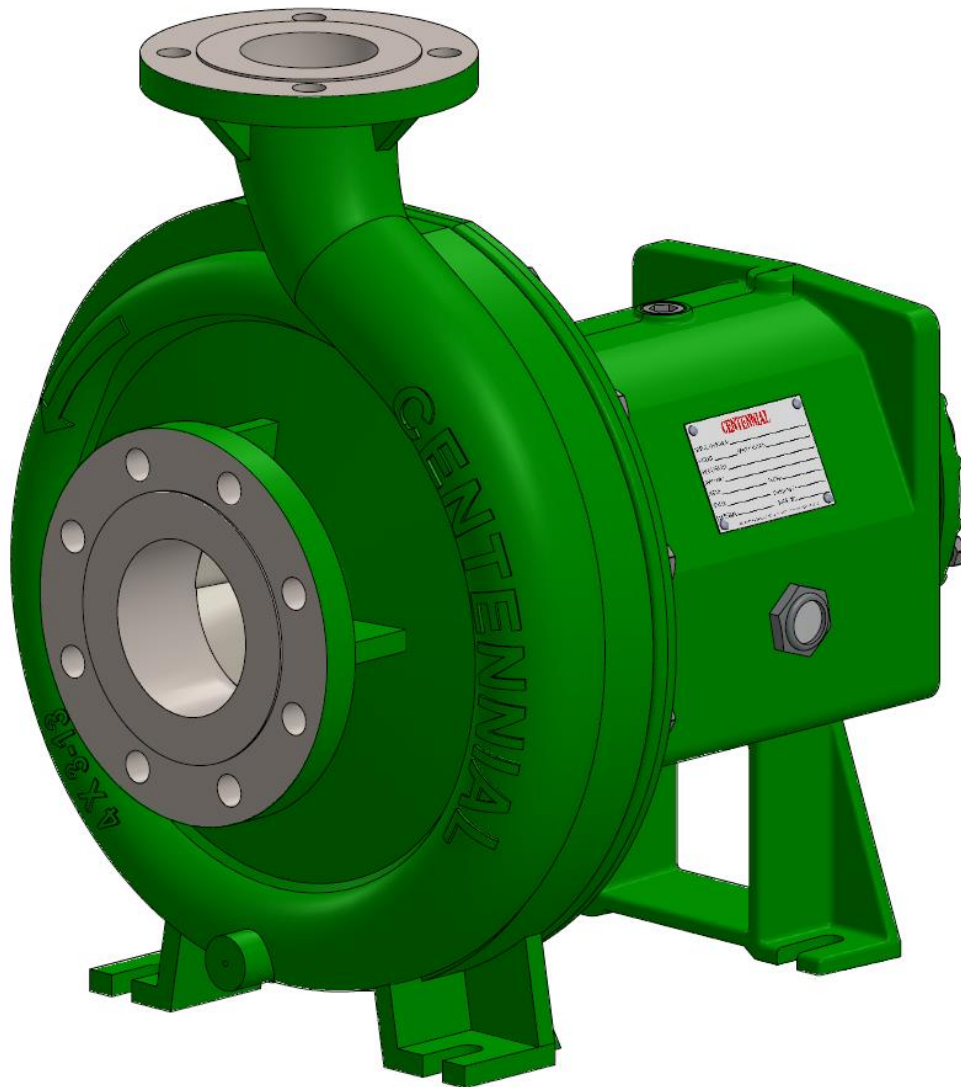


Model CA

Installation, Operation, Maintenance and Storage Manual



Centennial Chemical Process Pump

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1.0 Safety Considerations

It is extremely important that this entire manual be read prior to installation or operation of the pump.

Use of the equipment on a service other than what was outlined at the time of purchase could void the warranty unless Centennial has been consulted and provided written approval in advance. To assure proper installation, supervision from an authorized Centennial representative is recommended.

The Centennial Pump Company shall not be liable for damage or delays caused by a failure to observe the instructions that are contained in this manual.

Warranty is only valid when genuine Centennial parts are used. Contact your authorized Centennial representative for basic warranty information and before making any changes.

Proper pump selection should be made for applications based on conditions of service, material compatibility, solids content, fluid temperature, footprint size, as well as motor speed and energy considerations. Improper selection or improper use of pumps could risk injury or damage. For maximum safety and reliability, use only factory-supplied parts and closely follow all operating instructions and maintenance recommendations.

Every centrifugal pump has the potential to be dangerous, because of the following factors:

- Parts are rotating at high speeds.
- High pressures may be present.
- High temperatures may be present.
- Highly corrosive and/or toxic chemicals may be present.

ALWAYS COORDINATE REPAIR ACTIVITY WITH OPERATIONS PERSONNEL AND FOLLOW ALL PLANT SAFETY REQUIREMENTS AND APPLICABLE SAFETY AND HEALTH LAWS/REGULATIONS.

It is not possible to list all the conceivable misuses. Therefore, the following list is not meant to be complete and is provided only as a guide of the types of misuse that can damage a pump and cause injury. These below examples will void any and all warranties. Centennial Pumps shall not be liable for physical injury, damage or production delays caused by a failure to comply with the instructions contained in this manual.

1. Do not run a pump with the discharge valve closed or below minimum rated flow.
2. Do not run a pump in the reverse direction.
3. Do not start a pump that is "wind-milling" in the reverse direction due to fluid flowing back down the discharge pipe.
4. Do not continue to operate a pump when there are indications that something is rubbing, binding or knocking.
5. Do not continue to run a pump that gives an indication of overheating.
6. Do not operate a pump with the coupling guard removed. Make sure the guard fits snugly around the coupling so there are no openings.
7. Do not operate a pump that is excessively vibrating, surging or making abnormal noise.
8. Do not work on a pump unless the drive system is locked out and the pump is disconnected from the drive system.
9. Do not connect the pump to the drive system without first checking to see that the drive system is running in the correct direction.
10. Do not rely on the factory's alignment of the pump and the drive system. Alignment may have changed during shipment.
11. Do not put a cold liquid in or on a hot pump or a hot liquid in or on a cold pump.
12. Do not hit a pump with any object.
13. Do not use worn or faulty parts.
14. Do not stick hands, arms, legs or any other object into the discharge, suction or any other opening of a pump.
15. Do not weld attachments to the pump.
16. Do not apply external heat to the pump.
17. Do not lift the pump by its case only.
18. Do not examine a pump without using proper eye and face protection.
19. Do not run equipment dry or start the pump without the proper prime (Casing Flooded).
20. Do not exceed the maximum allowable pressure ("Max. P. @ 38°C" as shown on pump nameplate).

Paying constant attention to safety is always extremely important. However, there are often situations that require special attention. These situations are indicated throughout this book by the following symbols:

DANGER

DANGER – Immediate hazards that **WILL** result in severe personal injury or death.

WARNING

WARNING – Hazards or unsafe practices that **COULD** result in severe personal injury or death.

CAUTION

CAUTION - Hazards or unsafe practices that **COULD** result in minor personal injury, product, or property damage.

NOTE: ALWAYS COORDINATE REPAIR ACTIVITY WITH OPERATIONS PERSONNEL AND FOLLOW ALL PLANT SAFETY REQUIREMENTS AND APPLICABLE SAFETY AND HEALTH LAWS/REGULATIONS.

1.1 Safety Tips

Always follow best practices for safety—including but not limited to:

Apparel

- Insulated work gloves when handling hot bearings or using bearing heater
- Heavy work gloves when handling parts with sharp edges, especially impellers
- Safety glasses (with side shields) for eye protection, especially in machine shop areas
- Steel-toed shoes for protection when handling parts, heavy tools, etc.
- Other personal protective equipment to protect against hazardous/toxic fluids

Maintenance

- Always lockout/tagout power circuits
- Ensure pump is isolated from electrical system and pressure is relieved before disassembling any pressure containing parts.
- Use proper lifting and supporting equipment to prevent serious injury.
- Observe proper decontamination procedures.
- Know and follow company safety regulations.
- Never apply heat to remove impeller.
- Observe all cautions and warnings highlighted in pump instruction manual.

2.0 General Information

2.1 Storage Requirements

If the pump is inoperative for a long period of time, it is recommended that the pump be flushed and thoroughly dried to minimize corrosion. It is also advisable to drain the pump interior if there is any possibility of freezing. If the pump is to be stored for more than 15 days, the pump should be rotated once a month (with lubrication) for the bearings.

Long-Term Storage

The following guidelines should be followed when the pump or parts will be idle for a period of one month or more.

Pump Storage

1. All machined metal surfaces should be coated with a suitable corrosion inhibitor to ensure the integrity of these surfaces at the time of installation.
2. All openings must be covered with suitable covers to protect against contaminants and moisture.
3. Storage of the Components and Assemblies should be kept away from all potential vibration sources. (i.e., motors, rotating pumps, engines, etc.). This is to prevent unwanted vibration and possible damage to the bearings.

4. Components and assemblies are required to be stored indoors in a dry location. Temperature range should be between 40 degrees and 100 degrees Fahrenheit. If the environment is excessively humid (more than 70%), a suitable desiccant should be used.
5. If the pump is to be stored for more than 15 days, the pump should be rotated 2.25 revolutions a minimum of once per month (with lubrication) for the bearings.

Individual Parts Storage

Not all parts are packaged in a suitable manner from the factory for long-term storage. To ensure satisfactory part performance, all parts must be protected from corrosion and contamination.

Motor and Seal Storage

Refer to the manufacturer's manuals for storage instructions for these items.

2.2 Handling

The following describes how to lift pump components, assembled pumps, or pump, motor and baseplate assemblies. Do not attempt to lift a pump mounted on a baseplate by itself. A pump-motor assembly may only be lifted after it has been installed on a baseplate. Lifting should only be done by trained personnel. Pumps and motors often have integral lifting eyes or eye bolts. These are intended for use in lifting the individual piece of equipment.

CAUTION

Do not use eyebolts or cast-in lifting lugs to lift pump, motor and baseplate assemblies.

Before lifting the equipment, refer to the pump data sheet for the complete assembly weight.

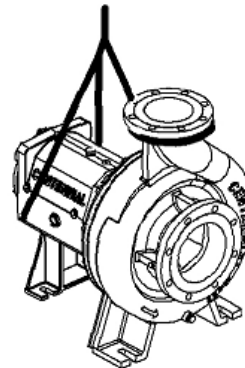
Individual Pump Components:

Casing: Use a choker hitch pulled tight around the discharge nozzle.

Bearing frame: Using an eye bolt in the NPT oil fill port or a choker hitch around the frame body to lift the Frame assembly. For largest size frames, straps may be used around the shaft and the body of the frame (captured by the mounting foot).

Bare Pump:

Sling around the pump discharge nozzle and around the outboard end of the bearing housing/frame with separate slings. Choker hitches must be used at both attachment points and pulled tight. Make sure the completion of the choker hitch on the discharge nozzle is toward the coupling end of the pump shaft. The sling lengths should be adjusted to balance the load before attaching the lifting hook.

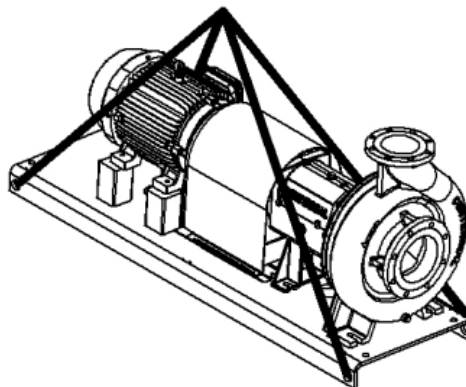


Bare Pump Lifting

NOTE: Refer to nameplate data for the bare pump weight. The listed weight does not include motor and/or baseplate.

Pump And motor with Steel Baseplate Assembly:

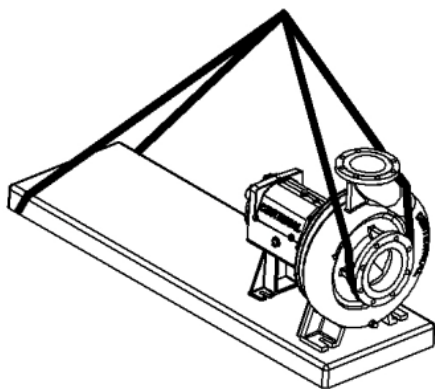
Insert lifting S hooks in the lifting lugs and use slings or chains to connect to the lifting eye. Do not use slings through the lifting holes.



Complete Pump Assembly Lifting

Pump and non-metallic baseplate assembly:

Nonmetallic baseplates can easily be damaged in handling. Be careful to handle the baseplate gently and avoid any shocks. If shipped in a wooden shipping crate, the crate should be left intact until final installation. The assembly should be forklifted to the installation site and then removed only when ready to be installed. Sling around the pump discharge nozzle and around the motor-mounting end of the baseplate. Choker hitches must be used at both attachment points and pulled tight. The sling lengths should be adjusted to balance the load before attaching the lifting hook. Do not use slings through any lifting holes and be careful not to damage the baseplate material.



Pump and non-metallic Baseplate Lifting

3.0 Installation

Inspection upon Arrival

Inspect the assembled pump upon arrival for any damage that may have occurred during shipment. Report any damage immediately to the carrier or distributor.

Leave all shipping covers attached to the pump unit until it is ready for installation. If installation is to be delayed more than 15 days, the pump shaft should be rotated by hand once every month with lubrication for care of the bearings.

Choosing Pump Location

The following recommendations may be helpful when choosing the best location for your pump:

1. Locate the pump as close to the liquid source as practical so the suction pipe is short and direct with a minimum of elbows, fittings and valves.
2. Place the pump in a location so the unit is accessible for inspection during operation as well as for maintenance operations involving removal and disassembly.

Foundation

The foundation should be sturdy enough to absorb any vibration and to form a permanent, rigid support for the baseplate. This is important to maintain the correct alignment of the direct connected unit. A concrete foundation on a solid base is satisfactory. Foundation bolts of the proper size should be embedded in the concrete.

Alignment

Alignment of the motor and pump is necessary after the complete unit has been leveled and tightened onto the foundation. See alignment procedures.

Piping

Both suction and discharge pipes should be supported independently near the pump so when the flange bolts are tightened no strain will be transmitted to the pump casing. The customer is responsible for proper suction and discharge pipe design and layout to avoid flow induced problems.

Discharge Piping

A valve should be installed in the discharge line to prevent fluid from flowing back through the pump when it is shut down. The valve should block the discharge line during maintenance.

Suction Piping

Care should be taken in sizing and locating suction piping to prevent cavitation. A valve should be installed in the suction line to prevent fluid from flowing into the pump when it is shut down.

Refer to the Hydraulic Institute Standards for centrifugal pumps for additional piping information.

3.1 Factory preliminary alignment procedure

The pump and motor are aligned at the factory to verify the assembly.

