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INSTRUCTIONS FOR THE USE AND MAINTENANCE OF VARISCO "M" SERIES PROGRESSING CAVITY PUMPS

SUMMARY

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1 PREMISE

This Functioning and Maintenance Manual (hereinafter named "Manual") was written according to par. 1.7.4 of the E.C.C. Directive 891391/ C.E.E., par. 1.7.4 of D.P.R. 459 of 24 July 1996 considering the normal operating conditions of the machine, with the purpose to inform, as set out in the instructions attached to the machine itself, the operators/users on the risks deriving from its use.
Note: the Manual is an integral part of the machine, must be carefully read before any operation is carried out and is to be kept for future reference.

1.1 CE MARKING

The CE marking has been applied according to the Directive of the Board 93/68/CEE (GUCE L 220 of 30/08/1993), and to the annex. III of Directive 89/392 (GUCE L 183 of 23/06/1989) and to any later modifications of it.
The documentation meant as technical file in compliance with the CE statement of conformance for this machine was drawn up according to the provisions set out in the Annex. V of ECC Directive 89/392 and its modifications, as well as in full complance with D.P.R. 459 of 24 July 1996, which takes in the above-mentioned EU Directive, and is kept by the Manufacturer.

1.2 NOISE

The noise made by the machine is: Leq=<80dB.
Based on the results assessed according to D.L.vo 277/91 and the provisions of D.L. 459/96, a list of obligations to be fulfilled by employers, executives and operators must be drawn up according to the degree of exposure to the noise by the workers.
The noise made by the machine is within range 1, wherein the noise risk is considered null.

1.3 SAFETY WARNINGS

These instructions contain basic warnings to be complied with during installation, operation and maintenance. Therefore, these instructions must absolutely be read by the assembler, the technical staff and by operators before assembly and startup, and must be kept available at any time on the site where the machine or plant is used.

1.4 PERSONNEL QUALIFICATION AND TRAINING

The staff in charge of operation, maintenance, inspection and assembly must be qualified. The plant manager must precisely set out any responsibilities, qualifications and control related to the personnel. If the personnel is not adequately informed, it is to be trained and informed. This can be made, if necessary, by the manufacturer/supplier on behalf of the machine user. Moreover, the user must check that the contents of these instructions are fully understood by the personnel.

1.5 TRANSPORT

The customer must be aware of the use of lifting devices and harnessing techniques in compliance with the relevant rules concerning accident prevention.
See par. 5.1 (Packing and transport).

1.6 STARTUP, USE AND MAINTENANCE

The customer must be aware of the features and working characteristics of the plant in which the pump is to be fixed. Moreover, he must get information on the pump functioning in advance, be informed of the safety warnings, startup and maintenance instructions.
The service staff shall be instructed on the use of the pump and related plant.

1.7 REPAIRING

The customer shall gather in advance detailed information on the pump, as illustrated in the repairing instructions.
The service staff shall be trained and repairing work shall be monitored.

1.8 RISKS IN THE EVENT OF NON-COMPLIANCE WITH SAFETY WARNINGS

Non-compliance with safety warnings may put people, the environment and the machine itself at risk.
In particular, for instance, non-compliance may lead to:

- Failure to perform important functions by the machine/plant.
- Malfunctioning of the methods prescribed for maintenance and repairing.
- Risk vs. people due to electric, mechanical and chemical effects.
- Environmental risks due to leakage of harzardous substances.

1.9 SAFE WORKING

It is necessary to observe the safety warnings set out in these instructions, the national rules on accident prevention and possible regulations concerning the work, service and safety of the operator.

1.10 WARNINGS CONCERNING THE SAFETY OF THE OPERATOR/USER

- In the event that cold or hot parts of the machine may lead to risks, the customer must provide protection against accidental contact (according to European regulation EN 563).
- The protection against accidental contact on the moving parts (e.g. joint) may not be removed when the machine is working.
- Leakage of hazardous materials (e.g. from shaft seal) such as explosive, poisonous and overheated materials, shall be disposed of without causing danger to both people and the environment. Provisions of the law shall be compiled by.

1.11 WARNINGS CONCERNING SAFETY DURING MAINTENANCE, INSPECTION AND ASSEMBLY

The customer shall make it sure that any maintenance, inspection and assembly operations are carried out by authorized, specialized and qualified staff, and that said personnel must be adequately informed by fully detailed service instructions.
The work on the machine shall be executed only when the machine is not working. The machine shall not be under pressure and shall be cooled. The procedure for machine stop shall be absolutely complied with.
Those pumps or units feeding hazardous materials shall be decontaminated.
After work is completed, every safety and protection devices shall be immediately refitted and reactivated.
Before restarting, the provisions of the chapter Startup shall be compiled by.

1.12 TRANSFORMATION AND ARBITRARY PRODUCTION OF SPARE PARTS

Any transformation or modification of the machine is allowed only by prior agreement with the manufacturer. Original spare parts and authorized accessories are required for safety. The use of other parts releases any responsibility for related damages.

1.13 PROPER USE

The safety of the machine is guaranteed only when the use of the machine is carried out according to the rules.

This machine has been designed considering its nominal working performance. Any indication concerning the nominal working performance is to be meant as a limit value, and shall not be exceeded in any case.

1.14 SPECIFIC WARNINGS FOR PROGRESSING CAVITY PUMPS

Progressing cavity pumps must be used only according to their destination, i.e. in compliance with the purpose which was meant for them when they were acquired.

Keep in mind that a progressing cavity pump is a positive displacement pump; hence it may theoretically produce infinite pressure.
In the event of closed delivery pipe, due for instance to clogging or accidental closing of a valve, the pump may generate a pressure several times greater than the maximum pressure allowed for the plant. In this case pipes may burst, which is to be avoided in particular if hazardous fluids are concerned.
The plant shall therefore be equipped with adequate safety devices, i.e. pressure switches, security valves and by-pass.

During maintenance and repair on the pump make sure that:

- the motor must be shut-off!
- when dismantling the pump, the rules related to the discharge material handling must be complied with (i.e., protecting apparel, smoking prohibition, etc.).
- before restarting, all protective devices, mechanical or other (e.g. chain cover or joint cover), must be regularly refitted.

WARNING

During use, maintenance and repairing, keep in mind your safety and follow the general European directives concerning machines then transformed into national laws, the European regulation EN 292, specific accident-prevention rules, instructions provided by the mining authorities and comply with the technical standards concerned.

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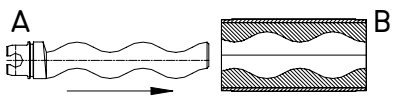
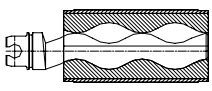
2 FUNCTIONING

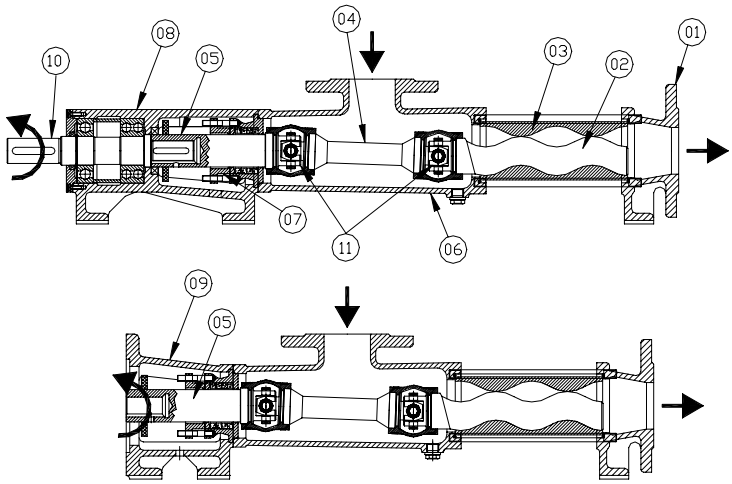
A progressing cavity pump is a rotating volumetric pump. The main parts of the system are a rotary part called **ROTOR** (see **A** below) and a fixed part called **STATOR** (see **B**).
The rotor is a round thread screw with a very large pitch, a deep thread and a small core diameter. The stator is double-threaded and has a pitch which is double compared to the rotor, so that between the stator and the rotor there are delivery chambers. These move continuously from the inlet side towards the outlet when the rotor is spinning inside the stator.
In progressing cavity pumps the axis of rotation of the rotor A does not coincide with the axis of rotation of the motor. The rotor is driven by a double-joint shaft. This shaft absorbs eccentric motions and shifts axial stresses towards the motor shaft.





