

TECHNICAL SERVICE
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CENTRIFUGAL PUMPS

CS Series



**INSTRUCTIONS FOR INSTALLATION,
OPERATION AND MAINTENANCE**



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FOREWORD

- Read the instructions carefully and keep them for future consultation.
- C.S.F. Inox S.p.A. reserves the right to make any changes to the documentation it deems necessary without being obliged to update publications that have already been issued.
- When requesting information, spare parts or assistance, always specify the pump type (*) and serial number (**) in order to ensure fast and efficient service: the complete code is given on the plate and in the purchase documents.

Plate example

Item.		
Mod. CS 50-175-2-10/B.PT31 (*)		
N° C012345 (**)	RPM 2900	
kW 7,5	Volt 380-660	Hz 50

1 SYMBOLS

	WARNING	<i>Pay the utmost attention to text blocks indicated by this symbol.</i>
		Danger: <i>failure to comply with these warnings can cause serious harm to persons and/or objects.</i>
		Danger: <i>only qualified personnel can carry out operations on the electrical part.</i>

2 SAFETY WARNINGS



When the pump is working the following occurs:

- Electric parts are in tension.
- Mechanical parts are moving.
- Pump body, pipelines and articulations are under internal pressure. Therefore do not remove any protection or locking, do not loosen screws or clampings, as this can cause serious damage to persons or objects. The clamp joining the pump casing and the lantern bracket must be well tightened and it should not be easily unscrewed by hand. The tightening of the clamp must be carried out by means of a spanner and NOT by hand.
- Non-observance of inspection and maintenance can cause damage to persons and objects, especially when dangerous or toxic liquids are pumped.
- When pumping liquids at a temperature over 60° C, adequate protection and warning signals are required.



- When you buy a pump with bare shaft, motor coupling operations have to be carried out according to technical directions and law, providing adequate protections for joints, gear belts, etc.
- Operations on the electric parts have to be carried out by skilled personnel, according to technical directions and law, on authorization of the responsible installer.
- Installation must ensure an adequate ventilation, in order to cool the motor, as well as enough space for maintenance operations.
- Before carrying out any operation which requires to disassemble the pump (inspection, cleaning, seal replacement, etc.), the following preliminary operations have to be carried out:
 - switch off the motor and disconnect 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 which are injurious to health (for example acids, solvents, etc.);
 - consider whether the liquid which flows out of the pump when disassembling is dangerous and arrange for adequate safety measures.

3 GUARANTEE

All products manufactured by C.S.F. Inox S.p.A. 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, accidental causes and from any action carried out by the purchaser not according to the normal instructions of the manufacturer.

WARNING Before returning any item to C.S.F. Inox S.p.A. to be replaced or repaired under guarantee, inform the Customer Assistance Office about the problem and follow instructions of the manufacturer. Any item must be properly packed in order to avoid damage 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 owed by 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 GOODS TRANSPORTATION, RECEIVING AND TRANSFERRING

4.1 TRANSPORTATION

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

4.2 RECEIVING

WARNING When receiving the goods, the wholeness of packing must be verified, in order to identify possible damage to the content during transportation and to claim them immediately to the carrier. Should any damage be ascertained, the following procedure must be observed:

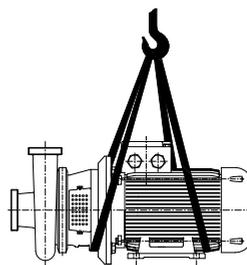
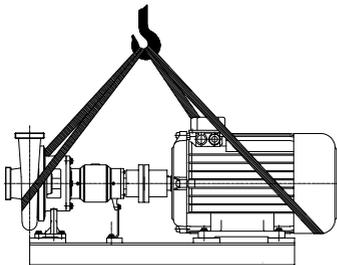
- collect the goods with reservation;
- take the necessary pictures showing the damage;
- notify the carrier of the damage undergone, by registered airmail, sending at the same time the pictures taken to show the damaged pieces.

4.3 TRANSFERRING



Carry the packed pumps as close as possible to the place of installation by means of appropriate lifting devices and unpack them. During this operation take care, as unsteady parts could fall down.

The material used for packing (wood, paper, cellophane, etc.) should be properly gotten rid of, according to the corresponding rules in force in the receiver's country. After unpacking the pump, use special lifting belts and move the pump-motor set 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. In versions complete with shroud, take the shroud off before moving the pump-motor set, in order to avoid damage.



5 DESCRIPTION

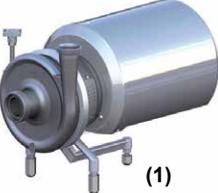
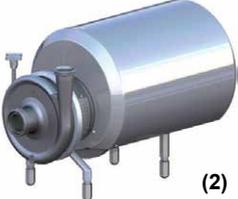
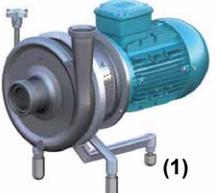
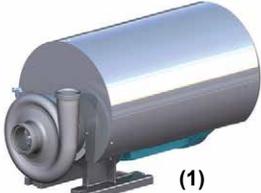
The CS series comprises single-stage centrifugal pumps with axial suction port, open centrifugal impeller and trapezoidal volute casing. All models have threaded connections for fittings according to DIN 11851 standards (unless otherwise requested) and all models are fitted with mechanical seals. The materials used for the components and the mechanical seal are chosen according to the liquid to be pumped.

They are fitted with three-phase electric motors, IP 55 protection rating, unless otherwise specified. They are intended for professional use.

These pumps are designed for applications where the liquid to be pumped:

- is not subject to pollution of any kind,
- is at a temperature between -30°C and +140°C,
- must under no circumstances come into contact with the outside environment,
- is chemically aggressive.

6 SETUPS

 <p>(1)</p>	 <p>(2)</p>	<p>(1) CS - exec. with shroud with adjustable feet kW 0.37 to kW 4</p> <p>(2) CS - exec. with shroud with adjustable feet kW 5.5 a kW 22</p>
 <p>(1)</p>	 <p>(2)</p>	<p>(1) CS - exec. without shroud with adjustable feet kW 0.37 to kW 4</p> <p>(2) CS - exec. without shroud with adjustable feet kW 5.5 a kW 22</p>
		<p>CS - exec. without shroud with fixed feet kW 0.37 ÷ 22</p>
 <p>(1)</p>	 <p>(2)</p>	<p>(1) CSX - exec. with shroud kW 30</p> <p>(2) CSX - exec. without shroud kW 30</p>
		<p>CSK - exec. with bare shaft (for coupling with base and joint)</p>

7 SOUND PRESSURE LEVEL

The sound pressure level of centrifugal pumps is the following (see table):

		Pump type					
Sound pressure level dB(A)	< 70	CS 25-145 4-poles	CS 25-175 4-poles	CS 32-110 4-poles	CS 32-145 4-poles	CS 32-175 4-poles	CS 32-210 4-poles
		CS 32-260 4-poles	CS 40-145 4-poles	CS 40-175 4-poles	CS 40-210 4-poles	CS 40-260 4-poles	CS 50-145 4-poles
		CS 50-175 4-poles	CS 50-210 4-poles	CS 50-260 4-poles	CS 65-145 4-poles	CS 65-175 4-poles	CS 65-210 4-poles
	71+75	CS 25-145 2-poles	CS 25-175 2-poles	CS 32-110 2-poles	CS 32-145 2-poles	CS 32-175 2-poles	CS 32-210 4-poles
		CS 80-175 4-poles	CS 80-210 4-poles	CS 80-260 4-poles			
76+80	CS 32-210 2-poles	CS 40-145 2-poles	CS 40-175 2-poles	CS 40-210 2-poles	CS 50-145 2-poles	CS 50-175 2-poles	
81+85	CS 32-260 2-poles	CS 65-145 2-poles	CS 100-260 4-poles	CS 40-260 2-poles	CS 65-175 2-poles	CS 125-260 4-poles	
	CS 50-260 2-poles	CS 80-310 4-poles	CS 100-310 4-poles	CS 80-175 2-poles			
86+90	CS 65-210 2-poles	CS 65-260 2-poles	CS 80-210 2-poles	CS 80-260 2-poles	CS 100-210 2-poles	CS 100-260 2-poles	

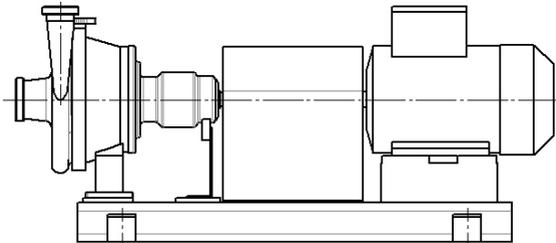
The measurement has been made by means of a sound level meter placed 1 m from the pump and at a height of 1.6 m from the ground.