3.2 Recommended Procedure for Baseplate Installation and Final Field Alignment

New Grouted Baseplates

1. The pump foundation should be located as close to the source of the fluid to be pumped as practical. There should be adequate space for workers to install, operate and maintain the pump. The foundation should be sufficient to absorb any vibration and should provide a rigid support for the pump and motor. Recommended mass of a concrete foundation should be three times that of the pump, motor and base.
2. Level the pump baseplate assembly with all components installed. The proper surfaces to reference when leveling the pump baseplate assembly are the pump suction and discharge flanges. Do not stress the baseplate. Do not bolt the suction or discharge flanges of the pump to the piping until the baseplate foundation is completely installed. If equipped, use leveling jackscrews to level the baseplate. If jackscrews are not provided, shims and wedges should be used. Check for levelness in both the longitudinal and lateral directions. Shims should be placed at all base anchor bolt locations and in the middle edge of the base if the base is more than five feet long. Do not rely on the bottom of the baseplate to be flat, it likely is not. Typically, the field-mounting surface is also not flat.
3. After leveling the baseplate, tighten the anchor bolts. If shims were used, make sure that the baseplate was shimmed near each anchor bolt before tightening. Failure to do this may result in twisting of the baseplate, which could make it impossible to obtain final alignment. Check the level of the baseplate to make sure that tightening the anchor bolts did not disturb the level of the baseplate. If the anchor bolts did change the level, adjust the jackscrews or shims as needed to level the baseplate. Continue adjusting the jackscrews or shims and tightening the anchor bolts until the baseplate is level.
4. Check initial alignment between the pump and driver with a straight edge and correct as needed.
5. Grout the baseplate. A non-shrinking grout should be used. Make sure that the grout fills the area under the baseplate. After the grout has cured, check for voids and repair them. Jackscrews, shims and wedges should be removed from under the baseplate at this time. If they were to be left in place, they could rust, swell and cause distortion in the baseplate.
6. Run piping to the suction and discharge of the pump. There should be no piping loads transmitted to the pump after connection is made. Recheck the alignment to verify that there are no significant loads.
7. Use the following procedure and set up the final alignment between the pump and driver.

Alignment Procedure

WARNING

The points at which alignment is checked and adjusted are:

- **Initial Alignment** is done prior to operation when the pump and the driver are at ambient temperature.
- **Final Alignment** is done after operation when the pump and driver are at operating temperature.

Adding or removing shims under the feet of the motor and pump and by shifting equipment horizontally as needed achieves alignment.

NOTE: Proper alignment is the responsibility of the installer and end user

Accurate alignment of the equipment must be obtained and sustained. Trouble-free operation can be accomplished by following the proper procedures.

Alignment Checks

Initial Alignment (Cold Alignment)

- Before Grouting Baseplate – To ensure alignment can be obtained.
- After Grouting Baseplate – To ensure no changes have occurred during the grout process.
- After Connecting Piping – To ensure pipe strains have not altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

Final Alignment (Hot Alignment)

- After First Run – To obtain correct alignment when both pump and driver are at operating temperature. Thereafter, alignment should be checked periodically in accordance with plant operating procedures.

Alignment Criteria

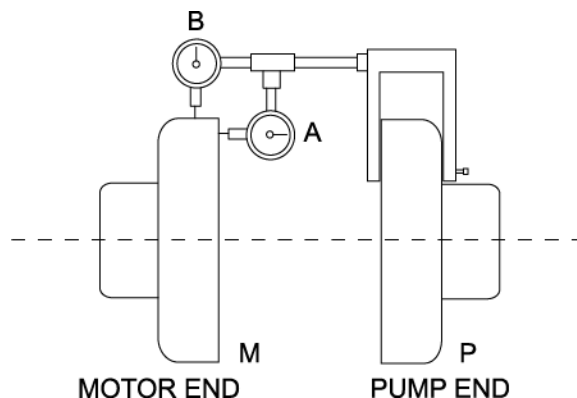
Good alignment is achieved when the dial indicator readings are specified in the alignment procedure as .002 in (.05 mm) Total Indicated Reading (T.I.R.) or less when the pump and driver are at operating temperature (Final Alignment).

During the installation phase, however, it is necessary to set the parallel alignment in the vertical direction to a different criterion due to differences in expansion rates of the pump and driver. Recommended preliminary (cold) settings for electric motor-driven pumps based on different pumpage temperatures are listed in the following table.

Pumpage Temp	Set Driver Shaft
50°F (10°C)	0.002 in (0.05 mm) LOW
122°F (50°C)	0.001 in (0.03 mm) HIGH
302°F (150°C)	0.005 in (0.12 mm) HIGH

Dual-Dial Indicator Alignment Setup

1. Mount two dial indicators on one of the coupling halves *P* so they contact the other coupling half *M*.
2. Check setting of indicators by rotating coupling half *P* to ensure indicators stay in contact with coupling half *M* but do not bottom out. Adjust indicators accordingly.



Alignment – Two-Dial Indicator Method

Measurement

1. To ensure accuracy of indicator readings, always rotate both coupling halves together so indicators contact the same point on coupling half *M*. This will eliminate any measurement problems due to runout on coupling half *M*.
2. Take indicator measurements with driver feet hold-down bolts tightened. Loosen hold-down bolts prior to making alignment corrections.
3. Take care not to damage indicators when moving driver during alignment corrections.

Angular Alignment

A unit is in angular alignment when indicator *A* (Angular Indicator) does not vary by more than .002 in (.05 mm) as measured at four points 90° apart.

Vertical Correction (Top to Bottom)

1. Zero indicator *A* at top dead center (12 o'clock) of coupling half *M*.
2. Rotate indicators to bottom dead center (6 o'clock). Observe needle and record reading.
3. **Negative Reading** – The coupling halves are further apart at the bottom than the top. Correct by either raising the driver feet at the shaft end (add shims) or lowering the driver feet at the other end (remove shims).

Positive Reading – The coupling halves are closer at the bottom than at the top. Correct by either lowering the driver feet at the shaft end (remove shims) or raising the driver feet at the other end (add shims).

4. Repeat steps 1–3 until indicator *A* reads .002 in (.05 mm) or less.

Horizontal Correction (Side to Side)

1. Zero indicator *A* on the left side of coupling half *M*, 90° from top dead center (9 o'clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o'clock). Observe needle and record reading.

3. **Negative Reading** – The coupling halves are further apart on the right side than the left. Correct by either sliding the shaft end of the driver to the left or the other end to the right.

Positive Reading – The coupling halves are closer together on the right side than the left. Correct by either sliding the shaft end of the driver to the right or the other end to the left.

4. Repeat steps 1–3 until indicator *A* reads .002 in (.05 mm) or less.
5. Re-check both horizontal and vertical readings to ensure adjustment of one did not disrupt the other.

Parallel Alignment

A unit is in parallel alignment when indicator *B* (Parallel Indicator) does not vary by more than .002 in (.05mm) as measured at four points 90° apart at operating temperature. Note the preliminary vertical cold setting table for values.

Vertical Correction (Top to Bottom)

1. Zero indicator *B* at top dead center of coupling (12 o'clock) half *M*.
2. Rotate indicator to bottom dead center (6 o'clock). Observe needle and record reading.
3. **Negative Reading** – Coupling half *P* is lower than coupling half *M*. Correct by adding shims of thickness equal to half of the indicator reading under each driver foot.

Positive Reading – Coupling half *P* is higher than coupling half *M*. Correct by removing shims of thickness equal to half of the indicator reading from each driver foot.

NOTE: Equal amounts of shims must be added to or removed from each driver foot. Otherwise, the vertical angular alignment will be affected.

4. Repeat steps 1–3 until indicator *B* reads within .002 in (.05 mm) or less when hot, or per the vertical cold setting table values.

Horizontal Correction (Side to Side)

1. Zero indicator *B* on the left side of the coupling half *M*, 90° from top dead center (9 o'clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o'clock). Observe needle and record reading.
3. **Negative Reading** – Coupling half *M* is to the left of coupling half *P*. Correct by sliding driver evenly in the appropriate direction.

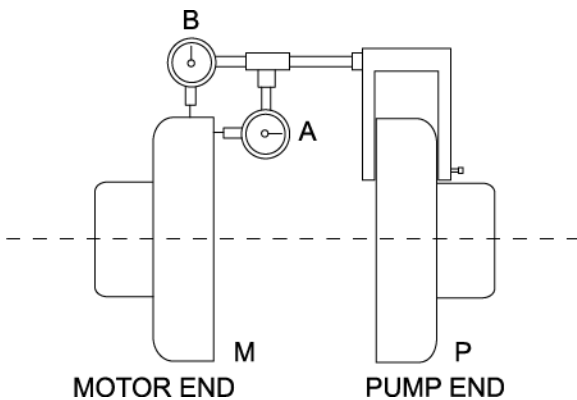
Positive Reading – coupling half *M* is to the right of coupling half *P*. Correct by sliding the driver evenly in the appropriate direction.

NOTE: Failure to slide motor evenly will affect horizontal angular correction.

4. Repeat steps 1–3 until indicator *B* reads .002 in (.05 mm) or less.
5. Re-check both horizontal and vertical readings to ensure adjustment of one did not disrupt the other. Correct as necessary.

Complete Alignment

A unit is in complete alignment when both indicators *A* (angular) and *B* (parallel) do not vary by more than 0.002 in (0.05 mm) as measured at four points 90° apart.



Alignment – Two-Dial Indicator Method

Vertical Correction (Top to Bottom)

1. Zero indicators *A* and *B* at top dead center (12 o'clock) of coupling half *M*.
2. Rotate indicator to bottom dead center (6 o'clock). Observe the needles and record the readings.
3. Make corrections as outlined previously.

Horizontal Correction (Side to Side)

1. Zero indicators *A* and *B* on the left side of coupling half *M*, 90° from top dead center (9 o'clock).
2. Rotate indicators through top dead center to the right side, 180° from the start (3 o'clock). Observe the needle, measure and record the reading.
3. Make corrections as outlined previously.
4. Re-check both vertical and horizontal readings to ensure adjustment of one did not disrupt the other. Correct as necessary.

NOTE: With experience, the installer will understand the interaction between angular and parallel and will make corrections appropriately.

Laser Alignment

Tools exist for a real-time accurate alignment in place of the dual dial indicator method. Please follow the instructions given by the laser equipment manufacturer.

Alignment Troubleshooting

Operate the pump for at least an hour or until it reaches final operating temperature. Shut the pump down and recheck alignment while the pump is hot. Piping thermal expansion may change the alignment. Realign pump as necessary. See table below for possible alignment issues.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Can't obtain horizontal (side to side) alignment, angular or parallel.	Driver feet bolt bound.	Loosen pump hold down bolts and slide pump and driver until horizontal alignment is achieved.
	Baseplate not leveled properly, possibly twisted.	Determine which corner(s) of the baseplate are high or low and remove or add shims at the appropriate corner(s) and realign.
Can't obtain vertical (top to bottom) alignment, angular or parallel.	Baseplate not leveled properly, possibly bowed.	Determine if center of baseplate should be raised or lowered and correct by evenly adding or removing shims at the center of the baseplate.

Existing Grouted Baseplates

When a pump is being installed on an existing grouted baseplate, the procedure is somewhat different from the previous section "New Grouted Baseplates".

1. Mount the pump on the existing baseplate.
2. Level the pump by putting a level on the discharge flange. If not level, adjust the foot piece by adding or deleting shims between the bearing frame and baseplate.
3. Check initial alignment between the pump and driver with a straight edge and correct as needed.
4. Run piping to the suction and discharge flanges of the pump.
5. Perform final alignment.
6. Recheck alignment after pump is hot.

3.3 Piping Connection – Suction/Discharge

All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be airtight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but that do not bottom out in the tapped holes before the joint is tight.

WARNING

Piping Forces:

Take care during installation and operation to minimize pipe forces and/or moments on the pump casing.

Suction Piping

To avoid NPSH and suction problems, suction pipe sizes must be the same or greater than the pump suction connection. **Never** use pipe or fittings on the suction that are smaller in diameter than the pump suction size.

The ideal piping configuration should have a minimum of 10 pipe diameters between the source and the pump suction. In most cases, horizontal reducers should be eccentric and mounted with the flat side on top or up with a maximum of one pipe size reduction. Never mount eccentric reducers with the flat side down. Horizontally mounted concentric reducers should not be used if there is any possibility of entrained air in the process fluid. Vertically mounted concentric reducers are acceptable. In applications where the fluid is completely de-aerated and free of any vapor or suspended solids, concentric reducers are preferable to eccentric reducers.

Avoid the use of throttling valves and strainers in the suction line. Start-up strainers must be removed shortly after startup. When the pump is installed below the source of supply, a valve should be installed in the suction line to isolate the pump and

to permit pump inspection and maintenance. However, never place a valve directly on the suction nozzle of the pump. Refer to the Centrifugal Pump IOM Section of the Hydraulic Institute Standards for additional recommendations on suction piping.

Discharge Piping

Install a valve in the discharge line. This valve is required for regulating flow and/or to isolate the pump for inspection and maintenance.

WARNING

A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

Pump and Shaft Alignment Check

After connecting piping, rotate the pump drive shaft clockwise (view from motor end) several complete revolutions by hand to be sure there is no binding and that all parts are free. Recheck shaft alignment. If piping caused unit to be out of alignment, correct piping to relieve strain on the pump.

3.4 Seal

Specific order requirements may specify that the seal be shipped separately, or none be supplied. It is the pump installer's responsibility to determine if a seal was installed. If a seal was supplied but not installed, use the seal manufacturer's recommendation for installation.

3.5 Coupling

The coupling should be installed as advised by the coupling manufacturer. If the spacer has been installed to facilitate alignment, then it must be removed prior to checking rotation. Remove protective material from the coupling and any exposed portions of the shaft before installing the coupling.

3.6 Safety Guards

WARNING

*Power must **never** be applied to the driver when the coupling and/or seal guards are not installed.*

Guards are safety devices intended to protect workers from the inherent dangers of rotating pump shafts, motor shafts and couplings. Never remove them except for when repairs or maintenance are required. Always reinstall safety devices. The guards are intended to prevent a safety hazard by reaching through or near the guard. Safety guards are not intended to provide complete protection from a disintegration event.

The Centennial coupling guard conforms to the U.S.A. standard ASME B11.19, "Performance Requirements For Risk Reduction Measures: Safeguarding And Other Means Of Reducing Risk."

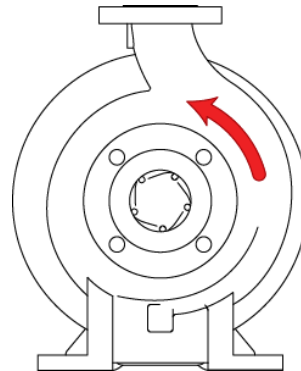
4.0 Operation

4.1 Rotation Check

CAUTION

A direction arrow is cast on the front of the casing. Make sure the motor rotates in the same direction before coupling the motor to the pump.

It is essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time, can dislodge the impeller, which may cause serious damage to the pump. All Centennial pumps turn clockwise as viewed from the motor end, or conversely, counterclockwise when viewed from the suction end.



