PRO Pump
And Equipment

Installation, Operation, and Maintenance Manual

Models 3180, 3181, 3185, and 3186

Table of Contents

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 ITT 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 are described in the supplier's applicable documentation.

1.2 Safety

WARNING:

- 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 ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.
- 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.

- 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.
- 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.
- 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.
- Never operate the pump with the suction valve closed.
- 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.
- 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.

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 ITT representative.
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

Hazard level	Indication
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 the equipment is properly insulated when it operates at extreme temperatures.
- Recognize the site emergency exits, eye wash stations, emergency showers and toilets.
- Allow all system and pump components to cool before you handle them.
- 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.
- Make sure that the product is thoroughly clean.
- Make sure that there are no poisonous gases within the work area.
- Make sure that you have quick access to a first-aid kit.
- Disconnect and lock out power before servicing.
- 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.
- Never operate a pump without a properly installed coupling guard.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.
- Never heat the condition monitor to temperatures in excess of 300°F (149°C).
- Never expose the condition monitor to open flames.
- Do not use the condition monitor in atmospheres containing acetic acid.
- Always wear protective gloves. The pump and condition monitor can be hot.

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.

1.3 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 an ITT 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 Goulds Pumps 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.

1.4 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.gouldspumps.com/en-US/Tools-and-Resources/Literature/IOMs/ 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.

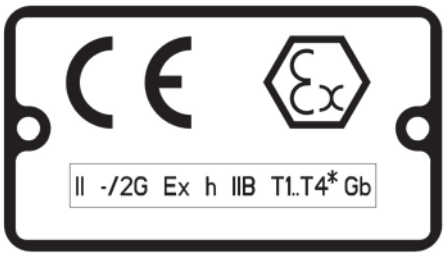


Figure 1: Typical Ex nameplate

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
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 13 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

Recommended bearing replacement interval (based on L10 life) = 17,520 hours of operation.

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

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 a Goulds 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. This includes ensuring that the PFA lined pumps (Model 3198), ETFE lined pumps (Model 3298, SP3298, V3298, E3198, CV3198), and the non-metallic liquid end pumps (Model NM3196) are pumping fluids that are conductive. If not, a static electric discharge may occur when the pump is drained and disassembled for maintenance purposes.
- 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.
- The impeller and wear ring clearance setting procedures 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 machine 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 Precautions

WARNING:

- Stay clear of suspended loads.
- Observe accident prevention regulations in force.

2.2.2 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.

2.2.3 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	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.
A base-mounted pump with baseplate lifting lugs	Use slings through clevises attached to baseplate lifting lugs

Examples

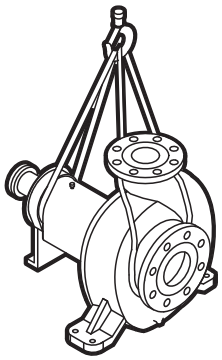


Figure 3: Example of a proper lifting method - centerline discharge

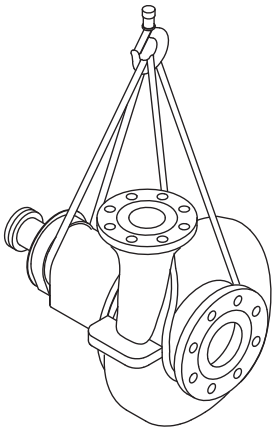


Figure 4: Example of a proper lifting method - tangential discharge

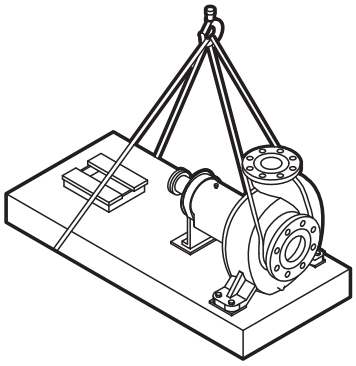


Figure 5: Example of a proper lifting method

NOTICE:
Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

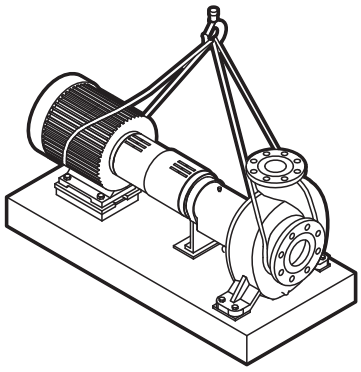


Figure 6: Example of a proper lifting method

NOTICE:
Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

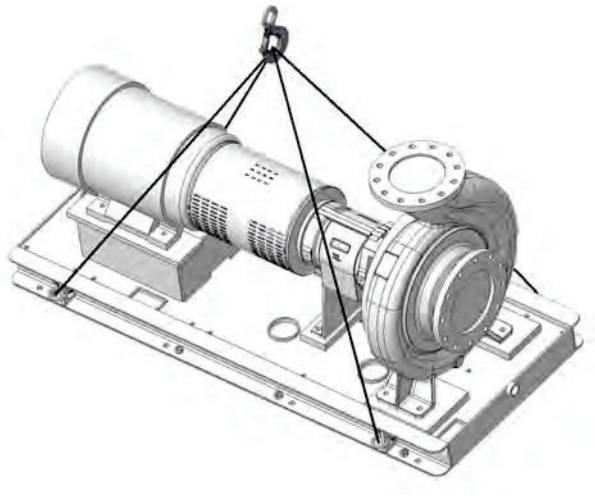


Figure 7: Example of a proper lifting method

2.3 Storage guidelines

2.3.1 Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

- Protect the product against humidity, heat sources, and mechanical damage.
- Do not place heavy weights on the packed product.

2.3.2 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. • Store the unit free from dirt and vibrations.
Long-term (more than six months)	• Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations. • Rotate the shaft by hand several times at least every three months.

NOTICE:
Risk of damage to the mechanical seal or shaft sleeve on units supplied with cartridge mechanical seals. Make sure to install and tighten the centering clips and loosen the set screws in the seal locking ring.

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

You can purchase long-term storage treatment with the initial unit order or you can purchase it and apply it after the units are already in the field. Contact your local ITT sales representative.

2.3.3 Frostproofing

This table shows to what degree the pump is frostproof:

When the pump is...	Then...
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.
Sitting idle	The pump might freeze.

3 Product Description

3.1 General description

The 3180 models are horizontal, end-suction, centrifugal pumps designed for heavy-duty process applications.