The preliminary condition is that the pump is fixed correctly; the above-mentioned values do not take into account external noise sources (e.g. valves, abrupt hydraulic deflections).

8 INSTALLATION - CSK SERIES

The pump/motor set is aligned on the base at C.S.F., before delivery.

After installation has been performed, bounding the set to the foundation and the suction and outlet pipelines have been connected, alignment must be verified.



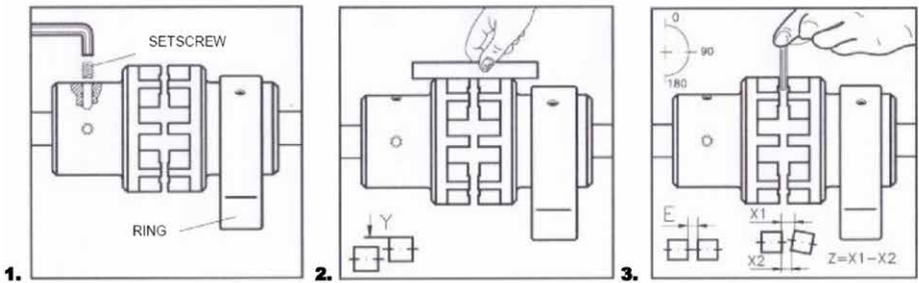
Before starting the unit, install a protective joint cover; it must be removed by specialised personnel to perform inspections and/or maintenance only after having stopped the unit and disconnected electrical power.

Warning: Misalignments and forcing cause stress and vibrations on transmission causing wear and tear and premature breakage of the joint and bearings.

8.1 TYPE "A" ELASTIC COUPLING ASSEMBLY INSTRUCTIONS

1. ASSEMBLING THE HUBS

Once the hubs have been fitted on the shafts, and prior to lining them up, do not forget to leave the attachment ring fastened onto one of the hubs. Check the pressure setscrews on the hubs are tight. If the coupling is used in Ex. hazardous areas, the pressure setscrews should be additionally secured against spontaneous loosening in the attachment of the hub to the shaft; for example, using Loctite (medium strength) or similar.

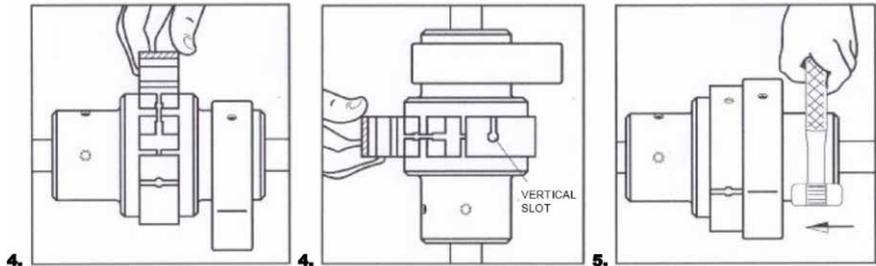


2. RADIAL ALIGNMENT

The radial alignment is controlled with a rule or a dial indicator or laser. By resting the rule on the periphery of the hubs and matching up two opposite teeth, you will have a sufficiently broad line of contact to check they match up throughout their surface area. Better alignment precision is obtained with the help of a dial indicator or laser (keep to radial tolerance Y).

3. AXIAL AND ANGULAR ALIGNMENT

Position the hubs at distance E, as for Table 1. Using the thickness feelers, you can control the gap between hubs, measurement E (keep to axial tolerance X). It is advisable to check the values of measurement E in three positions (0-90-180 degrees), as this will ensure more precise angular alignment (keep to angular alignment Z).

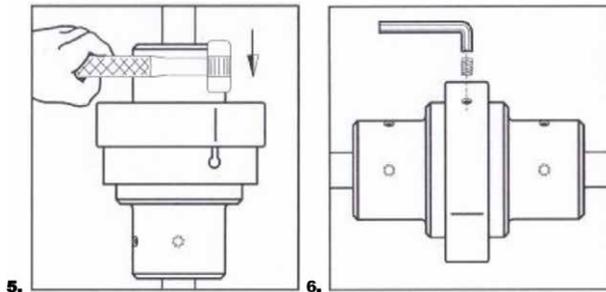


4. ASSEMBLING THE ELASTIC INSERT

Once the two hubs have been aligned, proceed to assemble the elastic insert in the slots formed by the parallel teeth. If the radial and angular alignment is correct, the ends of the elastic insert, once closed, should match up in their development and width. The elastic insert has two types of housing: a four housing, with dual inlets, for horizontal work, and a single-inlet housing for vertical work.

5. ASSEMBLING THE RING

Once the elastic insert has been fitted, the retention ring can be inserted manually, by matching up one of the two reference lines on the outside of the ring with the insertion grooves on the elastic insert. Using a nylon mallet, install the retention ring, tapping alternately on each side of the two areas of the reference marks, until the ring's lugs are coupled into the central housings of the elastic insert.

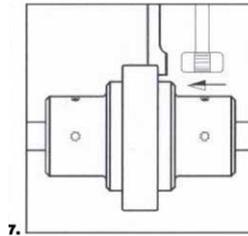


6. SECURING THE RING

Once the ring has been installed on the elastic insert, it needs to be fastened by inserting the two set screws (Tab. 2) into the threaded housings, which match up with those for the elastic insert. We recommend securing the tightness of the setscrews by applying Loctite (medium strength) to the screw-threading. Any potential axial displacement of the ring, due to misalignment of the equipment, is thereby secured.

7. DISASSEMBLY

Remove the two set screws from the ring. Shift the ring by tapping it on the side with a nylon hammer in the areas the pins (reference lines) are housed.

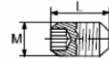


TAB. 1 MISALIGNMENT ADMISSABLE

Type	A00	A0	A1	A2	A3	A4	A45	A5	A55	A6	A7	A8	A9	A10	A11
E	1.5	1.5	1.5	2.5	2.5	3.5	3.5	3.5	3.5	3.5	4	5	5	6	6
Axial X	+0.3	+0.3	+0.5	+0.5	+0.7	+0.8	+1.0	+1.0	+1.0	+1.0	+1.0	+1.5	+1.5	+1.5	+1.5
Radial y	0.2	0.3	0.3	0.5	0.5	0.7	0.7	0.7	0.8	0.8	1.0	1.0	1.0	1.5	1.5
Angular Z	0.10	0.10	0.20	0.20	0.30	0.40	0.40	0.50	0.50	0.60	0.90	1.10	1.30	1.70	1.70

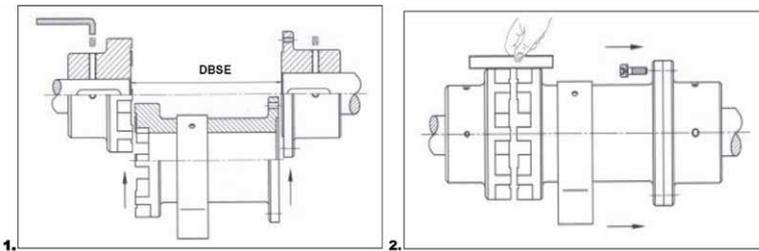
TAB. 2

Type	A00	A0	A1	A2	A3	A4	A45	A5	A55	A6
DIN 913	-	-	M5	M6	M8	M8	M10	M10	M10	M10
L	-	-	8	12	12	14	14	14	14	14



DIN 913

8.2 COUPLING WITH SPACER TYPE A..-SP



1. ASSEMBLING THE HUBS

Once the hubs have been fitted and secured with the setscrews, proceed to line them up, leaving gap DBSE (140 mm) to insert the spacerbody. Do not forget to fit the attachment ring first.

