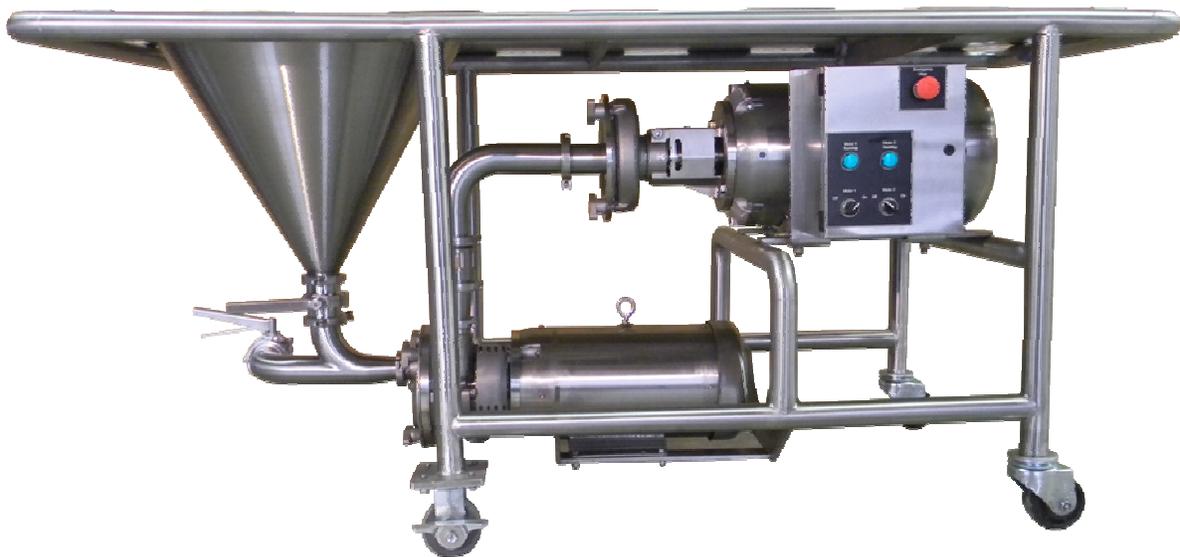




PM Powder Mixer Series

Operation and Maintenance Manual



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Introduction

To ensure the best results and service, please read and fully understand this manual prior to putting the unit into service. For any questions regarding operation or maintenance please contact your local distributor or Ampco Pumps Company:

*Ampco Pumps Company
2045 W. Mill Road
Glendale, WI 53209
Phone: (800) 737-8671 or (414) 643-1852
Fax: (414) 643-4452
Email: ampcocs@ampcopumps.com*

General Information

Ampco's ROLEC DH utilizes a SBI shear pump to recirculate a fermenter and simultaneously induce hop pellets into the stream of beer. The hop pellets remain dry until they meet the stream of beer. A pressurized chamber that is purged of air and constantly filled with CO₂ is used to induce the pellets for fermenting, finished, or crashed beer.

Shipping Damage or Loss

Upon receiving equipment that is damaged or if your shipment is lost in transit, immediately file a claim with the carrier. At time of pick-up, the carrier signed the bill of lading, acknowledging that they have received the product from Ampco in good condition.

Pump Receiving

When applicable, Ampco covers the pump inlet and discharge ports prior to shipping, ensuring that foreign matter does not enter the pump during shipment. If the protective covers are missing upon arrival, remove the pump cover and inspect to ensure it is free from contaminate before turning the shafts. Please make note of the serial number; this will assist in the process of ordering replacement parts and/or a warranty claim. For more information regarding shipment damage or warranty, please refer to Terms and Conditions (page 13).

Safety

IMPORTANT: ALWAYS WEAR SAEFTY GLASSES WHEN OPERATING THIS UNIT. Read and understand this manual BEFORE operation or maintenance of the unit. Improper operation or maintenance may result in severe injury or death. Equipment damage caused by user neglect will invalidate the warranty.

There are safety symbols used throughout this manual identifying safety concerns.



WARNING: Hazards or unsafe practices that COULD result in severe personal injury or death, and how to avoid them.

CAUTION: Hazards or unsafe practices that COULD result in minor personal injury or damage to product or property.

Unit Overview

Ampco's PM Powder Mixer is a proven design that includes a liquid ring pump and a shear blender for fast blending. The easy use design provides high-performance blending of wet and dry ingredients into one fluid stream.

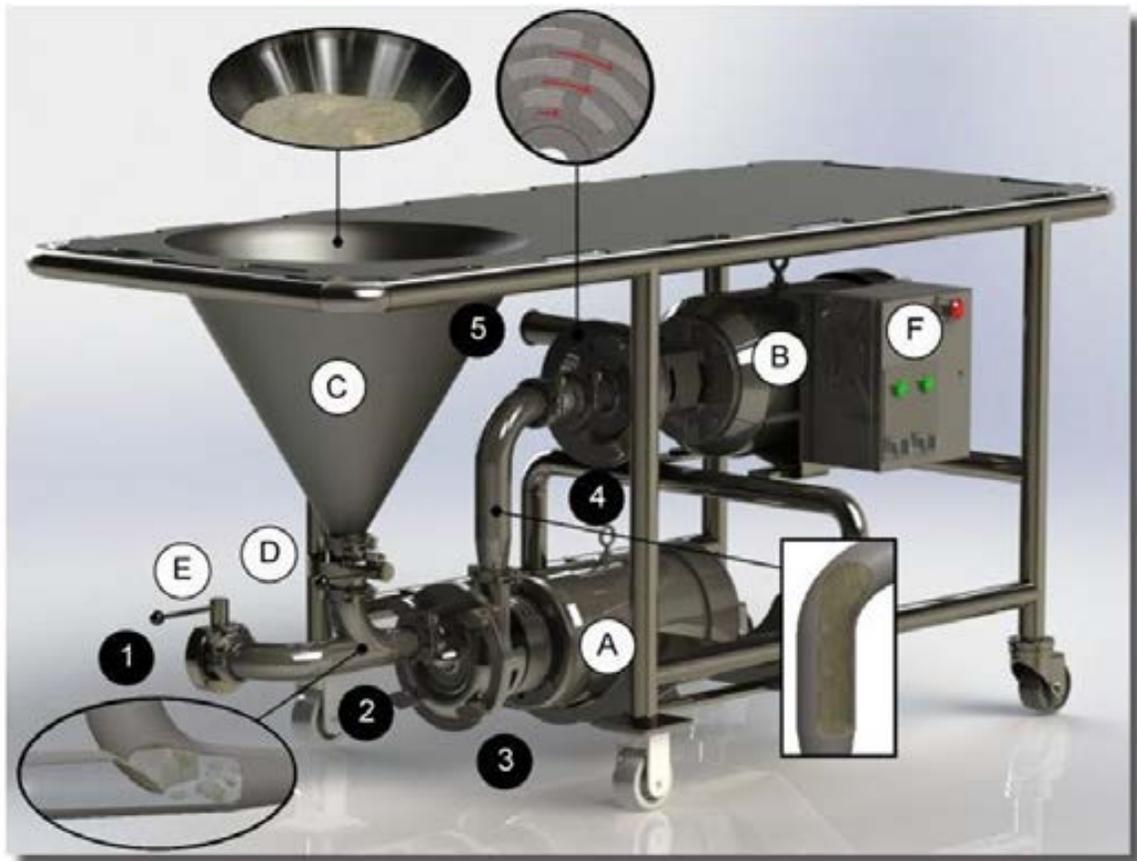
Because the SP Liquid Ring Pump provides consistent suction from the hopper, there is no plugging of product in the inlet flow area. The powder addition rate is steady, even when viscosity increases.

The rotor-stator design of the SBH Shear Pump provides smooth blending of product, eliminating lumps and clumps and offers repeatable batch-to-batch blending.



How It Works

1. The fluid from the batch tank is drawn in from the SP liquid ring pump.
2. Powder and fluid meet in the induction tube when the hopper's valve is opened.
3. Mixing begins in the SP pump – the mixture flows through a short transfer tube into the Shear Pump.
4. The Shear Pump (SBH) runs at high speed to thoroughly mixing the fluid and powder.
5. The final mixture is pumped to a batch or process tank.



- A - Ampco SP Liquid Ring Pump
- B - Ampco SBH Shear Pump
- C - Powder Hopper
- D - Powder Control Valve
- E - Fluid Control Valve
- F - Dual-Motor Starter

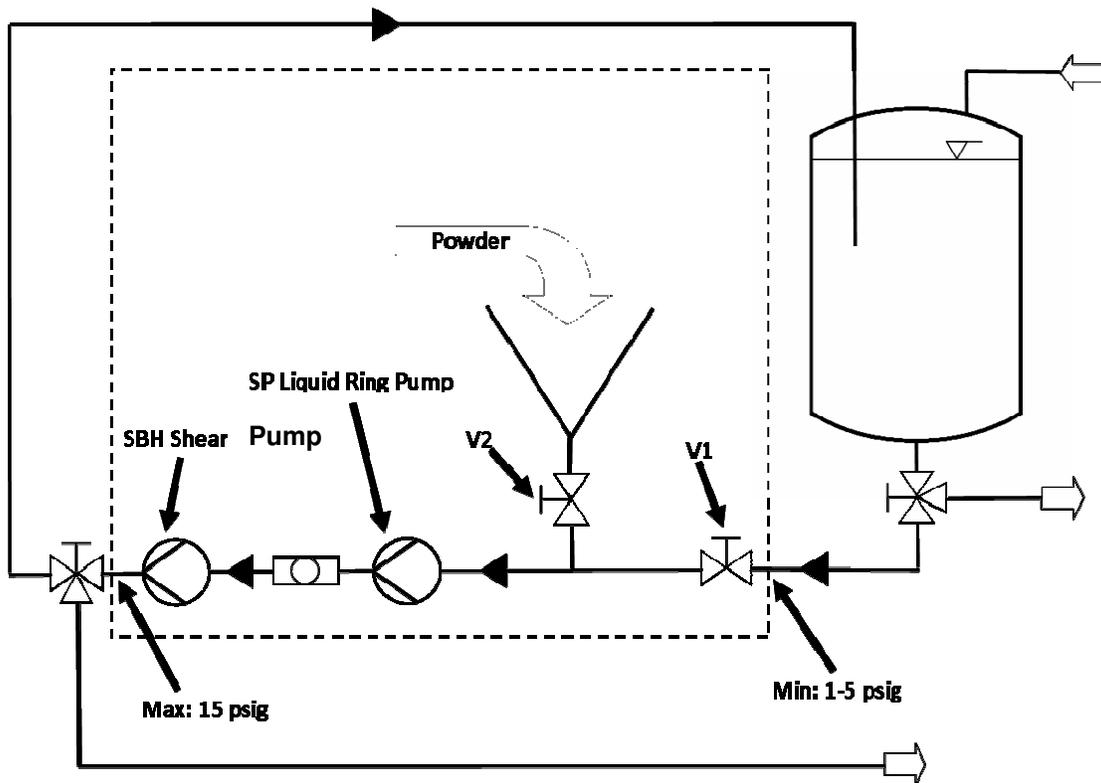
Unit Configuration

To prevent suction head loss, be sure the PM Powder Mixer is no more than ten (10) feet from the mixing tank. Study the drawing below. Check the system pressures listed. These pressures must be established so the PM Powder Mixer operates at its optimum efficiency.

* In front of the liquid control valve (V1), pressure should be 1 to 5 psig.

*Placement of the PM Powder Mixer more than ten (10) feet from the batch tank may require using a feed pump to the mixer. If a feed pump is required, it is recommended that you use a balance tank to dissipate the pressure at the inlet of the mixer.

