Ampco Pumps Company

QTS Series

Twin Screw Pump

Q-Pumps S.A. de C.V.

Operation and Maintenance Manual

QTS-AMPCO

FPSA

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ABOUT THIS MANUAL

To ensure the best performance of your pump, please read this manual before starting it. You will find useful information and instructions for the assembly and disassembly procedures required for the necessary pump maintenance.

For any questions related to the operation, maintenance, or installation, please contact your local distributor or Ampco Pumps:

Ampco Pumps Company
2045 W Mill Rd.
Glendale, WI 53209
414.643.1852 / 800.737.8671
Fax: 414.643.4452
sales@ampcopumps.com

The information in this manual may change without notice; we recommend visiting our website for any updates.

ABOUT THIS MANUAL

General Information

Every QTS pump is completely assembled, lubricated, synchronized, factory tested, and ready for use. Standard maintenance practices are described in this manual. For more information, please see the Maintenance section. Following these guidelines will grant a long pump service life under proper use and installation in a properly designed system.

If it is necessary to return the equipment under warranty, or for some other reason, contact Ampco Pumps to receive a Return Material Authorization (RMA).

Damage or loss during shipment

If you receive the equipment in poor condition or it is lost during transport, file a claim with the carrier immediately. The transport service provider is responsible for recovering the goods; Ampco Pumps will ensure they are received in good condition.

Receiving the pump

The pump inlet and outlet ports are covered prior to shipment to ensure that no foreign materials enter the pump during shipping. If the protective covers are missing at delivery, remove the pump cover and inspect the interior to ensure that it is free of contaminants before starting up the pump. Please keep the pump serial number; this will help to order replacement parts and / or make a warranty claim. For more information related to shipping damage and warranty claims please review the General Information or Warranty section in this manual.

SAFETY

IMPORTANT: Read and understand this manual before installation, operation, or maintenance of the pump. Installation, operation, and maintenance in combination with inappropriate or unsafe practices can cause serious individual risks or death and damage to the environment and the pump. Equipment damage caused by user negligence will void the pump warranty.
There are safety symbols used in this manual to identify dangerous situations and how to avoid them:

CAUTION: Hazards or unsafe practices that may result in minor injuries or damage to equipment or property.

DANGER: A situation in which there is a possibility of a potentially harmful incident; hazards or unsafe practices that could result in serious injury or death.

ELECTRICAL HAZARD: Risk caused by direct electrical energy contact, burns, electrical shocks, electric arc and fire or explosions caused directly by electricity.

ROTATING PARTS: Risks from exposure of personnel to rotating parts that may be dangerous and cause injury.

TEMPERATURE: The main risk is associated with direct contact of hot or cold sources.

Operate the pump only in accordance with its specific use mentioned in the data sheet and consider all risk and safety issues described in this manual.

In case of malfunction, the pump must be turned off immediately and the responsible staff must tend to those malfunctions. Do not allow access to the pump by unqualified personnel. Please contact your distributor.

Avoid operating procedures that endanger the personnel and/or people who are not directly involved in the process. The user must ensure that authorized and qualified personnel carry out the relevant activities of maintenance procedures, operation, and installation.

Provide safety devices for any of the following cases and ensure their proper performance:

- If conditions of heat, cold, and moving parts are in place, provide protection against accidental contact with the pump. Protection must not be removed during the operation. Guards are recommended.
- To avoid electric shocks, ground all electrical systems properly.
- Provide adequate pressure relief devices to prevent excessive pressure on the discharge side of the pump between the pump and the first stop device.
- Always follow local safety guidelines.

SAFETY

Electrical Connections

- A qualified and trained electrician should make the electrical connection to the motor.
- Use safety equipment when manipulating electricity.
- Use appropriate signs in areas where electrical equipment is exposed.
- The pump must be disconnected and secured to prevent startup before starting any work on electrical equipment.
- Use the proper wire number in accordance to the motor voltage and amperage.
- Follow diagram connections shown on the motor nameplate; check the motor installation manual for any questions.
- Isolate and protect the terminal ports and connections.
- Make sure the rotation of the pump is correct.
- The motor of your pump has been tested and was selected to meet the requirements of a specific application. The motor amperage consumption should be within the range indicated on the motor nameplate for proper operation.
- The user is responsible for the safety and proper operation of equipment when special or other motors are used (not supplied by Ampco).

Temperature

The QTS Series is designed to work in a normal temperature range between -40 ℃ (-40 ℉) and 100 ℃ (212 °F). Be careful when touching the body and gear case to avoid burns when the temperature rises. If the application requires a higher temperature range please contact Ampco Pumps for further information regarding the application

Moving Parts

The principal operation of the QTS Series is the rotation of a pair of synchronized rotors which can trap foreign objects and get stuck due to improper equipment operation. Never operate the pump without the front cover properly in place.

The gearbox contains rotating parts; never operate the pump without the gear case cover. Use caution around rotating shaft elements. Likewise, do not operate the pump without the coupling guard in position.

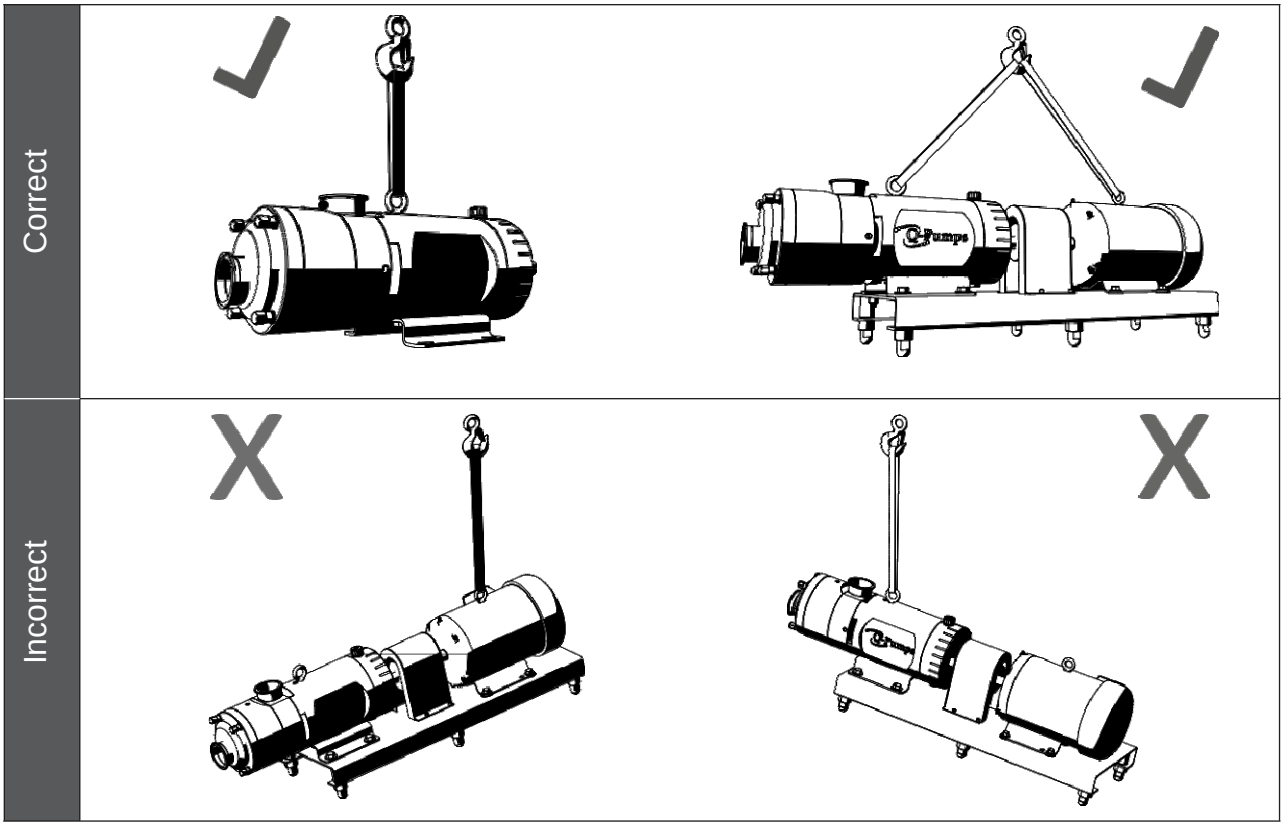
Lifting the Pump

Carefully transport the equipment avoiding contact, drops, or damage. To prevent damage, the QTS Series is equipped with an eye bolt located on the gear case for lifting.

Use proper equipment such as a forklift or crane with slings or straps with the right capacity to lift the total weight.

Take precautions and follow the manufacturer recommendations to use slings or straps.

When lifting assemblies, motor/gear-motor coupled to the pump, always try to lift them up simultaneously. Be sure to place the pump assembly on a stable surface. Once the assembly is in place, check that the screws are properly tightened and that the assembly is aligned; see coupling alignment section in this manual for further instructions.



KNOW YOUR PUMP

Congratulations! You've just purchased a high quality QTS Twin Screw for your sanitary pumping solutions. The QTS Series is the best solution in the market due to its special characteristics:

- Ideal to pump low and high viscosity fluids (up to 1,000,000 cP).
- All wet parts in contact with the fluid are made of 316L stainless steel.
- Ideal for handling abrasive products.
- Running speeds as high as 3,000 rpm depending on the pump model, type of fluid, and application. It is a bidirectional pump, capable of product recovery.
- Can be used as well as a CIP pump reducing cost in additional equipment and maintenance time.
- Enlarged suction and discharge ports are available.
- Completely drainable.
- Even when running at high speed, there is no rotor/rotor/body contact.
- Meets 3A and EHEDG (European Hygienic Engineering and Design) standards.
- Low NPSH requirement its high suction capacity.
- Can pump fluids with up to 60% entrained air.

Data Sheet

This document is linked to the serial number of your pump which is etched on the gear case. You can find valuable information such as the pump model, type and material of the mechanical seals as well as operating data (application) and the CIP process data requirements. This information must match the equipment selection. Be aware that operating your pump under different circumstances can void the warranty. Please keep the data sheet for any clarification.

Data Sheet

Data Sheet

Customer: Example

Model	QTS 203	Operating Conditions			VFD
Certification	3A / EHEDG	Capacity	60	gpm	
Screw material	AISI 316L	Diff. pressure	50	psi	
Housing material	AISI 316L	Pump speed	600	rpm	60 Hz
Shaft material	17-4 PH	Temperature	30	℃	
Screw hardening	Yes	Viscosity	500	cPs	
Housing hardening	Yes	Particle size	< 0.5	in	
Rotation (Front)	CW	bhp	4.9	hp	
Sealing	Single mechanical seal	Nominal power	7.5	hp	
Sealing material	SiC/C				
Elastomer material	EPDM	CIP			
Suction port location	Front cover port	Max. pump speed	1800	rpm	90 Hz
Suction port size	Tri-Clamp 2"	Max. CIP time	30	min	
Discharge port size	Tri-Clamp 2"	Max. diff. pressure	50	psi	
Thermal jacket	No	Piping size	2	in	
Drive	Electric motor with gear reduction				
VFD	Yes				

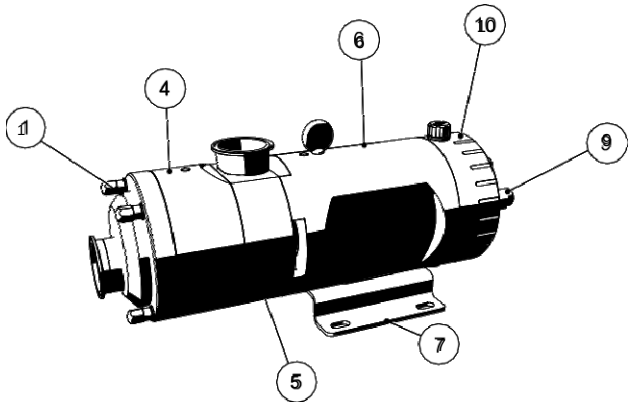
KNOW YOUR PUMP

KNOW YOUR PUMP

Pump General Assembly

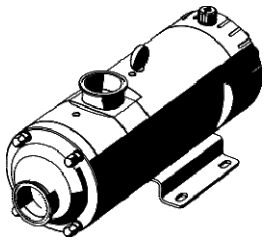
The pump uses twin screw rotors, when rotating they move the fluid through the casing. The elements inside the gearcase are responsible for transmitting the synchronized movement and the force required for pumping the fluid; gears, bearings, spacers, and shafts are inside the gear case.

1. Front cover (with port connection, typically inlet)
4. Pump casing
5. Back cover (with port connection, usually outlet)
6. Gear case
7. Pump base plate (NEMA/IEC)
9. Drive shaft
10. Gear case cover

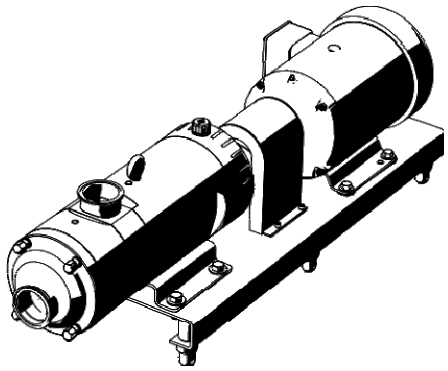


Pump Arrangements Assemblies

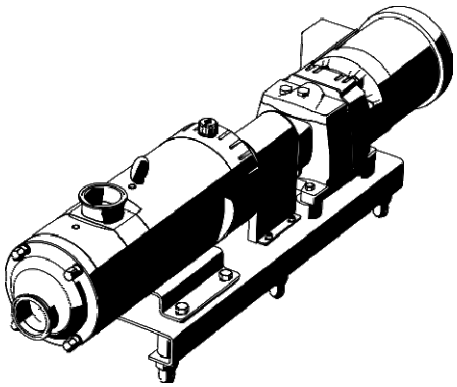
The QTS Series pumps can be delivered coupled to a drive element in different ways to fulfill specific application requirements. They can be ordered and delivered as follows:



Pump Only. In this case the pump is supplied with a drive shaft for coupling, and does not include motor/gear-motor, coupling or base.