2. ALIGNMENT AND ASSEMBLY

Once the spacerbody has been attached to the flange hub, and the screws secured with their tightening torque (table 4), position the hub and the spacerbody at distance E, as for table 3 (keeping to axial tolerance X).

Next, proceed in the same way as for alignment and assembly of coupling A.

TAB. 3

= MISALIGNMENT ADMISSABLE = Dimensions (E) and tolerances in mm.											
Type	A1C	A2C	A3C	A4C	A45C	A5C	A55C	A6C	A7C	A8C	
E	3.0	3.0	3.5	3.5	3.5	3.5	4.0	4.0	4.0	4.0	
Axial X	+0.5	+0.5	+0.7	+0.8	+1.0	+1.0	+1.0	+1.0	+1.0	+1.5	
Radial Y	0.1	0.1	0.15	0.20	0.20	0.20	0.20	0.20	0.30	0.30	
Angular Z	0.20	0.20	0.30	0.40	0.40	0.50	0.50	0.60	0.90	1.1	

TAB. 4

FLANGER CAP SCREWS TIGHTENING TORQUES										
Type	A1	A2	A3	A4	A45	A5	A55	A6	A7	A8
DIN 912	M6	M6	M8	M8	M10	M10	M10	M10	M12	M14
TQ (Nm.)	14	14	35	35	69	69	69	69	120	205

8.3 SUCTION AND INFLOW CONDITIONS (NPSH = Net Positive Suction Head)

NPSH of system (available NPSH)

In order to ensure that pump operation is free from cavitation, it is essential to observe the maximum permitted suction lift $h_{a\text{ geo max}}$ or the minimum allowable head $h_{c\text{ geo min}}$.

NPSH of pump (required NPSH)

The centrifugal pumps can operate correctly only if vapour has not formed inside. For this reason the static head at the reference point for the NPSH is the centre of the impeller, that is the point of intersection of the pump shaft axis with the vertical plane that passes through the external points of the blade inlet corners.

NPSH is the value required by the pump, expressed in metres, obtained from the performance curve. In practice 0.5 m should be added to this value as a safety margin.

8.4 PIPING

In order to prevent the creation of harmful strains, the suction and discharge pipes must be connected to the pump ports without the use of force. These pipes must also be supported independently avoiding causing stress on the pump. The internal diameter must be the same size as the pump connections. It must in any case not be smaller to avoid head loss and/or poor performances. Always use elbows with large radius. If the pipe diameter changes along the line, use reduction cones, choosing the ones that are most suitable to avoid any formation of air pockets (Fig. 1).

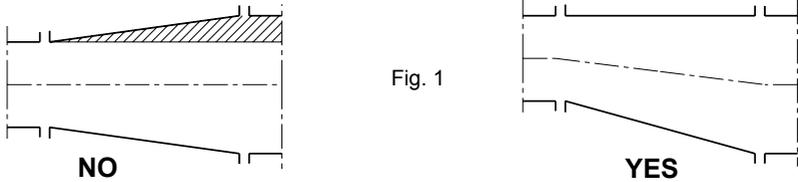


Fig. 1

The suction pipe must be as short as possible and rise as it moves towards the pump if it is sucking from a tank (Fig. 2). If on the other hand the pump is below the level of the liquid, the pipe should descend slightly (Fig. 3). If the pump is used for transporting hot liquids, fit expansion joints to compensate any expansion of the piping. The maximum velocity of the liquid in the suction pipe must not be greater than 3 m/s. Velocities between 1 and 2 m/s are recommended. The suction pipe must be designed in such a way as to prevent air from entering the pump.

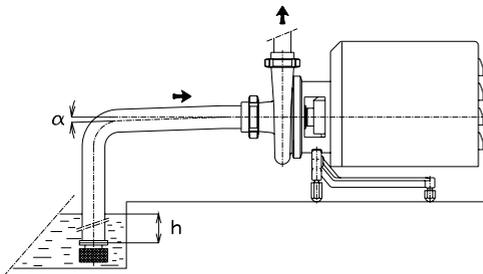


Fig. 2

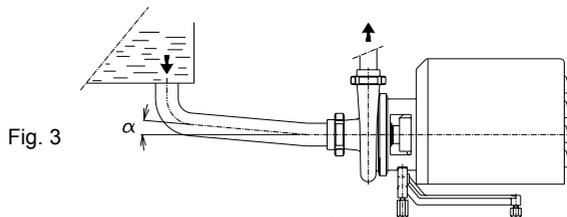


Fig. 3

For this reason, when sucking from a tank located at a lower level, the pipe must reach below the free surface of the liquid. In order to prevent the formation of vortices and avoid the risk of sucking in air, always keep a minimum head at the pipe inlet (h_{min}) equal to at least the dynamic head plus a safety margin of 0.1 m (Fig.2).

$$h_{min} = m$$

$$h_{min} = \frac{V a^2}{2g} + 0,1$$

$$V = m/s$$

In order to prevent the formation of vortices when it is not possible to observe the values of minimum available head, it is possible to fit crosses in the piping. This system is suitable even for tanks with a positive head.

- Avoid creating obstacles which could increase suction losses disrupting smooth fluid flow. Make sure that there are no restrictions, sharp turns or tight elbows on the discharge line, since these increase disturbance.

8.5 ELECTRICAL CONNECTION



Make the electrical connection only after the hydraulic connection has been completed; set up the motor control system in conformity with the technical standards and regulations in force (EN 60204-1): in particular a manual electric power switch must be installed with adequate current switching capacity; devices for overcurrent and overload protection (e.g. fuses, automatic switches, etc.) must also be fitted, plus, if necessary, a device to prevent accidental restarting.

Check that the main frequency and voltage and the available power are suitable for the motor installed. All the material used for the electrical connection (cables, cable clamps, switches and shielding) must have a suitable level of protection for the environment in which it is installed. Be sure to use cables of sufficient cross-section for the current shown on the motor plate so as to prevent them from overheating.

Before doing anything else, make the motor's earth connection, using the terminal on the motor and a cable of sufficient cross-section. The cables may be connected to the terminal board using either a delta or star arrangement. Follow the data given on the motor plate for the main voltage, as shown in the diagram in fig.4. When starting, the motor's current absorption increases briefly to 5-6 times the nominal value. If the mains supply is unable to sustain this increase in absorption, use a star-delta starter or other kind of device (e.g. an autotransformer).

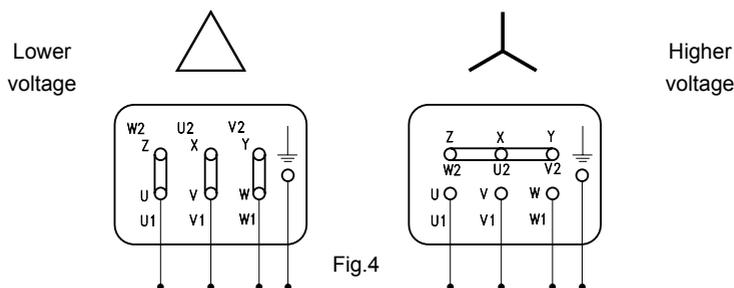


Fig.4

C. S.F. Inox S.p.A. will accept no responsibility for damage to property and/or injury to persons caused by failure to comply with technical standards and regulations in force.