Pump with Rotation Direction Arrow

4.2 Pre-Startup Checks

Prior to starting the pump, it is essential that the following checks be made.

- Visually check all main and auxiliary piping to ensure that all connections have been properly made.
- Check voltage, fuse, starter amperage ratings and frequency on the motor nameplate against the electrical supply characteristics.
- Visually inspect all electrical connections to the motor and control circuit.
- Check the rotation of the motor by momentarily starting the motor with motor disconnected from the pump assembly. Direction of rotation must be as shown by the arrow on the pump case and the direction of rotation plate on the top of the frame. Starting or running pump backwards will cause damage.
- Pump and motor are properly secured to the baseplate.
- All fasteners tightened to the correct torques.
- Coupling guard in place and not rubbing.
- Impeller clearance setting.
- Bearing lubrication.
- Pump instrumentation is operational.
- Pump is primed.

As a final step in preparation for operation, it is important to rotate the shaft by hand to be certain that all rotating parts move freely and that there are no foreign objects in the pump casing.

Starting

Before starting the pump, it is advisable to have the pump casing and suction line filled with liquid. It is normal to have the discharge valve momentarily closed when the pump is started since much less horsepower is required under these conditions.

DO NOT OPERATE THE PUMP IN A DEAD-HEAD (NO FLOW) CONDITION.

4.3 Startup Considerations

Ensuring Proper NPSHA

Net Positive Suction Head – Available (NPSHA) is the measure of the energy in a liquid above the vapor pressure. It is used to determine the likelihood that a fluid will vaporize in the pump. It is critical because a centrifugal pump is designed to pump a liquid, not a vapor. Vaporization in a pump will result in damage to the pump, deterioration of the Total Differential Head (TDH) and possibly a complete stoppage of pumping.

Net Positive Suction Head – Required (NPSHR) is the decrease of fluid energy between the inlet of the pump and the point of lowest pressure in the pump. This decrease occurs because of friction losses and fluid accelerations in the inlet region of the pump and, particularly, accelerations as the fluid enters the impeller vanes. The value for NPSHR for the specific pump purchased is given in the pump data sheet and on the pump performance curve. For a pump to operate properly the NPSHA must be greater than the NPSHR. Good practice dictates that this margin should be at least 3 ft (1 m) or 20%, whichever is greater.

CAUTION

Ensuring that NPSHA is larger than NPSHR by the suggested margin will greatly enhance pump performance and reliability. It will also reduce the likelihood of cavitation, which can severely damage the pump.

Minimum Flow

Minimum continuous stable flow is the lowest flow at which the pump can operate and still conform to the bearing life, shaft deflection and bearing housing vibration limits of ANSI/ASME B73.1 (latest revision). Pumps may be operated at lower flows, but it must be recognized that the pump may not conform to one or more of these limits and the operating life may be significantly reduced. For example, vibration may exceed the limit set by the ASME H.I. 9.6 standard. The size of the pump, the energy absorbed, and the liquid pumped are some of the considerations in determining the minimum flow. See the following table for general recommendations. Special conditions, such as solids handling, may significantly raise these recommendations.

PUMP SIZE/ DESIGNATION		% BEP	
		@ 3550 / 2950 RPM; 60/50 HZ	@ 1750 / 1450 RPM; 60/50 HZ
1.5x1-6	AA-6	15	10
3x1.5-6	AB-6	15	10
3x2-6	AC-6	15	10
1.5x1-8	AA-8	20	10
3x1.5-8	A50-8	20	10
3x2-8	A60-8	20	10
4x3-8	A70-8	20	10
2x1-10	A05-10	25	10
3x1.5-10	A50-10	25	10
3x2-10	A60-10	30	15
4x3-10	A70-10	30	15
6x4-10	A80-10	30	15
3x1.5-13	A20-13	30	15
3x2-13	A30-13	40	15
4x3-13	A40-13	40	40
6x4-13	A80-13	-	40
8x6-13	A90-13	-	40
6x4-15	A105-15	-	50
8x6-15	A110-15	-	50
10x8-17	A120-15	-	50

All pumps also have a “Minimum Thermal Flow.” This is defined as the minimum flow that will not cause an excessive temperature rise. Minimum Thermal Flow is application dependent.

WARNING

Do not operate the pump at or below Minimum Thermal Flow, as this could cause an excessive temperature rise. Contact a Centennial Pump Company Sales Engineer for determination of Minimum Thermal Flow.

4.4 Starting the Pump and Adjusting Flow

1. Open the suction valve to full-open position. It is very important to leave the suction valve open while the pump is operating. Any throttling or adjusting of flow must be done through the discharge valve. Partially closing the suction valve can create serious NPSH and pump performance problems or even severe damage.

DANGER

Never operate pump with both the suction and discharge valves closed. This could cause an explosion.

2. A standard centrifugal pump will not move liquid unless the pump is primed. A pump is said to be “primed” when the casing and the suction piping are completely void of air. Open the discharge valve a slight amount. This will allow any entrapped air to escape and will allow the pump to prime if the suction source is above the pump. When a condition exists where the suction pressure drops below the pump’s capability, it is advisable to add a low-pressure control device to shut the pump/motor down when the pressure drops below a predetermined minimum value.
3. All cooling, heating and flush lines must be started and regulated.
4. Start the driver (typically an electric motor).
5. Slowly open the discharge valve until the desired flow is reached, keeping in mind the minimum flow restrictions listed above.

DANGER

It is important that the discharge valve be opened within a short interval after starting the driver. Failure to do this could cause a dangerous build-up of heat and possibly an explosion.

6. Reduced Capacity

Avoid running a centrifugal pump at drastically reduced capacities or with the discharge valve closed for extended periods of time. Operating in this capacity could result in the liquid in the pump reaching its boiling point. If this occurs, the seal may be damaged, as it will have no lubrication and may score or seize to the stationary parts. It is also possible that it can create an explosive condition. If the suction valve is simultaneously closed, there is an even greater risk of a catastrophic failure.

Thermocouples may be used to safeguard against overheating by shutting down the pump at a predetermined temperature.

Pump safeguards should also be used to prevent operation with a closed discharge valve. This may be accomplished by installing a bypass back to the suction source. The size of the bypass line and the required bypass flow rate is a function of the input horsepower and the allowable temperature rise.

7. Reduced Head

Note that when discharge head drops, the pump's flow rate usually increases rapidly. Check motor for temperature rise as this may cause an overload in flow. If flow overloading occurs, adjust the discharge valve.

8. Surging Condition

A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

4.5 Thermal Shock Instructions

Centennial pumps can be used to handle liquids ranging from temperatures as low as 39.2°F (4°C) to as high as 500°F (260°C). Applications at either high or low temperatures, or ones involving temperature fluctuations greater than 100 °F (38°C), may require modifications of the standard pump design to provide resistance to thermal shock. Never exceed the pressure or temperature limitations of the pump. For thermal shock start-up instructions, please contact the manufacturer.

4.6 Operation to prevent Freezing Conditions

When using the pump in sub-freezing conditions especially if the pump is periodically idle, special attention should be given to the temperature. The pump should be properly drained or protected with thermal insulating devices which will keep the liquid in the pump from freezing.

4.7 Shutdown Considerations

When the pump is being shut down, the procedure should be the reverse of the start-up procedure. First, slowly close the discharge valve, shut down the driver and then close the suction valve. Remember, closing the suction valve while the pump is running is a safety hazard and could seriously damage the pump and other equipment.

5.0 Preventive Maintenance

5.1 General Servicing

It is recommended that the pump be inspected at regular intervals. It is also suggested that a service record be kept for the pump. A procedure for keeping accurate maintenance records is a critical part of any program to improve pump reliability. There are many variables that can contribute to pump failures. Analyzing these variables through pump maintenance records can often solve long-term and repetitive problems.

Motor

Refer to the motor manufacturer's manual for recommended service instructions. It is recommended that the motor is well ventilated when in operation because of the potential of heat build-up.

5.2 Periodic Servicing

The following table contains recommended service checks that should be performed on a periodic basis.

	After First Start-Up	Every Week	Every 6 Months
Flow, Pressure, Temperature (a)	X	X	
Visual (b)	X	X	
Noise / Vibration	X	X	
Oil Level	X	X	

- a. **Flow, Pressure, Temperature:** All flow, pressure and temperature gauges should be monitored to ensure that the pump is operating within specified limits. If the frame temperatures are monitored, this temperature generally should not exceed 160°F (71.1°C).
- b. **Visual:** Periodic visual inspection should be made of the pump and its installation.

This inspection should include the following:

1. All mounting supports should be secure.
2. All external nuts, bolts and fittings should be tight.
3. All suction and discharge piping should be secure.
4. All surfaces and joints should show no signs of leakage, corrosion or wear.

Need for Cleanliness

One of the major causes of pump failure is the presence of contaminants in the bearing housing. This contamination can be in the form of moisture, dust, dirt or other solid particles, such as metal chips. Contamination can also be harmful to the pump-shaft seal (especially the seal faces) as well as other parts of the pump. It is very important that proper cleanliness be maintained.

5.3 Maintenance Troubleshooting

The following is a guide to troubleshooting problems with pumps. Common problems are reviewed with suggested solutions.

It is impossible to cover every possible scenario. If a problem exists that is not covered by one of the examples, then contact your Distributor for assistance.

See next page.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Pump not reaching design flow rate. Problem #1	Insufficient NPSH.	Recalculate NPSH available. It must be greater than the NPSH required by pump at desired flow. If not, redesign suction piping, holding the number of elbows and number of planes to a minimum to avoid adverse flow rotation as it approaches the impeller.
	System head greater than anticipated.	Reduce system head by increasing the pipe size and/or reducing the number of fittings.
	Entrained air. Air leak from atmosphere on suction side.	Check suction line gaskets and threads for tightness. If vortex formation is observed in the suction tank, install vortex breaker. Check for minimum submergence.
	Entrained gas from process.	Process-generated gases may require larger pumps.
	Speed too low.	Check motor speed against design speed.
	Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three-phase motor. The pump should be disassembled and inspected before it is restarted.
	Impeller too small.	Replace with proper diameter impeller. NOTE: Increasing impeller diameter may require use of a larger motor.
	Impeller clearance too large.	Reset impeller clearance.
	Plugged impeller, suction line or casing, which may be due to a product or large solids.	Reduce length of fiber when possible. Reduce solids in the process fluid when possible. Consider larger pump.
Wet-end parts (casing cover, impeller) worn, corroded or missing.	Replace part or parts.	
Pump not reaching design head (TDH). Problem #2	Refer to possible causes under Problem #1.	Refer to remedies listed for Problem #1 & #3.
No discharge or flow. Problem #3	Not properly primed.	Repeat priming operation and recheck instructions. If pump has run dry, disassemble and inspect the pump before operation.
	Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three-phase motor. The pump should be disassembled and inspected before operation.
	Entrained air. Air leak from atmosphere on suction side.	Check suction line gaskets and threads for tightness. If vortex formation is observed in suction tank, install vortex breaker. Check for minimum submergence.
	Plugged impeller and/or suction line casing, which may be due to a fibrous product or large solids.	Reduce length of fiber when possible. Reduce solids in the process fluid when possible. Consider larger pump.
	Damaged pump shaft and/or impeller.	Replace damaged parts.
Pump operates for short period, then loses prime. Problem #4	Insufficient NPSH.	Recalculate NPSH available. It must be greater than the NPSH required by pump at desired flow. If not, redesign suction piping, holding the number of elbows and number of planes to a minimum to avoid adverse flow rotation as it approaches the impeller.