*Discharge pressure should be no more than 15 psig for the SBH Shear Pump. If the discharge pressure is higher than the 15 psig, it is recommended you add a booster pump to move the product from the mixer.



Due to the high vacuum created at the suction of the PM Powder Mixer, it is recommended suction rated hoses are used on the inlet side of the mixer. Ampco also recommends using hoses of like size to the inlet and outlet ports of mixer.

Electrical

Control panels on the PM Powder Mixer are standard NEMA 3R & 12 and require 40 or 60 amps at 460 volts. Control panels can be customized to suit customer requirements. See chart below for voltage, volt, and amperage for each model.

	SP Liquid Ring Pump		SBH Shear Pump		Electrical Specifications	
Model	Model	HP	Model	HP	Volts	Amps
PM 210/522	210	7.5	522	10	460	23
PM 215/532	215	10	532	20	460	36
PM 220/532	220	10	532	20	460	36
PM 225/542	225	20	542	50	460	74
PM 225/552	225	20	552	60	460	92

For electrical hook up to the control box, run the electrical cord through the access hole in the bottom of the box. Connect the cord to the terminals near the main switch in the control panel.



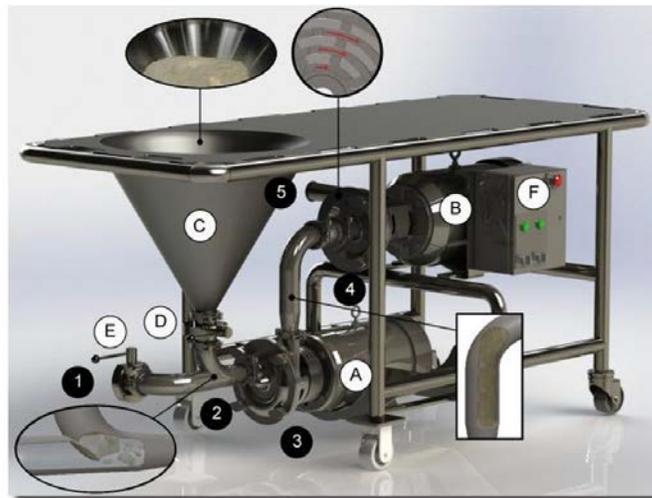
A check should be made that the pumps have the correct impeller rotation. To do so, first shut the throttling valve (V1). Fill the unit with water until the water is visible in the sight glass. Mechanical seals should be completely wetted. Running the pumps dry can result in seal damage.

Switch on both the SP Liquid Ring pump and the SBH Shear Pump for a brief time to check the rotation. The direction of the rotation should be clockwise when viewing from the fan end of the motor. If the rotation is incorrect, switch the wires fed into the control panel.

Operating

1. Shut the valve for the powder inlet (2).
2. Allow liquid to flow from the tank to the mixer by fully opening the liquid control valve (1).
3. Turn on the SP Liquid Ring (3) pump and circulate the base liquid until there is full flow.
4. Turn on the SBH Shear Pump (4).
5. To allow sufficient vacuum to build, the liquid control valve (1) should be closed to approximately 50%. To decrease the vacuum and slow down the flow of the powder into the mix, slowly open the liquid control valve.
6. Open the valve for the powder inlet (2). Check the suction by placing the back of your hand over the opening at the bottom of the hopper. If there is not sufficient suction or liquid is coming up through the hopper, slowly close the liquid control valve (1) until you achieve sufficient suction.
7. Close the valve for the powder inlet (2).
8. Fill the hopper with powder.
9. Slowly open the valve for the powder inlet (2).
10. To prevent air from being drawn into the product, close the valve for the powder inlet as soon as the hopper is empty.
11. If the product is shear-sensitive, the SBH Shear Pump should be shut off immediately.
12. Product may be circulated back through the mix for more blending.

Note: Products like gums or pectins that swell require that you add the powder slowly so the pumps do not plug. To slow the addition of these powders, open the liquid control valve (1) to reduce vacuum. The valve for the powder inlet valve (2) should be only partially opened .



Maintenance

The PM Powder Mixer should be cleaned after each use. If not properly cleaned, product residue may dry on the mechanical seal faces of the pumps and cause damage when the mixer is next started.

The mixer may be included in an existing CIP system. The hopper, induction tube, and control valves should be cleaned by hand after being removed from the unit. Simply disconnect the clamps and remove the pieces.

Spare Parts

Part Number	Description
B5101E250CC- C	Butterfly Valve 2.5 in. 316L (Valve Seat: Contact Factory)
S1100-2.50-BB	Sight Glass 316L (Borosilicate with Buna Gaskets)
13MHHM200	2.0 in. Single Pin Heavy Duty Clamp
13MHHM250	2.5 in. Single Pin Heavy Duty Clamp
40MPF-U200	2.0 in. Clamp Gasket – Buna
40MPF-U250	2.5 in. Clamp Gasket – Buna



SB / SBH / SBISeries

Instruction and Maintenance Manual

Technical Data

SPECIFICATIONS

MAXIMUM INLET PRESSURE.....	150 PSIG /10.3 BAR
TEMPERATURE RANGE.....	-40° F → 400° F
	-40° C → 204° C

MATERIALS OF CONSTRUCTION

Casing.....	AISI 316L STAINLESS STEEL
Cover	AISI 316L STAINLESS STEEL
Impeller	AISI 316L STAINLESS STEEL
Seal Driver.....	AISI 316L STAINLESS STEEL
Adapter.....	AISI 304 STAINLESS STEEL
O-RINGS & GASKETS.....	VITON (standard)
Optional Materials.....	EPDM, BUNA (others per request)
PRODUCT CONTACT SURFACE FINISH.....	.32Ra (standard)

SEAL

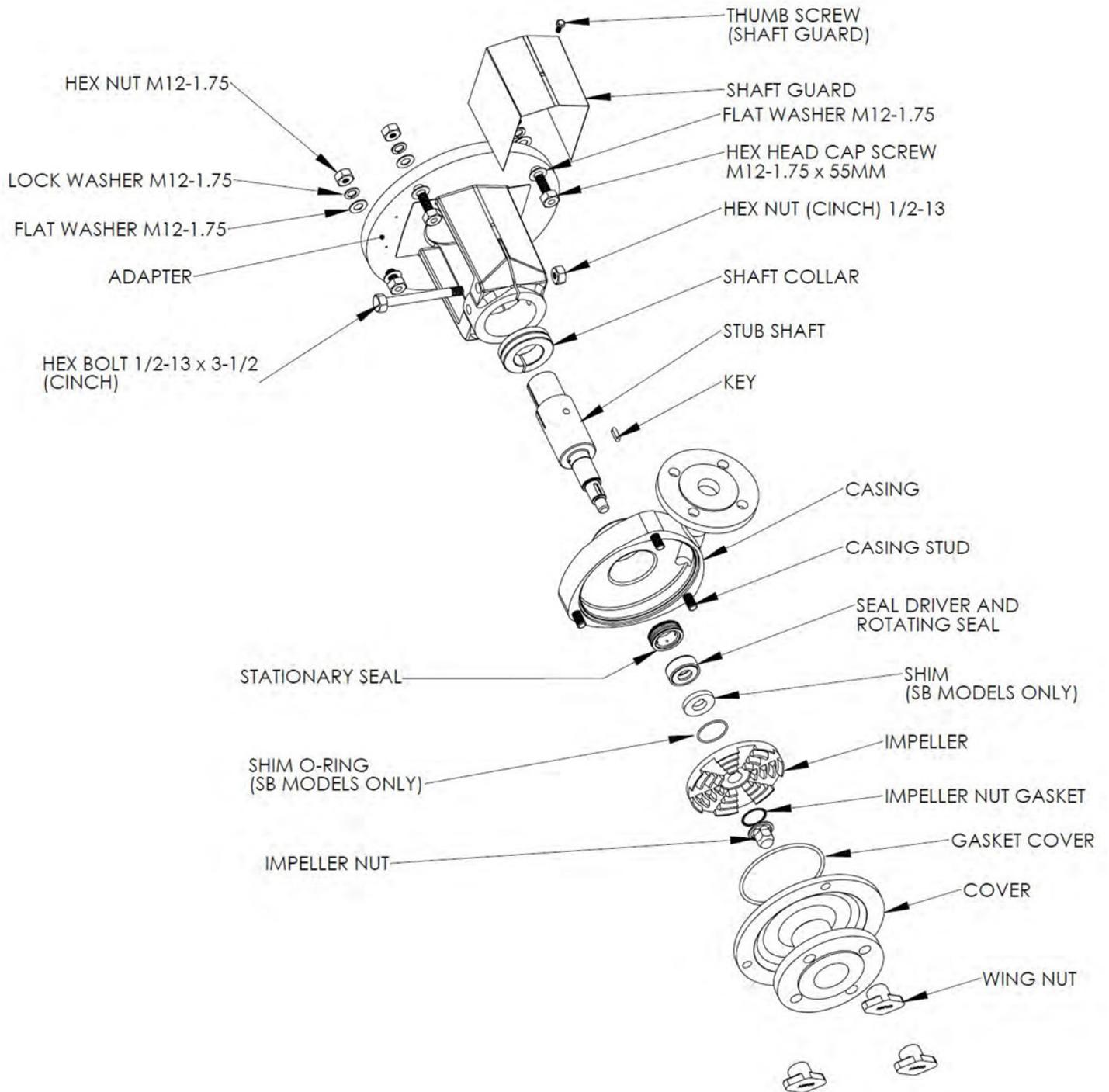
Type.....	INTERNAL SINGLE MECHANICAL
Stationary Seal Material.....	SILICON CARBIDE
Rotating Seal Material.....	CARBON

RECOMMENDED TORQUE VALUES

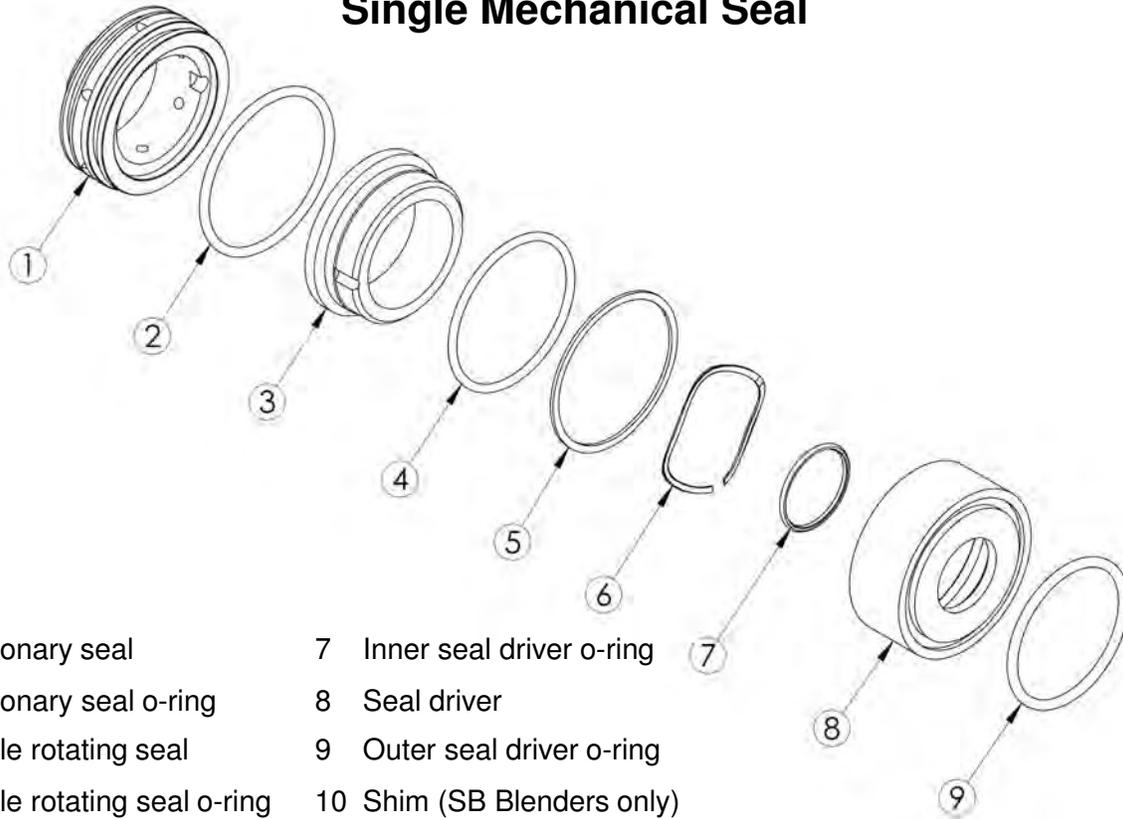
Impeller nut.....	40ft-lbs.
Adapter Clamping bolt.....	55ft-lbs. / 75N-m
Adapter Cap Screws	
NEMA 56C-140TC/ IEC 80-112.....	20ft-lbs / 27N-m
NEMA 180TC-280TC/ IEC 132-200.....	50ft-lbs / 68N-m
NEMA 320TC-360TC.....	110ft-lbs / 149N-m
Shaft Collar Socket Head Cap Screws	
NEMA 56C-140TC/ IEC 80-112.....	6ft-lbs / 8N-m
NEMA 180TC-280TC/ IEC 132-200.....	15ft-lbs / 20.5N-m
NEMA 320TC-360TC.....	40ft-lbs / 54N-m
Socket Head Cap Screw Size For Shaft Collar	
NEMA 56C-180TC.....	3/16" Hex
socket NEMA 210TC-280TC.....	1/4" Hex
socket NEMA 320TC-360TC.....	5/16" Hex
socket IEC 80-200.....	6mm
Hex socket IEC 225.....	8mm
Hex socket	