9 NON-PERMITTED USES

Do not use the pump with a suction pressure greater than the specified value (0.5 times the discharge head generated by the pump).

The pump must always be used in an environment appropriate to the level of protection of the motor. Always check this on the motor plate before installation.



WARNING THE PUMP MAY NOT BE USED IN ENVIRONMENTS WHICH REQUIRE A HIGHER LEVEL OF PROTECTION OR A HIGHER SPECIFICATION MOTOR OR ELECTRICAL PARTS.

Components complying with the safety standards for the environment in question must be used.

10 OPERATION

10.1 PRELIMINARY OPERATIONS

- Check that the pump turns freely under hand pressure.
- Check that the clamp joining the pump casing and the lantern bracket is well tightened and that it cannot be easily unscrewed by hand. The tightening of the clamp must be carried out by means of a spanner and NOT by hand.
- Check that the pump turns in the marked direction (CLOCKWISE, as seen from motor end).
- The suction pipe and the pump must be filled with liquid. There are two possible cases:
 - a) When the pump is to operate with a negative suction head, it must be primed by introducing liquid into the pump body.
 - b) When the pump is to 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.
- If the sealing chamber is to be cooled, open the cooling water supply and adjust the flow.

10.2 STARTING

- Carry out the preliminary operations, then close the discharge valve completely and make sure that the suction valve is completely open.
- Start the pump and check once again that it rotates in the right direction.

10.3 OPERATING CHECKS

- If the pump does not generate the required discharge head rapidly, stop and repeat the priming operations.
- If the discharge gate valve is opened more than necessary, i.e. further than the specified working point, and the pump is operating with a lower discharge head than that required, there will be an increase in delivered capacity and absorbed power. If this occurs, throttle the discharge until the required head and capacity values are obtained.
- If the discharge head generated by the pump is greater than that required, the diameter of the impeller can be reduced. If, on the contrary, the discharge head is lower than required, with the same capacity, it will be necessary to install a larger diameter impeller (if the one fitted is not already the largest available) and probably also a higher power motor.
- The pump must operate smoothly and without vibrations.
- Do not operate without liquid and in any case avoid prolonged operation with the discharge gate valve closed.
- Check that the suction liquid level is always sufficient to grant an adequate energy load for normal operation of the pump.
- Mechanical seal: check that there is no leakage along the shaft.

10.4 EXTENDED STOP

When stopping the pump for a longer time, empty the pump completely and wash it accurately in order to avoid the formation of scales and/or encrustations. When starting the pump again, please follow the above-mentioned instructions.

10.5 CLEANING THE PUMP

The pump does not require any special washing procedures. The washing cycles normally used for the plant in which it is installed are quite satisfactory. When using the pump for liquids that tend to harden or crystallize, always make sure it is washed before taking the machine out of operation. This will ensure durability of the seal and of the pump itself. It is the user's responsibility to ensure that the washing liquids are compatible with the process liquid and the pump.

11 DISPOSAL OF THE PUMP

For disposing of the pump please observe the following instructions:

- disconnect electrical and hydraulic connections according to technical rules and laws in force.
- Disassemble all components of the pump for separate dismantling; wash the components and clean the structure accurately.

The main components of the pump are made from the following materials:

- pump casing, cover, impeller, shaft, impeller nut S.S. Aisi 316L
- elastomers NBR-EPDM-FLUOROCARBON (FPM)-PTFE
- motor Aluminium - Cast iron - Copper

Components made from asbestos or lead are not used in our production.

WARNING The components of the pump should be properly gotten rid of, according to the corresponding rules in force in the receiver's country.

12 SPARE PARTS
12.1 REFERENCE TABLE OF MAIN PARTS SUBJECT TO REPLACEMENT

Pump type CS-CSX	32-110	25-145	25-175	32 40 50 65	32 40 50 65	32 40 50	80	65 80 100	32 40 50 65 80 100 125	80 100	125 150
	Part				-145	-175	-210	-175	-210	-260	-310
*Mechanical seal EN12756-ISO3069	D.20			D.28			D.43			D.55	
Pump casing "O-Ring"	OR 6412	OR 215	OR 6670	OR 215	OR 6670	OR 6795	OR 6670	OR 6795	OR 6995	OR 61200	OR 81300
Impeller nut "O-Ring"	OR 2087			OR 2112			OR 2150			OR 3206	
Bearing	IEC 71	3205		---			---			---	
	IEC 80	3207 A 2RS-C3		3208 A 2RS-C3			3208 A 2RS-C3			---	
	IEC 90	3208 A 2RS-C3		3208 A 2RS-C3			3208 A 2RS-C3			---	
	IEC 100	3208 A 2RS-C3		3208 A 2RS-C3			3208 A 2RS-C3			---	
	IEC 112	---		3210 A 2RS-C3			3210 A 2RS-C3			---	
	IEC 132	---		3212 A C3			3214 A C3			---	
	IEC 160	---		22214 E			22214 E			---	
	IEC 180	---		---			C 2216.C3			---	
"Gaco" seal ring	IEC 160	---		AS 70x90x10			AS 80x100x10			---	
	IEC 180	---		AS 80x100x10			AS 80x100x10			---	
"V-Ring"	IEC 200 (CSX)	---		---			V-Ring 90			---	
		---		---			V-Ring 75			---	

Pump type CSK	32-110	25-145	25-175	80	65 80 100	32 40 50 65 80 100 125	80 100	125 150			
	Part				-145	-175	-210	-175	-210	-260	-310
*Mechanical seal EN12756-ISO3069	D.28			D.43			D.55				
Pump casing "O-Ring"	OR 215	OR 6670	OR 6795	OR 6670	OR 6795	OR 6995	OR 61200	OR 81300			
Impeller nut "O-Ring"	OR 2112			OR 2150			OR 3206				
Bearings	Front	3206		3309			3311 C3				
	Rear	6206		6309			6311 C3				
"Gaco" seal ring	Front	AS 40x47x7		AS 45x62x8			AS 55x72x8				
	Rear	AS 40x47x7		AS 45x62x8			AS 55x72x8				
Speedi sleeve	D. 30 - CR99114			D. 45 - CR99177			D. 55 - CR99215				

* NB:
The type and materials of the rings are identified in the enclosed technical parts list

12.2 RECOMMENDED SUPPLY

RECOMMENDED SPARE PARTS FOR TWO YEARS OF OPERATION ACCORDING TO THE NUMBER OF PUMPS INSTALLED - VDMA STANDARDS					
Denomination	NUMBER OF PUMPS (including reserve)				
	1	2	3	4	5
MECHANICAL SEAL	1	2	3	4	4
PUMP COVER O-RING SEAL	2	3	5	6	7
IMPELLER NUT O-RING	2	3	5	6	7
BEARING	1	2	3	4	4
GACO Ring (for motor powers over kW 11)	1	2	3	4	4

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

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 or arrange a solution with a vacuum spring in case of vacuum suction operation.
- 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 or adjust the pump at a lower delivery point.
- 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 velocity (in case of a pump operated by an inverter).
 - Restore the correct direction of rotation; increase the motor speed.
- 9) The impeller is clogged by foreign matter (in case of pump with closed-impeller).
 - Remove foreign matter from the impeller.
- 10) Worn mechanical seals.
 - Replace worn parts.
- 11) Worn or partially clogged impeller.
 - Replace the impeller or remove foreign matter.
- 12) Product viscosity higher than foreseen.
 - Verify the pump size.
- 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.
- 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 velocity.
- 19) Internal frictions caused by slipping between rotating and fixed parts.
 - Restore normal assembly conditions.
- 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.