The fluid coming from the stator/rotor group is conveyed to the central body, and then ejected through the outlet.

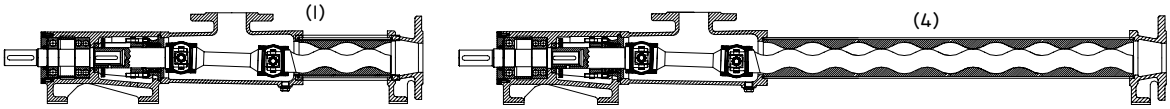
01	Outlet
02	Rotor
03	Stator
04	Connecting Rod
05	Hollow shaft
06	Pump body
07	Shaft seal
08	Bearing housing
09	Close coupled
10	Male shaft
11	Shaft joints



3 BRIEF DESCRIPTION OF THE PRODUCT

3.1 MAIN TECHNOLOGICAL FEATURES OF PROGRESSING CAVITY PUMPS

- Steady capacity, proportional to motor speed.
- Self-priming, with a min. suction of 4 mt, depending on the number of stages and rpm of the pump.
- Pumping of non-homogeneus products, containing gas and abrasive or solid and fibrous material in the fluid.
- Pumping of very high viscous liquids.
- Dosage of liquids.
- No inlet or delivery valves.
- Centrifugation-free pumping with low-tension stress in the pumped material.
- High pumping pressure (6 BAR for each stage). Pumps may have **one** up to **four** stages, according to the pressure required:



3.2 CLASSIFICATION

Progressing cavity pumps are divided into two main categories, according to the coupling between pump and motor:

- Progressing cavity pumps WITH BEARING HOUSING.
- Progressing cavity pumps CLOSED COUPLED.

3.3 MOTORS

Motors can be of different kinds; the pump can be fitted to:

- Electric motors
- Hydraulic motors
- Gearmotors
- Torque converters

3.4 AVAILABLE CONFIGURATIONS

Progressing cavity pumps can be assembled in different configurations, according to the needs:

- Feedbox and screw feeder
- Vibrating feedbox
- Barrel emptier
- Vertical

Note: customizations include specific inlet and delivery orifices, trailer-mounted base, simple base, electric board, thermal protections etc.

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4 COMPONENTS OF THE PRODUCT

4.1 ROTOR

The rotor may be made of different materials, such as carbon steel and stainless steel. It may also be coated with hardening surface treatments such as chromium plating, ceramic treatment, gas and ion nitriding, etc.

4.2 STATOR

The stator is built with a steel pipe internally coating with elastomeric material, chemically compatible with the properties of the fluid to be pumped.
It may be made with different elastomers:

Class	MST °C
T4	135
T5	100
T6	85

MATERIAL	MAX TEMP
VITON	180°C
EPDM	120°C
NBR	90°C
SBR	90°C
CSM	70°C

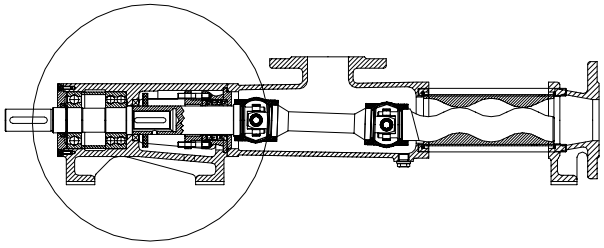
Class	Stator
T4	VITON
T5	EPDM
T6	NBR - SBR

MST: Maximum surface temperature allowed for machines of Group II (Cenelec standard EN 50014).
Note: It is possible to manufacture PTFE stators for special applications.

4.3 COUPLINGS

4.3.1 BEARING HOUSING COUPLING

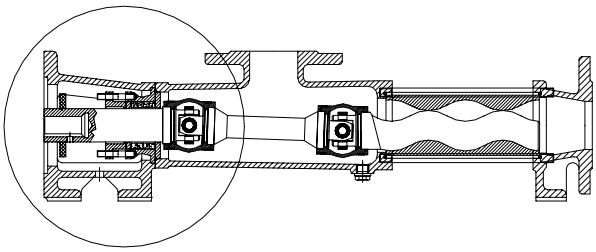
Using the bearing housing coupling the pump is linked to the motor by the male shaft, and it is mounted on a cast iron support through rolling bearings.
This configuration allows optimal resistance to the axial thrust towards the motor in those models working under high pressure. The choice of the motor in this case is not affected by axial thrust. The final coupling between motor and male shaft is made by elastic joints with a protective case.



4.3.2 CLOSED COUPLING

Closed coupling mounting does not take into account the use of a male shaft, therefore the hollow shaft of the pump is linked directly to the motor male shaft. In this case, it is necessary to use motors (or motoreducer in the case) capable of standing axial stresses coming from counter-pressure reactions during pumping.

Note: It is possible, for a special series of feedbox pumps, to link the propeller shaft directly to an angular worm screw gearmotor, without any support.



4.4 CONNECTING ROD JOINTS

Depending on the type of pump, the connecting rod can use different types of joints (see par. 9.3):

- Type SN1: Pin joint with elastomeric sleeve for smaller pumps.
- Type SN2: Universal joints with elastomeric sleeve and changeable bushing.
- Type SN3: Homokinetic joint with elastomeric sleeve.
- Type SN4: Pin joint with dual elastomeric sleeve and changeable bushing.
- Type SN5: Universal joint with elastomeric sleeve and changeable bushing for high power.
- Type SN6: Universal joint with elastomeric sleeve and changeable bushing.
- Type SN7: Open Pin joint for use with foods without sleeve.
- Type SN8: Pin joint with short bell and flat sleeve.
- Type SN9: Pin joint with short bell for high power.

4.5 SEALING SYSTEMS

The liquid sealing systems may change according to the type of fluid and to the technologic conditions of pumping. The following types are available (see par. 9.4 and Service manual):

- Type TEN 01: Packing seal.
- Type TEN 02: Fluxed packing seal.
- Type TEN 03: Oil seal.
- Type TEN 04: Single mechanical seal.
- Type TEN 05: Double fluxed mechanical seal.

Note: Mechanical seals can be fluxed, or employ quench techniques.
On request, it is possible to manufacture mechanical seals complying with API 610 standards.

4.6 ACCESSORIES

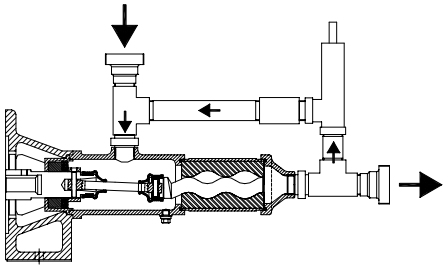
All pumps may be equipped with accessories to improve their performance.