Pump Coupled to a Motor Assembled on a Base. This assembly includes a motor with a coupling, coupling guard, and base.



Pump Coupled to a Gear-Motor Assembled on a Base. This assembly includes a gear-motor with a coupling, coupling guard, and base.

QTS Rotors and Clearances

The design of QTS rotors (twin screws) in addition to the clearances kept with the casing, allow pumping high viscosity fluids without the risk of contact between them. The correct operation of the pump is based on the proper rotor synchronization.

Using Variable Frequency Drives

The use of variable frequency drives is useful for performing various applications including the CIP process using the same pump. By changing the speed of the motor the pump can increase or decrease the flow to reach different points of operation.

If your equipment is supplied with a variable frequency drive it is as a result of an analysis of the applications of the pump, please follow the data shown in the Data Sheet.

If you would like to add a variable frequency drive after the analysis of the application, please contact your distributor or Ampco Pumps Company for additional information. Remember that using your pump under different conditions than those explained in the Data Sheet may result in damage to the equipment, injury to personnel and void your warranty.

PUMP OPERATION

Follow these steps for the proper operation of your pump before, during, and after start up. Remember that the correct operation of the pump ensures proper performance and long service life. Failure to follow these recommendations could result in damage to the pump voiding the warranty.

Start Up Procedure

Before starting the equipment, ensure the following:

- Ensure oil is filled to the center of the top sight glass. Mechanical seals are not leaking. Double mechanical seals must be lubricated, without exception. The pump is able to run dry for a short period of time (not recommended). Prevent dry starts to avoid damaging the mechanical seals.
- Jackets are properly connected and have adequate supply of heating or cooling medium.
- The pump is cleaned and sterilized.
- The pump is primed with the fluid to be pumped.
- In order to prevent cavitation, check the valves confirming the suction side is fully open.
- The valves on the discharge side are fully open to prevent overpressure inside the pump.
- Safety measures are taken at the discharge side of the pump to protect against overpressure (open valves, corresponding jacketed piping, by-pass, and recirculation or pressure relief valves).
- The manometers at the discharge are operational.

When starting the motor, check and adjust the operating speed according to the data sheet, after the motor reaches the operation speed search for leaks.

Shut - Down Procedure

After shutting down the motor check the following:

- The pump decelerates gradually. If a variable frequency drive is used both acceleration and deceleration ramps can be programed.
- If the pump has a double mechanical seal even when the pump is stopped continue the supply of the buffer fluid until it is depressurized.
- If a jacket is used adjust it until the pump temperature drops below 100 ℃/212 ℉.

Restart Procedure

Before restarting the pump check the smooth rotation of the shafts without restrictions and repeat the startup procedure.

MAINTENANCE: Pump Assembly and Disassembly

To assemble and disassemble the pump, follow the recommendations described below. Always use original spare parts and follow the instructions in this manual. Not following these recommendations could result in damage to the equipment and possibly void the warranty. Remember to read the safety recommendations.

Tools and Spare Parts

Some spare parts such as mechanical seals, O-rings, and gaskets kits may be required to avoid future pump failure.

The following tools are provided within the pump:

1. Special wrench to tighten lock nut (gear case).
2. Hook for O–ring removal.

Additional required tools:

1. Set of ball end Allen wrenches in standard sizes: 3/16”, 1/4”, 5/16” and 3/8”
2. Steel thicknesses gages in sizes of 0.001”, 0.002” and 0.005”
3. Socket wrench and set of six points hexagonal sockets
4. Wrenches 7/8”, 1” and 1 ½”
5. Torque wrench (capacity from 4 to 50 lb·ft)

You may also need FDA grade silicone base grease for incidental contact.

Oil and Oil Change

The pump comes with Food Grade Mineral Oil. All pump sizes use **ISO VG-68** oil.

An oil change is need if one of the following conditions is present:

First oil change	240 hours
Non-continuous operation*	2000 hours
Continuous operation**	2500 hours or 4 months (whichever comes first)

* Twelve or more pump startups per day

** Less than twelve pump startups per day

MAINTENANCE

Bill of Materials

Please use this table and diagram to identify each component to be assembled.

Bill of Materials:					
1	Front cover	19	Synchronization ring	37	Front bearing
2	Left rotor	20	Tapered driven ring	38	Rear bearing
3	Right rotor	21	Cover nut	39	Lock washer
4	Pump casing	22	Flat washer	40	Socket head cap screw
5	Back cover	23	Spring washer	41	Drive gear
6	Gear case	24	Set screw	42	Driven gear
7	Pump base plate	25	Dowel pin	43	Bearing lock washer
8	Driven shaft	26	O-ring	44	Bearing lock nut
9	Drive shaft	27	Gasket	45	Lock washer
10	Gear case cover	28	Socket head cap screw	46	Socket head cap screw
11	Rotor nut	29	Front seal	47	O-ring
12	Mechanical seal	30	Flat washer	48	Pressure release valve
13	Button head set screw	31	Hexagon bolt	49	Rear seal
14	Stud	32	Eye bolt	50	Oil sight glass
15	Bearing spacer	33	Hexagonal bolt	51	Hex Plug
16	Gear spacer	34	Gear key	52	Plug
17	Retaining flange	35	Coupling key	53	Plug
18	Tapered drive ring	36	Lock ring	54	Nipple flush

Note: Depending on the model, some components may not be included.

Torque Values

Use the following torque table to tighten each item when indicated in the manual:

# Part	Piece	QTS 100	QTS 200	QTS 300	
21	Front cover nuts	15	20	30	lb·ft
11	Rotor nut	35	40	50	lb-ft
40	Socket head cap screw (bearings)	10	15	20	lb-ft
44	Bearing lock nut	25	30	40	lb-ft
46	Socket head cap screw (sync ring)	2.1	4.2	6.25	lb-ft
		25	50	75	lb-in

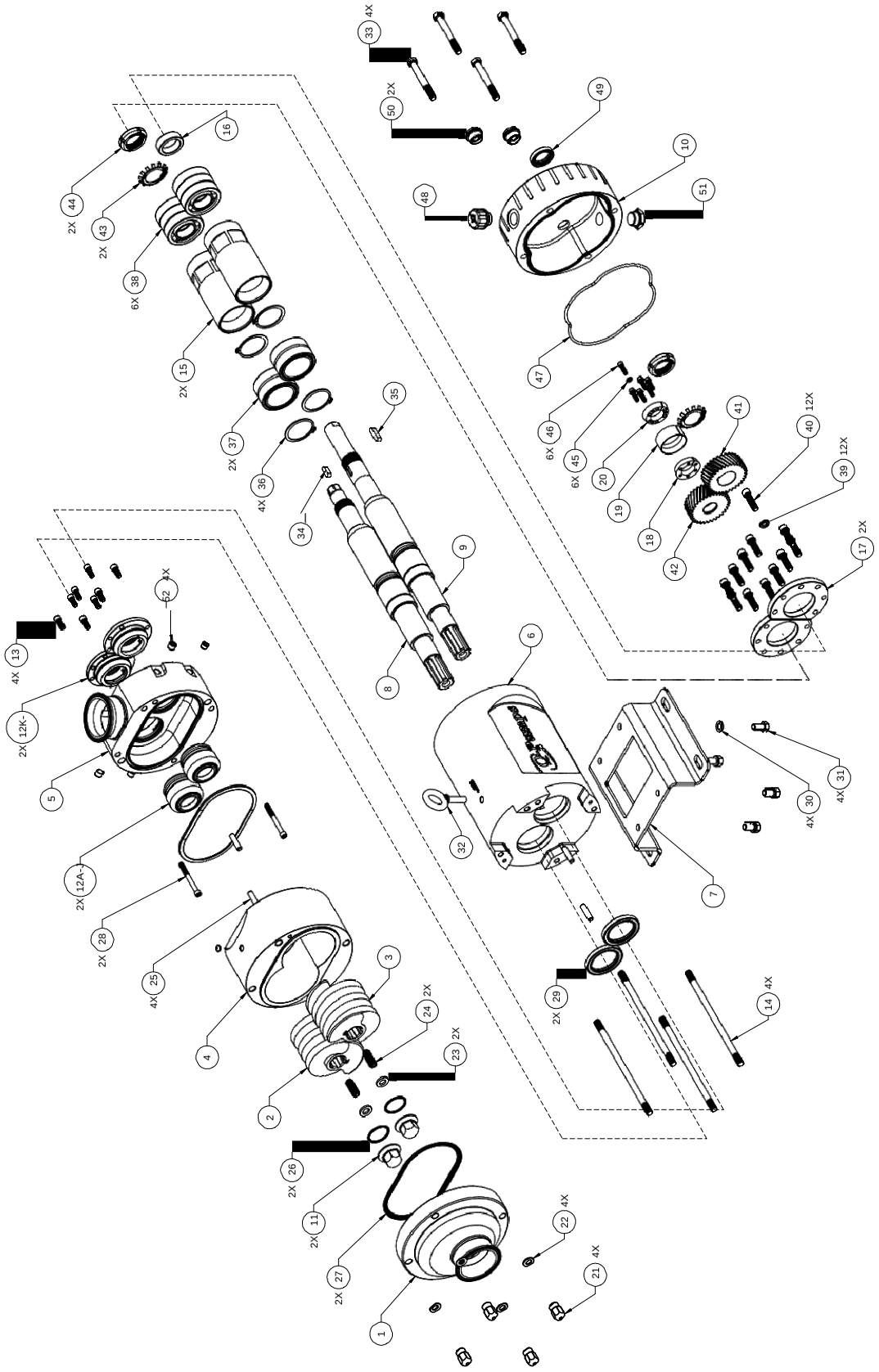
Coupling set screws 10 lb·ft for all models.
Hexagonal bolts/hexagonal nuts motor/base, pump/base, 40 lb·ft.
Any other screw 10 lb·ft.

Minimum Thickness Gage

Model	Value
100	0.007 in
200	0.007 in
300	0.010 in

Note: Value at both flanks of rotor

Exploded View



MAINTENANCE

MAINTENANCE

Be sure to read and understand the Safety section of this manual before servicing your pump.

Disconnect power to the unit and lock out the mechanism.

Handle all wet parts with caution; prevent harsh contact or scratches and always place them on a clean surface to avoid damage.

The preventive maintenance procedures and inspection comprises the change of the mechanical seal, O-ring, and gasket replacements, checking the oil level, checking the alignment of the coupling as well as noise, and vibration issues.

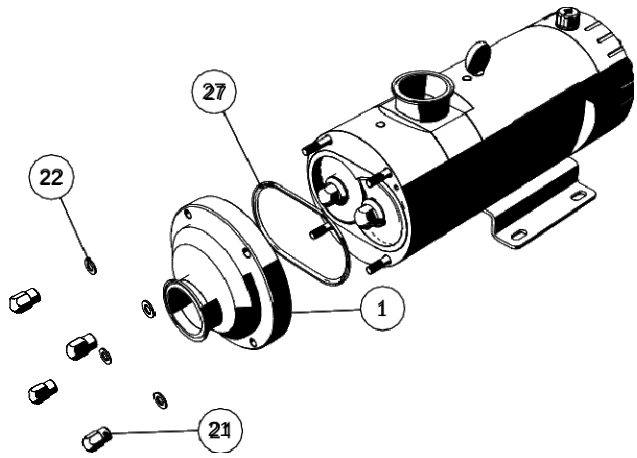
Removing the Rotors

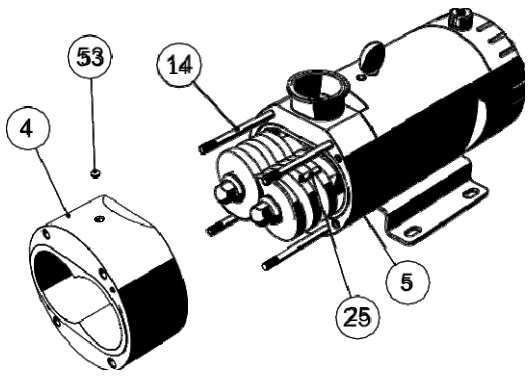
1. Remove the cover nuts (**21**) and flat washers (**22**); use a wrench or a six points female socket. Remove the front cover (**1**).

2. Carefully remove the front cover gasket (**27**); you may use the O-ring hook.

3. Remove the pump housing (**4**) carefully. It is fixed and centered over the back cover (**5**) using dowel pins (**25**). Pull straight out to slide the housing through the housing studs (**14**). The pins may be pulled out along the housing or stay on the back cover. You can remove the studs to increase the working area. The plug (**53**) is for sealing a hole in the housing which was used during machining and has no specific use.

Note: To remove the studs you may use the nut-and-locknut technique (see annex B).

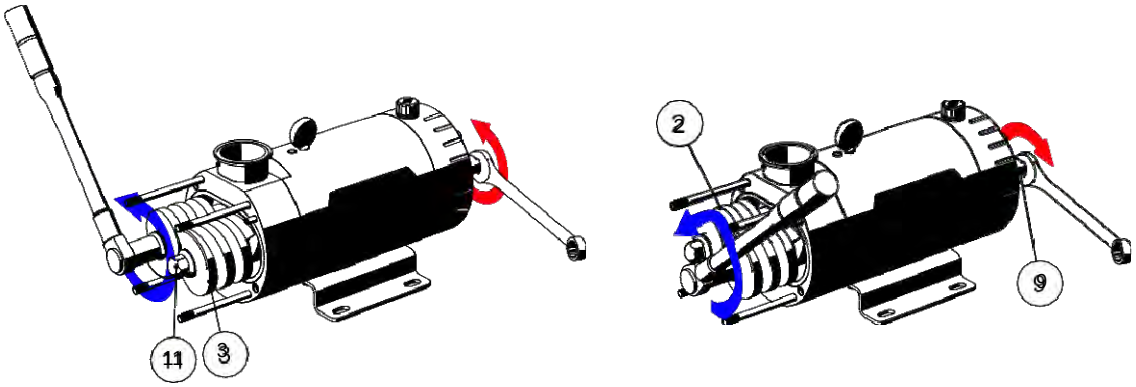




4. Block the rotors with the aid of a wrench using the drive shaft (**9**) end. Using a six points female socket loosen the rotor nuts (**11**). First loosen the left side rotor (**2**) nut torque, then change to the

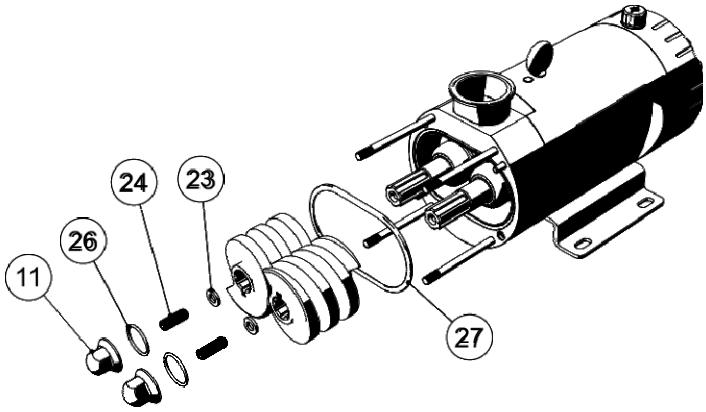
right side rotor (**3**) and just loosen the torque of the second nut. Slowly loosen simultaneously the two rotor nuts until both are out.

