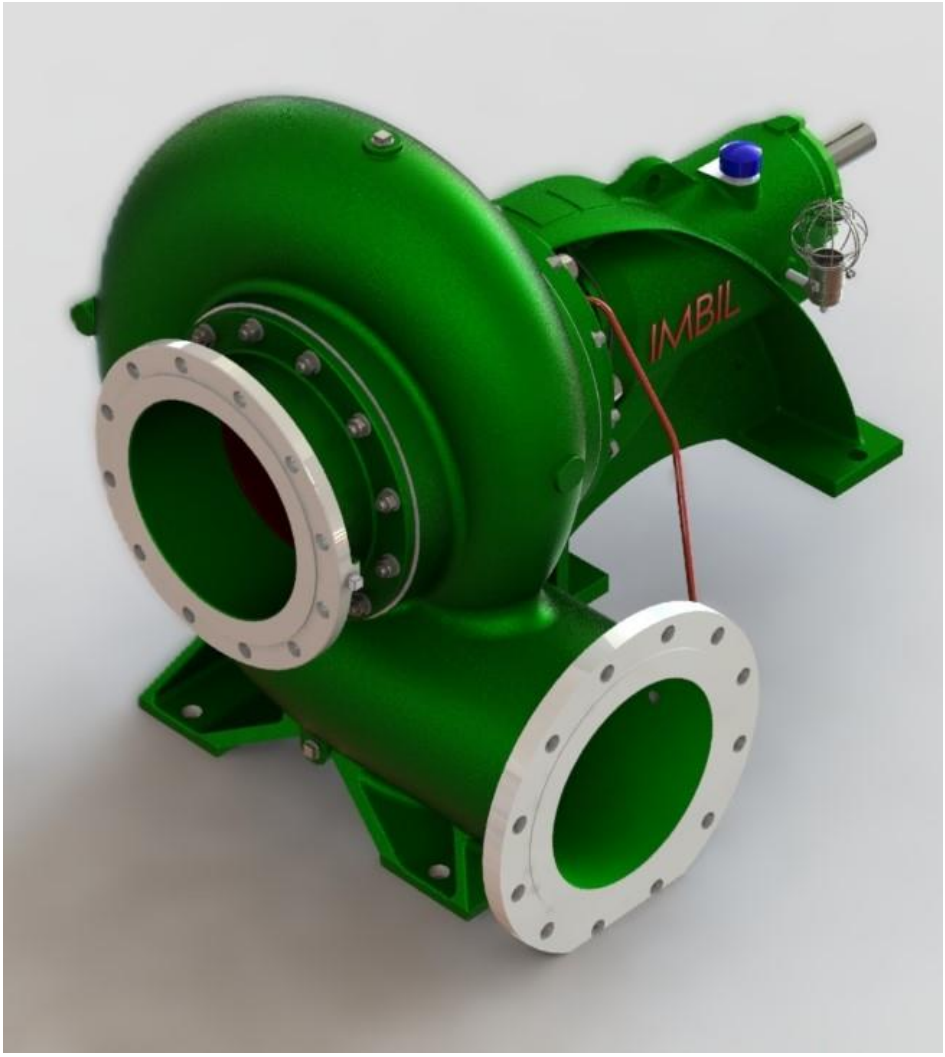
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

NCS 300-350



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IMBIL®

Pumping Solutions

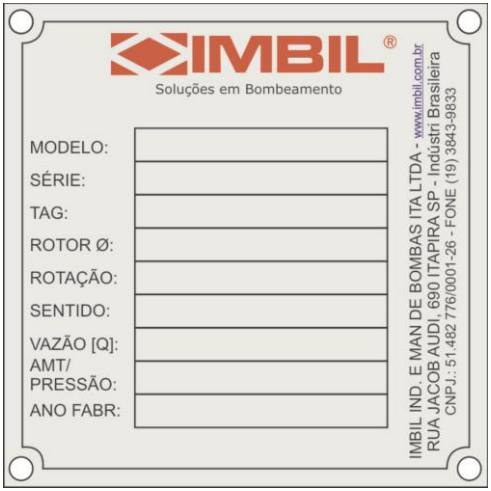
Mr. Proprietor

Congratulations! You just have purchased an easy to assemble equipment, designed and manufactured with the most advanced technology, having an excellent performance and providing easy maintenance.

The aim of this manual is to inform the user about the details of the equipment and the proper techniques for Installation, Operation and Maintenance.

IMBIL recommends the installation and handling of this piece of equipment according to the technical specification and the instructions of this manual. IMBIL also recommends that this piece of equipment be used according to the service conditions for which it was selected (volumetric flow, total head, speed, voltage, frequency, and temperature).

IMBIL is not responsible for faults due to ignorance of these service orientations. This Manual should be used by the people in charge of installation, operation and maintenance.



In case the equipment needs to be verified or when ordering spare parts, please indicate the part code, model, pump series and also the serial number.

NOTE: Right after receiving the WARRANTY DEED of your equipment, please fill in the data and send the customer to IMBIL, so that the information exchange between IMBIL and the client can be facilitated.

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INSPECTION UPON RECEIPT

Inspect the equipment as soon as it is received, check it against the invoice, and notify immediately if any parts are missing or damaged.

INTRODUCTION AND GENERAL CHARACTERISTICS

1 – IMBIL pumps of the NCS / NCI type are single-stage centrifugal pumps with single-suction overhung impeller.
2 – IMBIL pumps is composed of a number that represents the nominal discharge diameter, followed by a number that gives an idea of the size of the pump's impeller diameter.

CHARACTERISTICS

1 – Single-stage centrifugal pump with overhung single-suction impeller.
2 – Rotor and pump housing designed to allow the passage of small solids without blocking the flow.
3 – "Back-Pull-Out" assembly allows removal of the rotating assembly without disassembly of the pipe casing, reducing maintenance time.
4 – Dynamic rotor balancing ensures vibration-free operation, extending the life of the sealing system and bearings.
5 – Rolling bearings designed for an average life of over 20,000 hours of continuous operation.
6 – Double curved radial vane closed impeller, keyed to the drive shaft.
7 – Rigid shaft in all models, protected by sleeves in the sealing region. The sleeve is easily replaceable when it shows wear in the sealing region. Changing the sleeve does not require disassembly of the bearing.
8 – Shaft and seal housing dimensioned to withstand the additional stresses introduced by belt and pulley transmission.
9 – Face wear rings that allow deflections of the rotating assembly without friction, while maintaining a small clearance between the rings.
10 – Axial adjustment of the rotating assembly restores the original clearance between the wear rings without the need to replace them, maintaining high efficiency throughout the life of the rings, reducing operating costs.
11 – Inspection covers allow access to the inside of the pump without the need to disassemble the casing, reducing maintenance time and costs for unblocking the flow and removing small objects.

TRANSPORT

1 – Transport of the connected assembly or separate parts of the equipment must be done carefully and in accordance with security standards.

2 – Before the motor and pump are coupled, they must be transported by the hoisting eye or by the flange, as shown in the figure below.