4.6.1 DRY-RUN PROTECTION

The protection against dry run prevents stator damage whenever the liquid is missing. A thermal sensor is fitted to the stator, and linked to the electric board. If there is no fluid in the stator, the stator rubber overheats and the increase in temperature activates the electric circuit, which stops the motor. This device may be installed subsequently.

4.6.2 PROTECTION AGAINST DELIVERY OVERPRESSURE

The overpressure protection consists of a security valve set to the desired pressure and a bypass pipe which closes delivery or reduces the flow in case the pump may not be stopped.



4.6.3 RETURN VALVE IN DELIVERY

In case it is necessary to convey part of the product back to the tank in order to mix or make the product more homogeneus, it is possible to fit a valve in the delivery.

4.6.4 ELECTRIC BOARD

Upon request, pumps can be controlled by an elecric board, consisting of a main switch, a pilot light, a liter counter, two-position forward/backward selector and a reset emergency switch. The boards are also equipped with a safety lock. All boards are supplied with the Statement of Conformance required by the Law 46/90.

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5 PACKING, TRANSPORT, STORAGE

5.1 PACKING AND TRANSPORT

Progressing cavity pumps are shipped in containers (boxes on pallets, cases or cages), unless the customer requires something different.
The parcels are marked and supplied with handling instructions.
Upon receipt, check for possible damages.
Transport damages are to be reported immediately to the carrier.
Pumps are to be brought packed as near as possible to the installation site and kept packed as long as possible.
Horizontal axis pumps, once unpacked, can be lifted exclusively with the base. Use external holes and eyebolts on the base. (For dimensions, see drawing in the **Service Manual**).
Vertical axis pumps can be lifted using the holes in the support plate or eyebolts or in the bracket. The motor is usually at the top end. (For dimensions, see drawing in the **Service Manual**).

WARNING: do not lift machines with weight on top (with center of gravity above the lifting point). Make sure they do not capsize.

Vertical axis pumps must never rest in upright position without adequate fixing!
Warning: they may fall! Always arrange them horizontally. Absolutely do not lift the pump using the motor or reduction gear eyebolts. They are meant for transport of **motor or reduction gear only**.
Due to the diversification of configurations, these are to be considered as general instructions, usually meant for skilled personnel in charge of transport and assembly.
If more detailed instructions were needed, instructions related to specific machine can be supplied.

For trailer-mounted pumps follow this:

- Make sure that the motor is not running and that it cannot be accidentally started.
- Move the unit slowly and carefully, especially if over irregular ground. **Overturning hazard**!
- Make sure that the position in the new resting location is steady; lock all stopping devices on wheels/rolls, in order to avoid unwanted motion.
- Consider the reaction forces and the movements of flexible piping occuring during pump working.
- Possibly fix the unit with additional wedges.

5.2 STORAGE

The pumps, unless otherwise agreed, are protected during transport.
In case of prolonged storage prior to the assembly:

- Stator: In case of prolonged stop, the rotor may permamently buckle the stator on the contact surface (compression-set). This requires a greater pickup torque. Therefore, remove the stator, pack it in order to shelter it from light and air, and store it in a cool, dry place.
- Rotor: Rest it on wooden blocks and cover it for protection against mechanical damage.
- Shaft packing: Remove the gland, and grease the shaft.
- Stainless steel parts: No protection needed.
- Other non-painted pump parts: Grease.
- Motors: see manufacturer's instructions.

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6 ELECTRIC CONNECTION – PIPELINE CONNECTION

6.1 INSTALLATION OF MOTOR

6.1.1 ELECTRIC CONNECTION

The work relating to electric connections shall be carried out by authorized and specialized personnel, in compliance with local rules and directives issued by the authorities.
Control apparatus must comply with the latest edition of the Machine Directive EEC, Appendix 1, Chap. 1.2 (Control apparatuses).
The power supply must be equipped with a thermal magnetic overload cutout, or a fuse, and a compulsory earthing system, as mentioned above.
The electric wire shall be double-insulated and fire-retardant and with an adequate cross-section for every phase. It is necessary to properly ground the circuit, and, in compliance with the law and the rules of good technique, it is forbidden to connect the Neutral with the Ground.
Before starting the pump, check:

- tension, frequency and number of phases conform with the electric motor
- motor connections (star/triangle) conform with the alimentation available.
- wire section conform with the amperage concerned.

6.1.2 PUMP-MOTOR COUPLING

6.1.2.1 CLOSE COUPLED VERSION

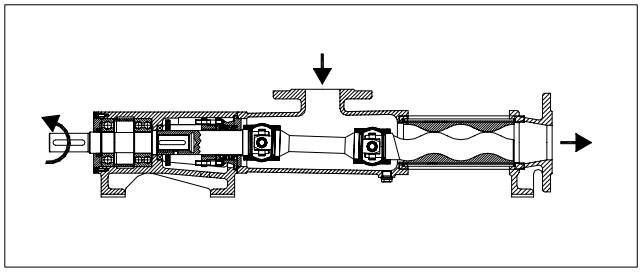
The coupling of a progressing cavity pump with its motor is not difficult, though problems may arise since the mechanical seal (or packing) is installed on the hollow shaft which, if not coupled to the motor/converter, can easily break the seal.

Therefore, during assembly, it is necessary to be careful not to move excessively the axis of the hollow shaft. Oil the male shaft of the motor/converter, place it so that its key is in line with the corrispondant bore.
Engage the propeller shaft until the two flanges (the motor's and the pump's) were connect. Then turn the motor/converter until the bolts holes of the flanges coincide. Let the pump shaft hit the motor shaft and tighten the grub screw (line it up with the cavity set it up on the gearmotor shaft).

6.1.2.2 BEARING HOUSING VERSION
(WITH ELASTIC JOINT)
Insert the half-joints (or pulleys, if belt drive is employed) at the ends of the shaft **without using a hammer** or other tools which may damage parts inside the support. For assembly, use the threaded hole on the end of the shaft.
The accurate alignment of motor and the male shaft of the pump is an essential condition for a proper operation.
If the pump is delivered completed, the alignment has already been carried out at the factory.
Nonetheless, it is possible that during the positioning on the floor a misalignment may occur, therefore it is necessary to remove the joint cover and check its alignment by means of a ruler before startup. If the foundation is not properly leveled, the base may buckle. The tolerances usually allowed in joints used by the company are:

- Allowed radial variation = 1%
- Allowed angular variation = 1°

6.1.3 DIRECTION OF ROTATION
The direction of pump rotation is shown on the label pump and described on the order confirmation.
The direction of pump rotation sets the direction of the flow through the progressing cavity pump.
Any different setup must be agreed with the supplier and approved by the same.
By changing the direction of pump rotation, the product flow reverses.
If the pump turns clockwise, seen from the motor side, it intakes from the orifice at the end and delivers from the middle one; if the pump turns counterclockwise it intakes from the middle orifice and delivers from the one at the end (see below).



Usually, the pump can work in both directions, be it mounted with packing or with a mechanical seal (unless it uses omokinetic joints which allow just one direction).
It is advisable, though, to use the pump turning counterclockwise to prevent that the packing rings (or the mechanical seal) or other parts were subject to high pressure that could be difficult to monitor.
The pumps with a mechanical seal, though reversing, shall always turn in the direction indicated on the pump label.
This direction of rotation shall be preset upon the order while the seal assembled shall be preset at the factory.

Contact Varisco if you need to change the direction of rotation for pumps that use mechanical seal.

IMPORTANT:
In close coupled versions, it is necessary to check periodically that the shaft grub screw were well tightened and fits properly in the propeller shaft cavity, especially if the pump is employed in both directions. To this purpose, see par. 6.1.2.1 of this Manual.

