounted on an overhung shaft that is supported by two anti-friction bearings in the bearing house.
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

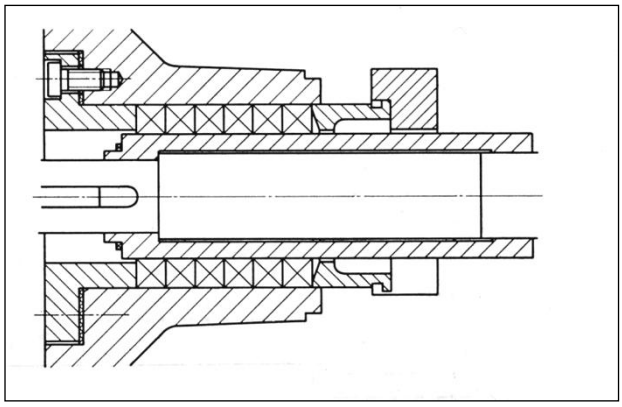


Figure 2 Arrangement a) stuffing box without lantern ring

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

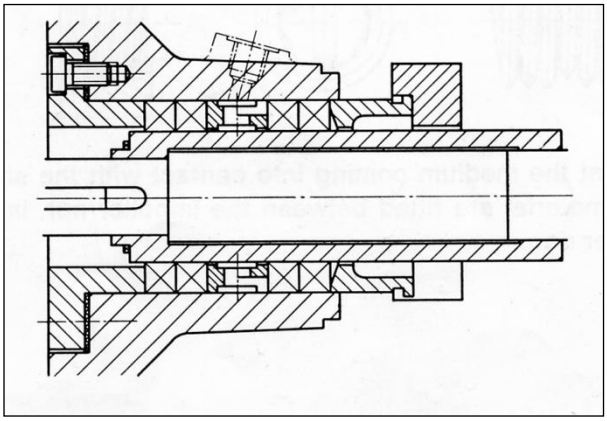


Figure 3 Arrangement b) Stuffing box with lantern ring between 4 packing rings

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

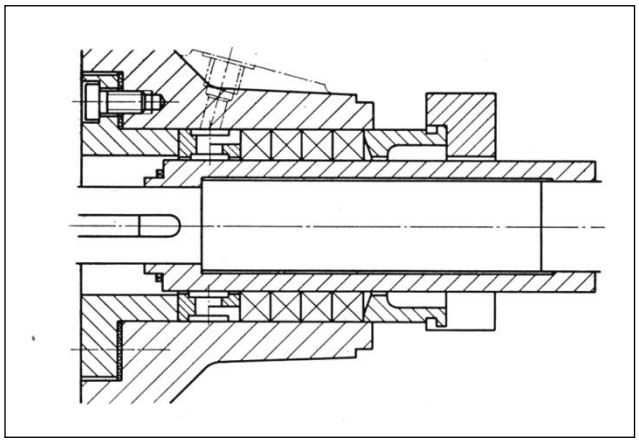


Figure 4 Arrangement c) Stuffing box with lantern ring at bottom end of stuffing box

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.

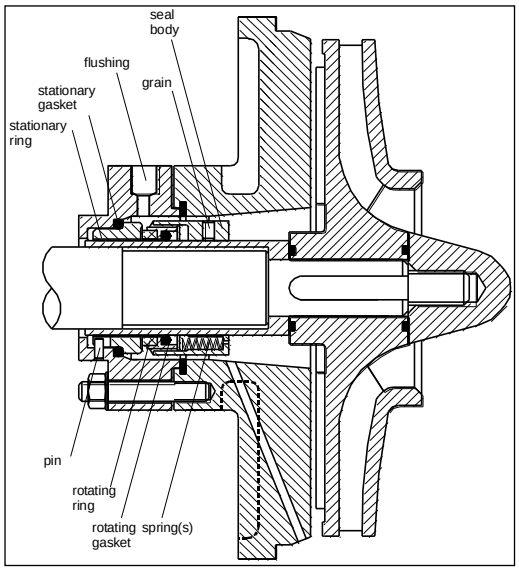


Figure 5 Single unbalanced mechanical seal

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.