		TROUBLE									
		A	B	C	D	E	F	G	H	I	L
POSSIBLE CAUSES AND NECESSARY OPERATIONS TO SOLVE THEM	1	●	●								
	2	●	●		●						
	3	●	●		●						
	4	●	●		●						
	5	●	●		●						
	6	●	●								
	7	●	●	●							
	8	●	●	●							
	9	●	●	●		●					
	10		●	●							
	11		●	●						●	
	12		●	●							
	13			●	●						
	14				●						
	15					●					
	16					●					
	17					●					
	18					●					
	19					●				●	●
	20					●	●	●		●	●
	21					●				●	
	22		●	●		●					
	23		●	●		●					
	24						●				
	25						●	●	●		
	26						●	●	●		
	27						●	●			
	28						●	●			
	29						●	●			
	30						●	●			
	31						●	●			
	32							●			
	33								●		
	34									●	●
	35									●	
	36									●	
	37									●	
	38										●
	39										●

- 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 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) Misassembly of the mechanical seal.
 - Assemble the mechanical seal again with attention.
- 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.
- 30) Dry operation of the pump.
 - Arrange the proper dry-running protection 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 selection.
- 33) Too high temperature or thermal shock.
 - Increase gradually the fluid temperature by avoiding instantaneous thermal amplitudes; prevent the pump from dry-running.
- 34) Out-of-balance of the impeller.
 - Replace the impeller.
- 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 (where lubrication is foreseen).
 - Replace bearings and restore their proper lubrication, which must be topped up from time to time according to work conditions.
- 39) Water seepage due to worn oil retainers.
 - Replace worn parts.

14 SEALS

All C.S.F. pumps of the CS series are fitted with unified mechanical seals according to EN 12756 - ISO 3069 standards, in order to grant the interchangeability (subject to verification of axial space). The type of mechanical seal and material are chosen according to the liquid to be pumped.

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

MATERIAL CODES

METALS

- H** - Nickel-plated stainless steel AISI 304
- X** - Stainless steel AISI 316L
- L** - Hastelloy (Ni alloy)

METAL OXIDES

- 2** - Alumina ceramic

ELASTOMERS

- 6** - Nitrile (NBR)
- 7** - Ethylene propylene (EPDM)
- W** - FPM for high T
- Y** - Fluorocarbon (FPM)
- B** - Silicone
- Q** - Chemraz
- U** - Kalrez

CARBONS

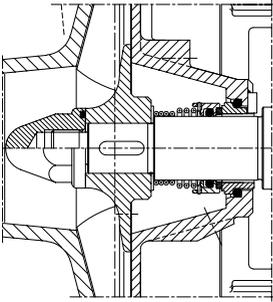
- V** - Normal carbon
- Z** - Special carbon

RESINS

- 5** - Normal PTFE
- 4** - Loaded PTFE
- F** - O-RING FEP

METAL CARBONS

- 3** - Hard metal welded on stainless steel (TUC)
- R** - Integral anti-corrosion hard metal (TUC)
- K** - Integral silicate carbon (SIC)



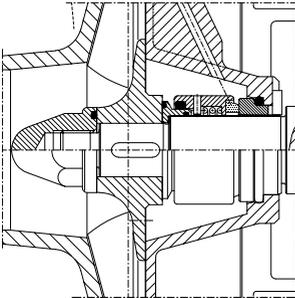
EXECUTION T / W

STANDARD MECHANICAL SEAL “T”

Standard execution foresees the assembly of an submerged internal mechanical seal on the product, housed behind the impeller in a specific tapered chamber so as to guarantee correct lubrication conditions.

MECHANICAL SEAL WITH CIRCULATION “W”

Internal mechanical seal with circulation forced by the pumped liquid.

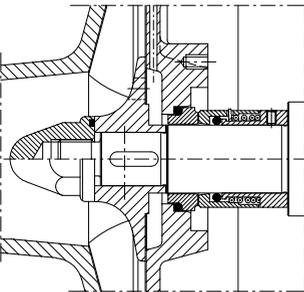


EXECUTION TH-WH

INTERNAL MECHANICAL SEAL “TH-WH”

Protected and balanced. It is easy to clean and therefore ideal for sanitary, pharmaceutical use etc.

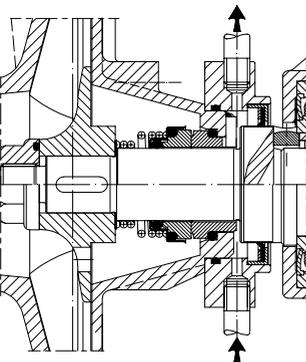
W= Execution with circulation forced by pumped liquid..



EXECUTION Y

EXTERNAL MECHANICAL SEAL “Y”

For all cases where the mechanical seal must not touch the pumped product, in order to avoid sanitary problems, corrosion and conditioning of its running.



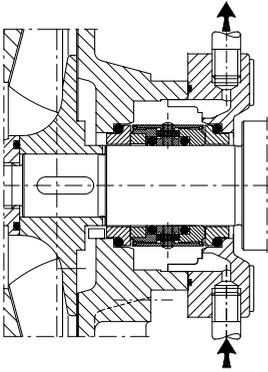
EXECUTION V

INTERNAL MECHANICAL SEAL “V”

The external liquid circulation chamber creates a protective barrier in the presence of aggressive or toxic liquids. The function is to clean the seal faces in order to limit wear.



16 DOUBLE MECHANICAL SEALS - CS / CSX /



EXECUTION Q

COMPACT DOUBLE MECHANICAL SEAL “Q”

Double mechanical seal with circulation of washing and cooling liquid. The function of flushing is that of cleaning, lubricating and cooling the seal; the liquid in circulation must be clean. If the seal is leaking, the flushing liquid will point out this fault.

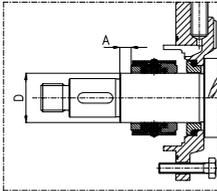


A = assembly measurement

D = 20 11 mm

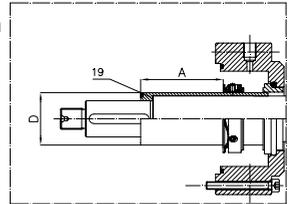
D = 28 8 mm

D = 43 20.5 mm

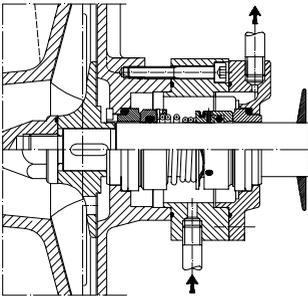


A = assembly measurement

D = 55 86,5 mm



17 DOUBLE MECHANICAL SEALS - CSK



EXECUTION Q FOR CSK SERIES

DOUBLE MECHANICAL SEAL “Q”

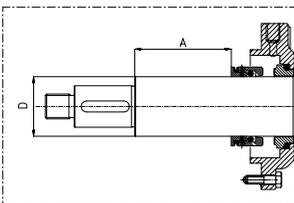
Double mechanical seal (back-to-back) with liquid circulation. The function of flushing is that of cleaning, lubricating and cooling the seal; the liquid in circulation must be clean. If the seal is leaking, the flushing liquid will point out this fault.



A = assembly measurement

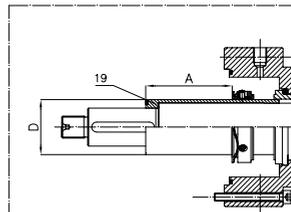
D = 28 42 mm

D = 43 70 mm



A = assembly measurement

D = 55 86,5 mm



"Q" and "V" Exec. mechanical seal auxiliary flushing

Upon the first start up, the filling of the pump, must be guaranteed. Furthermore, you must guarantee the full filling of the auxiliary systems, if present, such as the lubrication circuit of the external dual-seal (seal execution "Q") or the external flushing circuit (seal execution "V").