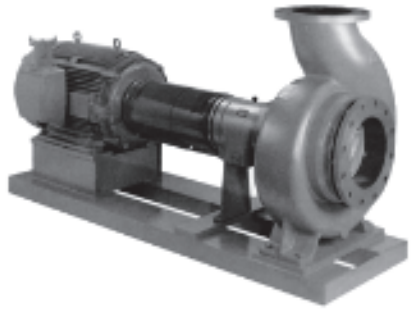


Figure 8: Model of 3180 and 3185

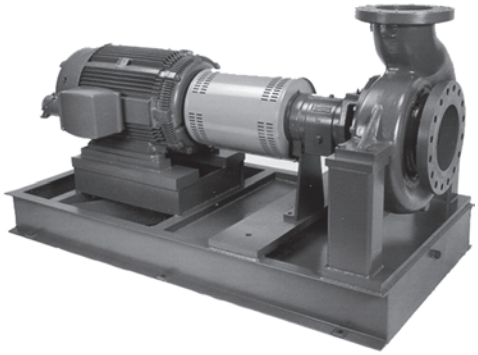


Figure 9: Model of 3181 and 3186

3.1.1 Part description

Casing

Feature	Description
Discharge	On majority of sizes, discharge has top centerline for ease in handling air-entrained liquids. Select sizes have tangential discharge with tapped vent plug for venting prior to startup.
Gasket	The gasket is fully confined between the casing and the stuffing box cover and is composed of this material: • 3180 and 3185: aramid fiber • 3181 and 3186: spiral-wound metallic
Mounting method	• 3180 and 3185: foot mount • 3181 and 3186: centerline mount

Feature	Description
Flange drilling	For the S, M, L, and XL groups, the flange drilling meets these standards: • 3180: ANSI class 125/150 • 3181: ANSI class 300 • 3185: ISO or JIS 16 bar • 3186: ISO NP40 or JIS 40K For the XL1, XL2-S, and XL2 groups, the flange drilling is ANSI class 150.

Impeller

Impeller option	Description
Open with suction sideplate	• Provided as standard with models 3180 and 3185 (except on noted sizes) • Provided as optional with models 3181 and 3186 • Not available on XL1 sizes 14x16-27, 24x24-27, 20x24-29, 28x24-29E, all XL2-S sizes, and all XL2 sizes • Is fully open, end-suction type • Contains Francis or radial design inlet • Constructed with large balance holes and back pump-out vanes that reduce stuffing box pressure and axial thrust • Keyed to the shaft and held in position by an impeller nut • Sealed on the nut and sleeve side by a PTFE O-ring for a dry shaft design • Handles the tough paper stock and process services The suction sideplate has these benefits: • Protects against casing wear • Removed easily • Secured to the casing with corrosion-resistant studs and capnuts • Sealed with a gasket and/or O-ring (not applicable to all sizes)
Enclosed with wear rings	• Standard with the 3181 and 3186 • Standard on XL1 sizes 14x16-27, 24x24-27, 20x24-29, 28x24-29E, all XL2-S sizes, and all XL2 sizes • Optional with selected sizes of the S, M, L, and XL 3180 and 3185 • Uses replaceable impeller wear ring and casing wear ring • Wear ring configuration allows for axial impeller adjustment to renew and maintain proper wear ring clearances • Can handle fine solids
Shearpeller™ with suction sideplate	• Provided as optional with eight sizes of models for 3180 and 3185 • Is fully open, end-suction type • Constructed with radial design inlet • Has scalloped shroud and back pump-out vanes that reduce axial thrust • Can handle the tough recycle mill applications • Can handle long, stringy solids without plugging or clogging

Stuffing box cover/seal chamber

The cover functions both as a way to seal the chamber and as a replaceable wear part. It is secured with a series of clamping lugs at the outside diameter of models 3180 and 3185, and it is through-bolted with capscrews on models 3181 and 3186. XL1, XL1-S1, XL1-S2, XL2-S, and XL2 sizes are through-bolted using a frame adapter to secure the stuffing box cover or seal chamber.

The table below shows the four available design options:

Seal chamber option	Description
Packed box	• Uses five rings of 1/2 in. (12.5 mm) packing, plus a lantern ring • Has a single flush connection at the lantern ring • Has an optional second connection at the lantern ring and the stuffing box throat • Has a plain split gland • Has a throat bushing
TaperBore™ PLUS	• Used with mechanical seals • Uses an optional Vane Particle Ejector (VPE) ring for increased seal life
TaperBore™ PLUS with packing conversion sleeve	• Only used with the 3181 and 3186 • Used with packing during startup, then converted to mechanical seal
Dynamic seal	• Only used with the S, M, L, and XL 3180 and 3185 • Not available on XL1, XL1-S1, XL1-S2, XL2-S and XL2 sizes • Used for tough applications where conventional mechanical seals or packing require outside flush • Contains a repeller mounted between the impeller and stuffing box cover to pump the liquid out of the stuffing box while the pump is running • Provides a static seal to prevent pumped fluid from leaking when the pump is shut down

Power end

Part	Description
Bearing frame and housing	For the S, M, L, and XL groups: • The bearing frame and housing are constructed of cast iron. • The frame is bolted and rabbeted to the stuffing box cover. • The frame is sealed with labyrinth seals. • No special parts are required to convert from grease to oil lubrication. • The bearing frame cooling can be supplied as an option with oil lubrication. • The bearing locknut and coupling extension are dimensioned in inches for models 3180 and in millimeters for models 3185 and 3186. For the XL1, XL1-S1, XL1-S2, XL2-S and XL2 groups: • The bearing frame and housing are constructed of cast iron. • The frame is bolted and rabbeted to the frame adapter. • The frame is sealed with labyrinth seals. • Bearing frame cooling is not available. • The bearing locknut is in millimeters. • The coupling extension is in inches.

Part	Description
Shaft sleeve	For the S, M, L, and XL groups: • The shaft sleeve is a renewable hook type, positively driven by the impeller key. • One end is free to expand with possible temperature variations. • A PTFE O-ring prevents leaks under the sleeve. • The sleeve is dimensioned in inches for models 3180 and 3181 and in millimeters for models 3185 and 3186. For the XL1, XL1-S1, XL1-S2, XL2-S and XL2 groups: • The shaft sleeve is a renewable hook type, positively driven by the impeller key. • One end is free to expand with possible temperature variations. • A PTFE O-ring prevents leaks under the sleeve. • The packing sleeve is dimensioned in millimeters, and the mechanical seal sleeve is dimensioned in inches.
Bearings	• The inboard bearing carries only radial loads. • The inboard bearing is free to float axially in the frame. • The outboard bearings are a 40° angular-contact, duplex set, mounted back-to-back. • The outboard bearings carry both radial and axial loads. • The outboard bearings are locked onto the shaft by a threaded locknut.

