

# Installation, Operation, and Maintenance Manual



Model: **PWA-SL**



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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-SL



**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:**

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



**WARNING:**

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



**CAUTION:**

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



**NOTICE:**

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

## Safety



**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-SL

The PWA-SL is a horizontal overhung, open impeller, sealless, magnetically driven, centrifugal pump. This pump is ANSI B73.3 compliant.



Figure 1: PWA-SL pump

Table 1 : Hydraulic sizes per Power Frame size

Power Frame size	Number of hydraulic sizes
Group 1	5
Group 2	9

## Part description PWA-SL

Table 2: Pump casing details

Part	Description
Discharge	Top-centerline
Casing ventilation	Self venting
Gasket	Fully confined
Mounting method	Integral foot
Standard flange	ANSI class 150# flat-face serrated flange
Optional flanges	<ul style="list-style-type: none"><li>• ANSI class 150# raised-face serrated flange</li><li>• ANSI class 300# flat-face serrated flange</li><li>• ANSI class 300# raised-face serrated flange</li></ul>

### Impeller

The impeller is

- Fully open
- Bolted to the outer drive magnetic
- Bolting threads are sealed from the pumped liquid by an o-ring

### Magnetic Coupling Unit

Patented Containment Shell

- Non-metallic PEEK, carbon fiber composite

## Magnetic Coupling

- Neodymium-Iron-Boron

**Table 3: Power Frame details**

Part	Description
Frame adapter	The carbon steel frame adapter has <ul style="list-style-type: none"><li>• A machined rabbet fitted to the Magnetic Coupling Unit</li></ul>
Power end	<ul style="list-style-type: none"><li>• Flinger oil lubrication is standard.</li><li>• No machining is required to convert from oil to grease or oil-mist lubrication. Regreaseable bearings and oil-mist lubrication are optional.</li><li>• The oil level is checked through a sight glass located on both sides of the power end.</li><li>• The power end is sealed with ISOMAG labyrinth seals.</li><li>• The power end is made in the following sizes:<ul style="list-style-type: none"><li>• Group 1</li><li>• Group 2</li></ul></li></ul>
Shaft	Separate threaded shaft attached to the inner drive magnet.
Bearings	<p>The Non-Drive End (INBOARD) bearing</p> <ul style="list-style-type: none"><li>• Carries only radial loads.</li><li>• Is free to float axially in the frame.</li><li>• Is a single-row deep-groove ball bearing</li></ul> <p>The Drive End (OUTBOARD) bearing</p> <ul style="list-style-type: none"><li>• Is shouldered and locked to the shaft and housing to enable it to carry radial and thrust loads.</li><li>• Is a double-row angular-contact bearing,</li></ul>

### 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.
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**Figure 2: Nameplate on the pump casing using English units**

MADE IN USA S/N  STD. NO.

**PumpWorks™**  
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.

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 3: Nameplate on the pump casing using metric units**

MADE IN USA S/N  STD. NO.

**PumpWorks™**  
FOR SERVICE CALL: 1-800-349-2018 MODEL  SIZE

FLOW M³/HR  HEAD M  R.P.M

HYDRO PRESS. kPag @ 30 °C  IMP. DIA.  MAX. DIA.

MAX. DES. WORKING PRESS. kPag @ 30 °C  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.

**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 <sup>3</sup> /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 4: Nameplate on the bearing frame**

FOR SERVICE CALL: 1-800-349-2018      MADE IN USA

S/N

ASSEMBLED IN       YEAR BUILT

LUBE

BRG. I.B.       BRG. O.B.

**WARNING**

Avoid death or serious injury, read and understand Installation, Operation, and Maintenance manual before operating this equipment. Do **NOT** operate this equipment without guarding properly installed.

**Table 7: Power Frame Nameplate Definitions**

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

#### 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.*



### WARNING

## 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 without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A base-mounted pump	Use slings under the pump casing and the drive unit, or under the base rails.
Mounted on a Polymer Composite Baseplate	See separate information regarding the Polymer Composite Baseplate.

## Examples

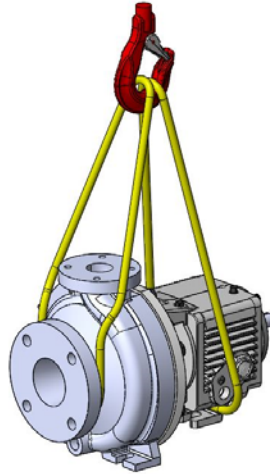
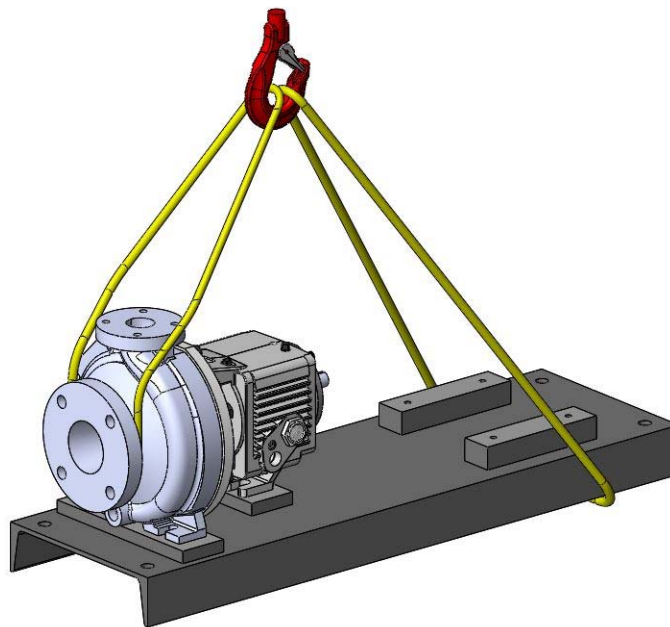


Figure 1: Example of Proper Lifting – Bare Pump

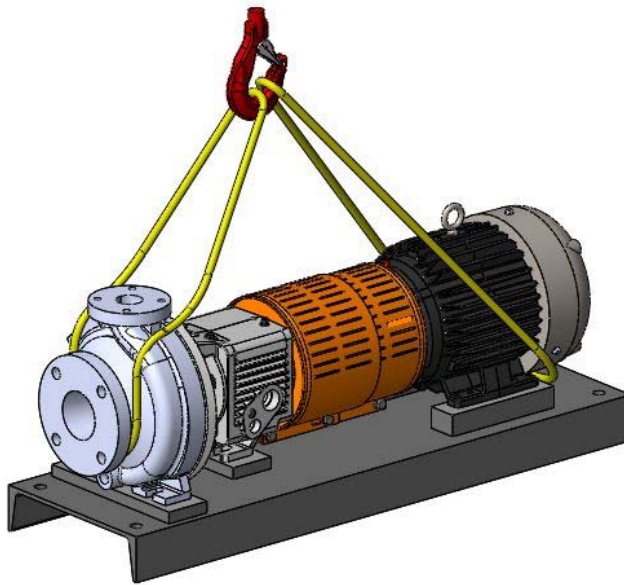


### NOTICE

**NOTICE:**

*Do not use this lifting method to lift a Polymer Composite Baseplate with the pump and motor mounted. Doing so may result in equipment damage.*

Figure 2: Example of Proper Lifting – Base Mounted Pump



**NOTICE**

**NOTICE:**

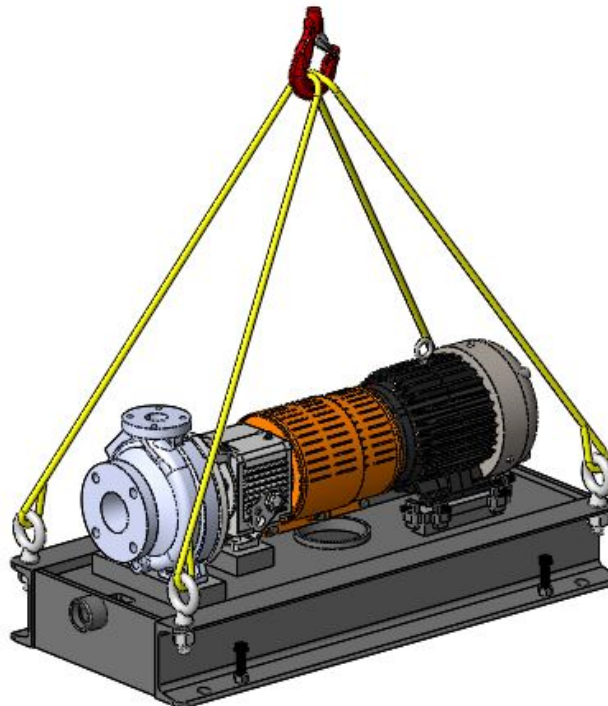
*Ensure that lifting strap is located at motor feet-frame, and clear of motor fan shroud prior to lifting.*

**NOTICE**

**NOTICE:**

*Do not use this lifting method to lift a Polymer Composite Baseplate with the pump and motor mounted. Doing so may result in equipment damage.*

