

Installation, Operation, and Maintenance Manual

Model: **PWA-IL**

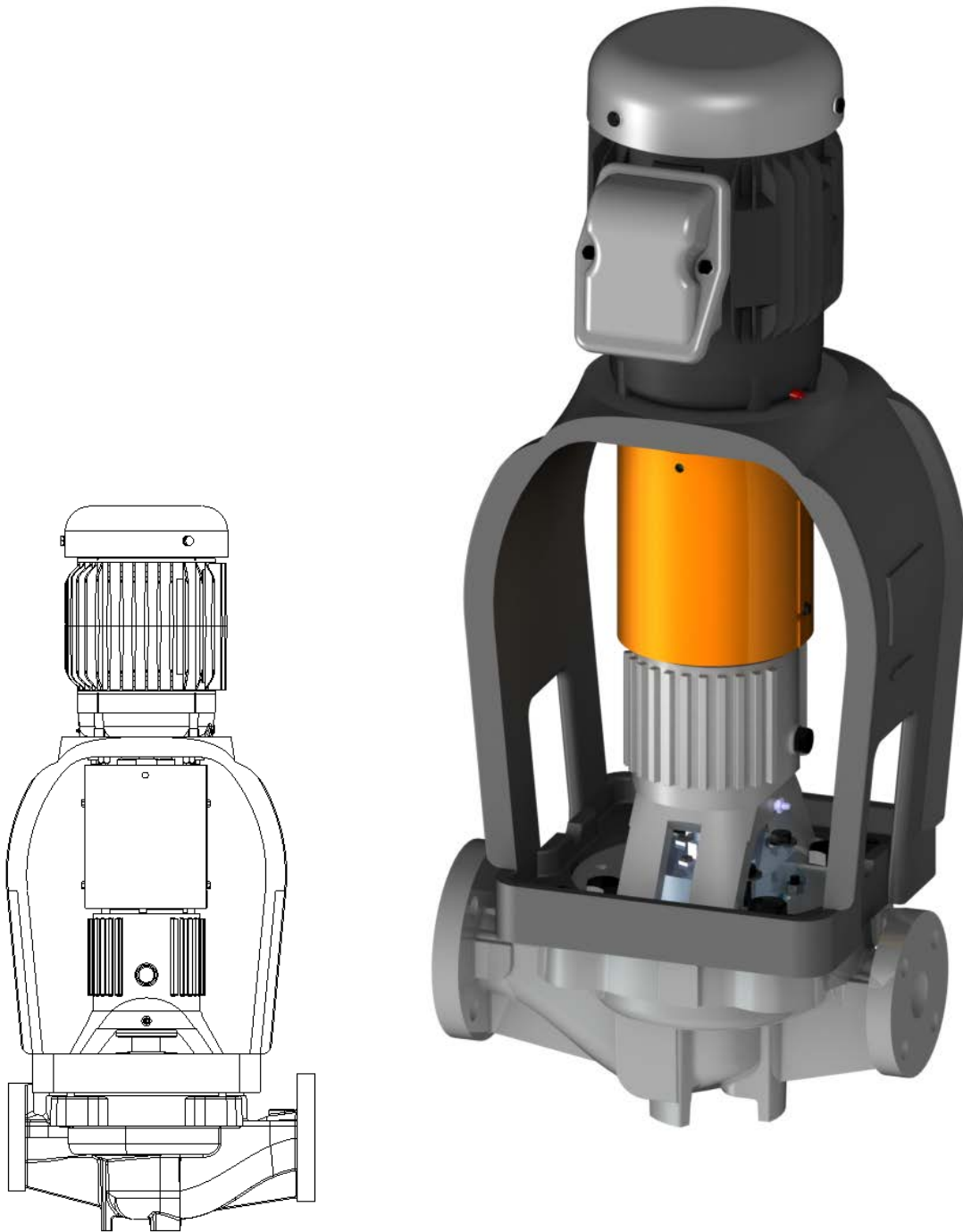


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Introduction and Safety

Introduction

The purpose of this manual is to provide necessary information for installation, operation and maintenance of the PumpWorks Industrial Model PWA-IL.

CAUTION

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages in this manual before handling the product. They are published to help prevent these specific hazards:

- Personal accidents and health
- Product damage
- Product malfunction

Hazard criteria

DANGER

DANGER:

A situation where a hazard, if not avoided, will result in serious bodily injury and/or death.

WARNING

WARNING:

A situation where a hazard, if not avoided, could result in serious bodily injury and/or death.

CAUTION

CAUTION:

A situation where a hazard, if not avoided, could result in less severe bodily injury.

NOTICE

NOTICE:

A potential situation, which if not avoided, could lead to product malfunctions.

Safety

WARNING

WARNING:

- *The operator must be aware of safety precautions to prevent physical injury.*
- *Any pressure-containing device can explode, rupture, or discharge its contents if it is over pressurized. Take all necessary measures to avoid over-pressurization.*
- *Operating, installing, or maintaining the unit in any way that is not intended could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by PW-IND. If there is a question regarding the intended use of the equipment, please contact a PW-IND representative before proceeding.*
- *This manual clearly identifies accepted methods for disassembling units. These methods must be followed. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers or their retaining devices to aid in their removal unless explicitly stated in this manual.*
- *If the pump/motor is damaged or leaking, do not operate as it may cause an electric shock, fire, explosion, release of toxic fumes, physical harm, or environmental damage. Correct/repair the problem prior to putting the pump back in service.*
- *Do not change the service application without the approval of an authorized PW-IND representative.*

User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.

Safety equipment

Use safety equipment according to local regulations. Use this safety equipment within the work area:

- Helmet
- Safety glasses
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- Safety devices

NOTICE

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local codes.

Precautions before work

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

Precautions during work

CAUTION

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

- Always wear Personal Protective Equipment (PPE).
- Always lift the product as illustrated in the Transportation and Storage Section.
- Beware of the risk of a sudden start if the product is used with an automatic control.
- Clean all components thoroughly after pump disassembly.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized.

- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.

Product Warranty

Basic Coverage

PW-IND will remedy faults in products under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to a PW-IND representative within the warranty period.
- The product is used only under the conditions described in this manual.
- All service and repair work is done by PW-IND authorized personnel.
- Genuine PW-IND parts are used.

PW-IND will replace the Power End for 5 years after shipment, regardless of cause of failure. Contact your PW-IND representative for more information on the Power End warranty program.

Limitations to Warranty:

Except where noted above, the warranty **does not** cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting PW-IND
- Incorrectly executed repair work
- Normal wear and tear

PW-IND assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses
- Environmental damage

Product Description

General description PWA-IL

The PWA-IL is a vertical inline, open impeller, centrifugal pump. This pump is ANSI B73.2 compliant.

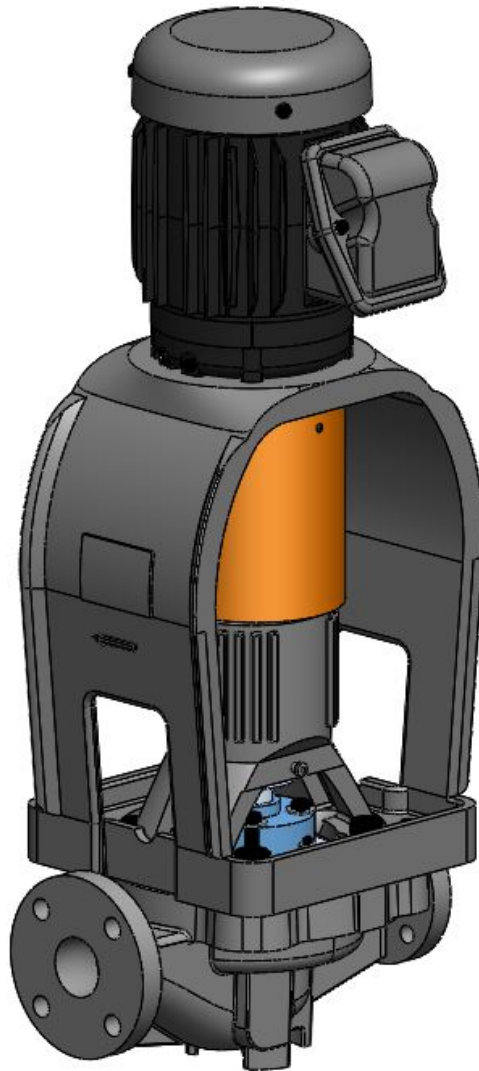


Figure 1: PWA-IL pump

Table 1 : Hydraulic sizes per drive unit size

Drive-unit size group	Number of hydraulic sizes
Group 1	5
Group 2	8

Part description PWA-IL

Table 2: Pump casing parts

Part	Description
Discharge	Side-centerline
Casing ventilation	Self venting
Gasket	Fully confined
Mounting method	In-line with piping
Standard flange	ANSI class 150# flat-face serrated flange
Optional flanges	<ul style="list-style-type: none"> • ANSI class 150# raised-face serrated flange • ANSI class 300# flat-face serrated flange • ANSI class 300# raised-face serrated flange

Impeller

The impeller is

- Fully open with radial vanes.
- Threaded to the shaft
- The threads are sealed from the pumped liquid by an o-ring.