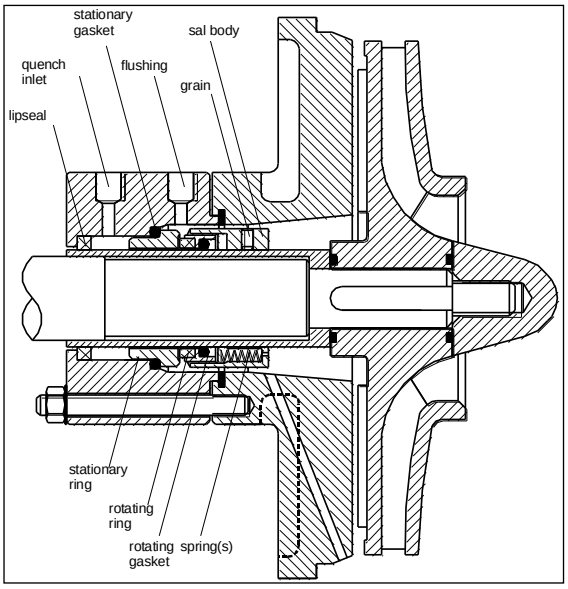


Figure 6 Quench

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.

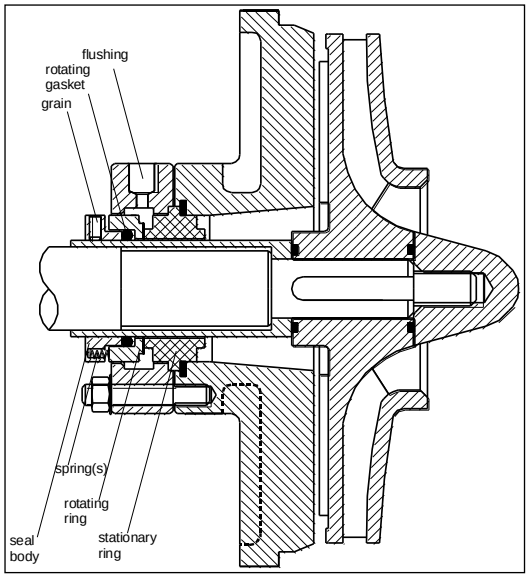


Figure 7 External mechanical seal

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.

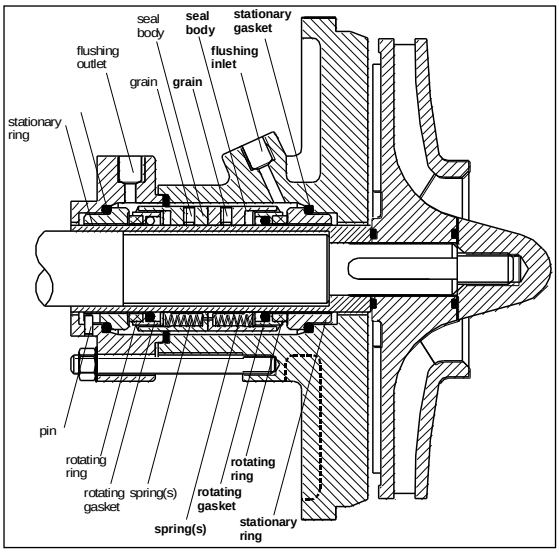


Figure 8 Double mechanical seal (back to back)

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.