**Figure 3: Example of Proper Lifting – Base Mounted Pump with Motor**



**Figure 4: Example of Proper Lifting – Fabricated Base Mounted Pump with Motor**



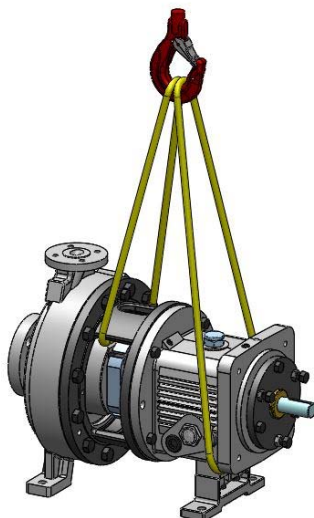


Figure 5: Example of Proper Lifting – Pump with Frame Adapter

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

#### 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.

# Frost proofing

Table 3: Situations when the pump is or is not frost proof

Situation	Condition
Operating	The pump is frost proof.
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. <b>NEVER USE AN ANTI-FREEZE AGENT IN THE PUMP BEARING HOUSING.</b>

# 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 space 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
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 foundation must form a permanent, rigid support for the unit.
- The location and size of the foundation fasteners should be in accordance with those shown on the construction drawing provided with the pump data package.
- The foundation must weigh between three and five times the weight of the entire pump package.
- Ensure foundation is level and free of discontinuity to prevent distortion when foundation bolts are tightened.

1. Baseplate
2. Shims or wedges
3. Foundation
4. Sleeve
5. Form
6. Bolt

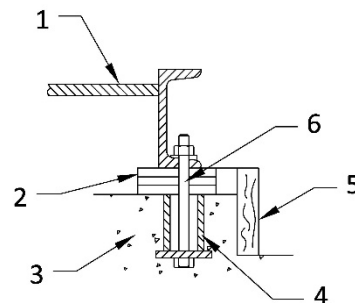
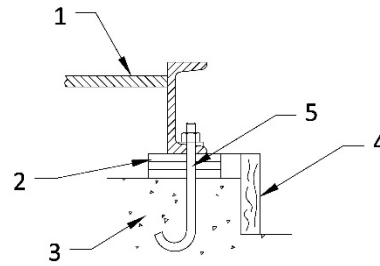


Figure 1: Sleeve-type bolts

1. Baseplate
2. Shims or wedges
3. Foundation
4. Form
5. Bolt



**Figure 2: J-type bolts**

## Baseplate mounting procedures

### Prepare the baseplate for mounting

1. Remove the pump and motor from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with a re-coatable epoxy primer.  
Use an epoxy primer only if you will be using an epoxy-based grout.
4. Remove the rust-proof coating from the machined mounting pads using an appropriate solvent.
5. Remove water and debris from the foundation-bolt holes.

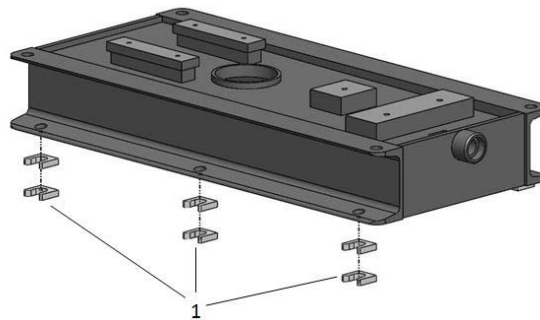
### Install the baseplate using shims

Required tools:

- Two sets of shims for each foundation bolt
- Two machinist's levels

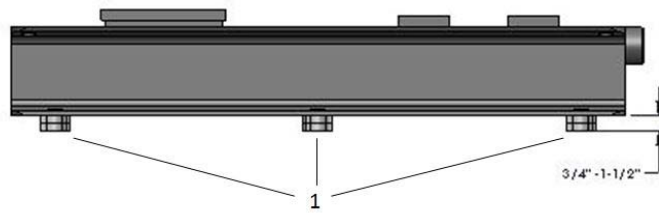
This procedure is applicable to fabricated steel baseplates.

1. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt sleeves.
2. Set shims on each side of each foundation bolt.  
The shims should have a height of between 0.75 in. (19 mm) and 1.50 in (38mm).



1. Shims

**Figure 3: Top view**



1. Shims

**Figure 4: Side view**

3. Lower the baseplate carefully onto the foundation bolts.
4. Set the machinist's levels across the mounting pads of the driver and the mounting pads of the pump.

### **NOTICE**

**NOTICE:**

*Remove all dirt from the mounting pads in order to make sure that you achieve the correct level indication.*

5. Level the baseplate both lengthwise and across by adding or removing shims.  
**The correct level measurement is a maximum of 0.005 in./ft (400 micrometers/m).**
6. Hand-tighten the foundation bolts.

## **Install the baseplate using jackscrews**

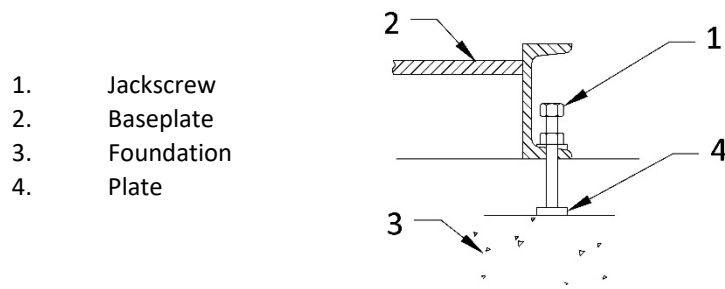
Tools required:

- Anti-seize compound
- Jackscrews
- Bar stock
- Two machinist's levels

This procedure is applicable to the Fabricated Steel *PLUS* baseplate and the Polymer Composite Baseplate

1. Apply an anti-seize compound on the jackscrews.  
The compound makes it easier to remove the screws after grouting.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:
  - a) Cut plates from bar stock and chamfer the edges of the plates in order to reduce stress concentrations.
  - b) Put the plates between the jackscrews and the foundation surface.
  - c) Use the jackscrews to raise the baseplate above the foundation.  
For grouted installations, make sure that the distance between the baseplate and the foundation surface is between 0.75 in. (19 mm) and 1.50 in. (38 mm).

For non-grouted installations, the baseplate should be raised the minimum distance required for leveling.



**Figure 5: Jackscrew bolts**

3. Level the driver mounting pads:  
**The correct level measurement is a maximum of 0.005 in./ft (400 micrometers/m).**

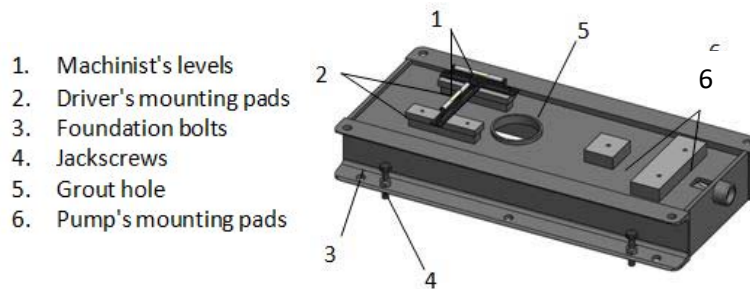
**NOTICE**

**NOTICE:**

*Remove all dirt from the mounting pads in order to make sure that you achieve the correct level indication.*

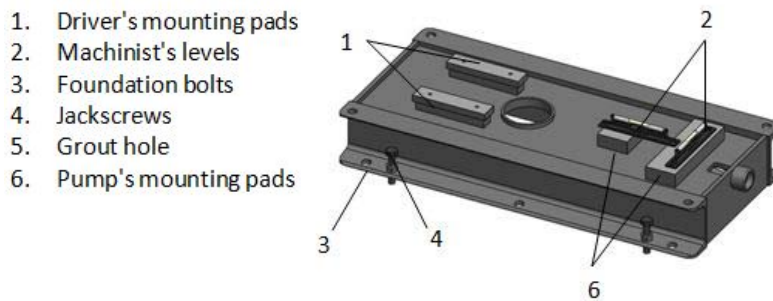
**The correct level measurement is a maximum of 0.005 in./ft (400 micrometers/m).**

- a) Put one machinist's level lengthwise on one of the two pads.
- b) Put the other machinist's level across the ends of the two pads.
- c) Level the pads by adjusting the four jackscrews in the corners.



**Figure 6: Leveling baseplate – motor pads**

4. Level the pump mounting pads.  
**The correct level measurement is a maximum of 0.005 in./ft (400 micrometers/m).**
  - a) Put one machinist's level lengthwise on one of the two pads.
  - b) Put the other level across the center of the two pads.
  - c) Level the pads by adjusting the four jackscrews in the corners.  
 Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.



**Figure 7: Leveling baseplate – pump pads**

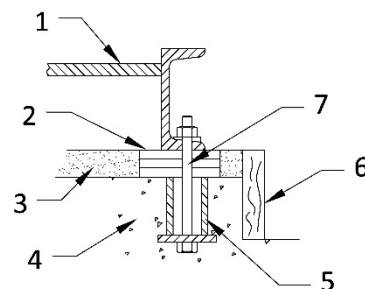
5. Hand-tighten the nuts for the foundation bolts.
6. Check that the driver's mounting pads are level and adjust the jackscrews and the foundation bolts if necessary.

