TECHNICAL SERVICE
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TWIN SCREW PUMPS
TS RANGE

INSTRUCTIONS FOR INSTALLATION, OPERATION AND MAINTENANCE

Contents

1 INTRODUCTION

This manual contains the instructions for the C.S.F. TS pumps relative to receiving delivery, installation and maintenance. The information given herein is of a general nature. Specific information for each version is given in the respective annexes. C.S.F. INOX SpA reserves the right to amend or modify the content of this manual without prior notice. This instruction manual contains the information necessary to understand and use the twin-screw pumps produced by C.S.F. INOX SpA. We recommend reading this manual and keeping it for future reference in a safe place near the pump itself.

When requesting information, replacement parts or assistance, always specify the pump type (*) and serial number (**) indicated on the identification plate, or the complete part number given in the purchase documentation.

Plate example

1.1 Symbols used

DANGER	
	Failure to comply with these recommendations can cause serious harm to persons and/or objects.

DANGER	
	Only qualified personnel can perform operations on the electrical part.

WARNING	
	Identifies a danger with moderate injury risk if not avoided.

CAUTION	
	Identifies a danger with low injury risk if not avoided.

NOTICE
Identifies a risk of damage to material goods if not avoided.

1.2 Descriptive notes

Twin-screw displacement pumps are machines with two counter-rotating shafts, synchronized by a gear placed externally to the pumping casing.
The two shafts support as many rotors, which engaging, rotate inside a gauged stator and transfer fluid volumes separated from the suction casing to the discharge casing.
Therefore, the main elements that determine the operation of a twin-screw pump are the rotors and the stator.
The former consist of a stainless steel screw with single or dual threads. Its sides have an optimized profile to minimize waste flow rate during rotation.
The latter consists of a cylinder shaped according to the shape given to the rotors' coupling.
If the rotation is reversed, so is the suction and discharge.

1.3 Use

Twin-screw displacement pumps are mainly used for viscous process fluids (up to a maximum of 1,000,000 centipoise, delicate, abrasive and with solid particles in suspension). They can also perform Cleaning/Sterilizing in Place. They are mainly used in the food and beverage industries, pharmaceutical industry, chemical, textile, ceramic and in water purification and treatment plants. However, this technology has its origin in the oil sector, because the operation principle is particularly suitable for the pumping of biphasic fluids.

The features of this type of pump are the virtually absence of pulsations and the smooth flow, for which fluid maintains its own rheological properties.
Indeed, due to the constant quantity of conveyed fluid and to the screws' geometry, the fluid is neither centrifuged nor mistreated, keeping its own organoleptic properties intact as well.

Note: For the field of application of the pump in your possession, please refer to the technical sheet.

1.4 Enclosed documentation

The following documents are enclosed with this manual:

- Complete sectional drawing of the pump
- Technical parts list, with details regarding pump components and application
- EC Declaration of Conformity

2 SAFETY WARNINGS

The following occurs during operation:

DANGER	
	- Electric parts are under tension. - Mechanical parts are moving. - Pump casing, pipes and couplings under internal pressure. Therefore, do not remove any protection or locking device; do not loosen screws or fastenings, as this can cause serious damage to persons or objects. - Absence of inspection and maintenance can cause damage to persons and objects, especially when dangerous or toxic liquids are pumped - When pumping liquids at temperatures over 60°C, adequate protection and warning signals are required. - When you buy a pump with a bare shaft, motor coupling operations must be carried out according to the technical standards and laws, providing adequate protections for joints, gear belts, etc.

DANGER	
	- Operations on the electric parts must be carried out by skilled personnel, according to technical standards and laws, subject to authorization from the person in charge of installation. - Installation must ensure adequate ventilation in order to cool the motor, as well as enough space for maintenance operations.

Before performing operations that require the disassembling of the unit (inspection, cleaning, complete seal replacement, etc.), the following preliminary operations must be carried out:
- switch off the motor and disconnect the electric power;
- close valves on suction and outlet pipelines in order to avoid the risk of inundation;
- use adequate protections for hands and face, if the pump contains liquids that are injurious to health (for example acids, solvents, etc.);
- consider if the liquid flowing out of the pump when disassembling is dangerous and arrange for adequate safety measures.

The staff performing inspection, maintenance and assembly operations must be adequately qualified.

2.1 Foreseen use

The correct use of this machine is detailed in the order confirmation. A different use or a use that disregards the foreseen use is not considered correct. If you want to change the product, pressure, speed or temperature, first you need to consult our company or one of our agents.

2.2 Improper use

Any other use that differs from the one stated in the paragraph ***2.1 Foreseen use*** is considered improper. For example:

- Pumping of acids or abrasive liquids, unless otherwise approved by our company;
- Pumping of gas or gaseous substances;
- Closing the outlet valve;
- Reversing the flow, unless otherwise approved by our company;
- Dry start, etc.

DANGER	
	The pump must always be used in an environment suitable to the level of protection of the motor. Always check this on the motor plate before installation. THE PUMP MAY NOT BE USED IN ENVIRONMENTS REQUIRING A HIGHER LEVEL OF PROTECTION OR A HIGHER MOTOR SPECIFICATION OR ELECTRICAL PARTS. In this case, use components that comply with the safety standards for the environment in question.

2.3 Dangers arising from the use of the machine

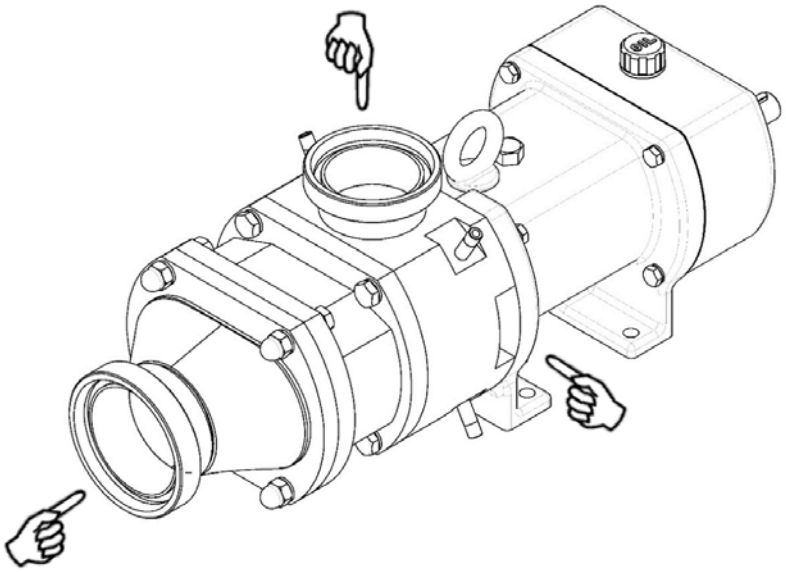
The TS pump is built according to the state of the art, complying with mechanical safety standards in force. Nevertheless, its use may pose a danger to the life and limbs of the operator or third persons and damage the machine and other goods. The machine must only be used:

- For the purpose for which it is built.
- By complying with the safety standards.

In case of malfunction that might compromise safety, stop using it and repair it.

2.4 Particularly dangerous points

DANGER	
 	**Rotors inside the pump** Danger of crushing or amputation of fingers and hands. **Mechanical seals inspection windows** Danger of dragging, crushing or amputation of fingers and hands.



The pump must be protected by the costumer in a way that prevents people from inserting their hands in the indicated openings while the rotors are moving. In case of operations with the rotors stopped, ensure the motor cannot start accidentally. The risk is greater if the tubes are disassembled and the pump is open.

2.5 Potentially explosive atmosphere

Follow the indications on explosion protection given in this section in case of operation in potentially explosive atmospheres.

DANGER	
	Only the pumps marked according to the ATEX directive and identified in such way in the list may be used in potentially explosive atmospheres. Special conditions apply to the use of pumps according to the 2014/34/EU (ATEX) directive. The use in explosive atmospheres is guaranteed only if the pump is used according to its foreseen use (see par. 2.1).

2.5.1 Marking

The marking on the pump only refers to the pump itself.
The coupling to the drive shaft needs a proper CE marking by the manufacturer.
The motor must be taken into account separately.

2.5.2 Temperature limits

Under normal operating conditions, the maximum temperatures are expected on the external surface of the bearings housing. Nevertheless, in case of the high temperatures of the processed media, the external surfaces of the pumping parts may achieve the highest temperature values.

NOTICE

Make sure that the temperature of the fluid processed by the pump does not change abruptly.
If this is inevitable, stop the pump for enough time (see par. 7.2.1)

If the pump is supplied with a bare shaft, when selecting the coupling motor it is necessary to consider the following conditions:

- The temperature limit allowed to the flange and drive shaft must be higher than the temperature generated by the pump;
- Contact C.S.F. for the actual temperatures of the pump.

2.6 Maintenance warnings

Perform specified adjustment, maintenance and inspection work on time. Inform operating personnel before starting the maintenance and repair work. Protect all plant parts and operating media connected before and after the machine such as compressed air and hydraulics and similar against unintentional start-up. In all maintenance, inspection and repair work switch the machine free of voltage and secure the main switch against unexpected switching back on. Fasten and secure larger assemblies on replacement carefully to lifting gear. Check loosened screw connections for firm seating. Use only original spare parts.
After ending the maintenance work, check the safety devices for function.

2.6.1 Cleaning the machine

Handle substances and materials used correctly, especially

- when working on lubricating systems
- when cleaning with solvents.

2.6.2 Faults

In the case of operating faults switch off the machine and secure it against unauthorized or inadvertent starting up again.

3 GUARANTEE

All products manufactured by C.S.F. Inox are guaranteed to the purchaser, for one year from the date of purchase, against hidden defects in materials or manufacture, providing that they are installed and used according to instructions and recommendations of the manufacturer. Excluded from the guarantee other than distinctive wear and tear are repairs to damage caused by improper use, abrasion, corrosion, negligence, defect of installation, non-observance of inspection and maintenance, use of non-genuine spare parts, cause of accident or fortuity and from any action carried out by the purchaser not according to the normal instructions of the manufacturer.

NOTICE

Before returning to C.S.F. Inox S.p.A. any item to be substituted or repaired under guarantee, inform about the problem the Customer Assistance Office and follow instructions of the manufacturer.
Any item must be properly packed in order to avoid damages during the transferring and a technical report explaining the fault occurred, must accompany the returned item/s.

Any item with a presumed fault should be returned to C.S.F. Inox S.p.A. with shipment costs at purchaser's charge, unless different agreements are given.
C.S.F. Inox S.p.A. will examine, repair and/or replace the returned piece and then send it back to the purchaser on ex-works basis. Should the piece be found under warranty, no further costs will be debit the purchaser. If, on the contrary, the fault is not found under warranty, all necessary reparations and replacements will be charged at normal cost to the purchaser. Commercial parts incorporated in C.S.F. products are guaranteed by their corresponding manufacturers.

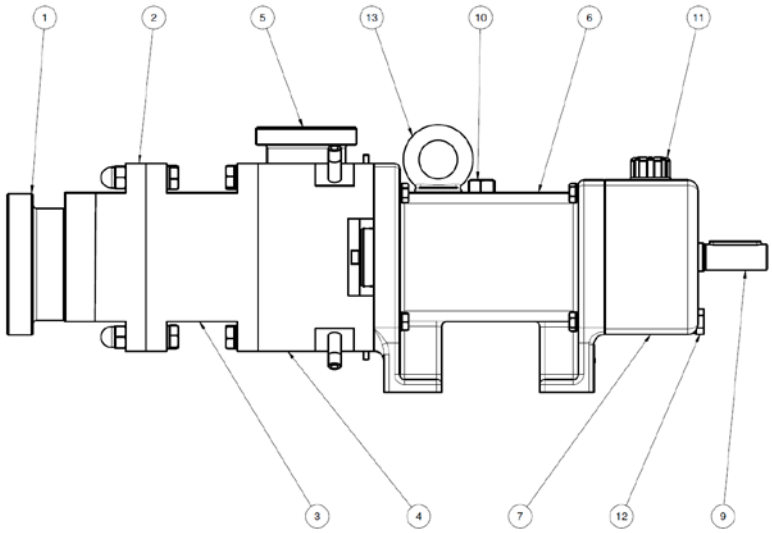
4 PUMP DESCRIPTION

This chapter reports the technical features of the pump, paying special attention to the types of mechanical seal used.

4.1 General description of the machine

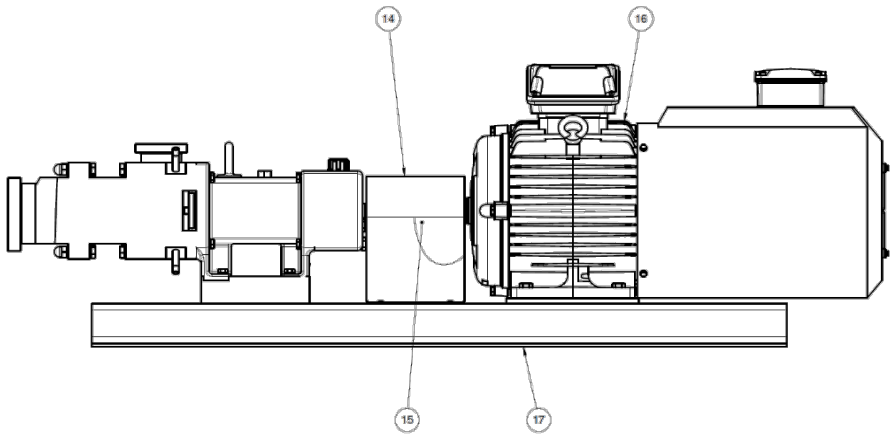
4.2 Technical description of the machine

Bare shaft pump



Pos.	Description
1	Inlet connection
2	Pump cover
3	Pump casing
4	Intermediate Casing
5	Outlet nozzle
6	Bearing housing
7	Gear casing
8	Foot
9	Drive shaft
10	Oil plug, filler
11	Vent plug
12	Oil plug, draining
13	Lifting eyebolt
14	Joint cover
15	Coupling joint
16	Motor
17	Base

Coupling with motor drive



4.3 Mechanical seals

The mechanical seal is a device designed to retain the fluid so that it does not get out of the pump. It consists of two sliding surfaces, one rotating in relation to the other, kept in axial contact by the pressure generated by the fluid (hydraulic force) and by the presence of components, such as springs or bellows (mechanical force).

