ProCast®

Installation, Operation, and Maintenance Manual

PC3

ITT

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1 Introduction and Safety

1.1 Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance

CAUTION:
Failure to observe the instructions contained in this manual could result in personal injury and/or property damage, and may void the warranty. Read this manual carefully before installing and using the product.

NOTICE:
Save this manual for future reference and keep it readily available.

1.1.1 Requesting other information

Special versions can be supplied with supplementary instruction leaflets. See the sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or in the sales documents, please contact the nearest ProCast representative.

Always specify the exact product type and serial number when requesting technical information or spare parts.

Specifications such as weights, dimensions or centers of gravity of the pump, pump unit or subassemblies can be requested through the factory.

1.2 Safety

WARNING:

- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
- Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.
- Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ProCast. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ProCast representative before proceeding.

- If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.

CAUTION:

- Risk of injury and/or property damage. Operating a pump in an inappropriate application can cause over pressurization, overheating, and/or unstable operation. Do not change the service application without the approval of an authorized ProCast representative.

WARNING:
This product contains Carbon Black a chemical known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov

1.2.1 Safety terminology and symbols

About safety messages

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

- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard levels

Hazard level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury
 **CAUTION:**	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:

ELECTRICAL HAZARD:

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

1.2.1.1 The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.

1.2.2 Environmental safety

The work area

Always keep the station clean to avoid and/or discover emissions.

WARNING:
Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

WARNING:
If the product has been contaminated in any way, such as from toxic chemicals or nuclear radiation, do NOT send the product to ITT until it has been properly decontaminated and advise ITT of these conditions before returning.

Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 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.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Safety equipment

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

- Hardhat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

Noise

WARNING:
Sound pressure levels may exceed 80 dbA in operating process plants. Clear visual warnings or other indicators should be available to those entering an area with unsafe noise levels. Personnel should wear appropriate hearing protection when working on or around any equipment, including pumps. Consider limiting personnel's exposure time to noise or, where possible, enclosing equipment to reduce noise. Local law may provide specific guidance regarding exposure of personnel to noise and when noise exposure reduction is required.

Temperature

WARNING:
Equipment and piping surfaces may exceed 130ºF (54ºC) in operating process plants. Clear visual warnings or other indicators should alert personnel to surfaces that may reach a potentially unsafe temperature. Do not touch hot surfaces. Allow pumps operating at a high temperature to cool sufficiently before performing maintenance. If touching a hot surface cannot be avoided, personnel should wear appropriate gloves, clothing, and other protective gear as necessary. Local law may provide specific guidance regarding exposure of personnel to unsafe temperatures.

1.2.3.1 Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- 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.

1.2.3.2 Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

CAUTION:
Failure to observe the instructions contained in this manual could result in personal injury and/or property damage, and may void the warranty. Read this manual carefully before installing and using the product.

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- 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.

1.2.3.3 Hazardous liquids

The product is designed for use in liquids that can be hazardous to your health. Observe these rules when you work with the product:

- Make sure that all personnel who work with biologically hazardous liquids are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.
- A small amount of liquid will be present in certain areas like the seal chamber.

1.2.3.4 Wash the skin and eyes

1. Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.2.4 Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards.

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.

- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.
- Do not operate the pump in processes that can cause shock waves or adiabatic compression (e.g. high pressure gases or oxidizing gases).

1.3 Product approval standards

Regular standards

WARNING:
Use of equipment unsuitable for the environment can pose risks of ignition and/or explosion. Ensure the pump driver and all other auxiliary components meet the required area classification at the site. If they are not compatible, do not operate the equipment and contact an ITT representative before proceeding.

All standard products are approved according to CSA standards in Canada and UL standards in USA. The drive unit degree of protection follows IP68 according to standard IEC 60529.

1.4 Product warranty

Coverage

ITT undertakes to remedy faults in products from ITT under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to a ProCast representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by ITT-authorized personnel.
- Genuine ProCast parts are used.
- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

Limitations

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 ITT
- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

1.5 Ex Considerations and Intended Use

Special care must be taken in potentially explosive environments to ensure that the equipment is properly operated and maintained. Compliance with the essential safety and health requirements has been assured by compliance with the following standards, method of protection Constructional Safety (C): ISO 80079-36 ISO 80079-37

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, EN 60079-17).

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

Description of Ex-Directives

The Ex-directives are a specification enforced in Europe and the United Kingdom for electrical and non-electrical equipment installed in those locations. Ex-directives deal with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmospheres. The relevance of the Ex-requirements is not limited to Europe or the UK. You can apply these guidelines to equipment installed in any potentially explosive atmosphere.

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an ITT representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079-14).

1. Monitoring the pump frame liquid end temperature.
2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

The Ex conformance is only applicable when the pump unit is operated within its intended use. Operating, installing or maintaining the pump unit in any way that is not covered in the Instruction, Operation, and Maintenance manual (IOM) can cause serious personal injury or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT Goulds Pumps. If there is any question regarding the intended use of the equipment, please contact an ITT Goulds representative before proceeding.

Current IOMs are available at https://www.procastparts.com or from your local ITT Goulds Pumps Sales representative.

All pumping unit (pump, seal, coupling, motor and pump accessories) certified for use in an Ex classified environment, are identified by an Ex tag secured to the pump or the baseplate on which it is mounted. A typical tag would look like this:

If applicable, your pump may have either a CE Ex (ATEX) tag or UKCA Ex tag affixed to the pump. See the Safety section for a description of the symbols and codes. Typical nameplate only shown below, the actual area classification may be different.

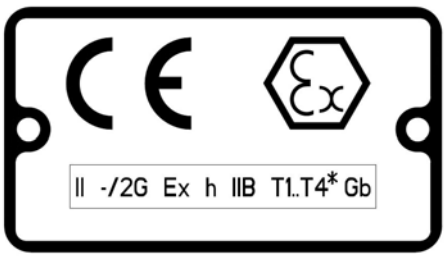


Figure 1: Typical Ex nameplate

Figure 2: Typical UKCA Ex nameplate

Table 1: Temperature class definitions

Code	Maximum permissible surface temperature in °C | °F	Maximum permissible liquid temperature in °C | °F
T1	440 | 824	372 | 700
T2	290 | 554	267 | 513
T3	195 | 383	172 | 342

Code	Maximum permissible surface temperature in °C | °F	Maximum permissible liquid temperature in °C | °F
T4	130 | 266	107 | 225
T5	Option not available	Option not available
T6	Option not available	Option not available

* Maximum liquid temperature may be limited by the pump model and order specific options. Table 1: Temperature class definitions on page 12 is for the purpose of determining T'x' code for Ex applications with liquid temperatures exceeding 107ºC | 225ºF.

The code classification marked on the equipment must be in accordance with the specified area where the equipment will be installed. If it is not, do not operate the equipment and contact your ITT Goulds Pumps sales representative before proceeding.

ISO 80079-37:2016 Section 5.7

Equipment for monitoring

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Pressure gauges
- Flow meters
- Level indicators
- Motor load readings
- Temperature detectors
- Bearing monitors
- Leak detectors
- PumpSmart control system

WARNING:

- When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact ProCast representative before proceeding.
- If equipment is to be installed in a potentially explosive atmosphere and these procedures are not followed, personal injury or equipment damage from an explosion may result.
- Particular care must be taken when the electrical power source to the equipment is energized.
- Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.
- Lock out driver power to prevent electric shock, accidental start-up and physical injury.
- NEVER start pump without proper prime.
- Equipment that will operate in a potentially explosive environment must be installed in accordance with the following instructions.
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge.
- When pumping fluids with conductivity less than 1000 ps/m follow IEC TS 60079 32-1 guidelines.
- Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer’s installation and operation procedures.

- When installing in a potentially explosive environment, ensure that the motor and accessories are properly certified.
- The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
- Service temperature in an Ex classified environment is limited to the area classification specified on the Ex tag affixed to the pump (reference Table 1 in the Safety section for Ex classifications).
- The coupling used in an Ex classified environment must be properly certified.
- The coupling guard used in an Ex classified environment must be constructed from a spark-resistant material.
- Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.
- The mechanical seal used in an Ex classified environment must be properly certified.
- The mechanical seal must have an appropriate seal flush system. Failure to do so will result in excess heat generation and seal failure.
- Packed stuffing boxes are not allowed in an Ex classified environment.
- Dynamic seals are not allowed in an Ex classified environment.
- Pumps must be fully primed at all times during operation.
- The preventive maintenance section must be adhered to in order to keep the applicable Ex classification of the equipment. Failure to follow these procedures will void the Ex classification for the equipment. Bearing replacement intervals are given in the specific pump model IOM.
- Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.
- Throughout this section on bearing lubrication, different pumpage temperatures are listed. If the equipment is Ex certified and the listed temperature exceeds the applicable value shown in Table 1 under SAFETY, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goulds representative.
- Cooling systems, such as those for bearing lubrication, mechanical seal systems, etc., where provided, must be operating properly to prevent excess heat generation, sparks and premature failure.
- Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation, sparks and premature failure.
- Flange loads from the piping system, including those from thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts which can result in excess heat generation, sparks and premature failure.
- Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.
- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check for magnetism on the pump shaft and demagnetize the shaft if there is any detectable magnetism. Magnetism will attract ferritic objects to the impeller, seals and bearings which can result in excess heat generation, sparks and premature failure.
- Leakage of process liquid may result in creation of an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid.

- Leakage of process liquid may result in creation of an explosive atmosphere. Follow all pump and seal assembly procedures.
- A buildup of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.
- Sealing systems that are not self purging or self venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
- Do not apply additional paint or coatings to the pump when in an Ex environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
- Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
- Stray electrical currents may ignite explosive atmospheres. Ensure drives are certified for variable frequency drive operation by the manufacturer.
- User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.
- For variable speed motor applications, the electric motor must be specified with shaft grounding and used with a conductive type coupling suitable for the area classification.
- In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.
- Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

2 Transportation and Storage

2.1 Inspect the delivery

2.1.1 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 if anything is out of order.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Inspect the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

2.2 Transportation guidelines

2.2.1 Pump handling

WARNING:
Dropping, rolling or tipping units, or applying other shock loads, can cause property damage and/or personal injury. Ensure that the unit is properly supported and secure during lifting and handling.

CAUTION:
Risk of injury or equipment damage from use of inadequate lifting devices. Ensure lifting devices (such as chains, straps, forklifts, cranes, etc.) are rated to sufficient capacity.

2.2.2 Lifting methods

WARNING:

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
- Safe lifting points are specifically identified in this manual. It is critical to lift the equipment only at these points. Integral lifting eyes or eye bolts on pump and motor components are intended for use in lifting the individual components only.
- Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

Table 2: Methods

Pump type	Lifting method
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.

Examples

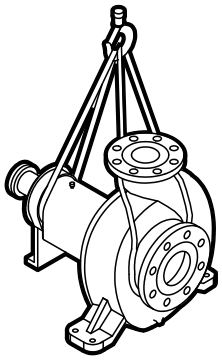


Figure 3: Example of a proper lifting method

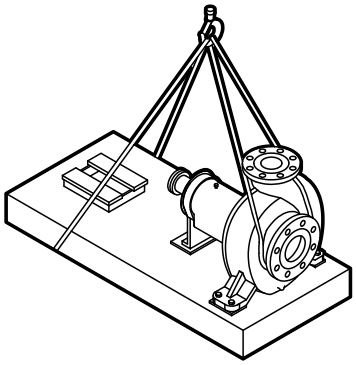


Figure 4: Example of a proper lifting method

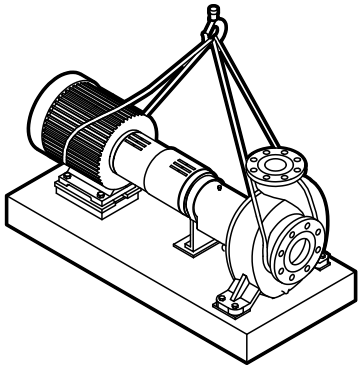


Figure 5: Example of a proper lifting method

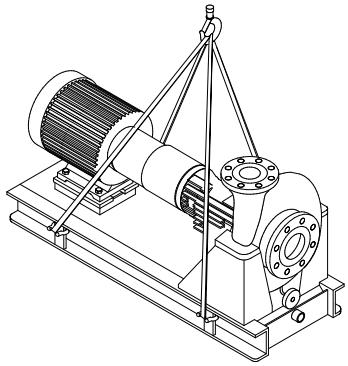


Figure 6: Example of a proper lifting method

2.3 Storage guidelines

2.3.1 Pump storage requirements

Storage requirements depend on the amount of time that you store the unit. The normal packaging is designed only to protect the unit during shipping.

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	• Store in a covered and dry location.
Long-term (more than six months)	• Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations.

2.3.2 Frostproofing

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

Situation	Condition
Operating	The pump is frostproof.
Immersed in a liquid	The pump is frostproof.
Lifted out of a liquid into a temperature below freezing	The impeller might freeze.