Cover

Standard seal

- The PWA-IL is available with three stuffing-box / seal chamber designs
 - Standard Bore
 - Big Bore
 - Taper Bore

Table 3: Power end main parts

Part	Description
Frame adapter	The carbon steel frame adapter has <ul style="list-style-type: none"> • A machined rabbet fitted to the seal chamber/ stuffing box cover
Power end	<ul style="list-style-type: none"> • No machining is required to convert from oil to grease or oil-mist lubrication. Regreaseable bearings and oil-mist lubrication are optional. • The oil level is checked through a sight glass located on both sides of the power end. • The power end is sealed with labyrinth seals. • The power end is made in the following sizes: <ul style="list-style-type: none"> • Group 1 • Group 2
Shaft	The shaft is available with or without a sleeve.
Bearings	The Non-Drive End (INBOARD) bearing <ul style="list-style-type: none"> • Carries only radial loads. • Is free to float axially in the frame. • Is a single-row deep-groove ball bearing The Drive End (OUTBOARD) bearing <ul style="list-style-type: none"> • Is shouldered and locked to the shaft and housing to enable it to carry radial and thrust loads. • Is a double-row angular-contact bearing, except for the Group 3 which uses a pair of single-row angular-contact ball bearings mounted back-to-back.

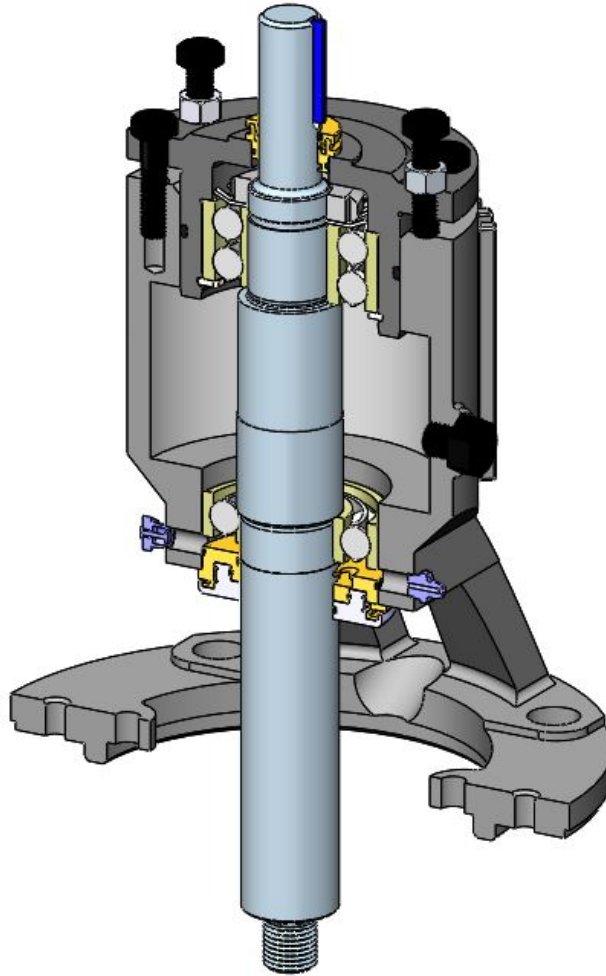


Figure 2: PWA-IL Power End Cross Sectional

Important information for ordering

Every pump has nameplates that provide information about the pump. The nameplates are located on the casing and the bearing frame.

When you order spare parts, identify this pump information:

- Model
- Size
- Serial number
- Item numbers of the required parts

Refer to the nameplate on the pump casing for most of the information. See Parts List for item numbers.

Nameplate types

Table 4: Nameplate Description

Nameplate	Description
Pump casing	Provides information about the hydraulic characteristics of the pump. Discharge x Suction x Nominal Maximum Impeller diameter (in inches). (Example: 2x3x8)
Bearing frame	Provides information about the bearings, lubrication and power end specific serial number.
ATEX	If applicable, your pump unit might have an ATEX nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the ATEX specifications of this pump.

Figure 3: Nameplate on the pump casing using English units

MADE IN USA S/N STD. NO.

PumpWorks™
INDUSTRIAL

FOR SERVICE CALL: 1-800-349-2018 MODEL SIZE

FLOW GPM HEAD FT R.P.M.

HYDRO PRESS. PSI @ 100°F IMP. DIA. MAX. DIA.

MAX. DES. WORKING PRESS., PSI @ 100°F MAT'L.

CONT/ITEM

WARNING Avoid death or serious injury. Read and understand installation, Operation, and Maintenance manual before operating this equipment. Do **NOT** operate pump against closed valves or blocked lines.

Figure 4: Pump Casing I.D. Tag

CASE ID PN

Table 5: Definition of nameplate on the pump casing english units

Nameplate field	Definition
IMPLR. DIA.	Trimmed Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute
FT HD	Rated pump head, in feet
RPM	Rated pump speed, revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST.	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX DSGN PSI @ 100°F	Maximum pressure at 100°F according to the pump design

Figure 5: Nameplate on the pump casing using metric units

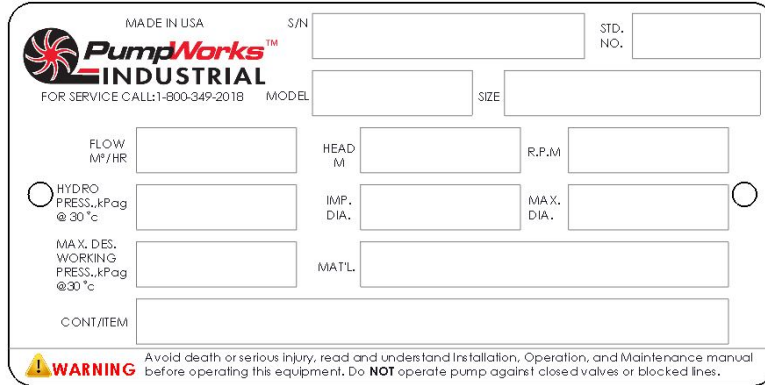


Table 6: Definition of nameplate on the pump casing in metric units

Nameplate field	Definition
IMPLR. DIA.	Impeller diameter, in mm
MAX. DIA.	Maximum impeller diameter, in mm
M ³ /HR	Rated pump flow, in cubic meters per hour
M HD	Rated pump head, in meters
RPM	Rated pump speed, in revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX. DSGN Pressure kPag 30°C	Maximum Design Working Pressure @ 30°C

Figure 6: Nameplate on the bearing frame

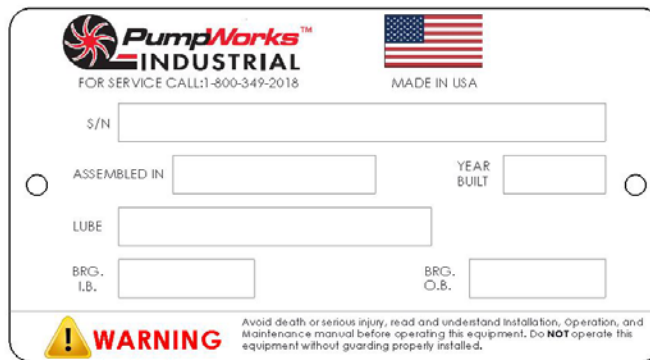


Table 7: Explanation of the nameplate on the Bearing Frame Assembly

Nameplate field	Definition
BRG. O. B.	Outboard bearing designation (Drive End)
BRG. I. B.	Inboard bearing designation (Non-Drive End)
S/N	Serial number of the Bearing Frame Assembly
LUBE	Oil or Grease Type

Transportation and Storage

Inspect the delivery

Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company immediately if anything is out of order.

NOTE: Contact your local PW-IND sales office if any items are missing or for replacement components.

Inspect the pump unit

1. Inspect the product to determine if any parts have been damaged or are missing.
2. Note and report any evidence of damaged paint to your PW-IND representative. This might be evidence of impact damage during shipment that could result in reduced product performance.

Transportation guidelines

Pump handling



WARNING:

- *Make sure that the unit cannot roll or fall over and injure people or damage property.*
- *PW-IND pumps contain sensitive parts that can be damaged if dropped or subjected to impact. Handle the equipment with care and do not attempt to install or operate a pump unit that is damaged.*

Lifting methods



WARNING:

- *All lifting must be done in compliance with all applicable regulations/standards.*
- *Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points.*
- *Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.*
- *Do not lift any pump or motor by attaching lifting equipment to shaft ends.*

Table 1: Lifting Methods

Pump type	Lifting method
A bare pump and stand without lifting handles	Use a suitable sling attached properly to solid points like the casing mounting supports
Pumps with drivers mounted	Use slings under the pump casing and the drive unit.