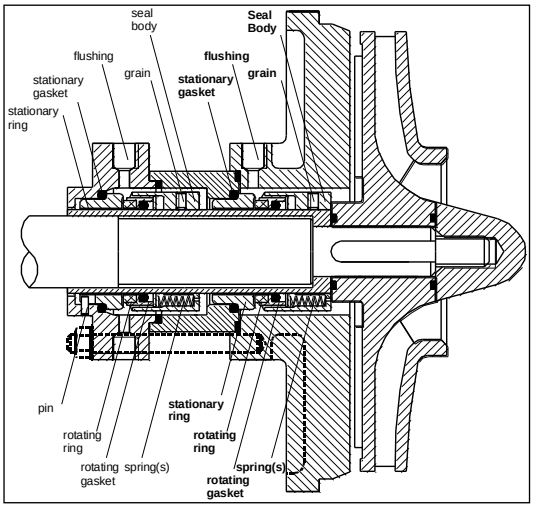


Figure 9 Double tandem mechanical seal

3. ERECTION OF THE PUMP

3.1. SETTING UP THE PUMP

If the pump is ordered with motor, baseplate and coupling these will be carefully assembled at our works. After the pump has been carefully examined at the site for possible damage in transit the following should be observed:

The baseplate should be carefully levelled with the aid of a spirit level and if necessary shims should be inserted, particularly near the anchor bolt holes. When the baseplate is standing true the shaft can be turned by hand at the coupling. The coupling cannot be used to counter any misalignment due to incorrect installation of the baseplate. After careful levelling up the baseplate should be set in a concrete bed and after this has firmly set the anchor bolts should be tightened evenly. To test whether the pump and motor have been correctly aligned a straight edge should be laid on the two coupling halves at various points to see if they are evenly aligned. Spacer type couplings are used to connect the driver to the pump, as only by using such couplings can the advantages of the back pull-out feature be fully realized.

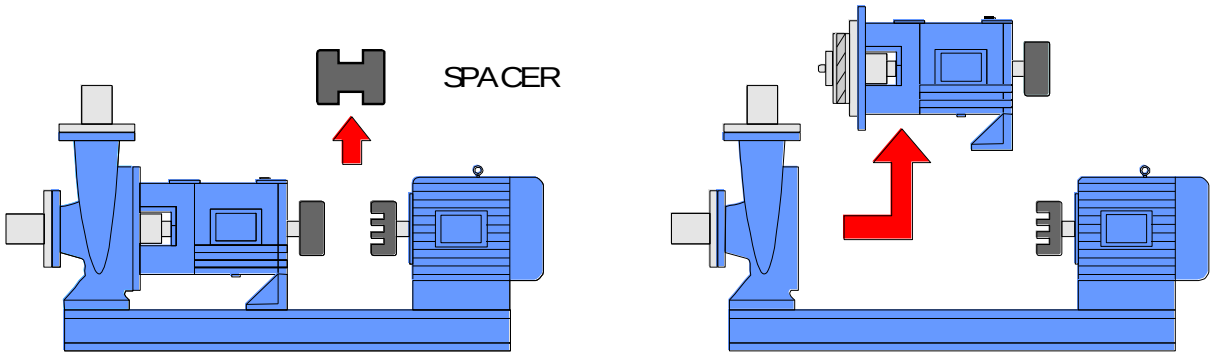


Figure 10 Back pull out

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.

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.

3.4. LOADS ON PIPINGS

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. Always verify axial alignement after connecting piping and expecially when thermal stresses occur install expansion joints on piping. See Appendix F for allowable forces and moments.

3.5. OIL IN BEARING HOUSE

The pump when delivered is supplied with no lubrication oil in the bearing house. Inser through the oil tap the proper oil quantity according to the following table depending on bearing housing size:

BEARING HOUSING SIZE	OIL QUANTITY [l]
0	0.15
1	0.25
2	0.65
3	0.85
4	1.7
5	2.2

The bearing housing size can be determined depending on pump size (see Appendix C). See also Section 4.1 for oil filling instructions.