3 Product Description

3.1 General description

The ProCast PC3 is a horizontal overhung, semi-closed impeller, centrifugal pump designed for chemical processes. This pump meets the dimensional requirements of ANSI B73.1.

3.2 Nomenclature

DBP1-1.5162-SS-CBS

Assembly

DBP - Durco Bare Pump

DPE - Durco Power End

DBPO - Durco Back Pull Out

DSK - Durco Shaft Kit

MK - Maintenance Kit

RK - Repair Kit

1st Numeric Digit

1 - Group 1

2 - Group 2

3 - Group 3

Middle Numeric Digits

Size - 1.5 X 1 (Suction/Discharge)

Last Numeric Digits

Impeller Max Diameter - 62 (6.25" OD)

Next two Alphanumeric digits

SS - Solid Shaft

SL - Sleeve Shaft

Next 3 Alphanumeric Digits

CBS - Small bore cover plate

CBL - Large bore cover plate

FML - Flow modifier large bore cover plate

FMS - Flow modifier small bore cover plate

TBP - Gould's Taper Bore Plus Design

Last Alphanumeric Digits

V - Upgraded Inpro Labby Seals

T - Add Trico Oiler

There may be other nomenclature for different assembly components that are different than above. Please contact ProCast for further explanation. Example is "DPE2-AF10-SS". This refers to a Durco Power End for a group 2 with adapter and foot for a 10" pump with a solid shaft.

4 Installation

4.1 Pre-installation

Precautions

WARNING:

- When installing in a potentially explosive environment, ensure that the motor is properly certified.
- All equipment being installed must be properly grounded to prevent unexpected discharge. Discharge can cause equipment damage, electric shock, and result in serious injury. Test the ground lead to verify it is connected correctly.

NOTICE:

- Electrical connections must be made by certified electricians in compliance with all international, national, state and local regulations.
- Supervision by an authorized ITT representative is recommended to ensure proper installation. Improper installation may result in equipment damage or decreased performance.

4.1.1 Pump location guidelines

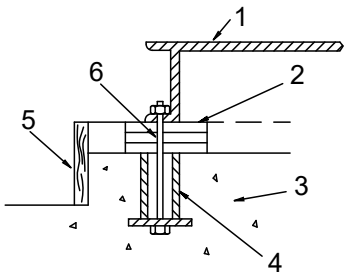
Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
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 location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: • Pressure relief valves • Compression tanks • Pressure controls • Temperature controls • Flow controls If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.
If the pump location is overhead, undertake special precautions to reduce possible noise transmission.	Consider a consultation with a noise specialist.

4.1.2 Foundation requirements

Requirements

- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three times the weight of the pump.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.

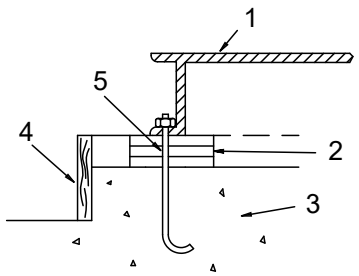
Sleeve-type bolts



Item	Description
1.	Baseplate
2.	Shims
3.	Foundation
4.	Sleeve
5.	Dam
6.	Bolt

Figure 7: Sleeve type bolts

J-type bolts



Item	Description
1.	Baseplate
2.	Shims or wedges
3.	Foundation
4.	Dam
5.	Bolt

Figure 8: J-type bolts

4.2 Baseplate-mounting procedures

4.2.1 Prepare the baseplate for mounting

1. Remove all the attached equipment from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with an epoxy primer.
   Use an epoxy primer only if using an epoxy-based grout.
4. Remove the rust-proofing coat from the machined mounting pads using an appropriate solvent.
5. Remove water and debris from the foundation-bolt holes.

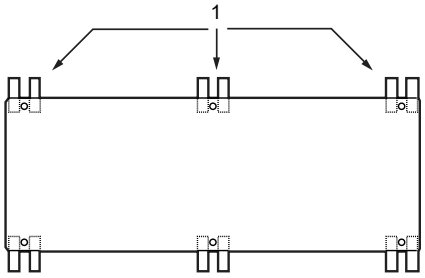
4.2.2 Install the baseplate using shims or wedges

Required tools:

- Two sets of shims or wedges for each foundation bolt
- Two machinist's levels
- Baseplate-leveling worksheet

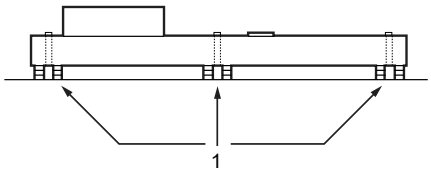
This procedure is applicable to cast iron and fabricated steel baseplates.

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



1. Shims or wedges

Figure 9: Top view



1. Shims or wedges

Figure 10: Side view

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

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

5. Level the baseplate both lengthwise and across by adding or removing shims or moving the wedges.

   These are the leveling tolerances:

   - A maximum difference of 3.2 mm | 0.125 in. lengthwise
   - A maximum difference of 1.5 mm | 0.059 in. across

   You can use the 4.2.6 Baseplate-leveling worksheet on page 29 when you take the readings.
6. Hand-tighten the nuts for the foundation.

4.2.3 Install the baseplate using jackscrews

Tools required:

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

This procedure is applicable to the feature-fabricated steel baseplate and the advantage base baseplate.

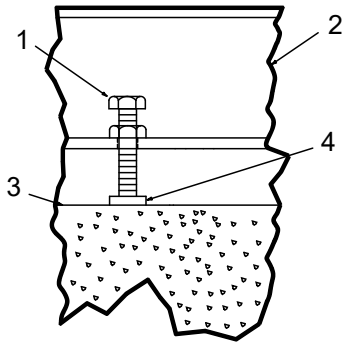
1. Apply an anti-seize compound on the jackscrews.
   The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:

   a) Cut the plates from the 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 four jackscrews in the corners in order to raise the baseplate above the foundation.
   Make sure that the distance between the baseplate and the foundation surface is between 19 mm | 0.75 in. and 38 mm | 1.50 in.

   d) Make sure that the center jackscrews do not touch the foundation surface yet.



Item	Description
1.	Jackscrew
2.	Baseplate
3.	Foundation
4.	Plate

Figure 11: Jackscrews

3. Level the driver mounting pads:

NOTICE:

Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

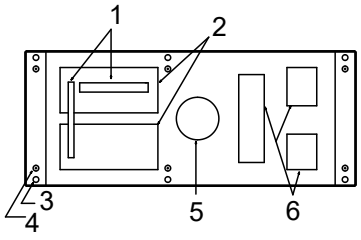
a) Put one machinist's level lengthwise on one of the two pads.

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.

Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.

Use the baseplate-leveling worksheet when you take the readings.



Item	Description
1.	Machinist's levels
2.	Driver's mounting pads
3.	Foundation bolts
4.	Jackscrews
5.	Grout hole
6.	Pump's mounting pads

Figure 12: Level driver mounting pads

4. Turn the center jackscrews down so that they rest on their plates on the foundation surface.
5. Level the pump mounting pads:

NOTICE:

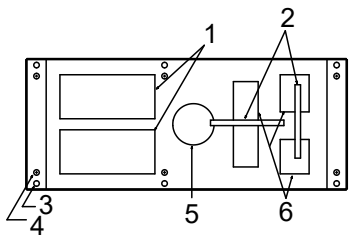
Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

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.



Item	Description
1.	Driver's mounting pads
2.	Machinist's levels
3.	Foundation bolts
4.	Jackscrews
5.	Grout hole
6.	Pump's mounting pads

Figure 13: Level pump mounting pads

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

   The correct level measurement is a maximum of 0.167 mm/m | 0.002 in./ft .

4.2.4 Install the baseplate using spring mounting

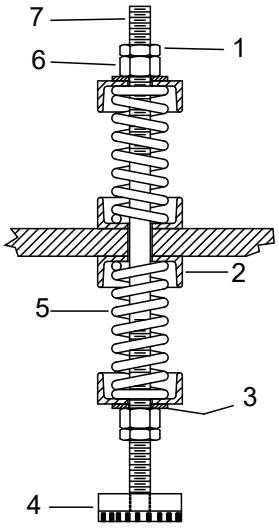
NOTICE:
The spring-mounted baseplate is designed only to support piping loads from thermal expansion. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

The foundation pads are not provided with the baseplate. Make sure that the foundation pads are 316 stainless-steel plates, which have a 16-20 micro-inch surface finish.

Before you start this procedure, make sure that the foundation pads are correctly installed on the foundation/floor (see the manufacturer's instructions).

1. Put the baseplate on a support above the foundation/floor.
   Make sure that there is enough space between the baseplate and the foundation/floor in order to install the spring assemblies.
2. Install the lower part of the spring assembly:
   a) Screw the lower jam nut onto the spring stud.
   b) Screw the lower adjusting nut onto the spring-stud, on top of the jam nut.
   c) Set the lower adjusting nut to the correct height.
   The correct height depends on the required distance between the foundation/floor and the baseplate.
   d) Put a washer, a follower, a spring, and one more follower onto the lower adjusting nut.
3. Install the spring assembly on the baseplate:
   a) Insert the spring assembly into the baseplate's anchorage hole from below.
   b) Put a follower, a spring, another follower, and a washer onto the spring stud.
   c) Fasten the spring assembly with the upper adjusting nut by hand.

4. Thread the upper jam nut onto the spring stud by hand.
5. Repeat steps 2 through 4 for all the spring assemblies.
6. Lower the baseplate so that the spring assemblies fit into the foundation pads.
7. Level the baseplate and make the final height adjustments:
   a) Loosen the upper jam nuts and adjusting nuts.
   b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
   c) When the baseplate is level, tighten the top adjusting nuts so that the top springs are not loose in their followers.
8. Fasten the lower and upper jam nuts on each spring assembly.



1. Upper jam nut
2. Follower
3. Washer
4. Foundation pads
5. Spring
6. Upper adjusting nut
7. Spring stud

Figure 14: Example of an installed spring assembly

4.2.5 Install the baseplate using stilt mounting

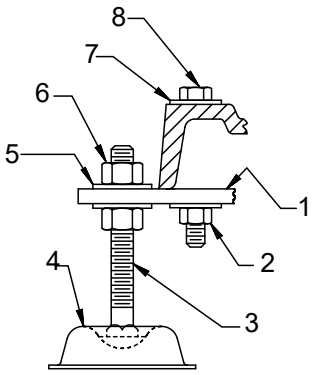
NOTICE:
The stilt-mounted baseplate is not designed to support static piping loads. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

1. Put the baseplate on a support above the foundation/floor.
   Make sure that there is enough space between the baseplate and the foundation/floor to install the stilts.
2. Install the lower part of the stilt assembly:
   a) Screw the lower jam nut and adjusting nut onto the stilt.
   b) Set the lower adjusting nut to the correct height.

The correct height depends on the required distance between the foundation/floor and the baseplate.

c) Put a washer onto the lower adjusting- nut.

3. Install the stilt assembly on the baseplate:
   a) Insert the stilt assembly into the baseplate's anchorage hole from below.
   b) Put a washer onto the stilt.
   c) Fasten the stilt assembly with the upper adjusting nut by hand.
4. Screw the upper jam nut onto the stilt by hand.
5. Repeat steps 2 through 4 for all the stilt assemblies.
6. Lower the baseplate so that the stilts fit into the foundation cups.
7. Level the baseplate and make the final height adjustments:
   a) Loosen the upper jam nuts and adjusting nuts.
   b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
   c) When the baseplate is level, tighten the top adjusting nuts.
8. Fasten the lower and upper jam nuts on each stilt.