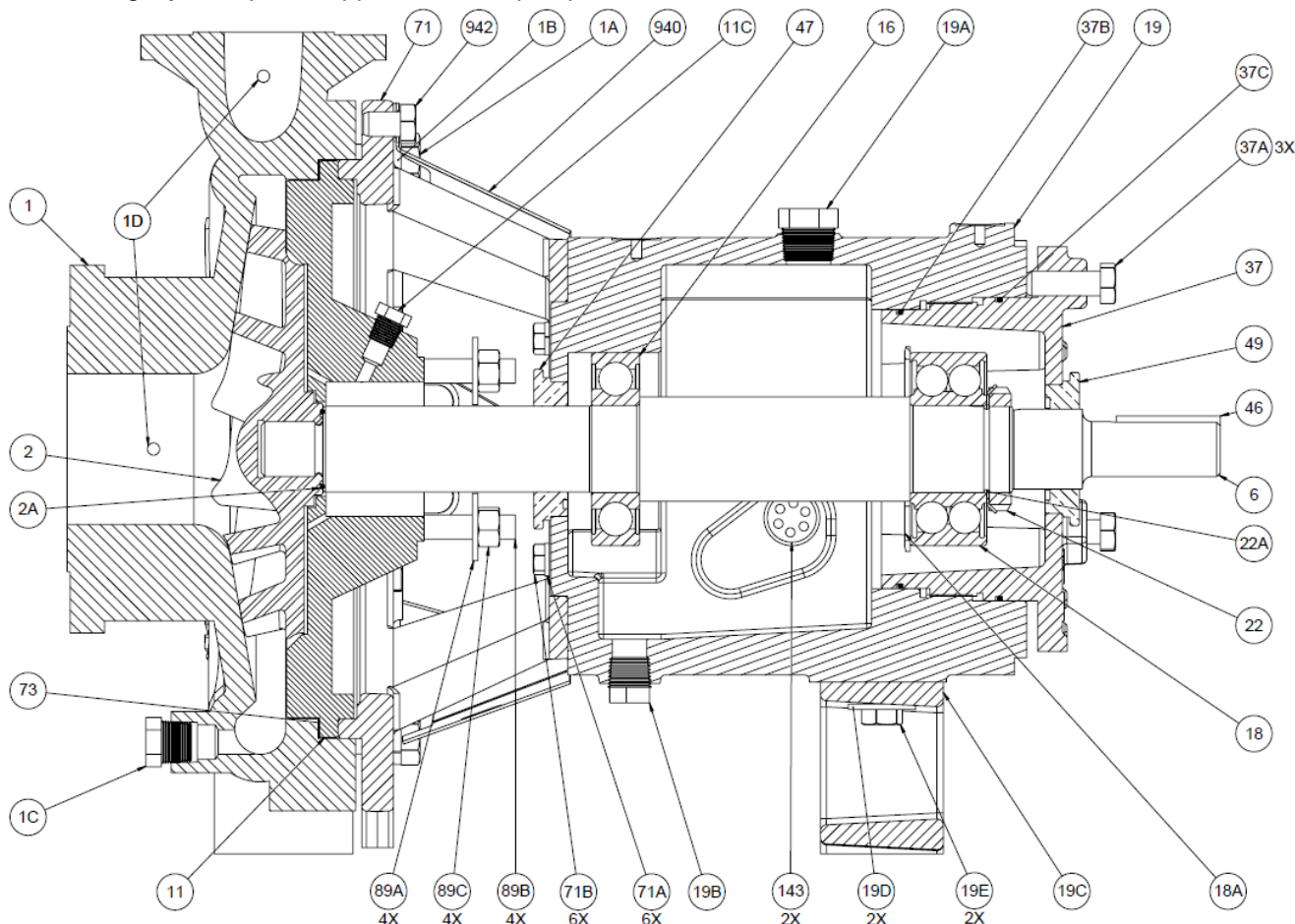
PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
	Entrained air. Air leak from atmosphere on suction side.	Check suction line gaskets and threads for tightness. If vortex formation is observed in the suction tank, install vortex breaker. Check for minimum submergence.
Excessive noise from wet end. Problem # 5	Cavitation – insufficient NPSH available.	Recalculate NPSH available. It must be greater than the NPSH required by pump at desired flow. If not, redesign suction piping, holding the number of elbows and number of planes to a minimum to avoid adverse flow rotation as it approaches the impeller.
	Abnormal fluid rotation due to complex suction piping.	Redesign suction piping, holding the number of elbows and number of planes to a minimum to avoid adverse fluid complex suction piping rotation as it approaches the impeller.
	Impeller rubbing.	Check and reset impeller clearance. Check outboard bearing assembly for axial endplay.
Excessive noise from power end. Problem #6	Bearing contamination appearing on the raceways as scoring, pitting, scratching or rusting caused by adverse environment and entrance of abrasive contaminants from atmosphere.	Replace bearings. Work with clean tools in clean surroundings. Remove all outside dirt from housing before exposing bearings. Handle with clean, dry hands. Treat a used bearing as carefully as a new one. Use clean solvent and flushing oil. Protect disassembled bearing from dirt and moisture. Keep bearings wrapped in paper or clean cloth while not in use. Clean inside of housing before replacing bearings. Check oil seals and replace as required. Check all plugs and tapped openings to make sure that they are tight.
	Brinelling of bearing identified by indentation on the ball races, usually caused by incorrectly applied forces in assembling the bearing or by shock loading such as hitting the bearing or drive shaft with a hammer.	Replace bearings. When mounting the bearing on the drive shaft use a proper size ring and apply the pressure against the inner ring only. Be sure, when mounting a bearing, to apply the mounting pressure slowly and evenly.
	False brinelling of bearing identified by either axial or circumferential indentations usually caused by vibration of the balls between the races in a stationary bearing.	Replace bearings. Where bearings are oil lubricated and employed in units that may be out of service for extended periods, the drive shaft should be turned over periodically to relubricate all bearing surfaces at intervals of one to three months. Correct the source of vibration.
	Thrust overload on bearing identified by flaking ball path on one side of the outer race or, in the case of maximum capacity bearings, may appear as a spalling of the races in the vicinity of the loading slot. These thrust failures are caused by improper mounting of the bearing or excessive thrust loads.	Replace bearings. Follow correct mounting procedures for bearings.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
(Cont.) Excessive noise from power end. Problem #6	Misalignment identified by fracture of ball retainer or a wide ball path on the inner race and a narrower cocked ball path on the outer race. Misalignment is caused by poor mounting practices or defective drive shaft. For example, bearing not square with the centerline or possibly a bent shaft due to improper handling.	Replace bearings. Handle parts carefully and follow recommended mounting procedures. Check all parts for proper fit and alignment.
	Bearing damaged by electric arcing identified as electro-etching of both inner and outer ring or as pitting or cratering. Electrical arcing is caused by a static electrical charge emanating from belt drives, electrical leakage or short-circuiting.	Replace bearings. Where current shunting through the bearing cannot be corrected, a shunt in the form of a slip-ring assembly should be incorporated. Check all wiring, insulation and rotor windings to be sure that they are sound, and all connections are properly made. Where pumps are belt driven, consider the elimination of static charges by proper grounding or consider belt material that is less generative.
	Bearing damage due to improper lubrication, identified by one or more of the following: Abnormal bearing temperature rise A stiff, cracked grease appearance. A brown or bluish discoloration of the bearing races.	Replace bearings. Be sure the lubricant is clean. Be sure proper amount of lubricant is used. In the case of greased, lubricated bearings, be sure that there is space adjacent to the bearing into which it can rid itself of excessive lubricant; otherwise, the bearing may overheat and fail prematurely. Be sure the proper grade of lubricant is used.

6.0 Centennial Disassembly and Reassembly

The following sections of this manual give instructions on how to perform a complete maintenance overhaul. However, it is also important to periodically repeat the "Pre-startup checks" listed in section 4.2. These checks will help extend pump life as well as the length of time between major overhauls.

Note: The pictures in the following section represent typical parts to clarify assembly. Details of the parts may differ slightly from parts supplied with the pump.



ITEM NO.	DESCRIPTION
1	CASING
1A	CASING BOLTS
1B	CASING WASHERS
1C	CASING DRAIN PLUG*
1D	CASING SUCTION/DISCHARGE PLUG*
2	IMPELLER
2A	IMPELLER O-RING
6	SHAFT
11	SEAL HOUSING
11A	SEAL HOUSING LOCKWASHER**
11B	SEAL HOUSING BOLTS**
11C	SEAL HOUSING PLUG
16	BEARING, RADIAL
18	BEARING, THRUST
18A	SNAP RING
19	FRAME
19A	OIL FILL PLUG
19B	OIL DRAIN PLUG
19C	FRAME FOOT
19D	FOOT WASHER*
19E	FOOT BOLT*

ITEM NO.	DESCRIPTION
22	BEARING LOCK NUT
22A	BEARING LOCK WASHER
37	BEARING CARRIER
37A	LOCK BOLT, BEARING CARRIER
37B	O-RING, BEARING CARRIER
37C	O-RING, BEARING CARRIER
46	SHAFT KEY
47	INBOARD BEARING ISOLATOR
49	OUTBOARD BEARING ISOLATOR
71	BRACKET
71A	BRACKET LOCKWASHER
71B	BRACKET BOLT
73	CASE GASKET
89	MECHANICAL SEAL (NOT SHOWN)
89A	WASHER, MECH. SEAL
89B	STUD, MECH. SEAL
89C	NUT, MECH. SEAL
143	OIL SIGHT GLASS
940	SEAL GUARD, RIGHT
941	SEAL GUARD, LEFT (NOT SHOWN)
942	MOUNTING BOLT, SEAL GARD

* Not on all assemblies. ** Not shown, see pg. 27.

6.1 Disassembly

1. Before performing any maintenance, disconnect the driver from its power supply and lock it offline.

DANGER

Lock out power to driver to prevent personal injury.

2. Close the discharge and suction valves and drain all liquid from the pump.
3. Close all valves on auxiliary equipment and piping, then disconnect all piping.
4. Decontaminate the pump, as necessary.

DANGER

If Centennial pumps contain dangerous chemicals, it is important to follow plant safety guidelines to avoid personal injury or death.

5. Remove the coupling guard.
6. Remove the spacer from the coupling.
7. Disconnect any seal drain piping.
8. Remove the fasteners holding the frame (19) and case (1) to the baseplate. Remove pump and relocate to a workstation.

CAUTION

It is important to follow plant safety guidelines when lifting pump components.

9. Remove drain plug (19B) and drain oil from the frame (19). Replace drain plug when done.
10. Remove the coupling hub from the pump shaft (6).
11. Remove the casing bolts (1A) holding the casing to the bracket (71), remove casing (1) and discard the casing gasket (73).

12. Mount a shaft key (46) and a shaft wrench to the end of the shaft (6). With the wrench handle pointing to the left when viewed from the impeller end, grasp the impeller (2) firmly with both hands (wear heavy gloves) and then rotate it until the wrench handle is at the 11 o'clock position; next, spin the impeller (2) quickly in a counterclockwise direction so that the wrench end makes a sudden impact with a hard surface. After several sharp raps, the impeller should be loose. The shaft wrench can be fabricated locally, per the shaft wrench drawing (see Appendix A).

13. Unscrew the impeller (2) and remove it from the shaft (6).

DANGER

Do not apply heat to the impeller. An explosion could occur.

14. Loosen and remove the three lock bolts (37A) on the bearing carrier (37).
15. Remove the bearing carrier assembly with the shaft (6) and bearings (16 & 18) from the frame (19) by spinning the assembly counterclockwise as seen from the key-end of the shaft.
16. Remove the O-rings (37B & 37C) from the bearing carrier (37) and discard them.

Further disassembly is not required unless the bearings (16 & 18) are to be replaced.

Replacing the Bearings

1. Remove the snap ring (18A) from the groove on the inside of the bearing carrier (37).
2. Remove shaft assembly from the inside of the bearing carrier (37).
3. Bend out the necessary tabs of the thrust bearing lock washer (22A) to allow for free rotation of the thrust bearing locknut (22).
4. The thrust bearing locknut (22) may now be removed from the shaft (6).

- An arbor or hydraulic press may be used to remove the bearings (16 & 18) from the shaft (6). It is extremely important to apply even pressure to the inner bearing race only. Never apply pressure to the outer race as this exerts excess load on the balls and causes damage. We recommend that all bearings be replaced after disassembly.

CAUTION

Applying pressure to the outer race could permanently damage the bearings.

6.2 Cleaning/Inspection

All parts should now be thoroughly cleaned and inspected. New bearings, O-rings, gaskets and oil seals should be used. Any parts that show wear or corrosion should be replaced with OEM Centennial parts.

Casing

- Thoroughly clean gasket surfaces and alignment fits to remove rust and debris.
- Inspect for any unusual erosive wear in volute.

Impeller

- Inspect leading and trailing edges of vanes for pitting, erosion or corrosion damage.

Frame

- Inspect frame (19), bracket (71) and frame foot (19C) for cracks.
- Inspect for corrosion or pitting if frame (19) has been exposed to pumpage.
- Inspect shaft (6) for wear.
- Inspect frame (19) bearing bores for roundness.

WARNING

It is important that only nonflammable, noncontaminated cleaning fluids are used. These fluids must comply with plant safety and environmental guidelines.

6.3 Critical Measurement and Tolerances

To maximize reliability of pumps, it is important that certain dimensions are within specified tolerances. Any parts that do not conform to the specifications should be replaced with new Centennial parts.

Shaft

The seal-mounting surface includes the shaft (6) or shaft sleeve (14) outside diameter within the seal housing (11) and extends beyond to accommodate outside seals. To provide for the possible use of a mechanical seal, the tolerance of that diameter shall not exceed nominal minus 0.002 in. (0.05 mm).

Shaft runout shall be limited as follows:

- Shaft rotated on centers: 0.001 in. (0.025mm) full indicator movement reading at any point.
- Outside diameter of shaft (6) when installed on pump: 0.002 in. (0.05mm) full indicator movement at the gland end of the seal housing.

6.4 Assembly

Required Supplies

In order to assemble the pump, there are lubricants, anti-seize and other items required in the process. The table below identifies these special supplies.

Description	Brand/Part Number/ Application
Anti-Seize	LOCTITE Nickel Anti-Seize (LB 771) or equivalent
Grease	DOW MOLYKOTE™ 111 Silicone Lubricant
Pipe Sealant	LOCTITE 565 PST Thread Sealant or P.T.F.E Thread Tape
Lubricating oil	ISO VG 32 oil. See Lubrication

The torque applied to a screw or bolt is mainly dependent on the size, material, and type of lubricant on the threads. Torque values are based on industry standards for lubricated fasteners.

Thread Size	Torque Value
3/8-16	15 FT-LBS
5/8-11	70 FT-LBS
3/4-10	100 FT-LBS

NOTE

All O-rings require oil lubrication to aid in assembly. All threaded parts require Anti-seize compound to aid in future disassembly.

CAUTION

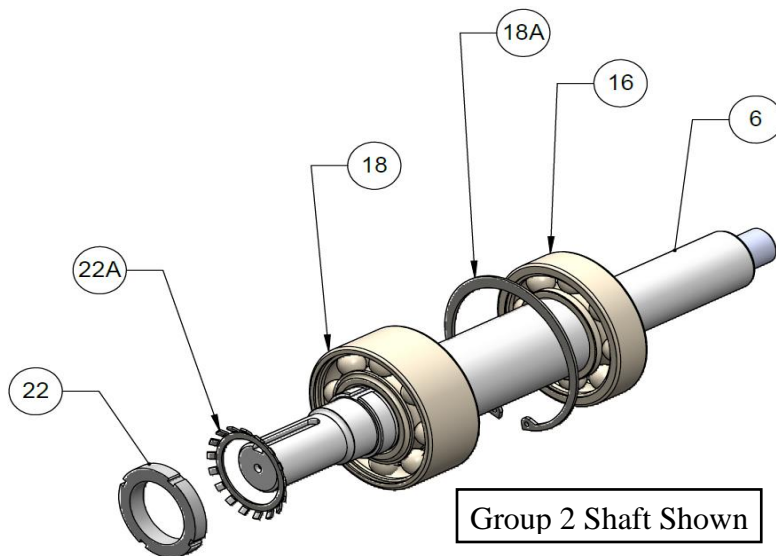
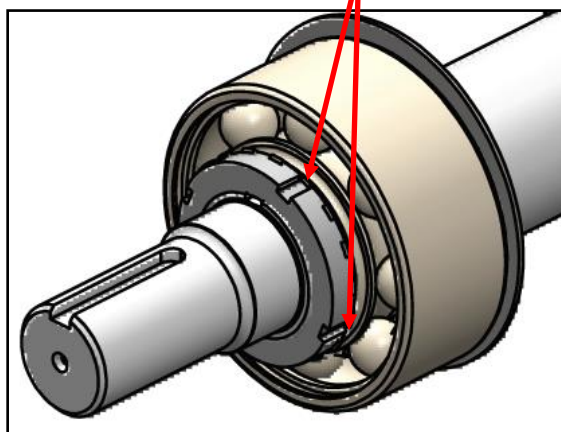
Never heat the bearings (16 & 18) above 230°F (110°C). Doing so may cause damage.

Power Frame - Bearings

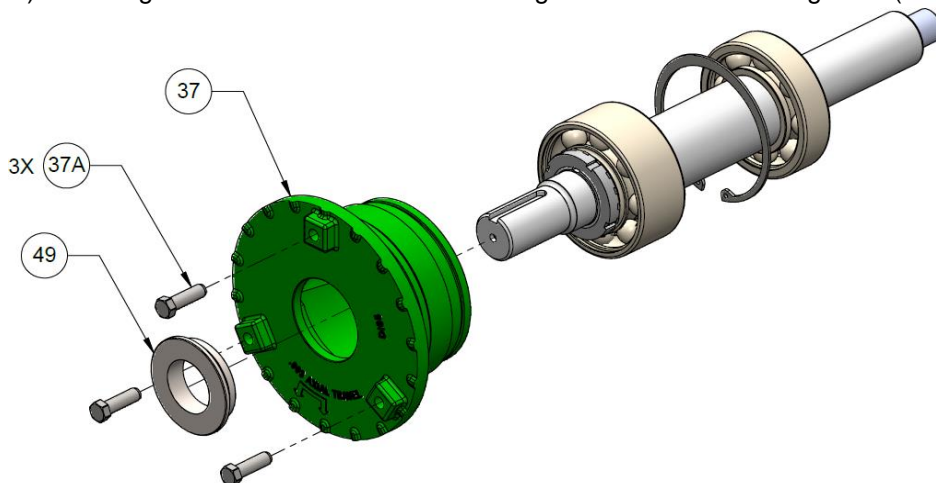
The Bearing Unit assembly is designed to wear together and is replaced as a unit. However, if parts are to be inspected or replaced, it may require disassembly and reassembly. The below procedure assumes replacement parts are available and ready for assembly.