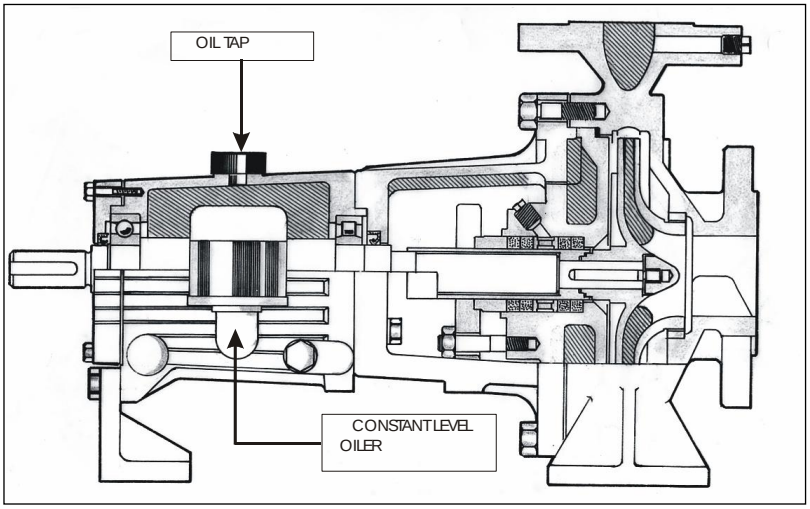


Figure 11 Oil filling

For the oil type see Appendix D.

4. OPERATION OF THE PUMP

4.1. COMMISSIONING

Before starting, the bearing house of the pump should be filled with oil. To fill the bearing house unscrew the breather plug (pos. 483) hinge back the reservoir of the constant level oilier (pos. 481) and then pour oil through the vent hole until it flows into the connection elbow of the constant level oilier. Then fill the reservoir with oil and hinge back into position and redtop the vent. For the required oil filling see the table on Appendix D. Only good brand name oils (viscosity 4, 5° E at 50° C) should be used to lubricate the bearings.

4.2. 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.

4.3. 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.

4.4. SUPERVISION AND MAINTENANCE

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

- Lubrication

Top up the constant level oilier when the oil level sinks to the point where only a small quantity is to be seen. With new bearings the oil should be changed after 200 running hours, thereafter approximately every 1000 running hours.

- 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.

4.5. 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

Due to the back pull-out feature the volute casing can be left attached to the piping and baseplate when the pump is dismantled and if a spacer type coupling is used the driver can also be left attached to the baseplate.

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

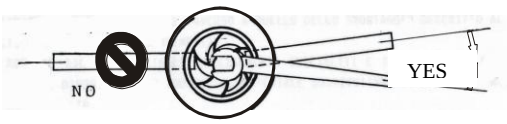
5.2. DISMANTLING THE PUMP

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

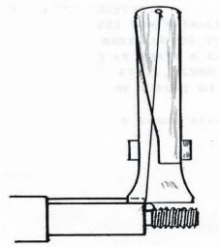
1. close discharge valve
2. close suction valve
3. avoid the possibility off turning on the pump
4. drain pump by opening drain plug (POS. 263)
5. undo auxiliary piping for cooling/flushing fluid.
6. dismantle the coupling guard
7. dismantle the spacer
8. remove support foot (POS. 113)
9. undo Nuts (POS: 472) on casing.
10. extract rotating assembly from casing.
11. remove the casing gasket (POS. 700)
12. check wearing rings (POS. 180) and remove them if damaged
13. bring rotating parts in a clean place
14. Remove oil drain plug (POS 483) and drain off oil (POS. 484)

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

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



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



19. remove the gasket (POS. 710)
20. 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.
21. remove the O-ring (POS. 756)
22. loose the coupling grain, remove the coupling by means of an extractor and remove the coupling key (POS: 520)
23. loose lantern screws (POS. 476) to dismantle the lantern (POS. 110)
24. remove the gasket (POS. 753)
25. dismantle the bearing housing (POS. 112), bearings (POS. 912 & POS. 921/922).
26. remove Angus rings (POS. 751) from lantern (POS. 752) and from bearing housing cover (POS. 211)

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) If new bearings are to be fitted ensure the correct sizes and quality are fitted — see Appendix C.

b) Carefully fit shaft into bearing house taking care not to damage the shaft sealing rings.