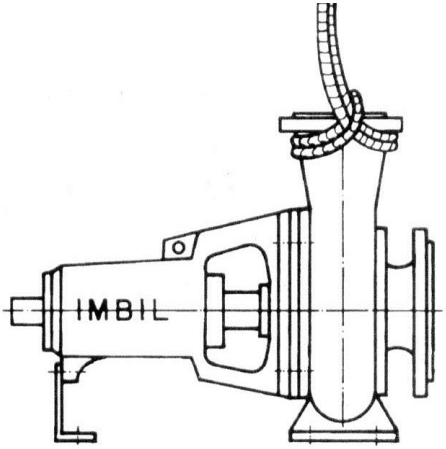

Figure 1 – Transport of the pump using discharge flange

3 – Before the motor and pump are coupled, they must be transported by the hoisting eye or by the flange, as shown in the figure below.

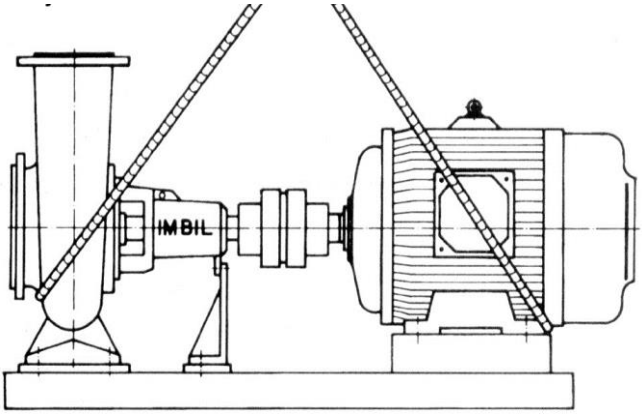

Figure 2 – Transport of the motor-pump assembly

STORAGE

1 – When it is necessary to store a pump until it can be installed, the nozzle protection flanges or any other protection supplied by IMBIL must not be removed.

2 – The bearings are lubricated at the factory, which protects against oxidation for a shorts period of the time.

- For pumps stored for periods longer than 30 days, special precautions will be required.
- Remove the gaskets to prevent corrosion of the bushings.
- Every 30 days, spray oil on the bearings and pump.
- Rotate the shaft by hand weekly so that all moving parts are lubricated.

NOTA: Before installing the pump, clean the shaft end, sleeve and flange protections with a suitable solvent and follow the instructions contained in this Manual.

LOCATION

Choose the installation location so that:

1 - Be easily accessible for inspection and maintenance.

2 - Be above flood level.

3 - The pipes are simple and direct so that the NPSH* is sufficient, avoiding cavitation.

4 - There is enough space to remove the motor and pump rotation assembly.

5 - The foundation must be stable so that it does not move horizontally and/or vertically, leaving the pump supported by the pipes.

6 - The pump and motor identification plates are visible.

7 - There must be sufficient air circulation around the engine to ensure perfect correction.

NPSH

Represents the minimum effective hydraulic energy in the suction required for the perfect operation of the equipment.

The required NPSH varies with the pump dimensions and, for a given pump, with its flow rate and speed. The NPSH required by the equipment can be obtained from the pump performance curves. To determine the NPSH available in your installation, consider Figure 4 and the following equation:

$$NPSH = +/- Z + \frac{(P - Pv)x10}{density} - hp - h1$$

Figure 3 – NPSH equation

Where:

Z = Static height from the free surface of the liquid to the centerline of the pump, considered positive if the liquid surface is above the axis, in meters.
P = Absolute pressure on the surface of the liquid in Kg/cm^2.
Pv = Absolute vapor pressure of the liquid, at the pumping temperature, in kg/cm^2.
hp = Pressure losses in the suction piping in meters of liquid column.
h1 = Pressure losses in the passage from the tank to the piping in meters of liquid column.
Density = density of the liquid at the pumping temperature, measured relative to that of water at 4ºC.

Note: If the available NPSH is lower than that required by the equipment, it must be increased, which is normally achieved by increasing the static suction head Z, the suction pressure P or by reducing the pumping temperature, which reduces the vapor pressure of the liquid.

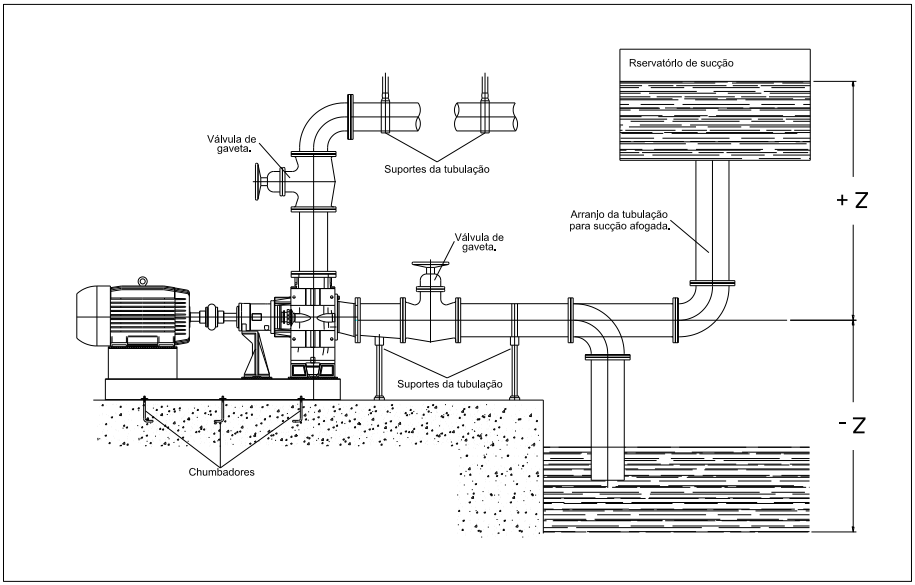

Figure 4 – Common installation

FOUNDATION

The pump should preferably be installed in a horizontal position. Use a single base for the pump and motor, on a permanent concrete or structural steel foundation with sufficient mass to absorb normal vibrations, preventing the assembly from suffering distortions or having its alignment compromised.

LEVELING AND LAYING THE BASE

1 - Place the anchors in the holes made in the foundation block under the base drilling. And between the anchors and the base, place metal shims for leveling.

2 - Introduce specific cement mortar around the anchors and under the base through the existing openings, filling all the gaps for a solid fixation and vibration-free operation.

3 - Tighten the anchor nuts after the mortar has cured, checking the transverse and longitudinal leveling with a precision level. If it is uneven, add thin sheets between the base and the shim to correct it.

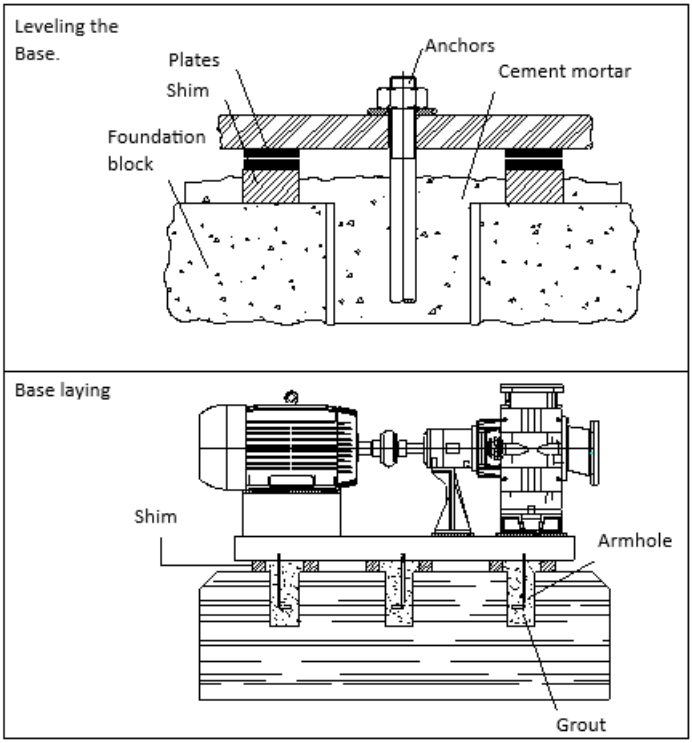

Figure 5 – Leveling and laying the base

Drive

NCS/NCI pumps can be driven by pulley and belt transmission or can be directly coupled to the motor using flexible couplings.