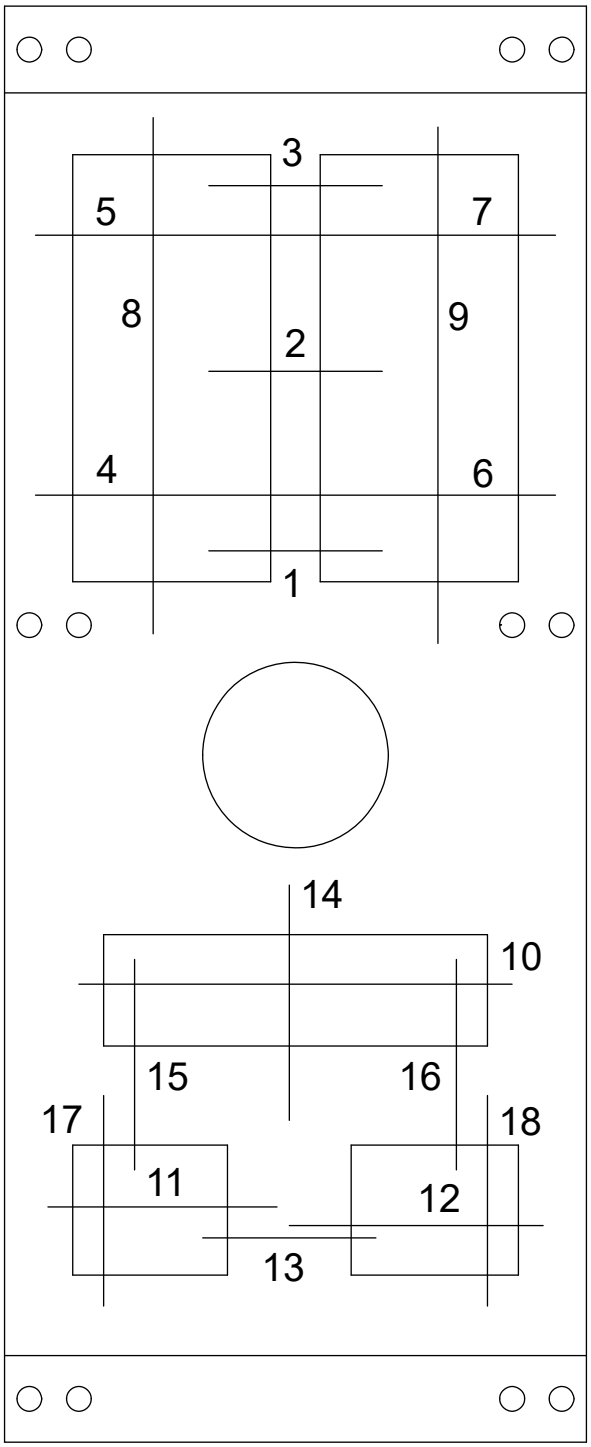


1. Mounting plate
2. Mounting nut
3. Stilt bolt
4. Foundation cups
5. Washer
6. Upper adjustment nut
7. Mounting washer
8. Mounting bolt

Figure 15: Example of an installed stilt assembly

4.2.6 Baseplate-leveling worksheet

Level measurements



1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

9)_____

10)_____

11)_____

12)_____

13)_____

14)_____

15)_____

16)_____

17)_____

18)_____

4.3 Pump-to-driver alignment

Precautions

WARNING:

- Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.
  - Follow the coupling installation and operation procedures from the coupling manufacturer.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

4.3.1 Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

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

Types of alignment checks

Type of check	When it is used
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) checks

When	Why
Before you	This ensures that alignment can be accomplished.
After you	This ensures that no changes have occurred during the .
After you connect the piping	This ensures that pipe strains have not altered the alignment.

Final alignment (hot alignment) checks

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.

4.3.2 Permitted indicator values for alignment checks

NOTICE:
The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. The correct tolerances must be used. Failure to do so can result in misalignment. Contact ITT for further information.

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 Indicated Reading (T.I.R.) is at 0.05 mm | 0.002 in. or less at operating temperature.
- The tolerance of the indicator is 0.0127 mm per mm | 0.0005 in. per in. of indicator separation for the reverse dial indicator or laser method when the pump and driver are at operating temperature.

4.3.2.1 Cold settings for parallel vertical alignment

Introduction

This section shows the recommended preliminary (cold) settings for electric motor-driven pumps based on different temperatures of pumped fluid. Consult driver manufacturers for recommended cold settings for other types of drivers such as steam turbines and engines.

Recommended settings

Pumpage temperature	Recommended setting
10°C | 50°F	0.05 mm | 0.002 in., low
65°C | 150°F	0.03 mm | 0.001 in., high
120°C | 250°F	0.12 mm | 0.005 in., high
175°C | 350°F	0.23 mm | 0.009 in., high
232°C | 450°F	0.33 mm | 0.013 in., high
288°C | 550°F	0.43 mm | 0.017 in., high
343°C | 650°F	Not applicable
371°C | 700°F	Not applicable

4.3.3 Alignment 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.	This prevents strain on the piping installations.
Make sure that the hold-down bolts for the driver 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 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.

4.3.4 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.

This indicator is used to measure angular misalignment.

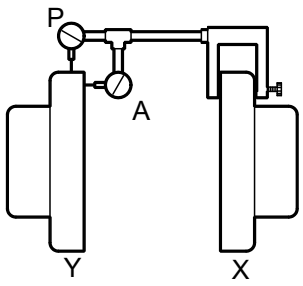


Figure 16: Dial indicator attachment

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.
3. Adjust the indicators if necessary.

4.3.5 Pump-to-driver alignment instructions

4.3.5.1 Perform angular alignment for a vertical correction

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

When the reading value is...	Then...
Negative	The coupling halves are farther apart at the bottom than at the top. Perform one of these steps: • Add shims in order to raise the feet of the driver at the shaft end. • Remove shims in order to lower the feet of the driver at the other end.
Positive	The coupling halves are closer at the bottom than at the top. Perform one of these steps: • Remove shims in order to lower the feet of the driver at the shaft end. • Add shims in order to raise the feet of the driver at the other end.

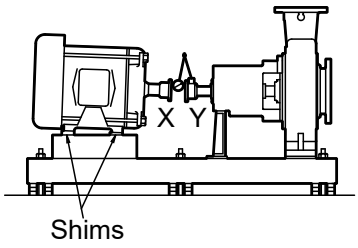


Figure 17: Side view of an incorrect vertical alignment

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

4.3.5.2 Perform angular alignment for a horizontal correction

1. 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).
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.

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: • Slide the shaft end of the driver to the left. • Slide the opposite end to the right.
Positive	The coupling halves are closer together on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the right. • Slide the opposite end to the left.

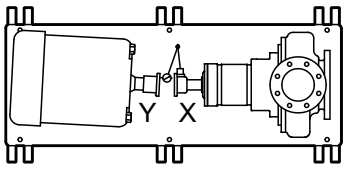


Figure 18: Top view of an incorrect horizontal alignment

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

   Maximum permitted value for angular alignment:

4.3.5.3 Perform parallel alignment for a vertical correction

Refer to 4.3.2.1 Cold settings for parallel vertical alignment on page 31

Before you start this procedure, make sure that the dial indicators are correctly set up.

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

Recommended settings

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

2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

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.

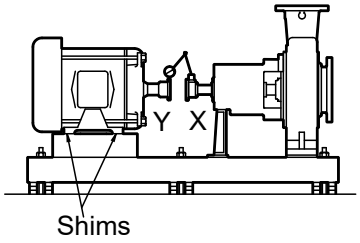


Figure 19: Side view of an incorrect vertical alignment

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

NOTICE:

The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. The correct tolerances must be used. Failure to do so can result in misalignment. Contact ITT for further information.

4.3.5.4 Perform parallel alignment for a horizontal correction

Refer to 4.3.2.1 Cold settings for parallel vertical alignment on page 31

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.05 mm | 0.002 in. 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.

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:

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

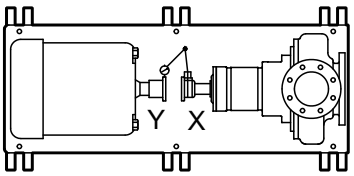


Figure 20: Top view of an incorrect horizontal alignment

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

NOTICE:

The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. The correct tolerances must be used. Failure to do so can result in misalignment. Contact ITT for further information.

4.3.5.5 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 0.05 mm | 0.002 in. 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.

4.3.5.6 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 0.05 mm | 0.002 in. 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.

4.4 Grout the baseplate

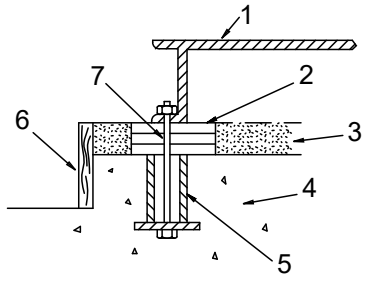
Required equipment:

- 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 dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.
4. Pour grout through the grout hole into the baseplate up to the level of the dam.
   When you pour the grout, remove air bubbles from it by using one of these methods:
   - Puddle with a vibrator.

- Pump the grout into place.

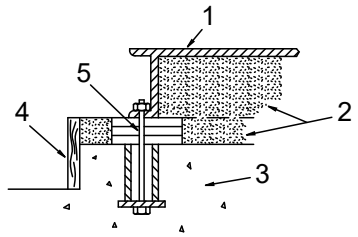
5. Allow the grout to set.



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

Figure 21: Pour grout into baseplate

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



Item	Description
1.	Baseplate
2.	Grout
3.	Foundation
4.	Dam
5.	Bolt

Figure 22: Fill remainder of baseplate with grout

7. Tighten the foundation bolts.

4.5 Piping checklists

4.5.1 General piping checklist

Precautions

WARNING:

- Risk of premature failure. Casing deformation can result in misalignment and contact with rotating parts, causing excess heat generation and sparks. Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump.
- Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.
  - Use fasteners of the proper size and material only.
  - Replace all corroded fasteners.
  - Ensure that all fasteners are properly tightened and that there are no missing fasteners.

NOTICE:

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

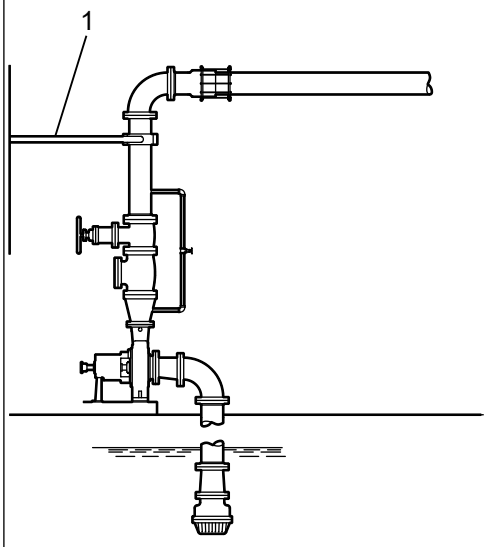
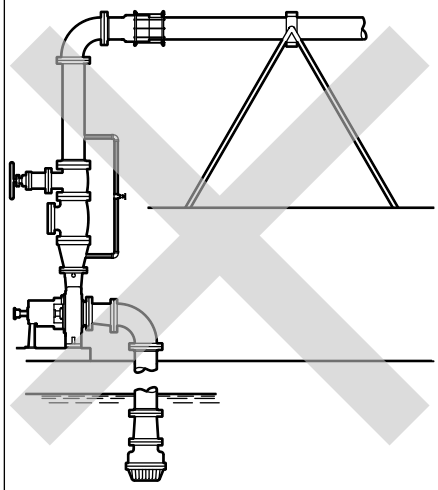
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	• Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings and the coupling	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Keep the piping as straight as possible. Avoid unnecessary bends. Use 45° or long radius 90° fittings where necessary.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Make sure that the inside diameters match properly when you use flange joints.	—	
Do not connect the piping to the pump until: • The grout for the baseplate or sub-base becomes hard.	—	

Check	Explanation/comment	Checked
• The grout for the pit cover becomes hard. • The hold-down bolts for the pump and the driver are tightened.		
Make sure that all the piping joints and fittings are airtight.		
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.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

Example: Installation for expansion

Correct	Incorrect
This illustration shows a correct installation for expansion:  1. Expansion loop/joint	This illustration shows an incorrect installation for expansion: 

4.5.1.1 Fastening

WARNING:
Risk of serious personal injury or property damage. Fasteners such as bolts and nuts are critical to the safe and reliable operation of the product. Ensure appropriate use of fasteners during installation or reassembly of the unit.

- Use fasteners of the proper size and material only.
- Replace all corroded fasteners.
- Ensure that all fasteners are properly tightened and that there are no missing fasteners.

4.5.2 Suction-piping checklist

Performance curve reference

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

Suction-piping checks

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and the closest elbow 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 elbows 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.	
Suggested suction strainers are used. Check that they are at least three times the area of the suction piping. Monitor the pressure drop across the suction strainer. An increased pressure drop across the strainer of 34.5 kPa | 5 psi indicates that the strainer should be removed and cleaned. After a period of time (24 hours minimum) system flushing should be complete and the suction strainer can be removed.	Suction strainers help to prevent debris from entering the pump. Mesh holes with a minimum diameter of 1.6 mm | 1/16 in. are recommended. Liquids with specific gravity less than 0.60 a pressure drop across the suction strainer may be due to ice buildup. Ice buildup can cause turbulence, low pressure areas and pumpage vaporization.	

Check	Explanation/comment	Checked
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 and prevent vapor locking especially with specific gravity of liquid less than 0.60.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	
Assure adequate insulation is applied for liquids with specific gravity less than 0.60.	To assure sufficient NPSHa.	