6.2 PIPE ASSEMBLY

6.2.1 IMPORTANT PREMISE

- Intake and outlet diameters must be adequate, according to viscosity and delivery involved.
- Accurately clean the pipes before connecting them to the pump.
- Pipes must be connected to the pump so that no external force may be applied to the pump itself.
- Fit adequate compensators between pump and pipes to protect the pump from vibrations which may damage the pump body.
- Intake and outlet pipes shall be fitted so that, the pump is not working, there is some fluid upstream and downstream, in order to ensure that there is always enough fluid in the pump to provide lubrication at startup.
- Minimize the air intake in the body pump.

Note: In case fluxed packing glands or fluxed mechanical seals or quenches were used, the feeding system connections and system tuning must to be carried out **prior to the first startup**.

6.2.2 MAX ALLOWED PRESSURE

Unless otherwise set out in the order confirmation, it is understood that **the maximum pressure inside the pump body (i.e. with pump turning clockwise) is 6 bar per stage**. The maximum allowed pressure at delivery is related its features:

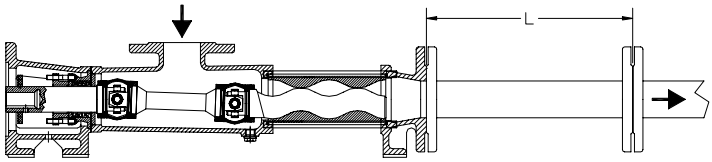
- flange: not exceeding nominal pressure (i.e. PN 16)
- female thread: not exceeding 25 bar
- sanitary male thread according to DIN 11851, up to DN 100:
  single and double stage pumps: not exceeding 12 bar
  multiple stage pumps: not exceeding 25 bar

Other configurations: In any case not exceeding 6 bar per stage of the stator being used.

6.2.3 USEFUL ADVICE

It is advisable to fit to the pipe union a stub pipe of L length. This will allow the replacement of the stator without the need of disassembling the pump. The L value is shown in the table below, according to the size of the pump and the number of stages:

	LENGTH L			
PUMP	1 STAGE	2 STAGE	3 STAGE	4 STAGE
010	-	80	-	-
015	80	160	-	-
020	110	170	-	360
030	160	300	-	-
040	200	420	-	-
050	260	-	530	-
053	-	-	-	530
055	270	550	-	980
060	440	-	-	1230
062	320	630	-	-
080	440	880	-	-
120	500	-	-	-
200	540	-	-	-
300	540	1050	-	2110
400	660	1260	-	-
500	820	1580	-	-



7 STARTUP

IMPORTANT

- **Never operate the pump when dry** - this is mandatory, otherwise the stator, made of elastomeric material will overheat and may burn. A few seconds are enough to cause damage to the stator.
- The eccentric screw pump is of the positive displacement type; **therefore it shall NEVER be operated with a closed delivery valve**. Since the theoretical pressure is infinite, this would cause excessive stress with partial or total damage to the pump or piping.
- Before startup, check that the direction of rotation were correct.

7.1 ADVICE FOR OPTIMAL OPERATION

To achieve long life and high performance, it is useful to follow these recommendations:

- The pump is self-priming, but it is advisable to fill its body with the liquid to be pumped before the first startup.
- Control the rate of delivery by modifying the rpm of the motor instead of setting choking valves.
- Install an immediate stop device in case of absence of liquid at intake, by means of a temperature sensor on the stator, to stop the pump after a few seconds of dry operation.

7.2 PUMPS FOR FOOD

The startup of pumps to be used with food requires the plant to be perfectly clean. Cleaning may be performed in two ways:

- Disassemble the pump and wash every part of it with suitable detergent. Re-assemble the parts making sure they stay clean.
- Perform Cleaning in Place (CIP) if the pump is suitable for this kind of cleaning.

7.2.1 WHEN TO PERFORM CLEANING

- Before startup
- After a prolonged stop
- After replacing parts
- After use if a prolonged stop is foreseen

Several companies supply products for CIP cleaning. Make sure the products used are compatible with the material to be pumped.

7.2.2 CIP CYCLE

- Pre-washing with clean water, to empty the pump
- Basic washing with caustic soda (1-2% at 60-80°C for 10-20 min.)
- Intermediate washing with clean water for 5-10 min.
- Washing with nitric acid (1-1.5%) at 50-70° C for 5-10 min.
- Final washing with clean water for 5-10 min.

Note: The washing speed of liquid detergents should not exceed 2 m/s at any point.

In this cycle the stator is subject to high chemical and thermal stress. Therefore, in this CIP cycle the pump shall stop and restart, that is, change the relative position of rotor and stator every 2-3 minutes, turning just a few times to make sure that every part of the stator gets cleaned.

7.3 TEMPORARY REST

After stopping the pump, empty it and possibly wash it if:

- The fluid may solidify.
- The mechanical seal may get encrusted.
- The liquid inside the pump may freeze due to the low ambient temperature.

7.3.1 PROCEDURES

7.3.1.1 STATOR

In case of prolonged stop, the rotor may permanently deform the stator on the contact surfaces (compression-set). In this case a greater pickup torque is required at restart.
It is therefore better to dismount the stator from the pump, pack it to shelter it from air and light and store it in a cool, dry place.

7.3.1.2 ROTOR

After the stator has been disassambled, rest the rotor on wooden blocks and cover it to prevent damage.
Before reassembly, degrease and clean the rotor to prevent conflicts with the stator material or with the product to be pumped.

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8 MAINTENANCE

IMPORTANT: All maintenance and cleaning operations must be performed with the machine at a standstill and cut out from any energy source.

After a stop and before restarting, the machine must be inspected to determine the cause of the stop command, and act with appropriate measures in order to prevent that from happening again.
The inherent vibrations of a progressing cavity pump are below 2.5 m/sec², therefore they hardly cause risk or trigger possible failures. **The vibrations, though, may lead to the loosening of the screws of the pump. It is therefore essential to regularly check the tightening of them**.

8.1 SUPERFICIAL CLEANING

It is important to schedule regular cleaning operations, depending on the liquid to be pumped. The pump may be cleaned:

- Through the cleaning windows if present on the pump body.
- Manually, disassembling the pump
- Automatically (CIP) for pumps with suitable connectors.

8.2 STATORS AND SEALING SYSTEMS
8.2.1 STATORS
Approx. every 900 hours of operation, it is necessary to check the wear, especially for the stator and the sealing system (packing or mechanical seal).
The frequency of control operations will be determined according to the wear of both of them, not exceeding anyway 1500 working hours.

8.2.2 SEALS
8.2.2.1 PACKING SEALS
Packing seals limit the leakage of product, but do not prevent it entirely. A small leakage is necessary to prevent excessive friction and subsequent possible overheating.
At startup, after replacement, tighten the gland bush lightly until it is set and in ideal working conditions (for 10-15 min.), then tighten it more strongly to obtain the smallest possible leakage.

FUNCTIONING ERRORS AND THEIR CONSEQUENCES
In case the pack were excessively compressed, the following damages may arise:

- Dry working
- Burnt pack
- Scored shaft (with subsequent leakage of fluid).

NOTE: The packing seal is in optimal working condition if constantly damped by the product to be pumped.

8.2.2.2 SINGLE MECHANICAL SEAL
The type and brand of the mechanical seal used is specified in the order confirmation. In case of significant leakage, check the surfaces of the seal faces and seat. Replace them if necessary.