- Coupling by pulleys and belts:

NCS/NCI pumps can be driven by pulleys and belts as long as the maximum drive speed limit is respected (RPM).

The recommendations of the manufacturer of the transmission used must be followed for selection, installation, operation and maintenance of the transmission. A poorly selected transmission or incorrect installation may induce stresses for which your pump was not designed, resulting in malfunction or breakdown.

Pulleys must always be dynamically balanced.

The pulley to be installed on the pump must be of rigid construction, firmly fixed to the shaft by means of a quick hub or a tapered clamping pair. The clearance between the shaft and the hub bore, before assembly, must be as small as possible and compatible with the clamping system.

- Direct coupling to the motor:

Alignment must be checked after assembling the suction and discharge pipes.

The flexible coupling is intended to compensate for slight deformations that may occur in service, but must not accommodate alignment deficiencies during assembly.

Note: The flexible coupling must remain completely uncoupled until the last alignment check. It should only be assembled and tightened immediately before putting the unit into operation.

COUPLING ALIGNMENT

To align the equipment, follow these instructions:

1. With the pump disconnected from the driver and using wedges and adjustment shims under the base, or fine alignment screws, level the pump and motor seating surfaces, longitudinally and transversely. Check the vertical and horizontal positions of the suction and discharge flanges. Tighten the base anchors, pump and motor mounting bolts.
2. Check the clearance between the two coupling parts according to the dimensional drawing. If necessary, move the motor, not the pump, to bring the clearance within the specified range.
3. Perform alignment with the suction and discharge pipes already connected.
4. Using a dial indicator or, if not available, a metal ruler and feeler gauge, check the radial and axial misalignment to avoid abnormal vibrations that could affect the equipment's service life. Rotate both halves of the coupling, taking readings on the indicator, as shown in the following figure. Check the alignment for parallelism with

the indicator resting on the coupling's outer diameter. Take readings in the same way as for angular alignment. To correct, move the motor, not the pump.

5. Screw the motor firmly onto the base and check the alignment as shown. Then fix the base to the structure and check the alignment. Determine the direction of rotation of the motor, correct it if necessary and then close the coupling, not forgetting to lubricate where necessary.
6. When the drive is made by belts, the pump and motor shafts must be parallel, the pulleys aligned with each other, and in turn, the belts correctly tensioned.
7. The radial and axial alignments must remain within a tolerance of 0.3 mm, respecting the clearance between the shaft ends of the motor and the pump, as specified by the coupling manufacturer.
8. For better operational safety, a Coupling Protector or Drive Protector (example: belt guard) must be installed, in accordance with Law 65/4, MTb ordinance 3214 (NR 12 item 12.3).

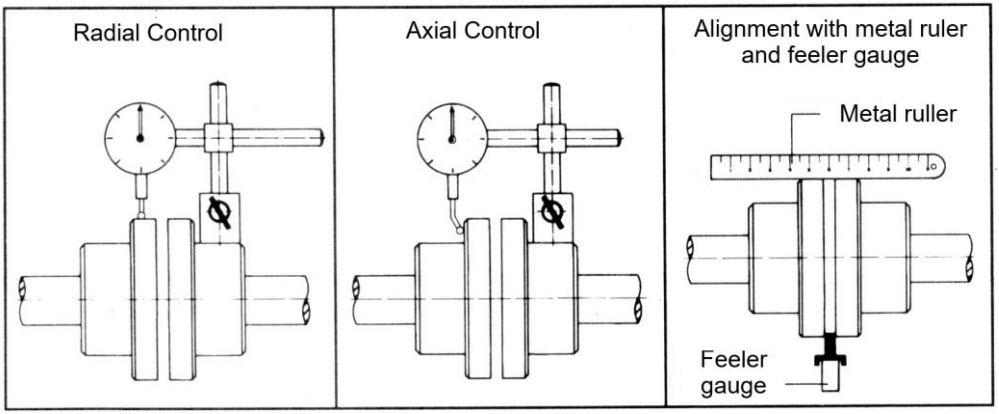

Figure 6 – Coupling alignment

GENERAL RECOMMENDATIONS FOR PIPING

For suction and discharge piping

1 – The piping should be connected to the pump flange only after the base mortar has cured.

2 – To avoid pressure losses, the piping should be short and straight as much as possible; bends, when necessary, should have a long radius.

3 – The pump must not be used as a support for piping. The piping flanges must be connected to those of the pump, completely free of tension, without transmitting forces to the casing, avoiding misalignment and its consequences.

4 – Expansion joints should be provided when the pumped liquid is subject to high temperature variations

5 – It is recommended to avoid 90º bends coupled directly to the suction flange to avoid imbalance in the hydraulic flow, which can cause cavitation problems on one side of the rotor and/or excessive axial load.

Only for suction piping

1 - The horizontal section of the suction pipe, when positive, must be installed with a slight slope in the pump-suction tank direction and, when negative, a slight slope in the same direction, to avoid the formation of air pockets. See figures on page 12.

2 - The horizontal section of the suction pipe, when positive, must be installed with a slight slope in the pump-suction tank direction and, when negative, a slight slope in the same direction, to avoid the formation of air pockets. See figures on page 12.

3 - Foot valve when applicable, usually receives a filter to prevent foreign bodies reaching the pump.

4 - Ensure that the valve passage area is 1.5 times larger than the piping area and that the filter's free passage area is 3 to 4 times larger than the piping area.

5 - In installations with positive suction, it is recommended to install a valve to block the flow of liquid. Check that the valve remains fully open during pump operation.

6 - It is advisable to avoid installing more than one pump in a single suction pipe, especially when the absolute pressure in this pipe is lower than the gauge pressure, with the pump in operation.

7 - A register must be provided for each pump in installations where several pumps draw from the same tank, and the tank and suction piping must be interconnected with changes of direction of less than 45 degrees.

Only for discharge piping

1 - It is necessary to install a valve to regulate the pumping flow and pressure, right after the pump discharge flange.

2 - It is advisable to install a check valve between the pump outlet and the register when the length of the discharge pipe is relatively long and the total lifting height of the pump is greater than 15 meters.

3 - When the pipe diameter is different from the discharge flange diameter, the connection must be made through a concentric reduction.

4 - Provide air valves where there is a need to expel air.

For pumps installed in parallel, each pump must have its own check valve to prevent backflow or overloading of the foot valve when one of the pumps is switched off.