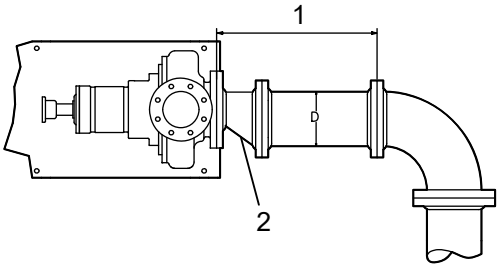
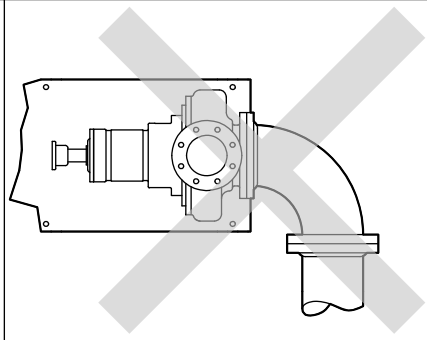
Liquid source below the pump

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.	—	
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.	

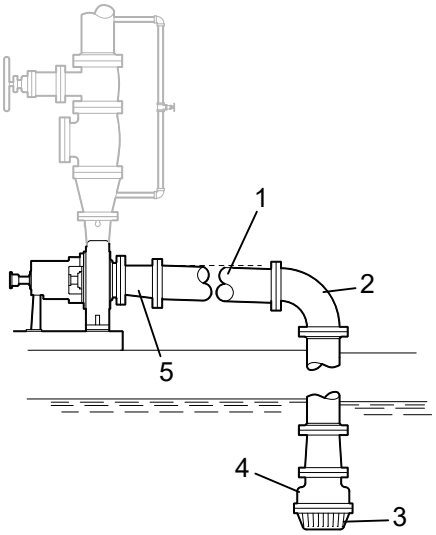
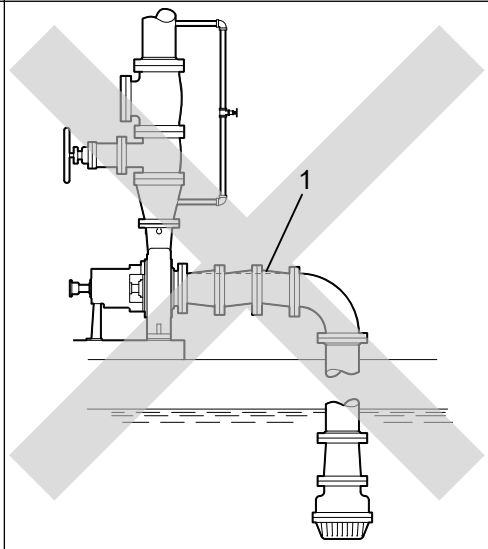
Liquid source above the pump

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 air pockets.	This helps to prevent the occurrence of air 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 source.	This prevents air from entering the pump through a suction vortex.	

Example: Elbow close to the pump suction inlet

Correct	Incorrect
The correct distance between the inlet flange of the pump and the closest elbow must be at least five pipe diameters.  1. Enough distance to prevent cavitation 2. Eccentric reducer with a level top	

Example: Suction piping equipment

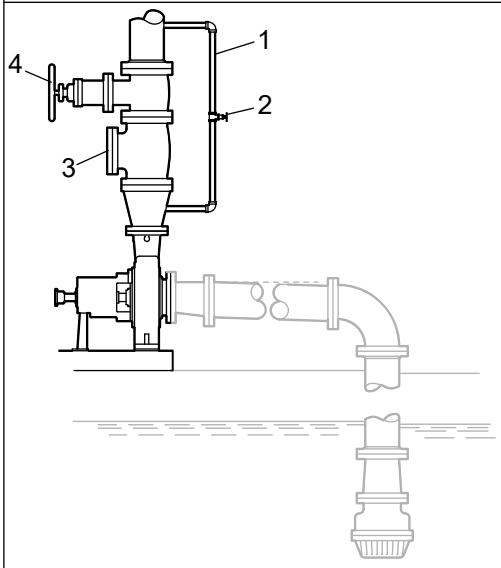
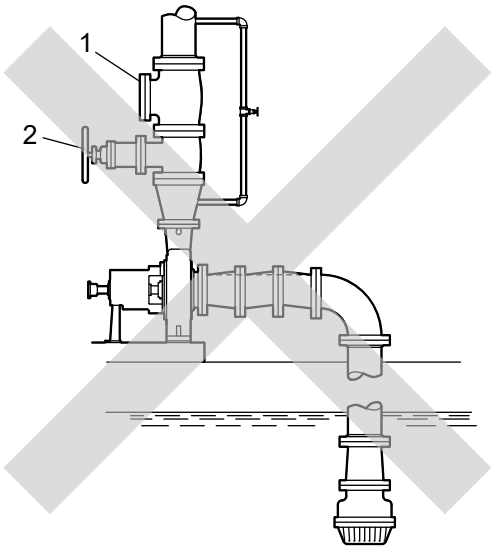
Correct	Incorrect
 1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top	 1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source

4.5.3 Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line. For specific gravity less than 0.60, minimize distance from pump discharge.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump • Reduce risk of pumpage vaporization and vapor locking at low flow rates for low specific gravity liquids. See Example: Discharge piping equipment for illustrations.	
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 the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow. 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 equipment

Correct	Incorrect
	
1. Bypass line 2. Shut-off valve 3. Check valve 4. Discharge isolation valve	1. Check valve (incorrect position) 2. The isolation valve should not be positioned between the check valve and the pump.

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup

WARNING:

- Risk of serious physical injury or death. Exceeding any of the pump operating limits (e.g. - pressure, temperature, power, etc.) could result in equipment failure, such as explosion, seizure, or breach of containment. Assure that the system operating conditions are within the capabilities of the pump.
- Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Ensure all openings are sealed prior to filling the pump.
- Breach of containment can cause fire, burns, and other serious injury. Failure to follow these precautions before starting the unit may lead to dangerous operating conditions, equipment failure, and breach of containment.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of breach of containment and equipment damage. Ensure the pump operates only between minimum and maximum rated flows. Operation outside of these limits can cause high vibration, mechanical seal and/or shaft failure, and/or loss of prime.

WARNING:

- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
    - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

Precautions

WARNING:
The mechanical seal used in an Ex-classified environment must be properly certified.

CAUTION:
When a cartridge mechanical seal is used, ensure that the set screws in the seal locking ring are tightened and that the centering clips have been removed prior to startup. This prevents seal or shaft sleeve damage by ensuring that the seal is properly installed and centered on the sleeve.

NOTICE:

- Verify the driver settings before you start any pump. Refer to the applicable drive equipment IOMs and operating procedures.
- Excessive warm-up rates can cause equipment damage. Ensure the warm-up rate does not exceed 1.4°C | 2.5°F per minute.

NOTICE:
You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.
- If temperatures of the pumped fluid will exceed 93°C | 200°F, then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 38°C | 100°F of the fluid temperature. Accomplish this by flowing fluid from pump inlet to discharge drain (optionally, the casing vent can be included in warm-up circuit but not required). Soak for (2) hours at process fluid temperature.

At initial startup, do not adjust the variable-speed drivers or check for speed governor or over-speed trip settings while the variable-speed driver is coupled to the pump. If the settings have not been verified, then uncouple the unit and refer to instructions supplied by the driver manufacturer.

5.2 Check the rotation

WARNING:

- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
    - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

1. Lock out power to the driver.
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 jog the driver long enough to determine that the direction of rotation corresponds to the arrow on the casing, bearing housing, or close-coupled frame.
6. Lock out power to the driver.

5.3 Bearing lubrication

WARNING:
Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

Pumps are shipped without oil. You must lubricate oil-lubricated bearings at the job site.

Standard lubrication is oil bath for PC3 pumps. Optional oil slinger can be purchased to allow for larger variance in oil level.

5.3.1 Lubricating-oil requirements

Oil requirements based on temperature

For the majority of operating conditions, bearing temperatures run between 49°C | 120°F and 82°C | 180°F, and you can use an oil of ISO viscosity grade 68 at 38°C | 100°F. If temperatures exceed 82°C | 180°F, refer to the table for temperature requirements.

Temperature	Oil requirement
Bearing temperatures exceed 82°C | 180°F	Use ISO viscosity grade 100.
Pumped-fluid temperatures exceed 177°C | 350°F	Use synthetic lubrication.

5.3.2 Acceptable oil for lubricating bearings

Acceptable lubricants

Table 4: Acceptable lubricants

Brand	Lubricant type
Chevron	GST Oil 68
Exxon	Teresstic EP 68
Mobil	DTE Heavy Medium
Phillips 66	Turbine Oil VG68
Shell	Turbo T 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Oil

5.3.3 Lubricate the bearings with oil

WARNING:
Risk of explosive hazard and premature failure from sparks and heat generation. Ensure bearings are properly lubricated prior to startup.

Use a high-quality turbine oil with rust and oxidation inhibitors.

1. Remove the fill plug.

2. Fill the bearing frame with oil through the 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 (200).

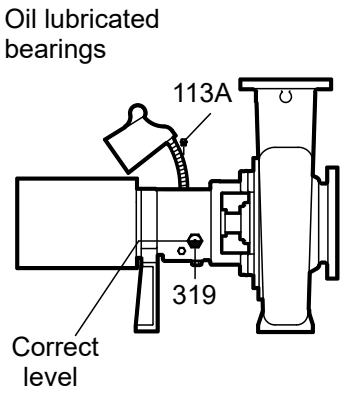


Figure 23: Oil filler connection

3. Replace the fill plug.

5.3.4 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.

5.4 Shaft-sealing options

In most cases, the manufacturer seals the shaft before shipping the pump. If your pump does not have a sealed shaft, see the Shaft-seal maintenance section in the Maintenance chapter.

This model uses these types of shaft seals:

- Cartridge mechanical seal
- Conventional inside-component mechanical seal
- Conventional outside-component mechanical seal
- Packed-stuffing-box option

5.4.1 Connection of sealing liquid for mechanical seals

Seal lubrication is required

Seal faces must have liquid film between them for proper lubrication. Locate the taps using the illustrations shipped with the seal.

Seal flushing methods

Table 5: You can use these methods in order to flush or cool the seal:

Method	Description
Product flush	Run the piping so that the pump pushes the pumped fluid from the casing and injects it into the seal gland. If necessary, an external heat exchanger cools the pumped fluid before it enters the seal gland.

Method	Description
External flush	Run the piping so that the pump injects a clean, cool, compatible liquid directly into the seal gland. The pressure of the flushing liquid must be 0.35 to 1.01 kg/cm^2 | 5 to 15 psi greater than the seal chamber pressure. The injection rate must be 2 to 8 lpm | 0.5 to 2 gpm.
Other	You can use other methods that employ multiple gland or seal chamber connections. Refer to the mechanical seal reference drawing and piping diagrams.

5.4.2 Packed stuffing box option

WARNING:
Packed stuffing boxes are not allowed in an Ex-classified environment.

The factory does not install the packing, lantern ring, or split gland.

These parts are included with the pump in the box of fittings. Before you start the pump, you must install the packing, lantern ring, and split gland according to the Packed stuffing box maintenance section in the Maintenance chapter.

5.4.3 Connection of sealing liquid for a packed stuffing box

NOTICE:
Make sure to lubricate the packing. Failure to do so may result in shortening the life of the packing and the pump.

You must use an external sealing liquid under these conditions:

- The pumped fluid includes abrasive particles.
- The stuffing-box pressure is below atmospheric pressure when the pump is running with a suction lift or when the suction source is in a vacuum. Under these conditions, packing is not cooled and lubricated and air is drawn into pump.

Conditions for application of an external liquid

Condition	Action
The stuffing box pressure is above atmospheric pressure and the pumped fluid is clean.	Normal gland leaks of 40 to 60 drops per minute is usually sufficient to lubricate and cool the packing. You do not need sealing liquid.
The stuffing box pressure is below atmospheric pressure or the pumped fluid is not clean.	An outside source of clean compatible liquid is required.
An outside source of clean compatible liquid is required.	You must connect the piping to the lantern ring connection with a 40 to 60 drops-per-minute leak rate. The pressure must be 1.01 kg/cm^2 | 15 psi above the stuffing box pressure.

5.5 Impeller clearance

WARNING:
Lock out driver power before beginning work on pump
Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.

- Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
- Refer to driver/coupling manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

CAUTION:
Check impeller clearance prior to starting. Setting may have changed during transit.

Impeller clearance is set by the factory at the lowest clearance setting, which is 0.015". Adjustment may need to be made prior to initial startup. (Refer to 5.5.1 Impeller clearance setting on page 48 for additional clearances and procedures for setting the clearance.)

Impeller clearance is the measurement between the back of the reverse vane impeller and the rear cover plate or for open impellers the measurement between the impeller vanes and the casing.

5.5.1 Impeller clearance setting

WARNING:
The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation, and equipment damage.

WARNING:

- Risk of serious physical injury or death. Exceeding any of the pump operating limits (e.g. - pressure, temperature, power, etc.) could result in equipment failure, such as explosion, seizure, or breach of containment. Assure that the system operating conditions are within the capabilities of the pump.
- Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Ensure all openings are sealed prior to filling the pump.
- Breach of containment can cause fire, burns, and other serious injury. Failure to follow these precautions before starting the unit may lead to dangerous operating conditions, equipment failure, and breach of containment.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of breach of containment and equipment damage. Ensure the pump operates only between minimum and maximum rated flows. Operation outside of these limits can cause high vibration, mechanical seal and/or shaft failure, and/or loss of prime.