8.2.2.3 MECHANICAL SEALS FOR VERTICAL PUMPS
Use particular caution on vertical pumps with motor on top (type SV/VM).
At startup, the mechanical seal has not yet been in contact with the fluid and briefly works dry until the air in the pump body has been expelled.
At first startup or after a prolonged stop, lubricate the mechanical seal before starting the pump.
Lubricate with water, glycerine or oil, depending on the product to be pumped: check for compatibility with the elastomers of the mechanical seal.

8.3 CONTROL AND REPLACEMENT OF ARTICULATED JOINTS
The driveline joint is one of the most stressed parts of the pump, therefore needs regular and adequate controls.
On any kind of joint, it is always necessary, though the pump may work normally, to immediately replace damaged sleeves, even if the damage is slight.
Sleeves of any kind are to be kept in warm water for some minutes before replacement, in order to soften them and ease the fitting to both ends of the joint and prevent damage on the elastomer they are made of.

8.4 LUBRICATION

8.4.1 IN GENERAL

The Nova Rotors progressing cavity pump is supplied with lubricant for about 3250 working hours. In case of replacement of parts involving lubrication, it is advisable to re-lubricate. To this purpose, see the table below:
Universal joints: VN 2461 C
Chrome steel joints (Universal joint and Pin joint): Agip SM2 - Esso Beacon Q2
AISI stainless steel joints (Universal joint and Pin joint): Agip SM2 - Esso Beacon Q2
Bearings: Agip MU3
Rubber stators for food: Agip vaseline 1718

Steel Universal Joints	Molycote VN 2461 C
Chromed steel, universal joint and pin joint	Agip SM2 - Esso Beacon Q2
Stainless steel, universal and pin joints	Agip SM2 - Esso Beacon Q2
Bearings	Agip MU3
Food grade stators	Agip vaseline 1718

8.4.2 BEARINGS

The male shaft bearings are greased at NR. In case they were removed, their seat shall be filled with grease according to the table above.

8.4.3 PROPELLER SHAFT JOINTS

Pin joints with sleeve are to be periodically lubricated.
Moreover, every time parts were replaced with original spare parts, their grease shall be replaced.
IMPORTANT: The pumps that uses sleeves over joints for food are supplied with food-compatible grease.

8.4.4 MOTOR VARIATOR

See Service Manual

8.5 MALFUNCTIONING

Below you can find a synthetic table
Malfuntioning References:

A	The pump does not work	F	The pump stops
B	The pump does not intake	G	Faulty stator
C	Wrong delivery	H	Faulty rotor
D	Uneven flow	I	The seal leaks
E	Noisy pump	J	Low delivery pressure

	A	B	C	D	E	F	G	H	I	J	POSSIBLE CAUSE
1	X						X				New stator and rotor are stuck together
2	X						X				Faulty electrical contact
3			X	X			X	X	X		Excessive delivery pressure
4	X		X			X	X				Unknown matter in the pump
5	X	X					X	X	X		High temperature, the stator squeezed
6	X	X					X				Stator of wrong material. Check the order
7	X				X	X	X	X			Product granulometry too high.
8	X	X		X		X	X	X		X	The product sediments when the pump is stopped

9		X		X	X						Air leakage at intake
10		X	X	X	X						Difficult intake
11		X	X	X	X						Air intake from seal or packing
12		X	X	X						X	Too Low speed
13		X	X	X					X		Wrong direction of rotation
14		X			X					X	Available NPSH below required
15		X	X	X		X	X			X	The pump is working dry
16		X	X							X	The stator is faulty – burned-over
17		X	X	X			X			X	Spoilt stator. Check rubber
18		X	X	X				X		X	Faulty rotor
19			X	X	X	X					Faulty connecting rod
20					X	X					The pump is not aligned to the elastic joint
21					X	X					Broken connecting rod
22					X	X					Spoilt bearings
23					X		X	X			Too high speed
24	X	X				X	X			X	Excessive viscosity
25		X	X	X	X		X		X	X	The gland needs to be adjusted
26			X						X	X	Inadequate sealing system

Reference for malfunctioning removal:

1) Fill the pump with suitable product, gliceryn or soap (DO NOT USE any kind of oil if an EPDM rubber stator is used).
2) Check on the order for details concerning electric connections and compare.
3) Measure pressure with a manometer and compare that with the order.
4) Remove unknown material and replace damaged parts.
5) If the temperature can not be lowered, install a downsized rotor.
6) Check if the fluid corresponds to the order, change stator rubber.
7) Increase the liquid percentage. Install a grid at intake.
8) Clean the pump and repeat the operation after each single use.
9) Increase the level of liquid at intake to prevent air intake.
10) Check seals and carefully tighten the pipes unions.
11) Tighten or replace the gland. If a mechanical seal is used, carefully clean and replace it if necessary.
12) Increase rpm.
13) Modify electric connections.
14) Increase the pressure at the inlet lowering the pump position and lower the inlet fluid temperature.
15) Fill the pump, install a device preventing dry working.
16) Replace the stator.
17) Replace the stator, check if the fluid corresponds to the order and if necessary change stator rubber.
18) Replace the rotor and try to identify the cause, which may be abrasion, corrosion or cavitation.
19) Replace worn parts.
20) Re-align pump and elastic joint.
21) Replace broken part and re-align.
22) Replace bearings, lubricate and tight.
23) Lower rpm through variator.
24) Check viscosity and compare it with the order.
25) Check specific weight and compare it with the order.
26) Choose a different mechanical seal or packing.

Note: For any query, please contact Nova Rotors or our local agent.

9 DISASSEMBLY AND ASSEMBLY OF COMPONENTS

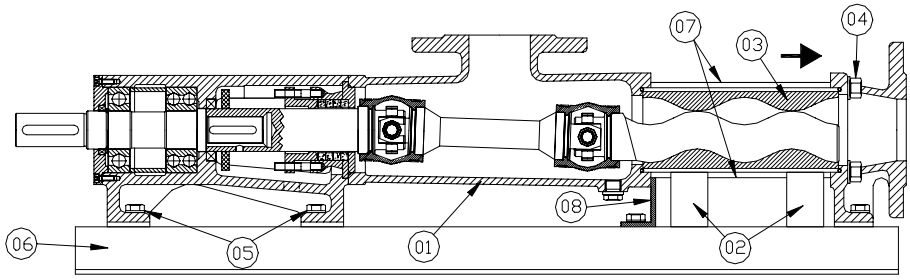
PREMISE

1. Comply with the safety measures set out in Chapter 2 of this Manual.
2. The pump and its piping shall be emptied and cooled.

9.1 DISASSEMBLY OF ROTOR-STATOR

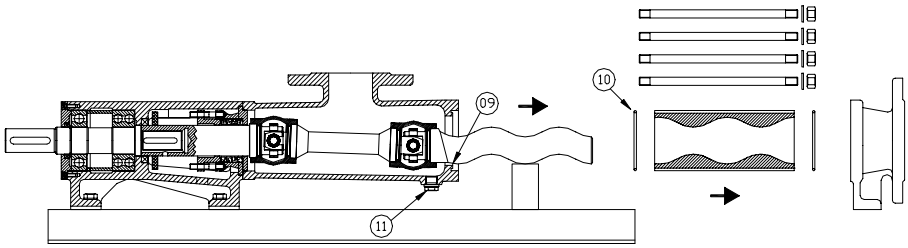
1. Disconnect the pump from intake and delivery pipes.
2. Support the pump body (01) with wooden blocks (02) under the stator (03).

3. Remove the screws holding outlet flange (04) and the housing (05) (bearing housing or close coupled housing pumps) to the base (06).
4. Remove the oulet flange by taking off the nuts and their washers.
5. Loosen the nuts and screw out the tie rods (07).
6. Remove the second foot (08) if present.
7. Extract the stator from the rotor by slowly turning the stator and pulling in the direction of the black arrow (see below) until they were completely free.