5. Progressively loosen both nuts by slowly alternating between the two. Fully loosening one side before the other will cause the seals to push the loose rotor forward creating interference between the two rotors.



6. Remove the O-rings (**26**), spring washers (**23**) and the rotor nut socket set screws (**24**). Sometimes the socket set screws may remain installed on the shafts, to remove them use a hexagonal key.

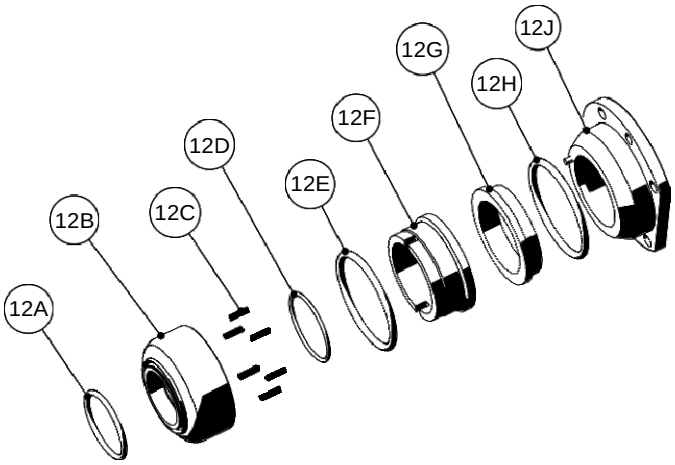
7. Take off the gasket (**27**) placed on the back cover. Sometimes this gasket may get stuck to the casing, pull out carefully to avoid damaging it on the studs or rotors. Pull both rotors straight out.



8. You have finished the rotor removal procedure. Every time you replace the rotors be sure to perform the synchronization procedure to guaranty the right assembly. Now continue with the replacement of the mechanical seals.

Mechanical Seal Replacement

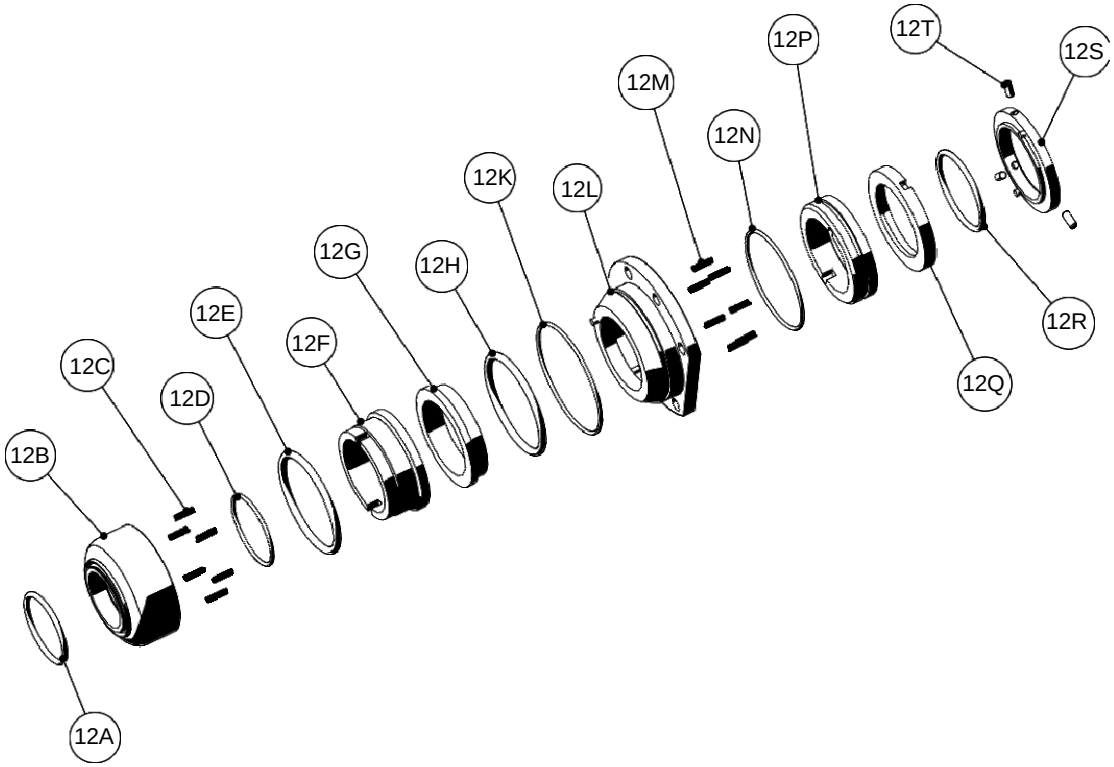
1. Here is a description of the procedures for inspection and replacement of the mechanical seals. Every pump has two mechanical seals.



2. Single mechanical seal kit: contains components **12A** to **12J**.

3. Double mechanical seal kit: contains all components of the single mechanical seal plus components **12K** to **12T**; in this case the stainless steel seal housing (**12J**) is replaced by the seal housing (**12L**) which is already included on the double mechanical seal kit.

4. The mechanical seal should be installed by hand. No special tools are required unless it is indicated. You may use a hook to remove the O-rings from their grooves. Be careful not to scratch the seal faces.



5. Look for defects on the sealing surfaces such as scratches or wear. If a replacement is necessary, it is recommended to change all components to ensure proper operation. If an O-ring is deformed or damaged it is recommended to replace the entire set of O-rings.

Uninstalling the Single Mechanical Seals

1. By hand, remove the stainless steel rotary holder subassembly (**12B-F**) by grabbing and pulling out from the rotating face (**12F**). When pulling, the static face (**12G**) may come along.

2. To inspect the O-rings inside, remove the rotating face pulling the rotary holder out gently; inside are the springs (**12C**) and the O-ring (**12D**), CAUTION, the springs are loose. Finally remove the O-ring (**12E**) which is on the rotary holder groove.

3. Remove the O-ring (**12A**) housed in the rotary holder on the front groove. Sometimes O-rings can come out of their grooves and get stuck to other components. This is normal.

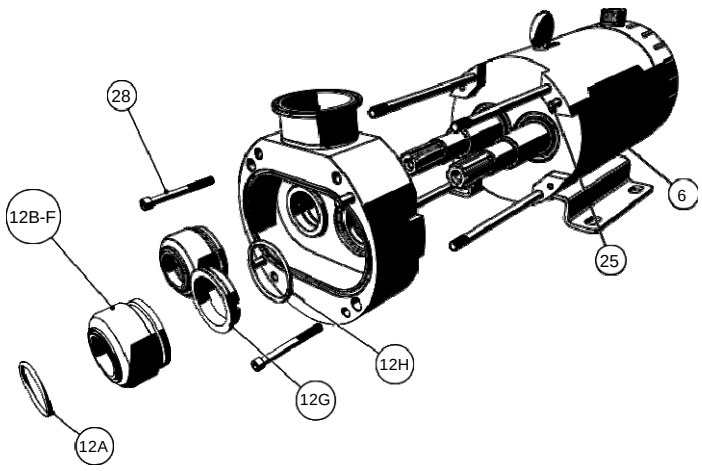
4. On the back cover (**5**) pull out the static face (**12G**) and the O-ring (**12H**). Avoid any harsh contact on the seal faces.

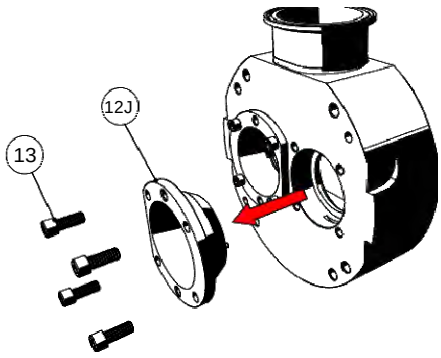
5. To remove the seal housing (**12J**) it is necessary to remove the back cover of the pump.

6. Loosen the hexagonal socket head cap screws (**28**) that hold the back cover to the gear case (**6**) and extract it through the studs (**14**). The back cover is centered with dowel pins (**25**); these pins can come out along with the back cover or can stay in the gear case as well.

7. Loosen the hexagonal socket head cap screws (**13**) on the back of the cover to eject the seal housing. Push with your thumbs from the front of the back cover. Be careful when removing the seal housing to avoid any harsh contact. This step is not necessary if only a seal replacement is required.

8. Repeat these steps to disassemble the other mechanical seal.





MAINTENANCE

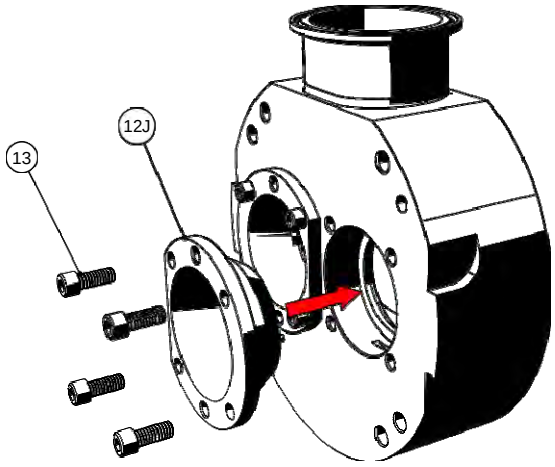
Installing the Single Mechanical Seals

1. Special tools are not required to install the mechanical seals; you can assemble the components by hand.

2. Insert the dowel pins (**25**) into the gear case, slide them carefully, if you feel resistance stop and check the surface finish of the pins and the gear case; replace the pins if necessary and clean the holes using a soft towel.

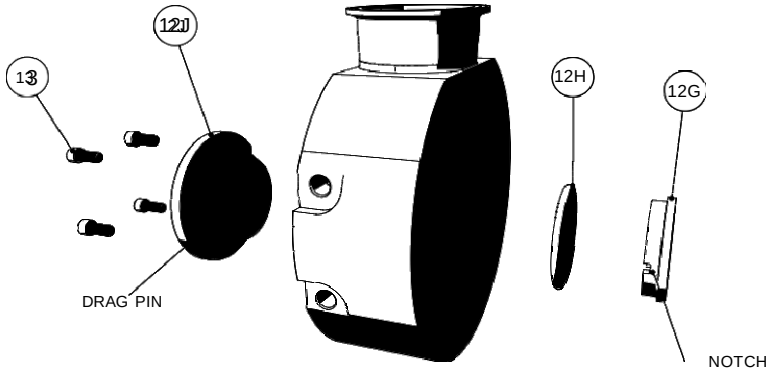
3. Place the seal housing (**12J**) into the back cover. It has a drag pin in the front for the static face (**12G**).

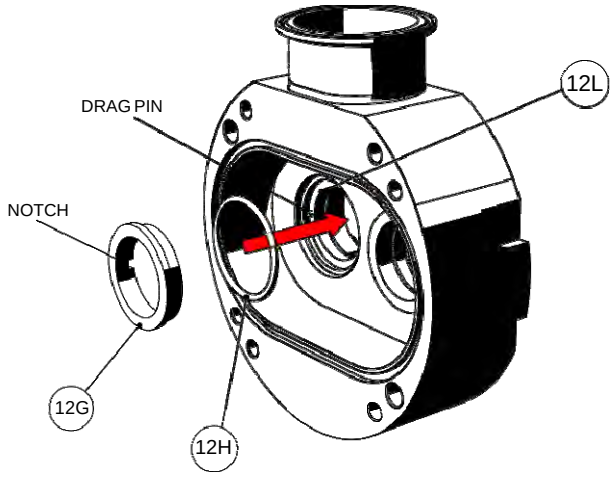
4. Tighten the button head screws (**13**) to secure the seal housing in the back cover.



5. Place the O-ring (**12H**) on the static face (**12G**).

6. Insert the static face (**12G**) in the back cover. Make sure the notch is aligned with the drag pin. There is no physical contact between the static face and the seal housing; the O-ring limits the position of the static face. This step is crucial for the correct assembly of the mechanical seal; failing to do so properly can cause damage to the mechanical seals, the rotors and can even alter the integrity of the pump.



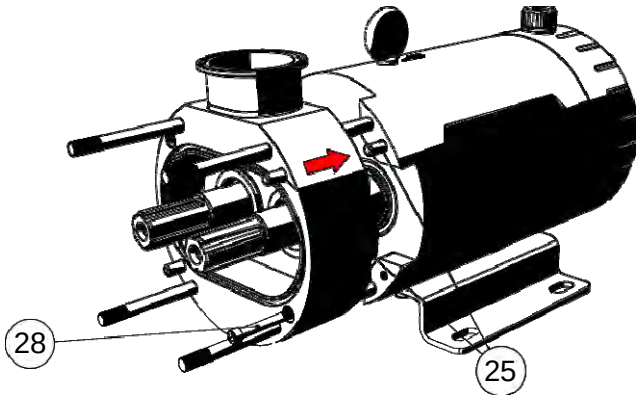


7. Repeat this procedure with the next housing.

8. Take the back cover (with the seal housing inside) and carefully slide along the studs and shafts pushing it to the back until making contact with the gear case; use the dowel pins to center it with the gear case.