Direction of rotation

The direction of rotation is clockwise (right hand) when viewed from the driver end.

ISO 2858 conformance

The Models 3185 and 3186 conform to the ISO 2858 Standard where applicable. The ISO standard allows for 125 mm flanges, which are nominal 5 in. flanges. Because ANSI standards no longer permit 5 in. flanges, they are not used on models 3185 and 3186.

3.2 General description i-ALERT® Equipment Health Monitor

Description

The i-ALERT® Equipment Health Monitor is a compact, battery-operated monitoring device that continuously measures the vibration and temperature of the pump power end. The i-ALERT® sensor uses blinking LED and wireless notification to alert the pump operator when the pump exceeds vibration and temperature limits. This allows the pump operator to make changes to the process or the pump before a catastrophic failure occurs. The i-ALERT® monitor allows customers to identify potential problems before they become costly failures. It tracks vibration, temperature, change in electromagnetic field and run-time hours and wirelessly syncs the data with the i-ALERT Gateway or with a smart phone or tablet using i-ALERT® mobile app.

More information available on https://www.i-alert.com/products/

Current IOMs are available at http://www.gouldspumps.com/en-us/tools-and-resources/literature/ - and - resources/literature/ IOMs, https://www.i-alert.com/ or your local ITT Goulds Pumps Sales Rep.

Alarm mode

The condition monitor enters alarm mode when either vibration or temperature limits are exceeded over two consecutive readings within a user defined period. Alarm mode is indicated with red flashing LED.

Table 3: Temperature and vibration limits

Variable	Limit
Temperature	100°C | 195°F Surface Temperature
Vibration	100% increase over the baseline level

Battery life

The i-ALERT® Condition Monitor battery is replaceable.

The battery life is not covered as part of the standard pump warranty.

This table shows the average condition monitor battery life under normal and alarm-mode operating conditions.

Condition monitor operational state	Battery life
Normal operating and environmental conditions	Three to five years
Alarm mode	One year

3.3 Nameplate information

Important information for ordering

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

When you order spare parts, identify this pump information:

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

Item numbers can be found in the spare parts list.

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

Nameplate on the pump casing using English units

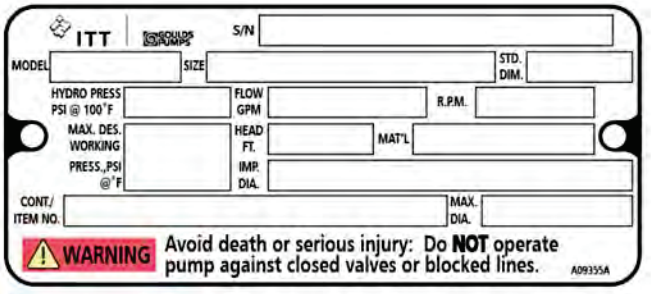


Figure 10: Nameplate on the pump casing using English units

Table 4: Explanation of nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute

Nameplate field	Explanation
FT HD	Rated pump head, in feet
RPM	Rated pump speed, revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	Does not apply
MAT L. CONST.	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX DSGN PSI @ 100ºF	Maximum pressure at 100º F according to the pump design

Nameplate on the pump casing using metric units

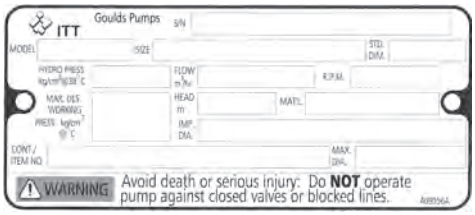


Figure 11: Metric units - nameplate on pump casing

Table 5: Explanation of the nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter
MAX. DIA.	Maximum impeller diameter
M^3/HR	Rated pump flow, in cubic meters per hour
M HD	Rated pump head, in meters
RPM	Rated pump speed, in revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	Does not apply
MAT L. CONST	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX. DSGN KG/CM^2@20 °C	Kilograms per square centimeter at 20°C

Nameplate on the bearing frame

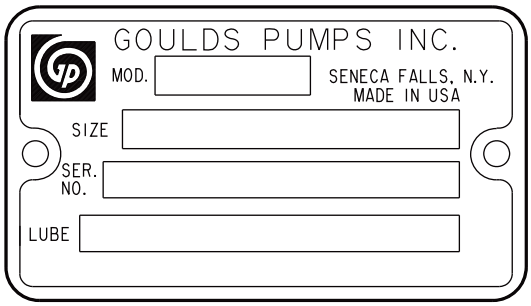


Figure 12: Nameplate on the bearing frame

Table 6: Explanation of the nameplate on the bearing frame

Nameplate field	Explanation
BRG. O. B.	Outboard bearing designation
BRG. I. B.	Inboard bearing designation
S/N	Serial number of the pump
LUBE	Lubricant, oil or grease

Ex nameplate

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 baseplate on which it is mounted. A typical tag would look like this:

Figure 13: Typical Ex nameplate

Figure 14: Typical UKCA Ex nameplate

Refer to Table 1: Temperature class definitions on page 13 for pumpage temperature restrictions.

The code classification marked on the equipment should be in accordance with the specified area where the equipment will be installed. If it is not, please contact your ITT/Goulds representative before proceeding.

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.

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

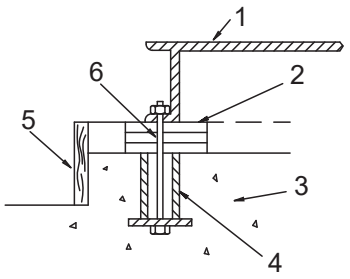
Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
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 complete pump, baseplate, and drive assembly.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.

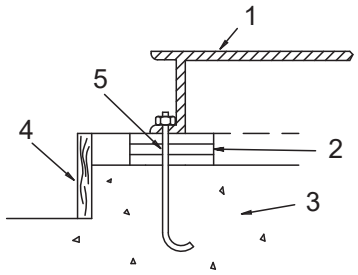
Sleeve-type bolts



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

Figure 15: Sleeve type bolts

J-type bolts



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

Figure 16: J-type bolts

4.2 Baseplate-mounting procedures

4.2.1 Prepare the baseplate for mounting

This procedure assumes you have a basic knowledge of baseplate and foundation design and installation methods. Follow industry standard procedures, such as PIP REIE 686/API RP686, and all grout manufacturers recommendations before grouting the baseplate.

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.