1. Heat bearings (16 & 18) to a temperature of 175° – 200°F using a bearing induction heater. The temperature will allow the bearing to slide onto the shaft without damage. Install thrust bearing (18) onto shaft (6), being sure that it fully bottoms. It may be helpful to this with the shaft in an upright position or using a special shaft vise.
2. Place snap ring (18A) in position on shaft (6) as it is not easy to install after both bearings have been seated. Note orientation—the beveled side of the snap ring must face away from the thrust bearing (18).

Locknut Keyways

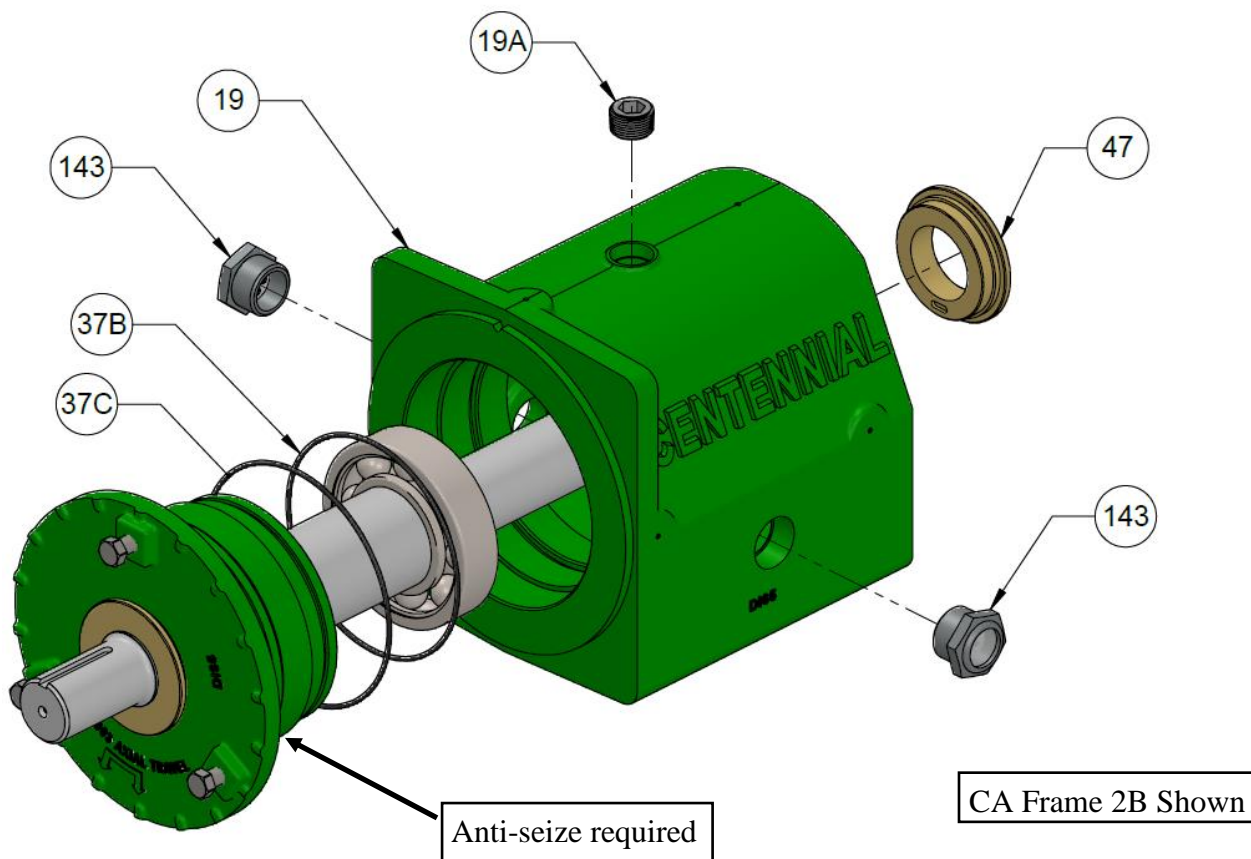


3. Install radial bearing (16) on shaft (6) against front bearing shoulder, being sure that it fully bottoms.
4. With bearings (16 & 18) cool, install thrust bearing lock washer (22A) on shaft (6). Ensure inner tang locates in the keyway of the shaft. Install thrust bearing locknut (22) on shaft and tighten against lock washer by hand. Once hand tight, torque to a tightening angle of 90 degrees with a spanner wrench or similar tool. Note orientation, with beveled corner facing the bearing.
5. Bend at least one tab into the four keyways of the thrust bearing lock nut (22), ensuring that the lock washer prevents the lock nut from rotating. Install bearing isolator (49) into the bearing carrier (37) using a press. Verify it is fully seated.
6. Insert shaft assembly with bearings into the bearing carrier (37). Be sure to lubricate shaft (6) with lubricant provided by Isolator Manufacturer. The thrust bearing (18) should seat inside the carrier. Secure together using snap ring (18A) into the groove on the inside of the bearing carrier. Thread locking bolts (37A) into bearing carrier.



Power Frame

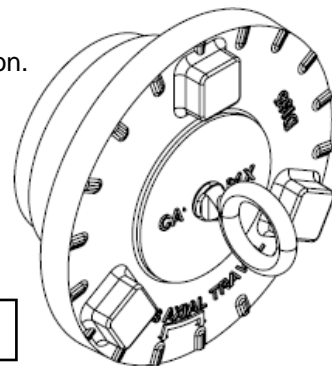
1. Install the bearing isolator (47) into the frame (19) using a press. Ensure that the oil return hole slot is located at the 6 o'clock position, allowing oil to drain from the isolator. Verify it is fully seated. Larger-sized frames have lifting carriers for lifting purposes as the frames get larger and heavier. (Please see chart and figure at bottom of page)
2. Spread anti-seize onto the fine threads of the bearing carrier (37). Install the two bearing carrier O-rings (37B, 37C) in the grooves on the bearing carrier. Lubricate generously with the same oil to be used for the bearings. Recommended ISO viscosity grade 32 for standard installations.



3. Lubricate the shaft (6) and the inboard bearing isolator (47) with lubricant provided by the isolator manufacturer. Insert the bearing carrier assembly into the frame (19), being sure to align the radial bearing (16) into the frame. Take care so that the two O-rings are not damaged.
4. Assemble together by threading the bearing carrier (37) into the frame (19). The assembly should go together by hand, but tools may aid in ease of assembly. Tighten the bearing carrier until it bottoms inside the frame.
5. Install sight glasses (143) with PTFE Thread tape or Thread Sealant. At this point, install Oil fill plug (19A) finger tight only, as it will need to be removed to add oil before operation.

Frame Size	Lifting Carrier Part #
Group 1	EQPT658-01
Group 2	EQPT658-02
Group 3	EQPT658-03

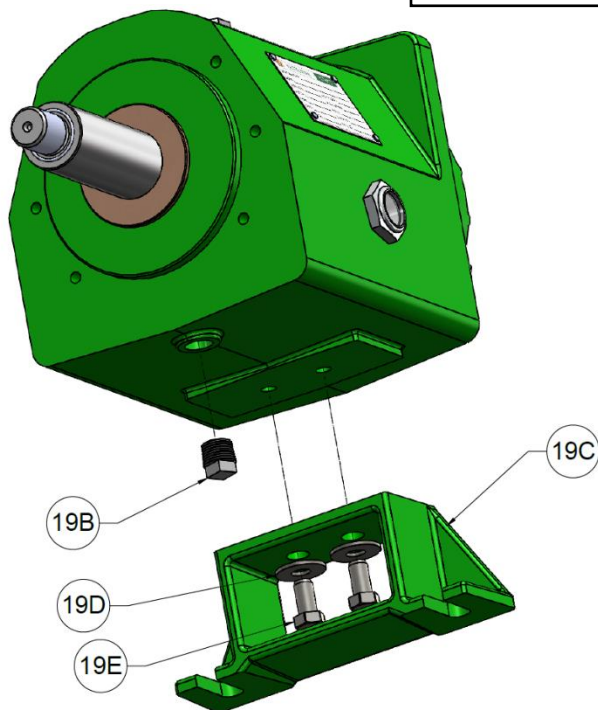
CA Frame 3 Lifting Tool



Mounting Foot

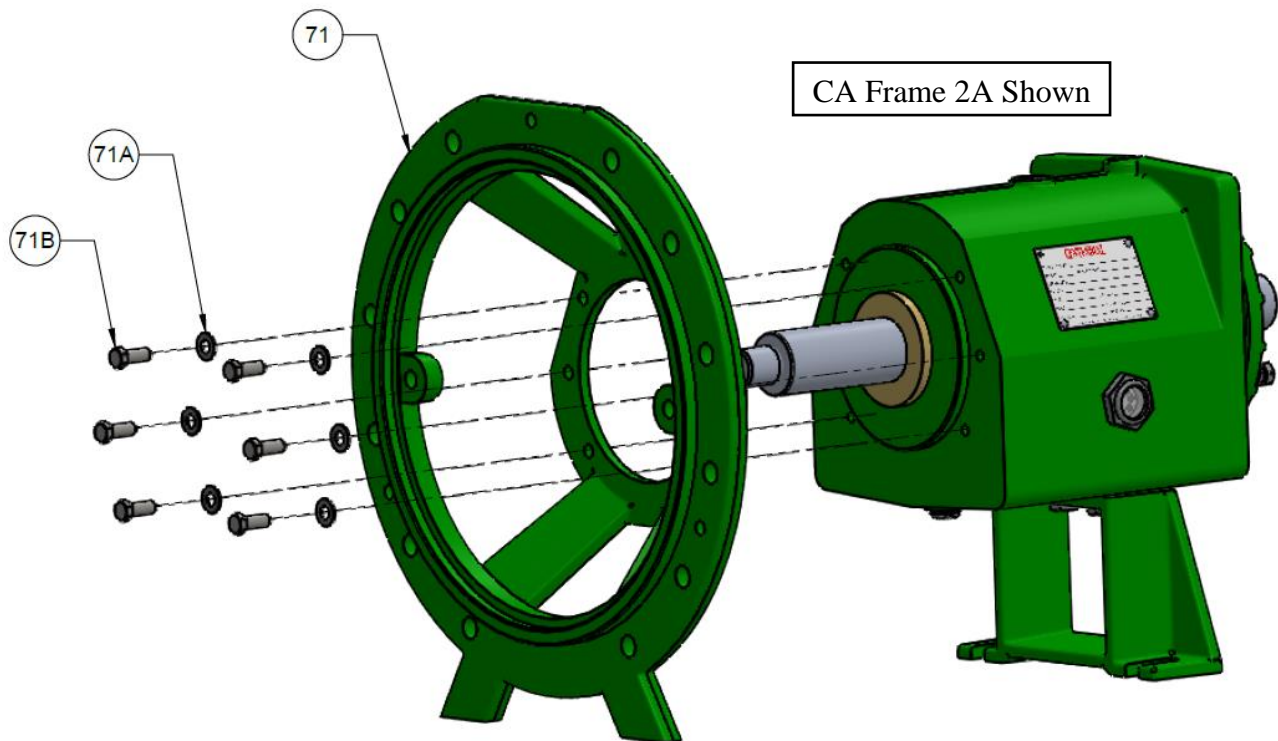
CA Frame 2A Shown

1. If not cast into the frame, assemble the mounting foot (19C) to the frame (19) using the foot bolts (19E) and foot washers (19D). Note orientation, allowing for back pull-out functionality. As shown in the image, the mounting foot slots should open towards the impeller side of the pump.
2. Thread the drain plug (19B) into the frame (19) making sure to use PTFE tape or thread sealant on the pipe threads.



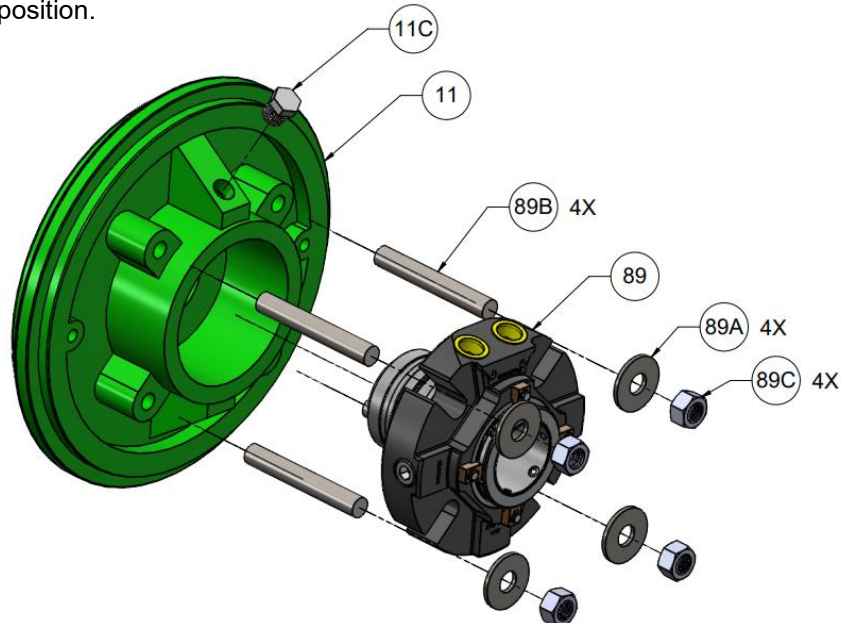
Bracket

1. Locate the bracket (71) onto the frame Assembly. Using bracket bolts (71B) and washers (71A), secure the bracket to the frame Assembly.