## Grout the baseplate

Required equipment:

- Cleaners: Do not use an oil-based cleaner because the grout will not bond to it. See the instructions provided by the grout manufacturer.
  - Grout: Non-shrink grout is recommended.
1. Clean all the areas of the baseplate that will come into contact with the grout.
  2. Build a form around the foundation.
  3. Refer to API 686 and grout manufactures installation instructions.
  4. Pour grout through the grout hole into the baseplate up to the level of the form.
- When you pour the grout, remove air bubbles by using one of these methods.
- Refer to API 686 and grout manufactures installation instructions.
5. Allow the grout to set 48 hours.

1. Baseplate
2. Shims or wedges
3. Grout
4. Foundation
5. Sleeve
6. Form
7. Bolt



**Figure 8: Initial Grout**



6. Fill the remainder of the baseplate with grout, and allow the grout to set for at least 48 hours.

1. Baseplate
2. Grout
3. Foundation
4. Form
5. Bolt

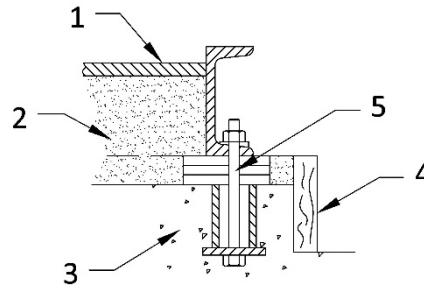


Figure 9: Final Grout

7. Refer to the grout manufacturer's instructions for tightening the foundation bolts. Over tightening the foundation bolts before proper cure can damage the grout and distort the baseplate.
8. Ping test baseplate for voids. Where voids are located, drill and tap an air release hole and an opposing hole. Tap and thread opposing hole with zerk fitting and gently fill void with grout.

**WARNING**

**WARNING:**

- Always re-confirm baseplate level AFTER GROUTING per the procedure in this section prior to re-installing the pump and motor.

## Install the pump, driver, and coupling

1. Mount and fasten the pump on the baseplate. Use appropriate bolts.
2. Mount the driver on the baseplate. Use appropriate bolts and hand tighten.
3. Install the coupling.  
(See the installation instructions from the coupling manufacturer.)

## Pump-to-driver alignment

### Precautions

**WARNING**

**WARNING:**

- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
- Always disconnect and lock out power all potential energy sources (electrical, hydraulic, pneumatic, etc.) before you perform any installation 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.

**NOTICE**

**NOTICE:**

Each PW-IND complete pump package is factory aligned to ensure assembly integrity. **It is the user's responsibility to perform a final alignment before start up.**

## Alignment checks

### When to perform alignment checks

Additional alignment checks are REQUIRED when:

- The process temperature changes.
- The piping changes.
- The pump has been serviced.

### Types of alignment checks

Table 2: Alignment checks

Type of alignment	When to perform
Initial alignment (cold alignment) check	Prior to operation when the pump and the driver are at ambient temperature.
Final alignment (hot alignment) check	After operation when the pump and the driver are at operating temperature.

### Initial alignment (cold alignment)

Table 3: Initial alignment - cold

When	Why
Before you grout the baseplate	This ensures that alignment can be accomplished.
After you grout the baseplate	This ensures that no changes have occurred during the grouting process.
After you connect the piping	This ensures that pipe strains have not altered the alignment. If changes have occurred, you must alter the piping to remove pipe strains on the pump flanges.

### Final alignment (hot alignment)

Table 4: Final alignment - hot

When	Why
After the first run	This ensures correct alignment when both the pump and the driver are at operating temperature.
Periodically	This follows the plant operating procedures

## Permitted indicator values for alignment checks

### NOTICE

#### NOTICE:

*The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. You must use the correct tolerances. Failure to do so can result in misalignment and reduced pump reliability.*

When dial indicators are used to check the final alignment, the pump and drive unit are correctly aligned when these conditions are true:

- The total indicator runout (TIR) is a maximum of 0.002 in. (0.05 mm) parallel offset at operating temperature.
- The tolerance of the indicator is 0.0005 in./in. (0.0127 mm/mm) angularity of indicator separation at operating temperature.

## Cold settings for parallel vertical alignment

A vertical offset of the pump driver is required during the cold alignment process. Consult the driver installation manual or your PW-IND representative for the proper vertical offset.

### Alignment measurement guidelines

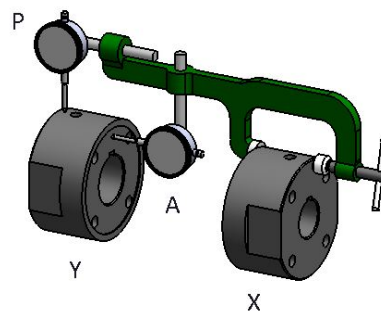
Table 5: Measurement guidelines

Guideline	Explanation
Rotate the pump coupling half and the driver coupling half together so that the indicator rods have contact with the same points on the driver coupling half.	This prevents incorrect measurement.
Move or shim only the driver in order to make adjustments. Avoid shimming the pump feet.	This prevents strain on the piping installations.
Make sure that the hold-down bolts for the driver feet are tight when you take indicator measurements.	This keeps the driver stationary since movement causes incorrect measurement.
Make sure that the hold-down bolts for the driver feet are loose before you make alignment corrections.	This makes it possible to move the driver when you make alignment corrections.
Check the alignment again after any mechanical adjustments.	This corrects any misalignments that an adjustment may have caused.

### Attach the dial indicators for alignment

You must have two dial indicators in order to complete this procedure.

1. Attach two dial indicators on the pump coupling half (X):
  - a) Attach one indicator (P) so that the indicator rod comes into contact with the perimeter of the driver coupling half (Y). This indicator is used to measure parallel misalignment.
  - b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.



P = Parallel Reading  
A = Angular Reading  
X = Motor Hub  
Y = Pump Hub

Figure 10: Dial indicator alignment

2. Rotate the pump coupling half (X) in order to check that the indicators are in contact with the driver coupling half (Y) but do not

- bottom out.
- Adjust the indicators if necessary.

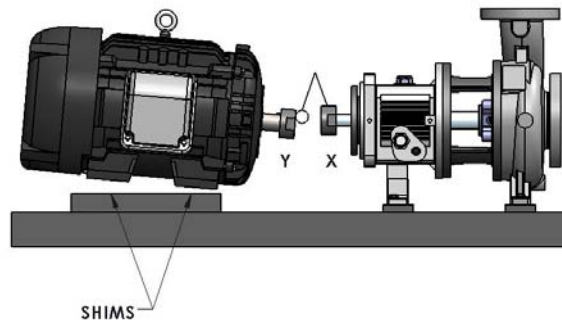
## Pump-to-driver alignment instructions

### Perform angular alignment for a vertical correction

- Set the angular alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
- Rotate the indicator to the bottom-center position (6 o'clock).
- Record the indicator reading.

**Table 6: Angular alignment for vertical correction guidelines**

When the reading value is...	Then...
Negative	<p>The coupling halves are farther apart at the bottom than at the top. Perform one of these steps:</p> <ul style="list-style-type: none"> <li>Add shims in order to raise the feet of the driver at the shaft end.</li> <li>Remove shims in order to lower the feet of the driver at the other end.</li> </ul>
Positive	<p>The coupling halves are closer at the bottom than at the top. Perform one of these steps:</p> <ul style="list-style-type: none"> <li>Remove shims in order to lower the feet of the driver at the shaft end.</li> <li>Add shims in order to raise the feet of the driver at the other end.</li> </ul>



**Figure 11: Side view of an incorrect vertical alignment**

- Repeat the previous steps until the permitted reading value is achieved.

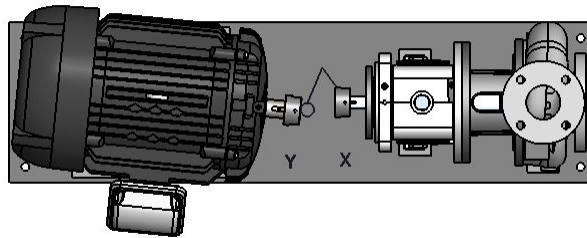
### Perform angular alignment for a horizontal correction

- Set the angular alignment indicator (A) to zero on left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
- Rotate the indicator through the top-center position to the right side, 180°

- from the start position (3 o'clock).
- Record the indicator reading.

**Table 7: Angular alignment horizontal correction guidelines**

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: <ul style="list-style-type: none"> <li>Slide the shaft end of the driver to the left.</li> <li>Slide the opposite end to the right.</li> </ul>
Positive	The coupling halves are closer together on the right side than the left. Perform one of these steps: <ul style="list-style-type: none"> <li>Slide the shaft end of the driver to the right.</li> <li>Slide the opposite end to the left.</li> </ul>



**Figure 12: Top view of an incorrect horizontal alignment**

- Repeat the previous steps until the permitted reading value is achieved.