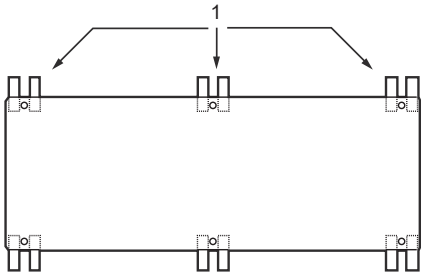
4.2.2 Install the baseplate using shims or wedges

Required tools:

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

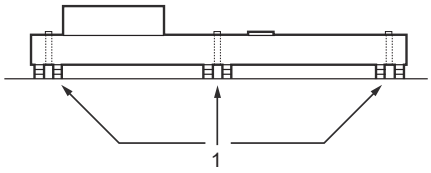
This procedure is applicable to cast iron and fabricated steel baseplates.

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 17: Top view



1. Shims or wedges

Figure 18: 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 4.2.5 Baseplate-leveling worksheet on page 39 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
- 4.2.5 Baseplate-leveling worksheet on page 39

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

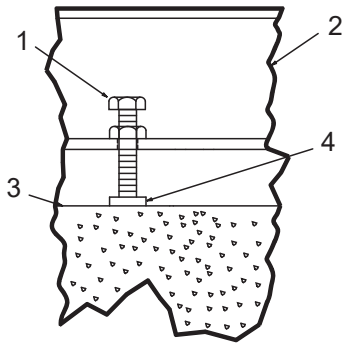
1. Apply an anti-seize compound on the jackscrews.
   The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:

   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 19: 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.

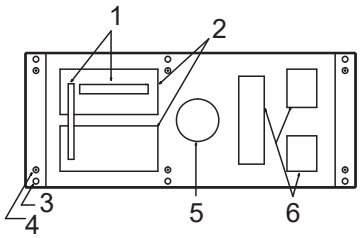
a) Put one machinist's level lengthwise on one of the two pads.

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 20: 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:

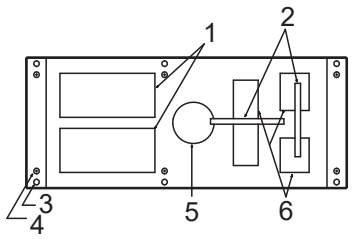
Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

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 21: 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 Spring mounted installation

WARNING:

Springs can store energy that can launch parts at a high velocity. Before you perform any tasks, make sure that all springs are positively locked against free expansion.

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.

Determine which spring-mounted baseplate you are working with:

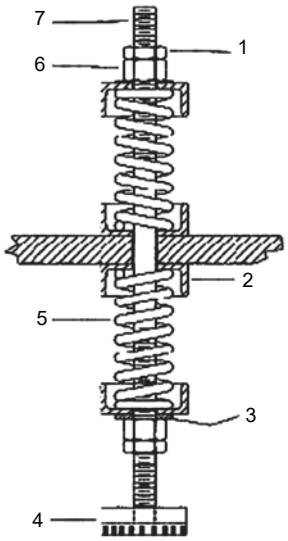
If...	Then...
The springs are of equal lengths with some mounted above the baseplate and some mounted below the baseplate.	Complete the steps in Install the baseplate using spring mounting (first generation).
The springs are of different lengths and mounted below the baseplate.	Complete the steps in Install the baseplate using spring mounting (second generation).

4.2.4.1 Install the baseplate using spring mounting (first generation)

Check these items before you start this procedure:

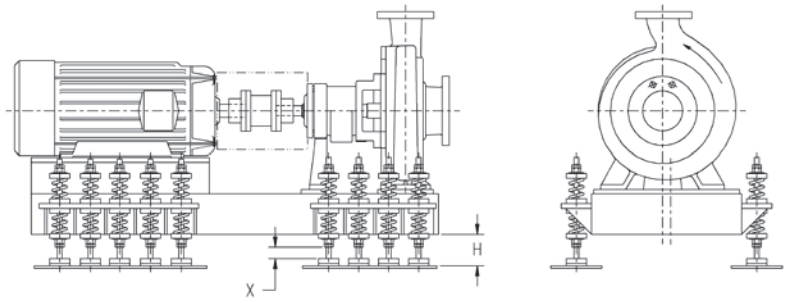
- All springs in the first-generation spring-mounted baseplate are identical and have the same spring constant.
- The foundation pads are not provided with the baseplate. Make sure that the foundation pads are 316 stainless steel plates, which have a 63 to 125 micro-inch surface finish.
- Make sure that the foundation pads are correctly installed on the foundation/floor. See the instructions from the manufacturer.

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. Assemble the spring assemblies:
   a) Set a hex jam nut and a hex nut on a spring stud to the height of 2.00 in. (5.00 cm).
   b) Install a bearing pad on the stud.
   c) Hand-tighten the stud to the bearing pad.
   d) Set the bottom adjusting nuts on the stud to the height (X) indicated on the certified GA dimension drawing.
   e) Install a flat washer on the stud.
   f) Install a spring follower on the stud with the flat bottom facing downward.
   g) Install a spring on the stud.
   h) Install another spring follower with the flat bottom facing upward.
   i) Install this subassembly from under the baseplate, pushing the stud up through the mounting bracket.
   j) Install a spring follower on the stud with the flat bottom facing downward.
   k) Install another spring on the stud.
   l) Install a spring follower with the flat bottom facing upward.
   m) Install a flat washer on the stud.
   n) Install a hex nut and a hex jam nut on the stud.



1. Hex jam nut
2. Follower
3. Flat washer
4. Bearing assembly
5. Spring
6. Hex nut
7. Stud

3. Repeat step 2 for each spring assembly.
4. Lower the baseplate so that the spring assemblies fit into the foundation pads.
5. Level the baseplate and make the final height adjustments:
   a) Loosen the upper hex jam nuts and hex nuts.
   b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
   c) When the baseplate is level, tighten the upper hex nuts so that the upper springs are not loose in the spring followers.
6. Fasten the lower and upper jam nuts on each spring assembly.



4.2.4.2 Install the baseplate using spring mounting (second generation)

Check these items before you start this procedure:

- The foundation pads are not provided with the baseplate. Make sure that the foundation pads are 316 stainless steel plates, which have a 63 to 125 micro-inch surface finish.
- Make sure that the foundation pads are correctly installed on the foundation/floor. See the instructions from the manufacturer.