WARNING:

- Risk of death, serious personal injury, and property damage. Heat and pressure buildup can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Starting the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment. Ensure correct driver settings prior to starting any pump.

A change in pump performance may be noted over time by a drop in head or flow or an increase in power required. Performance can usually be renewed by adjusting the impeller clearance. Clearance for reverse vane impellers is the measurement between the back of the impeller and the rear cover plate.

Table 6: Impeller Clearance Values

Temperature	Impeller Clearance
Below 93 °C | 200° F	0.46 mm ± 0.08 | 0.018" ± 0.003
93° C to 121 °C | 200° F to ≤ 250° F	0.53 mm | 0.021"
122 °C to 149 °C | 251° F to ≤ 300 ° F	0.61 mm | 0.024"
150 °C to 176 °C | 301° F to ≤ 350° F	0.69 mm | 0.027"
177 °C to 204 °C | 351° F to ≤ 400° F	0.76 mm | 0.030"
205 °C to 232 °C | 401° F to ≤ 450°	0.84 mm | 0.033"
Over 232 °C | 450° F	0.91 mm | 0.036"

1. Loosen the three set screws (201A) and rotate the bearing carrier.

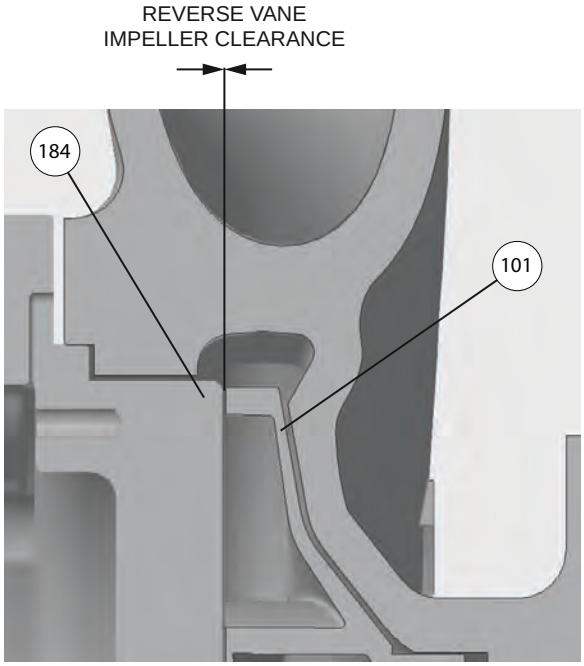


Figure 24: Impeller clearance

2. Use a wrench on the lugs on the face of the bearing carrier (201), turn the carrier (201) counter clockwise until the impeller makes light rubbing contact with the surface of the rear cover plate. Rotating the shaft (105) at the same time accurately determines the zero setting.

3. Rotate the bearing carrier (201) clockwise to set proper clearance. (Refer to *Impeller Clearance Values* table above for proper settings for operating temperatures.) Rotating the carrier the width of one of the indicator patterns on the bearing carrier (See Figure 25: Bearing Carrier on page 50.) moves the impeller axially 0.1mm | 0.004 inches. To determine how much rotation is required, divide the desired clearance by .004.

NOTICE:
For 3 x 1.5-13 and 3 x 2-13 pumps at 3500 RPM, add 0.08mm | 0.003 inches to clearance value.

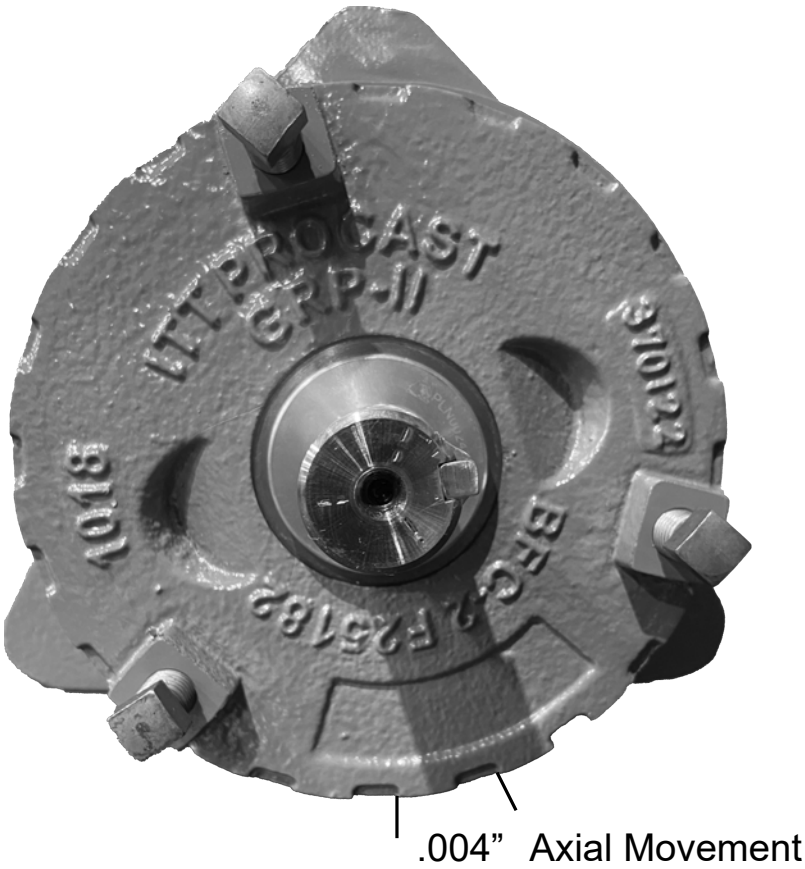


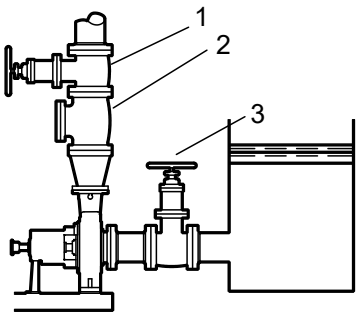
Figure 25: Bearing Carrier

4. Tightening the set screws (201A) causes the impeller to move approximately 0.002 inches (0.05mm) closer to the rear cover plate. This must be considered when setting the clearance.
5. When desired clearance is obtained, tighten the set screws (201A) in incremental steps until final torque is reached.

5.6 Pump priming

5.6.1 Prime the pump with the suction supply above the pump

1. Slowly open the suction isolation valve.
2. Open the air vents on the suction and discharge piping until the pumped fluid flows out.
3. Close the air vents.



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

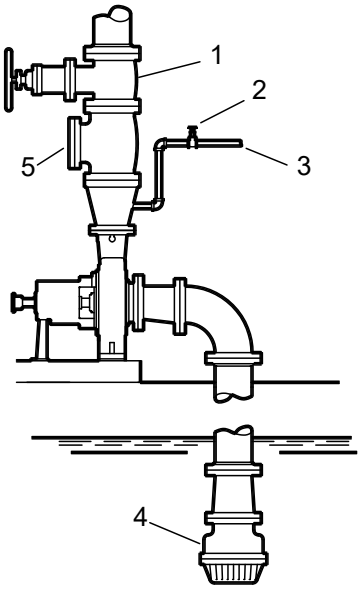
Figure 26: Suction supply above pump

5.6.2 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:

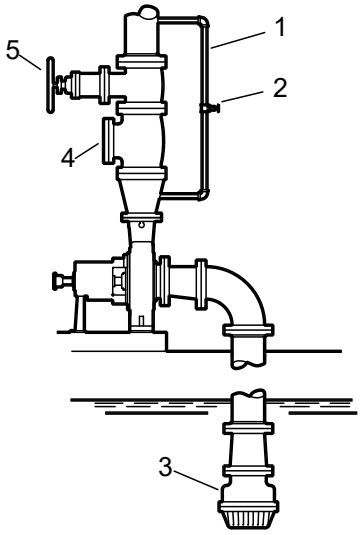
- A priming pump
- A pressurized discharge line
- Another outside supply

1. Close the discharge isolation valve.
2. Open the air vent 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.



Item	Description
1.	Discharge isolation valve
2.	Shutoff valve
3.	From outside supply
4.	Foot valve
5.	Check valve

Figure 27: Pump priming with suction supply below pump with foot valve and an outside supply



Item	Description
1.	By-pass line
2.	Shutoff valve
3.	Foot valve
4.	Check valve
5.	Discharge isolation valve

Figure 28: Pump priming with suction supply below pump with foot valve using bypass around check valve

5.6.3 Other methods of priming the pump

You can also use these methods in order to prime the pump:

- Prime by ejector
- Prime by automatic priming pump

5.7 Start the pump

WARNING:

- Risk of equipment damage, seal failure and breach of containment. Ensure all flush and cooling systems are operating correctly prior to starting pump.
-

NOTICE:

- Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.

- To avoid risk of equipment damage, observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

NOTICE:
Risk of equipment damage on pure or purge-oil mist-lubricated units. Remove the viewing port plugs to verify that oil mist is flowing properly. Reinstall the plugs after confirming.

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

- Open the suction valve.
- Open any recirculation or cooling lines.

1. Fully close or 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.

   A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
7. Repeat steps 5 and 6 until the pump runs properly.

5.8 Pump operation precautions

General considerations

WARNING:

- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.

Operation at reduced capacity

WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.

- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.

NOTICE:

- Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available ($NPSH_A$) always exceeds NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.
-

Operation under freezing conditions

NOTICE:
Do not expose an idle pump to freezing conditions. Drain all liquid that will freeze that is inside the pump and any auxiliary equipment. Failure to do so can cause liquid to freeze and damage the pump. Note that different liquids freeze at different temperatures. Some pump designs do not drain completely and may require flushing with a liquid that doesn't freeze.

5.9 Shut down the pump

WARNING:
Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.

1. Slowly close the discharge valve.
2. Shut down and lock out the driver to prevent accidental rotation.

5.10 Make the final alignment of the pump and driver

WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
  - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
  - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Misalignment can cause decreased performance, equipment damage, and even catastrophic failure of frame-mounted units leading to serious injury. Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of all drive components prior to operating the unit.

- Follow the coupling installation and operation procedures from the coupling manufacturer.

You must check the final alignment after the pump and driver are at operating temperature. For initial alignment instructions, see the Installation chapter.

1. Run the unit under actual operating conditions for enough time to bring the pump, driver, and associated system to operating temperature.
2. Shut down the pump and the driver.
3. Remove the coupling guard.
4. Check the alignment while the unit is still hot.
   Refer to 4.3 Pump-to-driver alignment on page 30 in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

6 Maintenance

6.1 Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

- Routine maintenance
- Routine inspections
- Three-month inspections
- Annual inspections

Shorten the inspection intervals appropriately if the pumped fluid is abrasive or corrosive or if the environment is classified as potentially explosive.

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

WARNING:
Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

- Lubricate the bearings.
- Inspect the seal.

Routine inspections

Perform these tasks whenever you check the pump during routine inspections:

WARNING:
Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.*
- Inspect the discharge pressure.
- Inspect the temperature.*
- Check the seal chamber and stuffing box for leaks.
    - Ensure that there are no leaks from the mechanical seal.
    - Adjust or replace the packing in the stuffing box if you notice excessive leaking.

NOTICE:
*If equipped, temperature and vibration levels can be retrieved by using your i-ALERT® monitoring sensor and app.

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the packing if the pump has been left idle, and replace as required.
- Change the oil every three months (2000 operating hours) at minimum.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

- Check the pump capacity.
- Check the pump pressure.
- Check the pump power.

If the pump performance does not satisfy your process requirements, and the process requirements have not changed, then perform these steps:

1. Disassemble the pump.
2. Inspect it.
3. Replace worn parts.

6.2 Bearing maintenance

These bearing lubrication sections list different temperatures of the pumped fluid. If the pump is Ex-certified and the temperature of the pumped fluid exceeds the permitted temperature values, then consult your ITT representative.

For Ex applications bearing replacement (all) is recommended after 17,500 hours of operation.

Bearing lubrication schedule

Type of bearing	First lubrication	Lubrication intervals
Oil-lubricated bearings	Add oil before you install and start the pump. Change the oil after 200 hours for new bearings.	After the first 200 hours, change the oil every 2000 operating hours or every three months.

6.2.1 Lubricating-oil requirements

Oil requirements based on temperature

For the majority of operating conditions, bearing temperatures run between 49°C | 120°F and 82°C | 180°F, and you can use an oil of ISO viscosity grade 68 at 38°C | 100°F. If temperatures exceed 82°C | 180°F, refer to the table for temperature requirements.