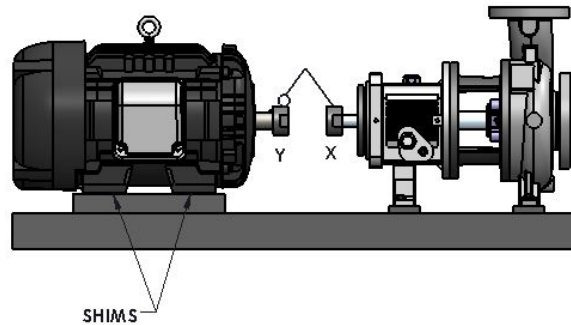
### Perform parallel alignment for a vertical correction

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

- Set the parallel alignment indicator (P) to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
- Rotate the indicator to the bottom-center position (6 o'clock).
- Record the indicator reading.

**Table 8: Parallel alignment for vertical correction guidelines**

When the reading value is...	Then...
Negative	The pump coupling half (X) is lower than the driver coupling half (Y). Remove shims of a thickness equal to half of the indicator reading value under each driver foot.
Positive	The pump coupling half (X) is higher than the driver coupling half (Y). Add shims of a thickness equal to half of the indicator reading value to each driver foot.



**Figure 13: Side view of an correct vertical alignment**

Repeat the previous steps until the permitted reading value is achieved.

### NOTICE

#### NOTICE:

*The specified permitted reading values are only valid at operating temperatures. For cold settings, other values are permitted. You must use the correct alignment tolerance. Failure to do so can result in misalignment and reduced pump reliability.*

### Perform parallel alignment for a horizontal correction

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

1. Set the parallel alignment indicator (P) to zero on the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

**Table 9: Parallel alignment for horizontal correction guidelines**

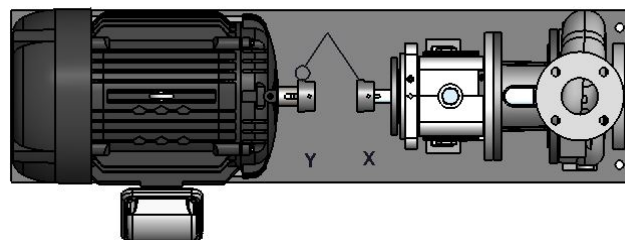
When the reading value is...	Then...
Negative	The driver coupling half (Y) is to the left of the pump coupling half (X).
Positive	The driver coupling half (Y) is to the right of the pump coupling half (X).

4. Slide the driver carefully in the appropriate direction.

### NOTICE

#### NOTICE:

*Make sure to slide the driver evenly. Failure to do so can negatively affect horizontal angular correction.*



**Figure 14: Top view of a correct horizontal alignment**

5. Repeat the previous steps until the permitted reading value is achieved

### NOTICE

#### NOTICE:

*The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. You must use the correct alignment tolerances. Failure to do so can result in misalignment and reduced pump reliability.*

### Perform complete alignment for a vertical correction

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

1. Set the angular and parallel dial indicators to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicators to the bottom-center position (6 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

### Perform complete alignment for a horizontal correction

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

1. Set the angular and parallel dial indicators to zero at the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicators through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

## Piping checklists

### General piping checklist

#### Precautions

#### CAUTION

#### CAUTION:

- *Never draw piping into place by using force at the flanged connections of the pump. This can impose dangerous strains on the unit and cause misalignment between the pump and driver. Pipe strain adversely affects the operation of the pump, which results in physical injury and damage to the equipment.*
- *Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.*

## Piping guidelines

Guidelines for piping are given in the Hydraulic Institute Standards

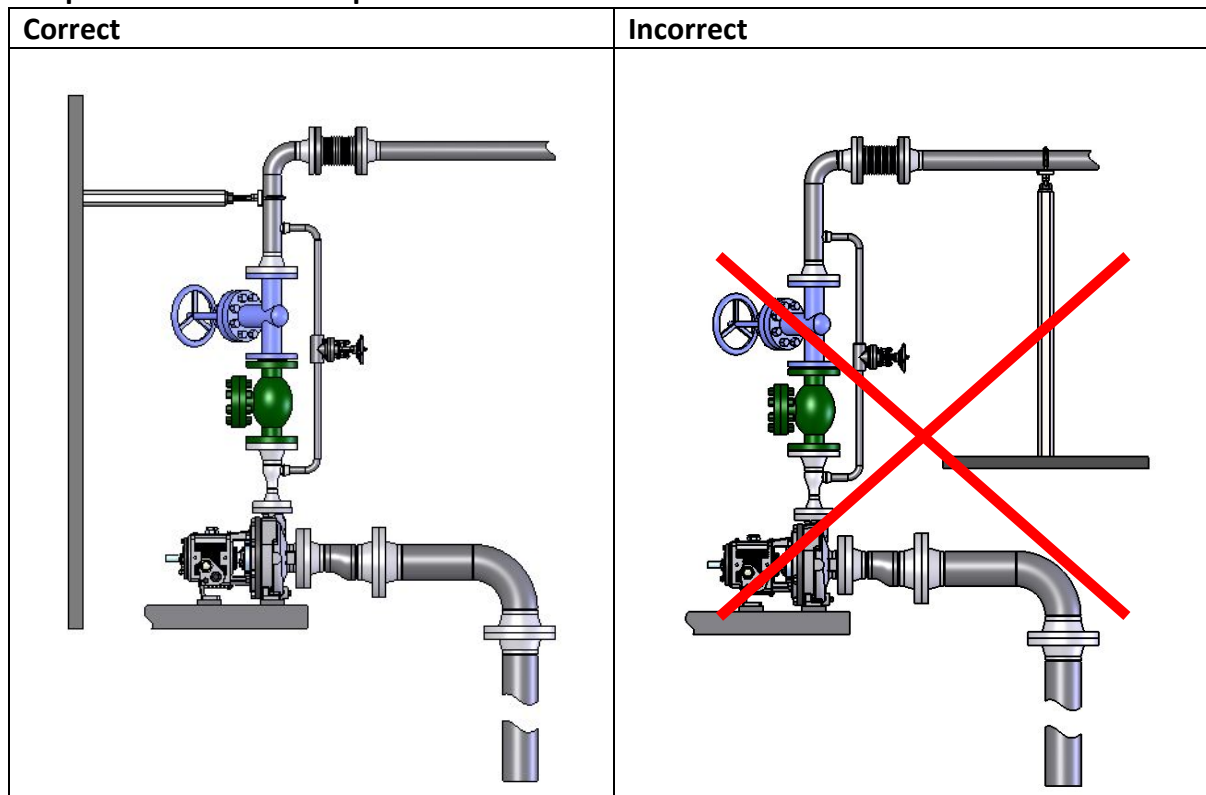
### Checklist

**Table 10: Piping guidelines**

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: <ul style="list-style-type: none"><li>• Strain on the pump</li><li>• Misalignment between the pump and the drive unit</li><li>• Wear on the pump bearings and the coupling</li><li>• Wear on the pump bearings, seal, and shafting</li></ul>	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: <ul style="list-style-type: none"><li>• The grout for the baseplate or sub-base becomes hard.</li><li>• The hold-down bolts for the pump and the driver are tightened.</li></ul>	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.		
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	
Pump flange and piping flange face alignment and separation.	<ul style="list-style-type: none"><li>• The pump and piping flange faces shall be parallel to a min. of .001 in./in. ( 10 micrometers/cm) of outer flange diameter.</li><li>• Flange face separation, including single gasket spacing, shall be 1/16" ( 1.5 mm).</li></ul>	



## Example: Installation for expansion



## Fastening



### WARNING:

- Only use fasteners of the proper size and material.
- Replace all corroded fasteners.
- Make sure that all fasteners are properly tightened and that there are no missing fasteners.

## Suction piping checklist

### Performance curve reference

Net positive suction head available ( $NPSH_A$ ) must always exceed  $NPSH$  required ( $NPSH_R$  or  $NPSH_3$ ) as shown on the published performance curve of the pump.

### Suction-piping checks

Table 11: Suction piping guidelines

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and the closest bend is at least five pipe diameters.	This minimizes the risk of cavitation in the suction inlet of the pump due to turbulence. See the Example sections for illustrations.	
Check that component or pipe diameter change in general do not have sharp bends.	See the Example sections for illustrations.	

Check that the suction piping is one or two sizes larger than the suction inlet of the pump. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump. See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: • Sloping side down • Horizontal side at the top	See the example illustrations.	
When suction strainers or suction bells are used, check that they are at least three times the area of the suction piping.	Suction strainers help to prevent clogging. Mesh holes with a minimum diameter of 1/16 in. (1.6 mm) are recommended.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	

### Liquid source below the pump

**Table 12: Suction piping guidelines – Liquid source below pump**

Check	Explanation/comment	Checked
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the suction piping slopes upwards from the liquid source to the pump inlet.	This prevents air from accumulating in the suction piping.	
If the pump is not self-priming, check that a device for priming the pump is installed.	Use a foot valve with a diameter that is at least equivalent to the diameter of the suction piping. End user must accommodate for foot valve friction losses in priming & suction calculations.	