IMPELLER CLEARANCE

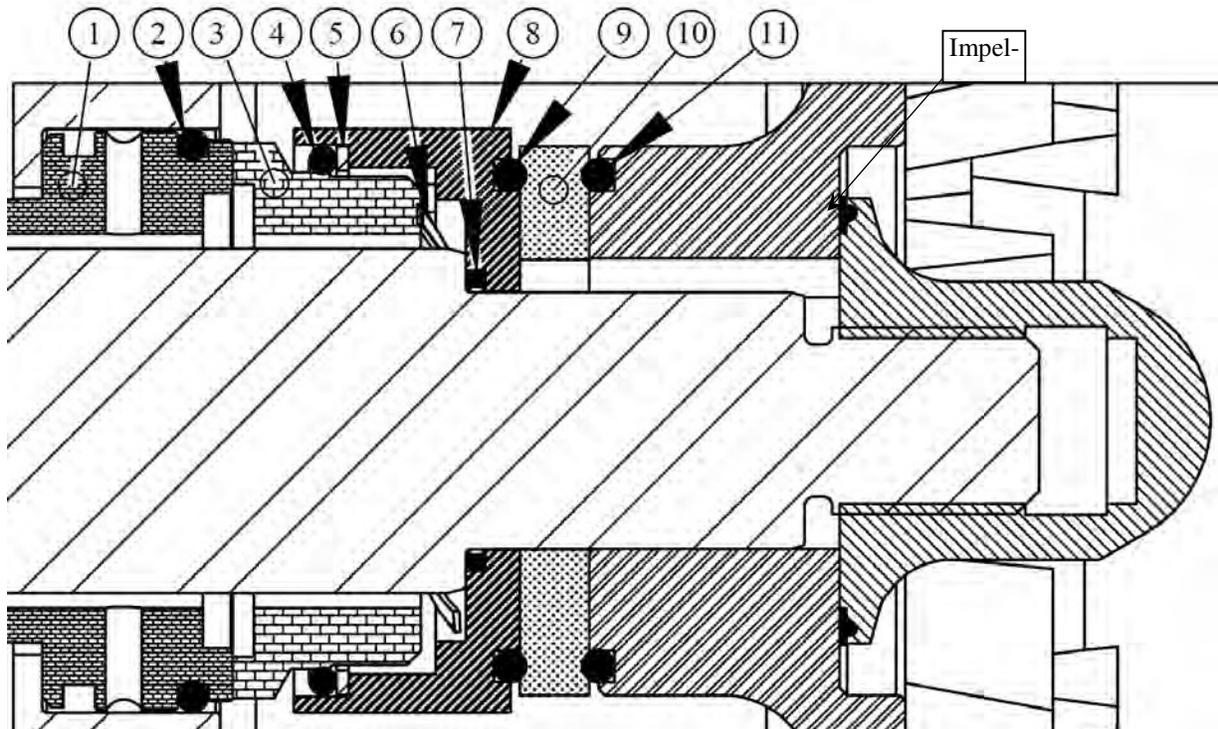
V (volute) SB and SBH pumps.....0.04" / 1.0mm



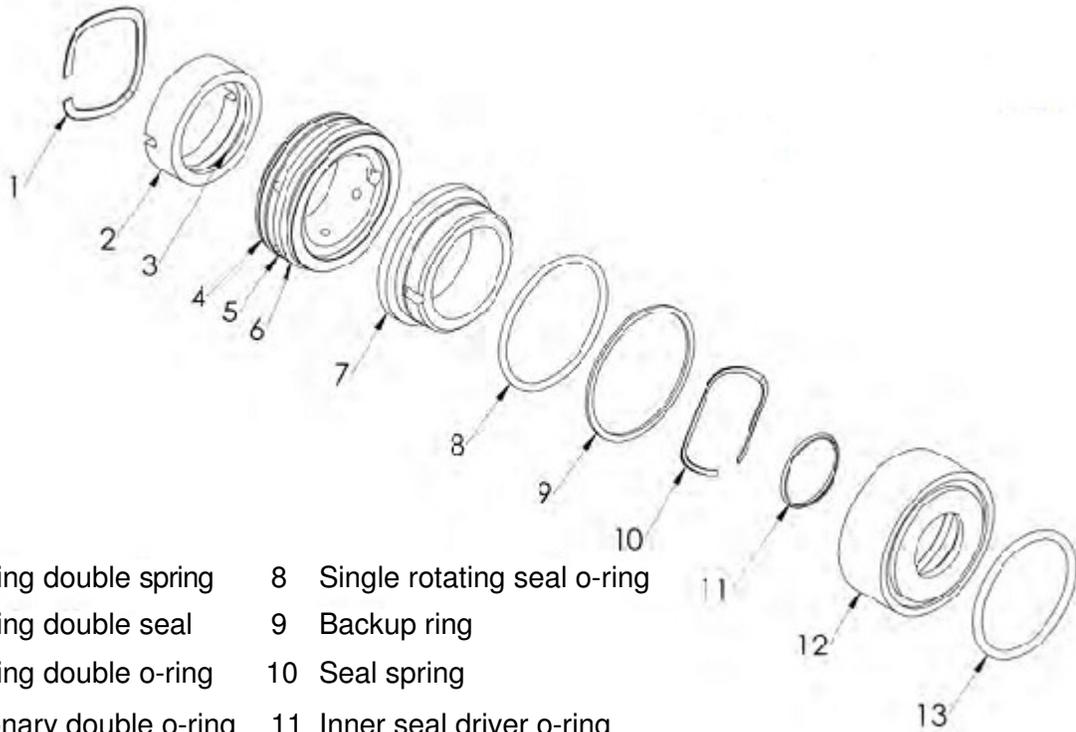
Single Mechanical Seal



- | | |
|-------------------------------|---------------------------------------|
| 1 Stationary seal | 7 Inner seal driver o-ring |
| 2 Stationary seal o-ring | 8 Seal driver |
| 3 Single rotating seal | 9 Outer seal driver o-ring |
| 4 Single rotating seal o-ring | 10 Shim (SB Blenders only) |
| 5 Backup ring | 11 Impeller o-ring (SB Blenders only) |
| 6 Seal spring | |

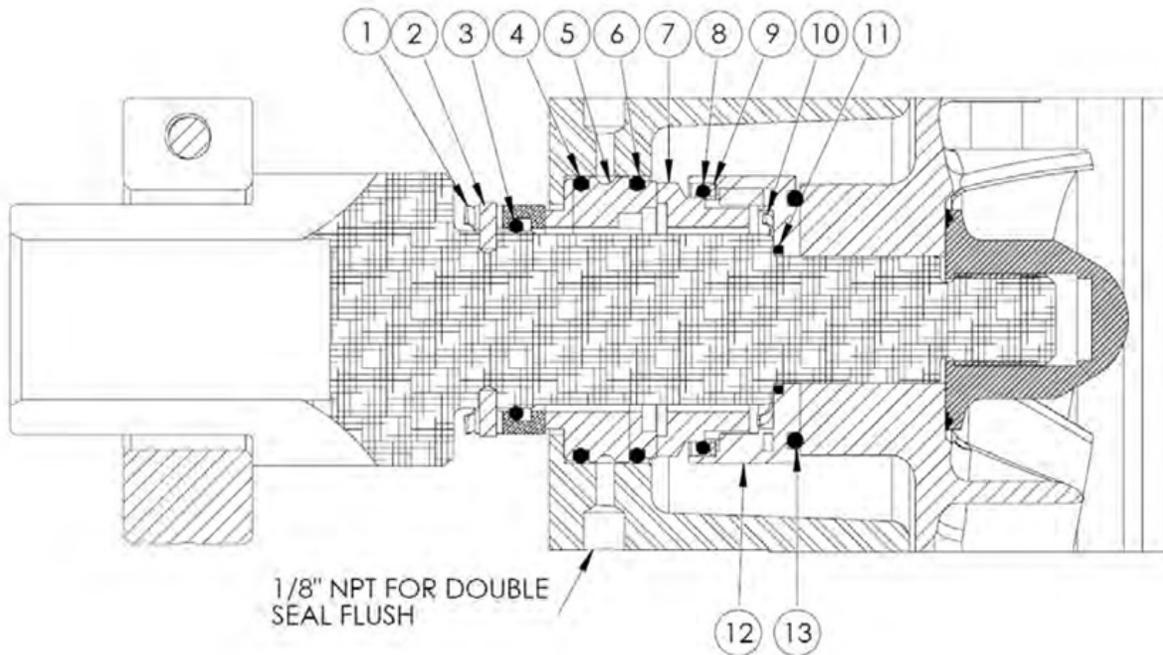


Double Mechanical Seal



- | | | | |
|---|--------------------------|----|-----------------------------|
| 1 | Rotating double spring | 8 | Single rotating seal o-ring |
| 2 | Rotating double seal | 9 | Backup ring |
| 3 | Rotating double o-ring | 10 | Seal spring |
| 4 | Stationary double o-ring | 11 | Inner seal driver o-ring |
| 5 | Stationary seal | 12 | Seal driver |
| 6 | Stationary seal o-ring | 13 | Outer seal driver o-ring |
| 7 | Single rotating seal | | |

Failure to flush a double mechanical seal will result in seal failure



Maintenance

Daily Pump Maintenance Checks

- Pump leakage (seal or otherwise)
- Pressure reading and flow indication
- Change in operating sound
- Change in bearing temperature
- Flow through lip seal lines

Motor lubrication schedule: Every 2200Hrs of standard service.
 Every 1100Hrs of severe service.
 Every 220Hrs of extreme service.

Standard service is 8-16 hours of service and up to 104°F/40°C in a clean/little corrosion atmospheric contamination.

Severe service is 16+ hours of service per day up to 120°F/50°C in a moderate dirt/corrosion atmospheric contamination.

Extreme service is 8-16 hours of service per day over 120°F/50°C in a severe dirt, abrasive dust, corrosive, heavy shock, or vibration environment.