Examples

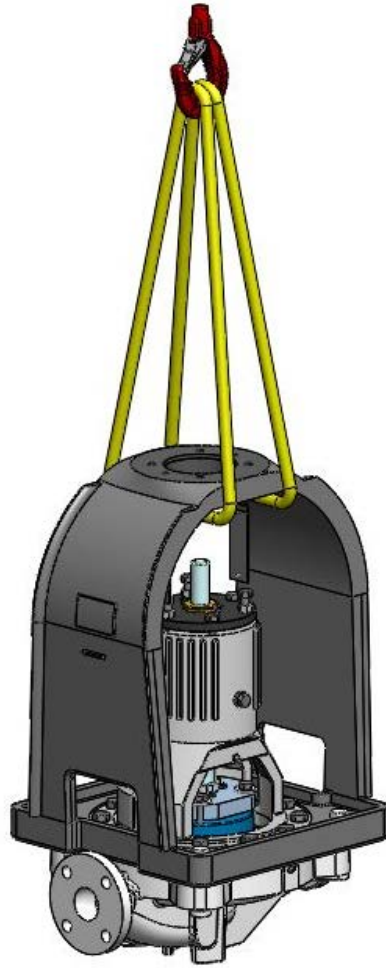


Figure 1: Example of Proper Lifting – Bare Pump with Stand

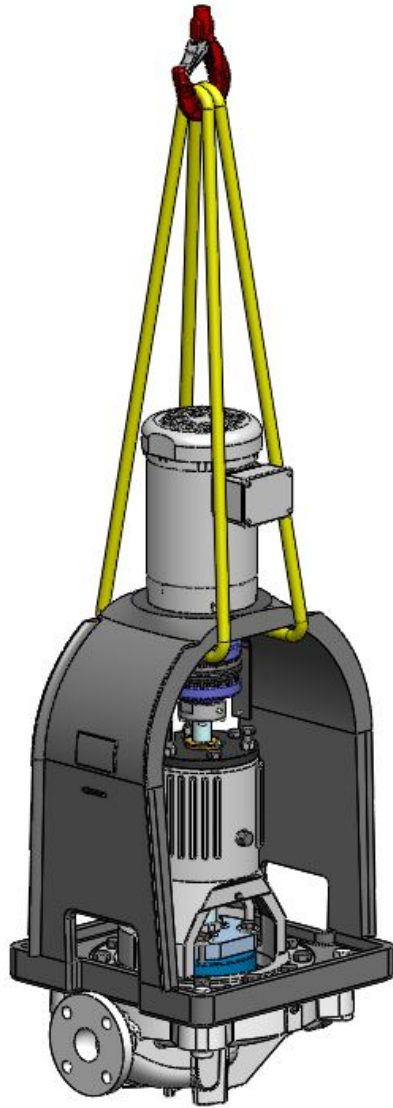


Figure 2: Example of Proper Lifting – Pump/Stand/Motor

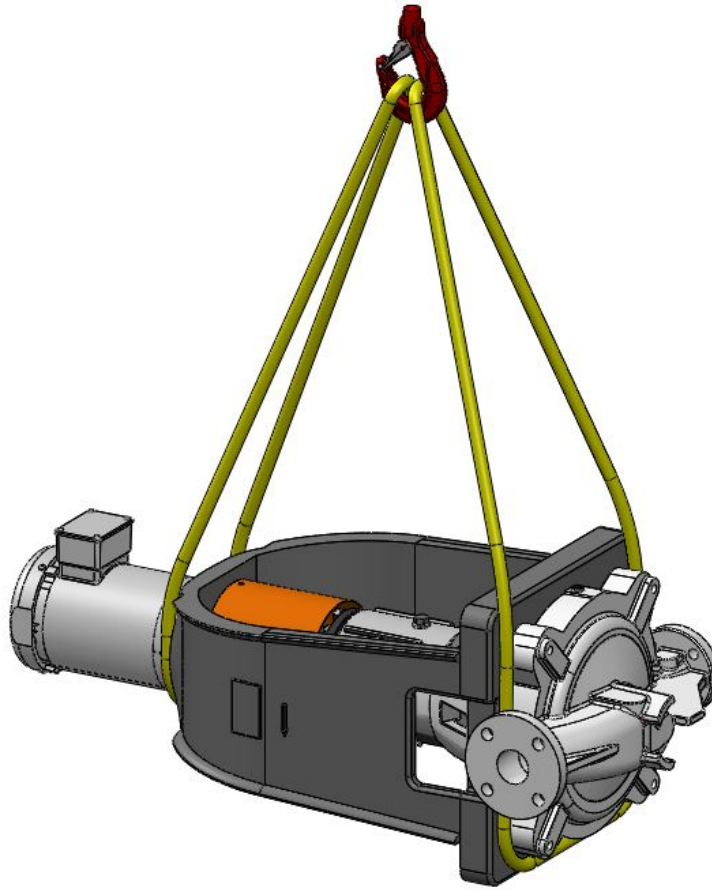


Figure 3: Example of Proper Lifting – Pump/Stand/Motor

Storage guidelines

Pump storage requirements

Storage requirements depend on the amount of time the pump unit will be stored prior to installation and start up. The normal packaging is designed only to protect the unit during shipping.

Table 2: Storage

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	<ul style="list-style-type: none"> • Store in a covered and dry location. • Store the unit free from dirt and vibration.
Long-term (more than six months)	<ul style="list-style-type: none"> • Store in a covered and dry location. • Store the unit free from heat, dirt, and vibration. • Rotate the shaft by hand several times at least every month ensuring that the shaft is not in the same position each time.

NOTICE

NOTICE:

Risk of damage to the mechanical seal or shaft sleeve on units supplied with

cartridge mechanical seals. Follow seal manufacture's recommendations for long term storage.

Treat bearing and machined surfaces so that they are well preserved. Refer to motor and coupling manufacturers for their long-term storage procedures.

Long term storage preparation is available as part of initial product purchase or after your pump has been delivered. Contact your local PW-IND sales representative.

Frostproofing

Table 3: Situations when the pump is or is not frostproof

Situation	Condition
Operating	The pump is frostproof.
Not Operating	The pump internals might be subject to frost damage. Protect non-operational units with climate control or an anti-freeze solution in the casing. NEVER USE AN ANTI-FREEZE AGENT IN THE PUMP BEARING HOUSING.

Installation

Precautions

WARNING

WARNING:

- When installing in a potentially explosive environment, make sure that the motor and other electrical equipment are properly rated for the area of classification.
- You must ground all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the ground lead to verify that it is connected correctly.
- Electrical Connections must be made by certified electricians in compliance with all international, national, state, and local rules.

NOTICE

NOTICE:

Supervision by an authorized PWA-IND representative is recommended to ensure proper installation. Failure to do so may result in equipment damage.

Pump location guidelines

Table 1: Guidelines for locations

Guideline	Explanation/comment
Keep the pump as close to the liquid source as possible.	This minimizes friction loss and keeps the suction piping as short as possible.
Make sure that the floor space and head room around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
If you require lifting equipment such as a hoist or tackle, make sure that there is enough space above the pump.	This makes it easier to properly use the lifting equipment and safely remove and relocate the components to a safe location.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor.

Foundation requirements

Requirements

- The PWA In-Line is designed to be mounted vertically and in-line with system piping at suction and discharge. Supports under the pump are not required. System pipe supports should be mounted as close to the pump as possible and be designed to support the weight of the complete unit.

Piping

Guidelines for piping are given in the “Hydraulic Institute Standards,” and must be reviewed prior to pump installation.

WARNING

WARNING:

Never draw piping into place by forcing at the flanged connections of the pump. This may impose dangerous strains on the unit and cause misalignment between pump and driver. Pipe strain will adversely affect the operation of the pump resulting in physical injury and damage to the equipment.

- Piping runs should be as short as possible to minimize friction losses.
- It is suggested that expansion loops be properly designed and installed in suction and/or discharge lines when handling liquids at elevated temperatures, so thermal expansion of piping will not draw pump out of alignment.

- The piping should be arranged to allow pump flushing prior to removal of the unit on services handling hazardous liquids.
- Carefully clean all pipe parts, valves and fittings, and pump branches prior to assembly.
- All piping must be supported independently of, and line up naturally with, the pump flanges. Table 1 shows piping flange alignment criteria.

Table 2 – Piping Flange Alignment

Type	Criteria
Axial	Flange gasket thickness +/- 0.8mm (.03 in.)
Parallel	0.001 mm/mm (.001 in./in.) of flange diameter to a maximum of 0.8 mm (0.3 in.)
Concentric	Flange bolts should easily install by hand.

Suction Piping

CAUTION

CAUTION:

- *NPSH must always exceed NPSHR as shown on PWI performance curves received with order.*
- *Pump must never be throttled from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.*

Properly designed and installed suction piping is a necessity for trouble-free pump operation. Suction piping should be flushed BEFORE connection to the pump.

- Use of elbows close to the pump suction flange should be avoided. There should be a minimum of two (2) pipe diameters of straight pipe [five (5) pipe diameters is preferred] between the elbow and suction inlet. Where used, elbows should be long radius.
- Use suction pipe one (1) or two (2) sizes larger than the pump suction, with a reducer at the suction flange. Suction piping should never be of smaller diameter than the pump suction.
- Reducers, if used, should be eccentric and located at the pump suction flange with sloping side down.
- A suction screen should be installed prior to initial start-up and when suction system has been opened for work. The screen should be of the cone type with a net area equal to at least three (3) times the cross sectional area of the suction pipe. The mesh of the screen should be sized to prevent particles larger than 1.6 mm (1/16 in.) from entering the pump and should be installed in a spool piece to allow removal for cleaning. The screen should remain in the system until periodic inspection shows system is clean.
- Separate suction lines are recommended when more than one pump is operating from the same source of supply.

Suction Lift Conditions

- Suction pipe must be free from air pockets
- Suction piping must slope upwards to pump
- All joints must be air tight
- A means of priming the pump must be provided.

Suction Head/ Flooded Suction Conditions

- An isolation valve should be installed in the suction line at least two (2) pipe diameters from the pump suction to permit closing of the line for pump inspection and maintenance.

- Keep suction piping free from air pockets
- Piping should be level or slope gradually downward from the source of supply.
- No portion of the piping should extend below pump suction flange.
- The size of entrance from supply should be one (1) or two (2) sizes larger than the suction pipe.
- The suction pipe must be adequately submerged below the liquid surface to prevent vortices and air entrainment at the supply.

Discharge Piping

Properly designed and installed discharge piping is a necessity for trouble-free pump operation.

- Discharge piping should be flushed BEFORE connection to the pump. Isolation and check valves should be installed in discharge line. Locate the check valve between isolation valve and pump; this will permit inspection of the check valve. The isolation valve is required for priming, regulation of flow, and for inspection and maintenance of pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.
- Increases, if used, should be placed between pump and check valves.
- Cushioning devices should be used to protect the pump from surges and water hammer if quick-closing valves are installed in system.