WARNING: Operating the pump without all four dowel pins in place will cause severe damage to the pump.

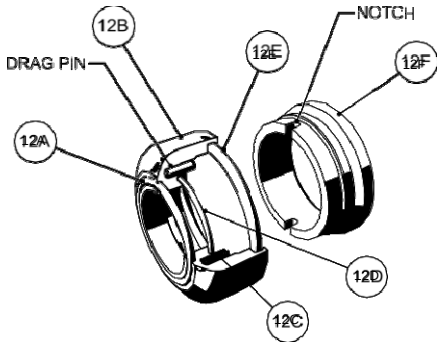
9. Assemble the back cover and the gear case using the hexagonal socket head cap screws (**28**) and tighten them firmly.

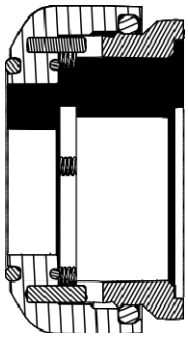


10. Place the O-ring (**12D**) within the inside groove of the rotating seal driver (**12B**). Next insert a spring into each of the holes located on the inside face of the seal driver.

11. Lubricate the inside diameter of the O-ring (**12E**) and place it on the inside groove of the holder. Make sure it is secured.

12. Take the rotating face (**12F**) and insert it into the O-ring; the holder pins must fit the notches on the rotating face. Use your hand to push against the holder until the spring are compressed and the rotating components stays inside the holder.

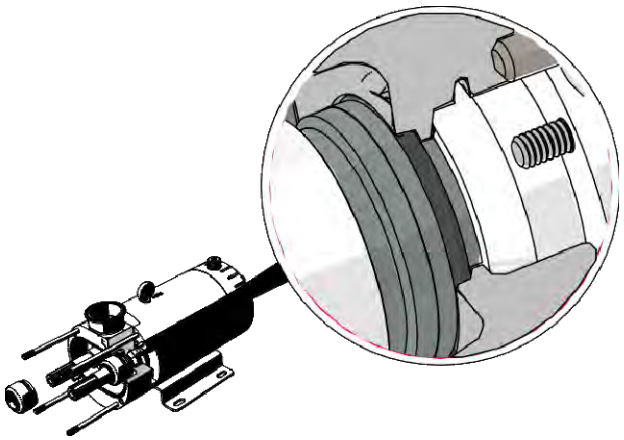




13. It is important that the notches of the rotating face fit the holder pins; the physical contact is led by the O-ring and the springs with no contact between metal and the rotating face. This step is critical to the correct assembly of the mechanical seal; failing to do so properly can cause damage to the mechanical seals, the rotors and can even alter the integrity of the pump. Place the O-ring (**12A**) into the front groove. This completes the subassembly of the rotating part of the seal.

14. With the subassembly assembled, insert the rotary holder on the shaft and push evenly until it reaches the static face placed previously on the back cover. Repeat this procedure to install the other single mechanical seal on the next shaft.

15. At this point you have completed the assembly of the single mechanical seals, continue with the assembly of the rotor.



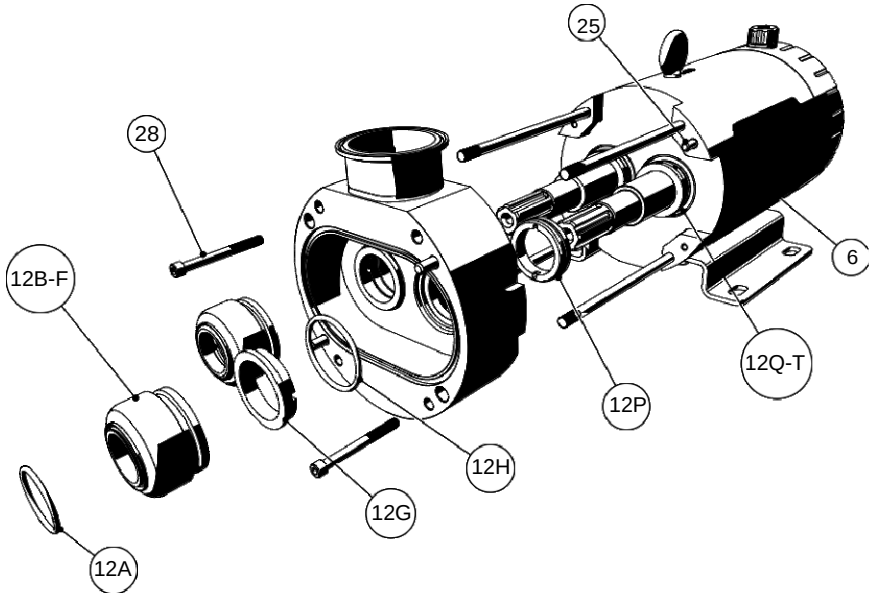
Uninstalling the Double Mechanical Seals

1. By hand, remove the stainless steel rotary holder subassembly (**12B-F**) by grabbing and pulling out from the rotating face (**12F**). When pulling, the static face (**12G**) might come together.

2. To inspect the O-rings inside, remove the rotating face by gently pulling out the rotary holder; inside are the springs (**12C**) and the O-ring (**12D**). CAUTION: the springs are loose. Finally, remove the O-ring (**12E**) which is on the rotary holder groove.

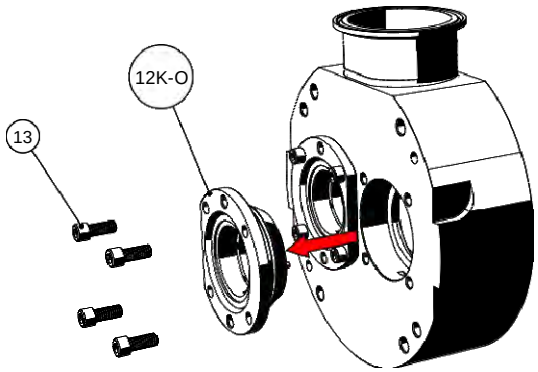
3. Remove the O-ring (**12A**) housed in the rotary holder on the front groove. Sometimes O-rings can come out of their grooves and get stuck to other components.

4. On the back cover (**5**) side pull out the static face (**12G**) and the O-ring (**12H**). Avoid any harsh contact on the seal faces.



5. To remove the seal housing (**12L**), O-rings (**12K** and **12N**), springs (**12M**) and the static face of secondary seal (**12P**) it is necessary to remove the back cover of the pump.

6. Loosen the hexagonal socket head cap screws (**28**) that secure the back cover to the gear case (**6**) and extract it through the studs. The back cover is centered by dowel pins (**25**); the pins may come out with the back cover or stay in the gear case.

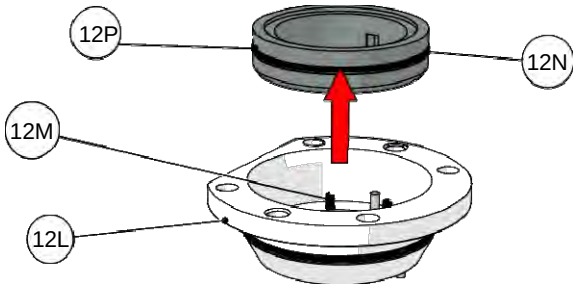


7. When removing the back cover it is possible that the rotating face (**12Q**) will be attached to the secondary static face (**12P**); handle it with care to prevent any harsh contact of the seal faces with the shafts.

8. Loosen the hexagonal socket head cap screws (**13**) on the back of the cover to remove the seal housing. Push with your thumbs from the front of the back cover. Use caution when removing the housing to avoid any harsh contact.

9. Remove the O-ring (**12K**) on the housing using the O-ring hook.

10. To remove the static face of the secondary mechanical seal (**12P**) hold the housing with the static face up and pull with your thumbs.



Note: Always work with the seal face up to prevent the springs from falling out.

11. using the O-ring hook, remove the O-ring (**12N**). Remove the springs (**12M**) if necessary.

12. To extract the rotating components of the secondary mechanical seal slide the seal face off of the shaft (**12Q**) and remove the O-ring (**12R**) located inside this rotating seal face.

13. With a hexagonal key, loosen the set screws (**12T**) from the drive ring (**12S**) and remove if needed.

14. Repeat these steps to uninstall the rest of the components of the second mechanical seal.

MAINTENANCE

Installing the Double Mechanical Seals

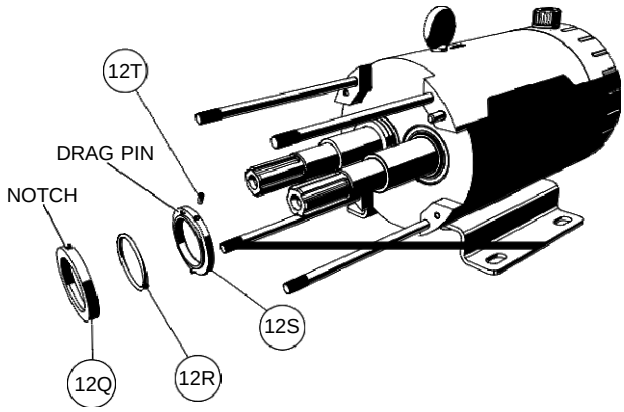
1. Special tools are not required to install the mechanical seals, components can be hand assembled.

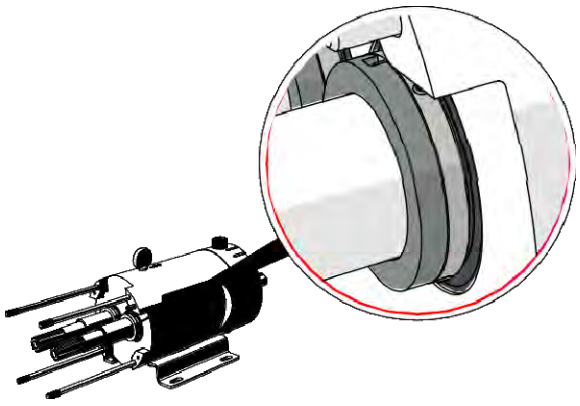
2. Place the dowel pins (**25**) on the gear case, slide them smoothly, if you feel resistance stop and check the surface finish of the pins and the holes in the gear case; replace the pins if necessary and clean the holes using a soft towel.

3. Place the set screws (**12T**) in the drive ring (**12S**) using a hexagonal key. The screws must not pass through the inner diameter of the drive ring. Slide the ring on the shafts until the end and tighten the set screws.

4. Insert the O-ring (**12R**) into the groove on the rotating face of the secondary mechanical seal (**12Q**) and slide them together on the shafts until reaching the drive ring. Make sure the set screws fit the notches on the rotating face.

5. Repeat these last two steps with the other rotating components of the double mechanical seal.

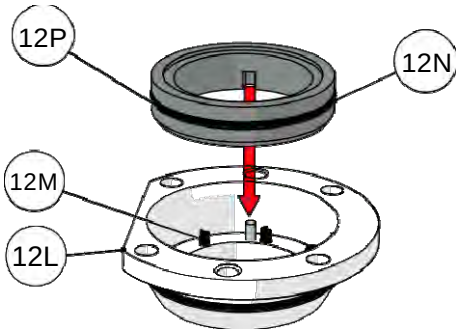




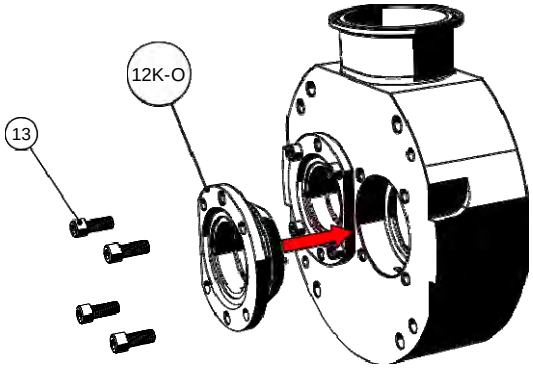
7. The seal housing (**12L**) has a drag pin in the front for the static face of the primary mechanical seal (**12G**) and two drag pins on the inside for the static face of the secondary mechanical seal (**12P**).

8. Place O-ring (**12K**) in the outside groove of the seal housing (**12L**).

9. Continue placing the springs (**12M**) inside the seal housing.



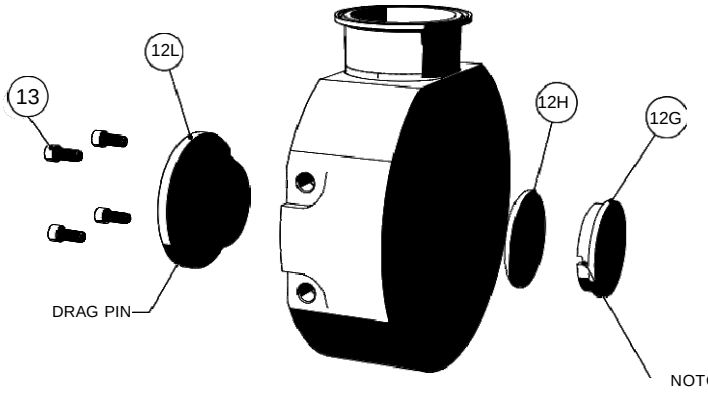
10. Place the O-ring (**12N**) on the static face of the secondary seal (**12P**) and insert it on the seal housing (**12L**); match the notches with the pins. Press evenly with both hands until the element is completely inside the housing. If the pins are not aligned with the notches the element can be damaged; the final position is determined by the spring and the O-ring so there should be no contact between metal and the static face of the secondary mechanical seal.



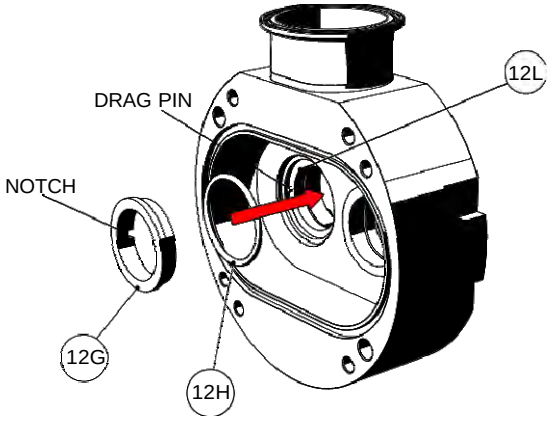
11. Continue placing the seal housings (with seal faces and O-rings) inside the back cover (**5**).