The springs in the second-generation spring-mounted baseplate are supplied in two sizes:

Free length of spring	Spring rate	Location	Length of stud used with the spring
7.125 in. (181 mm)	885 lbs/in.(149.72 newtons/mm)	Mounted under the base-plate below the pump	16 in. (406 mm)
11 in. (280 mm)	176 lbs/in.(30.82 newtons/mm)	Mounted under the base-plate below the motor	22 in. (559 mm)

1. Put the baseplate on a support above the foundation/floor.
   Make sure that there is approximately 16 in. (406 mm) between the baseplate and the foundation/floor in order to provide enough space to install the spring assemblies.
2. Apply an anti-galling compound to the threads of the studs, nuts, and bearing pads.
3. Assemble the spring assemblies:

   a) Set a hex nut and a hex jam nut on a spring stud and thread it down 1 in. (25 mm).

   b) Insert the stud from the top of the mounting bracket on the baseplate.
   Refer to the GA outline dimension drawing in order to determine the correct length of the studs for each location.

   c) Install a follower with the flat side facing up.

   d) Install a spring.
   Refer to the GA outline dimension drawing in order to determine the correct spring for each location.

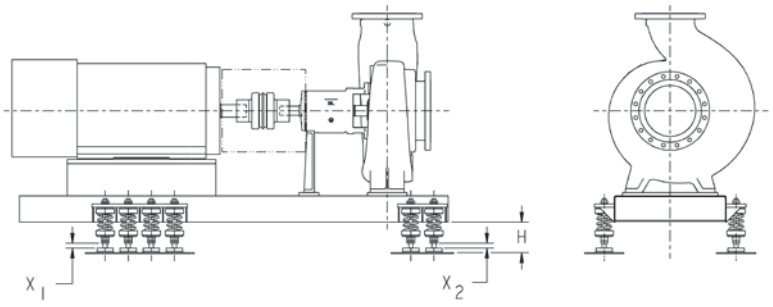
   e) Install a follower with the flat side facing down.

   f) Install a flat washer, a hex nut, and a hex jam nut and thread them up 2 in. (54 mm).

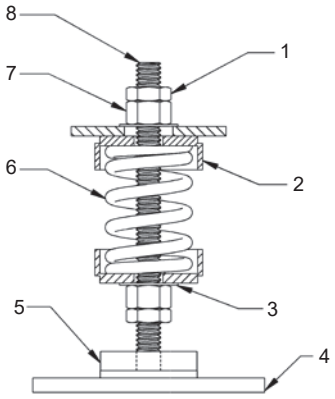
   g) Install a bearing pad on the lower end of the stud.

   h) Hand-tighten the stud to the bearing pad.
   The depth of the thread in the bearing pad is 1 in. (25 mm).

   i) Set the bottom adjusting nuts on the stud to the heights (X1 and X2) indicated on the certified GA dimension drawing.
   Adjust distances by moving the hex nut and the hex jam nut up or down.



4. Repeat step 3 for each stud and spring assembly.
5. Lower the baseplate so that the spring assemblies fit into the foundation pads.
   The weight of the baseplate compresses the springs, which leaves the upper nuts loose. You might have to level the baseplate by adjusting the X1 and X2 dimensions.

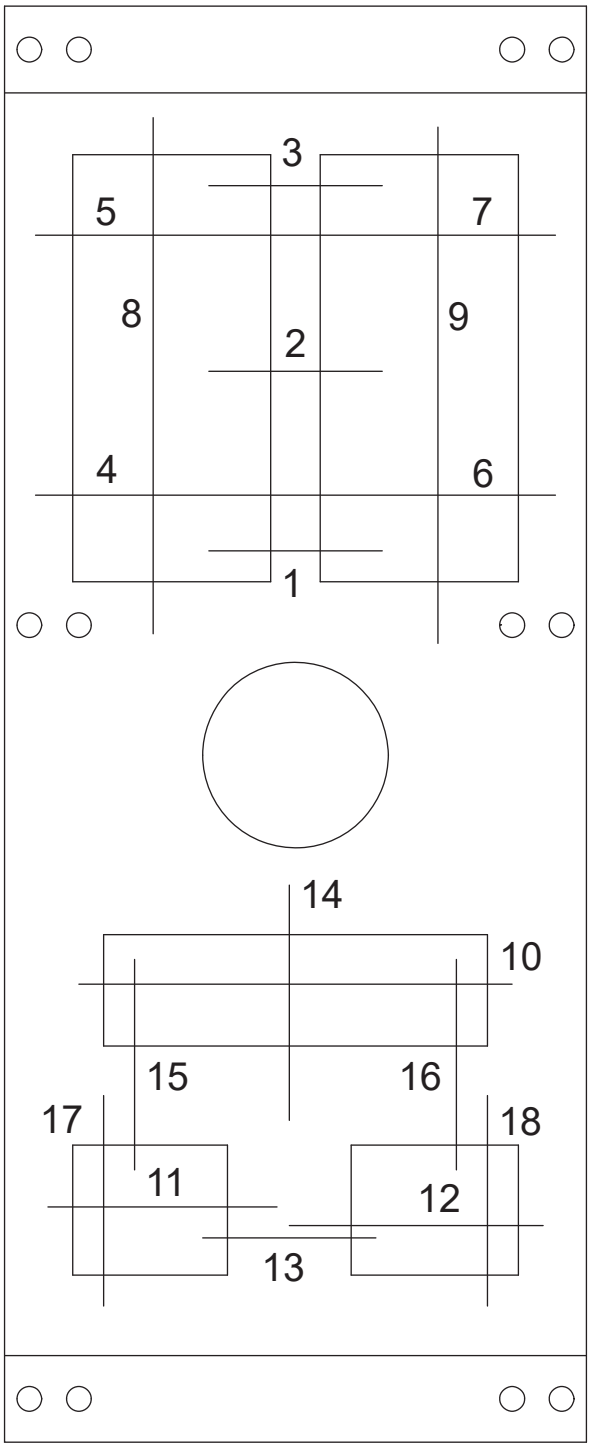


1. Hex jam nut
2. Follower
3. Flat washer
4. Foundation pad
5. Bearing assembly
6. Spring
7. Hex nut
8. Stud

6. Level the baseplate and make the final height adjustments:
   a) Keeping all upper nuts and jam nuts loose, adjust the X1 and X2 dimensions to adjust the level of the base.
   b) First adjust the X2 dimension to bring the centerline of the pump suction flange with the centerline of suction piping. Now level the baseplate by adjusting the X1 dimensions of the motor end springs.
   c) Once the baseplate is leveled, hand tighten the upper nut and fasten the hex jam nut against the upper hex nut. Repeat for each spring assembly.
   d) Fasten the lower hex jam nut against the lower hex nut on each spring assembly.
7. Fasten the lower and upper hex jam nuts against the hex nuts on each spring assembly.
8. Make notes of X1 and X2 dimensions in the GA dimension drawing for future reference.