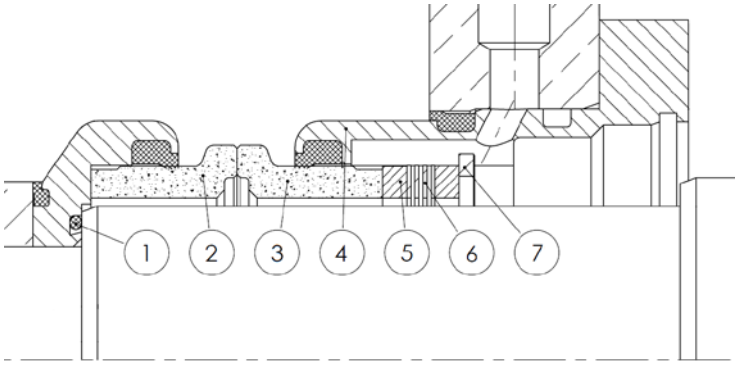
The mechanical seal is usually cooled by the retaining fluid. The materials used are selected according to the properties of the fluid used, under the conditions of use at which the seal is installed and for the required performance. The seals installed on twin-screw pumps are reversible.

NOTICE

Before using the pump with any liquids other than those specified when selecting and ordering, ensure that seals and gaskets are suitable for the new product.

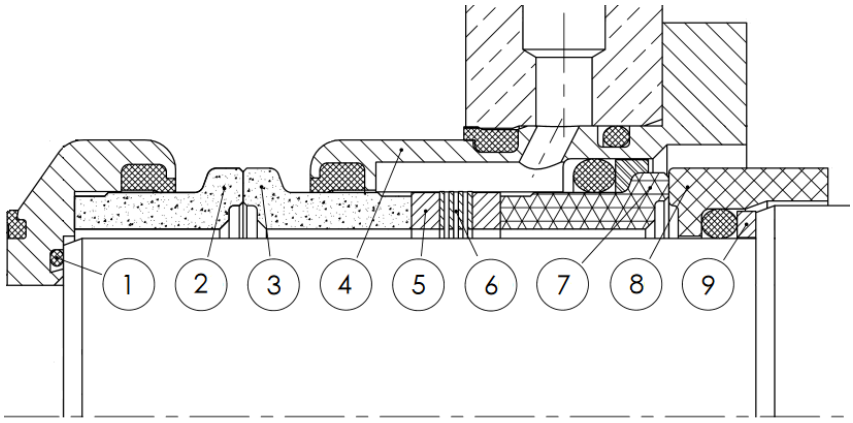
The pump may be equipped with a set of two single or dual mechanical seals:

4.3.1 Single mechanical seal with external quench



Pos.	Component
1	Rotary gasket
2	Rotary ring
3	Fixed ring
4	Frame
5	Guide ring
6	Spring
7	Internal retaining ring

4.3.2 Double flushed mechanical seal



Pos.	Component
1	Rotary gasket
2	Rotary ring 1
3	Fixed ring 1
4	Frame
5	Guide ring
6	Spring
7	Fixed ring 2
8	Rotary ring 2
9	Centering spacer

Here are the flushing parameters:

Maximum pressure of the flushing system: 16 bar
Minimum flow rate of the flushing system: 0.5 l/min

For applications with high sanitary requirements, we recommend using a non-pressurized system to avoid the contamination of the product in case of pressure drops.
In any case, the pressure difference between the processing fluid and the flushing system must not be higher than 5 bar.

5 TRANSPORTATION

5.1 Transportation

The packaging of all pumps manufactured by C.S.F. Inox S.p.A. is defined when placing the order. Unless prior arrangements, the goods are packed only for transit conditions and not for long-term storage; if it should be necessary to store the pumps outside, the pumps must be appropriately covered in order to protect the electrical parts (motor drive) from rain, dust, humidity etc.

5.2 Receipt

When receiving the goods, ensure the packaging is intact to identify possible damage to the content occurred during transport and report immediately to the carrier. If a damage is ascertained, the following procedure must be observed:

- Collect the goods with reservation;
- Take the necessary pictures showing the damage;
- Notify the carrier of the damage incurred by registered mail, sending at the same time the pictures taken to show the damaged pieces.

5.3 Handling

DANGER

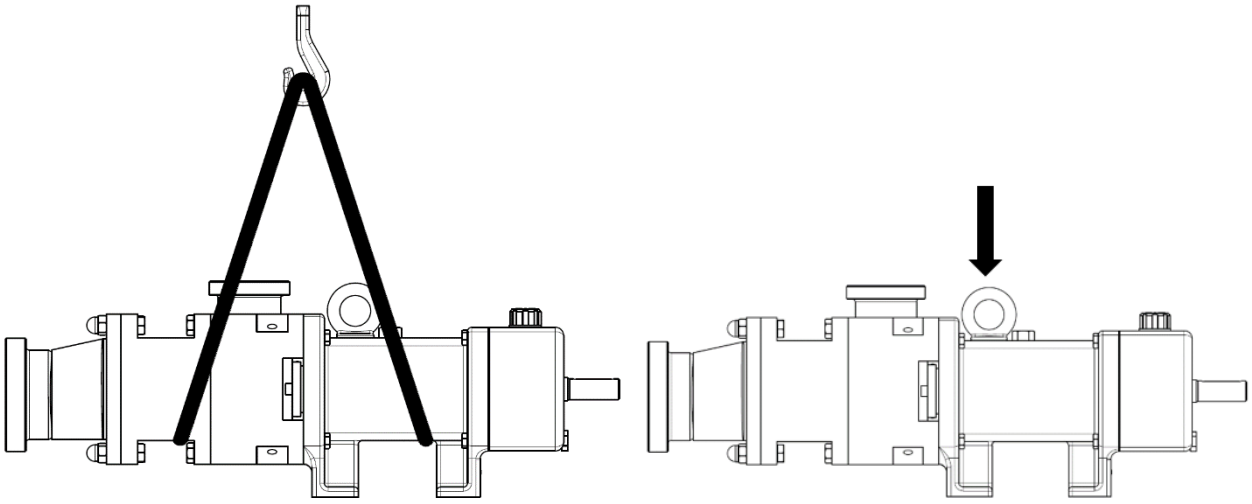
Carry the packed pumps as close as possible to the place of installation using appropriate lifting devices and unpack them. Take care during this operation, as unsteady parts might fall down.

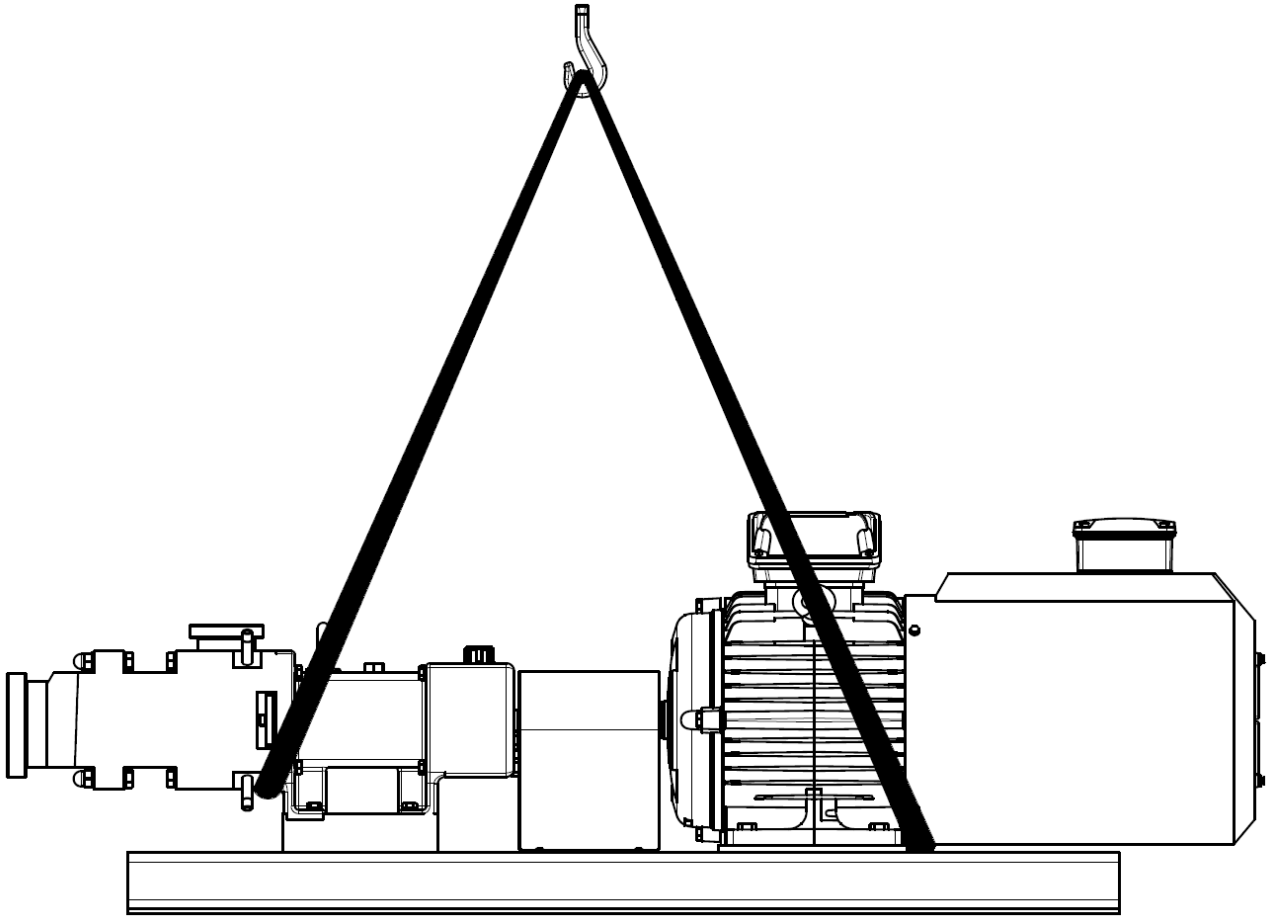
Dispose of any packaging material (wood, paper, cellophane, etc.) according to the corresponding rules in force in user's country.

After unpacking the pump, use special lifting slings and move the pump-motor unit to the place of installation; never use the eyebolts on the motor to move the pump, as the eyebolts are for moving the motor only.

NOTICE

In versions complete with a shroud, take the shroud off before moving the pump-motor unit in order to avoid damage.

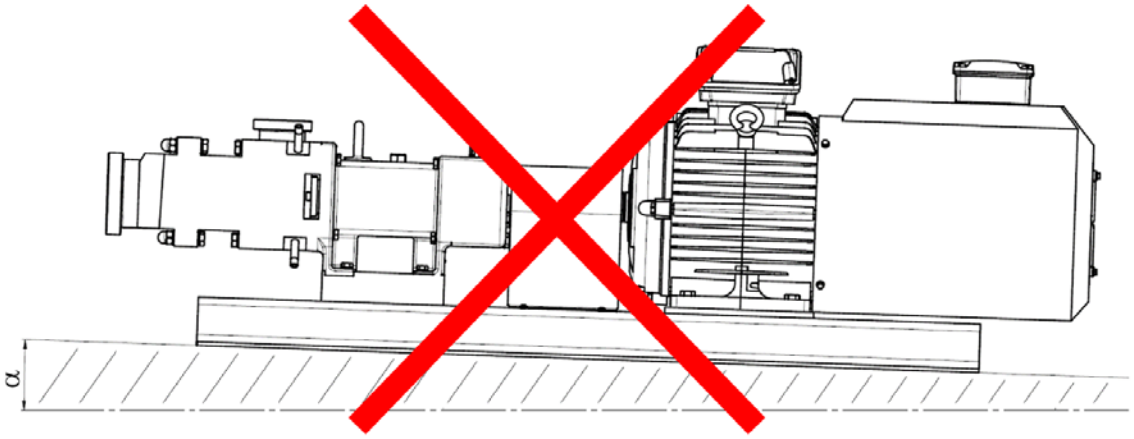




6 INSTALLATION

6.1 Pump preparation

DANGER	
	Position the pump over a plain surface.



DANGER	
	Do not start the pump without protections to avoid contact hazards!! The entire machine must be protected from any static charge. The connection between the drive shaft and the pump shaft must be protected from contact hazards!

WARNING	
	There must be enough space around the pump to allow for maintenance operations. Make sure that the motor is well ventilated. Align the pump shaft with the transmission shaft.

NOTICE
The size of the foundations must be able to support the weight of the pump.

If he pump is to be used in environments at risk of explosion, it will be necessary to use a motor with adequate protection against explosions.

6.2 Motor transmission couplings

Drive for independently mounted is transmitted via flexible couplings designed to absorb impact and torsional vibration.

These couplings compensate for both angular and radial misalignment and can sustain variations in load and rotation inversion.

The couplings are sized in compliance with DIN 740/2 standards.

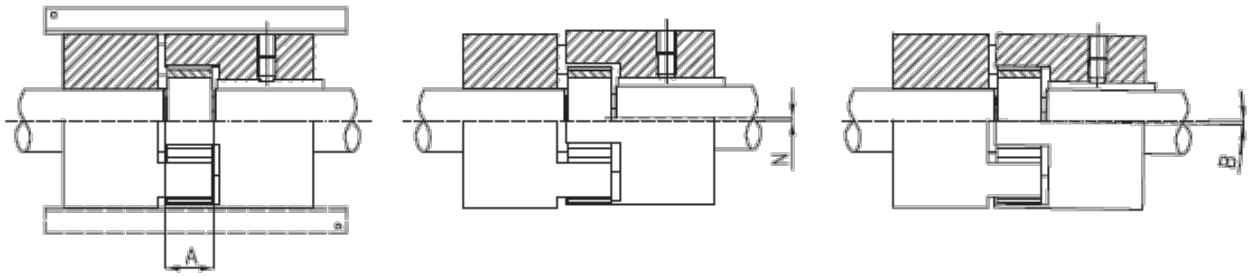
A coupling is sized so that the maximum moment transmitted by the coupling in different operating conditions is less than the maximum permissible strain for the coupling itself.