12. Tighten the hexagonal socket head cap screws (**13**) to secure the seal housing in the back cover.

13. Repeat this procedure with the next seal housing.



14. The face of the primary mechanical seal (**12G**) has a notch to prevent rotation. Place O-ring (**12H**) on this element and insert both in the pump housing. Be sure the notch matches the drag pin on the seal housing (**12L**) and push gently until the element gets completely inside; the final position is determined by the O-ring so there should be no contact between metal and the static face of the primary mechanical seal.

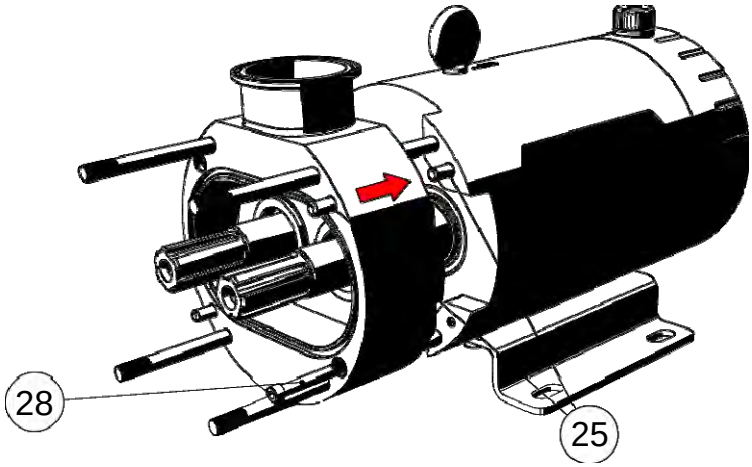


15. This step is crucial for the proper assembly of the double mechanical seal, failure to do so properly can cause damage to the pump.

16. Take the back cover (with the seal housing inside) and carefully slide thru the studs and shafts pushing it to the back until making contact with the secondary rotating face (**12Q**) ; use the dowel pins to center the part with the gear case.

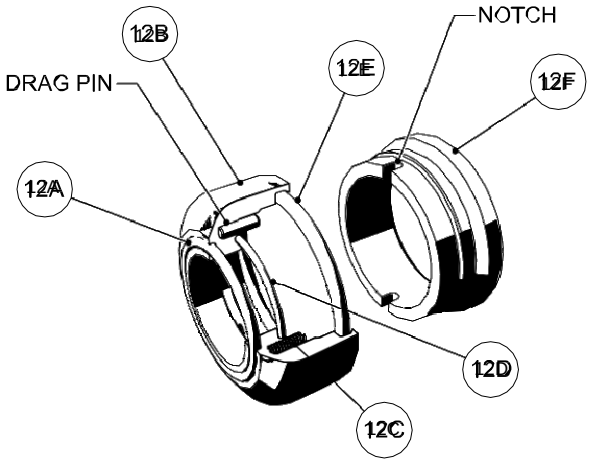
WARNING: Operating the pump without all four dowel pins in place will cause severe damage to the pump.

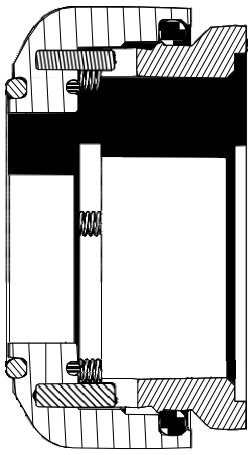
17. Secure the back cover to the gear case with the hexagonal socket head cap screws (**28**) and tighten them firmly.



18. Place the O-ring (**12D**) on the inside groove of the stainless steel rotary holder (**12B**). Insert the coil springs (**12C**) on the inside holes of the holder.

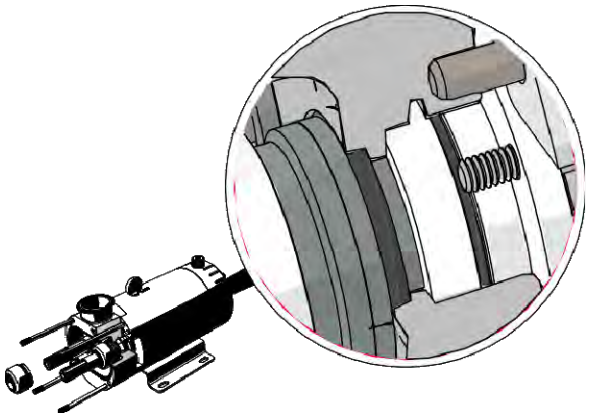
19. Lubricate the inside diameter of the O-ring (**12E**) and place it on the inside groove of the holder and make sure it is in place.





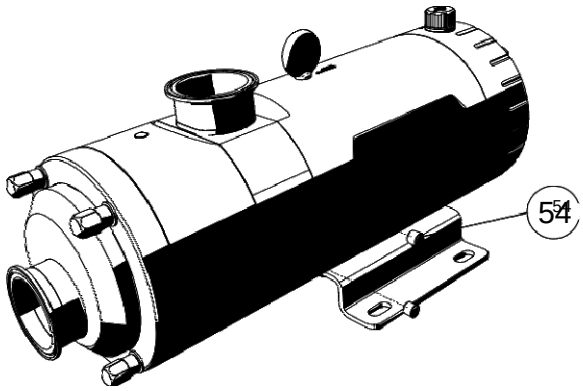
20. Take the rotating face (**12F**) and insert it into the O-ring; the holder pins must fit the notches on the rotating face. Push with your hand against the holder until the springs are compressed and the rotating component stays inside the holder. Check this subassembly by pressing the rotating face against the coil springs.

21. It is important that the notches on the rotating face fit the holder pins; the physical contact is determined by the O-ring and the springs with no contact between metal and the rotating face. This step is crucial for the proper assembly of the mechanical seal; failure to do so properly can cause damage to the mechanical seals, the rotors and can even alter the integrity of the pump. Place the O-ring (**12A**) into the holder front groove. This completes the subassembly of the rotating part of the seal.



22. With the subassembly ready, insert the rotary holder on the shaft and push gently until reaching the static face placed previously on the back cover. Repeat this procedure to install the other single mechanical seal on the next shaft.

ATTENTION: Remember that every double mechanical seal requires lubrication without exception. Insert the flush nipples (**54**), one on each side of the back cover, one works as the inlet and the other as the outlet of the fluid lubricant.



23. At this point you have completed assembly of the double mechanical seals, now continue with the assembly of the rotors.

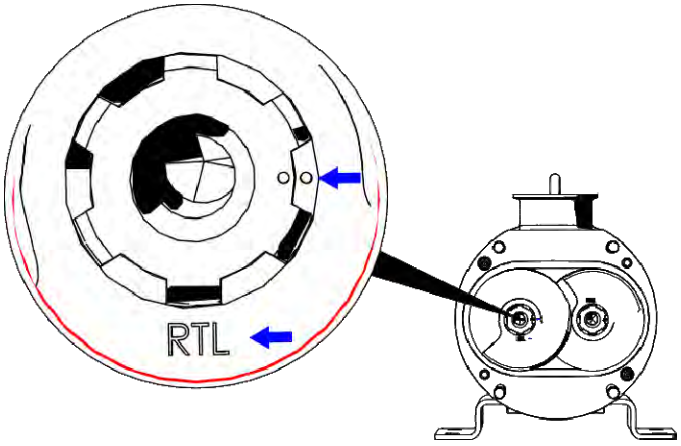
MAINTENANCE

Rotor Assembly

1. Make sure the mechanical seals are properly installed before assembling the rotors. If the studs (14) were removed replace them. Insert the gasket firmly (27) on the back cover groove.

Note: To place the studs you may use the nut-and-locknut technique (see annex B).

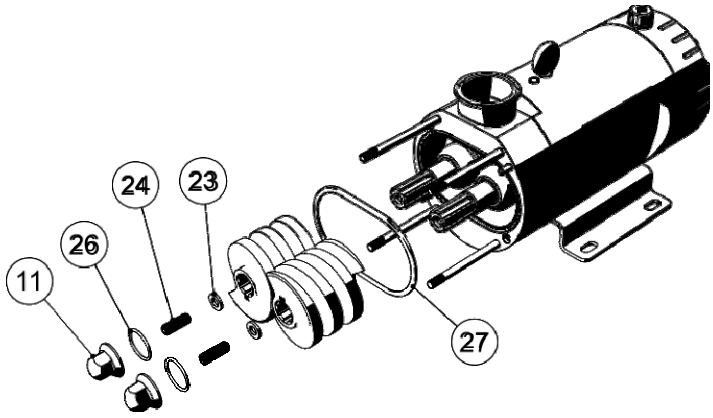
Shafts and rotors are marked on the front face with dots to indicate the position of the rotor relative to the spline on the shaft; the rotors are also marked to identify which is the right rotor (3) and the left rotor (2), it is important to match each rotor with its respective shaft for the right operation of the pump.



2. Mesh both rotors by hand so the front faces match and are leveled. Turn the drive shaft (**9**) and the rotors so the dots correspond.

4. Slide both rotors onto the shafts simultaneously. Some alignment might be needed. By effect of the mechanical seals the rotors have not yet reached their final position; it is necessary to tighten the nuts.

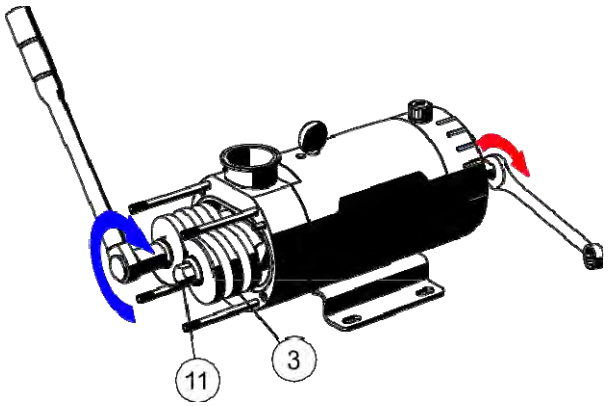
5. Place the set screws (**24**), the spring washers (**23**) and the O-rings (**26**) on the rotor nuts (**11**). Assembly the rotor nuts and tighten the rotor nuts as follows:

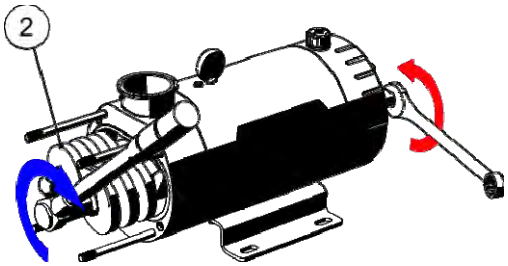


6. Block the drive shaft (**9**) with the aid of a wrench to prevent rotation of the rotors.

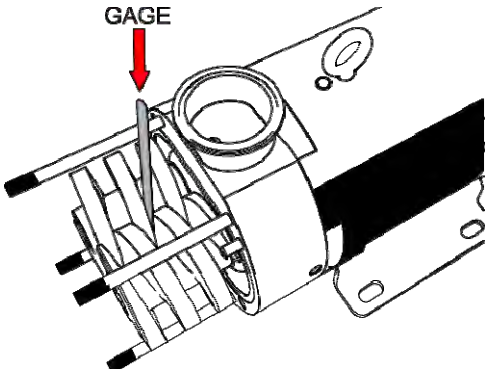
7. Tighten rotor nuts by hand (**11**) simultaneously as far as you can; then use a six point female socket to tighten the nuts. Gradually tighten both nuts simultaneously to avoid contact between them.

8. When the rotors reach their end position with the mechanical seals and shafts, tighten the nuts with the torque values according to the pump model. The front faces of the rotors should be aligned.





Using thickness gages check the clearances between the rotors turning them slowly and introducing one gage at every point where the rotors are meshed. A practical way is to put the gage between the rotors in the front side and slowly rotate them so the gage moves along the rotors by its rotation. If the clearances do not comply (according to the pump model) it is possible that the synchronization is incorrect.



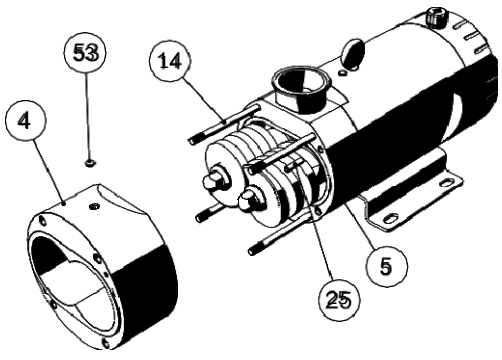
9. Once you have tightened and checked the rotor clearances continue closing the pump. Place the dowel pins (**25**) inside the holes on the back cover.

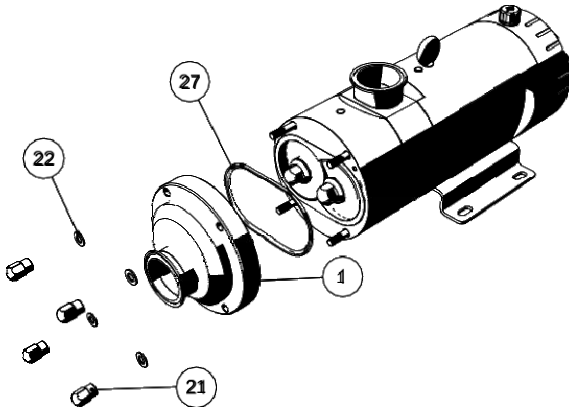
WARNING: Operating the pump without all four dowel pins in place will cause severe damage to the pump.

11. Insert the casing (**4**) carefully, it should be mounted and centered on the back cover (**5**) with the dowel pins. Push back to slide through the studs (**14**). The plug (**53**) on the casing was used during machining and has no specific use.

12. Insert gasket (**27**) into the groove on the front cover (**1**) and close the pump; use the pocket in the front cover as a guide for assembling it with the casing.