9.1.1 CERAMIC ROTOR

Ceramic rotors require particular care and no force of any kind. In particular, hammer strikes, concussions and collisions are to be avoided.
When the stator is extracted out of a ceramic rotor, the latter must be held to prevent it from toppling downwards and hitting the body edge (09), thus suffering damage.
The rotor shall not collide with the pump body under any circumstances. Struck parts become critical, and could trigger early failures.



9.2 ROTOR-STATOR RE-ASSEMBLY

1. Before re-assembly, it is necessary to carefully clean visible and disassembled parts.
2. Insert the stator on the rotor, lubricating it with glycerine, vaseline or neutral silicon oil. Assembly is carried out as described in Chap 9.1, with reversed order of operations.
3. The operation is completed by re-inserting the pump body, stator, tie rods and pipe union.

NOTE: Certain types of stators have at their end an integrated sealing profile.
In this case no O-Ring washers are needed (see picture Chap. 9.1.1), neither at the union side nor at the pump body side. In any other case, they shall be replaced every time the parts are disassembled.

WARNING: Do not tighten the pump body threaded cap too strongly (11) (pic. Chap. 9.1.1), since its cone-shaped thread could damage the pump body itself. The tightening torque is about 40-50 Nm. Do not over-tighten screws and tie rods. See table below:

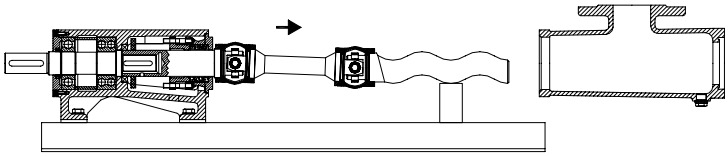
Screw	Dia	M6	M8	M10	M12	M16	M20	M24	M30
Torque	(Nm)	8	15	30	45	75	80	100	12

WARNING When inserting the rotor into the stator, your fingers may get hurt.

9.3 ROTOR/JOINT DISASSEMBLY AND JOINT REPLACEMENT
WARNING When re-assembling joints with sleeves, sleeves shall be dipped into hot water in order to soften them, thus easing their fitting in their cavities. To re-assemble them, follow the disassembling instructions backwards.

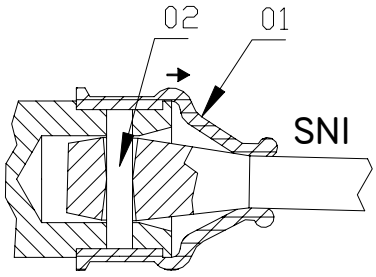
9.3.1 PRELIMINARY MEASURES

1. To remove the stator, follow instructions in Chap. 9.1.
2. Extract the pump body in the direction of the black arrow (see below). Then the drive joint connected to the rotor will be visible.
3. Follow the instructions given in this paragraph for each type of joint.



9.3.2 JOINT TYPE SN1

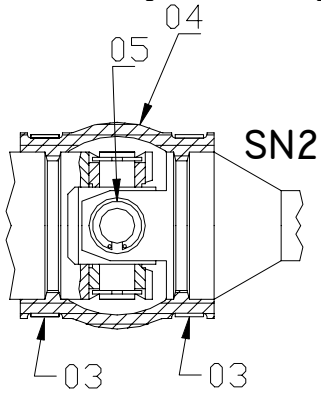
1. Move the sleeve backwards (1), following the direction of the arrow.
2. Remove the Pin (2). The rotor or hollow shaft drive then will be free.



This kind of joint has no spare parts available. In case of malfunctioning it shall be fully replaced.

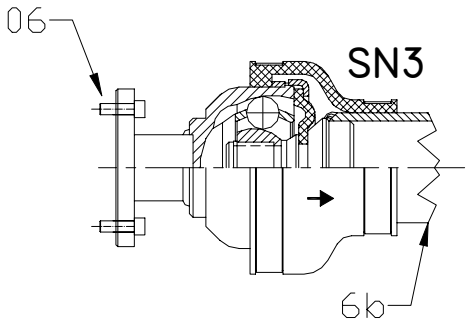
9.3.3 JOINT TYPE SN2

1. Remove the clamps (3).
2. Remove the sleeve (4) by levering with a screwdriver.
3. Remove the 2 retaining rings (5) that holds the pin. Then, after removing the pin and the spider, the rotor will be free and it will be possible to replace it.



9.3.4 JOINT TYPE SN3

1. Remove the screws (6) that hold the joint to the rotor.
2. Extract the propeller shaft (6b) in the direction of the black arrow.

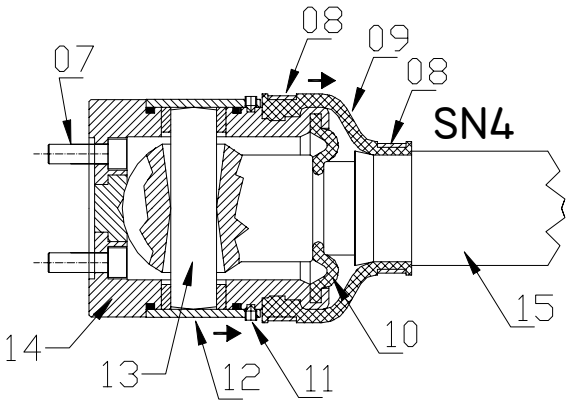


If the pump is equipped with this kind of joint, intake of fluid from the outlet is not possible (only counterclockwise rotation is allowed).
This kind of joint has no spare parts available. In case of malfunctioning it shall be fully replaced.

9.3.5 JOINT TYPE SN4

This type of joint shall be almost completely disassembled to be removed from the rotor.
Follow these steps:

1. Remove the two clamps (08) that hold the sleeve.
2. Force the rubber sleeve backwards (09) in the direction of the black arrow.
3. Remove the internal flat sleeve (10) by operating on the larger part, then move it in the direction of the black arrow.
4. Remove the grub screw (11).
5. Move the metallic cover (12) backwards in the direction of the arrow. The bushes and pin (13) will be visible.
6. Beat the pin with care, taking care not to damage the bell (14). Then, if necessary, the pin and the bushes can be replaced.
7. Pull the sphere in the direction of the black arrow. Since it is integral with the propeller shaft (15), they'll both be free of the joint. Then, the hexagonal-head screws that hold the bell to the rotor (or hollow shaft depending on the joint involved) will be visible.
8. Unscrew the screws (7). The bell will be completely free of the rotor (or hollow shaft, as mentioned above).



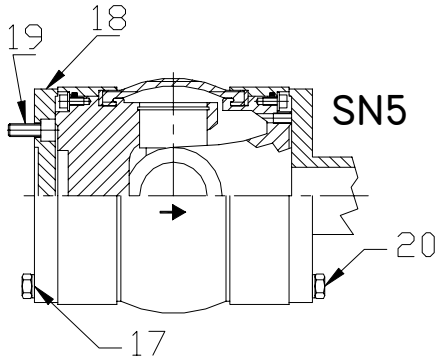
IMPORTANT: Bushes increase the life of the system but are integral with the pin, hence when the pin is replaced, they shall always be replaced as well.

To re-assemble the internal flat sleeve (10), it is advisable to grease the sphere and use two tools simultaneously (e.g. two large screwdrivers).

9.3.6 JOINT TYPE SN5

1. Remove the screws (17) on the rotor side. The joint will be free.
2. Take the joint apart from the rotor by moving it in the direction of the black arrow.
3. The rotor will still be connected to an adapter flange (18) by the screws (19), hence they shall be unscrewed in order to completely free the rotor of the adapter flange (18).