Semi-annual Pump Maintenance Checks

- 1.Mechanical seal assembly
- 2.Motor bearing lubrication

Annual Pump Maintenance Checks (INCLUDES SEMI-ANNUAL MAINTENANCE CHECKS PLUS)

- 1.Remove seal for inspection
- 2.Bearing check
- 3.Check of axis/running clearance of impeller

Contingency Plan

For inspection findings and breakdowns, an adequate supply of probable replacement parts should be kept on hand.

The minimum spare parts are:

- 1.Single mechanical seal kit
- 2.Cover gasket
- 3.Impeller key

In addition, Ampco recommends:

- 1.Impeller
- 2.Cover
- 3.Impeller nut

Where service cannot be interrupted, a complete stand-by pump unit fully assembled (in a by-pass line) is recommended.

SB & SBH Pump Installation**Receiving Pumps**

Visually inspect shipping crate(s)/pallet(s) for damage. Ampco pumps will be shipped in boxes labeled Ampco Pumps or in crates. If there is any damage it is imperative to notify the driver at the time of delivery. Failure to do so will make it difficult, if not impossible, to file a damage claim and Ampco Pumps will not be held accountable. Please contact Ampco Pumps shipping department with damage details ASAP.

Once unpacked, carefully inspect the pump for any damage that may have occurred during shipping. Using a 15/16" socket, an extension drive, and ratchet turn the impeller nut to make sure the impeller turns freely. There should be a little noise from the seal which is normal. If there is metal to metal contact when the impeller is turned shipping damage is likely. Leave the protective covers on the inlet and discharge connections until the pump is installed and is ready to be connected to piping.

Pump Location

Install pump in an optimal location. Be sure that there is room around the pump so it can be accessed readily for maintenance. Ensure that the motor has adequate ventilation. Make sure the motor type is suitable for the environment in which it is installed.

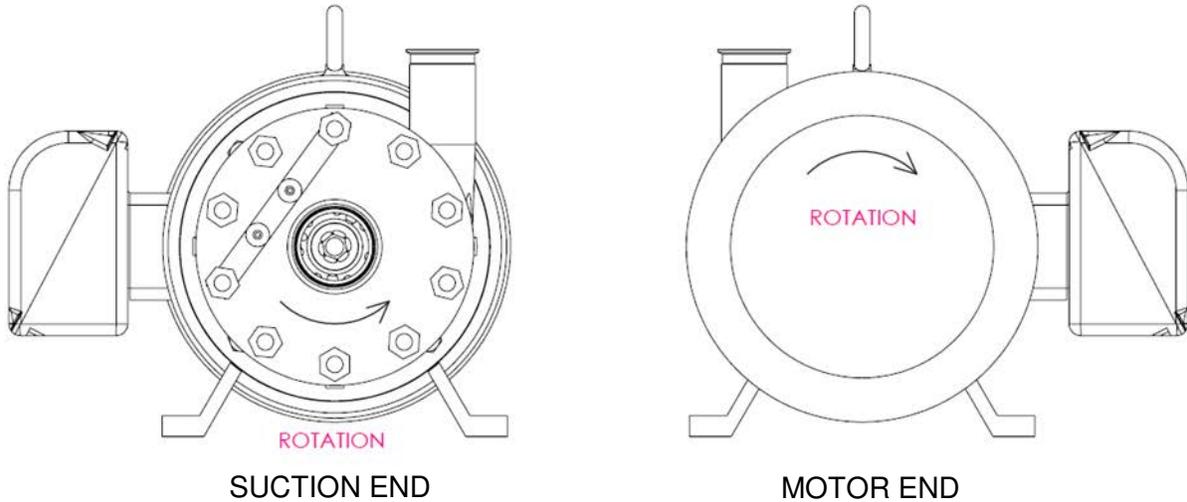
Electrical Installation

Have a qualified electrician connect the motor using sound electrical practices. Do not test run the motor with the pump dry. Mechanical seals can be damaged running dry even momentarily. The pump must be flooded and the flush must be connected with flushing water flowing before starting the pump. The pump and motor has been selected for a specific environment and system application. Changing the environment or system conditions (i.e. change of fluid, change in head losses, change in NPSHr) can overload the motor. When changing system conditions or when in doubt, contact Ampco Pumps Company for technical assistance and someone will be ready to assist.

Pump Operation

Make sure the pump is clean and free of any foreign matter.

Once the motor, flush, and piping all have been properly connected, the flush is turned on and is visibly flowing (if the pump has a flush option) and the pump has been flooded, the pump can be momentarily turned on to check the motor rotation. The correct rotation is counter-clockwise while looking at the pump from the suction end and clockwise if looking at the pump from the motor end.



When the rotation of the motor has been verified to be correct the pump is ready to run continuously for service.

Shutdown Instructions

1. Turn off power supply to the pump
2. Close shut-off valves
3. Drain and clean pump

Seal Removal & Changing Shims

ATTENTION: Before attempting any service on the pump or motor, disconnect or lockout electrical power to the pump motor. If the pump and motor are to be removed as a unit, note the wiring and configuration. Use colored or numbered tape to mark the wire connections of the pump motor and power source for reconnection.

Tools required to disassemble and remove seal:

- * 7/16" wrench
- * 15/16" socket wrench
- * 90° o-ring pick
- * Torque wrench
- * 3/8" round bar
- * Dead blow hammer

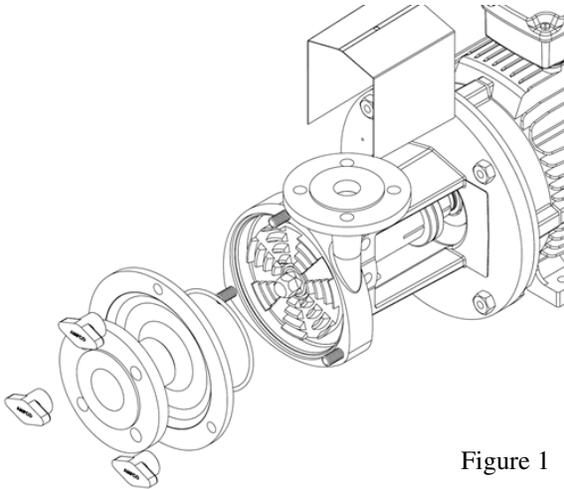


Figure 1

1. Disconnect electrical power to the pump motor and follow any lockout/tag-out procedures in place at your facility.
2. Disconnect pump from the suction piping. Drain all fluids from the pump.
3. Loosen cover nuts with a 1-1/4" wrench. Remove cover wing nuts, flat washers (if provided), lock washers (if provided), cover, cover gasket, and shaft guard. See Figure .

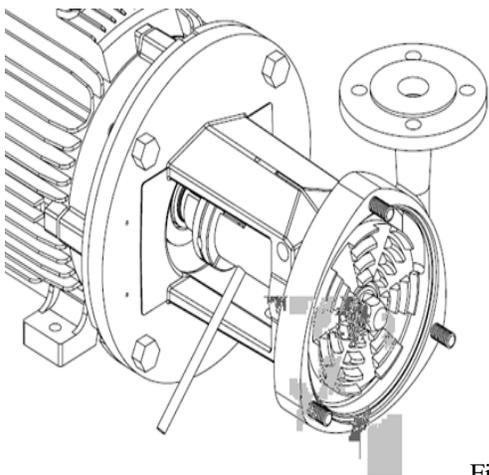


Figure 2

4. Insert a 3/8" bar in the hole in the stub shaft. See Figure 2. Loosen the impeller nut. Turn the impeller nut with a 15/16" wrench counter-clockwise.

n

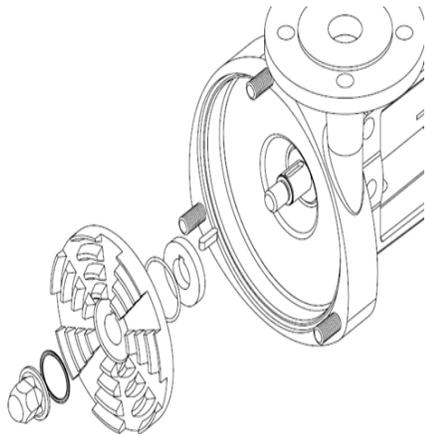


Figure 3

5. Remove the impeller nut, the nut gasket, impeller, shim, and then the key. This process can be seen in Figure 3.

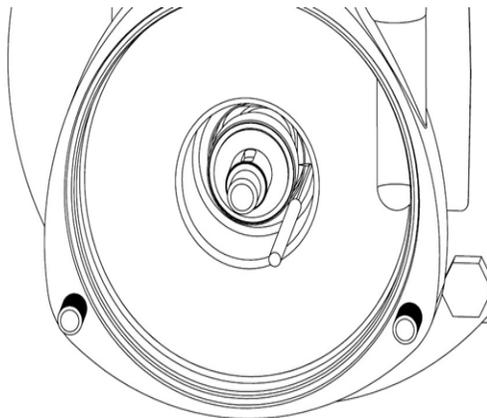


Figure 4

6. Pull out the seal driver. You may have to use a pick to separate the rotating seal from the stationary seal, Figure 4.

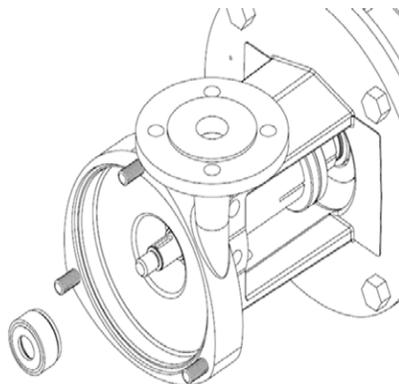


Figure 5

7. The rotating seal, o-ring, and spring will come out as a single component, Figure 5.

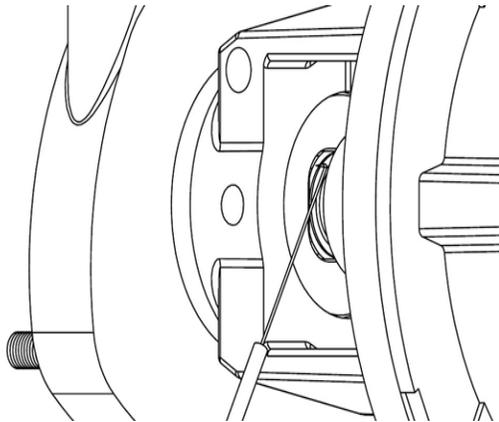


Figure 6

8. Push the stationary seal out from the back of the pump using an o-ring pick, your fingers, or both. Pushing on opposite sides of the shaft with constant light pressure, make sure to push outside of the rear seal face. See Figure 6.

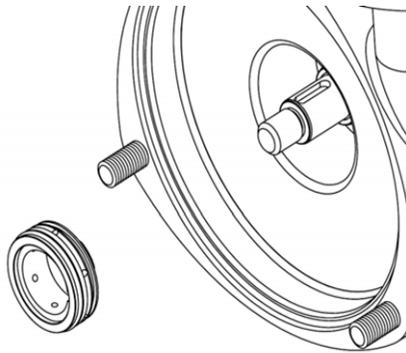


Figure 7

9. Remove stationary seal once pushed out of its' bore. See Figure 7. Check the condition of the casing, rotating seal, and stationary seal. Clean and remove any foreign matter before reinstalling the seal.

Pump Assembly and Seal Installation

When replacing the seal assembly lubricate all o-rings with food grade lubricant. Once the pump is fully assembled turn the stub shaft a few revolutions by hand making sure it turns relatively freely and nothing is rubbing inside the pump. Running the pump with foreign objects in the pump or having the impeller making contact with either the cover or the casing will result in serious damage if not completely destroying the pump.