Bypass Piping

Systems that require operation at reduced flows for prolonged periods should be provided with a bypass line connected from the discharge side (before any valves) to the source of suction.

A minimum flow orifice can be sized and installed in bypass line to preclude bypassing excessive flows. Consult nearest sales office or factory for assistance in sizing orifice.

An automatic recirculation control valve and/or solenoid operated valve should be considered if a constant bypass (i.e. orifice) is not possible.

Final Piping Check

After connecting the piping to pump:

- Rotate shaft several times by hand to be sure that there is no binding and all parts are free.
- Check alignment, per alignment criteria outlined previously, to determine if pipe strain has affected alignment. If pipe strain exists, correct piping.

Shaft Alignment

Alignment between pump and motor is built in by use of machined lock fit between the C-face motor and motor support. No further alignment is normally required.

Pump-to-driver alignment

The following assembly procedures have been developed to align the pump shaft and the driver shaft to .002" T.I.R. Each pump is assembled using a torque range of +/- 10% of the recommended torque value of the bolts. If .002" T.I.R. alignment is required, a final alignment must be done in the field.

- Inspect all machined fits for signs of contamination or damage. All fits must be clean. If the pump is new this step is not necessary.
- Loosen all motor, motor support, and casing bolts, but do not remove.
- Make sure jack bolts on the casing are backed off.
- Move shaft assembly (shaft, housing, and impeller) away from casing angle face, by adjusting the bearing housing. A 1/4 turn of bearing housing jack bolts is sufficient to ensure the impeller does not ride on the casing angle face. Proper indication cannot be done with the impeller touching the angle face.
- Tighten motor hold down bolts in a criss-cross pattern to the recommended torque. (Refer to the torque values listed in Table 2.)
- Tighten the motor support bolts in a criss-cross pattern to 90% of the recommended torque value of the bolts. For example, if the recommended torque value for the bolts is 60 ft.-lbs., tighten bolts to 54 ft.-lbs.
- Tighten casing bolts in a criss-cross pattern to 90% of the recommended torque value.
- Attach a dial indicator to the driver shaft and mark the pump shaft so the indicator always contacts the same location on the pump shaft.
- Rotate both shafts in the same direction and record the indicator readings every 90 degrees (4 places)
- Incrementally increase the torque value and begin to tighten the necessary bolts to bring the shafts into alignment. Do not exceed 110% of the recommended torque values. After each series of tightening, repeat Step #5 until the desired alignment is achieved.

NOTE: Indicate off the hub to the motor lock I.D., in the motor support , when supplying the pump less motor.

- Reset the clearance between the impeller and casing angle face to .008 (.015 if using the high temperature option). Ensure the bearing housing jack bolts are secured.

NOTE: Tighten coupling bolts and hub set screw onto shaft. Torqueing of these components is not done at the factory, yet is required at the site. Please reference the coupling manufacturer's instructions for correct torque levels.

Table 3 - Fastener Size and Recommended Torque Values

Fastener Standard	Fastener Nominal Size (inch)	Recommended Torque* (lb-ft)
SAE	5/16	6
	3/8	10
	7/16	18
	1/2	27
	5/8	53
	3/4	94
	7/8	152
	1	228

*Torque values shown for SAE fasteners are based on dry threads at 75% of proof load for ASTM307 Grades A and B (SAE Grade 1) fasteners.

For lubricated, plated, or PTFE-coated threads, use 75% of torque values shown.

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

WARNING

WARNING:

- *Failure to follow these precautions before you start-up the pump could lead to serious injury and equipment failure.*
- *Do not operate the pump below the minimum rated flow or with the suction or discharge valves closed.*
- *Avoid death or serious injury. Leaking fluid can cause fire and/or burns. Operating the pump above maximum rated flow shown on the pump curve leading to an increase in horsepower and vibration along with mechanical seal and/or shaft failure.*
- *Never operate the pump without the coupling guard correctly installed.*
- *Always disconnect and lock out all potential energy sources (electrical, hydraulic, pneumatic, etc) before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power could result in serious physical injury.*
- *Operating the pump in reverse rotation will result in the contact of metal parts, heat generation, and breach of containment.*

Precautions

NOTICE

NOTICE:

- *Verify the driver settings before you start any pump.*
- *Make sure that the pump casing warm-up rate does not exceed 5°F (2.8°C) per minute.*
- *Risk of damage to the mechanical seal or shaft sleeve on units supplied with cartridge mechanical seals. Prior to startup, make sure to tighten the set screws in the seal locking collar and remove the centering clips.*

You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly prior to start-up to remove dirt or debris in the pipe system.
- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 50°F (10°C) of the process fluid temperature. Soak for (2) hours at process fluid temperature.

Check the rotation

WARNING

WARNING:

- *Operating the pump in reverse rotation will result in the contact of metal parts, heat generation, and breach of containment.*
 - *Always disconnect and lock out all potential energy sources (electrical, hydraulic, pneumatic, etc) before you perform any installation or maintenance tasks. Failure to do so could result in serious physical injury.*
1. Lock out power to all potential energy sources (electric, hydraulic, pneumatic, etc.).
 2. Make sure that the coupling hubs are fastened securely to the shafts.
 3. Make sure that the coupling spacer is removed.
The pump ships with the coupling spacer removed.
 4. Unlock power to the driver.
 5. Make sure that everyone is clear, and then operate the driver long enough to determine that the direction of rotation corresponds to the arrow on the bearing housing or close coupled frame.

Bearing lubrication



WARNING:

Make sure to properly lubricate the bearings. Failure to do so can result in premature failure.

Grease Lubrication

Greased lubricated ball bearings are standard on the PWA-IL units.

The bearings are greased at the factory
See Preventive Maintenance section for lubrication recommendations.

Pure Oil Mist Lubrication

Pure oil mist is an optional feature for the PWA_IL. Follow oil mist generator manufacturer's instructions.
The inlet and outlet connections are located on the side of the bearing frame.

See Preventive Maintenance section for lubrication recommendations and connection locations.

Impeller-clearance check

The impeller-clearance check ensures the following:

- The pump turns freely.
- The pump operates at optimal efficiency for long equipment life.

Impeller clearances (PWA-IL)



WARNING:

For pumpage temperatures greater than 200°F (93°C), you must increase the cold (ambient) setting according to this table. Doing so prevents the impeller from contacting the casing due to differential expansion from the higher operating temperatures. Failure to do so may result in equipment damage.

NOTICE:

Do not set the maximum impeller setting to more than 0.005 in. (0.13 mm) greater than the values in this table. Doing so may result in a significant decrease in performance.

Table 1: Impeller clearances

Service temperature	Group 1 in. (mm)	Group 2 in. (mm)
-20 to 120°F (-29 to 66°C)	0.005 (0.13)	0.008 (0.20)
Up to 175°F (79°C)	0.005 (0.13)	0.008 (0.20)
Up to 200°F (93°C)	0.005 (0.13)	0.008 (0.20)
Up to 250°F (121°C)	0.006 (0.16)	0.009 (0.23)
Up to 300°F (149°C)	0.007 (0.19)	0.010 (0.26)
Up to 350°F (177°C)	0.009 (0.22)	0.012 (0.29)
Up to 400°F (204°C)	0.010 (0.25)	0.013 (0.32)
Up to 450°F (232°C)	0.011 (0.28)	0.014 (0.35)
Up to 500°F (260°C)	0.012 (0.30)	0.015 (0.38)

Couple the pump and driver

WARNING

WARNING:

Always disconnect and lock out power to all potential energy sources (electric, hydraulic, pneumatic, etc.) before you perform any installation maintenance tasks. Failure to do so will result in serious physical injury.

1. Install the coupling.
(See the installation instructions from the coupling manufacturer.)

Pump priming

Priming - Never start the pump until it has been properly primed. Several different methods of priming can be used, depending upon type of installation and service involved.

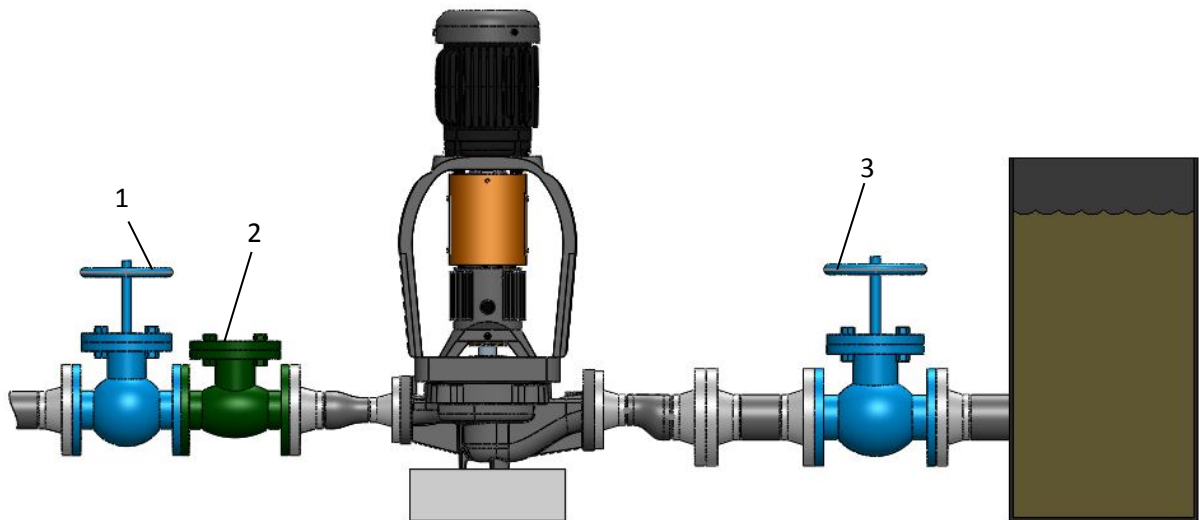
WARNING

WARNING:

Make sure to review MSDS regarding hazards for the pump process fluid. Personal Protective Equipment (PPE) should be worn during all activities around pump.