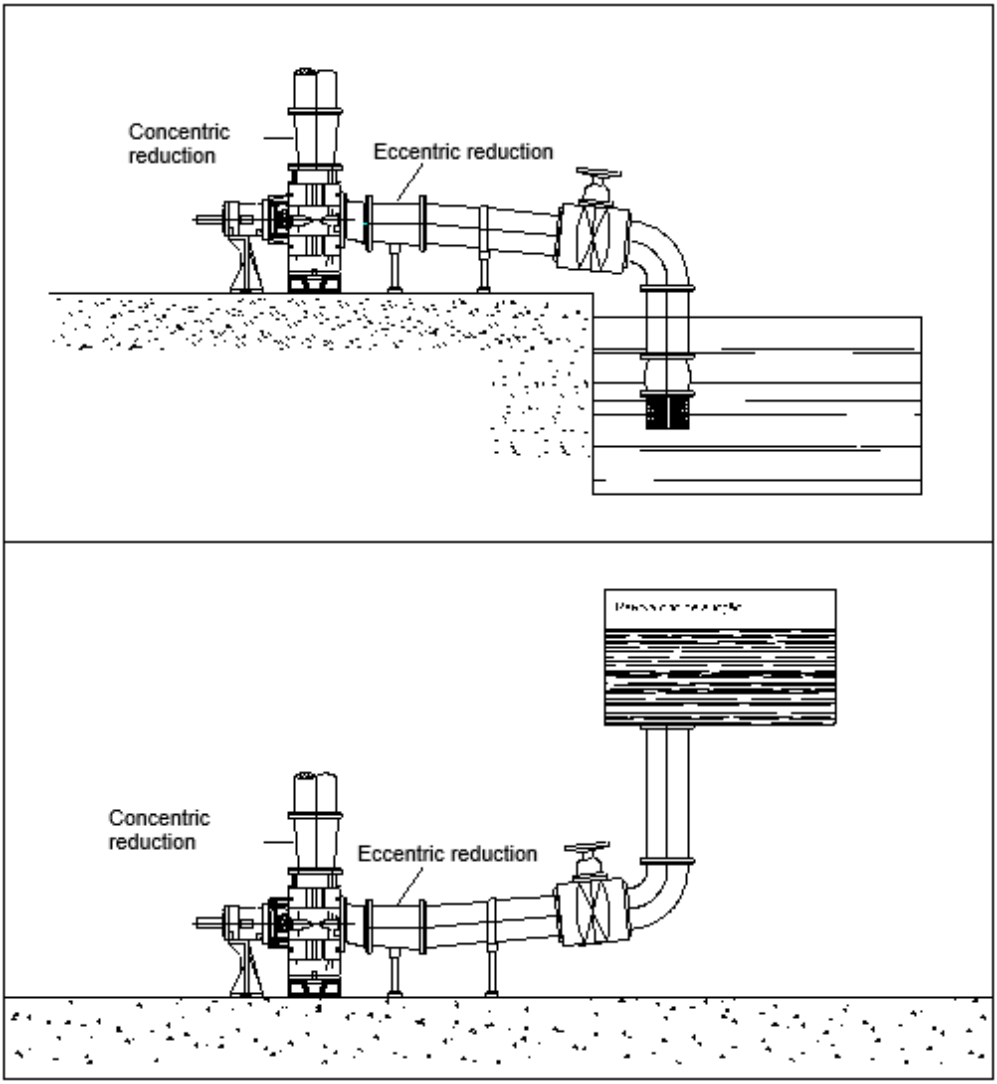

Figure 7 – General recommendations for piping

ARRANGEMENTS FOR STARTING OPERATIONS

1 - Make sure that the assembly is aligned and well-fixed to the base, that the suction and discharge flanges are well connected to the pipes and, where applicable, put the auxiliary connections into operation.

2 - Remove any dirt and moisture from the bearings and fill with oil in the quantity and quality as instructed in the “Bearing Maintenance” item.

3 - Make the electrical connection to ensure that the motor protection system works.

4 - Check the direction of rotation of the actuator with the pump uncoupled.

5 - Prime (fill) the pump and its suction pipe, eliminating any air present in it. Turn the pump shaft by hand to ensure proper priming. Priming can also be done by vacuum.

6 - When there is a suction pipe valve, it must be kept fully open. It must never be used to regulate the pump flow, avoiding the possibility of cavitation. It must only be used for maintenance isolation.

7 - The discharge pipe register must be closed at the start of operation, to avoid overloading the motor and the electrical network during start-up.

8 - When the actuator is already working at nominal speed, slowly open the discharge pipe valve to regulate the pump capacity.

9 - In long discharge pipes that are empty when the pump is started, it is essential that the discharge valve is closed at the start of operation.

IMMEDIATE ACTIONS AFTER STARTING UP OPERATION

1 - Make sure the unit operates without vibrations or abnormal noises.

2 - Control the mains voltage and the electric motor amperage.

3 - Control the temperature of the bearings, ensuring that it does not exceed 45º C above the ambient temperature.

4 - Adjust the packing by tightening the gland nuts evenly, allowing dripping (observing the minimum leakage values of 10 cm3/minute and maximum of 20 cm3/minute). The packing is lubricated by the pumped liquid itself.

5 - Check suction pressure, discharge pressure and flow rate.

NOTE: Check the above items every 30 minutes for the first two hours, hourly for the next 10 hours, and then weekly.

OPERATION

Start

Before starting the equipment, care must be taken to clean the suction pipe of debris and rust scales, and wash it carefully to prevent possible foreign bodies from being sucked into the pump and obstructing the rotor or damaging the equipment in some way.

Before each match we recommend checking the following items one by one.
We suggest never starting the equipment before going through the “checklist” below:

- Check the connections of pipes, valves, etc. Make sure that all pipes and accessories are properly connected, as before the first start-up or during maintenance, it is possible that you forget to connect some connection.

Check it out:

- Connection of flanges and all suction and discharge piping;
- Connection of pressure gauges, instruments, etc;
- Connection of auxiliary drain lines, vents, etc.

- Check that the motor and pump bearing are properly lubricated.

- Close the casing drain valve.

- Priming the system. Before starting any centrifugal pump, it is absolutely necessary that both the casing and the suction pipe are completely filled with liquid. This operation is called priming and can be achieved by one of the following methods:

- When the liquid level in the supply source is above the highest point of the suction piping and the pressure in the suction tank is equal to or greater than atmospheric, simply open the suction, discharge and casing vent valves so that the liquid flow displaces the air and fills the suction piping, pump casing and discharge line to the level of the supply source or up to the check valve.

- When the pump is drawing from a lower-level supply source and the suction line is equipped with a foot valve, the system must be filled with the liquid to be pumped through the discharge piping or some connection provided in the casing.

- Other methods of air removal, such as a vacuum pump, may be used, depending on the facilities available. This is necessary when the pump is operating from a lower-level supply source and there is no foot valve in the suction line. The connections for such methods should be placed at the top of the pump suction pipe. To prime, close the discharge line shut-off valve and the breather valve and do not start the motor until the pump and suction line are filled with liquid.

- Make sure the suction line valves are fully open and the discharge shut-off valve is not stuck or blocked.

- Start the pump, observing all the precautions recommended by the engine manufacturer.