Transmission couplings with ATEX marking are available for machines for use in potentially explosive environments.

Pumps supplied complete with motor and base are delivered already aligned during assembly. The baseplate may be warped, however, if fixed to an uneven surface.

Perfect alignment between the pump and motor is essential for correct operation.

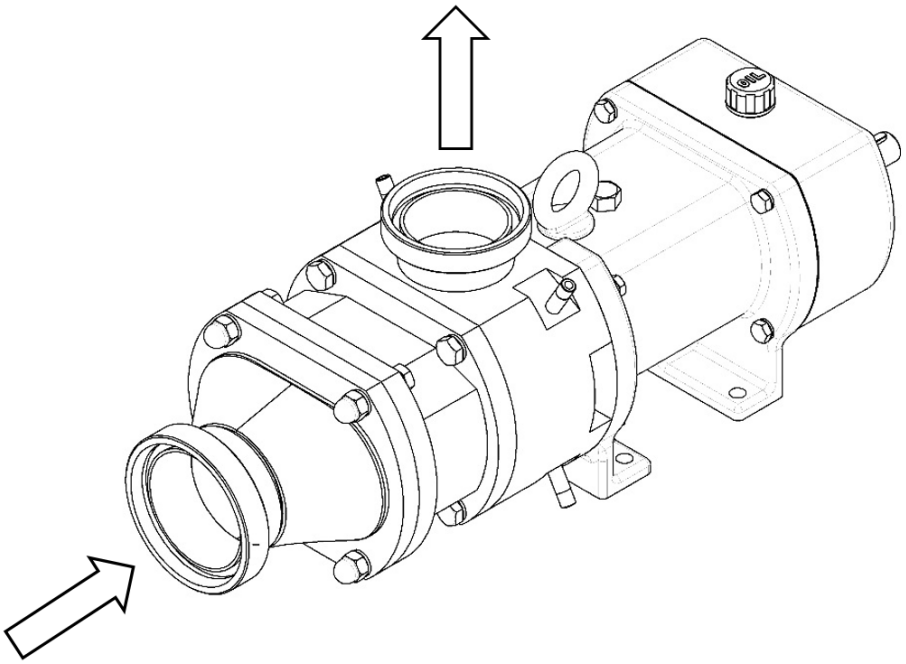
As a result, after installation, we recommend checking pump-motor alignment.



RADIAL MISALIGNMENT **ANGULAR MISALIGNMENT**

6.3 Changing the direction of rotation

NOTICE
TS pumps have been designed to transfer the fluid in the direction stated in the following image, unless otherwise stated in the attached list by C.S.F.



Subject to authorization, it is possible to reverse the fluid movement changing the direction of rotation of the motor. Such operation is allowed for short periods at reduced differential pressures.

For more information, please contact C.S.F. via the contact details in the end of this manual.

6.4 Connection to the piping

Before connection clean the piping and remove foreign bodies (e.g. welding work).

Install universal expansion or expansion joints between the pump connections and the piping. This should prevent vibrations of the pump being transmitted to the piping and torques acting from the piping on the pump connections.

The pressure line should point upwards, so that later residual liquid can always flow back into the pump. This total dry running is avoided. Further, it facilitates the later suction process.

The operator has to ensure that the pump respect the pressure agreed in the order and listed in the technical data.

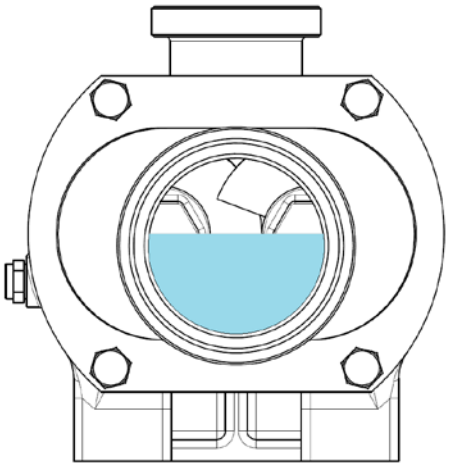
The TS pumps normally run with such a low resonant frequency that no corresponding damage is caused. However, particularly when running with converters, certain frequencies can cause interfering vibrations, which must be avoided. It is important during initial commissioning to ascertain whether such vibrations exist and to define them accordingly, so that the frequency converter can then be programmed to avoid these frequencies. Similarly, interference from cavitation or rigid lines must be ruled out.

6.5 Checks prior to start-up (!)

If cleaning or repairs have been performed or if the first start-up is about to be carried out, ensure all the screws are correctly and completely screwed before starting the pump.

In case of pumps for hazardous fluids, comply with the indications provided for such materials.

The costumer must ensure that the pump is installed in the right position and with all the necessary safety devices (sensors, switches, pressure gauges, etc.)!



The pump must always be filled with the product before the start-up and with a liquid level above the rotor during operation (see figure).
The pump must be filled outside the flammable area.

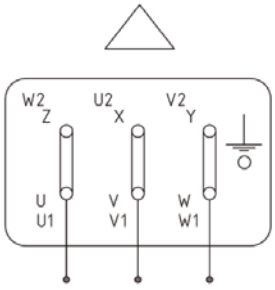
Ensure, before start-up, that all the valves are open. The pump will not be able to pump to a closed valve without an overpressure valve.

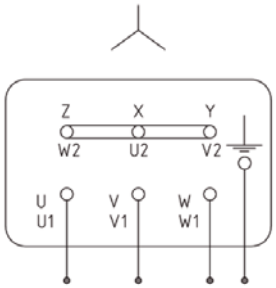
If the pump leaks, suspend the ongoing operation as soon as possible to replace the damaged gaskets.

6.6 Electrical connection

The connection to the electric system has to be carried out after the hydraulic connection, according to the agreements of technical directions and law (EN 60204-1).
Provide a manual power supply-disconnecting device with an adequate current breaking power. Further, install an overload and overcurrent protection (for example cutouts, automatic switches, etc.) and if necessary provide for a proper device to avoid spontaneous restarting.
Check that voltage, network frequency and number of phases conform to the technical features shown on the electric motor. The safety level of all components used for electric connection (cables, cable presses, switches and protections) must conform to the environment where the unit is installed; further, it is important to use electric cables of suitable section corresponding to the current values indicated on the motor plate, in order to avoid the overheating of the electrical conductors. First, carry out the motor grounding, using the clamp on the motor and an electric conductor of suitable section. The cable connection to the terminal box can both be star or delta connection, according to the values indicated on the motor plate and to the network voltage shown below in the following picture; the clamps must be clean and carefully tightened; do not force the clamps.

Lower voltage





Higher voltage

When starting the motor, current absorption raises (5-6 times the nominal value) for a very short period; if the network cannot bear this absorption increase, we advise to use star or delta starters or other systems (for example auto-transformer). C.S.F. Inox S.p.A. is not liable for damages to persons and/or objects in case of non-observance of technical directions and laws.

7 OPERATION

7.1 Preliminary operations

- Check that the pump turns in the marked direction.
- The suction pipe and the pump must be filled with liquid. Two possible cases can be distinguished:
  a) When the pump must operate with a negative suction head, it must be filled by introducing liquid into the pipes.
  b) When the pump must operate below the level of the suction liquid, i.e. with a positive head, the suction and discharge gate valves must be opened until the pressure gauge on the pump discharge shows a pressure corresponding to the positive suction head.

NOTICE

Dry operation of the pump is ONLY allowed if the flushing of the mechanical seals is guaranteed.
- If the sealing chamber is to be flushed, open the cooling water supply and adjust the flow.
- Ensure the suction and outlet valves are completely open.

WARNING

The twin-screw pump is a displacement pump and, therefore, must never operate with a closed valve on the outlet piping.

The twin-screw pump is a displacement pump that can produce a theoretically infinite pressure. If the outlet pipe is closed, the pressure generated by the pump may achieve values higher than those allowed by the system.
We recommend installing suitable safety devices on the plant, such as pressure switches or by-pass valves.
Start the pump and check it once again to ensure it rotates in the right direction.

7.2 Operation

The twin-screw pumps do not pressurize the fluid on their own, but they transfer it from the suction chamber to the outlet piping. Depending on the model of the pump used, differential pressures up to 16 bar can be achieved.

The maximum static pressure the pump may be subjected varies depending on the setup. For further detail, please contact C.S.F.

7.2.1 Fluid temperature

Fluid temperature variations may irreversibly damage the components of the pump. This may happen in case of two products at different temperature, as when washing the system, when the pump stops processing the process fluid and passes to the detergents, which can be at a considerably higher temperature.

In such situations, the pump should be stopped and the waiting times stated in the following table should be complied before starting it up again:

Temperature difference [°C]	Waiting time [s]
20	100
60	200
80	300

7.3 CIP/SIP

The twin-screw pump can perform Cleaning/Sterilizing in Place launch.

If one wishes to use the pump for processing and for washing and sterilization purposes, it is necessary to notify CSF SpA during the selection phase, in order to receive a machine suitable for the performance requested and for the processed fluids.

Below are the procedures to follow in order to protect the pump from temperature variations when starting the cleaning cycles.

The recommended fluids and operating conditions are reported in the paragraph ***10.7 Cleaning fluids.***

7.3.1 Flushed double mechanical seal

If the pump is equipped with flushed double mechanical seal, ensure that the flushing system is in operation and that the pump is stopped, then start the cleaning fluid on the system.

Based on the temperature difference between the processing fluid and the CIP, refer to the table in paragraph 7.2.1 for the waiting times that must be complied with before starting the pump for the washing cycle.

7.3.2 Single mechanical seal

If the pump is equipped with single seal, start the cleaning fluid in the system.

Based on the temperature difference between the processing fluid and the CIP, refer to the table in paragraph 7.2.1 for the waiting times that must be complied with before starting the pump for the washing cycle.

8 DISASSEMBLY OF THE TWIN-SCREW PUMP

DANGER

Electricity

Electrical shock hazard.

- Electrical connection/disconnection operations on the pump must only be performed by qualified personnel.

WARNING

Improper maintenance

Injury hazard.

- Only qualified maintenance technicians are authorized to perform maintenance operations.

CAUTION

Automatic start-up

Injury hazard due to the presence of rotating parts.

- Before any maintenance operations, disconnect the machine from the power socket and ensure that it cannot start accidentally.

CAUTION

Hot surface

Burning hazard.

- Check the temperature of the product.
- Allow the pump to cool down.
- Wear the designated personal protective equipment (PPE).

CAUTION

Dangerous fluids

Health risk.

- Avoid contact with skin.
- Follow the safety instructions of the fluid manufacturer.
- Wear the designated personal protective equipment (PPE).

NOTICE

Improper maintenance

Damaging the pump.

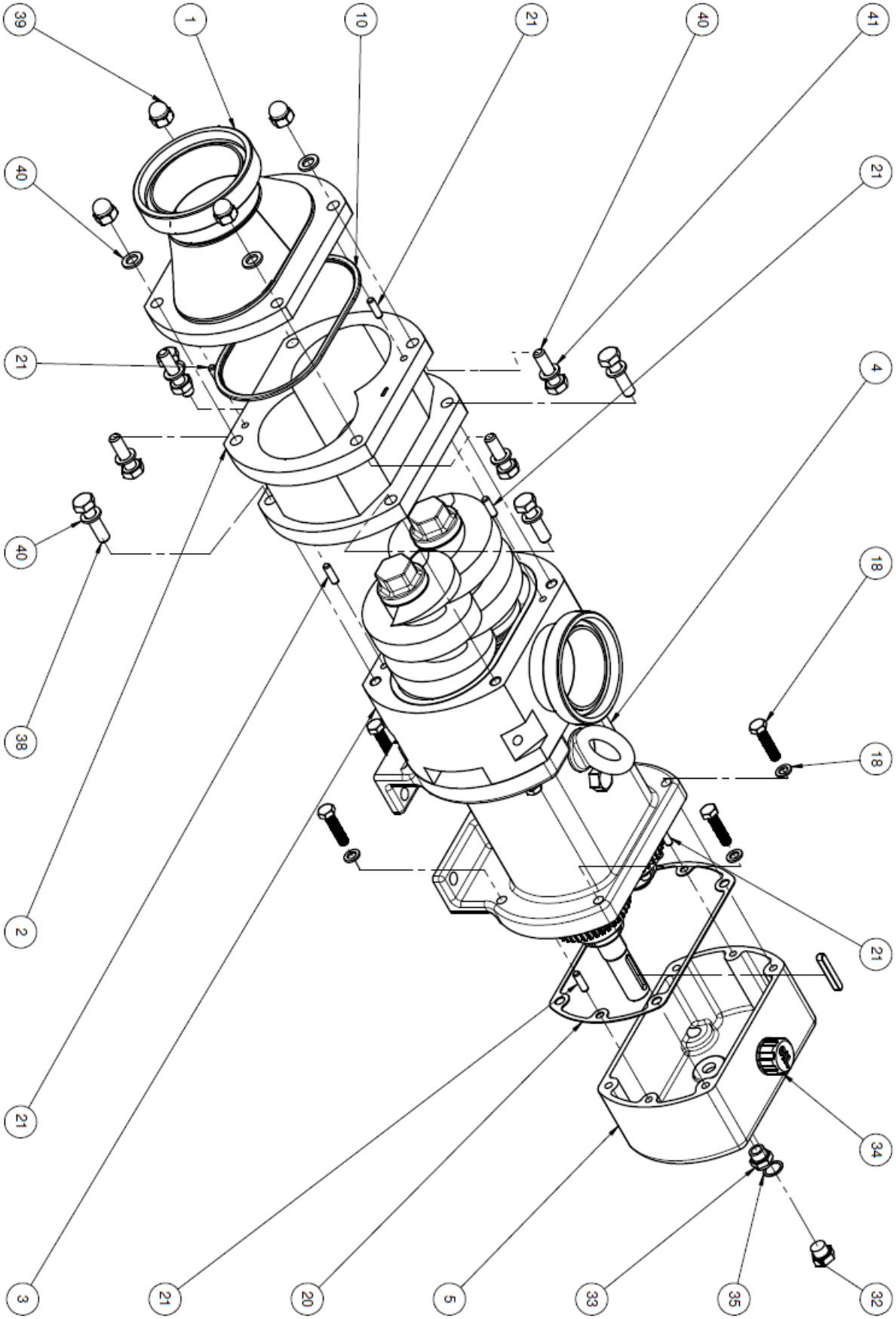
Before performing such operations, disconnect the electrical motor from the power grid, remove the pipes providing the connection to the system, uncouple the pump from the coupling joint and position it on a flat surface. Moreover, the pump must be washed internally.