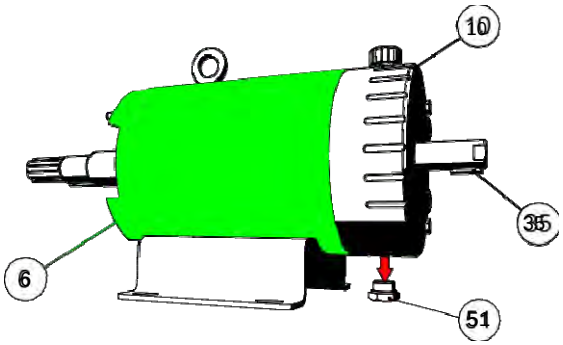
13. Secure the front cover with the washers (**22**) and nuts (**21**); tighten using a wrench or a six points female socket. Remember to use the corresponding torque values according to the pump model. This concludes the rotor assembly.





MAINTENANCE

Rotor Synchronization

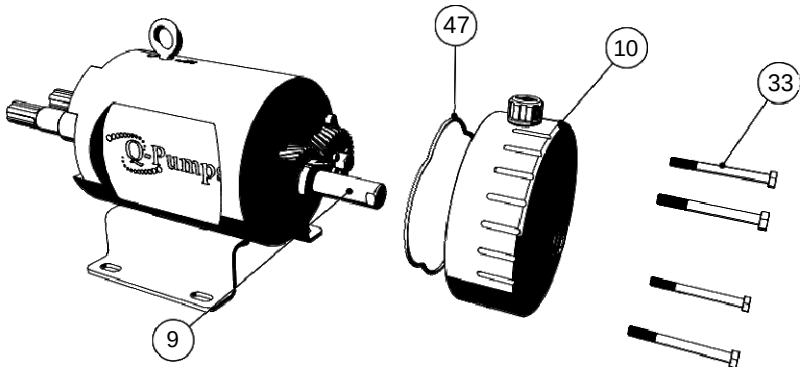


1. Once the pump is disassembled, proceed to drain the oil in the gearbox. Use the cap nut (**51**) on the bottom of the gear case cover (**10**). If the oil is in good condition, keep it in a closed reservoir in order to avoid contamination. Replace as required – see specifications.

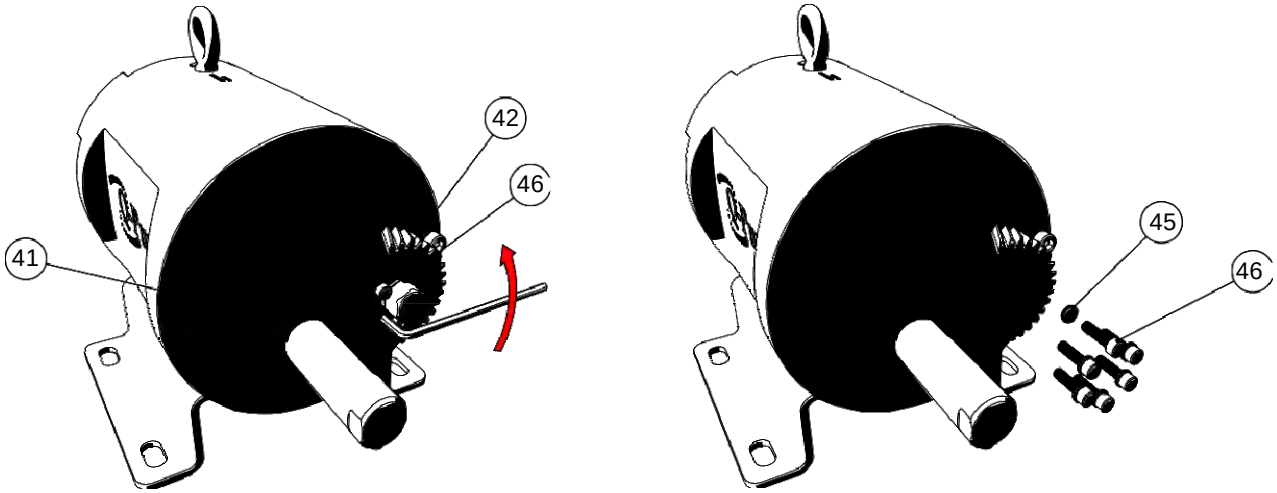
2. Remove the coupling key (**35**) from the drive shaft (**9**).

3. Loosen the hexagonal bolts (**33**) and remove the gear case cover. Inside are the gears that drive the pump. The drive gear (**41**) is driven with a key, while the driven gear (**42**) is locked by tapered rings.

NOTE: When the socket head cap screws of the keyless shaft hub are loose the gear will rotate independently of the shaft. When the keyless shaft hub is tight the gear will rotate with the shaft.

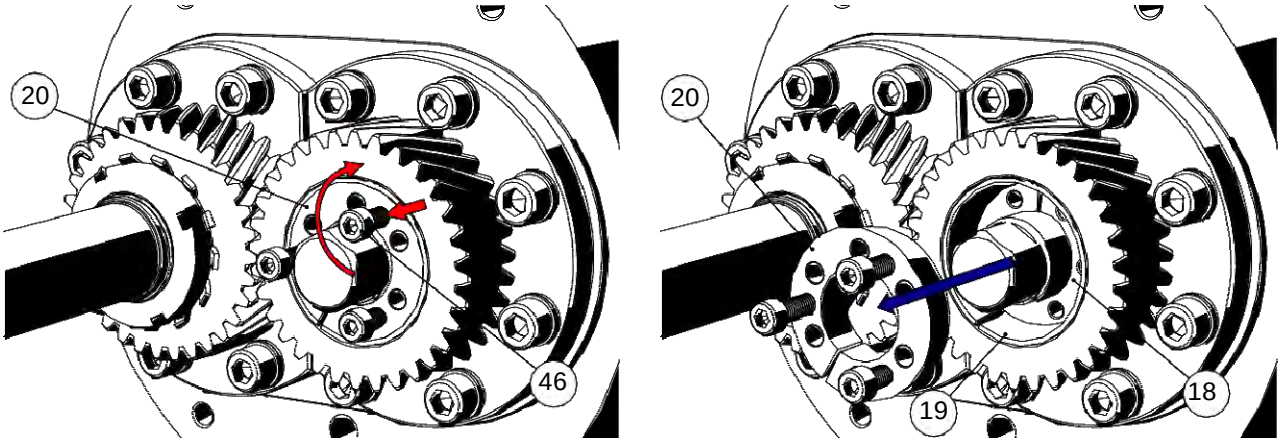


4. Undo the socket head cap screws (**46**) and remove. All screws have a lock washer (**45**).



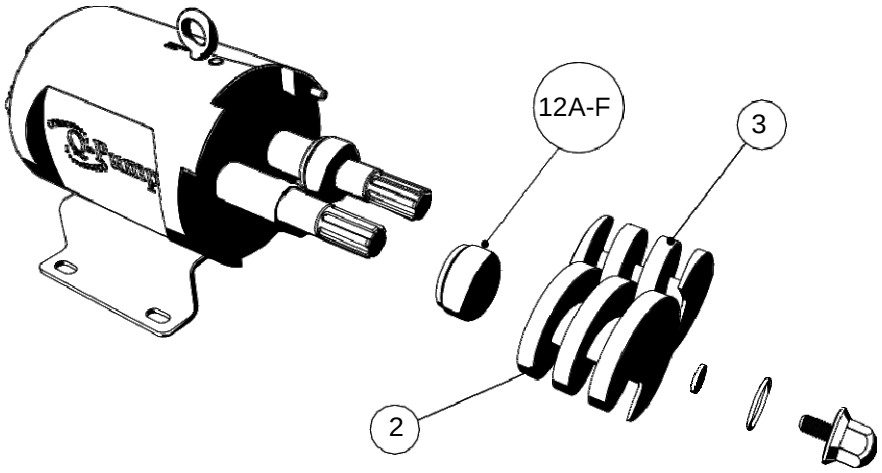
5. To loosen the tapered driven ring (**20**) it is necessary to use three of the socket head cap screws (**46**) to pull it out as illustrated. The first tapered driven ring has three threads for this purpose.

6. Remove the first half of the keyless shaft hub (20). Inside the bore of the gear will be the second half of the keyless shaft hub (18). By completely removing the hub, the driven gear (42) will rotate freely over the synchronization ring (19).



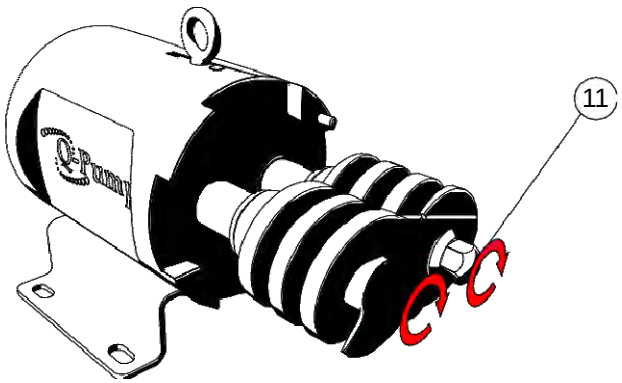
7. On the pump side place both rotary holder subassemblies (**12A-F**) on the shafts. In this step it is not necessary to assemble the complete seals; it is just a preliminary assembly to keep position. It is recommended to remove the O-rings (**12A** and **12D**) in the subassembly.

8. Take the new rotors with each hand respectively [left hand-left rotor (**2**) / right hand-right rotor (**3**)] and mesh them together. The faces of both rotors must be at the same level.



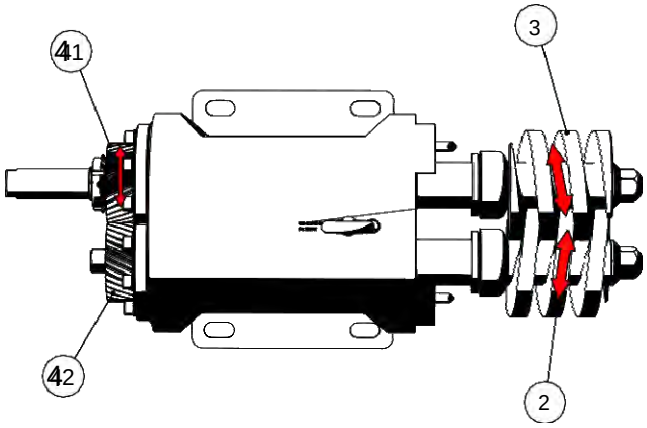
9. With the rotors meshed, place them on the shafts. Turn the shafts until the splines coincide.

10. Push the rotors on the shaft until they reach each rotary holder subassembly. Install the rotor nuts (**11**) and tighten them simultaneously. Avoid contact between rotors. Consult torque specifications for proper settings.



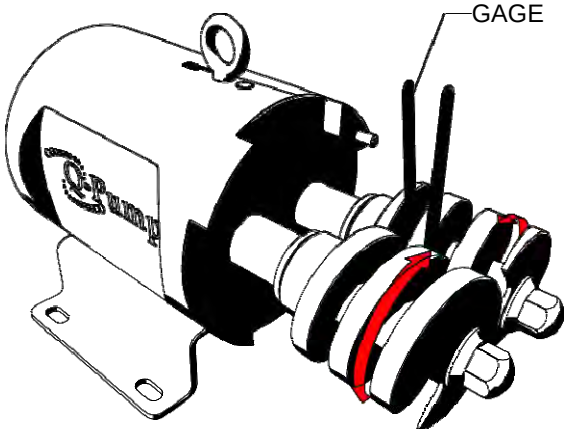
11. At this point the shafts can move independently. Insert a thickness gage at both flanks between rotors to synchronize them. Consult the thickness gage table.

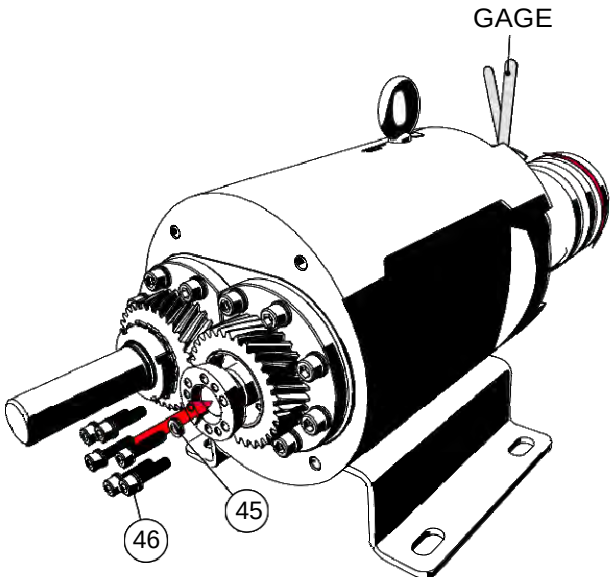
12. On the back of the pump, align the tapered rings together. Reset the tapered drive ring (18) to its original position if necessary (**20**) back on the shaft. This step is only for alignment, tightening is not required. Use a flat screwdriver if needed to open the ring.

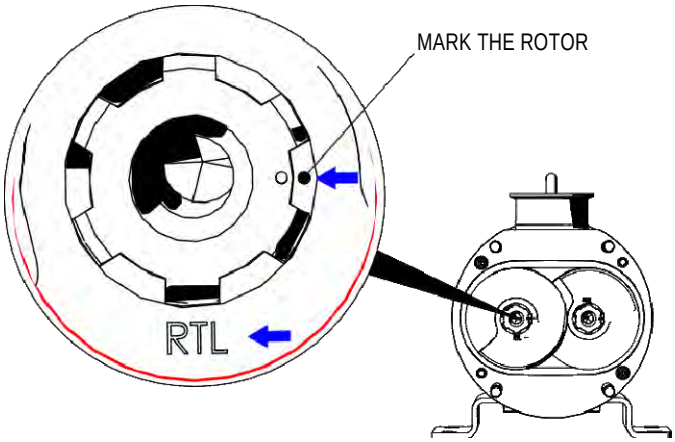


13. On the front of the pump, equally distribute the space between flanks using the thickness gages in both sides. Avoid excess gage compression while synchronizing the rotors.