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

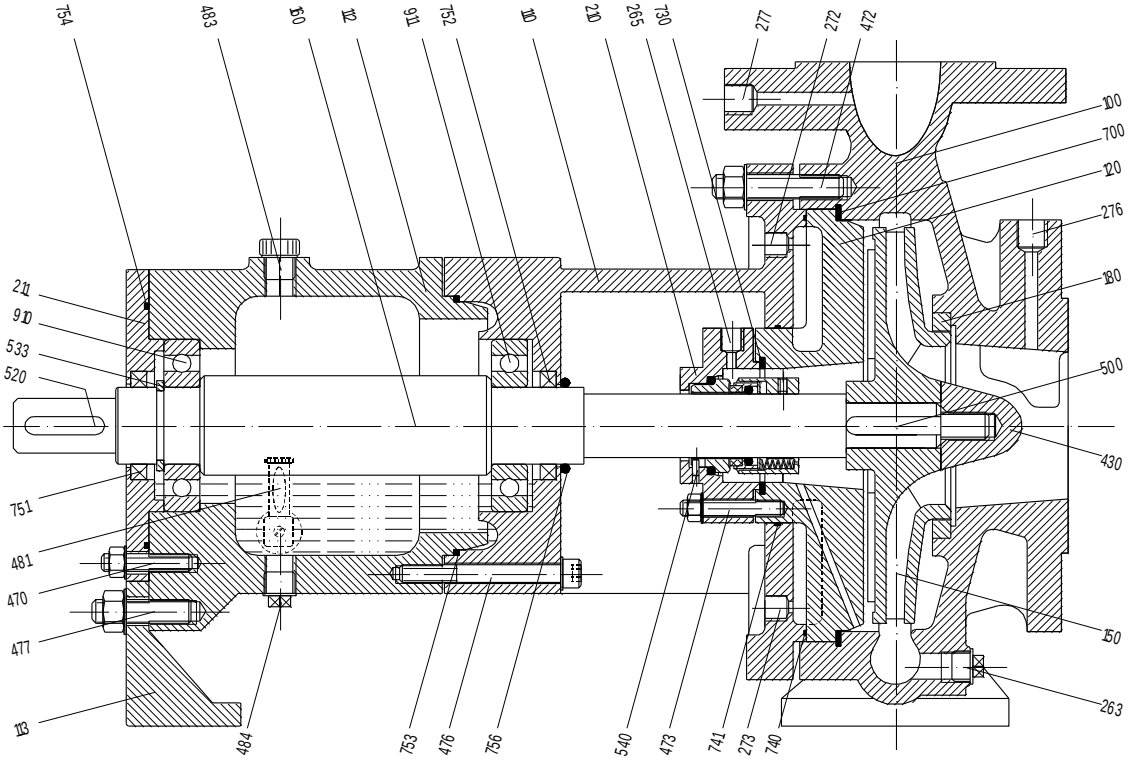
d) The shaft sleeve of soft packed pumps should be free from wear grooves and remnants of old packing.