- Use only original C.S.F. spare parts.
- Changes to the pump's components must be approved by C.S.F.
- Carefully clean the pump and provide the safety sheet of the fluid.
- Remove dirt on the inner parts of the pump.

Below are the steps to follow in order to disassemble the twin-screw pump completely.

Before performing such operations, disconnect the electrical motor from the power grid, remove the pipes that connect the pump to the system, uncouple the pump from the coupling joint and position it on a flat surface.

1- **Removal of the suction casing and rear box:**
   - loosen the vent plug (34) in the gear casing (5);
   - Remove the lubricating oil inside the pump by unscrewing the drain plug (32) and removing the Aluminum gasket (35);
   - Unscrew the 4 screws (18) fixing the rear casing to the bearings housing (4) and remove the washers (18);
   - Remove the gear casing (5) and the gasket (20);
   - Remove the 2 centering pins (21);
   - Unscrew the 4 bolts (39)(40)(41) that fix the pump cover (1) to the pump casing (2);
   - Remove pump cover (1) and the respective shaped gasket (10);
   - Remove the 2 centering pins (21);
   - Unscrew the 4 screws (38) fixing the pump casing (2) to the intermediate casing (3);
   - Pull the pump casing (2);
   - Remove the 2 centering pins (21);
   - Check the gaps between the rotors flanks.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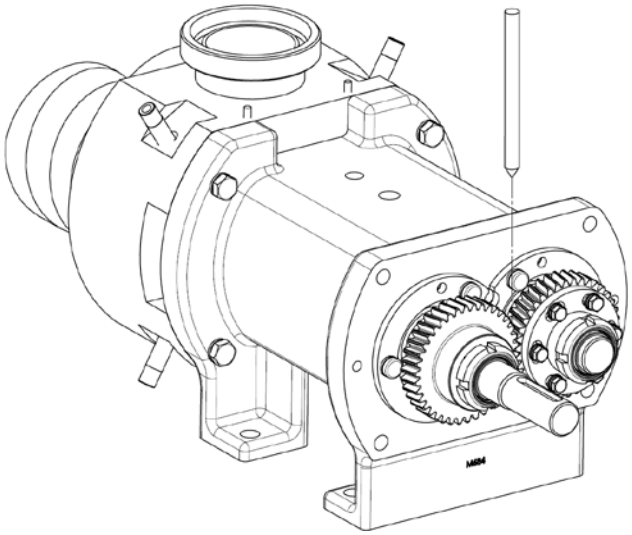
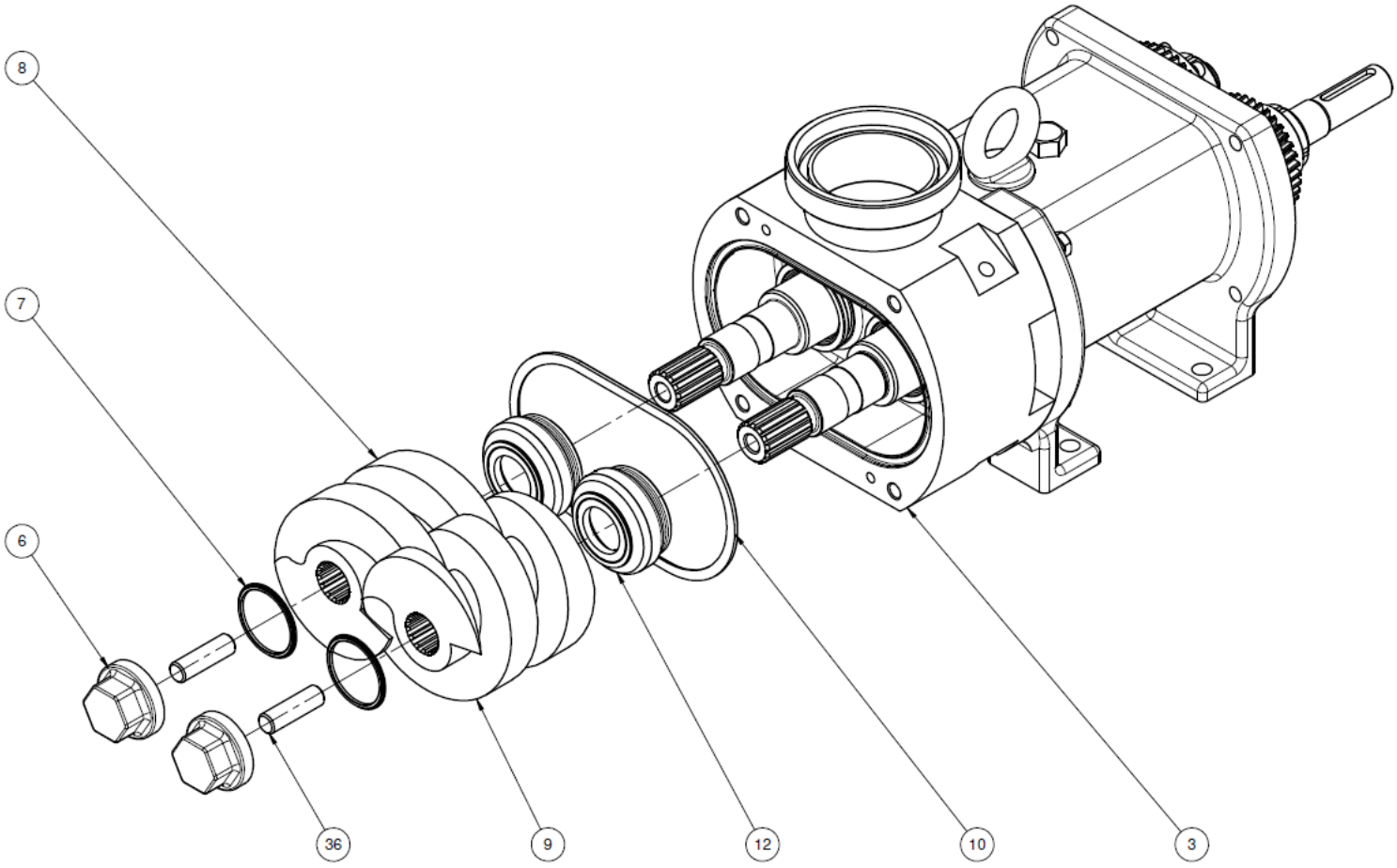
2- Removal of the rotors:

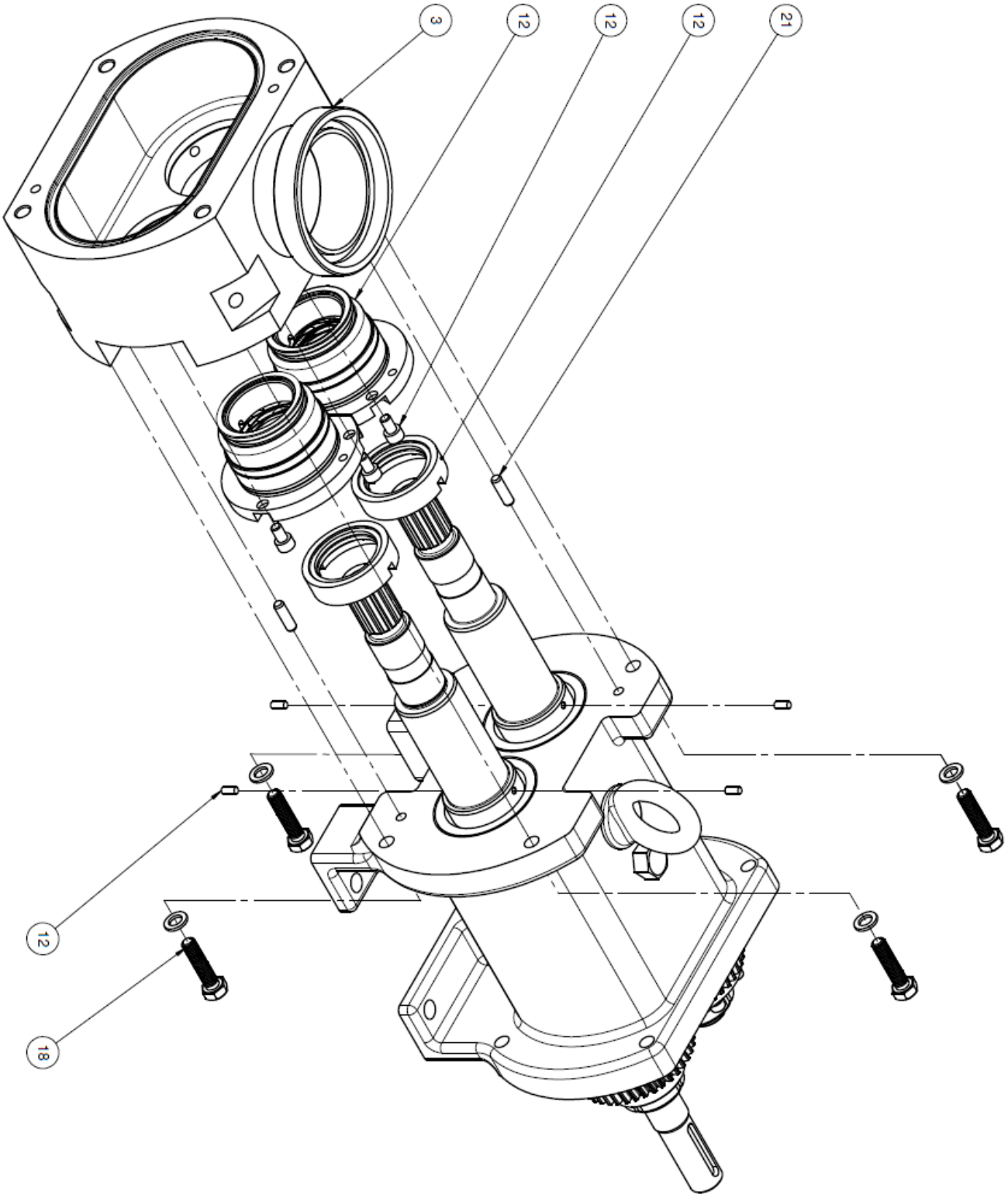
- Loosen the fixing nuts (6) of the rotors (8)(9), blocking the rear gear with a wedge of soft material, as described in the figure below;
- After the removal of the nuts (6), the studs (36) and the respective gaskets (7), pull out the rotors (8)(9);
- Remove the rotating part of the mechanical seals (12);
- Remove the gasket (10) from its housing on the intermediate casing (3).





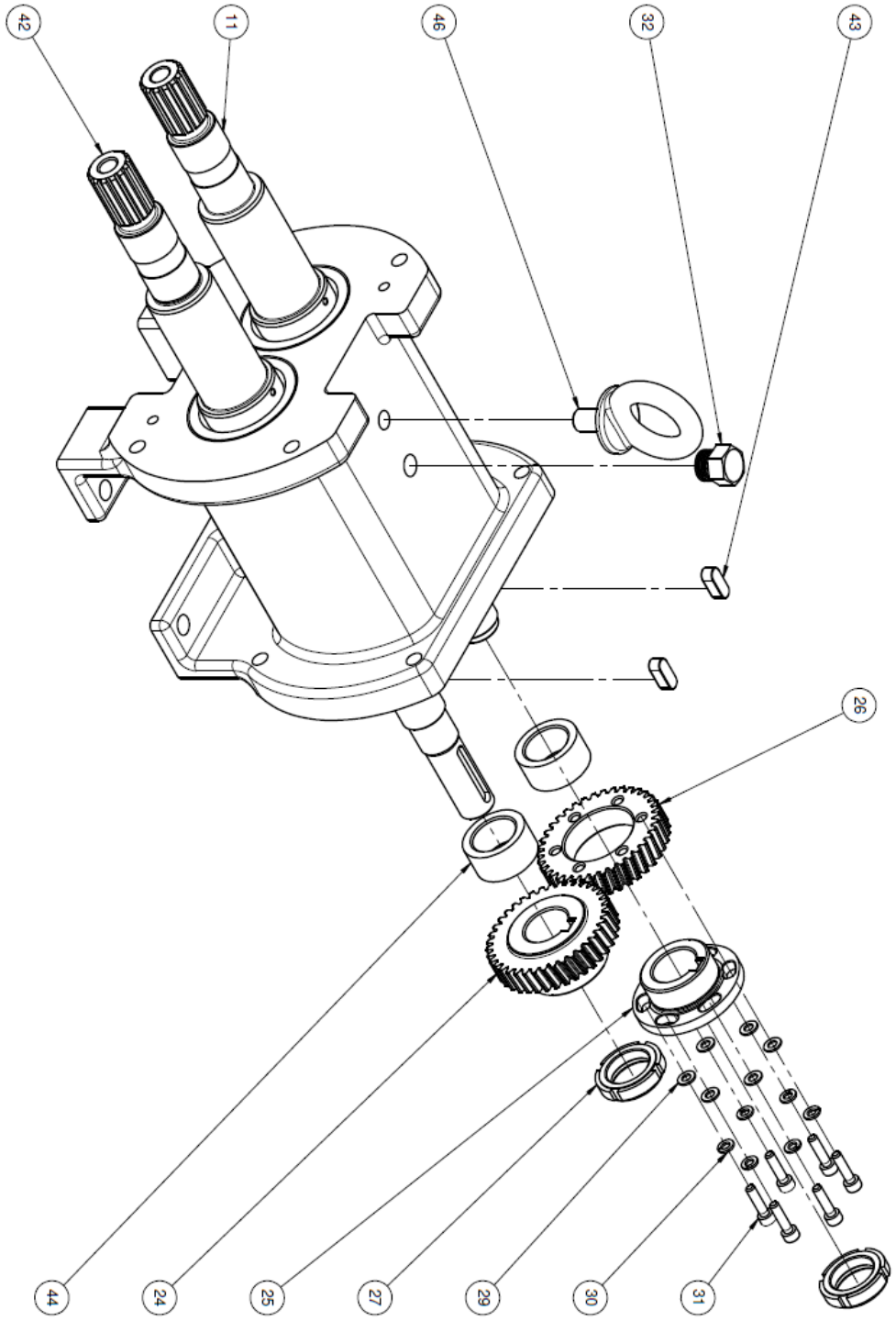
3- Removal of the outlet casing:

- Unscrew the 4 screws (18) fixing the intermediate casing (3) to the bearings housing (4);
- Pull out the intermediate casing (3) and the 2 centering pins (21);
- Remove the fixed parts of the mechanical seals (12) from the intermediate casing (3), acting on the 6 fixing screws and on the 4 extraction holes in the seal flange;
- Pull the rear rotating parts (12) from the mechanical seals and the grub



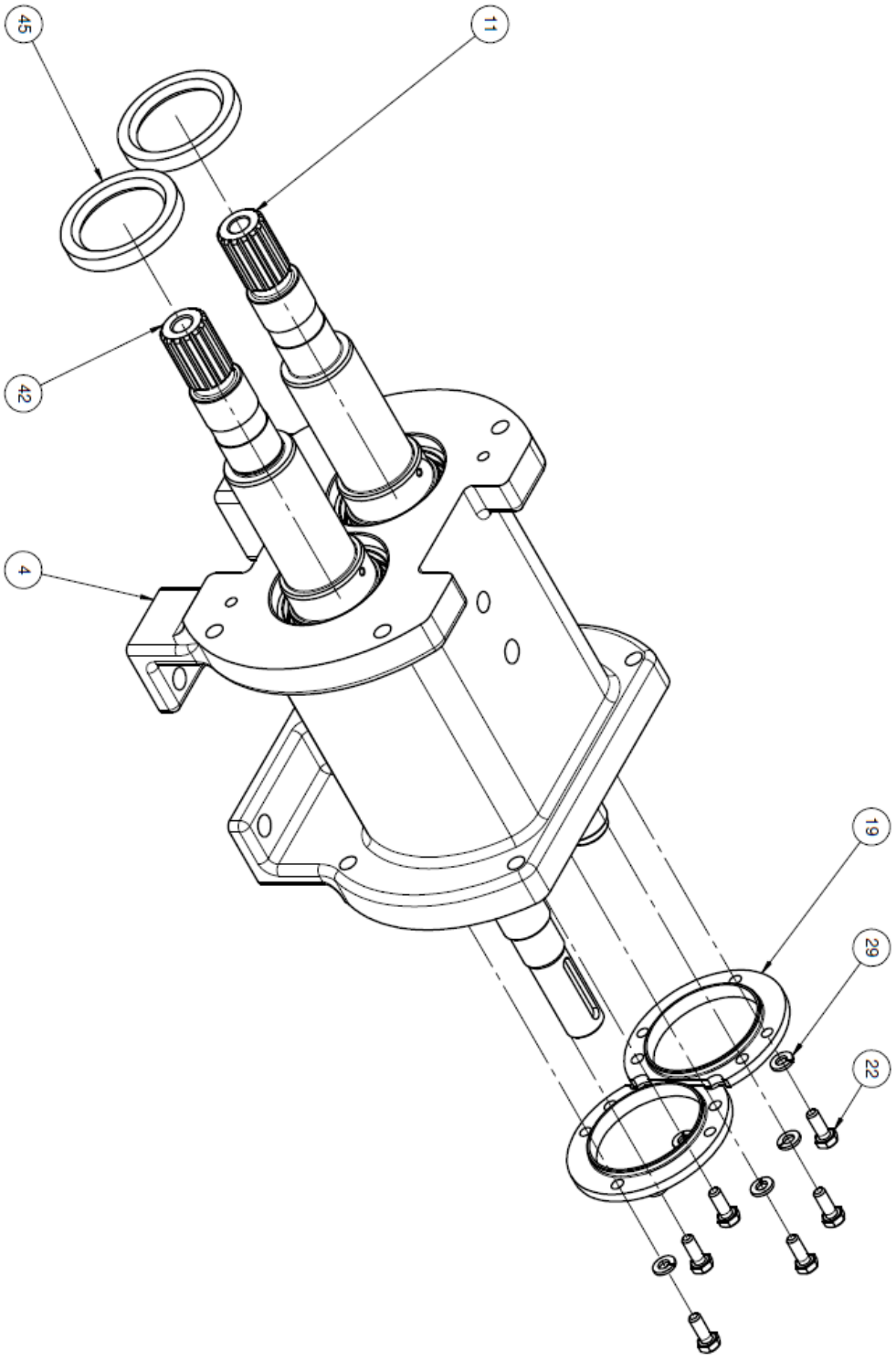
4- Removal of the synchronization gear:

- Unscrew the 2 grooved nuts (27) blocking the gearing (24)(25)(26);
- Loosen the 6 adjustment screws (31) of the synchronization;
- Remove the driving gear wheel (24) on the drive shaft (42);
- Remove the adjustable bush (25) and driven gear wheel (26) unit from the driven shaft (11);
- Remove the coupling keys of the gear wheels (43)
- Unscrew the 6 screws (31) of the driven wheel and remove the washers (29)(30);
- Pull out the spacers of the gear wheels (44);
- Remove the eyebolt (46) and the filler oil plug (32).



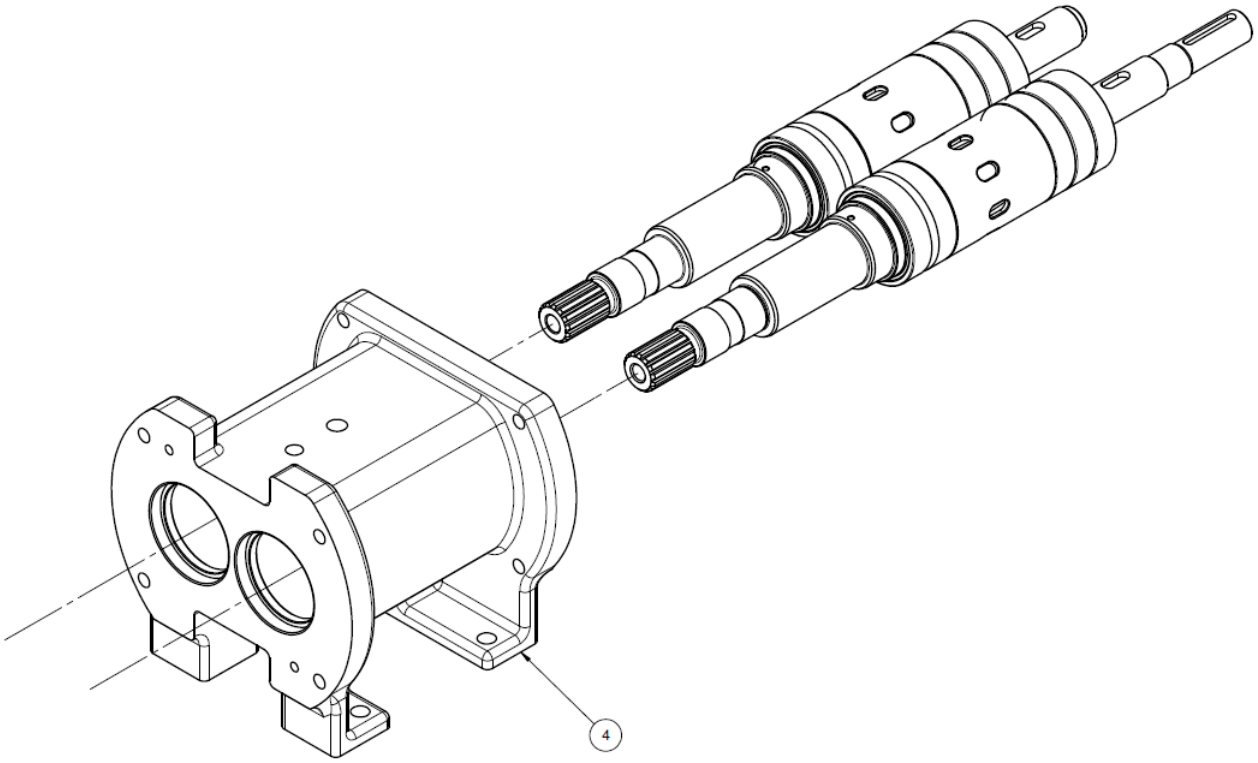
5- Removal of the drive and driven shaft from the synchronization gear side.

- Unscrew and pull the screws (22) of the bearing cover (19) and the washers (29);
- Remove the bearing covers (19);
- After removing the drive and driven shafts, take out the radial seal rings (45).



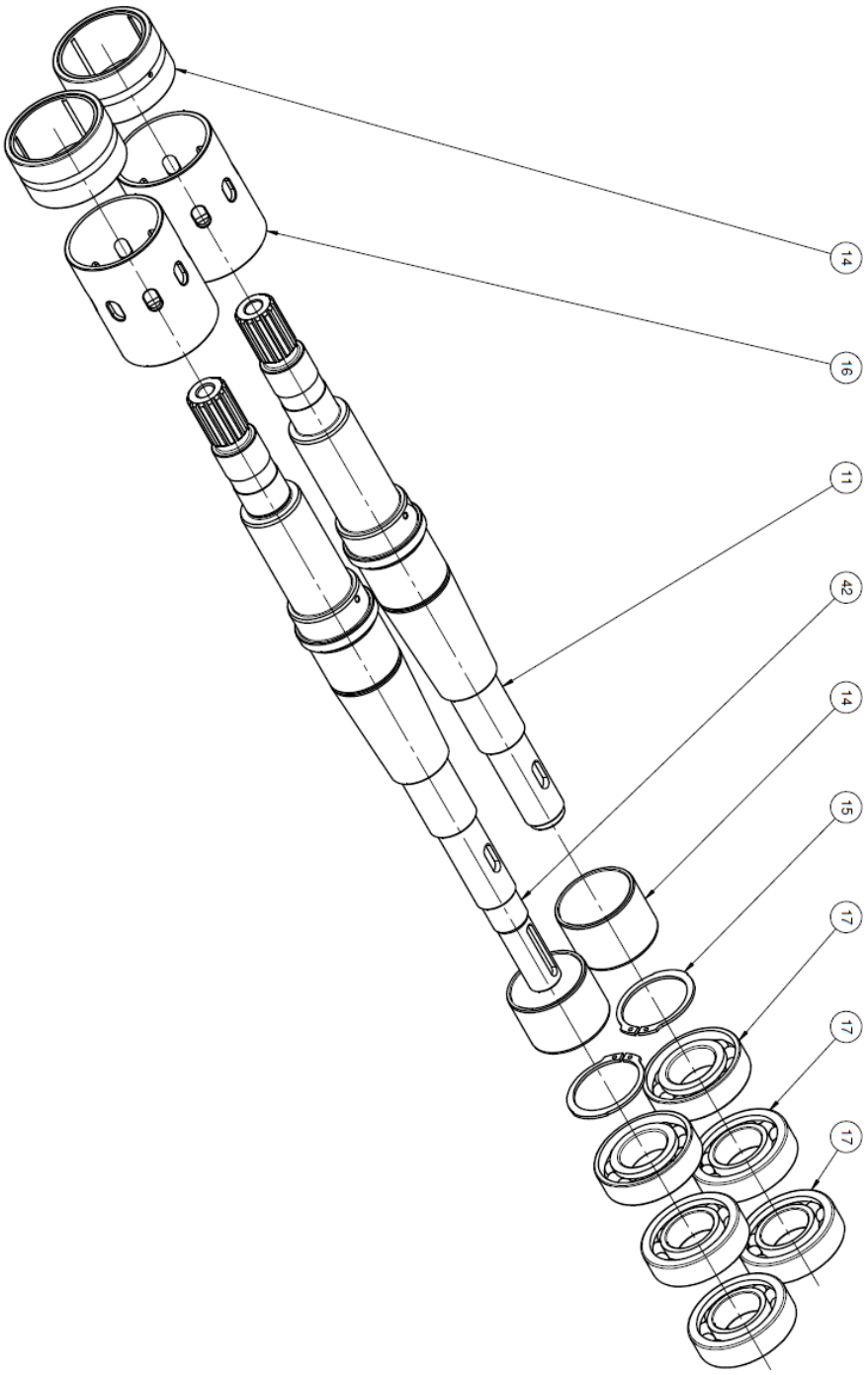
6- Removal of the shafts

Remove the rotating shafts from the rear of the bearings housings (4).



7- Disassembly of the shafts:

- Remove the external rings from the 2 needle bearings (14);
- Remove the external spacers (16);
- Remove the sets of 3 rear ball bearings (17);
- Remove the Seeger rings (15);
- Remove the internal rings from the needle bearings (14).