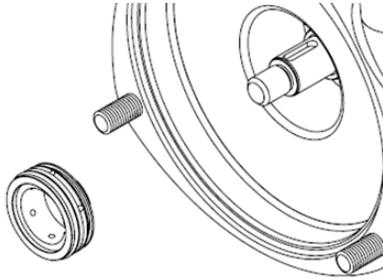


Figure 8

1. Use a food grade lubricant to lubricate all o-rings. It is important that the stationary and rotating seal o-rings are lubricated to ease assembly. Slide the stationary seal over the shaft and into the casing, Figure 8.

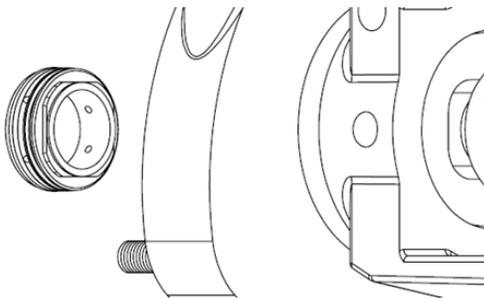


Figure 9

2. Line up a flat on the stationary seal to the a flat of the window of the casing and gently press the stationary seal into the casing bore. See Figure 9.

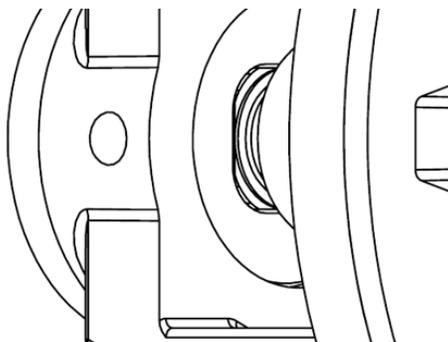


Figure 10

3. The stationary seal should be properly seated, as shown in Figure 10, before continuing the assembly of the pump.

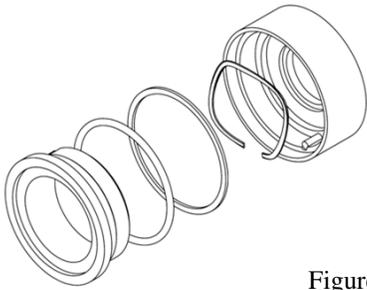


Figure 11

3. Assemble the rotating half of the seal. Insert the single seal spring into the seal driver. The single seal spring is smaller than the rotating double spring. Next insert the back-up ring. Insert the single rotating seal o-ring then insert the single rotating seal. Be sure to line up the slots in the rotating seal with the pins in the seal driver.

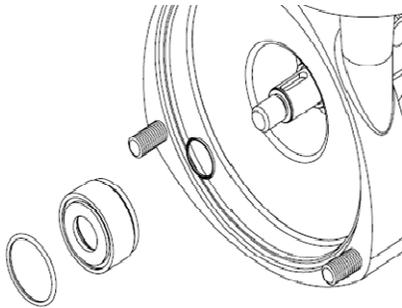


Figure 12

4. Install inner seal driver o-ring, then slide the rotating seal assembly onto the stub shaft, as seen in Figure 12, against the stationary seal. Be sure the outer seal driver o-ring is in the o-ring groove in the seal driver.

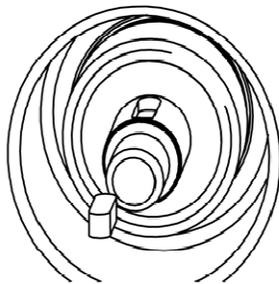


Figure 13

5. Insert key into the keyway in the stub shaft, Figure 13.

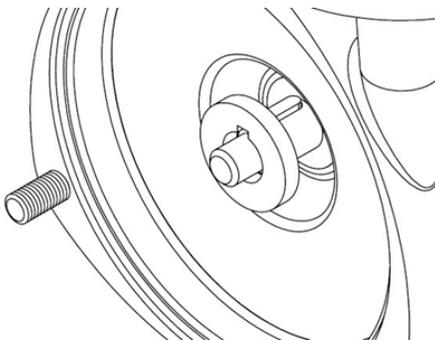


Figure 14

6. For SB Blenders install the shim as in Figure 14

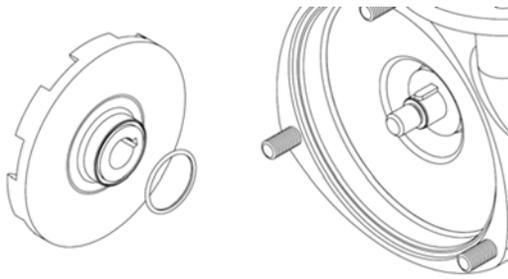


Figure 15

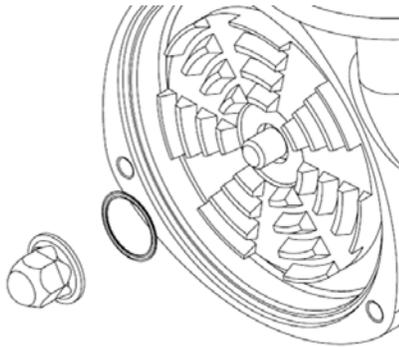


Figure 16

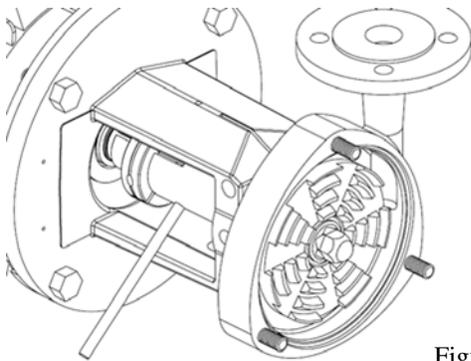


Figure 17

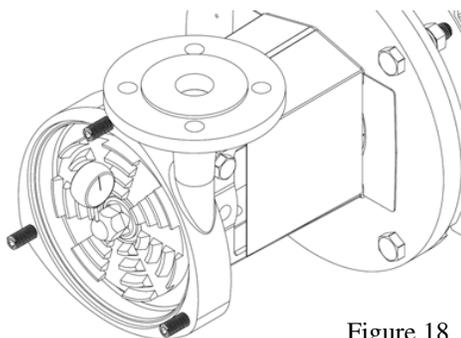


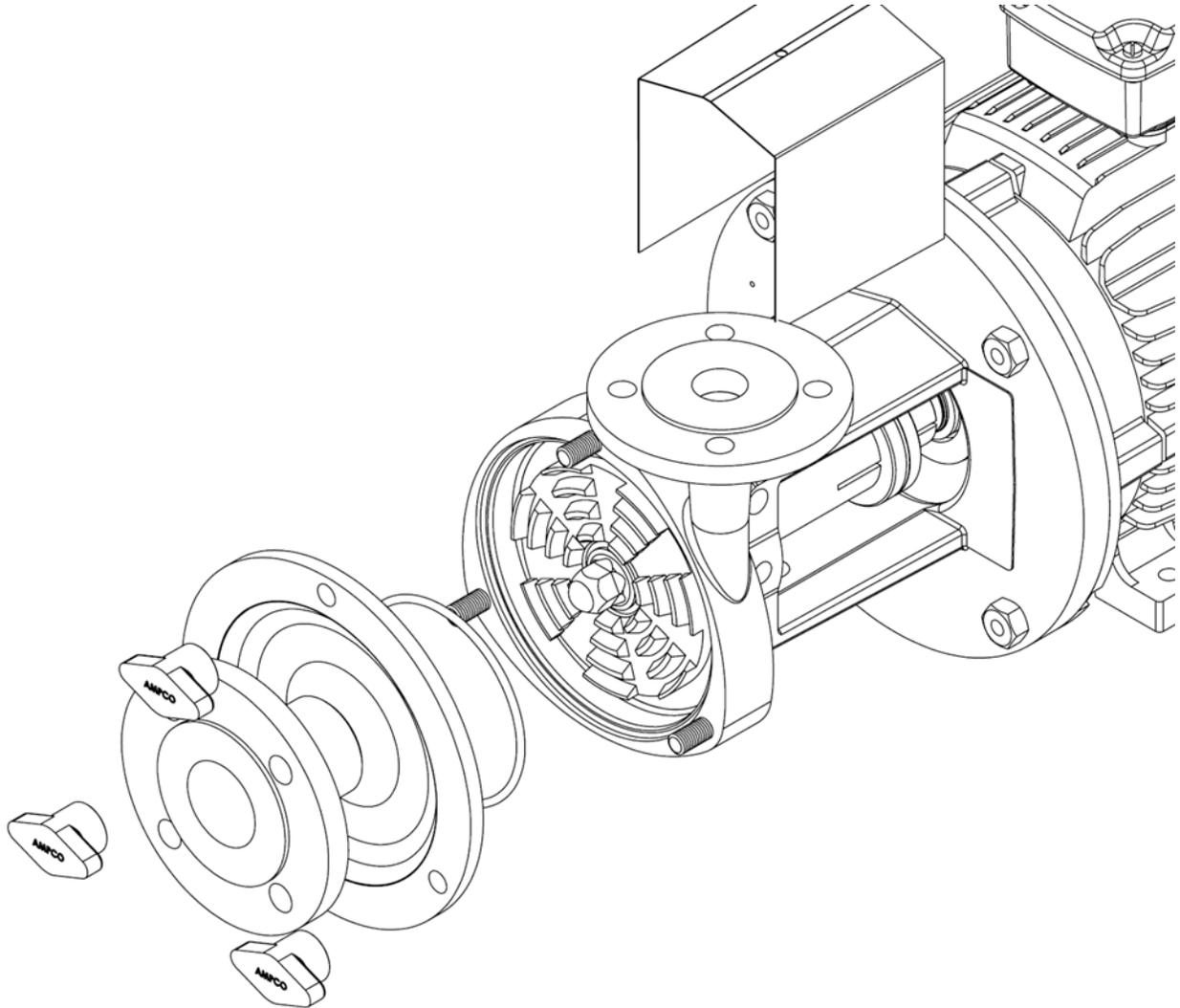
Figure 18

7. Before installing the impeller lubricate the impeller o-ring so it will stay in the impeller o-ring while installing the impeller (SB Blenders only). Slide impeller onto the shaft and over the key. Push impeller against the seal driver or shim (SB Blenders). See Figure 15.

8. Install the impeller nut and impeller nut gasket, Figure 16 .

9. Once again insert a 3/8" bar into the hole of the stub shaft to hold the rotating parts while tightening the impeller nut. See Figure 17.

10. Check the stub shaft run out. Fix an indicator to the pump. See Figure 18. Total indicator run out should not be greater than 0.003" (0.075mm). If stub shaft run out is greater than 0.003" remove the shaft guard, loosen collar, and then snug the shaft collar (do not torque yet). Mark the highest point of run out with a grease marker. Using a dead blow hammer tap stub shaft at high run out point and recheck run out. If run out is under 0.003" torque shaft collar screw and reassemble pump. If not repeat this step until run out is under 0.003".



11. Replace cover gasket, cover, wing nuts, and shaft guard. When replacing the cover, depending on the style of connection, the cover may only be installed correctly with one orientation. Note the orientation of flange bolt hole patterns before installing the cover. Make sure the wing nuts are tight and turn the impeller slowly with a 15/16" socket, extension, and ratchet to check if impeller turns freely .

Note: Always turn the stub shaft by hand before start up making sure nothing is rubbing inside the motor, such as foreign objects or the impeller touching either the back inside of the casing or the cover. Also never run this pump dry. Silicon carbide seals will heat up instantly at operating RPMs and will no longer seal when damaged.

WARNING: Mechanical seal must never run dry. Seal damage will result.