NOTE: The screw (20) serves the purpose of topping up the oil in the joint during the maintenance cycles.

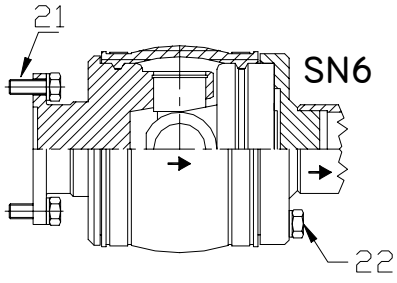


This kind of joint has no spare parts available. In case of malfunctioning it shall be fully replaced.

9.3.7 JOINT TYPE SN6

1. Remove the screws (21) on the rotor side
2. Take the joint apart from the rotor by moving it in the direction of the black arrow. Then the rotor will be free.
3.

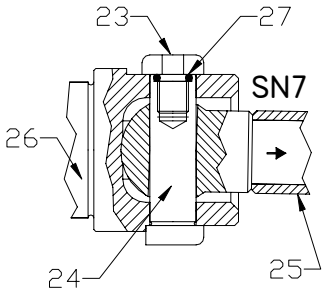
NOTE: (22) serves the purpose of filling the joint with oil during the maintenance cycles.



This kind of joint has no spare parts available. In case of malfunctioning it shall be fully replaced.

9.3.8 JOINT TYPE SN7

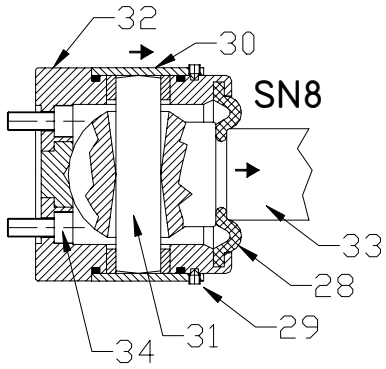
1. Remove the screw (23), the O-ring (27) and the pin (24).
2. Extract the propeller shaft (25) from the rotor (26) (or from the hollow shaft, depending on the joint involved) by moving it in the direction of the black arrow.



This kind of joint has no spare parts available. In case of malfunctioning it shall be fully replaced.

9.3.9 JOINT TYPE SN8

1. Remove the internal flat sleeve (28) by operating on the larger part, then move it in the direction of the black arrow.
2. Remove the grub screw (29).
3. Move the metallic cover backwards (30) in the direction of the arrow. The bushing and the pin (31) will then be visible.
4. Beat the pin with care, taking care not to damage the bell (32). Then, if necessary, the pin and the bushes can be replaced.
5. Pull the sphere in the direction of the black arrow. Since it is integral with the propeller shaft (33), they'll both be free of the joint. Then the hexagonal-head screws holding the bell to the rotor (or hollow shaft depending on the joint involved) will be visible
6. Unscrew the screws (34). The bell will be completely free of the rotor (or hollow shaft, as mentioned above).

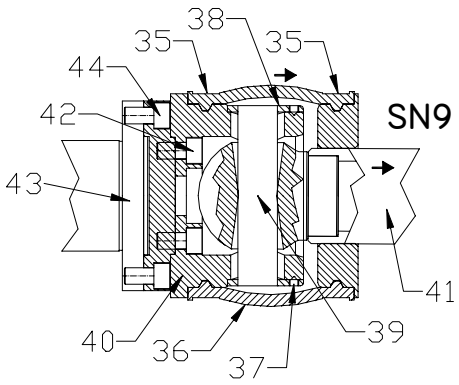


IMPORTANT: Bushes increase the life of the system but are integral with the pin, hence when the pin is replaced, they shall always be replaced as well.
To re-assemble the internal flat sleeve (28), it is advisable to grease the sphere and use two tools simultaneously (e.g. two large screwdrivers).

9.3.10 JOINT TYPE SN9

1. Remove the two clamps (35) that hold the sleeve.
2. Force the rubber sleeve backwards (36) in the direction of the black arrow.
3. Remove the grub screw (37).
4. Move backwards the metallic cover (38) in the direction of the arrow. The bushing and the pin (39) will then be visible.
5. Beat the pin with care, taking care not to damage the bell (40). Then, if necessary, the pin and the bushes can be replaced.

6. Pull the sphere in the direction of the black arrow. Since it is integral with the propeller shaft (41), they'll both be free of the joint. Then, the hexagonal-head screws holding the bell to the rotor (or hollow shaft depending on the joint involved) will be visible at the bottom.
7. Unscrew the screws (42). The bell will be completely free of the rotor (or hollow shaft, as mentioned above).
8. The rotor will still be anchored to the adapter flange (43), to be released through the screws (44). Then, the rotor will be completely free, ready for replacement.



IMPORTANT: Bushes increase the life of the system but are integral with the pin, hence when the pin is replaced they shall always be replaced as well.

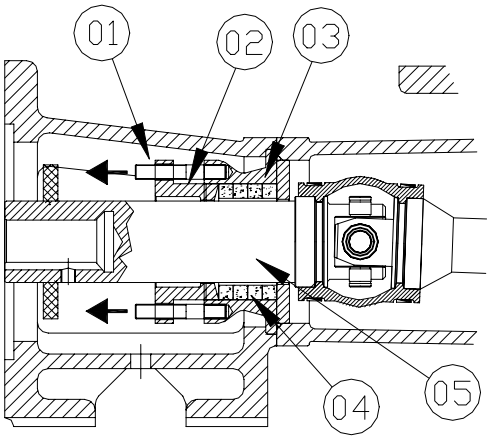
9.4 REPLACEMENT OF SEALS

9.4.1 PACKING SEAL

This operation is quite easy and fast, since it is possible to replace the packing without the need to remove any other part.

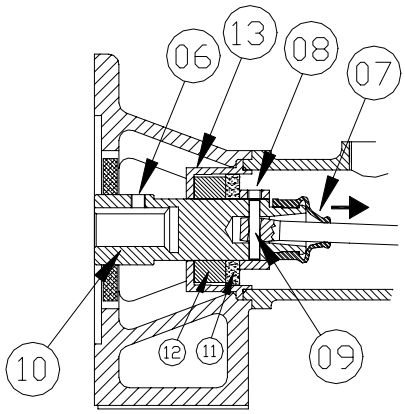
1. Loosen the screws (01) and force the gland (02) to move out of from the stuffing box (03) in the direction of the black arrow.
2. Remove the old or worn-out packing (04).
3. Clean the hollow shaft (05), and replace it if worn-out.
4. Insert the new packing, pushing it at first by hand to place it between the shaft and the stuffing box.

WARNING No sharpened tool shall be used for packing insertion, to prevent damage to the shaft or the packing itself.



9.4.2 MECHANIC SEAL REPLACEMENT
9.4.2.1 SMALL-SIZED PUMPS (MOD. 010 – 015 – 020 – 022)
DISASSEMBLY

1. Remove stator and pump body following the steps outlined in Chap. 9.3.1 (p. 1 and 2)
2. Loosen the fixing grub screw (06) and remove the pump motor by extracting it in the direction of the black arrow.
3. Move the sleeve (07) in the direction of the black arrow.
4. Unscrew the grub screw from the bush (08) in order to be able to move it along the shaft in the direction of the black arrow.
5. Extract the long pin (09) and detach the propeller shaft by moving the whole in the direction of the black arrow.
6. Extract the hollow shaft (10) from the pump in the opposite direction of the black arrow, holding the seal face (11) to prevent it from damage upon the disjunction of the seal from the hollow shaft.
7. Remove the stationary seat (12) using a screwdriver.