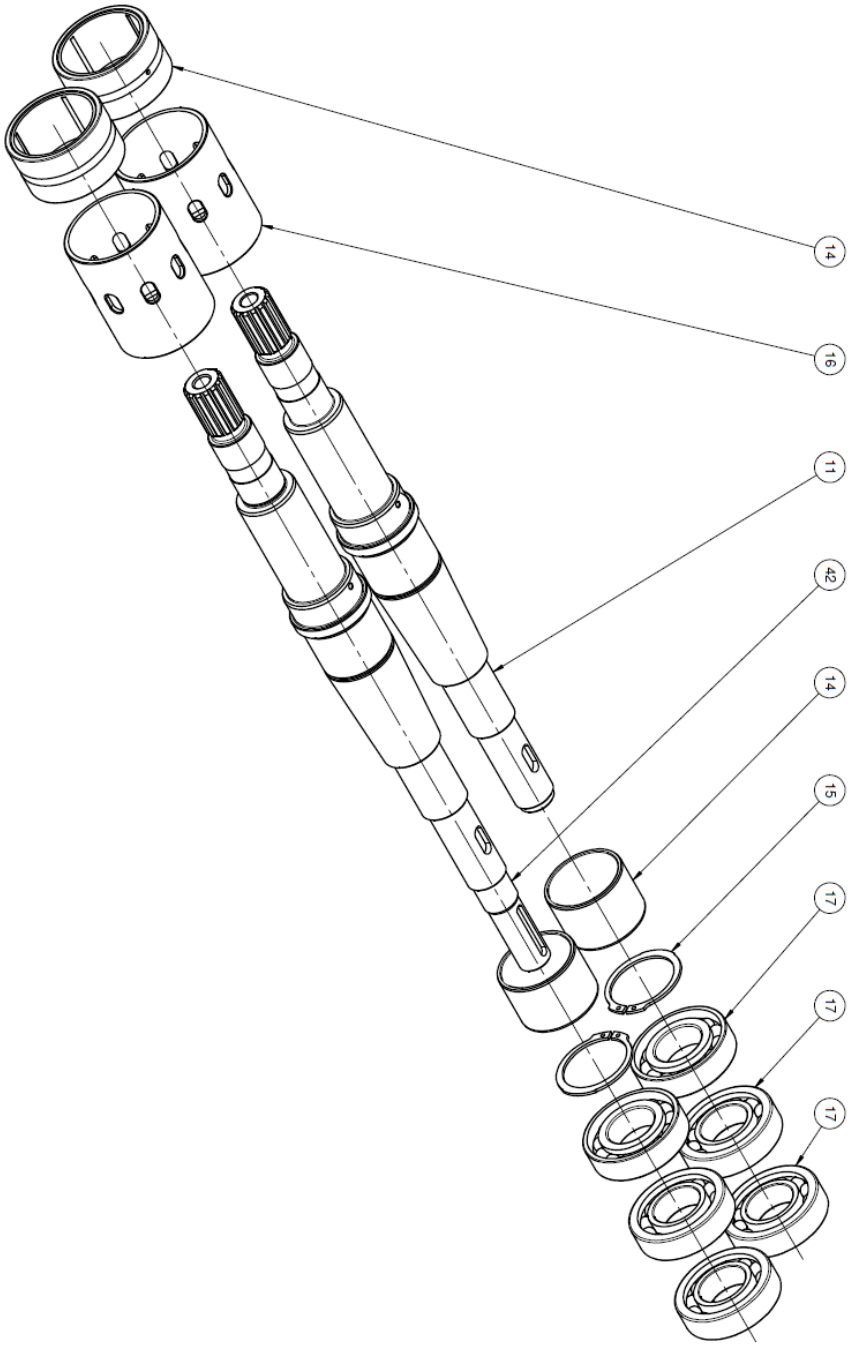
9 ASSEMBLY OF THE TWIN SCREW PUMP

After an accurate check of the conditions of the shafts and bearings, assembling of the pump can be performed.

Proceed as follows to assemble the twin-screw pump:

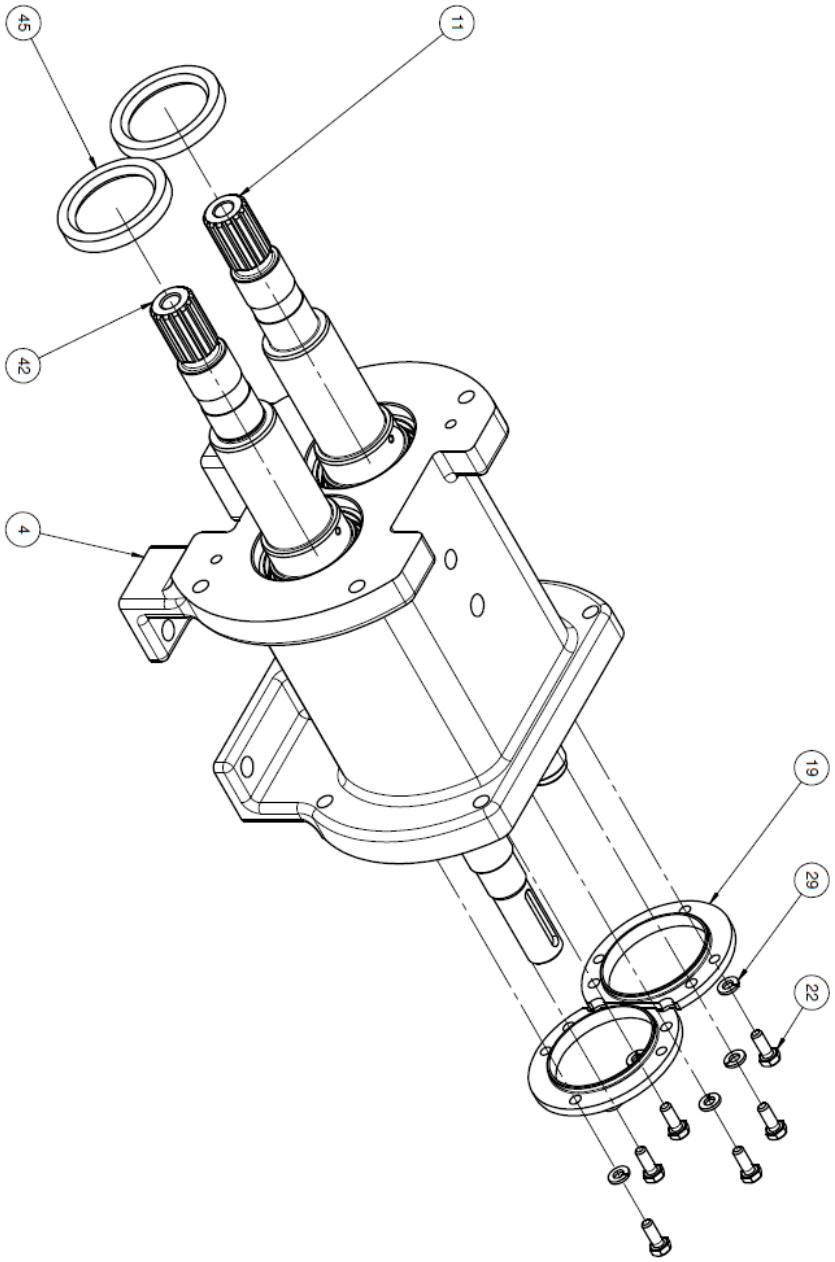
1- Shafts composition:

- Insert the inner rings of the front needle bearings (14) on the drive shaft (42) and driven shaft (11) bringing them to the end of their stroke;
- Insert the Seeger rings (15) in their housings;
- Complete the assembly of the front needle bearings by fitting the relative outer rings (14);
- Insert the external spacers (16);
- Fit the rear ball bearings sets (17);



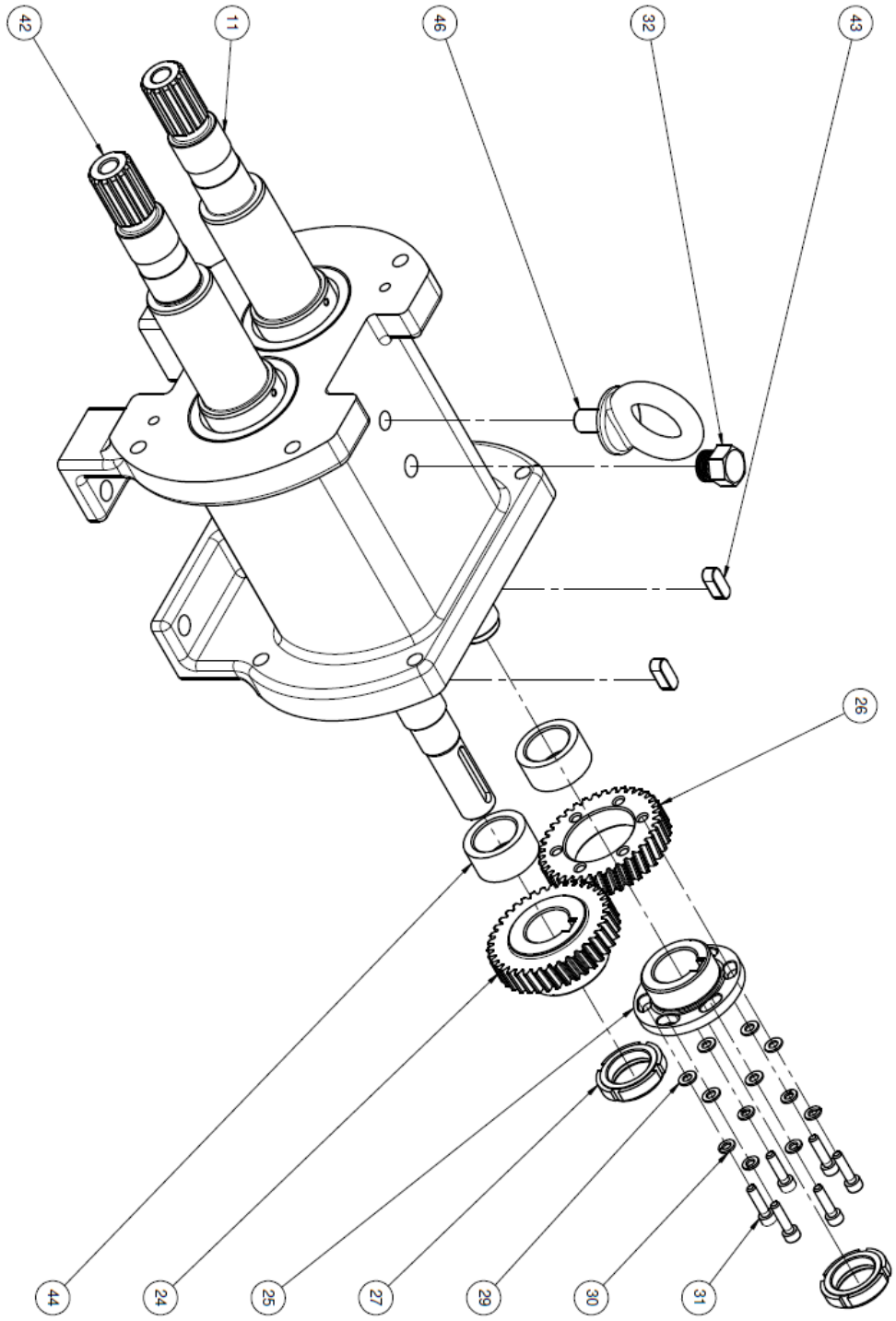
2- Insertion of the shafts in the bearings housing and the synchronization gear

- Fit the radial seal rings (45) on the front side of the bearings housing (4);
- Insert the shafts assembled in the previous point in the rear side of the bearings housing (4), bringing them to the end of their stroke.
- Fit the bearing covers (19), fixing them with 6 screws (22) and the washers (29);



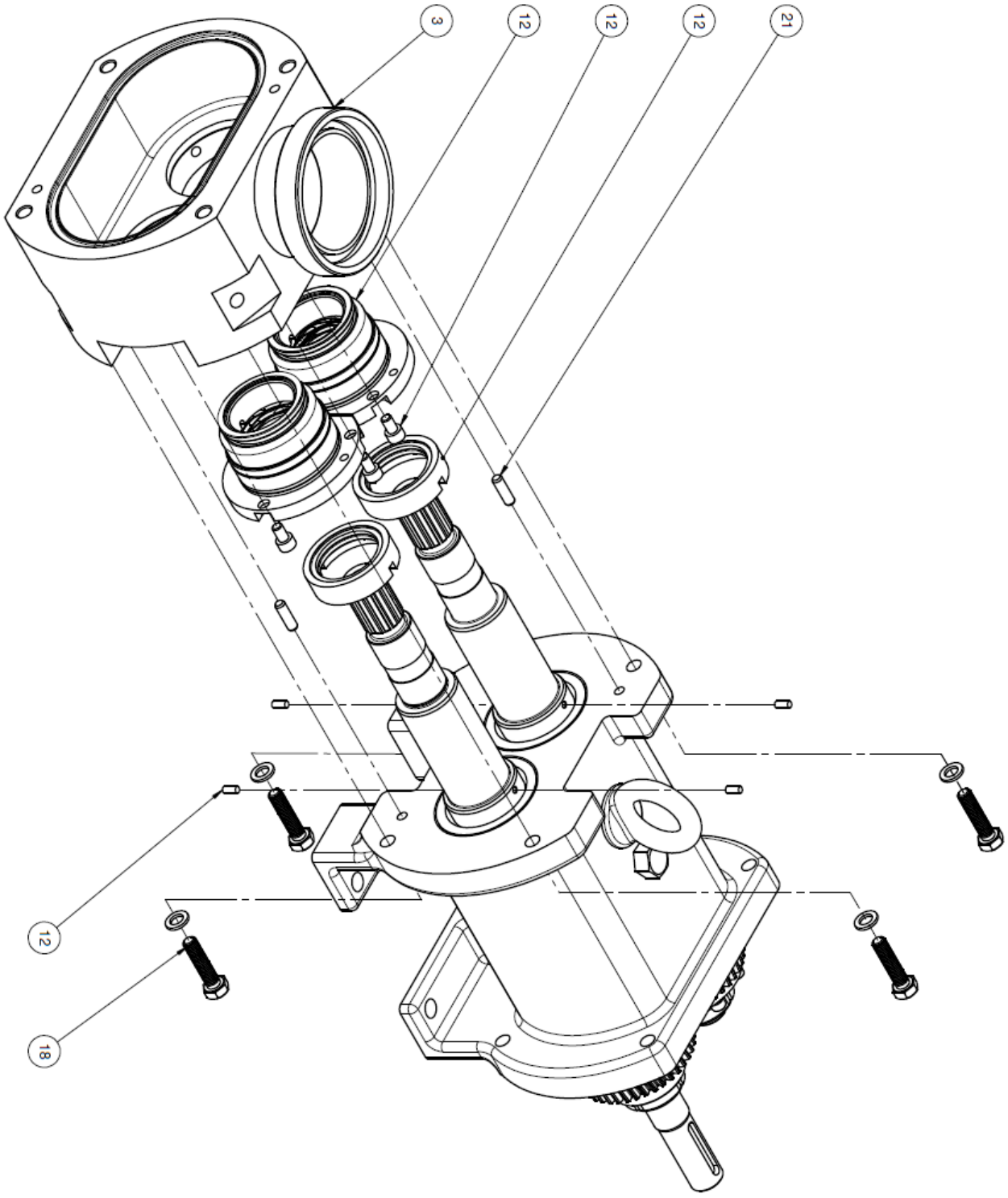
3- Insertion of the synchronization gear

- Insert the adjustable bush (25) in the driven gear wheel (26), by inserting the fixing screws (31) and the washers (29)(31) without tightening them;
- Splice the drive gear wheel (24) and the bush (25) and driven wheel (26) unit, assembled in the previous point, in the drive shafts (42) and driven shafts (11) by using the keys (43);
- Axially block the components assembled by screwing the grooving nuts (27).