- During the first half hour, observe the mechanical operation, pressures and temperatures. Make sure that everything is running smoothly before leaving the equipment running unattended.

- The operating temperature of the bearings is reached within one to three hours of operation. The normal operating temperature of the pump bearing housing is between 45°C and 75°C, measured on the external surface of the housing.

PROVISIONS FOR STOPPING THE PUMP

1 - Close the discharge pipe valve.

2 - Close the suction valve when maintenance is required.

3 - Turn off the actuator, observing the gradual stop of the equipment.

4 - Close auxiliary pipes when applicable.

OPERATIONAL DIFFICULTIES

If the recommended installation procedures have been followed, the pump should operate satisfactorily without any special care other than routine maintenance (gaskets, bearings, etc.). However, should difficulties occur, unnecessary expense and delay can be avoided by carefully observing the list below:

1 – The pump does not pump

- It was not primed.
- Insufficient speed. Consult the engine manual for the causes.
- Discharge pressure required by the system is greater than that for which the pump was selected.
- NPSH is insufficient.
- Reverse direction of rotation.
- Pockets of steam or air in the suction pipes.
- Suction pipe outlet insufficiently submerged or with vortex formation.
- Impeller blocked or loose.

2 – Insufficient flow

- Air inlet through the suction pipe.
- Drive speed too low.
- Discharge pressure required by the system is greater than that for which the pump was selected.
- Corroded or partially clogged impeller.
- NPSH is insufficient.
- Mechanical defects (damaged rotor, corroded rotor, etc.).
- Foot valve too small or clogged.
- Suction inlet insufficiently submerged.
- Reverse direction of rotation.
- Vortex formation in suction.
- Pump or suction piping not fully primed (presence of air).
- Excessive amount of air or gas dissolved in the liquid.
- Misfit or worn wear rings (axial clearance greater than recommended).

3 – Insufficient pressure in the discharge

- Leaks or air ingress into the suction line.
- Air or steam in the line.
- Mechanical defects (damaged rotor, corroded rotor, etc.).
- Reverse direction of rotation.

Excessive amount of air or gas dissolved in the liquid.

- Very low speed.
- Discharge pressure required by the system greater than that for which the pump was selected.
- Partially clogged rotor.
- Misfit or worn wear rings (axial clearance greater than recommended).

4 – Pump loses prime after starting

- Leakage or air ingress into the suction line.
- NPSH is insufficient.
- Excess air or vapor, dissolved or emulsified in the liquid.
- Air inlet through the suction flange inspection cover or through the suction flange gasket.
- Operation too far to the right in relation to the pump performance curve (flow rate too high).
- Air pockets in the suction line.
- Suction pipe outlet insufficiently submerged, or with vortex formation.

5 – The pump overloads the engine

- Drive speed higher than that calculated when selecting the motor.
- Rotor diameter larger than that suitable for service conditions.
- Reverse direction of rotation.
- Sum of system load losses lower than those predicted in the project, resulting in excess flow (operation too far to the right on the curve).
- Misfit or worn wear rings (with clearance greater than recommended).
- Internal recirculation between discharge and suction, due to wear, lack of pressure or assembly error.

6 – The pump is vibrating excessively

- Pump or suction piping not fully primed.
- NPSH is insufficient.
- Foot valve too small.
- Partially clogged foot valve or drains.
- Suction pipe socket insufficiently submerged.
- Operation at excessively low or excessively high flow rates, causing recirculation in the rotor or cavitation.
- Clogged or corroded rotor.
- Misalignment between pump and motor.

- Bent or worn axle.
- Rotating and stationary parts rubbing against each other.
- Damaged bearings.
- Shaft rotating off-center due to wear, warping or misalignment of bearings.
- Unbalanced rotor.
- Incorrectly lubricated bearings.

7 – Gaskets have short life or leak excessively.

- Bent axle.
- Shaft sleeve worn, corroded or rotating off-center.
- The seal ring is incorrectly located in the stuffing box, preventing the sealing fluid from being properly pumped into the box.
- Sealing liquid conduction tube blocked.
- Shaft rotating off-center due to worn bearings or misalignment.
- Unbalanced rotor, causing vibration.
- Solid abrasives in the pumped liquid.
- Gaskets incorrectly installed (see Gasket Maintenance).
- Gaskets poorly selected for operating conditions.
- Incorrectly tightened gasket. Too tight will prevent the flow of sealing fluid to the seal. Too little will not provide adequate sealing.
- Shaft with excessive deflection due to radial hydraulic load or excessive belt thrust.
- Inadequate sealing liquid.
- Misalignment between pump and motor.
- Excessive clearance between the shaft and the bottom of the stuffing box, causing the packing to be forced into the housing.

8 – Bearings have a short life.

- Misalignment between pump parts (casing, sealing chamber and bearing).
- Misalignment between pump and motor.
- Axle bent or damaged due to corrosion.
- Damaged bearing housing.
- Excessive axial load due to an imbalance in hydraulic flow.
- Excessive amount of grease in the bearings.
- Lack of lubrication.
- Incorrect type of grease.
- Incorrect assembly of bearings (damage during assembly, inverted assembly), etc.).
- Excessive impurities penetrating the bearing housings.
- Continuous flow lower than the recommended minimum.
- Excessive rotation.

9 – The pump overheats or seizes.

- Pump worked dry.
- Air or vapor pockets inside the pump.
- Continuous operation at very low flow rate.

- Parallel operation with other pumps, incorrectly selected.
- Internal misalignment due to expansion of pipes, incorrect foundation or incorrect parts.
- Friction between stationary and rotating surfaces.
- Worn bearing.
- Lack of lubrication.
- Incorrect assembly.

LUBRICATION

If the bearing case and roller bearings have been disassembled and cleaned, it will be necessary to lubricate the assembly.

Amount of grease for lubrication – The free space in the housing (between the grease retaining plate and the bearing cover) and in the bearing must be only partially filled with grease (30 to 50%). Excess can create an abnormal rise in temperature.

Greases used for lubrication of NCS/NCI pumps must be lithium soap-based greases containing rust-inhibiting additives, consistency according to the temperature ranges below:

0º to 20ºC – NLGI 1
20º to 80ºC - NLGI 2

Greases that satisfy the conditions specified for NCS/NCI pumps are listed in the table below for various manufacturers.

Recommended Greases Table

Manufacturer	Up to 3000 rpm
CASTROL	LM 2
ATLANTIC	LITHOLINE 2
ESSO	BEACON 2
IPIRANGA	ISAFLEX 2
MOBIL	MOBIL GREASE 77
PETROBRÁS	LUBRAX INDL GM A 2
SHELL	ALVANIA R 2
TEXACO	MARFAK MP 2

Relubrication

Grease lubrication intervals for a bearing depend on the type of bearing, its size, rotation speed, operating temperature and the type of grease used.

Amount of grease required for relubrication (data obtained from bearing manufacturers' manuals).

Your NCS/NCI must be relubricated every 1500 hours of continuous operation at maximum operating speed. In the case of operation at low speeds, this interval may be extended.

The listed lubrication intervals were calculated based on a temperature of 70°C.

For temperatures above this value, the change intervals must be reduced, for temperatures below this value, they can be extended (for example, at 50ºC or below, the change interval can be doubled).