Prime the pump with the suction supply above the pump

1. Slowly open the suction isolation valve.
2. Open the piping vents on the suction and discharge piping, seal chamber, and seal piping, if provided, until all gas is evacuated.
3. Close the piping vents.



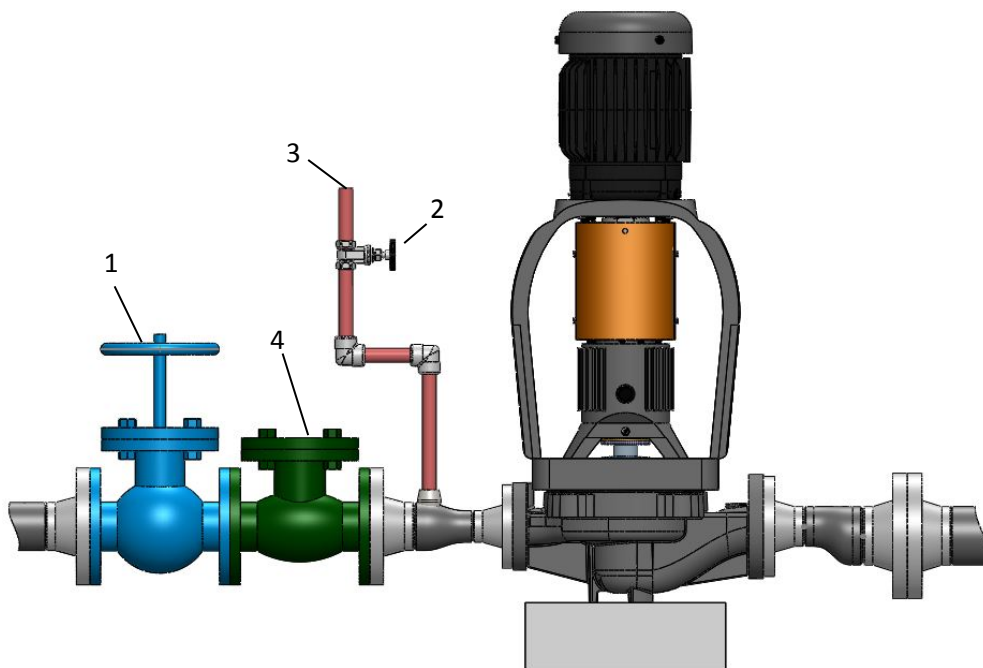
1. Discharge isolation valve
2. Check valve
3. Suction isolation valve

Figure 1: Pump Priming – supply above pump

Prime the pump with the suction supply below the pump

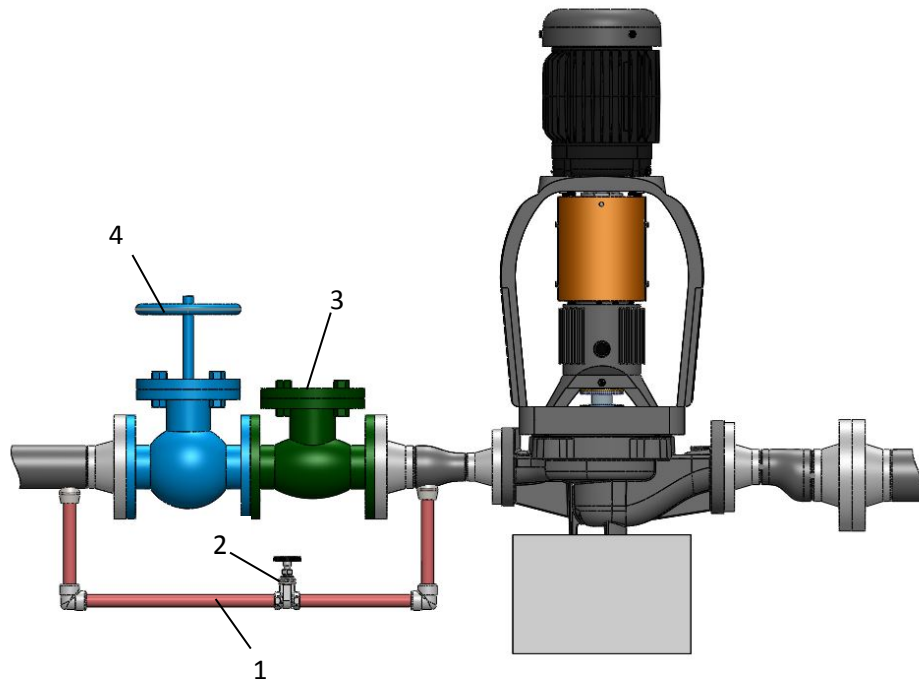
Use a foot valve and an outside source of liquid in order to prime the pump. The liquid can come from one of these sources:

- A priming pump
 - A pressurized discharge line
 - Another outside supply
1. Close the discharge isolation valve.
 2. Open the vent valves in the casing.
 3. Open the valve in the outside supply line until only liquid escapes from the vent valves.
 4. Close the vent valves.
 5. Close the outside supply line.



1. Discharge isolation valve
2. Priming shutoff valve
3. External priming fluid
4. Check valve
5. Foot valve (not shown)

Figure 2: Pump Priming with foot valve and outside supply



1. Priming by-pass line
2. Priming shutoff valve
3. Check valve
4. Discharge isolation valve
5. Foot valve (not shown)

Figure 3: Pump Priming with foot valve and bypass

Start the pump

⚠ WARNING

WARNING:

Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.

⚠ CAUTION

CAUTION:

- *Observe the pump vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.*
- *On pure or purge-oil mist-lubricated units, remove the power end vent plug to verify that oil mist flowing properly. Replace the plug.*
- *Ensure that the oil level is correct prior to starting pump.*

Before you start the pump, you must perform these tasks:

- Open the suction valve.
 - Open any recirculation or cooling lines.
1. Partially open the discharge valve, depending on system conditions.
 2. Start the driver.
 3. Slowly open the discharge valve until the pump reaches the desired flow.
 4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.

- a) Stop the driver.
 - b) Prime the pump again.
 - c) Restart the driver.
6. Monitor the pump while it is operating:
 - a) Check the pump for bearing temperature, excessive vibration, and noise.
 - b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.
 7. Repeat steps 5 and 6 until the pump runs properly.

Pump operation precautions

General considerations

CAUTION

CAUTION:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side since this can result in decreased performance, unexpected heat generation, and equipment damage.
- Do not operate pump past the maximum flow. For maximum flow refer to the pump performance curve.
- Do not overload the driver. Driver overload can result in unexpected heat generation and equipment damage. The driver can overload in these circumstance.
 - The specific gravity of the pumped fluid is greater than expected.
 - The pumped fluid exceeds the rated flow rate.
- Do not operate pump below minimum flow. For minimum flows refer to technical manual and pump performance curve.
- Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.

Operation at reduced capacity

WARNING

WARNING:

Never operate any pumping system with a blocked suction and discharge. Operation, even for a brief period under these conditions, can cause confined pumped fluid to overheat, which could result in a explosion. You must take all necessary measures to avoid this condition.

CAUTION

CAUTION:

- The pump and system must be free of foreign objects. If pump becomes plugged, shut down and unplug prior to restarting pump.
- Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
- Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
- Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.

Shut down the pump

1. Disengage driver.
2. Allow pump to coast down.
3. Close discharge valve.

Maintenance

Maintenance schedule

It is recommended that a maintenance plan and schedule is adopted, in line with these Instructions, to include the following:

Any auxiliary systems installed must be monitored, if necessary, to ensure they function correctly.

- Gland packing must be adjusted correctly to give visible leakage and concentric alignment of the gland follower to prevent excessive temperature of the packing or follower.
- Check for any leaks from gaskets and seals. The correct functioning of the shaft seal must be checked regularly.
- Check bearing lubricant level, and if the hours run show a lubricant change is required.
- Check that the duty condition is in the allowable operating range for the pump.
- Check vibration, noise level and surface temperature at the bearings to confirm satisfactory operation.
- Check dirt and dust is removed from areas around close clearances, bearing housings and motors.
- Check coupling alignment and re-align if necessary.

Our field service technicians can help with preventative maintenance records and provide condition monitoring for temperature and vibration to identify the onset of potential problems.

Routine inspection (daily/weekly)

The following checks should be made and the appropriate action taken to remedy any deviations:

- Check operating behavior. Ensure noise, vibration and bearing temperatures are normal.
- Check that there are no abnormal fluid or lubricant leaks (static and dynamic seals) and that any sealant systems (if fitted) are full and operating normally.
- Check the level and condition of oil lubricant. On grease lubricated pumps, check running hours since last recharge of grease or complete grease change.
- Check any auxiliary systems are functioning correctly.
- Refer to the manuals of any associated equipment for routine checks needed.

Periodic inspection (six month)

- Check foundation bolts for security of attachment and corrosion.
- Check pump running records for total operating hours since last service to determine if bearing lubricant requires changing.
- Check the coupling for correct alignment and worn driving elements.
- Refer to the manuals of any associated equipment for periodic checks needed.

Bearing maintenance

These bearing lubrication sections list different temperatures of the pumped fluid.