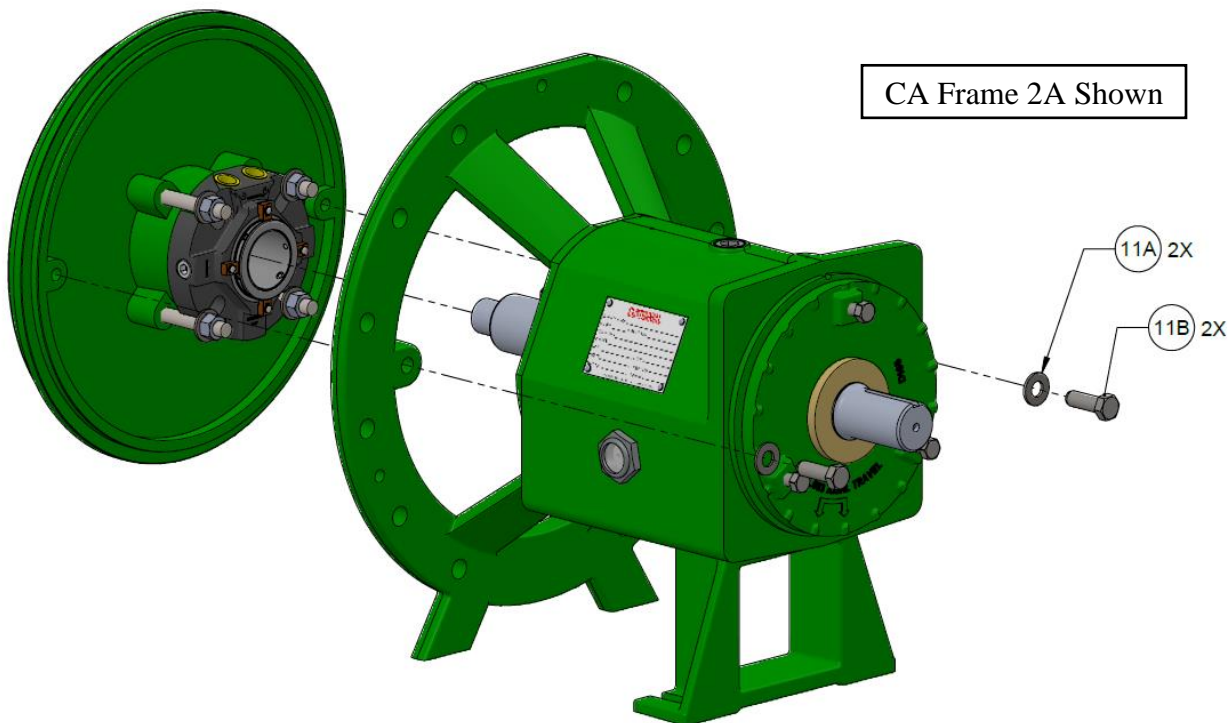


Seal Housing – Mechanical Seal

1. Install seal studs (89B) into seal housing (11) making sure that they bottom-out completely. If applicable, install the seal housing plug (11C) with P.T.F.E. tape or equivalent with the port at the 12 o'clock position.
2. Slide mechanical seal (89) onto seal studs (89B) and capture by installing the seal washers (89A) and seal nuts (89C). **At this point, only install to finger tight.** Verify any relevant flush ports on the seal housing (11) are at the 12 o'clock position.

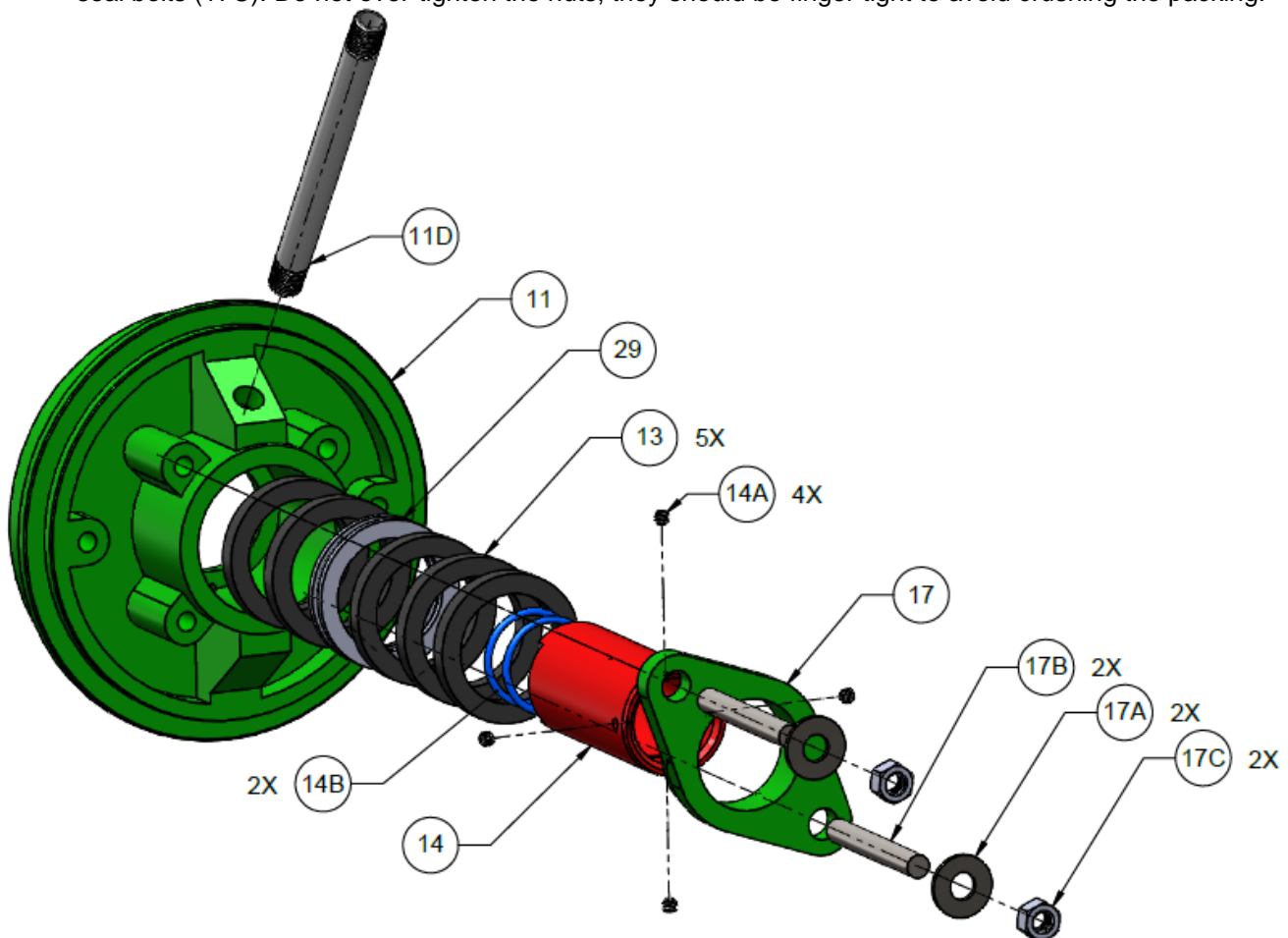


3. Lubricate shaft (6) and seal O-rings with lubricant provided by the seal manufacturer. Always follow the seal vendor's instruction procedure during assembly. Ensure that any flush or drain ports on the seal are oriented correctly. Carefully bring the seal housing assembly to the bracket (71). Guide the mechanical seal over the shaft nose and onto the shaft. Damage could occur if care is not taken.
4. Locate the seal housing assembly to the bracket (71) using the seal housing bolts (11B) and washers (11A). Tighten securely to the appropriate torque specification. Larger-sized seal housings have threaded holes for lifting purposes as the part(s) get larger and heavier.



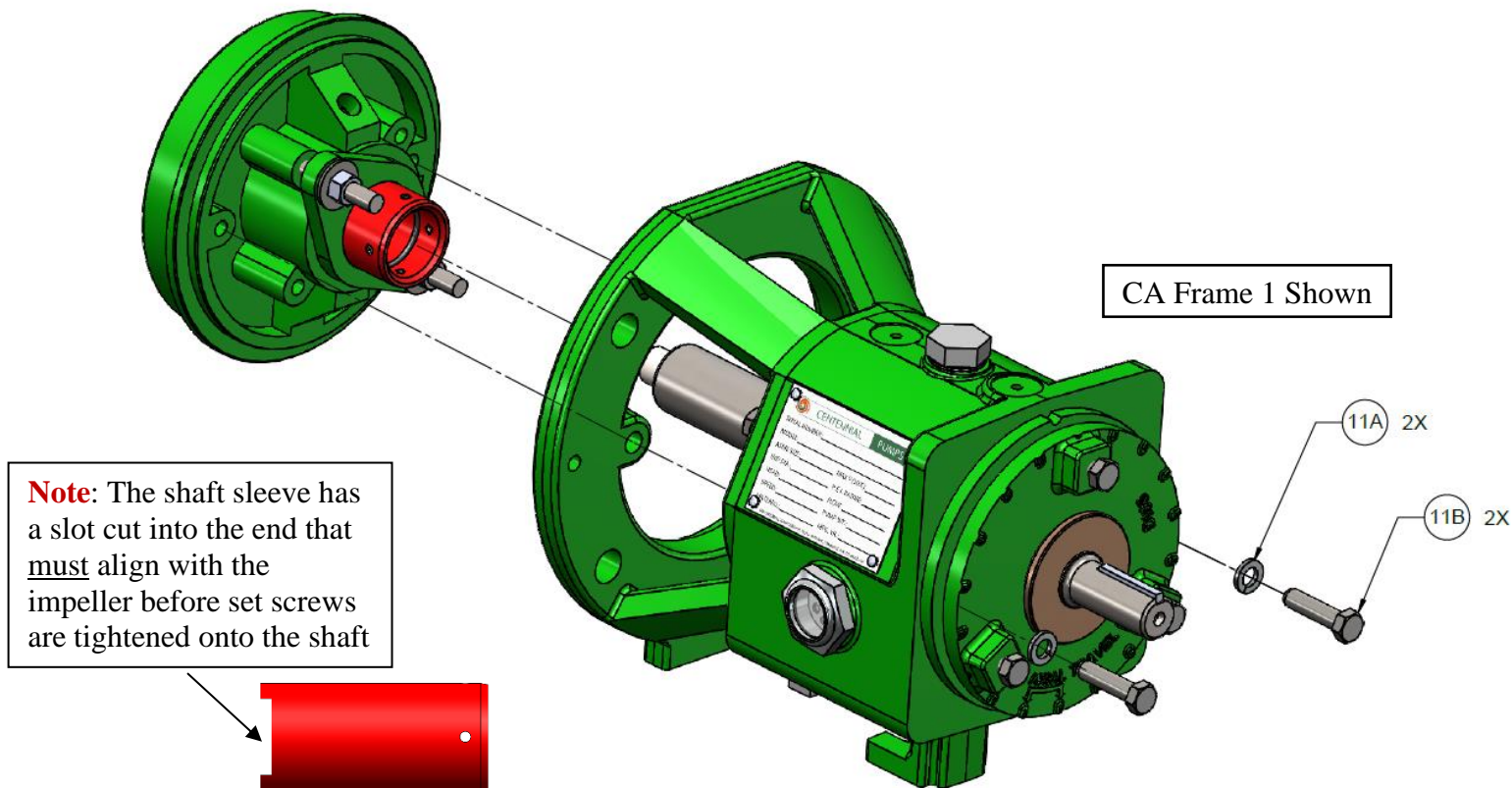
Seal Housing – Packing

1. Install seal studs (17B) into the seal housing (11), making sure that they bottom-out completely.
2. Slide two packing rings (13), the lantern ring (29) and three more packing rings into the bore of the seal housing (11). Be sure to stagger the seams of each packing ring by 45 degrees from the previous ring, to avoid creating a leak path.
3. Insert the two O-rings (14B) into the inside grooves of the shaft sleeve (14). Partially thread the shaft sleeve set screws (14A) into the shaft sleeve, making sure they do not extend into the inner diameter of the sleeve.
4. Slide the shaft sleeve (14), with the notch toward the seal housing, into the center of the packing rings until it is even with the inside face of the seal housing.
5. Guide the gland (17) onto the two seal studs (17B), securing it in place with the seal washers (17A) and seal bolts (17C). Do not over-tighten the nuts, they should be finger tight to avoid crushing the packing.



6. Lubricate shaft (6) and seal O-rings (14B). Carefully bring the seal housing assembly to the bracket (71). Guide the packing seal over the shaft nose and onto the shaft. Damage could occur if care is not taken.
7. Locate the seal housing assembly to the bracket (71) using the seal housing bolts (11B) and washers (11A). Tighten securely to the appropriate torque specification. Larger-sized seal housings have threaded holes for lifting purposes as the part(s) get larger and heavier.
8. **After** the seal housing assembly is installed, install the pipe nipple (11D) with P.T.F.E. tape or equivalent with the port at the 12 o'clock position.

- To ensure that the impeller (2) and shaft sleeve (14) are properly engaged, follow the procedure found in the next section, *Impeller Installation*. On step three, after several threads are engaged, slide the shaft sleeve forward until the interlocking tabs are engaged with the impeller. Tighten the impeller the rest of the way, until it bottoms on the end of the shaft. With the impeller tight, push the shaft sleeve towards the impeller to ensure it is fully seated. Tighten shaft sleeve set screws (14A).



- For operation and maintenance of weep-style packing seal, please refer to the packing manufacturer's recommended guidelines. The following chart lists recommended flushing water for each group of Centennial Acid pumps.

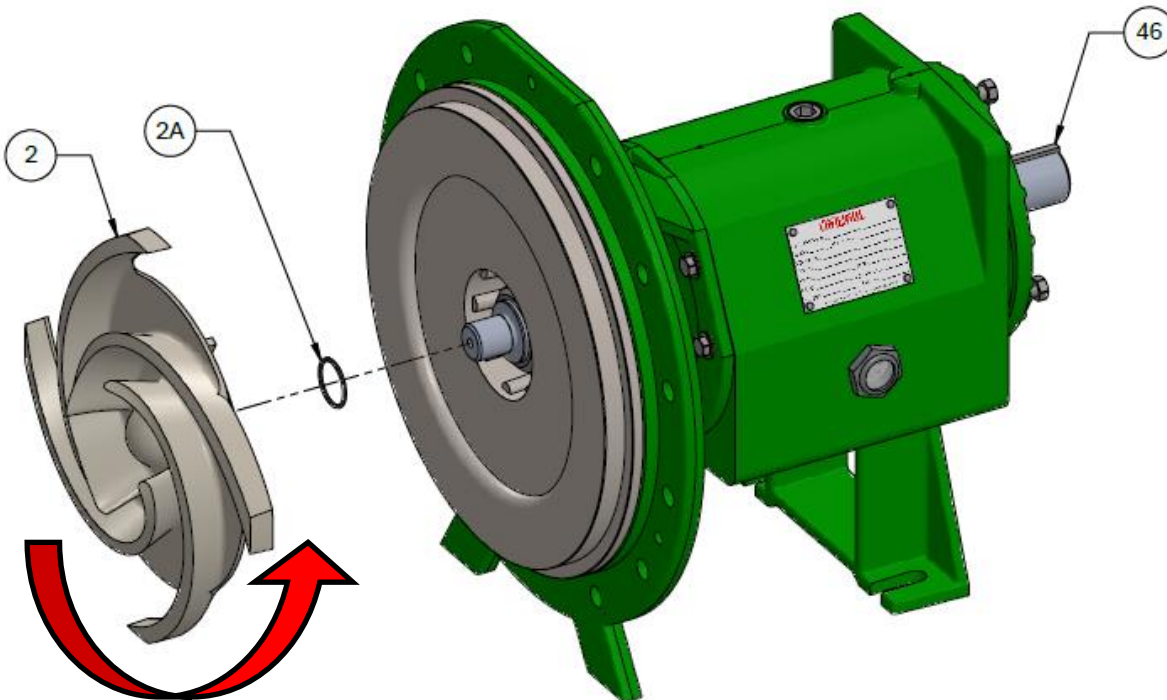
NOTE

These values are an estimate, based on the outside diameter of the shaft. They are subject to variation, dependent on shaft deflection, gland maintenance and other factors specific to the application.