4.2.5 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 Install the pump, driver, and coupling

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

4.4 Pump-to-driver alignment

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.

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

Final alignment (hot alignment) checks

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

When	Why
Periodically	This follows the plant operating procedures.

4.4.2 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 the total indicator runout is a maximum of 0.05 mm | 0.002 in. at operating temperature.

4.4.2.1 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 for model 3180 and 3185

Pumped fluid temperature	Recommended setting for driver shaft
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

4.4.3 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.

4.4.4 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.

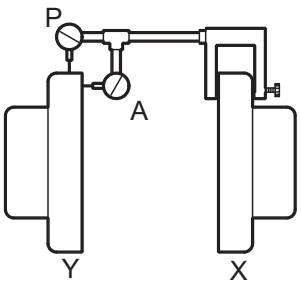


Figure 22: Dial indicator attachment

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.

4.4.5 Pump-to-driver alignment instructions

4.4.5.1 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.

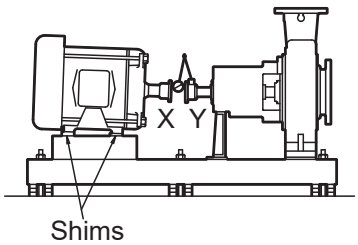


Figure 23: Side view of an incorrect vertical alignment

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

4.4.5.2 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.

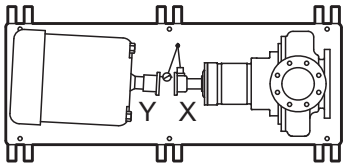


Figure 24: Top view of an incorrect horizontal alignment

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

   Maximum permitted value for angular alignment:

4.4.5.3 Perform parallel alignment for a vertical correction

Refer to the alignment table in "Permitted indicator values for alignment checks" (see Table of Contents for location of table) for the proper cold alignment value based on the motor temperature rise and the pump operating temperature.

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 4.4.2.1 Cold settings for parallel vertical alignment on page 41

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.

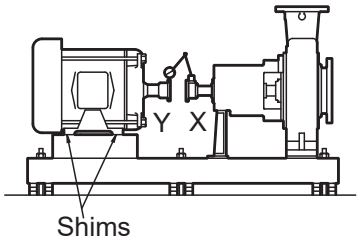


Figure 25: Side view of an incorrect vertical alignment

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.

4.4.5.4 Perform parallel alignment for a horizontal correction

Refer to the alignment table in "Permitted indicator values for alignment checks" (see Table of Contents for location of table) for the proper cold alignment value based on the motor temperature rise and the pump operating temperature.

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.

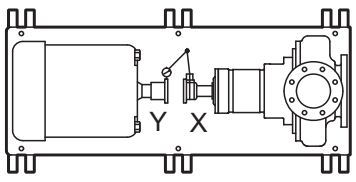


Figure 26: Top view of an incorrect horizontal alignment

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

4.4.5.5 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.

4.4.5.6 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.

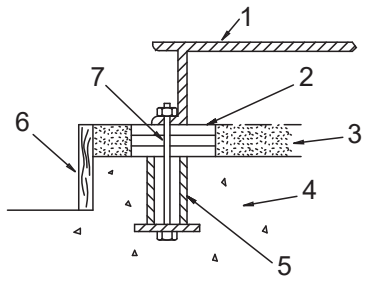
1. Set the angular and parallel dial indicators to zero at the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicators through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator readings.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

4.5 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.

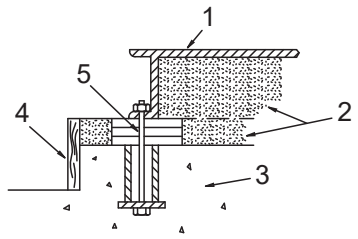
1. Clean all the areas of the baseplate that will come into contact with the grout.
2. Build a dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.
4. Pour grout through the grout hole into the baseplate up to the level of the dam.
   When you pour the 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 27: 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 28: Fill remainder of baseplate with grout

7. Tighten the foundation bolts.
8. Recheck the alignment.

4.6 Bypass-piping considerations

When to use a bypass line

Provide a bypass line for systems that require operation at reduced flows for prolonged periods. Connect a bypass line from the discharge side (before any valves) to the source of suction.

When to install a minimum-flow orifice

You can size and install a minimum-flow orifice in a bypass line in order to prevent bypassing excessive flows. Consult your ITT representative for assistance in sizing a minimum-flow orifice.

When a minimum-flow orifice is unavailable

Consider an automatic recirculation control valve or solenoid-operated valve if a constant bypass (minimum-flow orifice) is not possible.

4.7 Piping checklists

4.7.1 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.

CAUTION:
Do not move the pump to the pipe. This could make final alignment impossible.

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

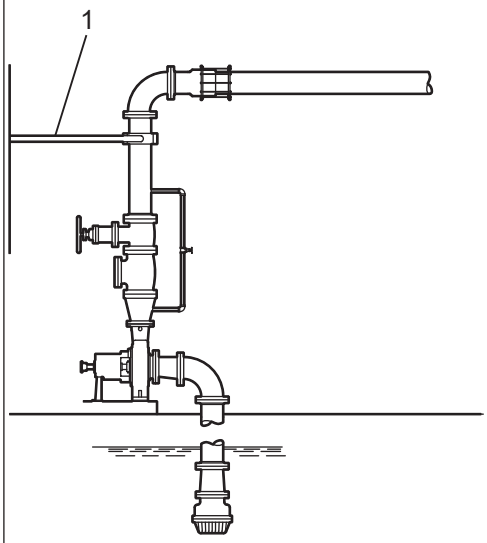
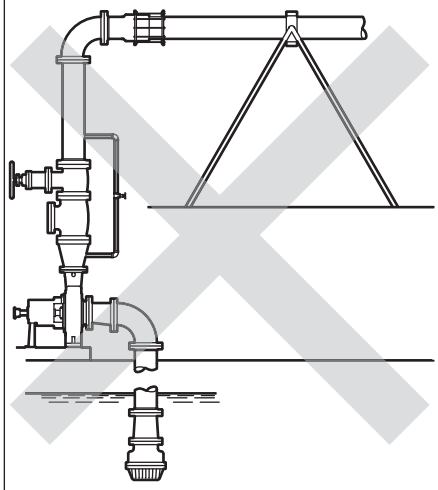
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

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	This helps to minimize friction losses.	

Check	Explanation/comment	Checked
45° or long radius 90° fittings where necessary.		
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. • 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.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
	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 the loads on the pump flanges exceed the limits described in the information provided with the order.		