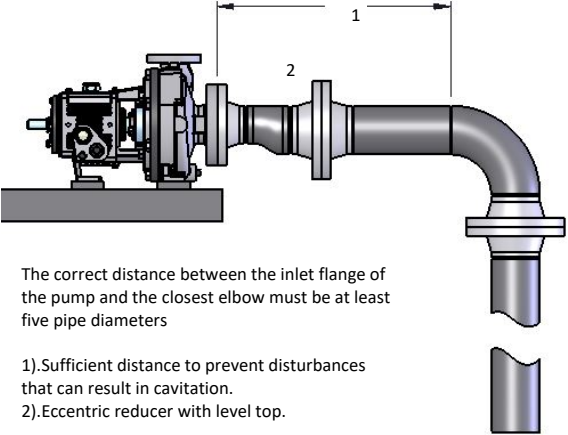
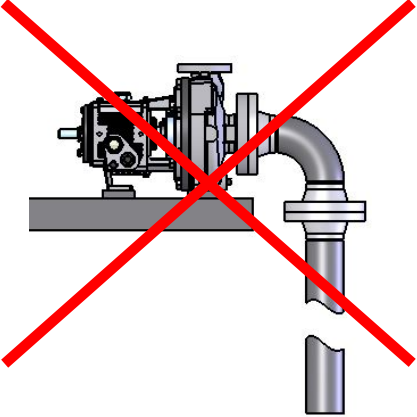
### Liquid source above the pump

**Table 13: Suction piping guidelines – Liquid source above pump**

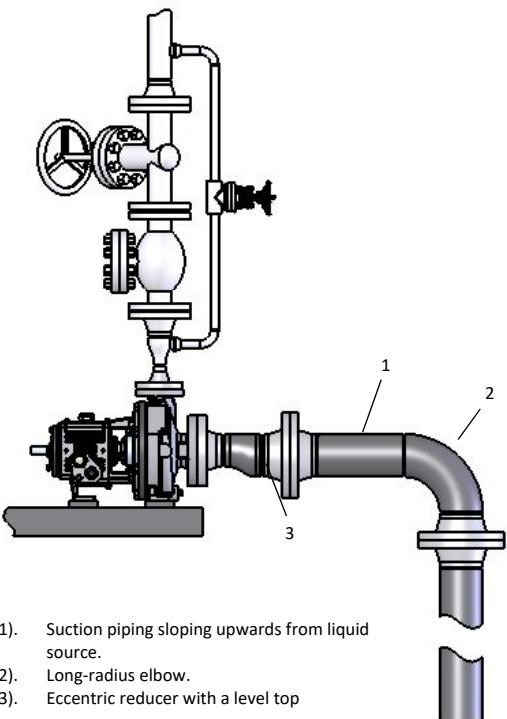
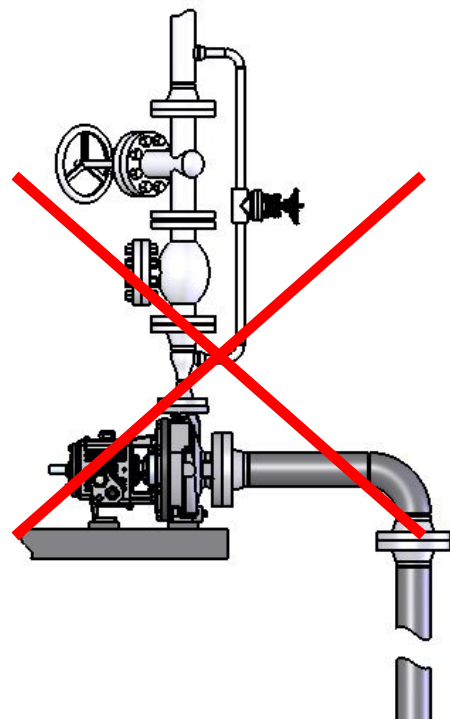
Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	This permits you to close the line during pump inspection and maintenance. Do not use the isolation valve to throttle the pump. Throttling can cause these problems: • Loss of priming • Excessive temperatures • Damage to the pump • Voiding the warranty	
Make sure that the suction piping is free from vapor pockets.	This helps to prevent the occurrence of vapors and cavitation in the pump inlet.	
Check that the piping is level or slopes downward from the liquid source.	—	
Make sure that no part of the suction piping extends below the suction flange of the pump.	—	

Make sure that the suction piping is adequately submerged below the surface of the liquid	This prevents air from entering the pump through a suction vortex.	
---	--	--

**Example: Elbow close to the pump suction inlet**

Correct	Incorrect
 <p>The correct distance between the inlet flange of the pump and the closest elbow must be at least five pipe diameters</p> <p>1). Sufficient distance to prevent disturbances that can result in cavitation. 2). Eccentric reducer with level top.</p>	

### Example: Suction piping below pump

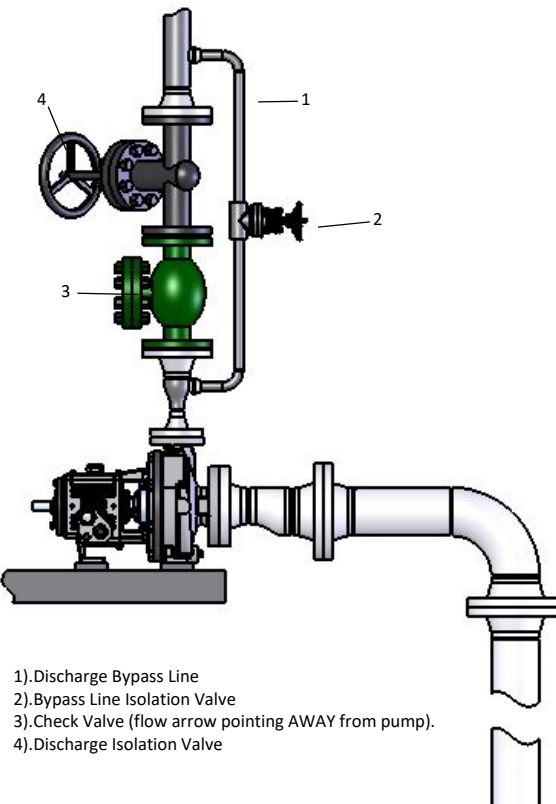
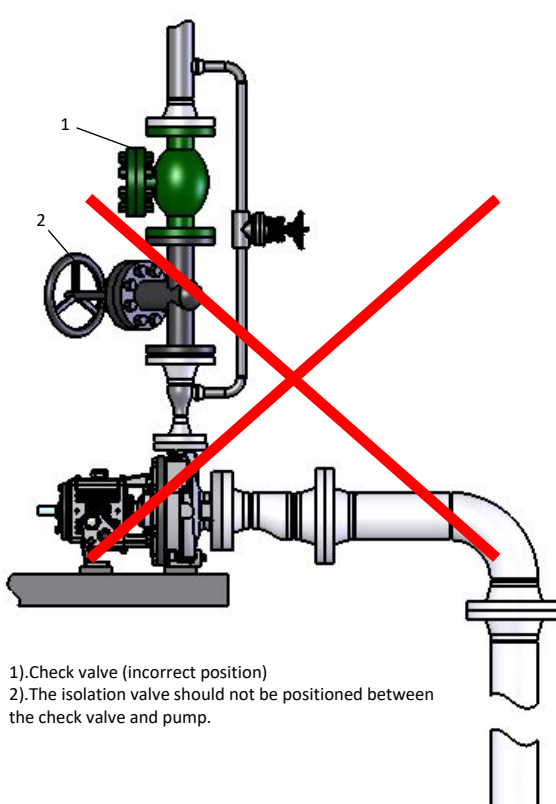
Correct	Incorrect
 <p>1). Suction piping sloping upwards from liquid source. 2). Long-radius elbow. 3). Eccentric reducer with a level top</p>	

### Discharge piping checklist

Table 14: Discharge piping guidelines

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: <ul style="list-style-type: none"> <li>• Priming</li> <li>• Regulation of flow</li> <li>• Inspection and maintenance of the pump See Example: Discharge piping equipment for illustrations.</li> </ul>	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to back flow through the pump when the drive unit is shut off. See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

### Example: Discharge piping

Correct	Incorrect
 <p>The diagram shows a pump assembly with a vertical discharge pipe. A bypass line (1) branches off to the right, containing a check valve (3) pointing away from the pump and an isolation valve (2) further right. A discharge isolation valve (4) is located on the main vertical pipe above the check valve. The pump is at the bottom, and the piping extends upwards and then turns right.</p> <p>1). Discharge Bypass Line 2). Bypass Line Isolation Valve 3). Check Valve (flow arrow pointing AWAY from pump). 4). Discharge Isolation Valve</p>	 <p>The diagram shows the same pump assembly but with incorrect valve placement. The check valve (1) is positioned between the pump and the isolation valve (2). The entire diagram is crossed out with a large red 'X'.</p> <p>1). Check valve (incorrect position) 2). The isolation valve should not be positioned between the check valve and pump.</p>

# **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.

## Remove the coupling guard

1. Remove the nut, bolt, and washers from the slotted hole in the center of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.