Temperature	Oil requirement
Bearing temperatures exceed 82°C | 180°F	Use ISO viscosity grade 100.

Temperature	Oil requirement
Pumped-fluid temperatures exceed 177°C | 350°F	Use synthetic lubrication.

6.2.1.1 Acceptable oil for lubricating bearings

Acceptable lubricants

Table 7: Acceptable lubricants

Brand	Lubricant type
Chevron	GST Oil 68
Exxon	Teresstic EP 68
Mobil	DTE Heavy Medium
Phillips 66	Turbine Oil VG68
Shell	Turbo T 68
Sunoco	Sunvis 968
Royal Purple	SYNFILM ISO VG 68 Synthetic Oil

6.2.1.2 Lubricate the bearings after a shutdown period

1. Flush out the bearings and bearing frame with a light oil to remove contaminants.
   During flushing, make sure to rotate the shaft slowly by hand.
2. Flush the bearing housing with the proper lubricating oil to ensure oil quality after cleaning.

6.3 Shaft-seal maintenance

6.3.1 Mechanical-seal maintenance

WARNING:

- The mechanical seal used in an Ex-classified environment must be properly certified.

CAUTION:
Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

Cartridge-type mechanical seals

Cartridge-type 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 disengagement of the holding clips prior to operation, allowing the seal to slide into place. If the seal has been installed in the pump by ITT, these clips have already been disengaged.

Other mechanical seal types

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

Reference drawing

The manufacturer supplies a reference drawing with the data package. Keep this drawing for future use when you perform maintenance and seal adjustments. The seal drawing specifies the required flush fluid and attachment points.

Before you start the pump

Check the seal and all flush piping.

6.3.2 Packed stuffing-box maintenance

WARNING:
Packed stuffing boxes are not allowed in an Ex-classified environment.

WARNING:
Failure to disconnect and lock out driver power may result in serious physical injury. Never attempt to replace the packing until the driver is properly locked out.

Accepted leakage rate

It is not necessary to shut down or disassemble the pump to inspect the packing operation. During normal operation, the packing should leak approximately one drop per second.

Adjustment of gland

Adjust the gland if the leakage rate is greater than or less than the specified rate.

Evenly adjust each of the two gland bolts with a one-quarter (1/4) turn until the desired leakage rate is obtained. Tighten the bolts to decrease the rate. Loosen the bolts to increase the rate.

Tightening of packing

NOTICE:
Never over-tighten packing to the point where less than one drop per second is observed. Over-tightening can cause excessive wear and power consumption during operation.

If you cannot tighten the packing to obtain less than the specified leakage rate, then replace the packing.

6.4 Disassembly

6.4.1 Disassembly precautions

WARNING:

- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.

    - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- Handling heavy equipment poses a crush hazard. Use caution during handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times.
- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.
- Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
- Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.

CAUTION:

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

6.4.2 Tools required

In order to disassemble the pump, you need these tools:

- Bearing puller
- Cleaning agents and solvents
- Dial indicators
- Feeler gauges
- Hex wrenches
- Hydraulic press
- Induction heater
- Lifting sling
- Rubber mallet
- Screwdriver
- Lifting eyebolt (dependent on pump / motor size)

6.4.3 Drain the pump

CAUTION:

- If the pumped fluid is non-conductive, drain and flush the pump with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.

1. Leave the suction pipe drain valve open to drain the pump casing as much as possible.
2. Leave the drain valve open and remove the drain plug located on the bottom of the pump housing. Do not reinstall the plug or close the drain valve until the reassembly is complete.
3. Remove the coupling guard.

6.4.4 Remove the coupling

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

6.4.5 Remove the back pull-out assembly

WARNING:
Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

1. Is your bearing frame oil lubricated?
   - If No: Proceed to step 2.
   - If Yes:
     1. Remove the bearing-frame drain plug (134) in order to drain oil from the bearing frame.
     2. Replace the plug after the oil is drained.
     3. Remove the oil reservoir, if equipped.

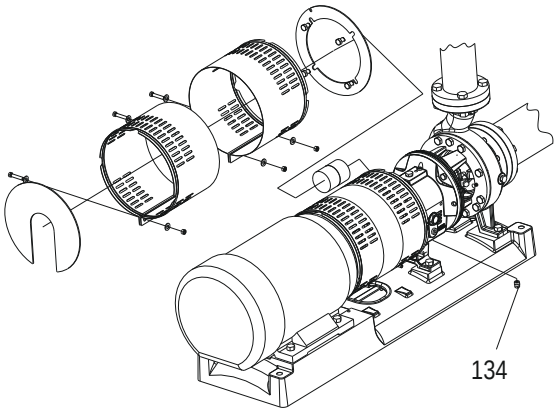


Figure 29: Back pull-out assembly removal (oil lubricated bearing frame)

Oil analysis should be part of a preventive maintenance program that determines the cause of a failure. Save the oil in a clean container for inspection.

2. The back pull out assembly consists of all parts except the casing (100). The casing (100) can remain on the foundation and in the piping, if it is not the casing itself, which must be repaired. Drain the casing, by removing the casing drain plug (if equipped).
3. Remove the hold-down bolts of the bearing frame foot.
4. Tighten the jackscrews evenly, using an alternating pattern, in order to remove the back pull-out assembly.
   You can use penetrating oil if the adapter to the casing joint is corroded.
5. Remove the back pull-out assembly from the casing (100).

   Make sure you support the back pullout with proper rigging to keep from damaging the unit or injuring yourself or others.

6. Mark and remove the shims from under the frame foot and save them for reassembly.
7. Remove and discard the casing gasket.
   You will insert a new casing gasket during reassembly.
8. Remove the jackscrews.
9. Clean all gasket surfaces.

Clean surfaces prevent the casing gasket from partially adhering to the casing due to binders and adhesives in the gasket material.

6.4.6 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.

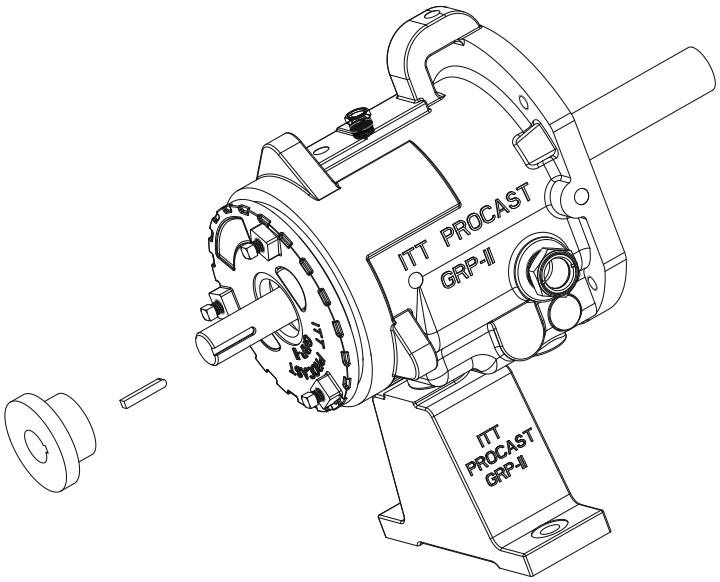


Figure 30: Coupling hub removal

6.4.7 Disassemble the pump

1. Remove the casing nuts (115A) and separate the back pullout.
2. Remove the impeller (101) from the shaft (122) while holding the shaft with a strap wrench or suitable tool that will not mark the shaft.

WARNING:

Never apply heat to remove an impeller. The use of heat may cause an explosion due to trapped liquid, resulting in severe physical injury and property damage.

NOTICE:

Threads are right handed.

3. Discard the impeller gasket (412A).

NOTICE:
If a cartridge type mechanical seal is used, spacing clips or tabs should be installed prior to loosening the set screws or removing from cover plate.

For a packed pump

4. Remove seal or gland nuts.
5. Remove screws attach the cover plate to the adapter and use care when removing the plate.
6. Remove packing, seal cage, and gland.

For Mechanical Seal

7. Remove the mechanical seal rotating element from the pump shaft sleeve by loosening the set screws and sliding off assembly. Discard all O-rings and gaskets.
   a) Remove shaft sleeve if quipped.
   b) Slide off seal gland with stationary seat and discard all O-rings and gaskets.
8. If packing is used, remove packing, seal cage, and gland.
9. If the pump is oil lubricated, remove the drain plug (408) and drain the oil from the bearing housing (228).
10. Remove the bearing housing adaptor (108) (except group 1) by removing the adapter to housing bolts (370B) and separate the bearing housing adapter (108) from the bearing housing (228). Discard O-ring.

NOTICE:
Group 1 housing has integral adapter and can not be removed or separated.

11. Loosen the set screws (500) on the bearing carrier (134) and unscrew the bearing carrier (134) from the bearing housing (228). Using a wrench on one of the three square lugs on the carrier, unscrew until the assembly is free from the bearing housing (228). Discard the O-rings (496).
12. On Group 1 and Group 2 pumps, remove the snap ring (506). On Group 3 pumps, remove the bolts (370G), that attaches the retainer to the carrier. Then the bearing carrier (134) can be removed by tapping with a rubber hammer.
13. Remove the bearing locknut (136) and bearing lock washer (382).
14. Remove the inboard bearing (503) and outboard bearing (502) utilizing an arbor press or bearing puller.

NOTICE:

Never use a hammer to drive the shaft through the bearings. Doing so can cause severe shaft and bearing damage.

NOTICE:

Use force only on the inner race when pressing bearings from the shaft. Failure to do so may result in equipment damage. Save bearings for inspection.

15. Complete the disassembly of bearing housing (228) by removing the remaining hardware.
16. Inspect all parts for cracks, erosion, pitting, rusting, damaged threads, corrosion, or a worn shaft or sleeve. Replace as needed.
17. Remove and replace laby seals outboard (332A) from bearing carrier (134). Group 1 remove inboard laby seal (333A) from bearing housing (228). Groups 2 and 3 remove inboard laby seal (333A) from bearing housing adaptor (108).

6.5 Pre-assembly inspections

Guidelines

Before you assemble the pump parts, make sure you follow these guidelines:

- Inspect the pump parts according to the information in these pre-assembly topics before you reassemble your pump. Replace any part that does not meet the required criteria.
- Make sure that the parts are clean. Clean the pump parts in solvent in order to remove oil, grease, and dirt.

NOTICE:

Protect machined surfaces while cleaning the parts. Failure to do so may result in equipment damage.

6.6 Reassembly

6.6.1 Assemble the pump

1. Install a new oil slinger on the shaft if one was removed during disassembly. Only used and is optional on oil lubricated bearing housings.
2. Install inboard bearing on the shaft.
   a) Inspect the shaft (122) to ensure that it is clean, dimensionally correct, and is free of nicks, burrs, etc.
   b) Lightly coat the bearing seating with a thin film of oil.
   c) Remove the bearing (112) from its packaging.
   d) Wipe the preservative from the bearing (112) bore and outer diameter.
   e) Use an induction heater with a demagnetizing cycle to heat bearing (112) to an inner ring temperature of 110 °C | 230 °F.

WARNING:

Risk of physical injury from hot bearings. Wear insulated gloves when using a bearing heater.

NOTICE:

There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings.

   f) Position the bearing (112) on the shaft (122) against the shoulder and against the bearing until it is cool.

NOTICE:

Regreasable bearing has a single shield. The outboard bearing is installed with shield toward impeller.

3. Install retaining ring or retainer (Group 1, 2 and Group 3 respectively) on the shaft. Retaining/snap ring needs to have the flat side towards the outboard bearing.
4. Install outboard bearing on the shaft.
   a) Inspect the shaft (122) to ensure that it is clean, dimensionally correct, and is free of nicks, burrs, etc.
   b) Lightly coat the bearing seating with a thin film of oil.
   c) Remove the bearing (112) from its packaging.
   d) Wipe the preservative from the bearing (112) bore and outer diameter.
   e) Use an induction heater with a demagnetizing cycle to heat bearing (112) to an inner ring temperature of 110 °C | 230 °F.

WARNING:

Risk of physical injury from hot bearings. Wear insulated gloves when using a bearing heater.

NOTICE:

There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings.

f) Position the bearing (112) on the shaft (122) against the shoulder and snug the locknut (136) against the bearing until it is cool. The locknut prevents the bearing from moving away from the shaft shoulder as it cools.

NOTICE:

Regreasable bearing has a single shield. The outboard bearing is installed with shield toward impeller.

g) Remove bearing locknut (136) after bearing (112) has cooled.

h) Place lockwasher (382) on shaft (122). Place tang of lockwasher in keyway of shaft.

i) Thread locknut (136) onto shaft (122). Tighten locknut one-eighth (1/8) to one-quarter (1/4) turn beyond snug. Bend any tang of lockwasher (382) into a slot of locknut.

NOTICE:

Tighten locknut if necessary to align the closest tab of lockwasher with slot on locknut, but do not overtighten.