When there is a greater risk of grease becoming contaminated (pumps exposed to the weather, constant movement, etc.) the change intervals should be reduced.

Recommended Oils Table

Manufacturer	Up to 3000 rpm	Above 3000 rpm
CASTROL	HYSPIN – 68	HYSPIN – 46
ATLANTIC	EUREKA – 68	EUREKA – 46
ESSO	TURBINE OIL – 68	TURBINE OIL – 46
IPIRANGA	IPTUR AW – 68	IPTUR AW – 46
MOBIL	DTE – 26	DTE – 24
PETROBRÁS	MARBRAX TR – 68	MARBRAX TR – 46
SHELL	TELLUS – 68	TELLUS – 46
TEXACO	REGAL R & O – 68	REGAL R & O – 46

PUMP MAINTENANCE

Your NCS/NCI pump is designed to operate with a minimum level of vibration and noise. However, if vibration is observed in the field at levels above normal, a general check is recommended. First, review the list of possible causes of vibrations as described earlier in the “Operating Difficulties” section.

Inspections:

During operations, the pump must be inspected at least daily, and it is advisable to do so once per shift. Whether or not a written record of observations is made, the operator must be alert to possible irregularities in the operation. Periodically, the behavior of the sealing system (gaskets) and bearings (temperature and vibration) must be observed and recorded.

A noticeable change in bearing temperature or vibration level is a sure indication of abnormality. Likewise, any change in the normal pump noise should be investigated, but does not necessarily imply that there is a problem.

Annually check, through an operational test, whether the pump capacity, its discharge pressure or the power consumed has decreased (or increased) over time. If there is a significant change, it may be necessary to re-adjust the axial clearance between the wear rings or replace them.

SEALING

To replace the packing of your pump, proceed as follows:

- Loosen the gland, remove the old packing rings with a suitable puller and clean the stuffing box.
- Make sure that the new packing rings are the correct type and size. Measure the stuffing box to determine the exact length of the packing rings. The packing rings must be cut to the exact length to form a perfect ring.
- Insert one ring at a time, pushing it as far as possible into the bottom of the box. Assemble each ring with its seam offset 120º to 180º in relation to the seam of the previous one.
- After assembling an appropriate number of rings, install the sealing ring. It is important to check that it is located directly below the connection hole and that the placement of subsequent rings will not affect this location.
- Add the remaining rings. Assemble the gland and tighten the nuts lightly. Make sure that the gland enters the stuffing box evenly so that the rings receive uniform tightening around their periphery.
- Now loosen the nuts and tighten them by hand. The sealing system is now ready to be broken in. When breaking in new packings, it is advisable to allow a small amount of leakage at first. Gradually tighten the gland during the first few hours of operation, at approximately 15-minute intervals, until the leakage is reduced to a steady trickle. Overtightening the gland causes abnormal friction, generating heat that can “glaze” the packings and damage the shaft sleeves. For proper operation, the packings must remain soft and flexible.

DISASSEMBLY SEQUENCE

It is not recommended to disassemble without indication of specific abnormality, such as change in pump performance, change in noise or vibration level, heating or replacement of the seal. Even in these cases, it is advisable to carefully analyze the change before dismantling the equipment. The frequency of disassembly depends on the severity of the service, the construction materials used in the pump and the care given to the equipment in operation and in preventive or periodic maintenance.

To disassemble the rotating assembly, it is not necessary to disconnect the suction and discharge pipes, as well as the breather and drain pipes from the casing, as it can remain fixed to the base. The rotating assembly can be removed from the back of the pump.

When disassembling the pump, take care not to damage the internal parts. To facilitate assembly, arrange the parts in the order in which they were disassembled. Protect machined surfaces from metal contact and corrosion. Do not disassemble the bearing unless absolutely necessary. Unless great care is taken when disassembling a bearing, it will be rendered useless in operation. Always check bearings immediately after disassembly for clearance or damage. It is recommended to install new bearings after disassembly whenever possible as the damage caused is often only noticed when the pump is put back into service.

Close the suction and discharge valves, as well as those of the cooling circuit and liquid seal. Drain the water from the casing by removing the appropriate plugs. Release the pump from its foundation .

As a reference, now use the pump cut-out drawing:

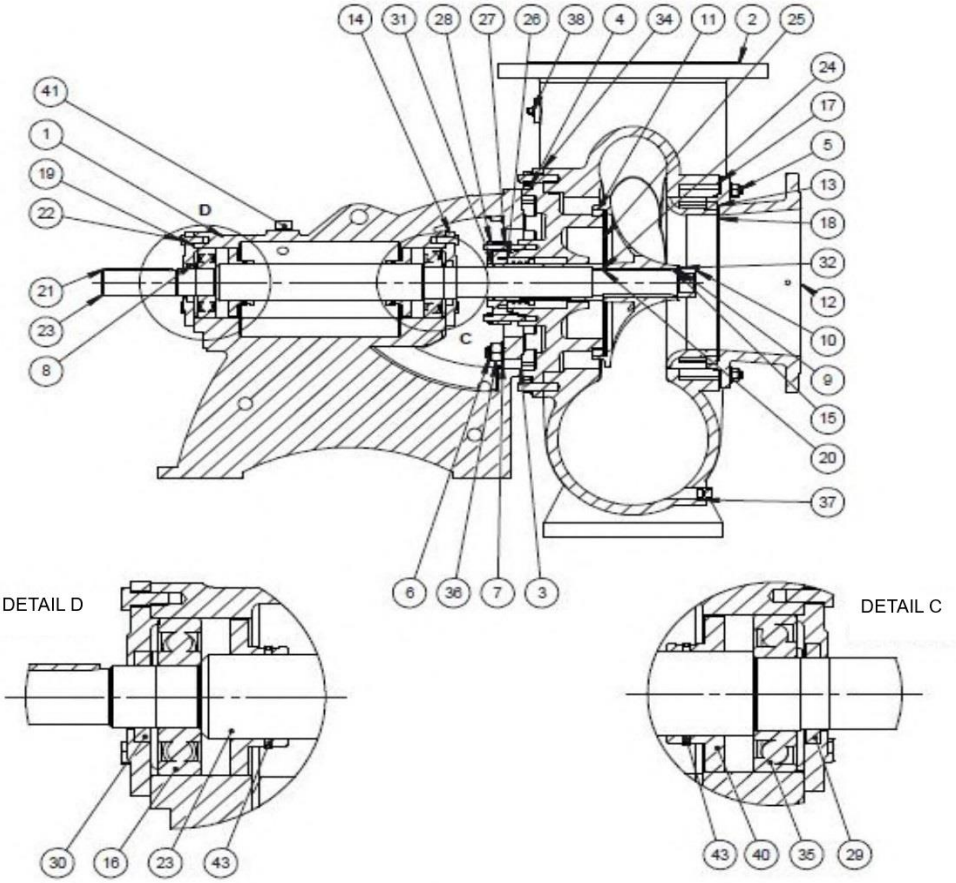

Figure 8 – Pump cut-out drawing

Item	Description	Quantity
1	Bearing Bracket	1
2	Case	1
3	Threaded bar	12
4	Flat washer	24
5	Hex nut	24
6	Threaded bar	6
7	Flat washer	6
8	Bearing cover	1
9	Impeller	1
10	Hex nut	1
11	Wear ring	1
12	Suction cap	1
13	Wear ring	1
14	Bearing cover	1
15	Key	2
16	Bearing	1
17	Joint	1
18	Threaded bar	12
19	Joint	2
20	Key	1
21	Key	1
22	Hex head screw	6
23	Drive shaft	1
24	Shaft sleeve	1
25	Cover	1
26	Mechanical seal	1
27	Threaded bar	4
28	Hex nut	4
29	Retainer	1
30	Retainer	1
31	O'-ring	1
32	Safety washer	1
33	Core plug	2
34	Joint	1
35	Bearing	1
36	Hex nut	6
37	Core plug	2
38	Core plug	2
39	Core plug	1
40	Grease deflector	2
41	Air breather	1
42	Straight grease	2
43	Lock pin	8