CA	RECOMMENDED FLUSHING WATER [GPM]
Group 1	0.4
Group 2a	0.5 - 0.6
Group 2b	0.6
Group 3	1.0

Impeller Installation

1. Lubricate and install the impeller O-ring (2A) inside the impeller (2). When lubricated, it should stick to the impeller.
2. Apply anti-seize onto the threads of the shaft (6). This will help for disassembly in the future.
3. Tighten impeller (2) onto shaft (6) using a shaft wrench (PN: A1471) or other method to hold the shaft and shaft key (46). Use care when tightening so as not to damage the impeller but be sure to tighten it all the way until it bottoms. If the bearing carrier (37) was not fully tightened, the impeller might interfere with the seal housing (11) first. Verify that the impeller is bottomed on the shaft and NOT on the seal housing.
4. As a rule of thumb, always turn the shaft and impeller in the direction of rotation, which is clockwise of the shaft when viewing from the shaft and key side.



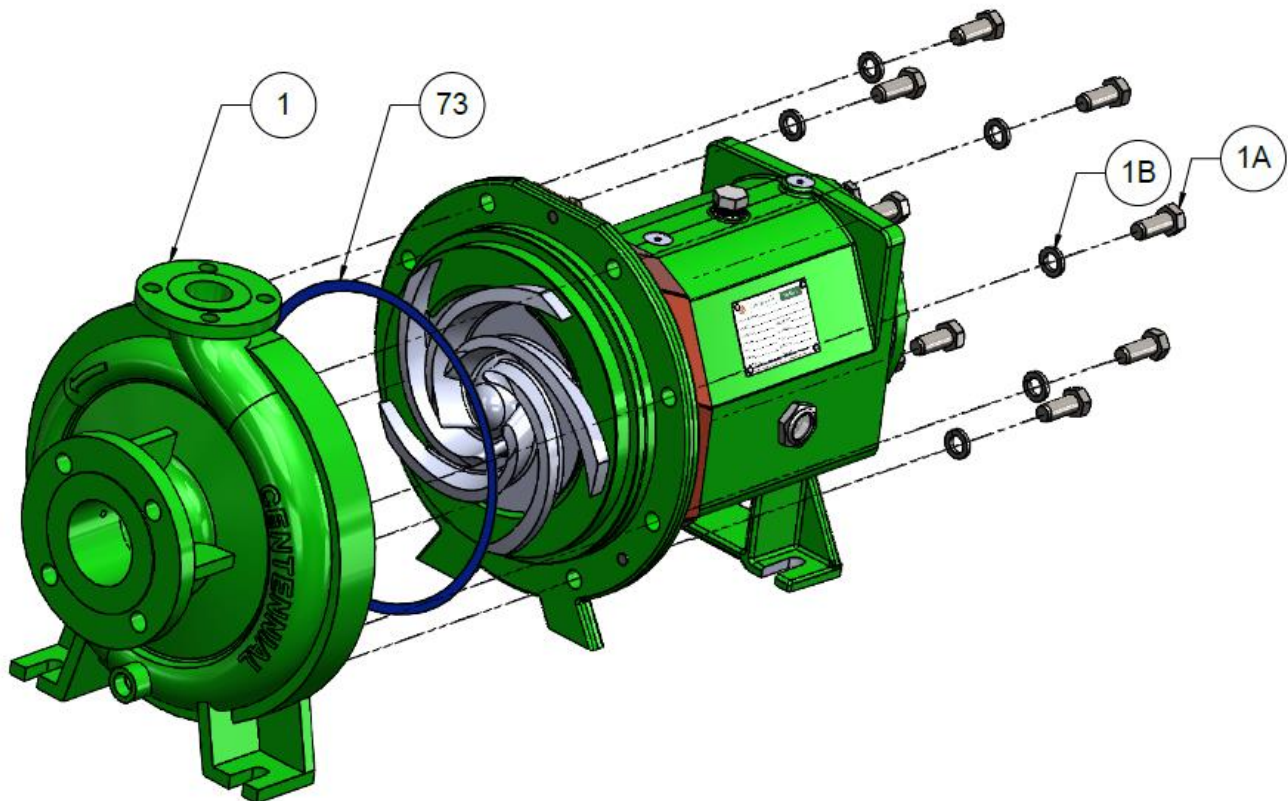
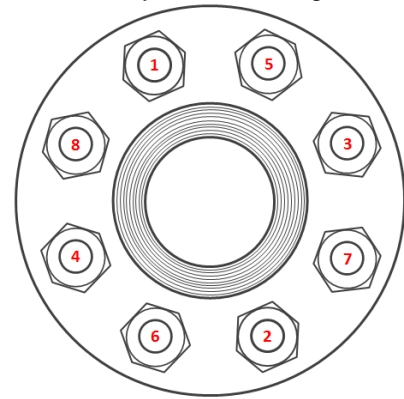
NOTE

The pump should be reinstalled as described in the installation section by following the field installation and alignment procedures.

Frame Size	Shaft Key Size	Shaft Key Part #
Frame 1	3/16" X 1 9/16"	SQ03025
Frame 2	1/4" X 2 1/8"	SQ04034
Frame 3	3/8" X 2 1/8"	SQ06034
Frame 4	5/8" X 2 7/8"	SQ10046

Case Installation

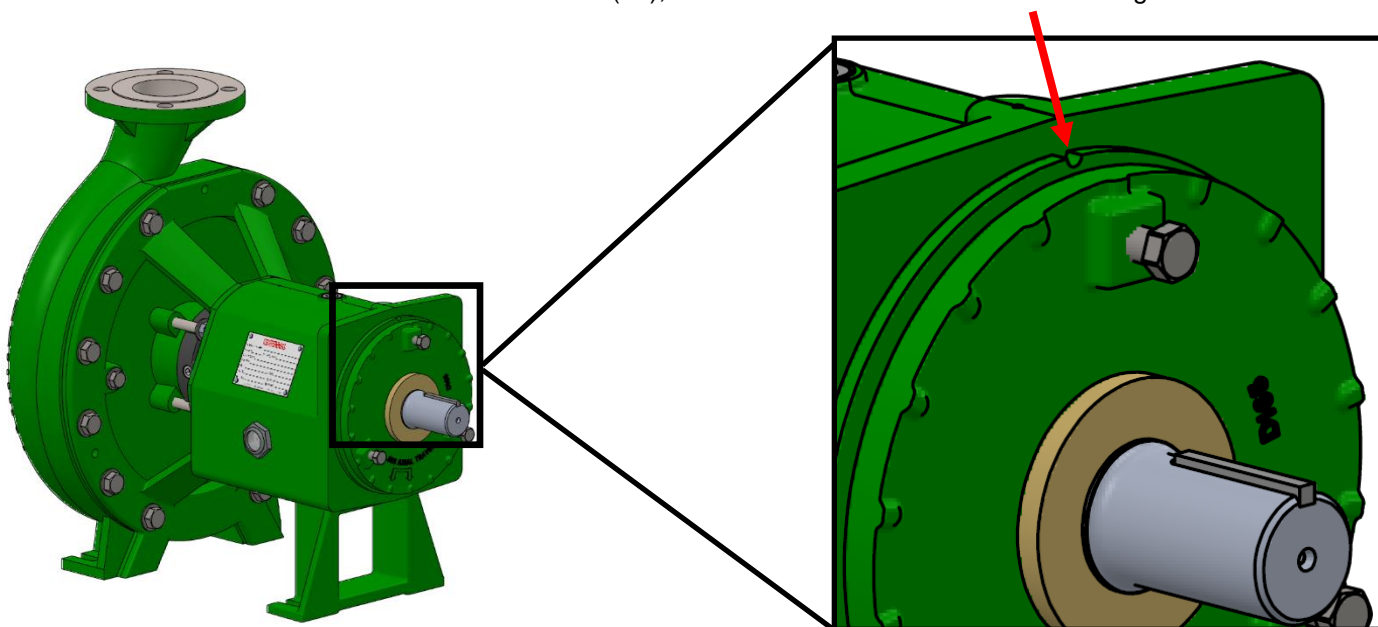
1. Turn the bearing carrier (37) counter-clockwise (as seen from the key-end of the shaft) to move the shaft (6) and impeller (2) all the way backward. The movement will stop when the impeller vanes are touching the seal housing (11). **This rearward position is critical to begin the case installation.**
2. Prop the bracket foot up on a suitable 1/8" shim. This will allow foot clearance to install the case (1).
3. Install the case gasket (73) onto the seal housing (11). Use specified grease as necessary to hold the gasket in position.
4. Locate the case (1) onto the bracket (71) mating bore. For this step, the case must be held concentric with the bracket, due to the tight fit of both parts. Once mated, the case will slide all the way to touch the gasket.
5. Apply anti-seize on the case bolts (1A), tighten the bolts to the case with the case washers (1B). **Always tighten in a crisscross pattern to ensure proper seating.** Use torque table specified in section 6.4.
6. Add appropriate amount of oil to the frame (19). The oil should be visible at the oil sight glasses (143) and is meant to sit in the middle of the glass. Install oil fill plug (19A) when appropriate oil level is reached. For more information on appropriate oil, see section 7.0.
7. If NPT suction, discharge, or case drain plugs (1C, 1D, 11C) are used, be sure to install with PTFE sealing tape or thread sealant.



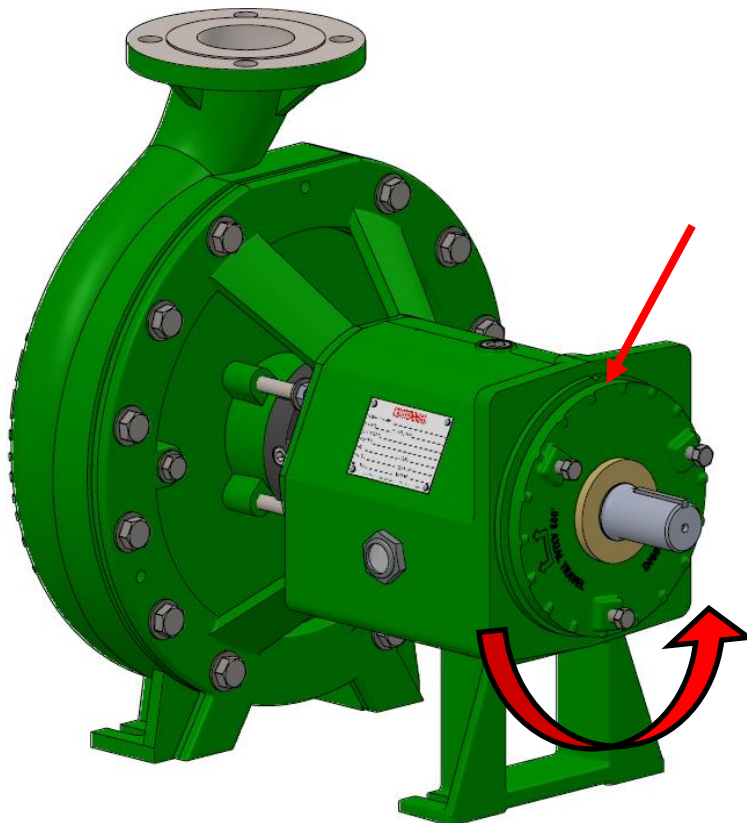
6.5 Setting Impeller Clearance

The bearing and shaft assembly is designed to be moved forward and backward to fine tune the impeller clearance with the case. As the pump ages, normal wear will cause degraded performance when the impeller-to-case clearance grows.

1. Be sure the bearing carrier locking bolts (37A) are loose. With a wrench, turn the bearing carrier (37) clockwise to move the rotating assembly forward until the impeller contacts the case.
2. With the impeller touching the case, the bearing carrier becomes difficult to turn. At this point, note the location of the indicator notch on the frame (19), relative to the cast-in tabs of the bearing carrier.



3. Rotate the bearing carrier counterclockwise to set the front clearance of the impeller (2). Each tab represents .003" travel of the impeller forward or back. The clearance should be set based on frame size. Refer to table below for approximate measurement rotation. Tighten locking bolts (37A) when clearance is set to prevent unwanted adjustment.
4. Follow mechanical seal installation procedure. Usually this includes tightening mounting nuts (89C) and seal set screws before removing tabs. Use seal manufacturer's installation procedure.



CA	Impeller Clearance Setting		
	0 - 150, °F	150 - 250, °F	250 - 500, °F
Group 1			
Group 2a	3 notches (0.009")	4 notches (0.012")	6 notches (0.018")
Group 2b			
Group 3	5 notches (0.015")	8 notches (0.024")	14 notches (0.042")

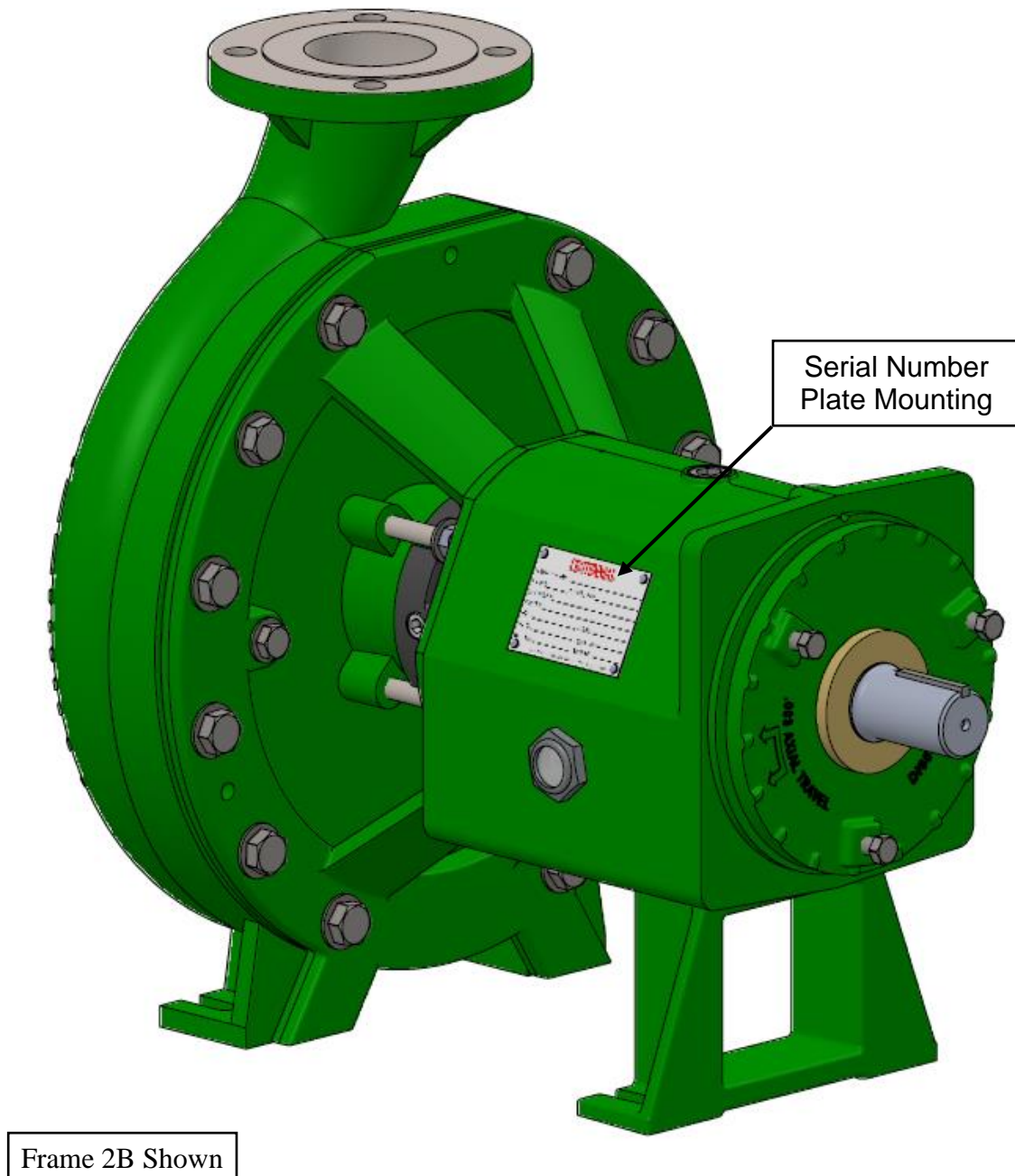
Set impeller off the FRONT of the case

Serial Number Plate

1. Etch serial number and relevant information from data sheet into the number plate. This includes the date code of assembly and the numeric serial identified by distributor ID.