5. Install new laby seal in bearing carrier and in housing for Group 1 or in adapter in Group 2 and 3.
6. Install new O-rings to the bearing carrier.
7. Insert the shaft with the outboard bearing into the bearing carrier.
8. Install the retaining device. For Group 1 and 2, make sure the snap ring fits inside the retaining groove. The taper design ensures that the slack from tolerance stack up is removed and provides a tight fit. Group 3, install and tighten the bolts that contain the bearing between the carrier and the ring.

NOTICE:

Retaining/snap ring may not fit completely in the groove. This is by design.

9. Make sure that you lubricate the O-rings on the carrier before installing the shaft assembly and then thread the shaft assembly into the bearing housing. The bearing carrier flange should be approximately 0.125" from the back face of the bearing housing before installing the set screws.
10. Install remaining hardware such as sight glass, plugs, etc, and foot with bolt.
11. Install the adapter O-ring onto the bearing housing, and then install the adapter to the bearing housing on Group 2 and 3 using the appropriate bolts.
12. Install sleeve if equipped.
13. Slide sealing device (ie, mechanical seal or packing gland) over the shaft/sleeve in the correct orientation.
14. Install the rear cover plate to the adapter with the 2 cover/adapter screws.
15. Install the impeller by threading it on the shaft with the impeller gasket already installed in the impeller. Use of a strap wrench or tool needs to be used to ensure that the impeller is tight on the shaft.
16. Set impeller clearance per instructions. Refer to 5.5.1 Impeller clearance setting on page 48 .

NOTICE:
Each manufacturer has their own seal assembly instructions. Follow seal manufacture's instructions for installation and maintenance.

17. Install and set seal whether packing or mechanical. If packing, insert two rings, seal ring, and then last two rows of packing. Make sure the holes in seal ring align with the flushing connections.
18. Install a new casing/cover gasket onto the cleaned surface of the plate. Ensure casing gasket surface is clean and free of burs, debris, and sharp areas.
19. Slide the back pullout into the casing.
20. Install the casing hardware and tighten in a star pattern.
21. Check the impeller clearance by rotating the shaft. If rubbing occurs, determine the issue and correct it.
22. Make sure bearing housing is lubricated with the appropriate lubrication and all unnecessary ports are plugged or tied into appropriate systems.

7 Assembly References

7.1 Bolt torque values

Item No	Description	Group 1	Group 2	Group 3
201E	Bearing retainer cap screws	N/A	N/A	5/16" - 16 Nm | 12 ft-lbf
139	Bearing housing/ adapter cap screws	N/A	1/2" - 54 Nm | 40 ft-lbf	5/8" - 122 Nm | 90 ft-lbf
111/111A	Mechanical seal gland studs/nuts with gasket	3/8" - 16 Nm | 12 ft-lbf	3/8" - 16 Nm | 12 ft-lbf 1/2" - 54 Nm | 40 ft-lbf	1/2" - 41 Nm | 30 ft-lbf
111/111A	Mechanical seal gland studs/nut with o-ring	3/8" - 27 Nm | 20 ft-lbf	3/8" - 27 Nm | 20 ft-lbf 1/2" - 54 Nm | 40 ft-lbf	1/2" - 54 Nm | 40 ft-lbf
115	Casing studs/ nuts	1/2" - 73 Nm | 54 ft-lbf	1/2" - 73 Nm | 54 ft-lbf 5/8" - 145 Nm | 107 ft-lbf	3/4" - 179 Nm | 132 ft-lbf 7/8" - 287 Nm | 212 ft-lbf
140	Cap screw cov- er/adapter	3/8" - 27 Nm | 20 ft-lbf	3/8" - 27 Nm | 20 ft-lbf	1/2" - 54 Nm | 40 ft-lbf
201A	Bearing carrier set screws	3/8" - 16 Nm | 12 ft-lbf	1/2" - 41 Nm | 30 ft-lbf	1/2" - 41 Nm | 30 ft-lbf
136	Cap screw foot	1/2" - 54 Nm | 40 ft-lbf	3/4" - 217 Nm | 160 ft-lbf	1" - 300 Nm | 228 ft-lbf
136	Bearing locknut	27 +4/-0 Nm | 20 +5/-0 ft-lbf	54 +7/-0 Nm | 40 +5/-0 ft-lbf	95 +7/-0 Nm | 70 +5/-0 ft-lbf

8 Troubleshooting

8.1 Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Re-prime the pump and check that the pump and suction line are full of liquid.
	The suction line is clogged.	Remove the obstructions.
	The impeller is clogged.	Back-flush the pump in order to clean the impeller.
	The shaft is rotating in the wrong direction.	Change the rotation. The rotation must match the arrow on the bearing housing or pump casing.
	The foot valve or suction pipe opening is not submerged enough.	Consult an ITT representative for the proper submersion depth. Use a baffle in order to eliminate vortices.
	The suction lift is too high.	Shorten the suction pipe.
The pump is not producing the rated flow or head.	The gasket or O-ring has an air leak.	Replace the gasket or O-ring.
	The stuffing box has an air leak.	Replace or readjust the mechanical seal.
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
		Adjust the impeller clearance.
	The suction head is not sufficient.	Make sure that the suction-line shutoff valve is fully open and that the line is unobstructed.
	The impeller is worn or broken.	Inspect and replace the impeller if necessary.
The pump starts and then stops pumping.	The pump is not primed.	Re-prime the pump and check that the pump and suction line are full of liquid.
	The suction line has air or vapor pockets.	Rearrange the piping in order to eliminate air pockets.
	The suction line has an air leak.	Repair the leak.
The bearings are running hot.	The pump and driver are not aligned properly.	Realign the pump and driver.
	There is not sufficient lubrication.	Check the lubricant for suitability and level.
	The lubrication was not cooled properly.	Check the cooling system.
The pump is noisy or vibrates.	The pump and driver are not aligned properly.	Realign the pump and driver.
	The impeller is partly clogged.	Back-flush the pump in order to clean the impeller.
	The impeller or shaft is broken or bent.	Replace the impeller or shaft as necessary.
	The foundation is not rigid.	Tighten the hold-down bolts of the pump and motor. Make sure the baseplate is properly grouted without voids or air pockets.
	The bearings are worn.	Replace the bearings.
	The suction or discharge piping is not anchored or properly supported.	Anchor the suction or discharge piping as necessary according to recommendations in the Hydraulic Institute Standards Manual.
	The pump is cavitating.	Locate and correct the system problem.
The mechanical seal is leaking excessively.	The packing gland is not adjusted properly.	Tighten the gland nuts.
	The mechanical seal parts are worn.	Replace the worn parts.

Symptom	Cause	Remedy
	The mechanical seal is overheating.	Check the lubrication and cooling lines.
	The shaft or shaft sleeve is scored.	Machine or replace the shaft sleeve as necessary.
The motor requires excessive power.	The discharge head has dropped below the rated point and is pumping too much liquid.	Install a throttle valve. If this does not help, then trim the impeller diameter. If this does not help, then contact your ITT representative.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The stuffing-box packing is too tight.	Readjust the packing. If the packing is worn, then replace the packing.
	Rotating parts are rubbing against each other.	Check the parts that are wearing for proper clearances.
	The impeller clearance is too tight.	Adjust the impeller clearance.

8.2 Alignment troubleshooting

Symptom	Cause	Remedy
Horizontal (side-to-side) alignment cannot be obtained (angular or parallel).	The driver feet are bolt-bound.	Loosen the pump's hold-down bolts, and slide the pump and driver until you achieve horizontal alignment.
	The baseplate is not leveled properly and is probably twisted.	1. Determine which corners of the baseplate are high or low. 2. Remove or add shims at the appropriate corners. 3. Realign the pump and driver.

8.3 Assembly troubleshooting

Symptom	Cause	Remedy
There is excessive shaft end play.	The internal clearance of the bearings exceeds the recommended amount.	Replace the bearings with a bearing of the correct type.
	The snap ring is loose in the bearing-housing groove.	Re-seat the snap ring.
There is excessive shaft and sleeve runout.	The sleeve is worn.	Replace the sleeve.
	The shaft is bent.	Replace the shaft.
There is excessive bearing-frame flange runout.	The shaft is bent.	Replace the shaft.
	The flange of the bearing frame is distorted.	Replace the bearing-frame flange.
There is excessive frame-adapter runout.	There is corrosion on the frame adapter.	Replace the frame adapter.
	The adapter-to-frame gasket is not seated properly.	Re-seat the frame adapter and make sure that the adapter-to-frame gasket is seated properly.
There is excessive seal chamber or stuffing-box cover runout.	The seal chamber or the stuffing-box cover is not properly seated in the frame adapter.	Re-seat the seal chamber or stuffing-box cover.
	There is corrosion or wear on the seal chamber or stuffing-box cover.	Replace the seal chamber or stuffing-box cover.
There is excessive vane-tip runout of the impeller.	The vane is bent.	Replace the impeller.

9 Parts Listings and Cross Sections

9.1 PC3 Group 1

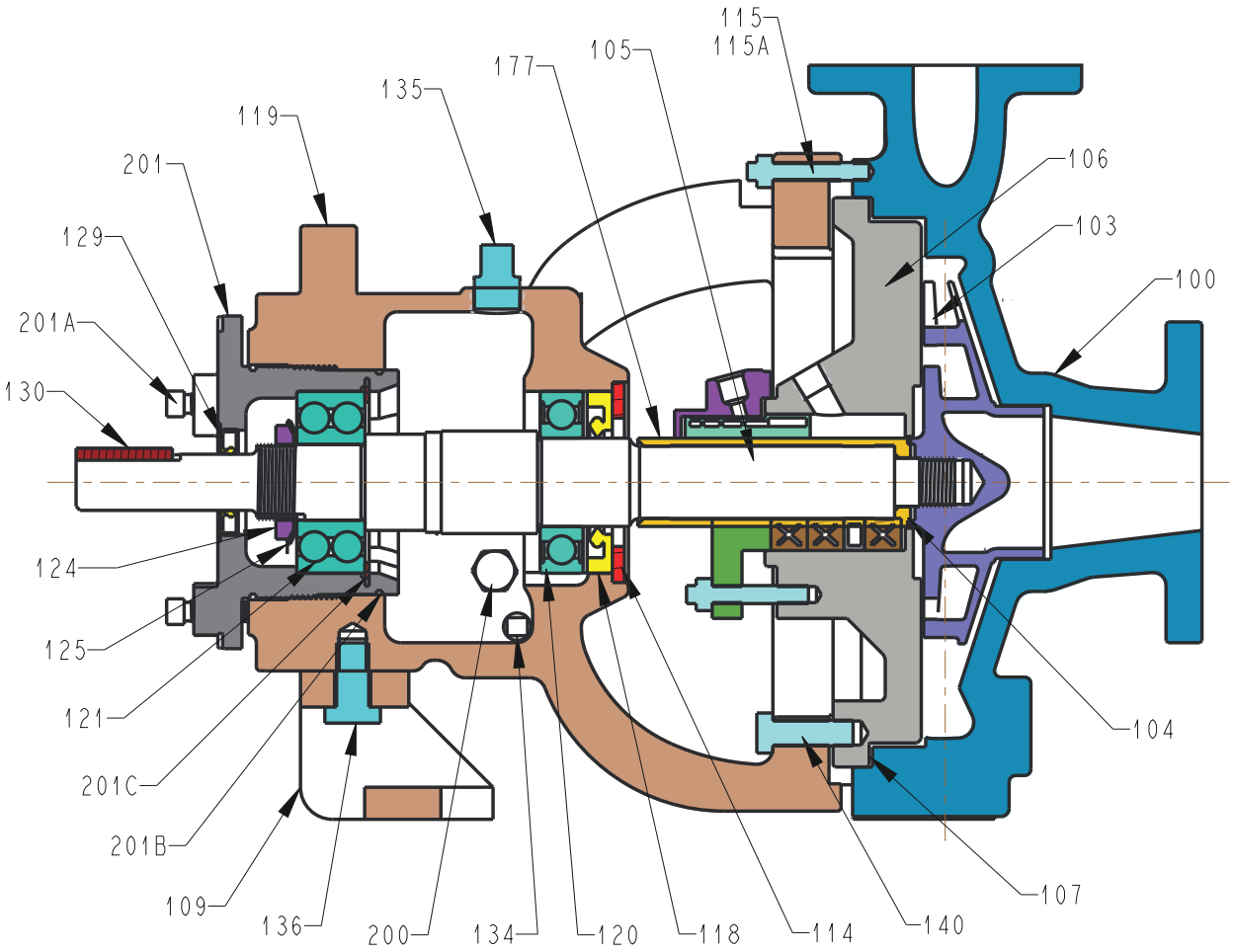


Table 8: Group 1 Parts List

Item #	Description	Item #	Description	Item #	Description
100	Casing	121	Bearing (Outboard)	200	Sight Gauge 1" NPT
103	Impeller - Reverse Vane	124	Locknut (Bearing)	201	Bearing Carrier
104	Gasket - Impeller Groove	125	Lockwasher (Bearing)	201A	Set Screw (Bearing Carrier)
105	Shaft - standard	129	Labyrinth seal, OB	201B	O-Ring (Bearing Carrier)
106	Cover	130	Key (Shaft/Coupling)	201D	Clamp
107	Gasket - Casing/Cover	131	O-ring Adapter/Housing		
108	Adapter - Bearing Hsg	133	Oiler (not shown)		
109	Foot - Bearing Housing	134	Drain Plug - Housing		
114	Deflector - Inboard	135	Filler Plug - housing		
115	Fastener - Casing	136	Fastener - Foot Bearing Hsg		
115A	Nut - Casing	139	Fastener - Adapter Housing		
118	Labyrinth seal (Inboard)	140	Fastener - Cover/Adapter		
119	Bearing Housing	172	Nipple - Oiler (not shown)		
120	Bearing (Inboard)	177	HookSleeve		