Setting The Impeller Clearance

Assemble the pump as described in the Pump Assembly and Seal Installation section of this manual. For double seals perform steps 1-10 and for single seals perform steps 4-10 of the Pump Assembly and Seal Installation instructions. Take note that the shaft collar screw must be torqued to the proper torque value as determined by the frame size of the motor. Using a torque value less than the prescribed value may allow the shaft to move toward the cove and cause damage to the pump.

Tools Required:

- * 7/16" wrench
- * Torque wrench
- * 0.04" (1.0mm) Shim for SB & SBH V Pumps
- * 15/16" socket wrench
- * 3/8" round bar
- * Dead blow hammer
- * Hex socket (for size see technical data)

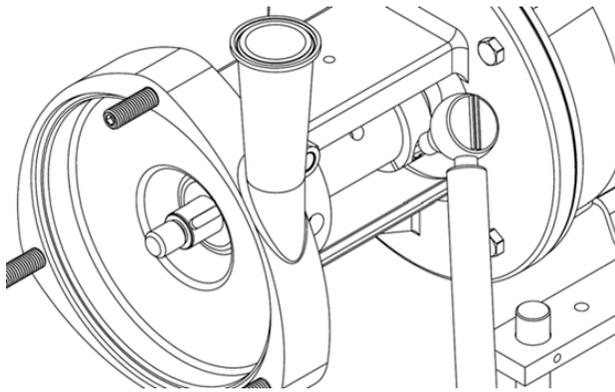


Figure 19

1. Remove the cover wing nuts, cover, cover o-ring, shaft guard, impeller nut, impeller nut gasket, and impeller as described in the pump disassembly part of this manual. For SB models make sure the thinnest impeller shim is on the stub shaft .

2. Loosen the socket head cap screw in the shaft collar and retighten it just enough so the stub shaft is still able move on the motors shaft. Figure 19.

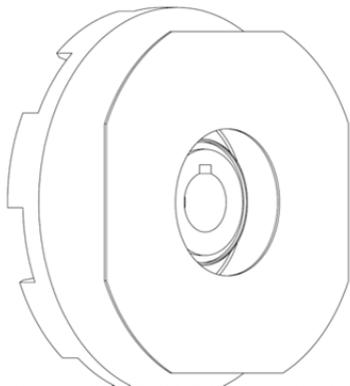


Figure 20

3. Once the stub shaft is able to slide on the motor shaft place the plastic stub-shaft setting shim on the back of the impeller, over the impeller hub. Figure 20.

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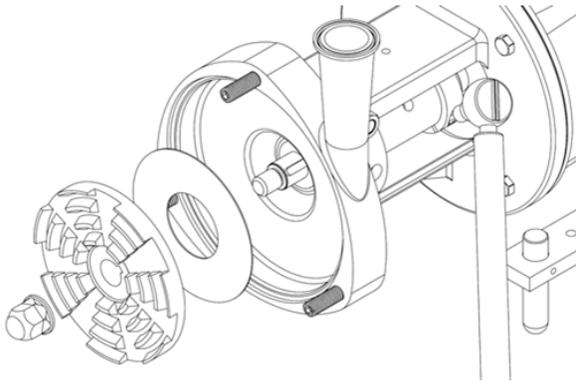


Figure 21

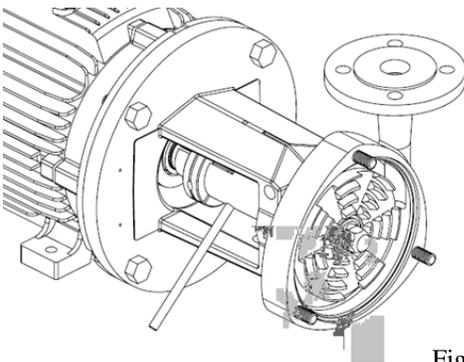


Figure 22

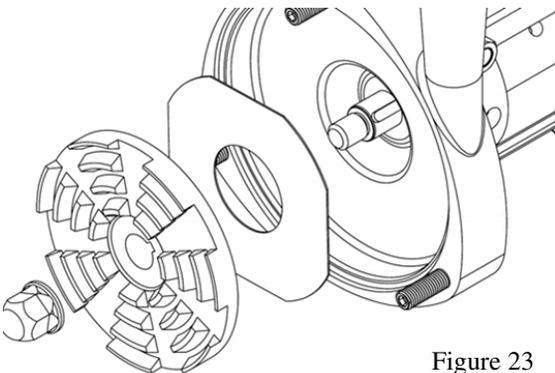


Figure 23

4. With the seal driver, the thinnest shim (SB models), and key on the stub shaft, slide the clearance shim and impeller on to the stub shaft and tighten the impeller nut on the stub shaft, Figure 21. While pushing the impeller nut, impeller, and shaft collar towards the motor slightly pinching the impeller clearance shim, tighten the socket head cap screw in the shaft collar. Torque the socket cap screw to the right torque value that correlates to the frame size of the motor. When the shaft collar screw is not torqued to the correct value the shaft may move during pump operation although the shaft cannot be moved by hand along the motors axis. Torqueing the shaft collar screw more than the recommended value may break the screw.

5. Now that the impeller clearance is set the clearance shim has to be removed and pump reassembled. Insert a 3/8" bar into the hole of the stub shaft and loosen the impeller nut. See Figure 22.

6. Remove the impeller nut, impeller, stub shaft, setting shim, and clearance shim, Figure 23.

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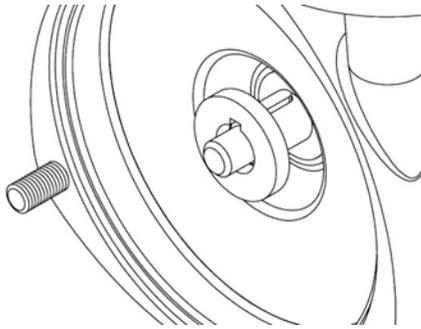


Figure 24

7. Insert the desired impeller shim (SB models only) Figure 24.

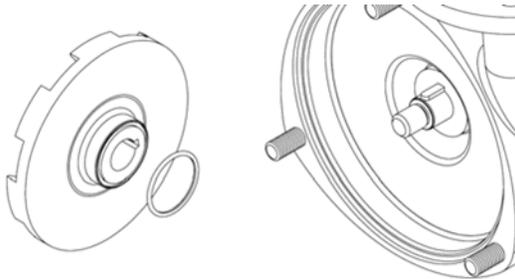


Figure 25

8. Install the impeller o-ring into the back of the impeller (SB models only) Figure 25.

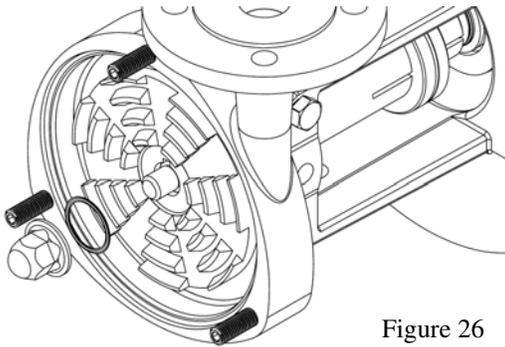


Figure 26

9. Install the impeller nut gasket and impeller nut. See Figure 26.

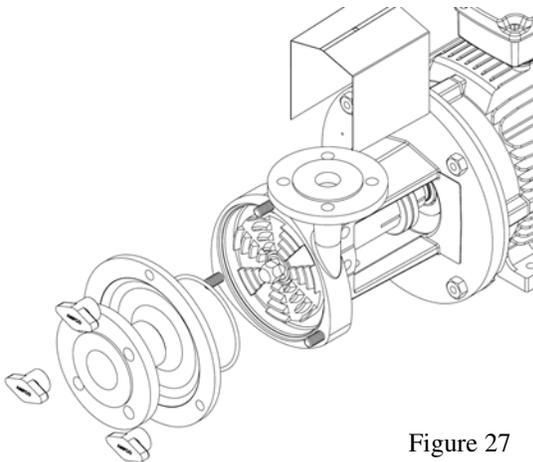


Figure 27

10. Replace cover gasket, cover, wing nuts, and shaft guard, Figure 27. When replacing the cover, depending on the style of connection, the cover may only be installed correctly with one orientation. Note the orientation of flange bolt hole patterns before installing the cover. Make sure the wing nuts are tight and turn the impeller slowly with a 15/16" socket, extension, and ratchet to check if impeller turns freely. If the impeller does not turn freely do not force it to turn and absolutely do not run the pump. Reset the impeller clearance.

Piping Configuration

Suction and discharge piping must be properly supported and aligned with the pumps suction and discharge ports.

Avoid throttling valves in the suction line of the system.

Check valves must be at a minimum of 5 feet (1.5m) from the pump's discharge, Figure 28.

Keep the suction piping short and direct as possible. Avoid elbows in the suction line of the system. If this is unavoidable, locate the elbow as least 5 pipe diameters away from the pumps inlet and elbows should not have a radii less than twice the diameter of pipe, Figure 28.

Make sure that the NPSH available is always greater than the system's NPSH required.

Avoid bending piping over piping as this will cause the formation of an air pocket in the suction line. Figure 29.

Route piping under any obstructions whenever possible. Figure 30.

When using a reducer on the suction end the reduced centerline should not be below the suction centerline as in Figure 31. The centerline of the small diameter end of the reducer should be above the centerline of the suction line as in Figure 32.

Injection line angles should be 45° or less. Figure 33 .

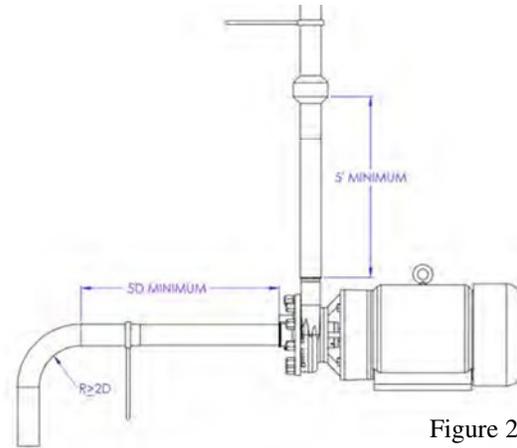


Figure 28

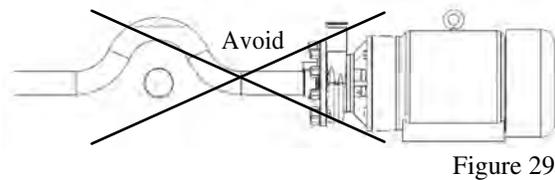


Figure 29

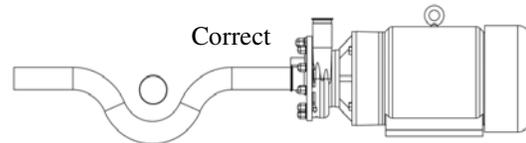


Figure 30

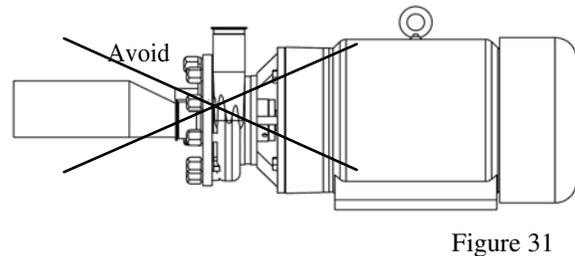


Figure 31

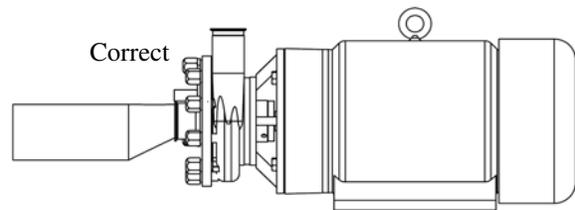


Figure 32

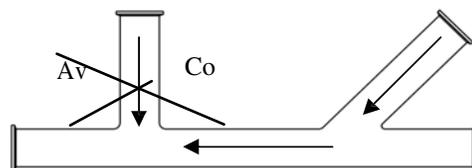


Figure 33

Troubleshooting

The following list of symptoms and causes is intended to assist users in determining the cause of pumping trouble. Use proper instruments to measure values of pressure, suction lift, speeds, temperature rise of motors, etc. When motor speeds are incorrect, check connections and measure voltage at motor terminals.