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: 

4.7.2 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.

4.7.3 Suction-piping checklist

Performance curve reference

CAUTION:
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.

Suction-piping checks

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and closest flow disruption (elbow, valve, strainer, or expansion joint) 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	Explanation/comment	Checked
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. Suction pipe reducers should have no more than two pipe diameter changes per reducer.	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.	
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.	

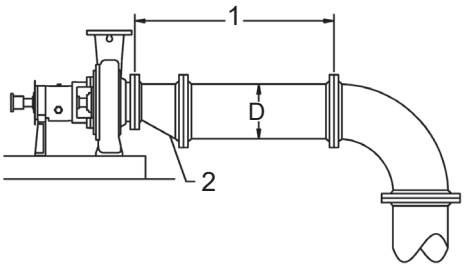
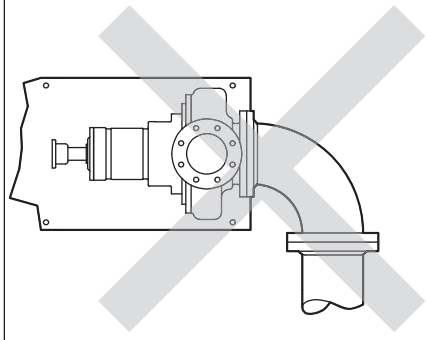
Liquid source below the pump

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.	

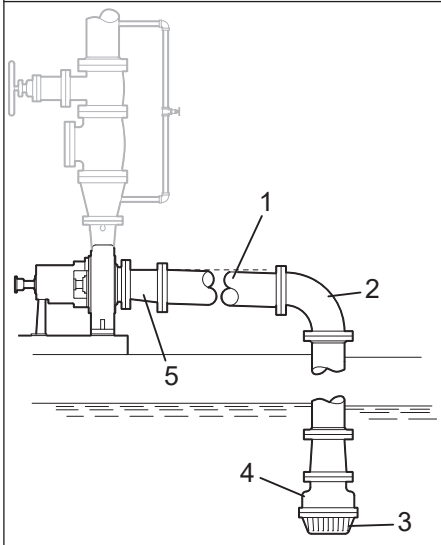
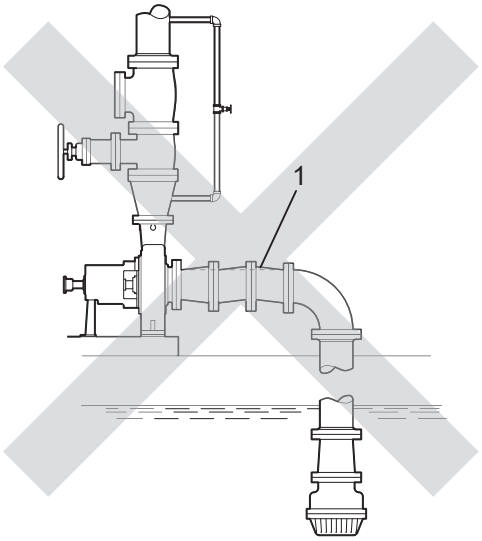
Liquid source above the pump

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 (or other flow disruption) close to the pump suction inlet

Correct	Incorrect
The correct distance between the inlet flange of the pump and the closest flow disruption (elbow, valve, strainer, or expansion joint) must be a least five pipe diameters.  **NOTICE:** This illustration shows a correctly installed elbow.	 **NOTICE:** This illustration shows an incorrectly installed elbow.

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 **NOTICE:** This illustration shows correctly installed equipment for the suction piping.	1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source **NOTICE:** This illustration shows incorrectly installed equipment for the suction piping.

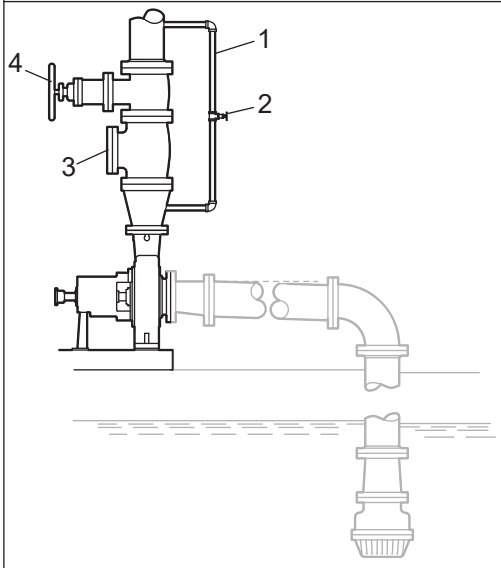
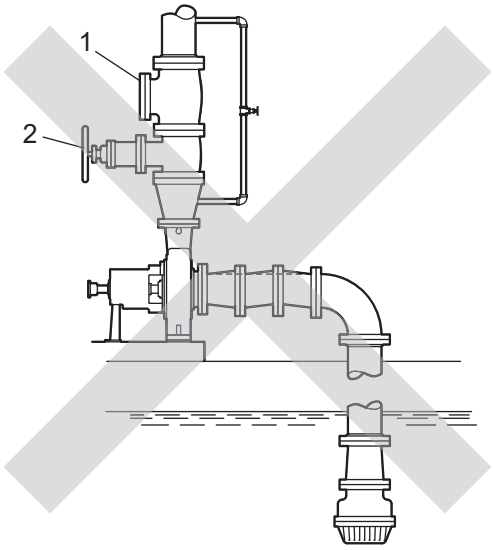
4.7.4 Discharge piping checklist

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	Explanation/comment	Checked
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.

4.7.5 Auxiliary-piping checklist

Precautions

NOTICE:

- Auxiliary cooling and flush systems must be operating properly to prevent excess heat generation, sparks, and/or premature failure. Ensure auxiliary piping is installed as specified on the pump data sheet prior to startup.

When to install

You may need to install auxiliary piping for bearing cooling, seal-chamber cover cooling, mechanical seal flush, or other special features supplied with the pump. Consult the pump data sheet for specific auxiliary piping recommendations.

Checklist

Check	Explanation/comment	Checked
Check that the minimum flow for each component is 4 lpm | 1 gpm. If the bearing and seal chamber cover cooling are provided, then the auxiliary piping must flow at 8 lpm | 2 gpm.	–	
Check that the cooling water pressure does not exceed 7.0 kg/cm^2 | 100 psig .	–	

4.7.6 Final piping checklist

Check	Explanation/comment	Checked
Check that the shaft rotates smoothly.	Rotate the shaft by hand. Make sure there is no rubbing that can lead to excess heat generation or sparks.	
Re-check the alignment to make sure that pipe strain has not caused any misalignment.	If pipe strain exists, then correct the piping.	