Table 1: Oil Change Schedule

Type of bearing	First lubrication	Lubrication intervals
Oil-lubricated bearings	Add oil before you install and start the pump. Change the oil after 400 hours for new bearings.	After the first 400 hours, change the oil every 2000 operating hours or every three months.
Grease-lubricated bearings	Grease-lubricated bearings are initially lubricated at the factory.	Re-grease bearings every 2000 operating hours or every three months.

Lubricating-grease requirements

For most operating conditions a lithium based mineral oil grease of NLGI consistency number 2 is recommended. This grease is acceptable for bearing temperatures of -15°C to 110°C (5°F to 230°F).

Bearing temperatures are generally about 20°F (18°C) higher than bearing housing outer surface temperature.

Acceptable greases

Table 2:
Examples of acceptable greases.

NLGI Consistency	2
Exxon	Unirex N2
Mobil	Mobilux N2
Sunoco	Multipurpose EP
SFK	LGMT 2

CAUTION

CAUTION:

Never mix greases of different consistency (NLGI 1 or 3 with NLGI 2) or different thickener. For example, never mix a lithium base grease with a polyurea base grease.

Lubricate the bearings with grease

1. Wipe dirt from both grease fittings (Fig. 1).
2. Remove two grease relief plugs from side of frame opposite grease fittings.
3. Fill both grease cavities through grease fittings with recommended grease until fresh grease comes out of the relief holes. Reinstall grease relief plugs until immediately prior to starting pump.

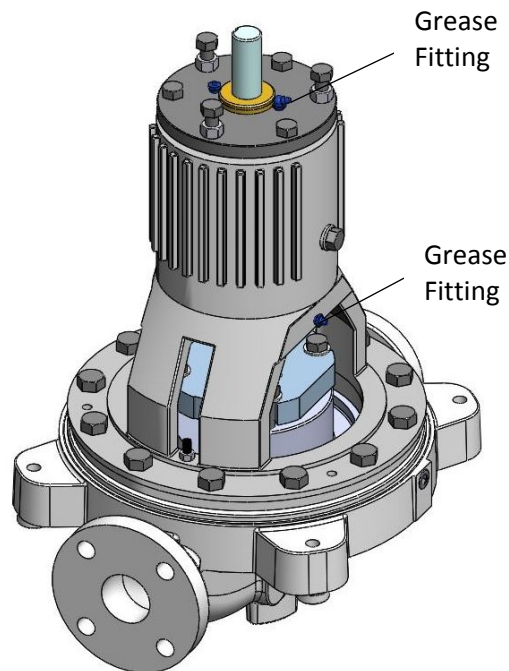


Figure 1. Grease Lube

Lubricate the bearings with pure oil mist (optional)

NOTICE

NOTE:

Pumps are shipped without oil. Oil mist lubricated bearings must be lubricated at the time of start-up.

1. Follow oil mist system supplier's instructions.
2. Connect oil mist supply lines to upper and center tapped connection.
3. Connect drain line to bottom tapped connection (Fig. 2).

Oil mist lubrication is required above pumpage temperature of 232°C (450° F), but may be used at lower temperatures.

A high quality turbine oil with rust and oxidation inhibitors should be used. For the majority of operational conditions, bearing temperatures will run between 50°C (120°F) and 82°C (180°F). In this range, an oil of ISO viscosity grade 68 at 40°C (100°F) is recommended. If bearing temperatures exceed 82°C (180°F), use ISO viscosity grade 100.

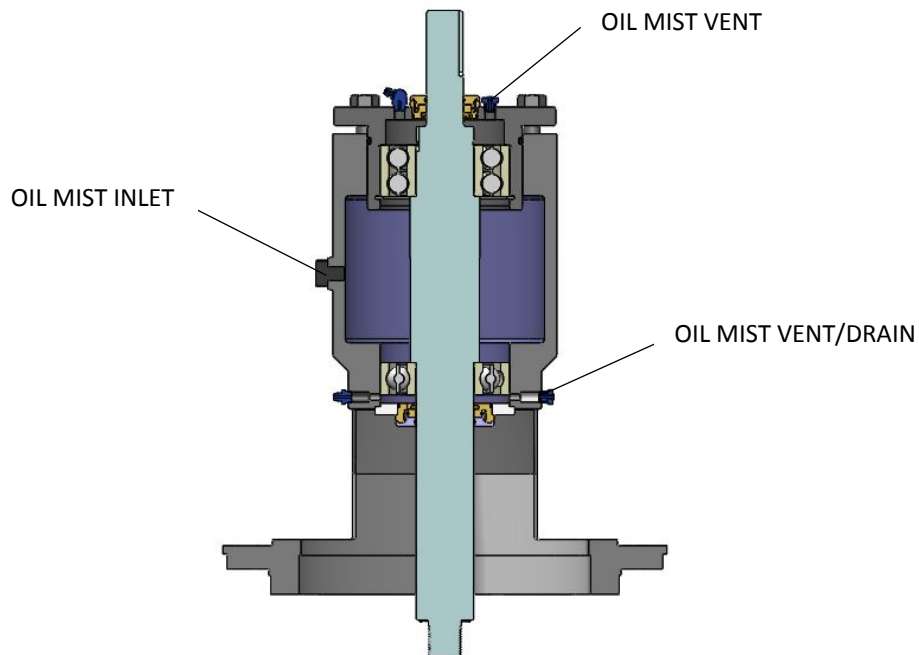


Figure 2. Oil Mist

Acceptable oil for lubricating bearings

Table 3:
Examples of acceptable high quality turbine oils with rust and oxidation inhibitors

Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Mobil	DTE 26 300 SSU @ 100°F (38°C)
Phillips	Mangus Oil 315
Shell	Tellus Turbo T 68 or Tellus S2 MX 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Lube

Shaft seal maintenance

Mechanical-seal maintenance



CAUTION:

Never operate the pump without liquid supplied to mechanical seal. Lack of seal flush can cause seal damage and catastrophic failure.

Cartridge mechanical seals

Cartridge mechanical seals are commonly used. Cartridge seals are preset by the seal manufacturer and require no field settings. Cartridge seals installed by the user require removal of the holding clips and engagement of the set screws prior to operation. If the seal has been installed in the pump by PW-IND, these clips have already been removed.

Other mechanical seal types

For other types of mechanical seals, refer to the instructions provided by the seal manufacturer for installation and setting.

Before you start the pump

Check the seal and all flush piping.

Impeller-clearance setting

Importance of a proper impeller clearance



WARNING:

- *The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in equipment damage.*
- *If you use a cartridge mechanical seal, you must install the centering clips and loosen the set screws before you set the impeller clearance. Failure to do so could result in mechanical seal damage.*

Impeller clearance methods

You can set the impeller clearance with either of these methods.

- Dial indicator method
- Feeler gauge method

Set the impeller clearance - dial indicator method

WARNING

WARNING:

Always disconnect and lock out all potential energy sources (electric, hydraulic, pneumatic, etc) before you perform any installation or maintenance tasks. Failure to do so will result in serious physical injury.

1. Remove the coupling guard.
2. Set the indicator so that the button contacts either the shaft end or the face of the coupling.

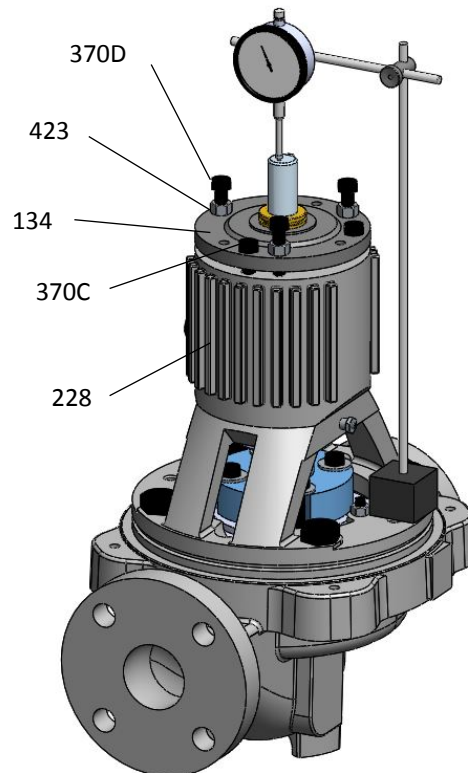


Figure 3: Mounting Indicator

3. Loosen the jam nuts (423) on the jack bolts (370D), and then back the bolts out about two turns.
4. Tighten the clamp bolts evenly (370C), bringing the bearing housing (134) towards the frame (228) until the impeller contacts the casing.
5. Turn the shaft in the direction of pump operation to ensure that there is slight contact between the impeller and the casing.
6. Set the indicator to zero and loosen the clamp bolt (370C) about one turn.
7. Thread in the jack bolts (370D) until the jack bolts evenly contact the bearing frame.
8. Tighten the jack bolts evenly about one flat at a time, moving the bearing housing (134) away from the bearing frame until the indicator shows the correct clearance.

Refer to the impeller clearance table to determine the correct clearance.

9. Tighten the bolts evenly in this order:
 - a) Tighten the clamp bolts (370C).
 - b) Tighten the jack bolts (370D).
 - c) Tighten jam nut (423)Make sure to keep the indicator reading at the proper setting.
10. Make sure the shaft turns freely.

Set the impeller clearance - feeler gauge method



WARNING

WARNING:

Always disconnect and lock out all potential energy sources (electric, hydraulic, pneumatic, etc) before you perform any installation or maintenance tasks. Failure to do so will result in serious physical injury.

- Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.

1. Remove the coupling guard.
2. Loosen the jam nuts (423) on the jack bolts (370D), and then back the bolts out about two turns.