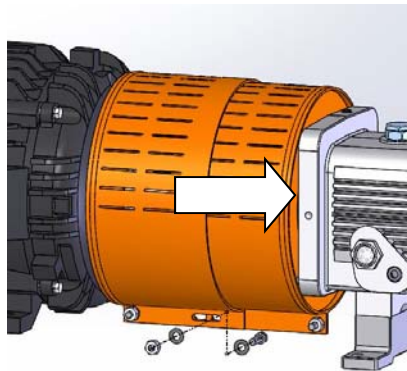
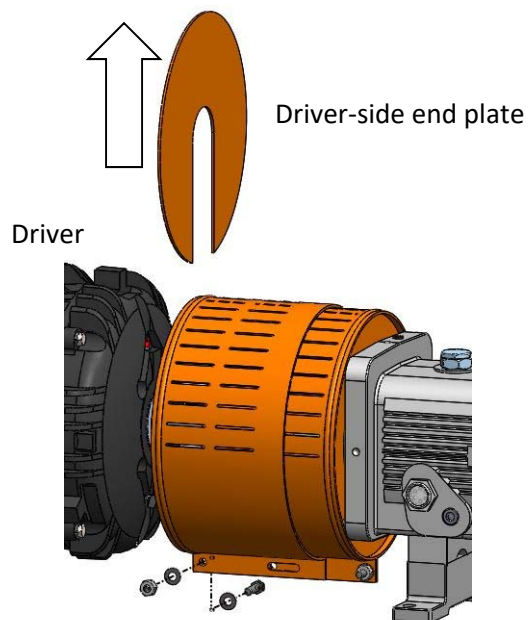


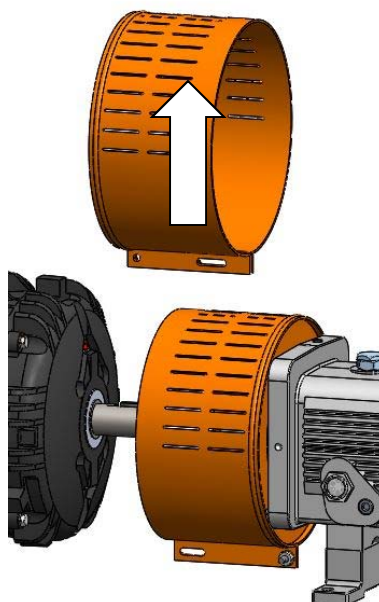
Figure 1: Guard removal – slide driver half

3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver-side end plate.



**Figure 2: Guard removal – driver side end plate**

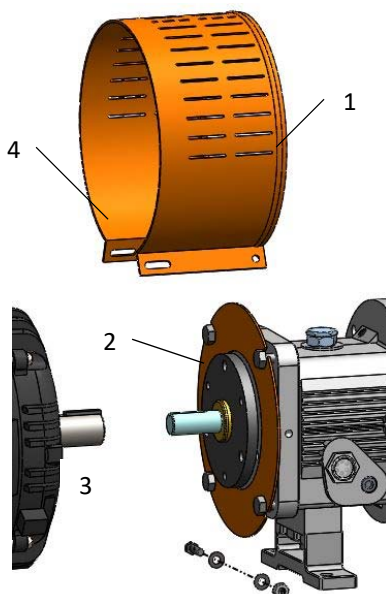
5. Remove the driver half of the coupling guard:
  - a) Slightly spread the bottom apart.
  - b) Lift upwards.



**Figure 3: Guard removal –driver half**



6. Remove the remaining nut, bolt, and washers from the pump half of the coupling guard. It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.
7. Remove the pump half of the coupling guard:
  - a) Spread the bottom of the guard apart
  - b) Lift upwards



**Figure 4: Guard removal – pump half**

1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

## Check the rotation - Frame Mounted

### **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.

## 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.*

## Install the coupling guard

### WARNING

#### WARNING:

- *Never operate a pump without a properly installed coupling guard. Personal injury will occur if you run the pump without a coupling guard.*
- *Refer to driver/coupling/gear manufacturers IOM for specific instructions and recommendations.*
- *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 disconnect and lock out driver power will result in serious physical injury.*

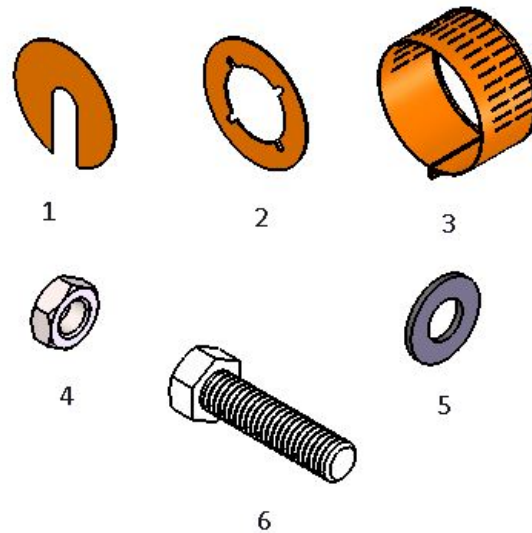


Figure 5: Required guard parts

1. End plate, drive end
  2. End plate, pump end
  3. Guard half, 2 required
  4. 3/8-16 nut, 3 required
  5. 3/8 in. washer, 6 required
  6. 3/8-16 x 2 in. hex head bolt, 3 required
1. Follow appropriate lock out/tag out procedures: De-energize the motor,

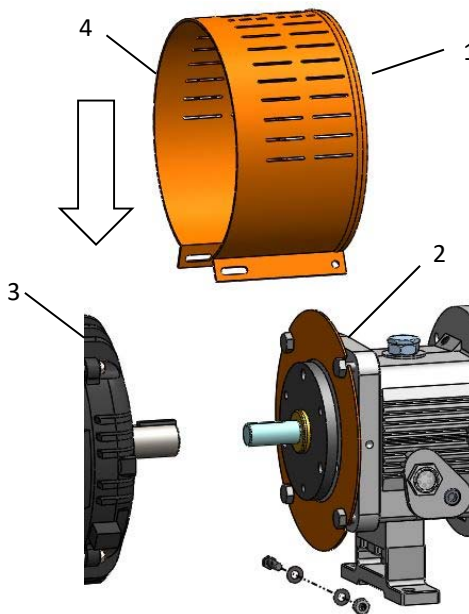
place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.

2. Put the pump-side end plate in place.  
If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.

**Table 1: Group – Guard Installation guidelines**

If the pump size is...	Then...
Group 1, 2	Align the pump-side end plate to the bearing frame.

3. Put the pump-half of the coupling guard in place:
  - a) Slightly spread the bottom apart.
  - b) Place the coupling guard half over the pump-side end plate.

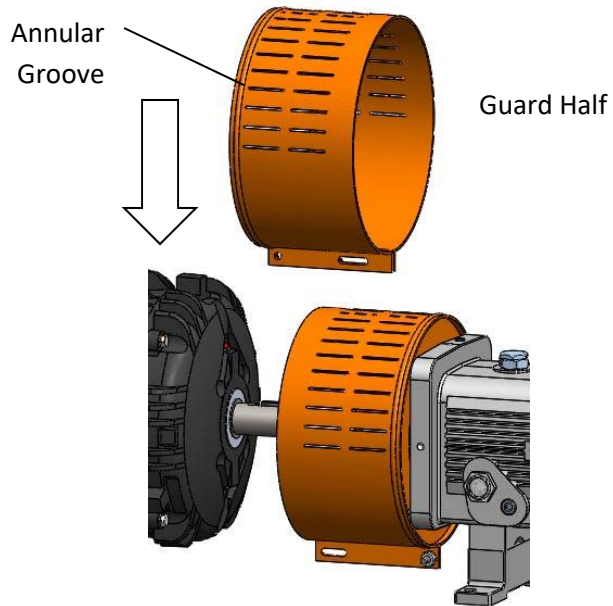


**Figure 6: Guard install – slide pump half**

1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

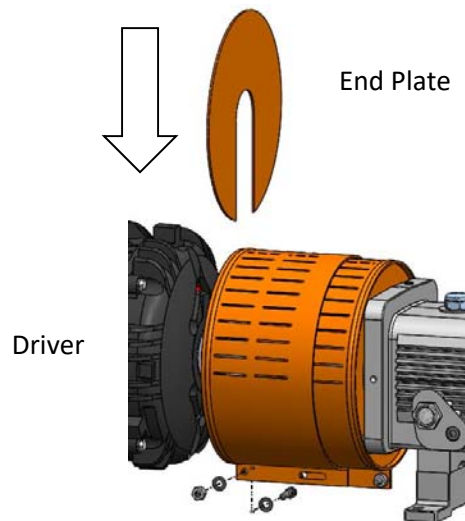
The annular groove in the coupling guard half must fit around the end plate.

4. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Tighten securely.
5. Put the driver half of the coupling guard in place.
  - a) Slightly spread the bottom apart.
  - b) Place the driver half of the coupling guard over the pump half of the coupling guard. The annular groove in the coupling guard half must face the motor.



**Figure 7: Guard install – slide motor half**

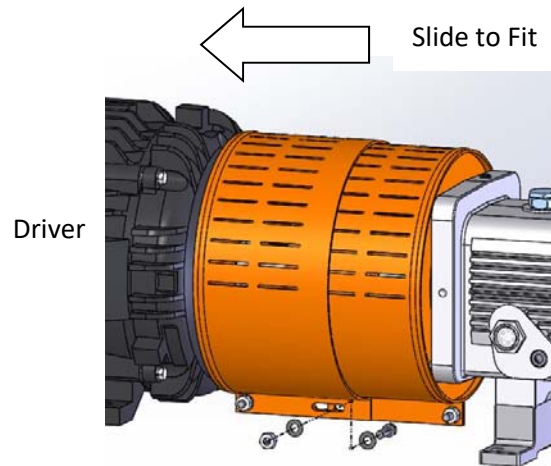
6. Place the driver-side end plate over the motor shaft.



**Figure 8: Guard install – slide end plate**

7. Place the driver-side end plate in the annular groove of the driver-half of the coupling guard.
8. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Hand-tighten only.

- The hole is located on the driver-side of the coupling guard half.
- Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.



**Figure 9: Guard Install – slide motor half to fit**

- Use a nut, a bolt, and two washers to secure the coupling guard halves together.
- Tighten all nuts on the guard assembly.

## Bearing lubrication

### **WARNING**

**WARNING:**

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

*The PW-IND Model PWA bearings are lubricated by an OIL FLINGER. Oil Level must be maintained at the center of the power end sight glass.*

### **NOTICE**

**NOTE:**

*Pumps are shipped without oil. You must lubricate oil-lubricated bearings at the time of start-up*

## Lubricating Oil Fill Capacities

Table 2: Lubrication capacity requirements

Frame	Qts.	Oz.	ml
Group 1	0.5	14.5	429
Group 2	1.0	30	887

## Lubricating-oil requirements

### Oil requirements based on temperature

Table 3: Oil requirements based on temperature

Temperature	Oil requirement
Pumped Fluid Temperatures below 350°F	Use ISO VG 68
Pumped-fluid temperatures exceed 350°F (177°C)	Use synthetic lubrication ISO VG 100. Use PWA Water Cooling Coil

### Acceptable oil for lubricating bearings

#### Acceptable lubricants

Table 4:

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)
Philips	Mangus Oil 315
Shell	Tellus Oil 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Lube

**Note:** When Shell Turbo 54 X 32 lubricant is used there is no oil change required for up to 5 years.

### Lubricate the bearings with oil

1. Remove the vent cap .
2. Fill the bearing frame with oil through the vent / filler connection, which is located on top of the bearing frame.  
Fill the bearing frame with oil until the oil level reaches the middle of the sight glass (319).

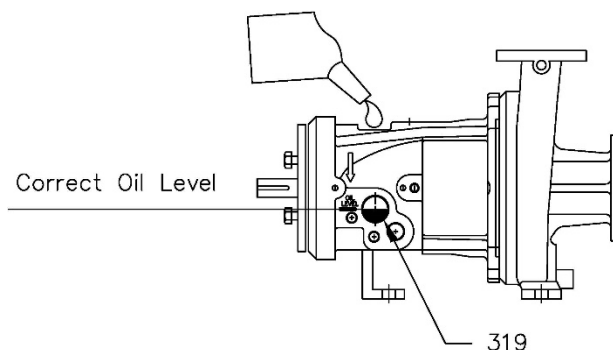


Figure 10: Power End – lube fill

3. Replace the fill plug.

## Lubricate the bearings with pure oil mist

Oil mist is an optional feature for this pump.

To lubricate bearings with pure oil mist, follow the instructions provided by the manufacturer of the oil-mist generator.

The inlet connections are on the top of the bearing frame

## Pump priming



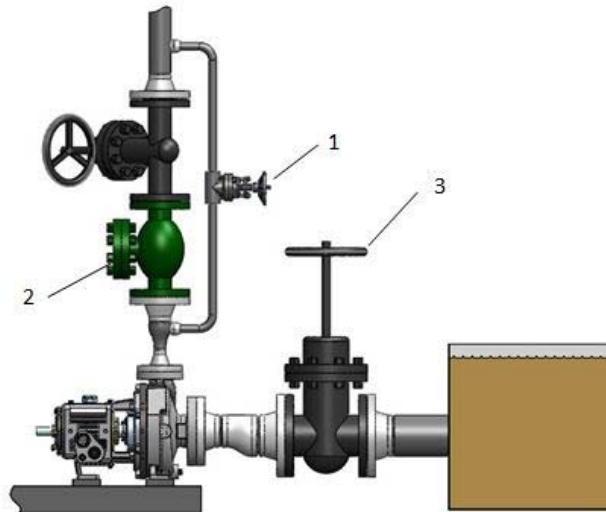
**WARNING**

### **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 until all gas is evacuated.
3. Close the piping vents.



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

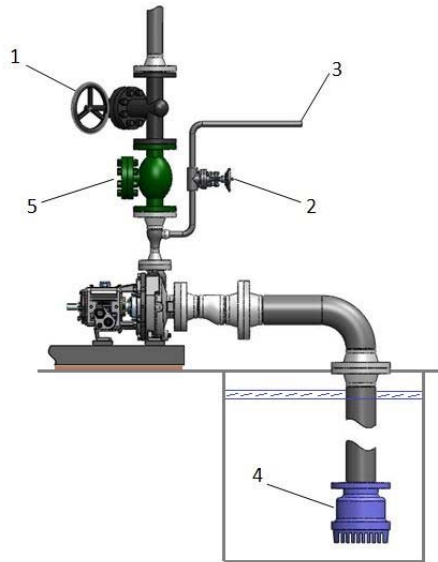
**Figure 11: Pump Priming – supply above pump**

## 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:

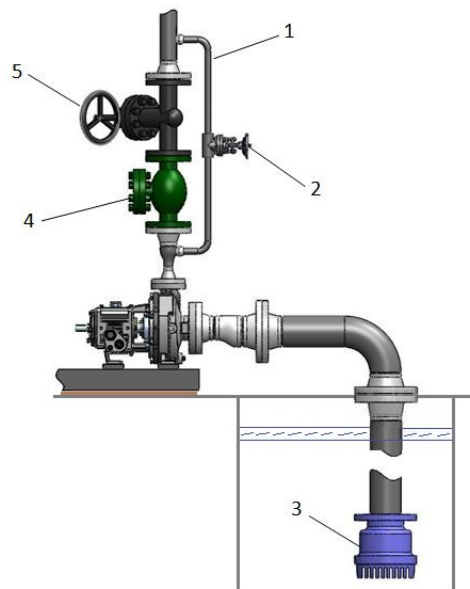
- A priming pump
- A pressurized discharge line
- Another outside supply

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. Foot valve
5. Check valve

**Figure 12: Pump Priming with foot valve and outside supply**





1. Priming by-pass line
2. Priming shutoff valve
3. Foot valve
4. Check valve
5. Discharge isolation valve

**Figure 13: 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, re-prime, 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.
  5. If the pump fails to reach the correct pressure, perform these steps:
    - 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. <b>Change the oil after 400 hours for new bearings.</b>	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-oil requirements

### Lubricating Oil Fill Capacities

Table 2: Required amount of oil for oil-lubricated bearings.

Frame	Qts.	Oz.	ml
Group 1	0.5	14.5	429
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### Lubricating-oil requirements

Table 3: Oil requirements based on temperature

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Pumped fluid temperatures below 350° F	Use ISO VG 68
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### Acceptable oil for lubricating bearings

#### Acceptable lubricants

Table 4:

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)
Philips	Mangus Oil 315
Shell	Tellus Turbo T 68 or Tellus S2 MX 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Lube

**Note:** When Shell Turbo 54 X 32 lubricant is used there is no oil change required for up to 5 years.

## Disassembly

### Disassembly precautions



#### 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

Hex wrenches  
Lifting sling  
Rubber mallet  
Screwdriver  
Shaft wrench  
Torque wrench with sockets  
Wrenches

## Drain the pump

### 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.

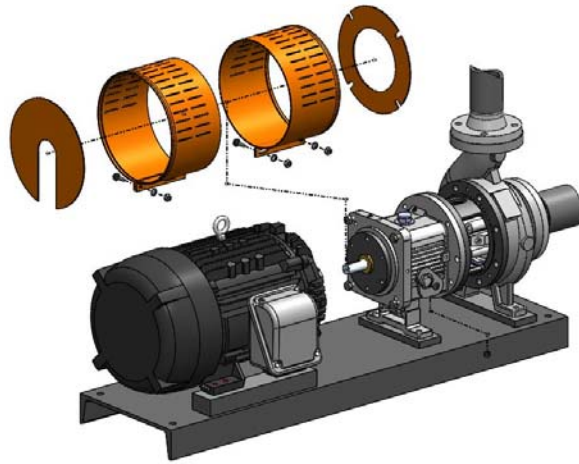
## Remove the coupling

1. Disconnect the coupling.
2. Remove the coupling guard and motor end plate.
3. Remove the coupling-guard pump end-plate.