Lack of compliance with the present requirements causes the dry operation of the pump and of the mechanical seal; consequently the mechanical seal can be overheated and damaged.

The auxiliary services (optional) are the following:

- flushing for the double external mechanical seal (seal execution "Q")
- external flushing for the internal seal (execution "V").

The following conditions are recommended:

Mechanical seal	Ø Flushing pipe	Speed	Capacity l/min	Pressure bar
Q 1 st Gr. 20	Ø 1/8" Gas male	1450-2900	0,2-0,5	See seal instructions
Q 2 nd Gr. 28	Ø 1/8" Gas male	1450-2900	0,5-1,0	See seal instructions
Q 3 rd Gr. 43	Ø 1/8" Gas male	1450-2900	0,7-2,0	See seal instructions
Q 4 th Gr. 55	Ø 1/4" Gas male/female	1450	0,8-2,2	See seal instructions
V 1 st /2 nd Gr. 20-28	Ø 1/8" Gas male	1450-2900	0,2-0,5	0,5-1,0
V 3 rd Gr. 43	Ø 1/8" Gas male	1450-2900	0,5-1,0	0,5-1,0
V 4 th Gr. 55	Ø 1/4" Gas female	1450	0,8-1,5	See seal instructions

Exec."Q": in case of leaks from the process seal (pump side) the flushing liquid comes into contact with the pump fluid; always use a flushing liquid that is compatible with the process liquid.

The flushing must be arranged with a pressure value of 0,5 ÷ 1 Bar higher than the pressure foreseen at the suction, in order to have the right compensation.

The mixing of incompatible liquids can cause strong exothermic reactions with the development of heat.

In the presence of dangerous liquids and /or use of flushed seals (execution "Q"- "V") the presence of the flushing liquid must be monitored by means of a system that can intervene to stop the pump in case of flushing liquid absence.

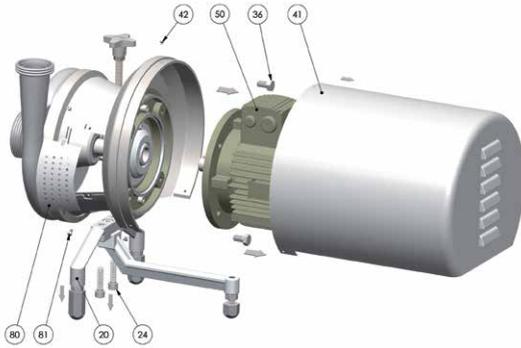
In the presence of liquids dangerous to health and/or the environment, it is advisable to insert a monitoring device of the seal flushing liquid that can intervene to stop the pump or as an alarm sign, in case of contamination of the flushing liquid.

Operation checks

Verify the presence of flushing of the mechanical seal (execution "Q"- "V").

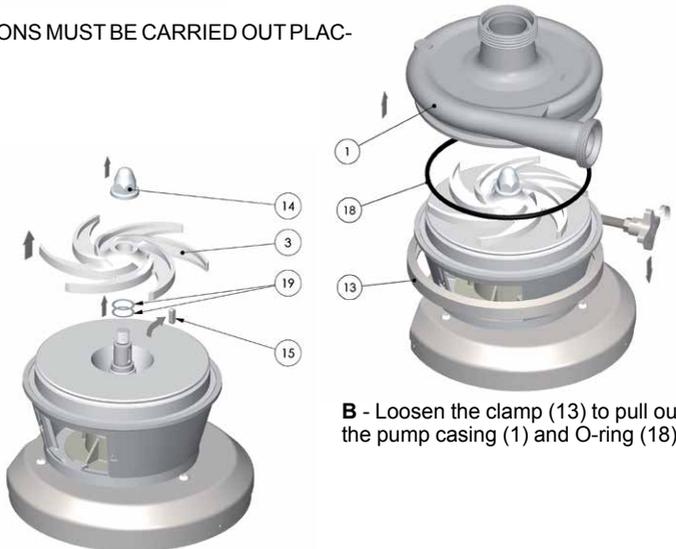
Verify the absence of leaks from the auxiliary service connections of the seal (if present).

18 DISASSEMBLY
18.1 DISASSEMBLY OF CS PUMP "T/W" EXEC.
(Version with single mechanical seal)

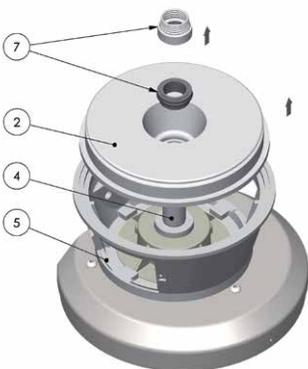


- A** - Remove the screws (42-81) to disassemble shroud (41) and protections (80).
 - Remove screws (36) from motor and pull it off the pump.
 - Disassemble the front and rear foot (20-23) with the screws (24).

NB: THE FOLLOWING OPERATIONS MUST BE CARRIED OUT PLACING THE PUMP UPRIGHT



- B** - Loosen the clamp (13) to pull out the pump casing (1) and O-ring (18).



- D** - Extract the rotary part of the mechanical seal (7) turning the spring anti-clockwise.
 Separate the cover (2) from the lantern bracket (5), pull off the fixed part of the mechanical seal (7) housed on it.

- C** - Unscrew the nut (14) anti-clockwise; this operation can be carried out:

- 1) with a pneumatic wrench
 - 2) using a fixed wrench blocking the pump shaft on the motor end.
- NB:** if the motor has not been disassembled, the fan cover can be removed and the motor shaft blocked with self-locking pliers.

NB: Hexagon dimension of the impeller nut (14):

CS 1 st Gr.	CH=20
CS 2 nd Gr.	CH=26
CS 3 rd Gr.	CH=36
CS 4 th Gr.	CH=50

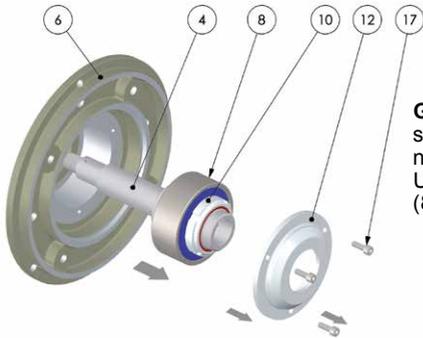
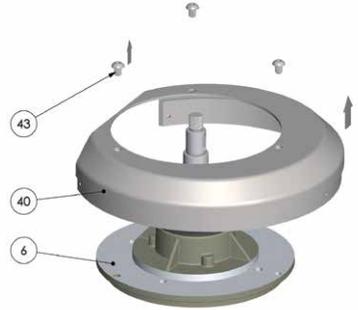
Remove the impeller (3) and the shims (19) which implement assembly play.



E - Turn it over to access the screws (35) which allow you to separate the support (6) from the lantern bracket (5).

F - Unscrew the screws (43) and remove the eccentric shroud (40) from the support (6).

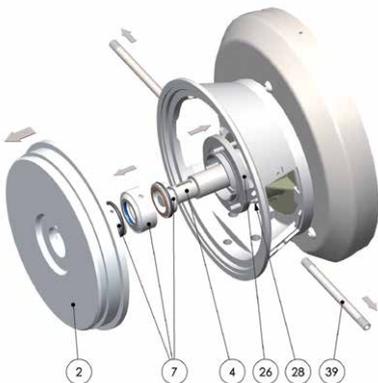
N:B: Only for versions with shroud.