9.2 PC3 Group 2 and 3

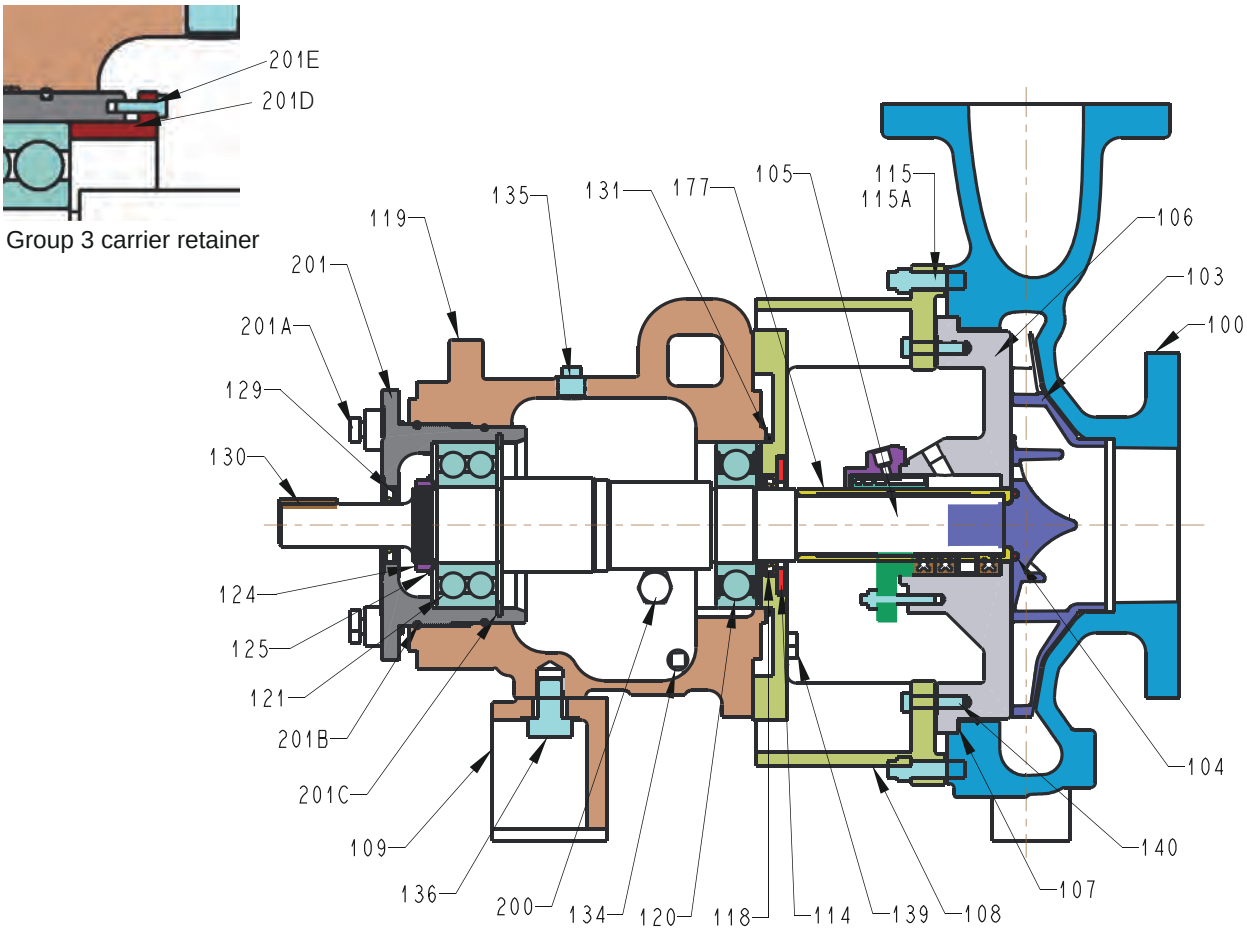


Table 9: Group 2 and 3 Parts List

Item #	Description	Item #	Description	Item #	Description
100	Casing	124	Locknut (Bearing)	201A	Set Screw (Bearing Carrier)
103	Impeller - Reverse Vane	125	Lockwasher (Bearing)	201B	O-Ring (Bearing Carrier)
104	Gasket - Impeller Groove	129	Labyrinth seal, OB	201C	Retainer - Bearing Carrier
105	Shaft - standard	130	Key (Shaft/Coupling)	201D	Clamp
106	Cover	131	O-ring Adapter/Housing	201E	Fastener - Clamp
107	Gasket - Casing/Cover	133	Oiler (not shown)		
108	Adapter - Bearing Hsg	134	Drain Plug - Housing		
109	Foot - Bearing Housing	135	Filler Plug - housing		
114	Deflector - Inboard	136	Fastener - Foot Bearing Hsg		
115	Fastener - Casing	139	Fastener - Adapter Housing		
115A	Nut - Casing	140	Fastener - Cover/Adapter		
118	Labyrinth seal (Inboard)	172	Nipple - Oiler (not shown)		
119	Bearing Housing	177	Hook Sleeve		
120	Bearing (Inboard)	200	Sight Gauge 1" NPT		
121	Bearing (Outboard)	201	Bearing Carrier		

9.3 Recommended spare parts

Please consult your local ITT ProCast Pump Distributor for ordering replacement parts. Reference the cross-section views in 9.1 PC3 Group 1 on page 70, 9.2 PC3 Group 2 and 3 on page 71, and the price catalog when placing an order to ITT ProCast. State the part number and description on the purchase order.

Table 10: Group 1 Parts List

Item #	Description	Item #	Description	Item #	Description
101	Impeller	184	Rear Cover Plate	408	Drain Plug
105	Lantern Ring	250	Gland (Mechanical Seal)	412A	Gasket (Impeller)
106	Packing	250A	Gasket (Gland)	496	O-Ring (Bearing Carrier)
107	Gland (Packing)	351	Gasket (Rear Cover)	502	Bearing (Outboard)
122	Shaft	382	Lockwasher (Bearing)	503	Bearing (Inboard)
126	Sleeve	383	Mechanical Seal	506	Retainer
136	Locknut (Bearing)	400	Key (Shaft/Coupling)		

Table 11: Group 2 Parts List

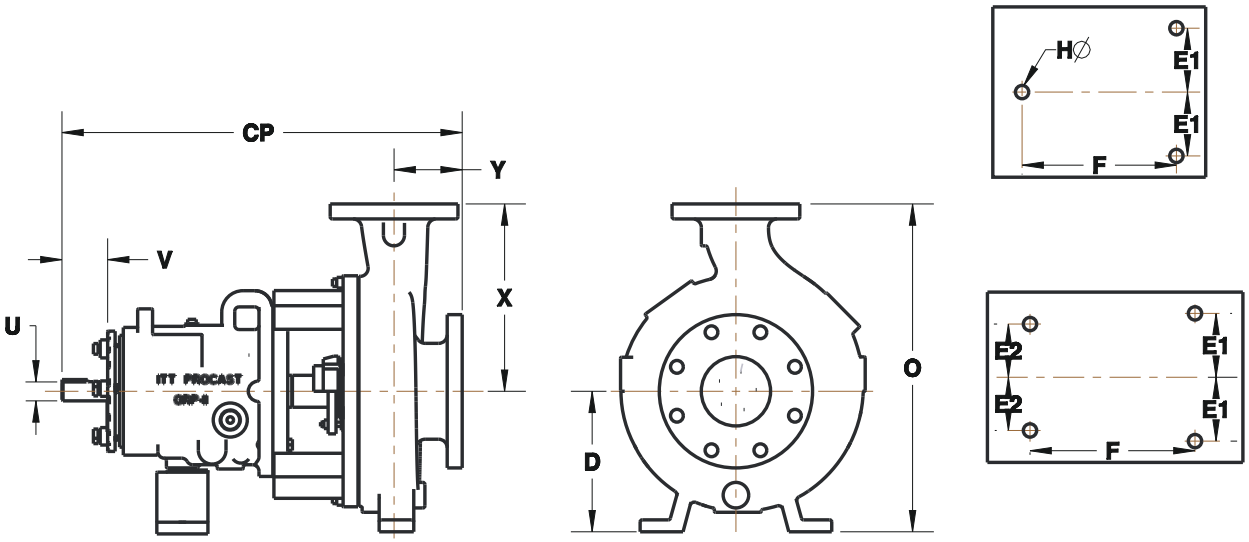
Item #	Description	Item #	Description	Item #	Description
101	Impeller	184	Rear Cover Plate	496	O-Ring (Bearing Carrier)
105	Lantern Ring	250	Gland (Mechanical Seal)	502	Bearing (Outboard)
106	Packing	250A	Gasket (Gland)	503	Bearing (Inboard)
107	Gland (Packing)	351	Gasket (Rear Cover)	506	Retainer
122	Shaft	382	Lockwasher (Bearing)		
126	Sleeve	383	Mechanical Seal		
136	Locknut (Bearing)	412A	Gasket (Impeller)		

Table 12: Group 3 Parts List

Item #	Description	Item #	Description	Item #	Description
101	Impeller	136	Locknut (Bearing)	382	Lockwasher (Bearing)
105	Lantern Ring	184	Rear Cover Plate	383	Mechanical Seal
106	Packing	250	Gland (Mechanical Seal)	412A	Gasket (Impeller)
107	Gland (Packing)	250A	Gasket (Gland)	496	O-Ring (Bearing Carrier)
122	Shaft	351	Gasket (Rear Cover)	502	Bearing (Outboard)
126	Sleeve	360Q	O-Ring (Adapter)	503	Bearing (Inboard)

10 Dimensional Drawing

10.1 Dimensional Data



Pump	Size	ANSI	X	D	B	CP	Foot Pattern				Shaft			Pump Wt.
							E1	E2	F	H	U	KWY	V	
Group 1	1.5x1-6	AA	6 1/2	5 1/4	4	17 1/2	3	0	7 1/4	5/8	7/8	3/16x3/32	2	100
	3x1.5-6	AB												110
	3x2-6	AC												115
	1.5x1-8	AA												100
Group 2	3x1.5-8	AB	7 1/2	7	4	23 1/2	4 7/8	3 5/8	12 1/2	5/8	1 1/8	1/4x1/8	2 5/8	125
	3x2-8	A60	9 1/2	8 1/4	4									200
	4x3-8	A70	11											230
	2x1-10A	A05	8 1/2											210
	3x1.5-10A	A50	8 1/2											220
	3x2-10A	A60	9 1/2											225
	4x3-10	A70	11											225
	4x3-10H	A40	12 1/2	10	4	23 1/2	4 7/8	3 5/8	12 1/2	5/8	1 1/8	1/4x1/8	2 5/8	250
	6x4-10*	A80	13 1/2	10	4	23 1/2	4 7/8	3 5/8	12 1/2	5/8	1 1/8	1/4x1/8	2 5/8	290
	6x4-10H	A80	13 1/2											330
	3x1.5-14	A20	10 1/2	10	4	23 1/2	4 7/8	3 5/8	12 1/2	5/8	1 1/8	1/4x1/8	2 5/8	250
	3x2-13	A30	11 1/2											260
	4x3-13**	A40	12 1/2											280
	4x3-13HH	A40	12 1/2											280
	6x4-13A	A80	13 1/2											325
Group 3	8x6-14A	A90	16	14 1/2	6	33 7/8	8	4 1/2	18 3/4	7/8	2 3/8	5/8x5/16	4	680
	10x8-14	A100	18											900
	6x4-16		16											640
	10x8-16	A120	A120											920
	10x8-16H	A120	A120											990

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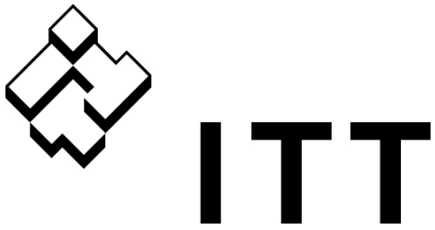

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