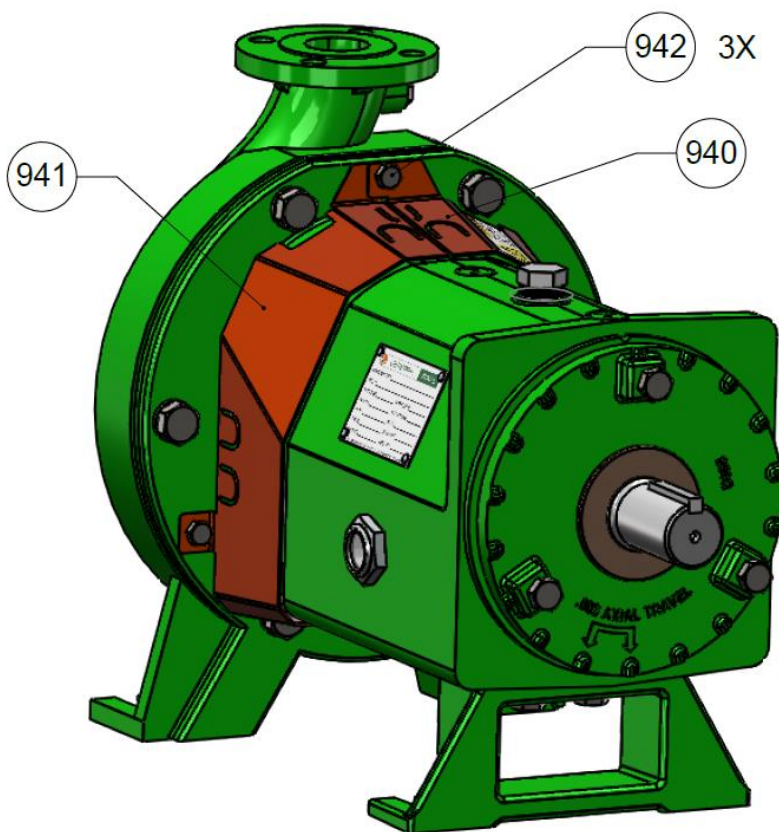
Sample Serial Number: CA000111AA-AAAA

2. Mount serial number plate using four drive screws onto the mounting area on the frame (19). The name plate should be secured permanently so that serial number and pump information is clearly identifiable in the future.
3. Install any relevant Guards, Couplings, or Sub-bases as required (see next section).



Seal Guards

1. Seal guards must be installed for safety prior to pump operation. The rotating parts pose a danger to anything in the near vicinity and the guards must remain in place before the pump is started for operation.
2. Install the left seal guard (941) using a mounting bolt (942) to secure it to the pump.
3. Install right seal guard (940) and mount it using the remaining two mounting bolts.

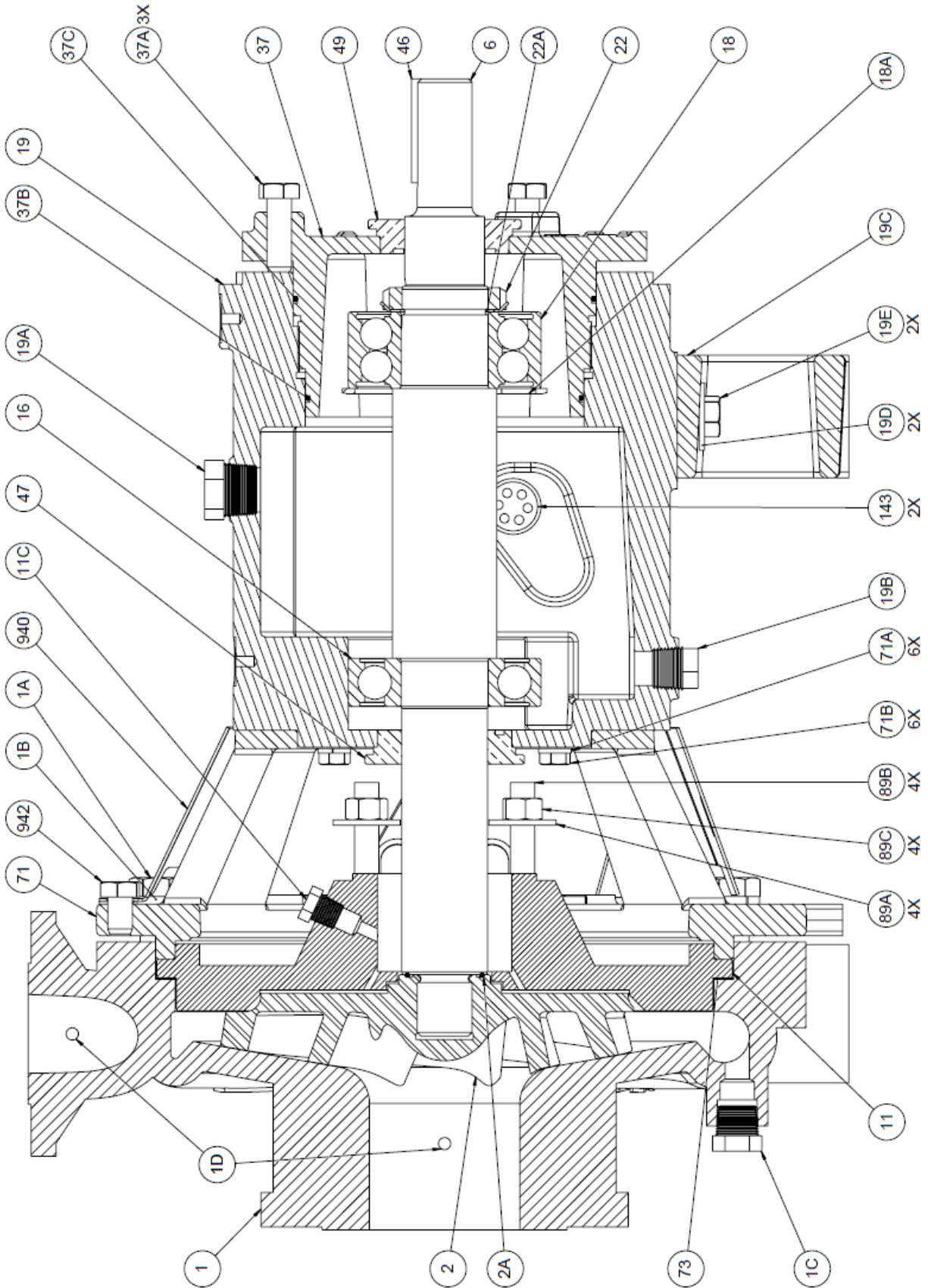


Frame 2B Shown

CAUTION

The rotating parts pose a danger to anything in the near vicinity. Care should always be taken when removing the guard configuration so that the machinery cannot be started accidentally. Always use relevant coupling guards and safety items with rotating machinery.

Cross Sectional View



6.6 Assembly Troubleshooting

See table below for possible assembly issues.

SYMPTOM	CAUSE
Excessive shaft endplay.	Bearing internal clearance too great. Replace bearings with correct type. Snap ring loose in bearing housing groove. Reseat.
Excessive shaft/sleeve runout.	Sleeve worn. Replace. Shaft bent. Replace.
Excessive bearing frame flange runout.	Shaft bent. Replace. Bearing frame flange distorted. Replace.
Excessive frame adapter runout.	Corrosion. Replace. Adapter to frame gasket not seated properly. Reseat.
Excessive seal housing box cover runout.	Seal housing not properly seated in frame. Corrosion or wear. Replace.
Excessive impeller vane tip runout.	Bent vane(s). Replace impeller.

Reinstallation

1. Reinstall the pump to the base.

CAUTION

The pump should be reinstalled as described in the installation section by following the field installation and alignment procedures.

2. Install the coupling following the manufacturer's installation instructions.
3. Install the coupling guard, ensuring that the guard is not in contact with the shaft and coupling.

Please refer to the Pre-startup instructions in section 4.2. Follow all safety precautions and ensure that all safety guards are in place

6.7 Troubleshooting Pump Leaks

Pump Leaks

Before removing your Centennial pump, determine if the leakage is occurring while running or not running. During these inspections you should try to determine the exact origin of the leak. Once you have determined when the pump is leaking, refer to the guide below.

Pump Leaks While Running

Test	Test Results	Indicates
Visually determine the exact leakage point.	Leakage from the seal area.	Damaged mechanical seal or seal housing sealing surface.
	Leakage comes from case or gasket area.	Damaged seal surface, gasket failure or loose bolts.

Pump Leaks While NOT Running

Test	Test Results	Indicates
Verify that leakage originates from the seal area.	Leakage comes from case or gasket area.	Damaged sealing surface, gasket failure or loose bolts.
Verify that leakage originates from the seal area.	Leakage is observed on seal or shaft sleeve.	Seal problem.

7.0 Lubrication

Bearing Lubrication

Oil Lubrication

Fill the frame until the oil level is approximately in the middle of the sight glass.

Acceptable Oils

Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Gulf	Gulf Harmony 68
Mobil	Mobil DTE26 300 SSU 100°F (38°C)
Phillips	Mangus Oil Grade 315
Phillips	MM motor Oil SAE 20-20W

Lubricating Oil Requirements

	Process Liquid Temp. < 300°F (150°C)	Process Liquid Temp. > 300°F (150°C)
ISO Grade	VG 68	VG 100
Approx. SSU at 100°F (38°C)	300	470
DIN 51517	C68	C100
Kinem. viscosity at 105°F (40.6°C) in mm²/sec	68	100

Approximate Oil Volumes

	Oil Volume
Group 1	13 oz. (390 ml)
Group 2	56 oz. (1650 ml)
Group 3	105 oz. (3075 ml)

It is recommended that the oil be changed according to the customer's preventive maintenance program. Every service may be different, which varies the length of time between oil changes. If a maintenance program is already in place, follow that. If no program is in place, Centennial recommends changing the pump oil once every 3 months.

8.0 Ordering Parts

Please include the serial number or model number of your pump to the distributor when ordering spare parts. With this number, the original configuration and materials of construction can be determined.

9.0 Special Service

Please contact The Centennial Pump Company or any of our authorized representatives at any time concerning special service requests or assistance not covered by distributors.

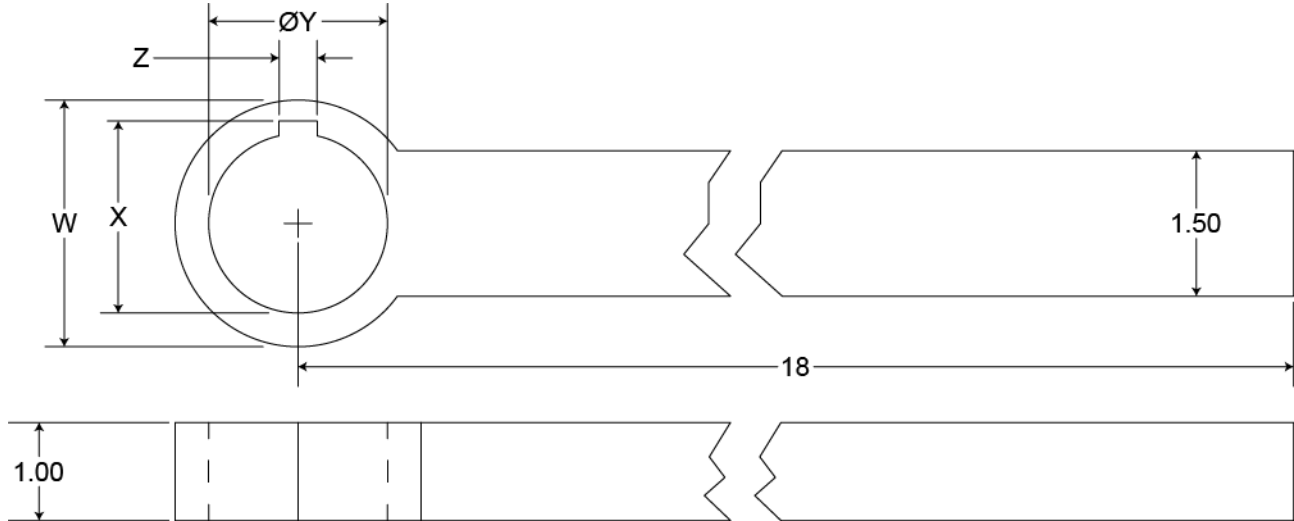
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10.0 Revision History

Revision	Description	Date
A	• Issued	May 2021

Appendix A – Shaft Wrench



Shaft Wrench Drawing

NOMINAL SHAFT DIAMETER	W	X (+.06)	Y	Z
0.875	1.50	0.968	0.878 - 0.884	0.192 - 0.198
1.125	2.25	1.254	1.135 - 1.140	0.260 - 0.265
1.625	2.75	1.806	1.635 - 1.640	0.379 - 0.385
2.375	3.50	2.670	2.390 - 2.400	0.635 - 0.640

DIMENSIONS ARE IN INCHES