G - Remove the bearing cover (12) pulling off the screws (17); extract the shaft (4) - bearing (8) - ring nut (10) unit from the support (6). Unscrew the ring nut (10) and extract the bearing (8) from the shaft (4).

18.2 DISASSEMBLY OF CS PUMP "Q" EXEC. (Version with double mechanical seal)

1st Phase: carry out the operations as in parag. 17.1 (A-B-C)



2nd Phase: after having disassembled the flushing pipes (39) separate the seal box cover (26) from the cover (2) by unscrewing the screws (28). Pull the cover (2) from the lantern bracket (5). Disassemble the seal (7): The internal fixed part is housed inside the cover (2), so they just need to be separated; after having loosened the fixing dowels, pull the rotating part from the shaft (4), and disassemble the external fixed part from the seal box cover (26).

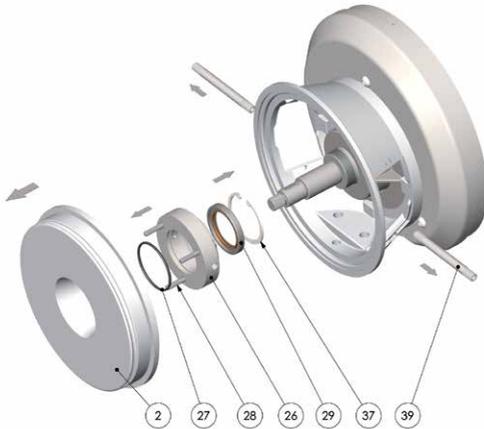
3rd Phase: carry out the operations as in parag. 17.1 (E-F-G)

18.3 DISASSEMBLY OF CS PUMP "V" EXEC.

1st Phase: carry out the operations as in parag. 17.1 (A-B-C)



2nd Phase: extract the rotating part of the mechanical seal (7) by turning the spring anticlockwise.



3rd Phase: after having disassembled the flushing pipes (39) separate the seal box cover (26) from the cover (2) by unscrewing the screws (28). Disassemble the Seeger ring (37) and the radial mechanical seal (29). Remove the OR seal ring (27) from the cover (2).

4th Phase: carry out the operations as in parag. 17.1 (E-F-G)

18.4 ASSEMBLY OF CS PUMP T / W / V EXEC.

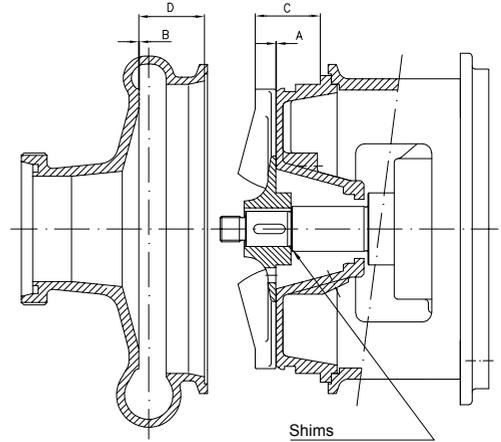
The pump can be assembled by performing the disassembly operations in the reverse order.

ASSEMBLY OF CS PUMP Q EXEC.

Respect the seals positioning as in parag. 15 when performing the assembly operations.

NB: Refer to the table (parag. 19) for the assembly allowance.
Use the shims pos. 19 for this operation.

	CS-CSX CSK Pump	Dimensions			
		A	B	C	D
1 th Gr.	25-145	0,3	0,3	34,9	35,2
	25-175	0,3	0,3	34,3	34,6
	32-110	0,3	0,4	29,8	30,2
2 nd Gr.	32-145	0,3	0,3	37,8	38,1
	32-175	0,3	0,4	36,3	36,7
	32-210	0,3	0,5	37,3	37,8
3 th Gr.	32-260	0,4	0,4	41,4	41,7
2 nd Gr.	40-145	0,3	0,4	38,8	39,2
	40-175	0,4	0,4	39,4	39,8
	40-210	0,4	0,4	38,9	39,3
3 th Gr.	40-260	0,4	0,4	42,4	42,8
2 nd Gr.	50-145	0,4	0,4	43,9	44,3
	50-175	0,4	0,4	40,9	41,3
	50-210	0,4	0,4	40,9	41,3
3 th Gr.	50-260	0,4	0,4	44,9	45,3
2 nd Gr.	65-145	0,5	0,3	51,0	51,3
	65-175	0,4	0,4	48,9	49,3
3 th Gr.	65-210	0,4	0,4	51,9	52,3
	65-260	0,5	0,5	49,5	50,0
	80-175	0,4	0,4	64,4	64,8
	80-210	0,4	0,4	56,9	57,3
	80-260	0,5	0,5	54,0	54,5
	80-310	0,5	0,5	54,9	55,3
	100-210	0,5	0,5	64,0	64,5
	100-260	0,5	0,5	57,8	58,3
	100-310	0,5	0,5	61,9	62,3
	125-260	0,5	0,5	63,9	64,3
4 st Gr.	125-350	0,5	0,5	74	74,5
	150-350	0,5	0,5	86	86,5



A = Impeller/cover assembly allowance (implemented with shims pos. 19)

B = Impeller/pump casing assembly allowance

C = Impeller/shroud distance with shims

D = Internal pump casing depth corresponding to B+C

20 BEARINGS MAINTENANCE

20.1 BEARINGS MAINTENANCE FOR CS SERIES PUMPS

In CS series pumps up to motor size 132 (5.5 + 9.2 kW) the bearings installed are shielded and consequently do not need to be lubricated.

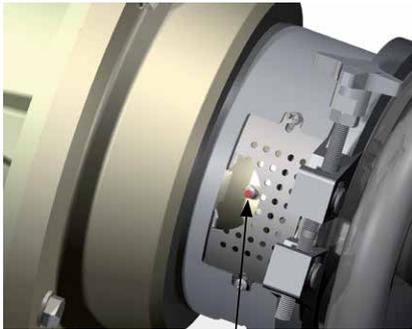
20.2 BEARINGS MAINTENANCE FOR CS - CSX SERIES PUMPS WITH HOUSING SIZE 160 ÷ 200

The bearings of CS pumps are sized for an operational life of 20,000 hours or more.

The life of the bearing and feasible re-lubrication interval may be reduced in the following cases: harsh working conditions (high ambient temperature and humidity, dust, aggressive atmosphere), use with frequent starting and stopping cycles and/or at variable loads and extended periods of inactivity.

Maintenance intervals are therefore to be established according to the conditions of use and based on acquired experience.

“CS” series pumps
(Pict. 1)



Grease nipple

“CSX” series pumps
(Pict. 2)



Grease nipples

In CS series pumps with housing size 160 ÷ 200 (11 ÷ 22 kW), the bearings must be lubricated periodically; to ensure correct lubrication, the bearing must be disassembled, cleaned thoroughly and lubricated with fresh grease, making sure only to fill the crowns to half their volume. They can be topped-up with grease periodically via the grease nipple on the bearing housing (see pict. 1 - pict. 2).

Each time the bearing is disassembled, replace the grease lip sealing gasket (pos.32 CS, pos. 206-207 CSX), making sure the ring sealing seat is not worn.

To lubricate the bearings correctly, you are recommended to use high performance grease of SKF LGHP2 with temperature range -30°C/150°C.

The following table provides indications on the re-lubrication interval on the amount of grease recommended and the type of bearing on the pump.

CS-CSX Pumps		32	32	32	80	65	32	80	Lubrication interval (hours of operation)	Q.ty of grease (grams)
		40	40	40		80	50			
Item	Bearings	50	50	50	175	210	260	310	5000	20
		65	65	65		210	260			
Motor IEC 160	Bearings	3212 A C3			3214 A C3			5000	20	
Motor IEC 180		22214 E			22214 E			500	20	
30 kW 2-poles motor IEC 200 (CSX with 2 bearings)		---			C 2216			500	23	
		---			6216 A				18	

20.3 BEARINGS MAINTENANCE FOR CSK SERIES PUMPS

The bearings of the pump support are lubricated using the oil bath method.