RE-ASSEMBLY

1. Check the condition of O'Rings, seal and stationary seat faces.
2. Check the condition of the hollow shaft.
3. Clean the hollow shaft, the housing (13) (see picture above) and all involved parts.
4. Clean and oil the propeller shaft (Rust jams the shafts coupling, thus increasing the danger of damage during disassembly).
5. Wet with glycerine the hollow shaft (10) and the bush (08) on the involved area to ease the insertion of the mechanic seal.
6. Carefully clean the seal faces before assembly.
7. Perform the steps backwards described in Chap. 9.5.2.1.1.

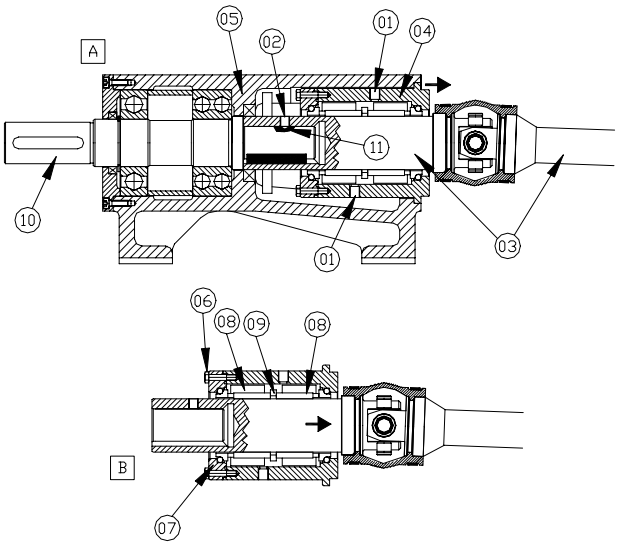
WARNING: During re-assembly, it is necessary to distribute the pressure uniformly on the fixed ring, to prevent malfunctioning or failures.

9.4.2.2 MEDIUM AND LARGE SIZED PUMPS
DOUBLE MECHANIC SEAL

9.4.2.2.1.1 DISASSEMBLY

1. Disconnect the flow pipes at the indicated points (01) (see picture A).
2. Remove stator and pump body following the procedure in Chap. 9.3.1 (points 1 and 2).

3. Loosen the fixing grub screw in the threaded hole (02) and extract from the support (05) the drive (03) + housing (04) in the direction of the black arrow.
4. Extract the drive housing slowly, making sure not to damage the seals inside (see picture B).
5. Remove the screws (06) and the gland (07).
6. Remove the seals (08) and the separating ring (09).



WARNING In bearings-mounted pumps as in the picture above, before inserting the male shaft (10) in the hollow shaft, make sure the grub screw slot (11) coincides with the threaded hole (02) in the hollow shaft; then the mechanic seal will be correctly positioned. Otherwise, push the propeller shaft as far as the slot coincides with the threaded hole of the hollow shaft grub screw.

9.4.2.2.1.2 RE-ASSEMBLY

1. Check the condition of the seal faces (as well as the O rings in some types of seal).
2. Check the condition of the hollow shaft.
3. Clean the hollow shaft, the slot (04) (see picture above) and all involved parts.
4. Clean and oil the male shaft (10) (Rust jams the shafts coupling, thus increasing the danger of damage during disassembly).
5. Wet with glycerine the hollow shaft on the involved area to ease the insertion of the mechanic seal.
6. Carefully clean the seal faces and the separating ring before assembly.
7. Perform the steps as described in Chap. 9.5.2.2.1.1 backwards.

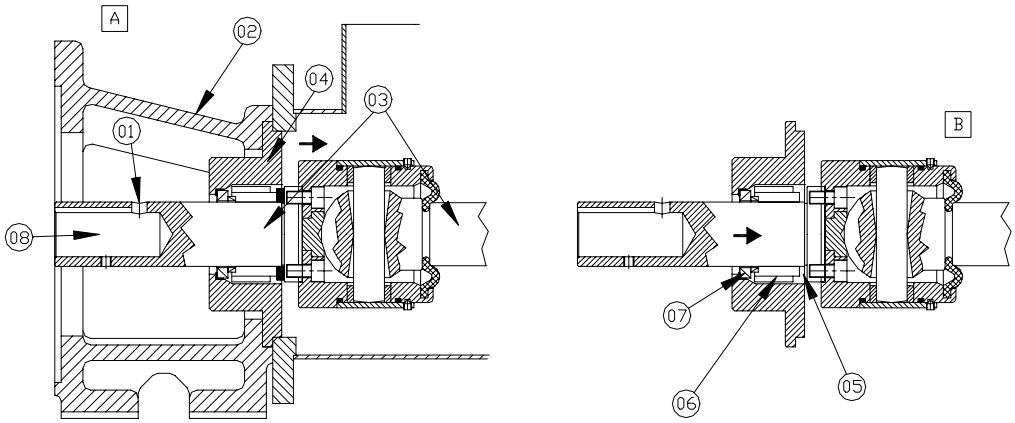
WARNING: During re-assembly, it is necessary to distribute the pressure uniformly on the fixed ring, to prevent malfunctioning or failures.

SINGLE MECHANIC SEAL

9.4.2.2.1.3 DISASSEMBLY

1. Disconnext flux piping (if fluxed seal).
2. Remove the motor (see picture A), after unscrewing the grub screw in the thread (01).
3. Remove the stator and the pump body following the procedure outlined in Chap. 9.3.1 (points 1 and 2).
4. Extract from the support (02) the drive (03) + housing (04) in the direction of the black arrow.

5. Extract the drive housing slowly, making sure not to damage the seals inside (see picture B).
6. Remove the separating ring (05), the mobile part of the seal (06) and the fixed part (07).



WARNING: In bearings-mounted pumps as in the picture above, before inserting the hollow shaft (08) in the hollow shaft, make sure the grub screw slot on the motor shaft coincides with the threaded hole (01) in the hollow shaft; then, the mechanic seal will be correctly positioned. Otherwise, push the propeller shaft until the slot coincides with the threaded hole of the hollow shaft grub screw.

9.4.2.2.1.4 RE-ASSEMBLY

1. Check the condition of the seal faces (as well as the O'Rings in some types of seal).
2. Check the condition of the hollow shaft.
3. Clean the hollow shaft, the gland (04) (see picture above) and all involved parts.
4. Clean and oil the motor shaft (Rust jams the shafts coupling, thus increasing the danger of damage during disassembly).
5. Wet with glycerine the hollow shaft on the involved area to ease the insertion of the mechanic seal.
6. Carefully clean the seal faces and the separating ring before assembly.
7. Perform the steps described in Chap. 9.5.2.2.2.1 backwards.

WARNING: During re-assembly it is necessary to distribute the pressure uniformly on the fixed ring, to prevent malfunctioning or failures.

9.5 MOTORS

9.5.1 USEFUL INFORMATION

9.5.1.1 TYPE OF SERVICE (SEC. IEC 34-1)

1. CONTINUOUS SERVICE
   Operation with constant load of sufficient duration to achieve thermal equilibrium.
2. TEMPORARY SERVICE
   Operation with constant load of duration not sufficient to achieve thermal equilibrium, followed by a standoff long enough to restore the ambient temperature in the motor.
3. INTERMITTENT-PERIODIC SERVICE
   Operation with identical cycles, each one including constant load operationg and a standoff. The motor warming is not significant.

9.5.1.2 WORKING CONDITIONS

In compliance with IEC 34-1, the motors can work under the following working conditions.

1. Ambient temp. °C between -16 and +40
2. Elevation less than 1000 m.

9.5.2 MOTORS CONNECTION

Single-speed motors with star-delta connection (6 terminals)