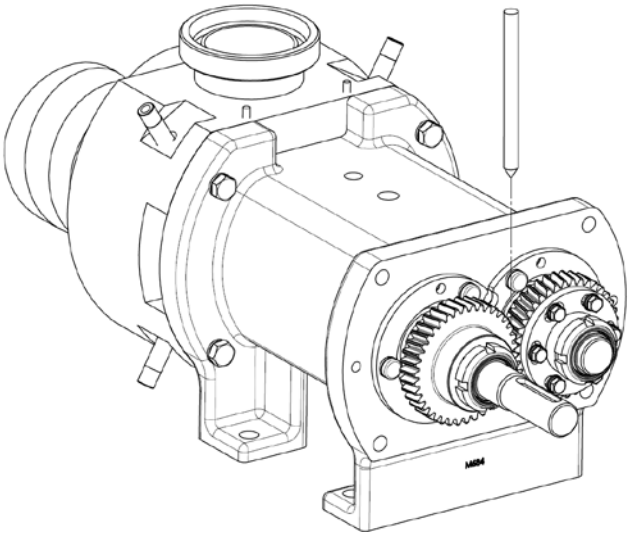
4- Assembly of the mechanical seals and pump casing

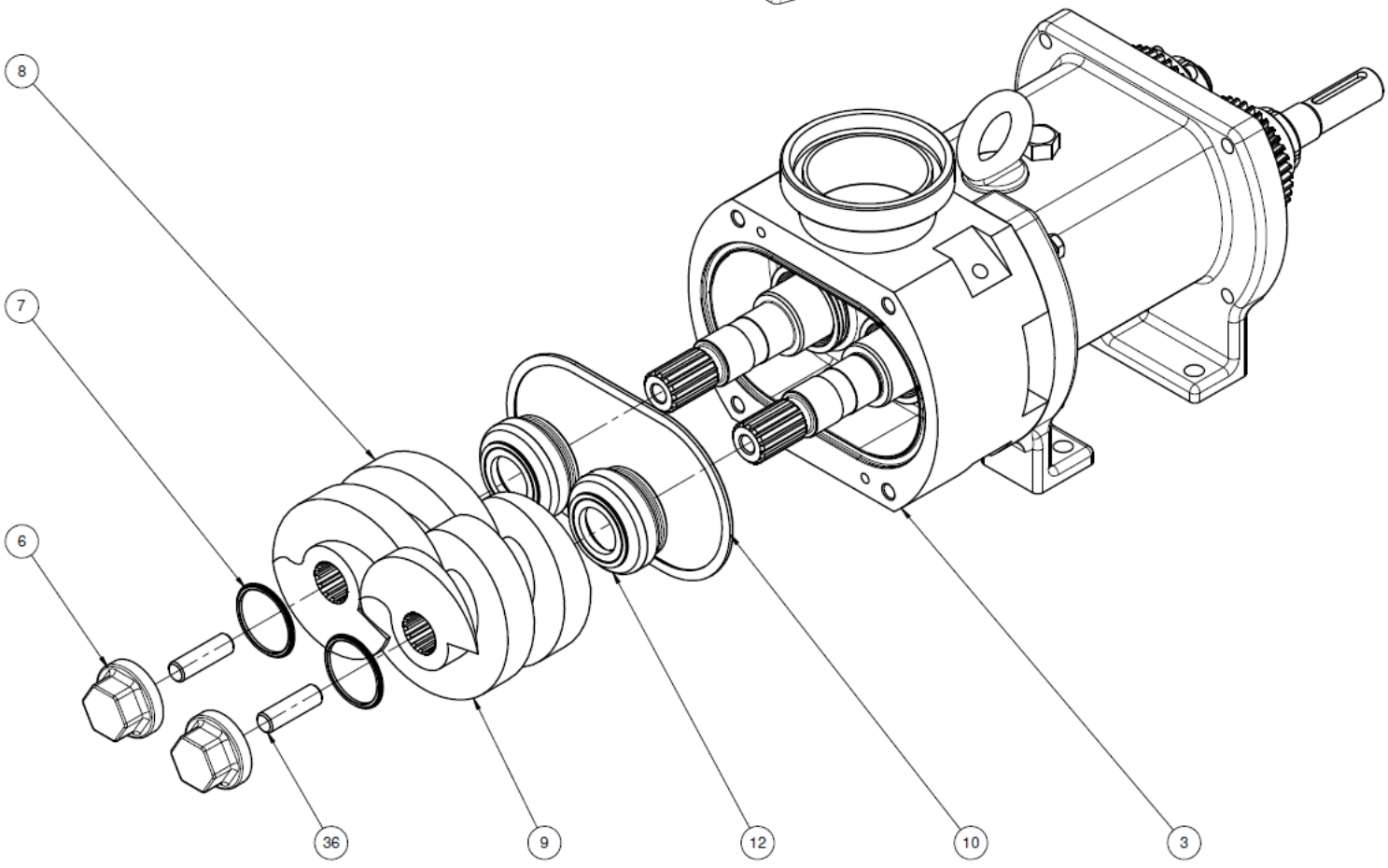
- Insert the fixing grub screws of the mechanical seal on the drive shaft (42) and driven shaft (11);
- Insert the external rotating parts of the mechanical seals (12), bringing them to the end of their stroke on the shafts and fixing them tangentially to the grub screws inserted in the previous point;
- Insert the fixed parts of the seals (12) in the rear part of the intermediate casing (3), by fixing them with the 6 screws;
- Fit the unit assembled in the previous point on the bearings housing, centering it with the pins (21) and tightening the screws (18) with the washers.



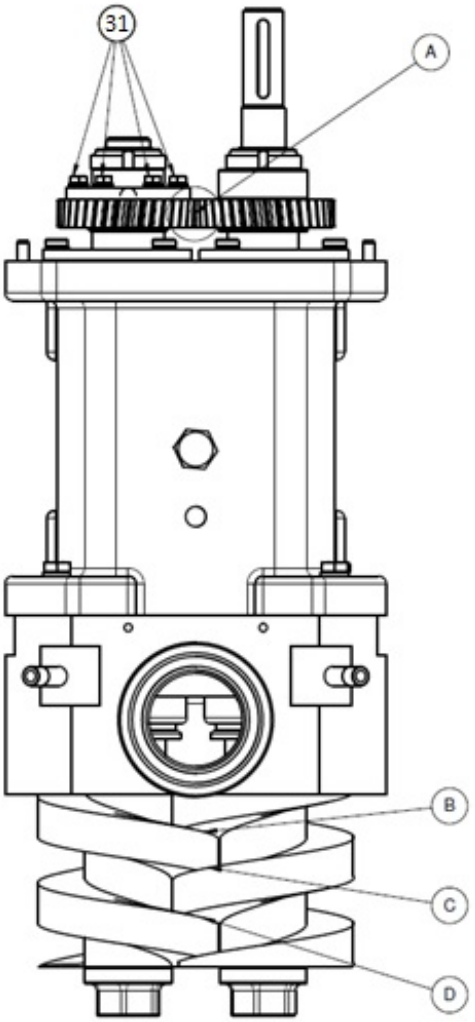
5- Insertion of the rotors

- Fix the gasket (10) in the housing on the pump casing (3);
- Insert the inner rotating parts of the mechanical seal (12) on the drive and driven shafts, bringing them to the end of their stroke;
- Assemble both rotors (8)(9) simultaneously on the respective shafts, coupling them by using the grooved profile at the end of the shafts;
- Fix the gaskets (7) and the studs (36) in the blocking nuts of the rotors (6);
- Screw the unit assembled in the previous point on the drive and driven shafts, tightening the 2 locking nuts (6).

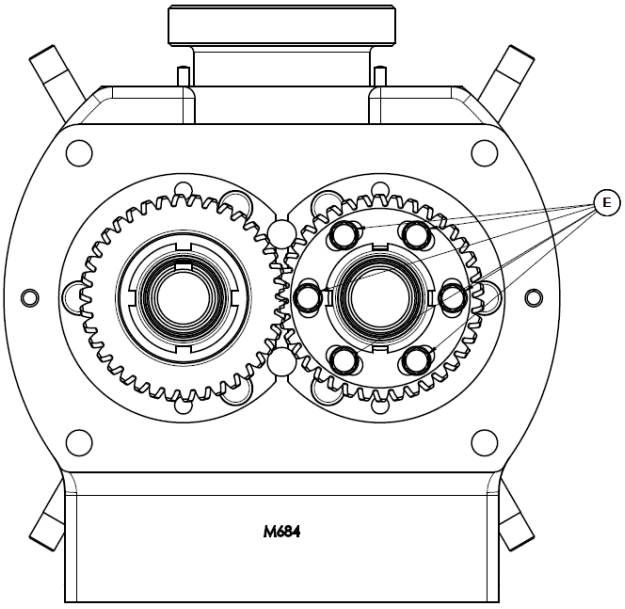




6- Synchronization of the rotors



- Insert a wedge of soft material between the gear wheels to block the gear (A);
- Rotate the shafts to ensure that the 6 synchronization screws (31) are positioned at the center of the 6 slots (E);
- Insert the shims in the points (B)(C)(D) between the sides of the screw rotors;
- Tighten the 6 synchronization screws (31) with the tightening torque as in the specific table featured in the appendix to this manual.



For further technical details on the assembly and disassembly of the several components of the pump, please contact the C.S.F. customer care service.

7- Pump closing

- Fit the gasket (20) and the gear casing (5) on the bearings housing (4), fixing them with 4 screws (18) and the washers (18);
- Insert the lubricant oil draining plug (32) with its own aluminum gasket (35) and oil level screw (33);
- Close the vent hole on the upper part of the casing (5) using the plug (34)
- Close the plug on the upper surface of the bearings housing (32);

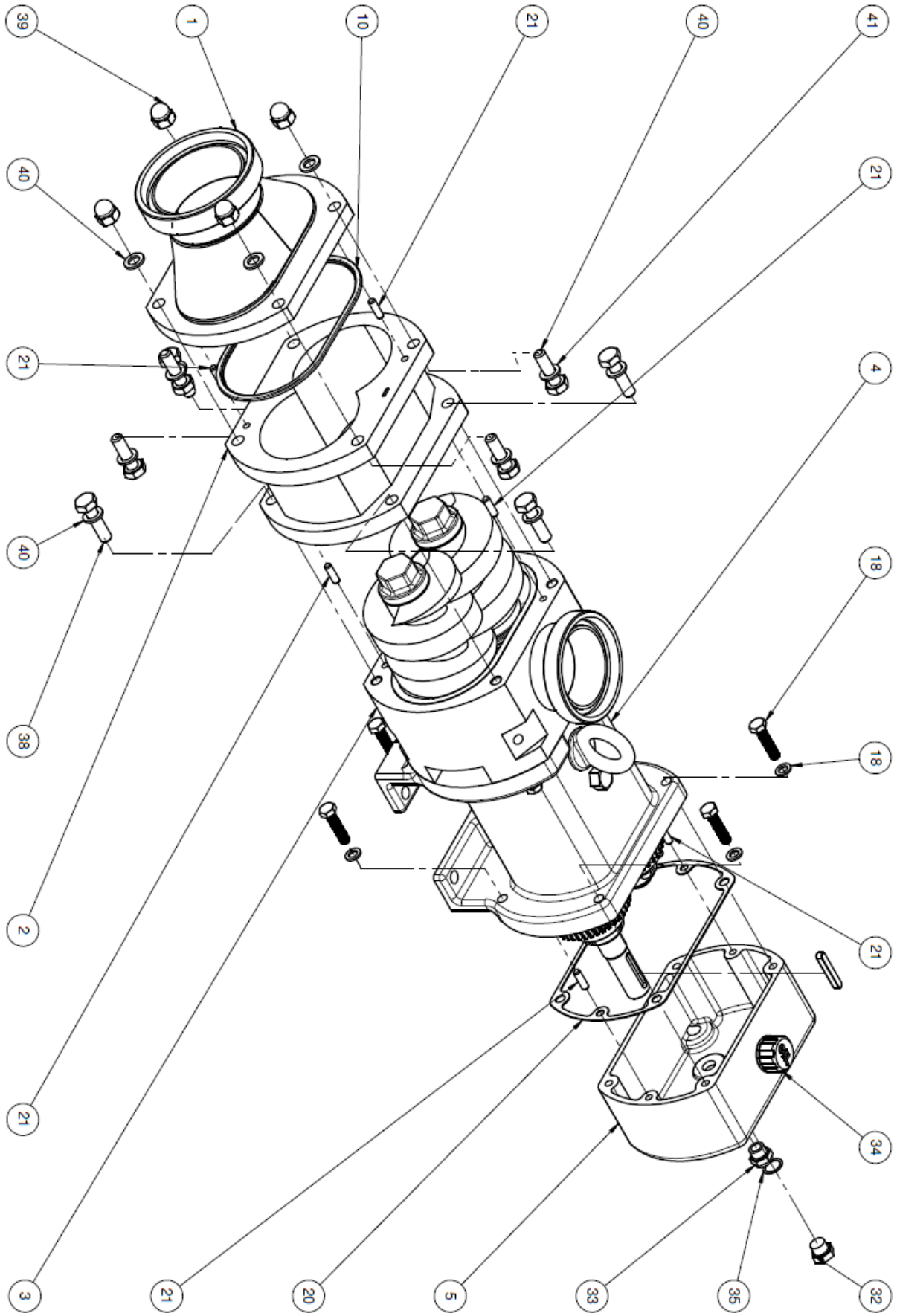
DANGER

	Crushing hazard! During the next operations, the pump might lose its balance forward: keep it in place!