## Remove the back pull-out assembly

1. Is your bearing frame oil lubricated?
  - If No: Proceed to step 2
  - If Yes:
    1. Remove the bearing-frame drain plug (408A) in order to drain oil from the bearing frame.

2. Replace the plug after the oil is drained.
3. Remove the constant level oiler, if equipped.

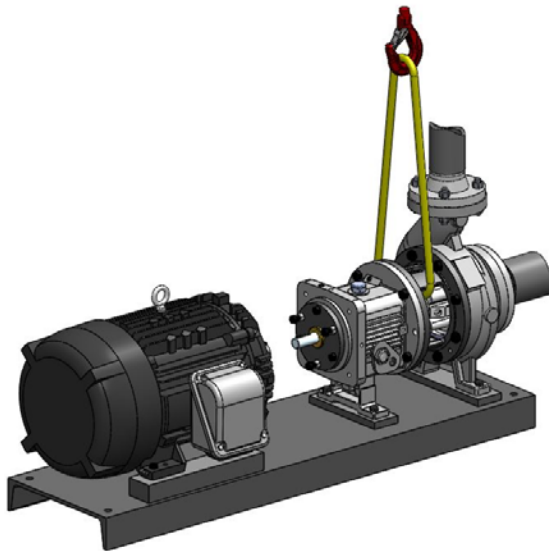


**Figure 1: Guard removal**

**NOTICE**

**NOTICE:**

*Pump oil can be used as part of a predictive / preventive maintenance program. Save oil in a clean container for further review.*



**Figure 2: Back pull-out removal**

2. Remove the hold-down bolts of the bearing frame foot.
3. Remove the casing bolts.

**WARNING**

**WARNING:**

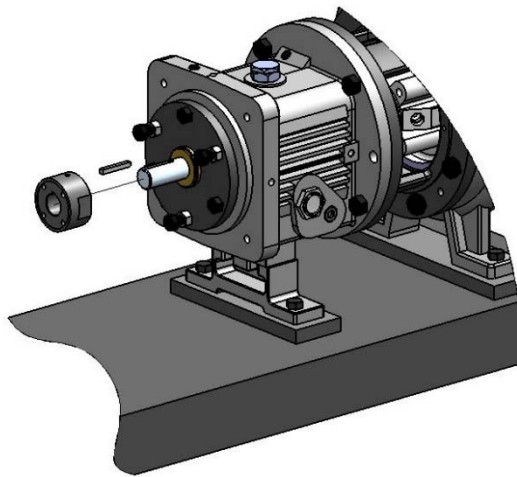
- *Never use heat to disassemble the pump due to the risk of an explosion from trapped*

*liquid.*

4. Tighten the casing jack bolts evenly, using an alternating pattern, in order to remove the back pull-out assembly.  
Use penetrating oil if the adapter to the casing joint is corroded.
5. Remove the back pull-out assembly from the casing (100).
6. Mark and remove the shims from under the frame foot and save them for reassembly. Reusing the shims assumes that the same motor frame and frame foot are being installed, and that there has been no change in piping and/or foundation.
7. Remove and discard the casing gasket.  
Do not ever re-use the casing gasket.
8. Remove the jackscrews.
9. Clean all gasket surfaces.

### **Remove the coupling hub**

1. Clamp the frame adapter securely to the workbench.
2. Remove the coupling hub.  
Mark the shaft for relocation of the coupling hub during reassembly.  
Reusing the coupling hub assumes that the same motor frame, RPM, and horsepower are being installed, and that there has been no change in pump operating conditions.



**Figure 3: Coupling hub removal**



## Pump Repair Notice

PWA-SL pump repairs and rebuilds will be accomplished by PumpWorksIndustrial, Houston, TX. It is recommended the casing remain in line, with only the back-pull out assembly returned.

Please note the following process for return to PumpWorks, repair and return to the requesting facility:

1. Return Material Authorization (RMA)-contact PumpWorks at [orders@pumpworksind.com](mailto:orders@pumpworksind.com) for RMA documents. Include, if possible the pump serial number and / or a photo of the pump nameplate.
2. PumpWorksIndustrial will issue RMA documents to be completed.
3. Additionally for protection of our employee's and in accordance with Department of Transportation (DOT) federal regulations the following is required prior to return to PumpWorksIndustrial:
  - a. All lubricants are to be removed from the bearing housing,
  - b. The Material Safety Data Sheet (MSDS) for the pumped liquid is to be provided with the completed RMA.
  - c. A written statement that the pump has been decontaminated from the pump liquid is required.
4. Upon completion of the above, PumpWorks Industrial will issue an RMA number authorizing return of the back-pull out assembly. Freight both to PumpWorksIndustrial, Houston, TX and return to the requesting location is to be paid by the requestor.
5. Upon receipt and inspection, PumpWorks will provide a repair proposal cost and lead-time.
6. Fully warranted repair will begin upon receipt of the requesting Purchase Order. The Purchase Order is to be sent to [orders@pumpworksind.com](mailto:orders@pumpworksind.com) and the purchase order is to reference the RMA number issued by PumpWorksIndustrial.

Upon receipt of the back-pull out assembly, proceed with the installation.

## Install the back pull-out assembly

1. Clean the casing fit and install the casing gasket (351) on the seal chamber / stuffing- box cover.
2. Loosen the clamping bolts (370C) and jack bolts (370D) on the bearing housing.
3. Install the back pull-out assembly in the casing.
4. Install casing bolts (370) and hand tighten, then tighten to appropriate torque values in table 14.  
Refer to the bolt torque values for information on how to tighten the casing bolts.
5. Install and tighten the casing jackscrews (418).

### NOTICE

#### **NOTICE:**

*Do not over tighten the casing jackscrews. Doing so may result in equipment damage.*

7. Check the total clearance of the impeller in the casing.  
With new parts, an acceptable range is 0.030 in. (0.76 mm) to 0.065 in. (1.65 mm). If the impeller clearance is outside of this range, you either have the incorrect parts, an improper installation, or too much pipe strain. Determine the cause and correct the problem before you proceed.
8. Adjust the impeller clearance.  
Refer to the Impeller clearance setting section for more information.
9. Replace the auxiliary piping.
10. Fill the pump with the proper lubricant. See Lubricating-oil requirements.
11. Reinstall the coupling guard.  
See Install the coupling guard for more information.

### NOTICE

#### **NOTICE:**

*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 ring and remove the centering clips.*

## Post-assembly checks

Perform these checks after you assemble the pump, then continue with pump startup:

- Rotate the shaft by hand in order to make sure that it rotates easily and smoothly and that there is no rubbing.
- Open the isolation valves and check the pump for leaks.

## Assembly references

### Bolt torque values

**Table 5: Maximum torque values in lb-ft (Nm) for casing bolts**

This table provides the maximum torque values for casing bolts.

		PWA-SL with 150 lb (68 kg) casing flanges			
		Material specification			
		Carbon Steel casing with A307 Grade B casing bolts		Alloy casing with (304SS) F593 Grade 1 or (316SS F593) Grade 2 casing bolts	
Frame	Casing bolt diameter (in.)	Lube	Dry	Lube	Dry
8 inch, Group 1	0.50	20 (27)	30 (41)	35 (47)	54 (73)
6 inch Group 1, Group 2	0.625	39 (53)	59 (80)	71 (96)	107 (145)
	0.625	39 (53)	59 (80)	71 (96)	107 (145)

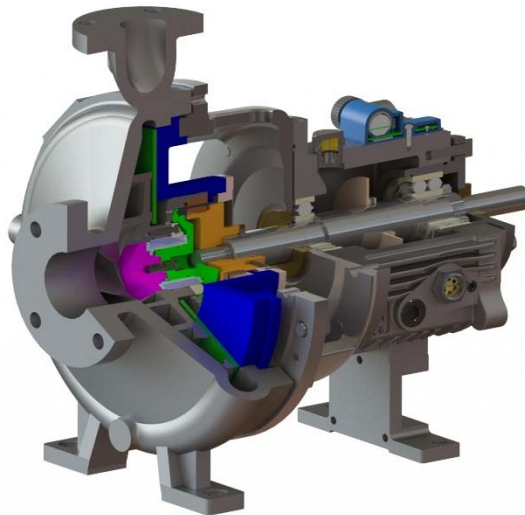
### Bearing types

**Table 6: Bearing types**

Frame Double Row	Inboard bearing duplex	Outboard bearing	
		Double Row	Duplex
Group 1	6	3	7
Group 2	6	3	7

Visit our website for more information for the PWA-SL and all other PumpWorks products at:

[www.pumpworks.com](http://www.pumpworks.com)



PWA-SL June-2020



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