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

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

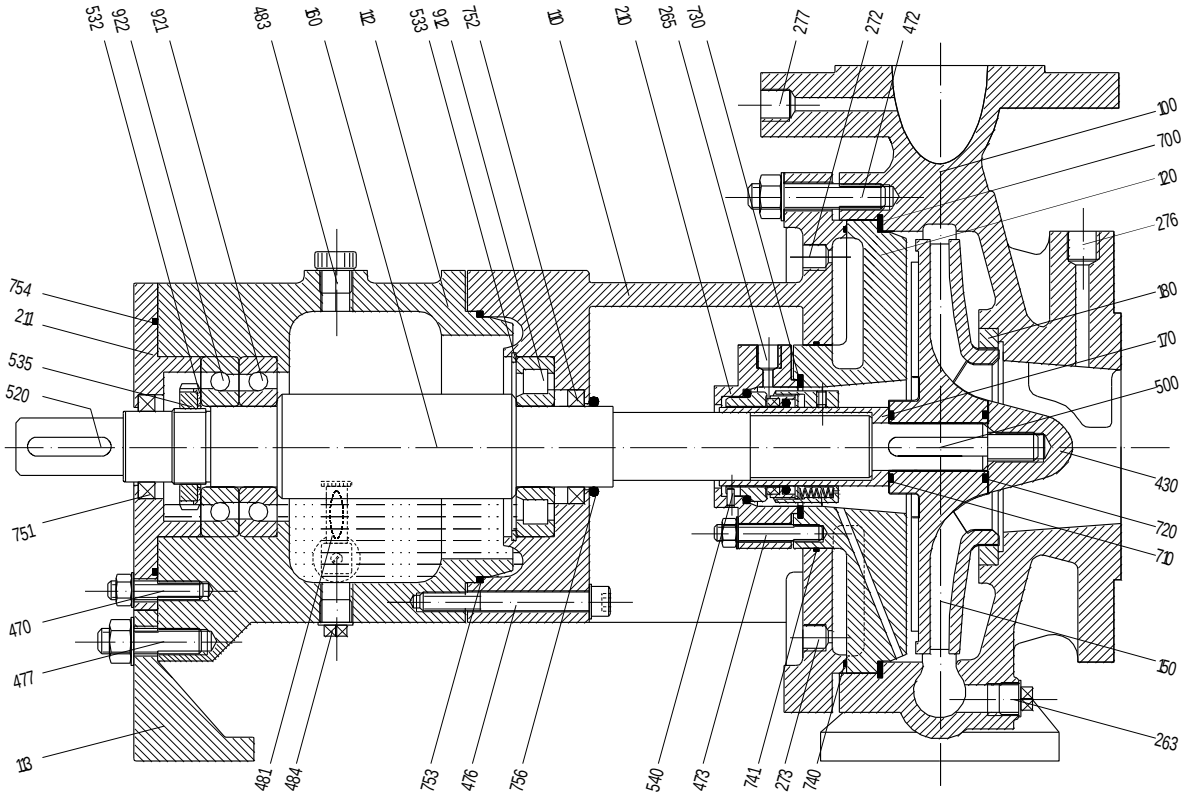
g) Assembly of the set and aligning of the coupling — see section 3.