- Fasten the pump casing (2) to the intermadiate casing (3) using the 4 screws (38) and the washers (40);
- Assemble the pump cover (1) on the pump casing (2), tightening the bolts consisting of the 4 screws (40), the washers (41) and the 4 acorn nuts (39).

NOTICE

The assembly of the pump is completed with the insertion of the lubricant oil. For further details, refer to the chapter *10.6 Lubrication.*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10 ROUTINE MAINTENANCE

The following paragraphs contain the indications regarding the routine maintenance operations of the twin-screw pumps. For any further information, please contact C.S.F. via the contact details in the end of this manual.

10.1 Pump monitoring

DANGER	
  	**Injury hazard due to contact with moving parts!** - Do not touch the pump during operation. - Do not operate on the pump during operation. - If needed, let the pump cool down before operating on it.

DANGER	
	**Injury and poisoning hazard due to hazardous fluids!** - Wear the personal protective equipment.

To ensure the proper operation of the pump, please check the following features regularly:

- Bearings temperature
- Maintenance of regular operating conditions
- Coupling alignment and status of the connection of the elastic components providing the connection between the pump and motor
- Auxiliary systems conditions
- Status of the seals and conditions of the flushing system
- Lubricant oil level

It is also necessary to ensure, the compliance with the following requirements, in order to guarantee the correct operation of the machine:

- Avoid dry running
- Avoid cavitation
- Open suction valves
- Open outlet valves
- The filters in the system must be free and clean
- The supply pressure must be enough to ensure the correct operating of the system
- No vibrations or unusual noises while the pump is operating
- No leaks on the seals and gaskets
- Clean the outer surfaces of the pump regularly.

10.2 Wear parts

The following components have a limited duration and, therefore, are excluded from the warranty:

- Mechanical seals
- gaskets
- Lip seals

Namely, the listed components must be replaced in the following cases:

- If deformed in terms of shape or surface
- After 500 CIP
- After 6000h
- After 2 years

NOTICE

In case of EPDM gaskets, these components should not be exposed to lubricant fluids.

10.3 Spare parts

Reference table of main parts subject to replacement:

RECOMMENDED SPARE PARTS FOR TWO YEARS OF OPERATION ACCORDING TO THE NUMBER OF PUMPS INSTALLED - VDMA STANDARDS					
Description	**NUMBER OF PUMPS** (including reserve)				
	1	2	3	4	5
MECHANICAL SEAL	2	4	6	8	8
INTERMEDIATE CASING AND PUMP COVER GASKET	4	6	10	12	14
ROTOR NUT GASKETS	4	6	10	12	14
GACO RINGS	2	4	6	8	8

C.S.F. Inox declines all responsibility for damage or injury resulting from the use of non-original spare parts.

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10.3.1 Bearings maintenance

The operations on the bearings of the TS pumps can ONLY be performed by authorized CSF Inox personnel, therefore please report the need for maintenance operations.

10.4 Repairs

If repairs are needed, please fill the “Decontamination declaration” form enclosed with this manual and attach it to the pump, sending the pump and the form to the address stated in the form itself.
Contact C.S.F. for further information.

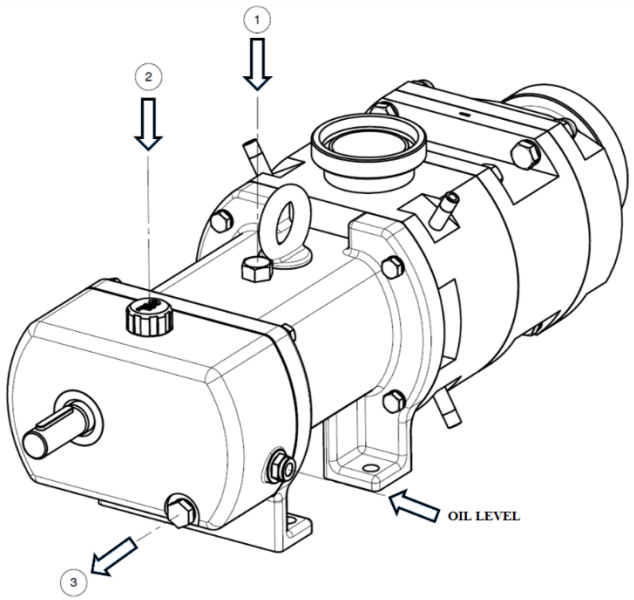
10.5 Maintenance table

Component	Staff	Operation	Intervention timetable
Flushing/quenching and seal system	Specialized technician	Check the correct operation of the flushing/quenching system	Hourly during start-up, then weekly
		Replace the quenching fluid	Every 3 months
		Leaks checking	Weekly
Coupling with the drive	Specialized technician	Check the alignment and the coupling status	Weekly
Rear gear casing	Specialized technician	Check the oil level; Top up as required	Weekly
		Replace the oil	After the first 250 hours, then after 3 months
			Continuous operation: each 8000 hours
			Discontinuous operation: each 2000 hours/6 months
Radial seal rings	Specialized technician	Leaks checking	Weekly

10.6 Lubrication

The following image highlights:

- Points ① e ②, where to pour the lubricant;
- The oil draining plug ③;
- The level indicator of the lubricant inside the pump, located at the side of the gear casing (OIL LEVEL). The pump must be filled up to half of the level indicator plug.



C.S.F. inox recommends KLÜBEROIL H1 oil for the first filling or oil with ISO 100 viscosity grade and temperature field between -10°C a 60°C.

To process fluids with a temperature higher than 90°C and/or speed of rotation consistently higher than 2000rpm it is recommended the use of FDA lubricant oil with ISO VS 150 viscosity grade.

Filling volumes:

TS 65 approx. 0.40 liters

TS80 approx. 0.60 liters

TS100 approx. 0.80 liters

Disposal:

Send exhausted oils or greases to companies specialized in their treatment.

10.7 Cleaning fluids

DANGER

The fluids and procedures reported in this paragraph may cause SEVERE damage to persons or objects.

Please bear in mind that the manager of the production process is responsible for the suitable washing procedure.

NOTICE

The cleaning of stainless steel pumps depends on the process liquid.

C.S.F. Inox recommends a fluid velocity between 1,5-3 m/s, with rinsing water and chemical agent like alkaline detergent and acid.

Chemicals like hypochlorite and chlorine must be avoided because stainless steel could be damaged by corrosion.

Alkaline detergent:

A sodium hydroxide/water solution may be used at concentration 1-3% at a temperature of 70-90°C; a surfactant could be added to increase the rinse cleaning.

Acid solution:

It is used to neutralize alkaline residual and for the passivation of the stainless steel surface; a solution of nitric acid at 1-2,5% could be used at ambient temperature up to 45°C.

Other acid solution could be: citric acid and water (0,5-3% at 70°C) and phosphoric acid at 0,5% with a temperature up to 45°C (with inhibitor of corrosion).

Suggested cleaning process:

WARNING	
	During cleaning process, the surfaces of the pump can reach high temperatures. Pay attention!

1) Pre-rinse with cold water (15-25°C) for 10-15 minutes to remove any residue.
2) Warm pre-rinse with water at 45-60°C for 10 minutes.
3) Rinse with alkaline solution at 70-95°C for 20-30 minutes.
4) Intermediate rinse with water (warm or cold) up to 60°C for 5-10 minutes.
5) Rinse with acid solution like nitric acid for 10 – 15 minutes at ambient temperature.
6) Final rinse with cold water for 10-15 minutes or until any traces of cleaning agent have been removed.

NOTICE
During the CIP process, there are thermal expansion: take care that there are not rapid temperature variation. Control the concentrations and temperature of chemical agents during the CIP.

WARNING	
 	Chemical agents at high temperature can cause potential health risk: respect the safety regulation and use protection devices. Store the cleaning agents in compliance with the safety regulations.

Sterilization:

WARNING	
	During sterilization process, the surfaces of the pump can reach high temperatures. Pay attention!

If requested, a sterilization can be performed by means of hot water or steam; the pump must be stopped during the sterilization process with steam. See the admissible temperature for sterilization depending on gasket compound.

Any sterilization process must be previously approved by C.S.F.

11 WORKING IRREGULARITIES

We are herewith listing some of the possible working irregularities, which may occur using the pumps, with a table helping to find out the possible causes and how to solve the problem.

Trouble:

A) The pump does not run
B) The delivery is not sufficient
C) The pressure is not sufficient
D) The pump stops priming
E) Power absorption too high
F) Leakages from the mechanical seal
G) Short life of the mechanical seal
H) Failure of the mechanical seal
I) Anomalous vibrations and/or noise
L) Short life of bearings

Possible causes and necessary operations to solve them:

1) The pump is not properly primed.
- Repeat the priming.
2) Air entering from suction connections.
- Check the lock.
3) Air entering from the mechanical seal.
- Replace the mechanical seal.
4) Obstructions present along suction pipes or valves closed along pipes.
- Verify and remove all foreign matter from pipes and finally verify valve status (if closed, open them).
5) NPSH available in the plant is lower than NPSH needed by the pump.
- Reduce the friction loss.
6) Defective operation of the standing valve (not flooded pumps).
- Restore the proper operation of the valve or replace it with a perfect one.
7) Plant friction losses higher than pump performances.
- Reduce friction losses or replace the pump with a more suitable one for requested performances.
8) Opposite direction of rotation or too low speed.
- Restore the correct direction of rotation; increase the motor speed.
9) The rotors are clogged by foreign matter
- Remove foreign matter from the rotors.
10) Worn mechanical seals.
- Replace worn parts.
11) Worn or partially clogged rotors.
- Replace the rotors or remove foreign matter.
12) Product viscosity higher than foreseen.
- Verify the pump size and selection.
13) Presence of too much gas in the fluid.
- Fit an air relief valve.
14) Plant friction losses lower than foreseen.
- Increase friction losses or adjust the pump at a higher working point.

		TROUBLE									
		A	B	C	D	E	F	G	H	I	J
POSSIBLE CAUSES AND NECESSARY OPERATIONS TO SOLVE THEM	1	●	●								
	2	●	●		●						
	3	●	●		●						
	4	●	●		●						
	5	●	●		●						
	6	●	●								
	7	●	●	●							
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	39										●

15) Fluid specific gravity higher than foreseen.
- Increase the installed motor power.
16) Pumped fluid too viscous.
- Verify the pump size.
17) Higher pump delivery during operation due to plant friction losses lower than foreseen.
- Adjust the pump at a lower working point or increase the plant friction losses.
18) Rotation speed too high (when pump is controlled by an inverter).
- Reduce the speed.
19) Internal frictions caused by slipping between rotating and fixed parts.
- Restore normal assembly conditions.
- Check that the working differential pressure corresponds to the design pressure.
20) Misalignment of pump-motor or deformed shaft.
- Restore the correct alignment between pump and motor; replace the shaft with a new one.
21) Damaged bearings of pump or motor.
- Replace the bearings.
22) Electric misconnection.
- Modify the electric connection by strictly following ratings written on the motor plate according to the available voltage.
23) Voltage not suitable for the installed motor.
- Replace the motor with one having a suitable voltage.
24) Mechanical seal worn.
- Replace the mechanical seal.
25) Pump fluid and/or temperature not suitable for the assembled mechanical seal or its parts.
- Verify the mechanical seal selection.
26) Non-cleaning when using fluids which tend to crystallize.
- Increase washing cycles and don't leave the product inside the pump for a long time.
27) Misassemble of the mechanical seal.
- Carefully assemble the mechanical seal again.
28) Opposite rotation direction for non-reversible mechanical seals.
- Restore the correct direction of rotation.
29) Flushing non sufficient for external flushed seals.
- Increase the flushing fluid (*see par.* ***4.3 Mechanical seals***).
30) Dry operation of the pump.
- Arrange the proper dry-running protection (e.g. flow switch) in order to avoid the problem.
31) Oscillations on the shaft due to a too high assembly allowance, worn bearings, etc.
- Restore normal assembly conditions by replacing the worn pieces.
32) Suspended solid parts in the fluid.
- Verify the mechanical seal and pump selection.
33) Too high temperature or thermal shock.
- Increase gradually the fluid temperature by avoiding instantaneous thermal amplitudes; prevent the pump from dry-running (*see par.* ***7.2 Operation***).
34) Out-of-balance of the rotors.
- Replace the rotors.
35) The pump runs at a low flow rate.
- Adjust the pump at a higher working point.
36) The pump runs at a high flow rate.
- Adjust the pump at a lower working point.
37) Pump and/or pipes are not properly anchored.

- Verify and adjust anchorage of the involved parts.

38) Bearings not lubricated.

- Replace bearings and restore their proper lubrication, which must be topped up from time to time according to work conditions (*see par.* ***10.6 Lubrication***).

39) Water seepage due to worn oil retainers.

- Replace worn parts.

12 REMOVAL FROM SERVICE

12.1 Temporary removal from service

Short term:

DANGER	
	Remove product waste (cleaning) ⇩ Switch off the main switch ⇩ Clean the surfaces of the pump
	
	

Long term:

DANGER	
	Remove product waste (cleaning) ⇩ Switch off the main switch ⇩ Clean the surfaces of the pump ⇩ Disconnect the connections ⇩ Discharge the flushing liquid ⇩ Loosen the flushing connections
	
	
	
	
	

12.2 Permanent removal from service

DANGER	
	Disconnect power supply ⇩ Discharge the liquids ⇩ Send exhausted oils or greases to companies specialized in their treatment.
	
	

A. APPENDIX – TORQUE

The following table reports the torques for the TS65, TS80 and TS100 pumps.

Size	TS 65		TS 80		TS 100	
	Screw	Torque [Nm]	Screw	Torque [Nm]	Screw	Torque [Nm]
Suction casing - Rotor casing	M10	44	M12	80	-	-
Rotor casing - Pump casing	M10	44	M12	80	-	-
Blocking of the rotors	M12 (WAF 30)	80	M12 (WAF 30)	80	-	-
Pump casing – Bearings housing	M8	20	M10	44	-	-
Bearings housing - Gear guard	M8	20	M10	44	-	-
Synchronization screws	M6	15	M8	20	M8	20
Bearing covers	M6	15	M8	20	M8	20
Mechanical seal screws	M6	15	M6	15		

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