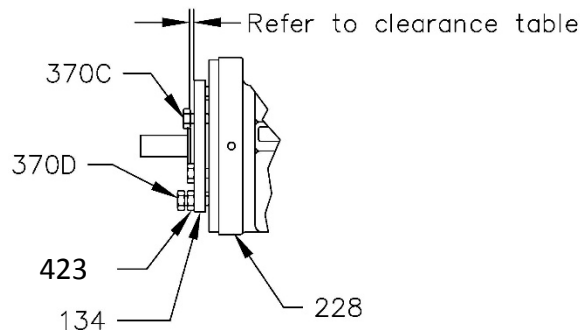


Figure 4: Setting Impeller Clearance-feeler gauge

3. Evenly tighten the clamp bolts (370C), bringing the bearing housing (134) towards the frame (228) until the impeller contacts the casing.
4. Turn the shaft in direction of rotation to ensure that there is slight contact between the impeller and the casing.
5. Use a feeler gauge to set the gap between the three clamp bolts (370C) and the bearing housing (134) to the correct impeller clearance.
Refer to the impeller clearance table to determine the correct clearance.
6. Use the three jack bolts (370D) to evenly move the bearing housing (134) until it contacts the clamp bolts (370C).
7. Evenly tighten the jam nuts (423).
8. Make sure the shaft turns freely.

Disassembly

This procedure covers disassembly. Refer to Figure1 in Parts Section for applicable item number.

Disassembly precautions

WARNING

WARNING:

- *This manual clearly identifies accepted methods for disassembling units. These methods must be followed to ensure safe maintenance of the pump. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers or other pump components to aid in their removal unless explicitly stated in this manual.*
- *Always disconnect and lock out power to all potential energy sources (electric, hydraulic, pneumatic, etc.) before you perform any installation or maintenance tasks. Failure to do so will result in serious physical injury.*
- *Refer to driver/coupling/gear manufacturers installation and operation manuals (IOM) for specific instructions and recommendations.*
- *The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks.*
- *A small amount of liquid will be present in the seal chamber and casing. Take proper precautions to avoid contact with hazardous fluids.*

NOTICE

NOTICE:

- *Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.*

Tools required

Bearing puller
Brass drift punch
Cleaning agents and solvents
Dial indicators
Feeler gauges
Hex wrenches
Hydraulic press
Induction heater
Leveling blocks and shims
Lifting sling
Micrometer
Rubber mallet
Screwdriver
Shaft wrench
Snap-ring pliers
Torque wrench with sockets
Wrenches

Disassembly Procedure

CAUTION

CAUTION:

- *Allow all system and pump components to cool before you handle them to prevent physical injury.*

1. Close the isolation valves on the suction and discharge sides of the pump.
You must drain the system if no valves are installed. Always disconnect and lock out all potential energy sources (electrical, hydraulic, pneumatic, etc.) before you perform any installation or maintenance tasks.
2. Drain the pump.
Do not proceed until liquid stops coming out of the drain valve.
3. Leave the drain valve open and remove the drain plug located on the bottom of the pump housing (if supplied).
Do not reinstall the plug or close the drain valve until the reassembly is complete.
4. Drain the liquid from the piping and flush the pump if it is necessary.
5. Disconnect all auxiliary piping and tubing.
6. Remove the coupling guard.
7. Remove the bolts (370) that hold the frame (228) to the casing. Jacking bolts (418) are provided to assist disassembly. Tighten the bolts evenly, a flat at a time, to jack assembly from casing.
8. Remove casing gasket (351).
9. Unscrew impeller (101) from shaft (122). The threads are right-hand. Prevent the shaft turning by using a wrench on coupling "flats". Do not lose or damage the O-ring (412A) which seals between the impeller (101) and shaft (122) or shaft sleeve (126).
10. On units with mechanical seal (383).
 - a. Inside single or double seal – remove gland stud nuts (355) and carefully slide gland (250) off studs. Do not damage seal faces.
 - b. Outside seal – loosen set screws which position rotary portion of seal and slide seal toward bearing frame (228). Remove gland stud nuts (355) and carefully slide gland (250) off studs. Do not damage seal faces.
11. Remove stud nuts (370H) which hold stuffing box cover (184) from frame. Do not allow stuffing box to contact shaft (122), sleeve (126), shaft threads or any mechanical seal parts. Slide sleeve (126), if any, off shaft (122).
12. On units with mechanical seal, loosen set screws which position rotary portion of seal to shaft (122) and carefully slide seal and gland (250) assembly off shaft. On units which have a shaft sleeve, (126), it is not necessary to remove rotary portion of seal from the sleeve unless replacement of seal is required.
13. Slide deflector (123) off shaft (122).
14. Scribe shaft (122) at coupling hub for proper positioning of hub during reassembly and remove hub.
15. Remove bearing housing bolts (370C). Impeller adjustment bolts (370D) with jam nuts can be used to assist in the removal of the shaft (122) and bearing assembly from the bearing frame (228).
16. Slide complete shaft assembly from bearing frame. This will include the shaft (122), both bearings (112 and 168), and bearing housing (134). Do not lose or damage O-ring (496). Do not damage inboard grease seal (333).
17. Pull inboard bearing (168).
18. Remove bearing retaining ring (361A) and slide bearing housing off ball bearing. Do not damage bearing housing grease seal (332).
19. Straighten "tang" in lock washer (382) and remove bearing locknut (136) and lock washer. Pull ball bearing (112).

Inspection and Replacement

1. Impeller (101) – Replace if impeller shows excessive erosion (especially on ejector vanes on back side of impeller), corrosion, extreme wear or vane breakage. O-ring groove and impeller hub must be in good condition. Check impeller balance.
2. Shaft (122) – Check for runout to see that shaft has not been bent. On pumps without shaft sleeves, shaft surface in stuffing box area must be smooth and free of grooves. Bearing seats and oil seal areas must be smooth and free of scratches or grooves. Shaft threads must be in good condition. Replace shaft if necessary.
3. Shaft Sleeve (126) – Surface in stuffing box must be smooth and free of grooves. If grooved, replace.
4. Mechanical Seal (383) – Seal faces, gaskets, and shaft sealing members must be in perfect condition or excessive leakage may result. Replace worn or damaged parts.
5. Ball bearings (112 and 168) – Replace if worn, loose or rough and noisy when rotated. New bearings should not be unwrapped until ready for use. Where possible, avoid reusing bearings that have been pulled.
6. Grease Seals (332 and 333) – Replace if torn or otherwise damaged. For seal sizes, see Vendor Identification Number table below. Seals are held by press fit. Lips on seals should face outward (away from bearings).
7. General – All parts should be clean before assembly. This is especially important at retaining ring and O-ring grooves, threads, lock fits, gasket surfaces and bearing lubricated areas. Any burrs should be removed with crocus cloth.

Reassembly

This procedure covers reassembly of pump after complete disassembly. Make sure all directions in Inspection and Replacement section have been followed. Refer to Figure 1 in Parts Section for applicable item number.

1. Oil bearing seat on coupling end of shaft (122). Slide coupling end bearing (112) (double row) on shaft as far as possible by hand. Place pipe or driving sleeve over shaft, making sure it rests against inner race only. Make sure bearing is “square” on shaft, especially where it contacts the grease seal.
2. Place lockwasher (382) and bearing locknut (136) on shaft and tighten firmly. Bend “tang” of lockwasher into slot in locknut.
3. Slide bearing housing (134) with O-ring (496) in place, on shaft and over bearing as far as possible. Do not damage grease seal (332).
4. Insert retaining ring (361) into groove in bearing housing (134). Flat side of retaining ring must be against bearing.
5. Oil inboard bearing seat on shaft (122). Slide inboard ball bearing (168) on shaft as far as possible by hand. Place pipe or driving sleeve over shaft, making sure it rests against inner race only. Make sure bearing is “square” on shaft. Tap or press evenly until bearing is seated firmly against the shaft shoulder. Do not mar the shaft, especially where it contacts the grease seal.
6. Place a small amount of O-ring lubricant on inside of bearing frame (228) at bearing housing (134) and inboard bearing seats, on O-ring, and on inboard grease seal (333). Carefully slide shaft assembly into the bearing frame as far as possible. Do not damage inboard grease seal. Be sure O-ring (496) is in place in groove on housing. Screw bearing housing bolts (370C) about ½” (12 mm) into bearing frame.
7. Slide deflector (123) on shaft (122).
8. If unit has mechanical seal (383):
The following instructions refer to pumps equipped with mechanical seals, either with or without sleeves.

On units with sleeves, the rotary portion of the seal may be mounted on the sleeve, and the seal-sleeve assembly mounted on the shaft as a unit.

Before mounting any seals, wipe the seal faces carefully with a clean soft cloth and lubricate with clean oil.

A preliminary impeller adjustment must be performed to assure proper positioning of the mechanical seal.

- a. Position sleeve (126) if any, on shaft (122) and engage groove in sleeve with drive pin (469) on shaft. Place stuffing box cover (184) against frame (228). Make sure studs (370H) align with proper holes in frame. Firmly tighten nuts or bolts.
- b. Screw impeller (101) with O-ring (412A) in place on shaft. Make sure that shaft assembly extends through stuffing box cover (184) so that the impeller will NOT contact face of stuffing box cover.
- c. Using impeller adjusting bolts (370C & 370D), adjust the impeller clearance until a .020" (0.51 mm) feeler gauge can be inserted between the back of the impeller and the face of the stuffing box cover.
- d. Remove impeller (101) and stuffing box cover (184).