No liquid delivered

- Pump and suction line not completely primed
- Speed too low
- Required discharge too high
- Suction lift too high
- Impeller, piping, or fittings completely plugged up
- Wrong direction of rotation

Not sufficient capacity

- Air leaks in suction pipe for shaft seal
- Speed too low
- Required discharge head too high
- Suction lift too high or insufficient NPSH available
- Impeller, piping, or fittings partially plugged
- Insufficient positive suction head for hot water or other volatile liquids
- Liquid viscosity too high
- Mechanical problems-impeller damaged, shaft seal defective
- Wrong direction of rotation
- Suction pipe entrance too close to surface of liquid
- Air pockets in pipe high points

Not sufficient pressure

- Speed too low
- Mechanical problems— impeller damaged, shaft seal defective
- Small impeller diameter
- Air or gas in liquid
- Wrong direction of rotation
- Air pockets in pipe high points

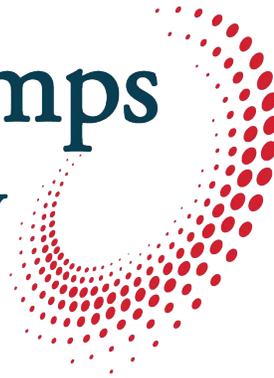
Pump operates for a while, then quits

- Leaky suction line
- Air leaking in through shaft seal
- Suction lift too high or insufficient NPSH available
- Air or gas in liquid
- Suction piping and fitting not completely freed of air during priming
- Air pockets in pipe high points

Pump takes too much power

- Speed too high
- Pumping too much liquid because required head is lower than anticipated.
- Viscosity and / or specific gravity is higher than specified
- Mechanical problems—binding inside seal from distortion due to piping strains, shaft bent, and/or impeller rubbing casing

Ampco Pumps Company



SP Series Centrifugal Pump

- Operation and Maintenance Manual



Ampco SP Series
Centrifugal Pump

INSTALLATION AND MAINTENANCE OF AMPCO CENTRIFUGAL PUMPS

INSTRUCTIONS

Your Ampco centrifugal pump is a rugged unit designed to provide years of low cost pumping service. There is a small amount of necessary care required to ensure you of this expected long service. It is recommended that you carefully review the installation and operating sections in this manual.

Every Ampco pump receives a careful running test at the factory to ensure that the head-capacity rating is met in accordance the Hydraulic Institute Standards and to ensure mechanical soundness. Special instructions and advice for unusual conditions, such as corrosive, abrasive, and other problems are too numerous to be included in this general book, but will be the subject of specific discussion on orders or inquires for special applications..

LOCATION

The immediate environment, in which the unit is located, while usually of prime importance to the pump, may determine the enclosure needed for the motor. Ampco can supply several different motor enclosures to meet specific requirements.

The SP Series pumps series are supplied with totally enclosed motors as standard. They may be installed where dirt, moisture and mild corrosion are present or in outdoor locations. Washdown duty motors, with epoxy paint or paint free stainless steel, are designed for applications where the motor is frequently subject to washdown to maintain a bacteria-free operating environment. Specialty motors may be required for moist, corrosive, or explosive environments. Motor drain plugs (if not equipped with automatic drains) must be removed periodically to drain accumulated condensation.

Pump units should be located where daily visual inspection is possible and no surrounding structure interferes with ventilating air over or through the motor.

Submerged suction is the most economical and convenient method of priming a pump when installed in such a position that the top of the casing is below the surface of the liquid to be pumped. The liquid will flow by gravity into the pump and displace the air (through the discharge if possible or a vent when available).

INSTALLATION

Begin with a suction line as direct and as simple as possible. The suction line is usually the most sensitive part of the entire pumping system being totally dependent on outside forces to provide liquid flow into the center of the impeller.

Locate the pump as close to the supply of liquid as possible, with short and direct suction piping. Use wide radius elbows to help reduce friction loss. Air pockets due to high sections, concentric reducers, valve bonnets, etc. should be eliminated by installing a suction having a continual rise or at very least a straight horizontal run with an air eliminator near the pump suction entry. To prevent air pockets use eccentric pipe reducers that are mounted in a horizontal position across the top of the pipeline and valves that can be positioned in a plane rather than the normal upright position as an air pocket may exist in the upright valve bonnet.

SP SERIES PUMPS



Above all, remember that until the liquid reaches the leading edges of the rotating impeller vane the pump cannot impart its energy to move the liquid.

If possible, try not to connect an elbow directly to the inlet of the pump. This may cause excessive turbulence and hinder pump performance.

STARTING

The pump must be primed before starting, as the mechanical seal depends on the liquid being pumped for lubrication and cooling. Even a short run to determine direction of rotation without first priming may seriously damage the seal. Even though the SP Series are "self-priming" they require fluid inside the pump casing to draw a proper vacuum to initiate the priming.

The correct direction of rotation is counter-clockwise when viewed from the suction end of the pump. It is recommended to turn the pump by hand before starting the first time to ensure the unit is not binding.

MAINTENANCE

Since long-term breakdown cannot be tolerated in most services, maintenance procedures and a contingency plan must be established in advance to minimize any production loss caused by down time. During building and start-up it is common to use outside personnel. Operating personnel should acquaint themselves with the pump, particularly its running performance. This will aid in establishing a standard for future reference. This manual and other information provided with the pump should be filed for future reference.

All possible performance data should be recorded once the system is functioning properly and stable. Suction and discharge pressure readings, flow rate, seal leakage rate, bearing temperature, noise and vibration levels all provide input to a pump's performance in the system. It is unlikely that all of this data can be measured, but any information gathered can help alert the user of problems with the pump or system.

Operating personnel should know that any changes in the system or the liquid being pumped might have an effect on the pump's performance. It is advisable to also record the fluid temperature, specific gravity, viscosity, liquid concentration, percent of solid concentration, other additives and properties.

Single Mechanical Seal

A proper maintenance procedure should begin with a file for each pump. All known data relative to the pump, fluid handled and system should be included. Complete records of maintenance and repair costs along with a log of the unit's operating hours should be kept.

In addition, complete pump identification- size, type, operating speed, manufacturer, serial number, model number, and material of construction should be noted.

Maintenance Procedures

Daily Check-possibly the most important inspection will be the daily observation.

1. Seal leakage rate
2. Pressure reading and flow indication
3. Change in operating sound
4. Change in bearing temperature
5. Check to make sure flow is going through the double seal flush lines (for Double Seal pumps)

Semi-Annual Inspection-typically made at 6-month intervals with results noted in pump's maintenance file.

1. Check of mechanical seal assembly
2. Check of bearing lubrication

Annual Inspection-includes Semi-Annual inspection plus:

3. Removal of seal for inspection
4. Bearing Check
5. Check of axis/running clearance of impeller

Contingency Plan

For inspection findings and breakdowns, a contingency plan should be developed. To begin, an adequate supply of probable replacement parts should be kept on hand.

The minimum recommended spare parts are as follows:

1. Mechanical seal kit (complete with o-ring set)
2. Casing o-ring
3. Impeller Key

In addition Ampco recommends

4. Impeller
5. Impeller Nut

Where service cannot be interrupted, a complete stand-by pump unit fully assembled (and in a by-pass line) is recommended.

DISMANTLE AND REPLACE PARTS AS FOLLOWS :

Before attempting any service on the pump or motor, disconnect or lock out electrical power to the pump motor. If the pump and motor are to be removed as a unit, note the wiring configuration. Use colored or numbered tape to mark the wire connections of the motor and power source, for reconnection.

These instructions are limited to fluid ends only. See other drawings and literature applicable to motors, pedestals, frames, shafts, etc., if additional repairs are required.

1. Disconnect pump from both suction and discharge piping. Remove the shaft cover guard at this time by taking off the cover guard bolts.
2. Remove cover by taking off casing nuts. A rubber mallet may be necessary to loosen the nuts.
3. Remove the impeller nut using a 15/16" socket and holding the stub shaft with a 3/8" rod in the predrilled hole. Ease the impeller off the shaft. Pinch bars between the impeller and cover may be required. Be careful not to mar the pump's surface finish. Remove the impeller.

4. Use a 3/4" wrench to remove all three bolts between the pump volute and the adapter and gently slide the pump volute off the pump shaft.

5. Lay the pump volute down on the casing studs, and remove the stationary seal. The wave springs for the seal should also be removed. In double seal pumps, there is an extra stationary piece and wave spring to remove.

6. Remove the two stationary seal o-rings. This is best done by using a small flat-blade screwdriver.

7. Remove the rotating seal and rotating seal o-ring from the stub shaft.

The Mechanical seal is the only expendable pump part. It is suggested that the complete mechanical seal, both stationary and rotating members, be replaced whenever dripping or leakage occurs at the shaft, or whenever parts are removed to the point of separating the primary sealing surfaces.

The fluid end is now completely dismantled: Additional procedures are dictated by purpose for which unit was disassembled.

Mechanical Seal Replacement and Reassembly

Please see the table on page 5 for proper identification of all pump components. The numbers in parenthesis refer to the diagram on page 5 for mechanical seal components.

1. Begin by installing the rotating assembly onto the stub shaft. Lubricate the rotating o-ring with a food grade lubricant (use de-ionized water if oil is not permitted i.e. EPDM) and fit it into the rotating seal. Slide the assembly onto the shaft and line it up with the notches on the shaft.

2. Set the pump volute down on the casing studs. Lubricate the inner stationary seal o-ring and put it in groove in the seal cavity. For double seal pumps, the outer stationary o-ring fits into the larger groove in the seal cavity.

3. Place the inner (and outer) wave spring into the seal cavity and align it around the pins in the seal cavity. The wave spring should be positioned so that the waves with the notches face downward by the pins.

4. Install the inner stationary seal. The notches in the seal will line up with the pins in the cavity. For a double seal, install the outer rotating seal second.

5. Being careful not to bump the seal on the pump stub shaft, gently slide the volute over the stub shaft and shoulder it against the adapter.

6. Using a 3/4" wrench to alternately tighten all bolts between the volute and the adapter.

7. Place the impeller key onto the shaft keyway in the pump.

8. Lubricate the impeller o-ring and fit it into the groove on the back of the impeller.

9. Slide the impeller onto the pump shaft over the key. Next, lubricate the impeller nut gasket (11) and install it on the impeller along with threading on the impeller nut. Be sure that the gasket fits into the groove in the impeller nut.

Single Mechanical Seal

10. Tighten the impeller nut. This should be done with a 15/16" six point socket while using a 3/8" rod in the stub shaft hole to keep the pump shaft from rotating. Check the freedom of parts by hand rotating the impeller.

11. Install the cover onto the pump volute with a new cover o-ring. It is best to put the o-ring on the cover as it is placed against the volute. Tighten all cover nuts uniformly. Rotate the shaft again by hand again to check for rubbing.

12. Re-install the shaft cover guard.

13. For double seal pumps, install the flush lines through the back of the casing. Run flush water at about 1-2 gallons per hour. The maximum pressure for the seal is 5 PSI. Flush water should be throttled before the pump, and there should be about 2-5 feet of vertical tubing after the flush water exits the pump to maintain this.