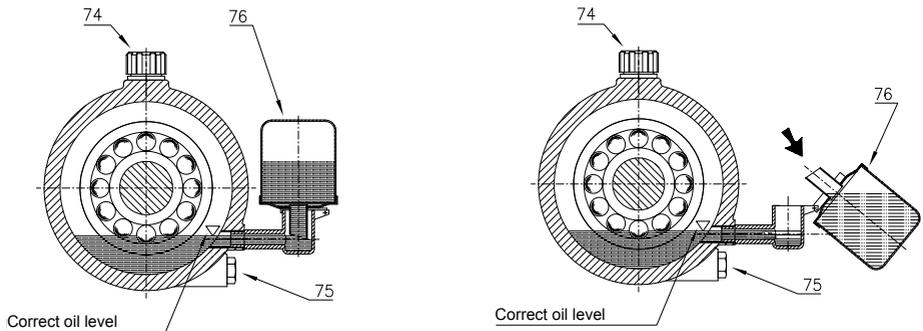
The pump is supplied with the support without oil; fill the support before starting the pump, using oil supplied by C.S.F., or an equivalent type of oil.

The procedure to fill with oil is the following: with the pump off, unscrew the release plug (pos. 74) and turn the bulb of the constant level oiler (pos. 76), as shown in the figure, then pour the oil through the release plug until it reaches the level of the hole at the side where the constant level oil-feeder is situated, as shown in the figure; then partially fill the bulb as a reserve and turn it to the closed position and screw the release plug back on.

After a short amount of time check whether the reserve level in the bulb has dropped; it is important to maintain the correct reserve level. It is important to check the oil level periodically, topping it up if necessary, without exceeding the level shown in the figure. An excessive amount of oil will cause the temperature of the bearings to increase.

It is recommended to change the oil after approximately 300-500 hours the first time, and subsequently approximately every 8.000 hours, for operating bearing temperatures up to 60°C (anyway, oil must be replaced every year) and reduce the interval for higher temperatures (refer to C.S.F. Inox or follow the SKF instructions). To change the oil in the support, unscrew the release plug (pos. 75) and drain the exhausted oil out into a specific container, then screw the plug back on and pour the new oil in, according to the procedure described above.

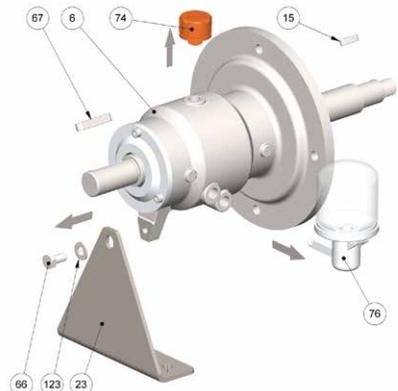
BRAND	TYPE	VISCOSITY INDEX	ISO GRADATION
MOBIL	DTE OIL LIGHT	112	32

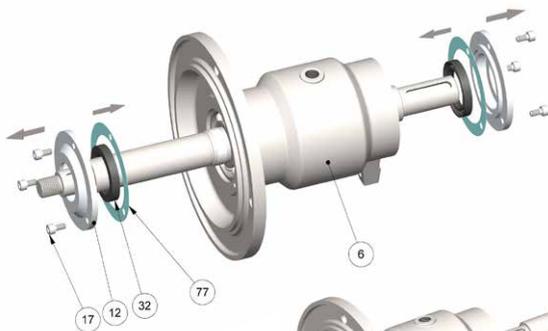


Q.TY OF OIL EXPECTED
CSK 2° Gr. = 10,1 of oil
CSK 3° Gr. = 10,3 of oil
CSK 4° Gr. = 10,5 of oil

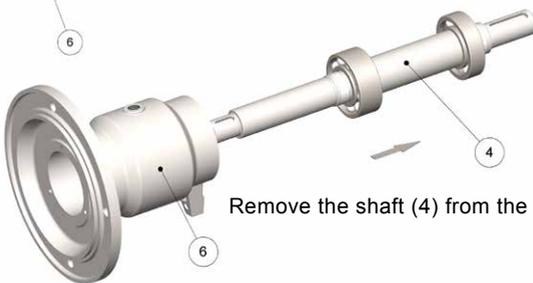
20.4 DISASSEMBLY

Separate the vent plug (74), the oiler (76), the rear foot (23) with a screw and washer (66-123) and the flaps (15-67) from the support of the bearings (6).



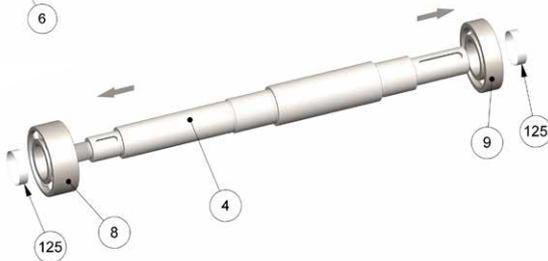


Remove the covers of the front and rear bearing (12) with seal rings (32) and gaskets (77).

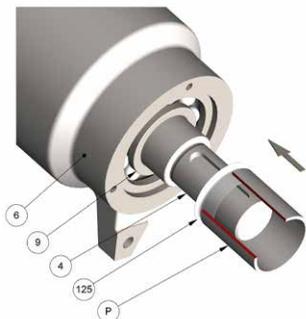


Remove the shaft (4) from the support (6).

Complete the disassembly by removing the bearings (8-9) and Speedi sleeve rings (125) from the shaft (4).

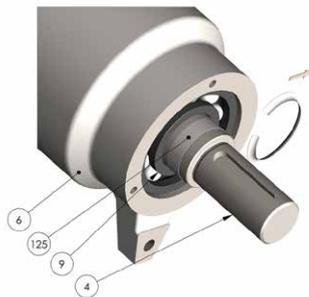


20.5 ASSEMBLY



Perform the disassembly steps in inverse order to assemble the support of the bearings.

N.B.: After assembling the bearings (8-9) insert the Speedy sleeve rings (125) using an adequately sized pipe. Then remove the frame of the rings with suitable pliers.



The following table provides indications on the type of bearings on the pump.

CSK Pumps		32	32	32	80	65	32	80	125
		40	40	40		80	40		
Item		50	50	50	175	100	50	260	350
		65	65	65		210	65		
		145	175	210	175	210	260	310	350
Bearings	Front	3206			3309 C3			3311 C3	
	Rear	6206			6309 C3			6311 C3	

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

Typically the cleaning process should be developed by a plant responsible of sanitization.

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:

- 1) Prerinse with cold water (15-25°C) for 10-15 minutes to remove any residue.
- 2) Warm prerinse 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.

Caution:

- 1) During the CIP process there are thermal expansion: take care that there are not rapid temperature variation.
- 2) Chemical agents at high temperature can cause potential health risk: respect the safety regulation and use protection devices
- 3) Control the concentrations and temperature of chemical agents during the CIP.
- 4) Store the cleaning agents in compliance with the safety regulations

Sterilization:

If requested, a sterilization can be carried out 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.

Temperature limits for rubber gasket	Steam/hot water	Chemical bactericidal
EPDM	121°C	82°C
FPM/FKM	149°C	82°C

Impeller nut cleaning and sterilization:

- 1) The dismantled nut should be cleaned before assembling (internal threads).
- 2) Clean the nut with Ultrasound washing system or detergent and rinsing with clean water.
- 3) Sterilize the nut with steam at 143°C for 30 minutes in autoclave or using chemicals solution (i.e. glutaraldehyde solution). Do not use chlorine solutions because stainless steel could be damaged by corrosion.



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