Single Inside Seal

1. Assemble the gland (250), gaskets and stationary seat. If unit has sleeve (126), position sleeve on shaft (122). Slide gland assembly on shaft or sleeve.
2. Refer to Section V-D for instructions on proper positioning of mechanical seals.
3. Place stuffing box cover (184) against frame (228) making sure that studs (370H) align with proper holes in frame. Replace nuts and firmly tighten. Do not allow stuffing box cover to contact shaft, sleeves, if any, or mechanical seal.
4. Refer to Step 10 for further instructions.

Outside Seal

1. If unit has shaft sleeve (126), slide on shaft (122).
2. Lubricate rotary portion of seal and slide on shaft sleeve. Do not tighten set screws.
3. Assemble gland (250), gaskets, and stationary seat and slide assembly on shaft or sleeve.
4. Place stuffing box cover (184) against frame making sure that the studs (370H) align with the proper holes in frame. Firmly tighten nuts.
5. Place gland assembly against face of stuffing box and firmly tighten stud nuts.
6. Slide rotary portion toward gland until it contacts stationary seat. Compress the rotary. Tighten screws.

Double Seal

1. Assemble the gland (250), gaskets and stationary seat. If unit has shaft sleeve (126), position sleeve on shaft (122) and engage groove in sleeve with drive pin (469) on shaft. Slide gland assembly on shaft or sleeve.
2. Refer to the Additional Details section for instructions on proper positioning of

mechanical seals.

3. Place inboard stationary seat and gaskets into bottom of stuffing box.
 4. Place stuffing box cover (184) against frame making sure that studs (370H), align with proper holes in frame. Firmly tighten nuts.
 5. Refer to Step 9 for further instructions.
-
9. Screw impeller (101) with O-ring (412A) in place, on the shaft (122).
 10. Install and position coupling hub at scribe mark on shaft.
 11. Place casing gasket (351) against shoulder in casing.
 12. Slide the pullout assembly into the casing (100). Drain slot in stuffing box cover (184) should line up with drain connection in casing. Install and tighten the frame-to-casing. Install and tighten the frame-to-casing. Install and tighten the frame-to-casing. Make sure pump turns FREELY. If not, adjust the impeller adjusting bolts (370C & 370D). Install and tighten the frame to casing bolts (370) evenly while turning the pump by hand. Do not jam the impeller into the casing.
 13. Reset impeller clearances.
 - a. Loosen bolts (370 – C & D)
 - b. Tighten bolts (370C) while turning shaft until impeller starts to rub against casing.
 - c. Loosen bolts (370C) until a 0.015 inch (0.375 mm) feeler guage can be placed between the bolt head and the bearing housing.
 - d. Tighten bolts (370D) evenly. Bearing housing, shaft and impeller will be jacked to proper clearance from casing. Tighten bolts (370D) and jam nuts on bolts (370D).
 - e. If desired, a dial indicator can be used instead of a feeler gauge to check that the bearing housing has been moved the correct 0.015 inch (0.375 mm) distance.

Additional Details

Positioning of Mechanical Seals

1. Place stuffing box cover (184) against frame (228), making sure that the studs (370H) align with the proper holes in frame. Firmly tighten nuts.
2. Correct location of the rotary portion of a mechanical seal can be determined by two methods.

Scribe Method

- a. Scribe the shaft (122) or sleeve (126) lightly at the face of the stuffing box.
- b. Remove the nuts or bolts and slide stuffing box cover (184) away from the frame.
- c. Lubricate rotary portion of seal and slide on shaft or sleeve.
- d. Compress rotary portion of seal to correct dimension as shown on seal manufacturer's drawing and tighten set screws.

Modified Visegrip Method

- a. Slide the gland assembly (250) against the stuffing box. Do not damage seal face. Do not bolt gland to stuffing box.
- b. Clamp modified visegrip on the shaft (122) or sleeve (126) directly against the gland.

- c. Leaving visegrip in position, remove nuts or bolts and slide stuffing box cover away from frame adapter.
- d. Lubricate rotary portion of seal and slide on shaft (122) or sleeve (126).
- e. Compress rotary portion of seal to correct dimension as shown on seal manufacturer's drawing and tighten set screws.
- f. Remove visegrip and refer to Step 9 for further instructions.

Parts Listings and Cross-Sectional Drawings

Table 1 - Parts List

Item	Quantity	Part name
100	1	Casing
101	1	Impeller
105	1	Lantern Ring
108	1	Frame Adapter
112A	1	Outboard Bearing
113	2	Plug—Grease Relief
119	1	Bearing End Cover
122	1	Shaft—With Sleeve
123	1	Deflector
126	1	Shaft Assy
134	1	Bearing Housing
136	1	Bearing Locknut
168	1	Radial Bearing
184	1	Seal Chamber/Stuffing Box Cover
193	2	Grease Fitting
228	1	Bearing Frame
240	1	Motor Support
250	1	Gland—Mechanical Seal
332A	1	Outboard Labyrinth Seal w/O-rings
333A	1	Inboard Labyrinth Seal w/O-rings
351	1	Casing Gasket
353	4	Gland Stud
355	4	Gland Stud Nut
360Q	1	Gasket—Gland-to-Stuffing Box Cover
361A	1	Retaining Ring
370	**	Bolt – Adapter to Case
370C	3	Clamp Bolt —Bearing Housing
370D	3	Jack Bolt—Bearing Housing
370H	2	Stud—Stuffing Box Cover-to-Adapter
370Y	2	Bolt—Cap Casing to Support
382	1	Bearing Lockwasher
383	1	Mechanical Seal
400	1	Coupling Key
412A	1	O-Ring, Teflon Impeller
415	3	Hex Nut
418	3	Jack Bolt—Adapter-to-Case
423	3	Jam Nut—Bearing Housing Jack Bolt
428	1	Gasket, Plug

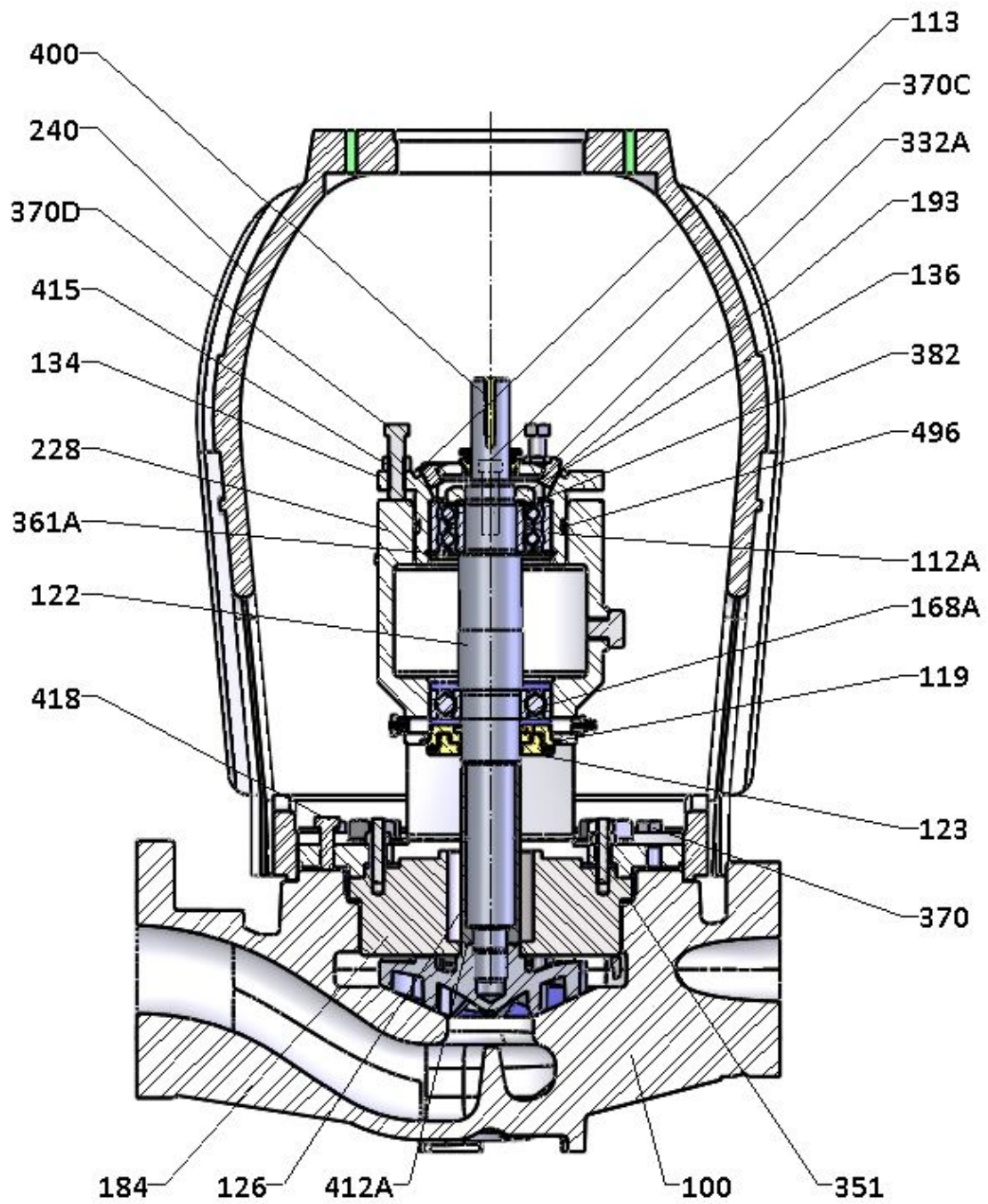


Figure 1: Pump Sectional View