14. Tighten the tapered driven ring (**20**). Tighten the socket head cap screws (**46**) uniformly, by alternating between them until the maximum torque is reached. View torque table.





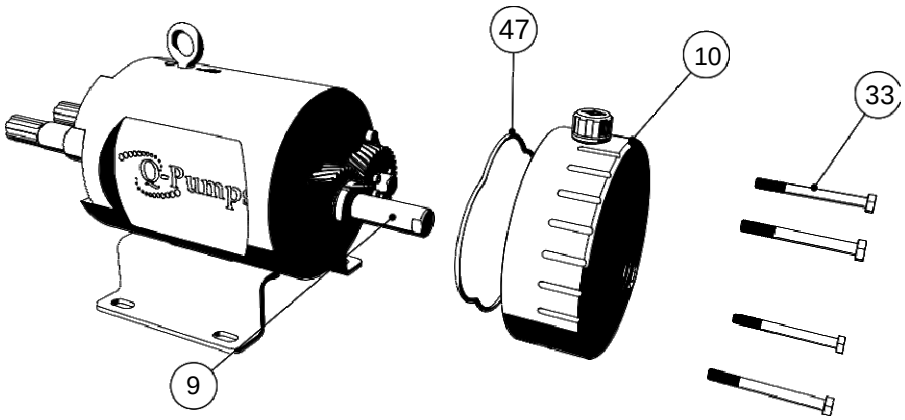


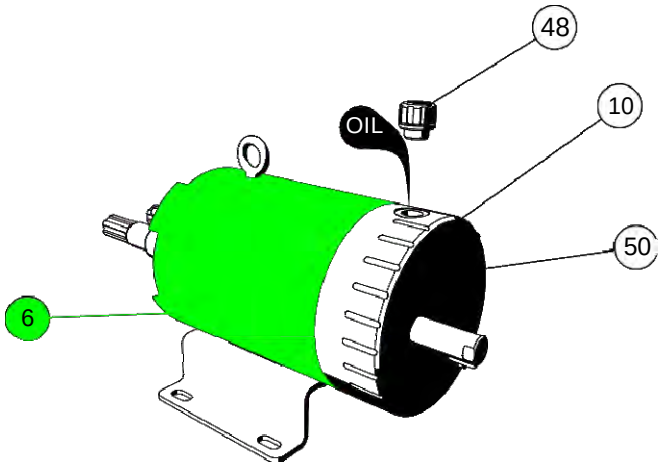
15. At this point gears are locked, rotors are synchronized and you can remove the thickness gages.

16. Undo the rotor nuts (**11**) and mark the rotors with their corresponding marks on the shaft using permanent ink or by making a notch. View original rotors spline as example.

17. Remove the rotors and rotary holder subassemblies.

18. Assemble the gear case cover (**10**) and fill it with ISO VG-68 oil.





19. Continue to assemble the pump, described in the Seal Assembly and Rotor Assembly section.

MAINTENANCE

Important Notes

1. Use a six point female socket to loosen and tighten the front cover nuts to prevent marking them.

2. The wet parts are comprised of the front cover (**1**), rotor nut (**11**), rotors (**2**, **3**), pump casing (**4**), mechanical seals (**12**) and the back cover (**5**). Check that these components are free from damage such as hit marks, abrasion from fluids, or any damage caused by foreign objects. If considerable damage exists and the pump efficiency is reduced, contact your distributor for spare parts. NOTE: Any damage to the casing or rotors can cause pump failure due to the tight clearance of the QTS.

3. If any of the gaskets or O-rings are damaged (marks, wear or deformation) replace them all together; use a replacement kit for gaskets and O-rings of the same material according to the pump application (either EPDM or Viton).

4. Use caution near gasket grooves, damage to the groove may cause the gasket to leak.

5. Always use a six point female socket to loosen and tighten the rotor nuts to avoid indentations.

6. The dowel pins surface finish is rectified. If they are damaged, replace them to prevent assembly problems.

7. If rubbing marks are visible between the rotors synchronization or rotor assembly is not correct. If rotor replacement is required it is necessary to repeat the gear synchronization procedure. Please contact Ampco for additional information.

8. Single mechanical seal housing (**12J**) has only one external groove while the double mechanical seal housing (**12U**) has two external grooves.

9. You may use water or a FDA food grade silicon based lubricant to lubricate O-rings and gaskets.

10. When an O-ring is damaged, it is highly recommended to replace the entire set of O-rings (including both shafts) at the same time to ensure the service life.

11. The seal faces are very fragile; handle them with care to avoid breaking or loosing.

12. If any seal face is scratched, hit or damaged, it is highly recommended to replace the entire seal kit to ensure the service life.

13. Ensure that the drag pins match the notches on the seal elements to assure the correct position and assembly.

14. Every double mechanical seal without exception should be properly lubricated. Even the shortest time operating without lubrication may damage the mechanical seals. The flush system must be installed before starting the pump.

15. Cavitation of the pump can cause noise and vibration which can damage the mechanical seals. If cavitation is detected, gather all system information available and verify the application. Remember that your equipment was selected for a particular application and any other use without prior consent may result in damages that can void the pump warranty.

16. When assembling the rotors they should be contact free.

17. Rotors are inside the casing and their front faces must be aligned.

18. Use the torque values (according to the pump model) on the components that are indicated.

19. If you have any questions regarding assembly or disassembly, please contact Ampco Pumps.

ANNEX A

Cleaning guidelines for CIP (Clean in Place) systems with QTS Series

At the end of each production run, it is important to recover as much of the remaining product in the pump as possible. The QTS design allows 100% draining in vertical and horizontal mounting positions.
The QTS has the ability to pump low viscosity fluids at high speed for creating turbulent flow and works well as a CIP supply pump.

Cleaning procedure for QTS pumps

The type of fluid being pumped and its characteristics affect the cleaning strategy, for example cleaning methods suitable for dairy products may not be suitable for juice products, blood or chocolate.

The cycle times, temperatures, cleaning mediums and concentrations of the detergents used will all influence the effectiveness of the cleaning cycle. Care must be taken when defining these processes to ensure that they are suitable for use with the particular product being pumped.

The best way to improve CIP efficiency is to implement structured guidelines and procedures. Cleaning according to schedules and defined guidelines increases the control over cleaning parameters to ensure fluid safety and quality. Use care when determining the right guidelines for each type of fluid.

Chemical compatibility between the cleaning detergents and the pump wet elements (construction of SS 316L) should be verified. It is critical that the correct temperature clearance rotors are fitted for the CIP cycle.

It is recommended that a differential pressure of 2 to 3 bar is created across the pump to promote efficient cleaning; use valve(s) during the CIP cycle to promote pressure and flow variations that may enhance the cleaning process.

If the QTS pump is used for CIP, there must be enough flow to ensure cleaning solution velocity. If another pump is being used for CIP, a bypass should be installed around the QTS pump to maintain line velocity throughout the system. The QTS should be run at a speed that minimizes pressure drop.

Internationally accepted protocol for CIP suggests that during all phases of the CIP cycle, a pipeline velocity between 1.5 m/sec and 3.0 m/sec is required. Velocities within this range have proven to provide effective cleaning, although as a general rule the higher the velocity the greater the cleaning

The following table shows the recommended flow in GPM (LPM) for CIP:

Pipe diameter		1.5	2.0	2.5	3.0	4.0	6.0
Speed	1.5 m/s	24 (91)	42 (159)	68 (257)	99 (375)	177 (670)	410 (1552)
	3.0 m/s	48 (121)	84 (318)	136 (295)	198 (749)	354 (1340)	820 (3104)

Below is a general but effective cleaning guideline, a typical cleaning cycle incorporates five stages:

1. An initial rinse of clean, cold water.

Rinse with clean water at ambient temperature to remove any remaining residue, 10 to 15 minutes is usually sufficient for this part of the cycle but this will depend on the condition and volume of the residue to be removed.

2. Rinsing with an alkaline detergent.

Rinse with an alkaline detergent, typically a 2.5% solution of Caustic Soda (NaOH) at 70 ºC to 95 ºC (158 ºF to 203 ºF) for a period of 10 to 30 minutes could be used. It is also common to add a wetting agent (surfactant) to lower the surface tension of the detergent and hence aid its cleansing ability. This phase of the cleaning cycle should dissolve and remove organic matter such as fats and proteins.

Another mild detergent solution may be used consisting of 2.0% (w/w) EO/PO Blockcopolumer 10% EO, Genapol PF10, or similar product, 44.0% (w/w) sodium carbonate 96/98%, 20.0% (w/w) sodium metasilicate (anhydrous), 20.0% (w/w) sodium tripolyphosphate (anhydrous) and 14.0% (w/w) sodium sulphate (anhydrous).

The detergent solution may vary depending on the properties of the fluid being pumped.

3. Intermediate rinse with cold water.

Intermediate rinse with clean water at ambient temperature for a period of 5 to 10 minutes. This phase should remove any residual detergents.

4. Rinsing with an acidic disinfectant.

Rinse with an acidic disinfectant, typically a 2.5% solution of Nitric Acid (HNO3) at ambient temperature for a period of 10 to 15 minutes would be used. This phase of the cleaning cycle should remove proteins, mineral salts, calcium oxides and other deposits.

5. Final rinse with clean cold water.

Final rinse with clean water at ambient temperature for a period of 10 to 15 minutes or until all traces of the cleaning fluid has been removed.

During the CIP cycle it is important that the required concentration of cleaning detergents is constantly maintained. A significant increase in concentration could cause damage to the pumps and other components in the system. A significant decrease in concentration could affect the detergents cleaning efficiency. A facility for monitoring and adjusting the detergent concentration should be considered.

Consideration should also be given to the disposal or recycling of used cleaning liquids and the potential requirement for handling concentrated detergents. Specialists should make the final selection of cleaning detergents/disinfectants.

ANNEX A

After CIP cleaning, an additional sterilization in place process (SIP) may be required when highly sensitive products are handled, inactivating any micro-organisms which might be still present in the pump. The sterilization can be carried out by means of chemicals, hot water or steam. In the dairy industry the sterilization temperature is approximately 145 ºC (293 ºF). Contact Ampco Pumps in cases where temperatures will exceed 100 ºC (212 ºF).

Because the QTS pump is capable of high speeds it is important to specify the required RPM values for CIP supply if available.

Normally when ordered, the QTS Pump is selected for both, the application and CIP supply.

RPM speed table for each pump model. Flow required to achieve the CIP process in different pipe dimensions:

Pipe Diameter	1.5	2.0	2.5	3.0	4.0	6.0
QTS102 - 1.5 m/s	1146	2100	3372			
QTS102 - 3.0 m/s	2291					
QTS103 - 1.5 m/s	1707	3133				
QTS103 - 3.0 m/s	3414					
QTS202 - 1.5 m/s		799	1281	1418		
QTS202 - 3.0 m/s		1598	2562			
QTS203 - 1.5 m/s		1188	1906	2149		
QTS203 - 3.0 m/s		2375				
QTS302 - 1.5 m/s			532	780	1418	
QTS302 - 3.0 m/s			1064	1562		
QTS303 - 1.5 m/s			807	1183	2149	
QTS303 - 3.0 m/s			1612	2370		

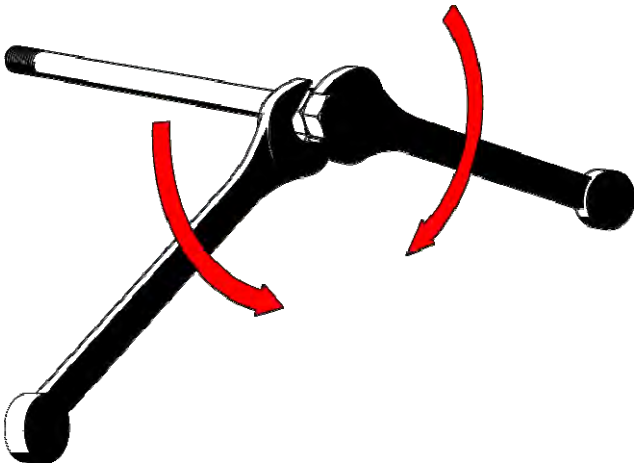
For more information please contact Q-Pumps.

ANNEX A

ANNEX B

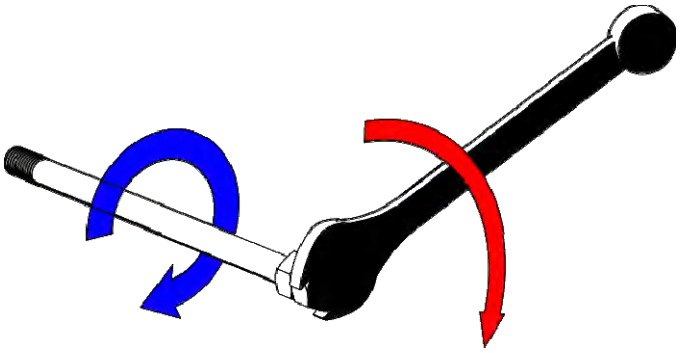
Nut-and-Locknut Technique

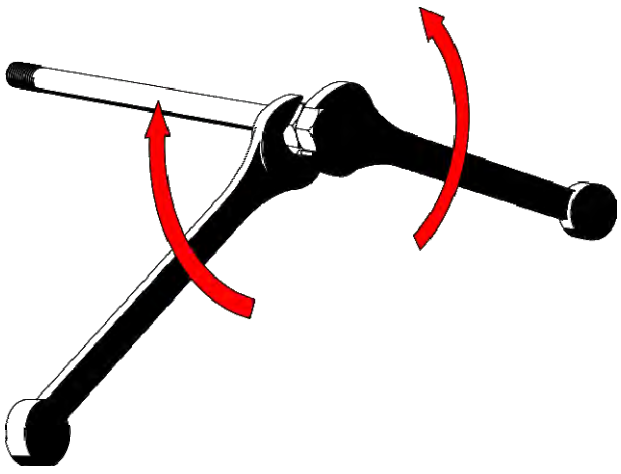
The nut-and-locknut technique serves to prevent a nut from loosening by superimposing another nut.



Thus it is possible to use as a fastening device. This technique is useful to remove and tighten the studs from the gearbox.