- Loosen the nuts on the stuffing box fixing studs to the housing (27). Remove the rotating assembly, bearing and stuffing box from the housing using the separation screws.
- Support the rotating assembly vertically, with the rotor facing upwards. If necessary, clean the parts exposed to the pumped liquid with a jet of water. Then remove the rotor nut (10), at which point the rotor is ready to be removed from the shaft.
- Disassemble the gland and sealing system as described in the previous section of this manual.
- Remove the fixing screws (27) of the stuffing box to the bearing. Move the stuffing box away from the bearing. Now remove the shaft sleeve (24) and the gland clamping ring.
- Loosen the fixing screws (22) of the radial side bearing cover (14), moving the cover away.
- Loosen the screws (22) of the outer bearing cover (14).
- To disassemble the bearings, support the bearing firmly on a bench with the shaft end corresponding to the rotor facing downwards. Protect the exposed shaft face with a piece of wood and push the shaft down, tapping lightly on the face facing upwards. The thrust bearing will be loose in the housing. The bearing caps will be slightly pressed into the housing. The shaft will come out together with the radial bearing.

CHECKS

- **General**

Wash each part carefully separately with kerosene or another suitable solvent and dry them with air. Check for wear due to corrosion/abrasion. Unclog drain and breather connections and flush seal or gaskets.

- **Wear Rings**

Check the wear rings on the rotor and suction flange. The axial clearance is specified in the “Axial adjustment of the rotating assembly” section. Replace one of the two (or both if necessary) if this clearance reaches more than twice the specified value and it is not possible to restore it by means of axial adjustment described in the “Axial adjustment of the rotating assembly” section.

- **Axle**

Whenever you disassemble your pump, carefully inspect the shaft in the rotor area, under the sleeve and in the bearing housing. The shaft may be damaged by corrosion due to leakage under the rotor or under the sleeve. Check the shaft keyway for distortion. Excessive heat or corrosion can loosen the rotor from the shaft, placing abnormal stress on the keys and their slots. Replace shafts that are bent or twisted. Shaft sleeves that are subject to wear should be replaced if the wear is so severe that the packing no longer allows an adequate seal. Shaft sleeves that are scratched or have worn sections will damage new packing rings as soon as they are installed.

- **Casing Gaskets**

Replace the housing gaskets every time the housing needs to be opened. Each gasket must be glued to the housing flange with a quick-drying “gasket sealant”. It is important to use a gasket of the correct thickness, as gaskets of different thicknesses may cause difficulties in sealing or axial adjustment of the rotating assembly. It is recommended to use original IMBIL spare parts.

- **Bearing Bracket**

Check the condition of the outer bearing cover seal to see if it needs replacing. Replace the outer bearing cover gaskets if they have been disassembled.
Check the condition of the bearing housings in their fitting diameter.

- **Bearing**

Like all other equipment elements, bearings must be cleaned and inspected. Clean the bearings with a suitable solvent (turpentine, kerosene, etc.). After cleaning, they must be immediately protected with oil to prevent corrosion.

- **Impeller**

Check the rotor blades for wear, however, the impeller will only need to be replaced when the pump's service conditions are no longer met in terms of flow, head and efficiency, or when it is no longer possible to balance it.

Dynamic balancing must be checked and redone if necessary.

Also check the condition of the impeller hub.

WEAR AREAS

1 - When the pump presents insufficient flow or pressure, caused by the wear of the rings, they must be replaced. IMBIL and its Authorized Distributors can supply parts with the appropriate tolerance and maintenance services.

2 - The replacement should be made when the clearance between the rotor and the rings on the cover or casing shows wear values three times greater than the original clearance.

REPLACEMENTS

- **Impeller and suction flange wear rings**

The wear rings (3 and 4) of your NCS/NCI pump can be easily replaced using their retaining screws (52 and 37). However, when reassembling the pump, the retaining screws must be locked with a high-torque chemical lock (LOCTITE 270, TREE BOND or similar). Axial alignment must also be carried out as described in the item below.

- **Joints**

All gaskets in your pump must be replaced each time it is disassembled or when they start to leak. It is recommended to use original IMBIL gaskets. If these are not available, the gaskets must be cut from a single piece of hydraulic cardboard, following the contours of the part for which they are intended.

PERIODIC SUPERVISION OF EQUIPMENT

WHAT?	WHEN?			
	WEEKLY	MONTHLY	SEMESTER	ANNUAL
Abnormal vibrations and noises.	■			
Leaking gaskets.	■			
Pump operating point.	■			
Suction pressure.	■			
Oil level.	■			
Current consumed by the motor and voltage value in the network.	■			
Bearing temperature.		■		
Lubricant (See item: Lubrication).		■		
Alignment of the Motor-Pump set.			■	
Pump, Base and Actuator Fixing Screws.			■	
Replace packing if necessary.			■	
Coupling lubrication, where applicable.			■	
Disassemble the pump for maintenance and inspect: bearings and rollers thoroughly, seals, O-rings, gaskets, rotors, internal part of the casing, wall thickness, wear areas, coupling, etc.				■

- In installations operating in good conditions and the pumped liquid not being aggressive to the Pump materials, Annual supervision may be Bi-Annual.

OPERATION ANOMALIES AND LIKELY CAUSES

- **TEN SYMPTOMS**

1 – Pump does not pump;
2 – Insufficient capacity;
3 – Insufficient pressure;
4 – Pump loses priming after start-up;
5 – Pump overloads the engine;
6 – Mechanical seal leaks excessively;
7 – Mechanical seal has low durability;
8 – Pump vibrates or makes noise;
9 – Bearings have low durability;
10 – Pump overheating or knocking;

LIKELY CAUSES	SYMPTOMS (NUMBER)									
	1	2	3	4	5	6	7	8	9	10
Pump was not primed.	X									X
Pump or suction piping not completely filled with liquid	X	X			X			X		
Suction height is excessive.	X	X			X		X	X		
Minimal difference between vapor pressure and suction pressure.	X	X						X		X
Excessive quantity of air or gas in the liquid.		X		X	X					
Admission of air into suction line.		X			X					
Admission of air through the mechanical seal, sleeve joints, volute case joint or plugs.					X					
Foot valve too small		X						X		
Foot valve partially obstructed.		X						X		
Suction piping inlet insufficiently submerged.	X	X			X			X		
Rotation too low.	X	X		X						
Rotation too high.						X				
Wrong rotation direction.	X			X		X				
Total height greater than the pump was designed for.	X		X	X						
Total height lower than the pump was designed for						X				