14. Place the pump back into service and inspect for proper rotation and leaks.

Motor / Pump Shaft Disassembly

Before attempting any service on the pump or motor, disconnect or lock out electrical power to the pump motor. If the pump and motor are to be removed as a unit, note the wiring configuration. Use colored or numbered tape to mark the wire connections of the motor and power source, for reconnection.

1. Begin with pump disassembly as noted previously.

2. Loosen the shaft collar with an Allen wrench (3/16" or 1/4"; see sizes in table on page 5) so that the stub shaft can be taken off the motor. A rubber mallet may be used to tap the stub shaft if it will not slide off. Be careful not to drop the shaft collar when the stub shaft comes off the motor.

At this time the motor can be replaced by unbolting the adapter from it and separating the two items.

Motor / Pump Shaft Assembly

If the pump stub shaft is being replaced, it is recommended that a new shaft collar also be installed.

1. Begin by bolting the adapter onto the motor. Please note correct tightness of all fastening components in the table on page 5.

2. Slide the shaft collar onto the stub shaft and slide the two together onto the motor shaft, keeping the motor keyway in line with one of the slots in the stub shaft. If the collar has an identification groove in it, this will rest against the step in the stub shaft.

3. Line up the slot in the collar with the stub shaft slot and motor keyway gap. Do not tighten the shaft collar yet. Since the shaft was disassembled, the impeller clearance in the volute may have changed. The impeller must be repositioned to ensure the impeller will not rub and also for proper pump performance. The critical impeller gap is the gap between the volute and the impeller. This will be measured using the spacer provided with the SP Series pumps. *Please see the table on page 5 within the manual for the correct impeller gaps.*

4. Slide the volute over the pump shaft and shoulder it against the adapter.

5. Using a 3/4" wrench to alternately tighten all bolts between the volute and the adapter.

6. Place the spacer provided with the pump between the casing and the impeller. Install the impeller key, followed by the impeller, impeller nut gasket, and impeller nut. Tighten the impeller nut using a socket wrench and the 3/8" rod to hold the shaft to secure the assembly.

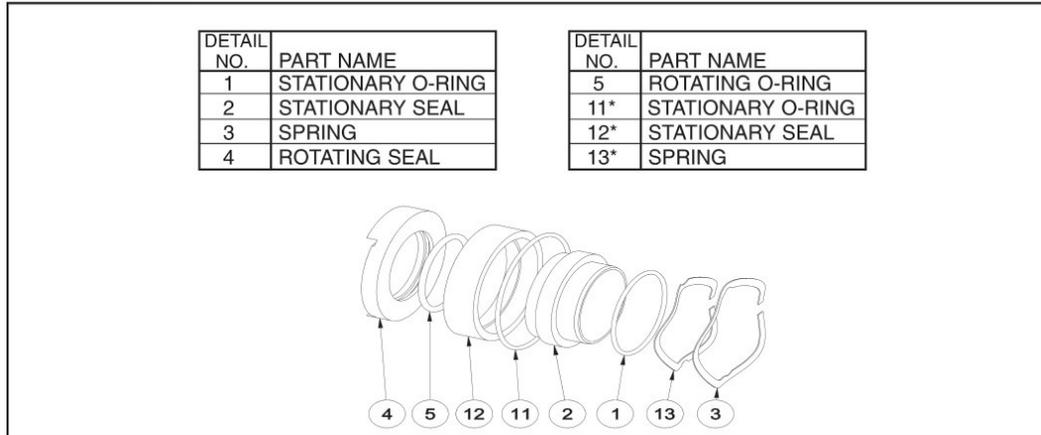
7. With a rubber mallet, gently tap the impeller nut to drive the stub shaft towards the motor while the spacer is between the impeller and volute. This will create the critical impeller gap.

8. When the impeller gap is correct, align the shaft collar slot with the slot in the stub shaft and the motor shaft keyway, and tighten the shaft collar with an Allen wrench, (3/16" or 1/4"; see sizes in table on page 5) to secure the shaft position.

9. Remove the impeller nut, gasket, and impeller from the shaft, and spacer. Now finish reassembling the pump.

Single Internal Mechanical Seal

Seal Breakdown For SP Series Pumps (Items 11-13 for double seal pumps only)



Proper Torque For Bolts on SP Series Pumps

Item	Torque (ft-lbs)	Pumps Included
Motor Bolts	50	All SP200 Pumps
Adapter / Casing Bolts	50	All SP200 Pumps
Volute Casing Nuts	50	280 + Frame
Shaft Collar Bolt(s)	15	180 Frame
	30	210 - 250 Frame
Impeller Nut	40	SP200 Series

Proper Impeller Gaps For SP Series Pumps

Pump Series	Impeller to Volute
SP200	0.008"

Required Tools

1. Rubber Mallet
2. 15/16" socket - for impeller nut
3. 3/8" diameter steel rod - to hold stub shaft
4. One - 3/4" wrench (frame sizes 280 & larger) - adapter bolts
5. Food grade lubricant
6. 3/16" Allen wrench - shaft collar bolt 180 frames
1/4" Allen wrench - shaft collar bolt 210-280 frames
7. Impeller puller / pinch bars (may be necessary)
8. Shim (see Impeller Gap chart for sizes)

Single Internal Mechanical Seal

SP PUMPS
EXTERNAL SEAL
 SP Series Pumps

AMPCO PUMPS COMPANY
 PARTS BREAKDOWN

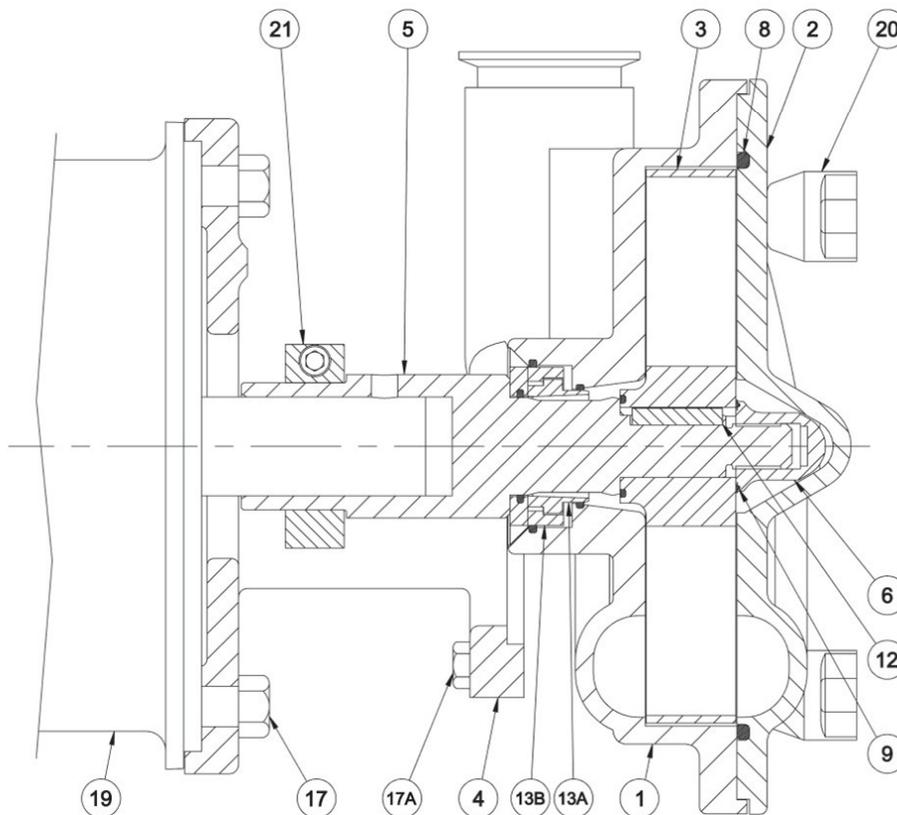
DETAIL NO.	REQ. NO.	PART NAME
21	1	SHAFT COLLAR
20	X ²	STAR NUT
19	1	MOTOR
17A	3	CAP SCREW (CASING/ADAPTER)
17	4	CAP SCREW (MOTOR/ADAPTER)
16 ¹	2	DRIVE SCREW
15 ¹	1	NAME PLATE
13B	1	DOUBLE MECHANICAL SEAL ^v
13A	1	SINGLE MECHANICAL SEAL
12	1	IMPELLER KEY

DETAIL NO.	REQ. NO.	PART NAME
11B ¹	2	SHAFT GUARD CAP SCREW
11A ¹	1	SHAFT GUARD
9	1	GASKET (IMPELLER SCREW)
8	1	O-RING (CASING/COVER)
6	1	IMPELLER NUT
5	1	STUB SHAFT
4	1	ADAPTER
3	1	IMPELLER
2	1	COVER
1	1	CASING

¹NOT SHOWN

²STAR NUT QUANTITY VARIES WITH PUMP MODEL

NOTE: Please be sure to always include pump type, size, and serial number with any reference to above numbers and names.



INSTALLATION AND MAINTENANCE OF AMPCO CENTRIFUGAL PUMPS

4

Troubleshooting and Applications

COMMON TROUBLES AND THEIR CAUSES

It is to the user's advantage to be familiar with a systematic procedure to determine reasons and causes for unsatisfactory pump operation. The following list of troubles and causes is intended to assist users in determining the cause of any pumping trouble. Faulty installations can then be corrected and a clear description given the manufacturer if assistance is required. Human judgment should not be relied on to measure operating conditions. Use proper instruments to measure values of pressure, suction lift, speeds, temperature rise of motors, etc. When motor speeds are incorrect, check connections and measure voltage at motor terminals.

1. No liquid delivered

- a. Pump and suction line not completely primed
- b. Speed too low
- c. Required discharge too high
- d. Suction lift too high
- e. Impeller, piping, or fittings completely plugged up
- f. Wrong direction of rotation

2. Not sufficient capacity

- a. Air leaks in suction pipe or shaft seal
- b. Speed too low
- c. Required discharge head too high
- d. Suction lift too high or insufficient NPSH available
- e. Impeller, piping, or fittings partially plugged
- f. Insufficient positive suction head for hot water or other volatile liquids
- g. Liquid viscosity too high
- h. Mechanical problems - impeller damaged, shaft seal defective
- i. Wrong direction of rotation
- j. Suction pipe entrance too close to surface of liquid
- k. Air pockets in pipe high points

3. Not sufficient pressure

- a. Speed too low
- b. Mechanical problems - impeller damaged, shaft seal defective
- c. Small impeller diameter
- d. Air or gas in liquid
- e. Wrong direction of rotation
- f. Air pockets in pipe high points

4. Pump operates for a while, then quits

- a. Leaky suction line
- b. Air leaking in through shaft seal
- c. Suction lift too high or insufficient NPSH available
- d. Air or gas in liquid
- e. Suction piping and fittings not completely freed of air during priming
- f. Air pockets in pipe high points

5. Pump takes too much power

- a. Speed too high
- b. Pumping too little water (too much pressure) because required head is higher than anticipated
- c. Viscosity and/or specific gravity is higher than specified
- d. Mechanical problems - binding inside seal from distortion due to piping strains, shaft bent, impeller rubbing casing
- e. Wrong direction of rotation
- f. Wrong motor voltage or wiring

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AMPCO PUMPS

Made of SELECTED corrosion-resistant alloys

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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 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 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 ten (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 without liability.

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, CONSEQUENTIAL 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 THEIR SALE, USE OR INSTALLATION.

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Ampco Pumps Company

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.

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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 shipment.

(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.

Return Policy

Ampco Pumps Company

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.

<u>Type of Return</u>	<u>Restocking Charge</u>
Standard pump with a replacement order	10%
Standard pump without a replacement order	20%
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 circumstances.

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.
4. For any pumps and/or parts purchased over (1) year ago, credit will be determined on a case-by-case basis.

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.

Notes



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For additional information on the PM Powder Mixer series and other Ampco Pumps products, please visit our website: **www.ampcopumps.com**