Two wrenches are used to tighten one nut against the other so they cannot loosen.





To loosen both nuts two wrenches are used turning in the opposite direction.

RETURN POLICY

This policy is intended for returns that are not covered by product warranty, i.e. wrong pump or part was ordered, customer canceled order, etc. Before returning any product, contact us for a Returned Material Authorization Number (RMA#). This will eliminate confusion when the parts are received and facilitate processing the return. No action will be taken on returned parts without an RMA.

Type of Return	Restocking Charge
Standard pump with a replacement order	10%
Standard pump without a replacement order	15%
Standard parts with a replacement order	5%
Standard parts without a replacement order	10%

Additional restocking charges may be assessed for any of the following

1. Special order motors and seals are not returnable unless we have a use for them. Credit will be determined on a case-by-case basis.

2. Impellers that are trimmed to a diameter that we don't regularly use are not returnable. Credit will be determined on a case-by-case basis.

3. Used seals and motors are not returnable.

Credits

Credit will be issued only after parts are returned and inspected. Customer is responsible for packaging parts so they are returned in "as new" condition. Any labor required by Ampco to return the parts to "as new" condition will be deducted from the credit.

TERMS AND CONDITIONS

1. ENTIRE AGREEMENT. This document contains all of the terms and conditions of the agreement ("the agreement") between Ampco Pumps Company, Inc. ("Seller") and the purchaser ("Purchaser") of the Products ("Products") to be sold to Purchaser, to the exclusion of any other statements and agreements, and to the exclusion of any terms and conditions incorporated- ted in Purchaser's order or other documents of Purchaser. Seller's acceptance of Purchaser's order is expressly conditioned on Purchaser's acceptance of the terms and conditions contained herein, and Purchaser, upon placing an order, is presumed to have accepted all the terms and conditions without modification. No alteration, waiver, modification of or addition to the terms and conditions herein shall be binding on Seller unless set forth in writing and specifically agreed to by an officer of Seller No course of dealing, usage of trade or course of performance will be relevant to supplement or explain any terms used in the agreement. All offers to purchase, quotations and contracts of sale are subject to final acceptance by Seller at its home office at Milwaukee, Wisconsin.

2. PRICES. Prices for Products manufactured by Seller pursuant to written accepted orders will remain firm for thirty (30) days from the date of any subsequent price change.

3. TERMS OF PAYMENT. Standard terms are ½% 10 days, 30 days net, from date of invoice unless otherwise stated. If, in the judgment of Seller, the financial condition of Purchaser at any time does not justify continuance of production or shipment on the terms of payment specified, Seller may require full or partial payment in advance. In cases of delays in payment, Seller reserves the right to charge interest on delinquent balances at the rate of 1 ½% per month.

4. DELIVERY. Except as otherwise provided expressly stated in the agreement, Products are sold F.O.B. Milwaukee. Seller will use reasonable commercial efforts to fill orders within the time stated, but the stated delivery date is approximate only, and Seller reserves the right to readjust shipment schedules without liability. Acceptance by Purchaser of the Products waives any claim for loss or damage resulting from a delay, regardless of the cause of the delay. Except as otherwise provided herein, Seller will not be responsible for freight, transportation, insurance, shipping, storage, handling, demurrage or similar charges. Claims by Purchaser for shortages in the Products must be made to Seller in writing within t e n (10) days after date of receipt of the Products. No such shortage shall entitle Purchaser to withhold payment for Products which were received by Purchaser. Each such claim shall set forth in detail the basis and amount of such claim.

5. TAXES AND FEES. Seller shall pay all present and future sales, excise, privilege, use or other taxes, customs duties, and all other fees or other costs, imposed by any federal, state, foreign, or local authorities arising from the sale, purchase, transportation, delivery, storage, use or consumption of the Products or will, if applicable, provide Seller with an appropriate exemption certificate. Seller shall be under no obligation to contest the validity of any such taxes or to prosecute any claims for refunds or returns.

6. INSTALLATION. The Products shall be installed by and at the expense of Purchaser.

7. LOSS, DAMAGE OR DELAY. Seller will not be liable for loss, damage or delay resulting from causes beyond its reasonable control, including, without limitation, strikes or labor difficulties, lockouts, acts or omissions of any governmental authority or Seller, insurrection or riot, war, fires, floods, Acts of God, breakdown of essential machinery, accidents, embargoes, cargo or material shortages, delays in transportation, lack of production capacity or inability to obtain labor, materials or parts from usual sources. In the event of any such delay, performance will be postponed by such length of time as may be reasonably necessary to compensate for the delay. In the event performance by Seller under the agreement cannot be accomplished by Seller due to any of the foregoing causes within a reasonable period of time, Seller may, at its option, terminate the agreement

8. RETURNS. No Products or parts may be returned by Purchaser without the prior written consent of Seller.

9. WARRANTY. Seller warrants that the Products manufactured by Seller will be free from defects, material and workmanship under normal use and service for a period of one (1) year from date of shipment. In addition, the specified rating of each pump is warranted; however, the characteristic shape of the performance curves may vary from the published standards, and the capacity, head and efficiency guarantees are based on actual shop tests using clear cold water, and therefore the rating is specified in equivalent units of clear cold water. The sole obligation of Seller and the exclusive remedy of Purchaser for breach of this warranty shall be the repair (at Seller's facility) or replacement by Seller (F.O.B. Milwaukee, Wisconsin), at Seller's option, of any parts found to be defective, without charge and shall be conditioned upon Seller receiving written notice of any alleged breach of this warranty within a reasonable time after discovery of the defects, but in no event later than the end of the warranty period. The parts alleged to be defective shall be returned to Seller upon its request, freight prepaid. This warranty does not cover ordinary wear and tear, abuse, misuse, overloading, alteration or Products or parts which have not been installed, operated or maintained in accordance with Seller's written instructions. Seller shall not be liable for any expenses for repairs, additions or modifications to the Products outside of Seller's factory without its prior written consent, and any such repairs without such consent shall void this warranty. THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Seller may from time to time provide its facilities, personnel and experience to assist customers in the selection of materials, design, installation and operation of Products for maximum resistance to corrosion and abrasion with due consideration to the economy of the installation. This service is provided in an advisory capacity only and the final selection and operation of the Products and ancillary equipment shall be the sole responsibility of Purchaser or any user thereof. Accessories and parts manufactured by third parties are warranted only to the extent of such third party's warranty. IN NO EVENT SHALL SELLER BE LIABLE UNDER ANY CIRCUMSTANCES FOR ANY INCIDENTAL, CONSE- QUENTIAL OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY LOST PROFITS OR LABOR COSTS) ARISING FROM THE BREACH OF THIS WARRANTY OR OTHERWISE ARISING FROM OR RELATING TO THE PRODUCTS OR

10. CHANGES. Changes in any work to be performed hereunder may be made only upon Purchaser's written instructions and acceptance by Seller in its discretion. Any change in drawings, materials or design of the Products, or to tools, fixtures or other items used to produce the Products, which affects Seller's cost to produce the Products will entitle Seller to adjust the price to take into account any additional costs. If work has been started, Seller shall be properly reimbursed for work already performed; if Products already produced are not accepted by Purchaser, Seller has the right to adjust the price to take into account any additional costs caused by an increase or decrease in quantities or in the time required for performance under the agreement.

11. TERMINATION. After Seller has commenced work, ordered any materials or made any other commitments pursuant to the agreement, it may be terminated only with the prior written agreement of Seller providing for equitable cancellation charges. Such charges shall reimburse Seller for any completed items at the contract price, and for any work-in-process items at the contract price less the cost to complete. Termination on any other basis must be specifically agreed on in writing in advance between Purchaser and Seller.

12. DEFERRED DELIVERIES. Orders or deliveries will be deferred only upon the prior written agreement of Seller in its discretion, and then only upon the following conditions:

(a) The deferral period may not exceed sixty (60) days. At the end of the deferral period, if no release is provided by Purchaser, Seller reserves the right to render an invoice for and ship the completed portion of the order to the destination specified in Purchaser's order, or to store such material at Purchaser's expense at Seller's standard storage charges then in effect.

(b) For the portion of the order that is not completed, if no release is provided by Purchaser at the expiration of the deferral period, Seller reserves the right to render an invoice for any completed items at the contract price, and for any work-in-process items at the contract price less the cost to complete.

(c) Purchaser shall bear the risk of loss or damage to materials held at Purchaser's request.

13. LIMITATION OF LIABILITY. IN NO EVENT SHALL SELLER BE LIABLE UNDER ANY CIRCUMSTANCES: (a) FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, ANY LOST PROFITS OR LABOR COSTS) ARISING FROM OR RELATING TO THE PRODUCTS OR THEIR SALE, USE OR INSTALLATION; (b) FOR DAMAGES TO PROPERTY (OTHER THAN THE PRODUCTS PURCHASED FROM SELLER); (c) FROM ANY BREACH OF ITS WARRANTY OR ANY OTHER OBLIGATIONS TO BUYER; OR (d) FOR ANY OTHER CAUSE WHATSOEVER, WHETHER BASED ON WARRANTY (EXPRESSED OR IMPLIED) OR OTHERWISE BASED ON CONTRACT, OR ON TORT OR OTHER THEORY OF LIABILITY, AND REGARDLESS OF ANY ADVICE OR REPRESENTATIONS (WHETHER OR NOT IN WRITING) THAT MAY HAVE BEEN RENDERED BY SELLER CONCERNING THE DESIGN, MANUFACTURE, SALE, USE OR INSTALLATION OF THE PRODUCTS.

14. INFRINGEMENT. Seller at its expense will defend and hold Purchaser harmless from and against all damages, costs and expenses arising from any valid claim of infringement by a third party with respect to any patent or other intellectual property rights (collectively, the "Intellectual Property Rights") caused by Products originally manufactured by Seller, provided Purchaser (a) has not modified such Products, (b) gives Seller immediate notice in writing of any claim or commencement or threat of suit, and (c) permits Seller to defend or settle the same, and gives all immediate information, assistance and authority to enable Seller to do so. In the event any such originally manufactured Products are held to infringe an Intellectual Property Right and if Purchaser's use thereof is enjoined, Seller will, at its expense and option: (1) obtain for Purchaser the right to continue using the Products, (2) supply non-infringing Products, (3) modify the Products so that they become non-infringing, or (4) refund the then market value of such Products. In no event shall Seller's liability exceed the sale price of the infringing Products. THE FOREGOING REPRESENTS SELLER'S ENTIRE AND EXCLUSIVE OBLIGATION WITH RESPECT TO ANY CHARGE OF INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT AND IS IN LIEU OF ANY STATUTORY WARRANTY RELATING TO INFRINGEMENT. Notwithstanding the foregoing, Seller shall have no liability as to any Products or parts thereof that are manufactured or modified by Purchaser or a third party, or that are manufactured or modified by Seller in accordance with Purchaser's specifications. Purchaser will defend and hold Seller harmless from and against all damages, costs, and expenses whatsoever arising from any claim for infringement of any Intellectual Property Rights relating to Products that have been manufactured or modified by Seller according to specifications provided by Purchaser.

15. CERTAIN LAWS. Seller will comply with the applicable requirements of the Fair Labor Standards Act of 1938, as amended, Executive Order 11246, and THE rules, regulations and orders of the Secretary of Labor relating thereto.

16. PERIOD FOR ACCEPTING QUOTATIONS. Unless accepted without modification within thirty (30) days of issuance, or prior to withdrawal by Seller if earlier, all quotations automatically expire at the end of such thirty (30) day period.

17. PROVISIONS FOR INTERNATIONAL TRANSACTIONS. The following provisions shall apply if the Products are to be shipped to Purchaser at a location outside the United States, and apply regardless of other provisions set forth in these Terms and Conditions:

(a) The 1980 United Nations Convention on Contracts for the International Sale of Products shall not apply.

(b) Except as otherwise provided expressly stated in the agreement, terms of delivery are Ex-Works (within the meaning of INCOTERMS 2000) and all customs fees, import duties, cargo insurance, taxes and other charges imposed on or relating to the purchase or sale of the Products shall be paid by Purchaser in addition to the stated price.

(c) Except as otherwise provided expressly stated elsewhere in the agreement, payment shall be made by issuance to Seller of an irrevocable letter of credit which (i) is issued and confirmed by a U.S. bank acceptable to Seller, (ii) is governed by the Uniform Customs and Practice for Documentary Credits (UCP 600) and otherwise acceptable in form and substance to Seller, and (iii) provides for payment to Seller of the purchase price in U.S. dollars upon presentation by Seller of Seller's certification and/or such other documents as shall be required by the letter of credit. All banking and other charges for such letter of credit shall be for the account of Purchaser.

(d) Prices include Seller's standard commercial export packaging which may vary depending on whether shipment is made by air, land or sea. Except as otherwise provided expressly stated in the agreement, Purchaser will bear any additional expenses required to satisfy Purchaser's packaging requirements. Packages will be marked in accordance with Purchaser's instructions, if any. Seller shall furnish packing lists and such other information as may be necessary to enable Purchaser's agent to prepare documents required for export

(e) All shipments hereunder are subject to compliance with the U.S. Export Administration Act, as amended, regulations thereunder and all other U.S. laws and regulations concerning exports. Purchaser shall comply with all such laws and regulations concerning the use, disposition, re-export and sale of the Products provided hereunder.

18. GENERAL. No modification or waiver of the agreement or any of its provisions is valid unless expressly agreed to by Seller in writing, and no waiver by Seller of any default under the agreement is a waiver of any other or subsequent default. The unenforceability or invalidity of one or more of the provisions of the agreement will not affect the enforceability or validity of any other provision of the agreement. Purchaser may not assign any of its rights, duties or obligations under the agreement without Seller's prior written consent and any attempted assignment without such consent, even if by operation of law, will be void. The agreement is governed by and shall be construed in accordance with the laws of the State of Wisconsin, including the Uniform Commercial Code as enacted by such state, without giving effect to its conflict of laws principles.

Ampco Pumps Company

Operation and Maintenance Manual
Positive Displacement Pump
QTS Series Twin Screw Pump

CSI
417.831.1411
csidesigns.com