LIKELY CAUSES	SYMPTOMS (NUMBER)									
	1	2	3	4	5	6	7	8	9	10
Density of liquid different from that used for selection						X				
Viscosity of liquid different from that used for selection			X	X		X				
Operation at greatly reduced capacities								X		X
Operation of pumps in parallel inadequate for this application	X		X	X						X
Foreign particles into the impeller	X		X			X		X		
Misalignment due to expansion of piping						X	X	X		X
Improper foundations								X		
Warped shaft						X	X	X		X
Rotating and stationary parts rubbing						X		X		X
Worn bearings							X	X		X
Worn wear ring				X		X				
Damaged or corroded impeller			X	X					X	
Leakage under sleeve due to deterioration of the sealing ring or joint							X			
Shaft sleeve worn, corroded or rotating off center							X	X		
Mechanical seal incorrectly installed						X	X	X		
Type of mechanical seal incorrectly selected for the operating conditions						X	X	X		
Shaft rotating off center due to wear or misalignment of bearings							X	X	X	X
Unbalanced impeller, resulting in vibration							X	X	X	X
Solid abrasives in the pumped liquid.							X		X	
Internal misalignment of the parts, preventing the stationary seat and the rotating ring of the seal from properly adjusting to each other.								X	X	

LIKELY CAUSES	SYMPTOMS (NUMBER)									
	1	2	3	4	5	6	7	8	9	10
Mechanical seal operated dry							X	X		
Exaggerated axial load due to internal mechanical faults									X	X
Excessive grease in the bearings									X	X
Bearings not lubricated									X	X
Bearings assembled incorrectly (damage during assembling, wrong type of bearing, etc.)									X	X
Corroded bearings due to admission of water through the retainer									X	X
Excess, lack or use of wrong bearing housing oil								X	X	X
The clearance in the coupling is not being followed according to the instructions								X		
The motor is operating in two phases only	X	X	X		X			X		X
Admission of air into the sealing box	X	X	X	X	X					
Wear of internal parts	X	X	X	X				X		
The pump-drive assembly is misaligned					X			X	X	X

RECOMMENDED SPARE PARTS

IMBIL recommends for continuous work of 2 years, the quantity of spare parts according to the number of Pumps as per the table below:

Denomination	Number of Pumps							
	1	2	3	4	5	6-7	8-9	10 or more
	Quantity of spare parts							
Drive Shaft	1	1	1	2	2	2	3	30%
Impeller	1	1	1	2	2	2	3	30%
Bearing (Set)	1	1	1	2	2	3	4	50%
Bearing Housing	-	-	-	-	-	-	1	2 units
Retainer (Set)	1	2	3	4	5	6	8	50%
Gasket (5 rings)	1	4	4	6	6	6	8	40%
Wear ring (Set)	1	2	2	2	3	3	4	50%
Shaft protective sleeve	1	1	1	1	2	2	2	20%
Joint set	4	4	6	8	8	9	12	150%
O-ring set	4	4	6	8	8	9	12	150%
For execution with mechanical Seal								
Joint set	4	4	6	8	8	9	12	150%
O-ring set	4	4	6	8	8	9	12	150%
Entire mechanical seal	2	2	2	3	3	3	4	20%

EXTERNAL CUSTOMER SATISFACTION SURVEY FORM

CUSTOMER SERVICE → (55++) 0800-0148500

IMBIL GROUP COMPANIES:

Dear Customer,

The biggest concern of IMBIL Group is to offer you the best Customer Service, Product, Associated Services and Technical Support. For us, it is very important to know your opinion about the IMBIL brand quality and because of your opinion IMBIL Group will be able to improve continually its quality. You can participate and contribute by filling out this External Customer Satisfaction Survey Form.

IMBIL GROUP thanks for your help.

CUSTOMER INFORMATION			
COMPANY NAME: - - -		CNPJ #: *000.000.000/000-00*	
ADDRESS: - - -	CITY: - - -		STATE: - - -
CONTACT: Mr.(Mrs.) - - -	DEPARTMENT: - - -		
PHONE: *(xx) xxxxx-xxxx*	CELL PHONE: *(xx) xxxxx-xxxx*	e-MAIL: - - -	

EQUIPMENT OR ITEM INFORMATION			
EQUIPMENT OR ITEM CODE: - - -			INVOICE #: - - -
EQUIPMENT OR ITEM DESCRIPTION: - - -			
MANUFACTURER: *IMBIL*	IMBIL´S SALES ORDER #: - - -	CUSTOMER´S PURCHASE ORDER: - - -	SERIE #: - - -
TAG: - - -	MANUFACTURE DATE: / /		REPAIR DATE: / /
PURCHASED FROM: ☐ IMBIL ☐ AUTHORIZED DISTRIBUTOR (- - -)		☐ SALES REPRESENTATIVE (- - -)	

REGION

BRAZIL
- ☐ North
- ☐ Northeast
- ☐ South
- ☐ Southeast
- ☐ West Central

WORLDWIDE
- ☐ África
- ☐ Central America
- ☐ North America
- ☐ South America
- ☐ Asia
- ☐ Europe
- ☐ Oceania

APPLICATION

- ☐ Sugar and Ethanol Industry
- ☐ Distilleries
- ☐ Mining / Steel Industry
- ☐ Sanitation
- ☐ Pulp and Paper
- ☐ Irrigation
- ☐ Valve
- ☐ Air Conditioning
- ☐ Chemical / Petrochemical / Naval
- ☐ Food Industry / Textile
- ☐ Steam Generation / Cogeneration
- ☐ Fire Fighting
- ☐ Other (- - -)

EVALUATION	Completely Satisfied	Very Satisfied	Satisfied	Dissatisfied	Completely Dissatisfied
1. CUSTOMER SERVICES QUALITY ✓ *Facility for contact, agility and efficiency in providing the information requested.*	☐	☐	☐	☐	☐
2. COMMERCIAL CONDITIONS ✓ *Comply with your expectations regarding to commercial conditions.*	☐	☐	☐	☐	☐
3. DELIVERY TIME ✓ *Comply with your expectations regarding to delivery time.*	☐	☐	☐	☐	☐
4. TECHNICAL INFORMATION ✓ *Comply with your expectations regarding to technical information provided with the product.*	☐	☐	☐	☐	☐
5. DELIVERY QUALITY ✓ *Comply with your expectations regarding to product delivery conditions (Visual and packaging aspects. Product and Customer requirements).*	☐	☐	☐	☐	☐
6. OPERATION QUALITY ✓ *Comply with your expectations regarding to operation conditions agreed.*	☐	☐	☐	☐	☐
7. POST SALES ✓ *Efficiency on services provided.*	☐	☐	☐	☐	☐

Would you have any suggestion on how to increase the customer satisfaction regarding to IMBIL's Products or Services?

- - -

Note: This form can be filled out and sent immediately to IMBIL, according to the interest of the end user and/or responsible party. However, it is recommended that it is sent again six months later.

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Sales Engineering	(19) 99853-4501	engenhariadeaplicacao@imbil.com.br	Logistics / Delivery	(19) 3843-9711	ilogistica@imbil.com.br
Quality	(19) 3843-9872	iqualidade@imbil.com.br	Other Contacts	www.imbil.com.br → Contato	

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