APPENDIX A – SECTIONAL DRAWING – standard execution



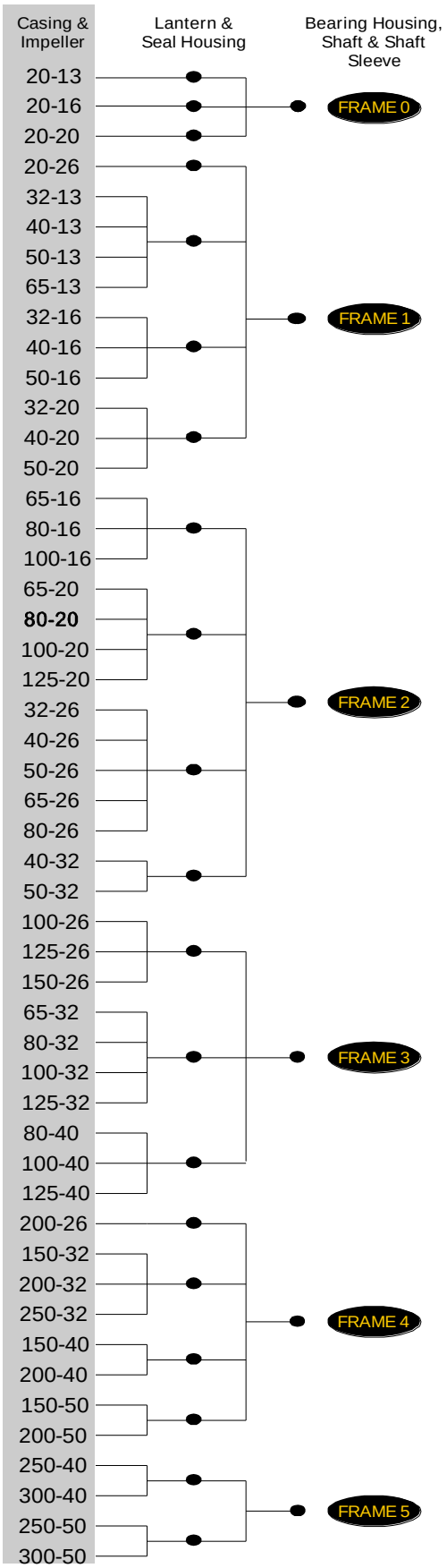
POS	DESCRIPTION	POS	DESCRIPTION	POS	DESCRIPTION
100	CASING	277	CONNECTION	540	PIN
110	LANTERN	430	IMPELLER NUT	700	CASING GASKET
112	BEARING HOUSING	470	SCREW	710	GASKET
120	SEAL HOUSING	472	SCREW	720	GASKET
150	IMPELLER	473	SCREW	730	GASKET
160	SHAFT	475	SCREW	740	GASKET
170	SHAFT SLEEVE	476	SCREW	741	GASKET
180	WEAR RING	477	SCREW	751	LIP SEAL
210	MECHANICAL SEAL FLANGE	481	CONSTANT LEVEL OILIER	752	LIP SEAL
211	BEARING COVER	483	FILLING OIL PLUG	753	GASKET
263	CASING DRAIN	484	OIL DRAIN	754	GASKET
265	FLUSHING	500	IMPELLER KEY	756	SPLASH GUARD
272	DISCHARGE CONNECTION	520	COUPLING KEY	910	BALL BEARING
273	CONNECTION	533	ANCHOR PIN CIRCLIP	911	BALL BEARING
276	SUCTION CONNECTION				

APPENDIX B – SECTIONAL DRAWING – NCM/R reinforced execution and sleeved shaft



POS	DESCRIPTION	POS	DESCRIPTION	POS	DESCRIPTION
100	CASING	430	IMPELLER NUT	540	PIN
110	LANTERN	470	SCREW	700	CASING GASKET
112	BEARING HOUSING	472	SCREW	710	GASKET
120	SEAL HOUSING	473	SCREW	720	GASKET
150	IMPELLER	475	SCREW	730	GASKET
160	SHAFT	476	SCREW	740	GASKET
170	SHAFT SLEEVE	477	SCREW	741	GASKET
180	WEAR RING	481	CONSTANT LEVEL OILIER	751	LIP SEAL
210	MECHANICAL SEAL FLANGE	483	FILLING OIL PLUG	752	LIP SEAL
211	BEARING COVER	484	OIL DRAIN	753	GASKET
263	CASING DRAIN	500	IMPELLER KEY	754	GASKET
265	FLUSHING	520	COUPLING KEY	756	SPLASH GUARD
272	DISCHARGE CONNECTION	532	WASHER	912	ROLLER BEARING
273	CONNECTION	533	ANCHOR PIN CIRCLIP	921	ANGULAR CONTACT THRUST BEARING
276	SUCTION CONNECTION	535	THREADED RING	922	ANGULAR CONTACT THRUST BEARING
277	CONNECTION				

APPENDIX C – INTERCHANGEABILITY CHART



Bearings				Shaft ø [mm]		
Standard Execution		Reinforced Execution /R		in Seal Housing		at Coupling
Pump End	Motor End	Pump End	Motor End	Solid Shaft	Sleeved Shaft	
6305 C3	6305 C3	NU 305	2x 7305 BG	24	28	22
6306 C3	6306 C3	NU 306	2x 7306 BG	28	33	24
6308C3	6308 C3	NU 308	2x 7308 BG	38	45	32
6309 C3	6309 C3	NU 309	2x 7313 BG	43	53	42
6411 C3	6411 C3	NU 413	2x 7313 BG	53	63	48
6413 C3	6313 C3	NU 413	2x 7313 BG	63	75	60

APPENDIX D – BEARING LUBRICATION

BRAND	UP TO 1500 RPM	OVER 1500 RPM
ARAL	ARAL OIL CMY ARAL OIL TU 524	ARAL OIL CMU ARAL OIL TU 518
BP	BP ENERGEL HP 30	BP ENERGEL BP 20
CHEVRON	CHEVRON GP OLI 19 CHEVRON OC TURBINE O IL 19	CHEVRON GP OIL 14 CHEVRON OC TURBINE O IL 15
DEA	DEA VISCOBIL SERAMIT 6	DEA VISCOBIL SERAMIT 4
ESSO	ESSTIC 55 TERESSO 56	ESSTIC 50 TERESSE 52
MOBIL	MOBIL VACTRA OIL HEAVY MOBIL D.T.E. OIL HEAVY VAC HLP 49	MOBIL VACTRA OIL HEAVY MED. MOBIL D.T.E. OIL HEAVY MED. VAC HLP 36
SHELL	SHELL OIL VITREA 33 SHELL OIL TELLUS 33	SHELL OIL VITREA 31 SHELL OIL TELLUS 29
VALVOLINE	VALVOLINE R- 306	VALVOLINE R- 206

APPENDIX E – RECOMMENDED SPARE PARTS

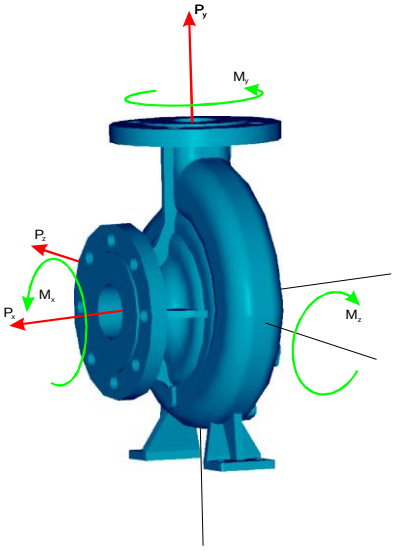
RECOMMENDED SPARE PARTS FOR 2 YEARS WORKING									
POS.	DESCRIPTION	No. OF PUMPS							
		1	2	3	4	5/6	7/8	9	10 (+)
160	**SHAFT**	**0**	**1**	**1**	**2**	**2**	**2**	**3**	**30%**
150	**IMPELLER**	**0**	**1**	**1**	**2**	**2**	**2**	**3**	**30%**
912-921-922	**BEARING SET**	**1**	**1**	**1**	**2**	**2**	**3**	**4**	**50%**
112-211-113-753-754-751-752	**COMPLETE BEARING HOUSING**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**20%**
180-190	**WEARING RINGS**	**1**	**2**	**2**	**2**	**2**	**3**	**4**	**50%**
170	**SHAFT SLEEVE**	**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

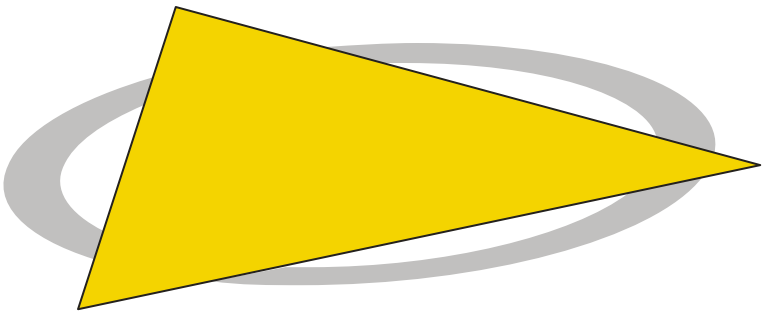
Forces and moments acting on the pump flanges due to pipe loads may induce misalignment of pump and driver shafts, deformation and over stressing of pump casing, or over stressing of the fixing bolts between pump and baseplate.
Following table value are referred to steel construction, for different materials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