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:

- Foreign objects in the pumped liquid or piping system can block the flow and cause excess heat generation, sparks and premature failure. Make sure that the pump and systems are free of foreign objects before and during operation.
- If the pump does not prime properly, or loses prime during start-up, it should be shutdown and the condition corrected before the procedure is repeated.
-  A build-up of gases within the pump, sealing system, or process piping system may result in an explosive environment. Make sure the 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.
- 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.

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

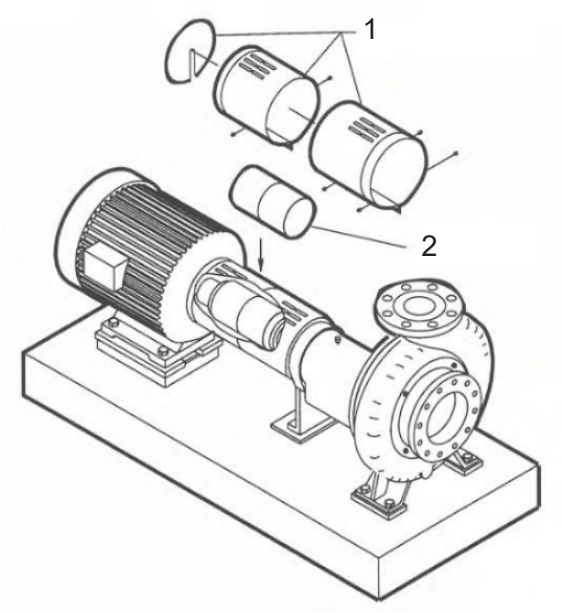
- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- If temperatures of the pumped fluid will exceed 93°C | 200°F, then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until 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.
- Bring variable-speed drivers to the rated speed as quickly as possible.

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 Remove the coupling guard

1. Remove the bolt from the u-nut located in the center slot of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.
3. Remove the bolt from the u-nut located on the driver half of the coupling guard.
4. Remove the driver half of the coupling guard:
    a) Slightly spread the bottom apart.
    b) Lift upwards.

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



Item	Description
1.	Coupling guard
2.	Coupling

5.3 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 bearing housing, or close-coupled frame.
6. Lock out power to the driver.

5.4 Impeller-clearance check

The impeller-clearance check ensures the following:

- The pump turns freely.
- The pump operates at optimal efficiency for long equipment life and low energy consumption.

5.4.1 Impeller axial clearances

Total axial adjustment

Open Impeller – The clearance between the front of the impeller and the suction sideplate should be set to the value shown in Table 7: Ambient Temperature Axial Clearance for the Open Impeller on page 58 for the appropriate cold temperature. The total axial adjustment of the impeller available between the suction sideplate and stuffing box cover is also shown in Table 7: Ambient Temperature Axial Clearance for the Open Impeller on page 58

Closed Impeller – The clearance between the front of the impeller and the should be set to the value shown in Table 8: Ambient Temperature Axial Clearance for the Closed Impeller on page 60 for the appropriate cold temperature. The total axial adjustment of the impeller available between the casing wear ring and stuffing box cover is also shown in Table 8: Ambient Temperature Axial Clearance for the Closed Impeller on page 60.

Ambient temperature axial clearance for the open and closed impeller

Table 7: Ambient Temperature Axial Clearance for the Open Impeller

Group	Size	Total Axial Adjustment				Cold Axial Front Clearance Setting - Open Impeller									
		Min.		Max.		122°F (50°C)		212°F (100°C)		302°F (150°C)		392°F (200°C)		446°F (230°C)	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
S	3X6-12	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	4X6-12	0.028	0.7	0.087	2.2										
	6X8-12	0.028	0.7	0.087	2.2										
	8X8-12	0.028	0.7	0.087	2.2										
	8X10-12E	0.033	0.8	0.094	2.4										
	3X6-14	0.028	0.7	0.087	2.2										
	4X6-14	0.028	0.7	0.087	2.2										
	3X6-16E	0.031	0.8	0.092	2.3										
	4X6-16	0.028	0.7	0.087	2.2										
	4X8-16E	0.053	1.3	0.114	2.9										
M	6X8-14	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	8X8-14	0.028	0.7	0.087	2.2										
	8X10-14E	0.031	0.8	0.092	2.3										
	10X10-14	0.028	0.7	0.087	2.2										
	10X12-14E	0.033	0.8	0.094	2.4										
	12X12-14	0.028	0.7	0.087	2.2										
	6X8-16	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	4X6-19	0.028	0.7	0.087	2.2										

Group	Size	Total Axial Adjustment				Cold Axial Front Clearance Setting - Open Impeller									
		Min.		Max.		122°F (50°C)		212°F (100°C)		302°F (150°C)		392°F (200°C)		446°F (230°C)	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
L	14X12-14E	0.036	0.9	0.089	2.3	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	6X10-16	0.028	0.7	0.087	2.2										
	6X10-16E	0.083	2.1	0.144	3.7										
	6X10-16AE	0.053	1.3	0.114	2.9										
	8X10-16	0.028	0.7	0.087	2.2										
	10X12-16	0.028	0.7	0.087	2.2										
	12X14-16E	0.054	1.4	0.115	2.9										
	14X14-16	0.028	0.7	0.087	2.2										
	14X14-16E	0.035	0.9	0.096	2.4										
	4X8-19	0.028	0.7	0.087	2.2										
	6X10-19	0.028	0.7	0.087	2.2										
	8X10-19	0.028	0.7	0.087	2.2										
	10X12-19	0.028	0.7	0.087	2.2										
	6X10-22	0.028	0.7	0.087	2.2										
	6X10-22E	0.083	2.1	0.144	3.7										
	8X10-22	0.028	0.7	0.087	2.2										
XL	10X16-19E	0.053	1.3	0.114	2.9	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	12X14-19	0.028	0.7	0.087	2.2										
	14X16-19E	0.083	2.1	0.144	3.7										
	16X16-19	0.028	0.7	0.087	2.2										
	18X16-19E	0.083	2.1	0.144	3.7										
	20X18-21E	0.052	1.3	0.113	2.9										
	8X12-22E	0.083	2.1	0.144	3.7										
	10X12-22	0.028	0.7	0.087	2.2										
	10X14-22AE	0.083	2.1	0.144	3.7										
	12X14-22	0.028	0.7	0.087	2.2										
	14X16-22	0.028	0.7	0.087	2.2										
	16X18-22E	0.03	0.8	0.091	2.3										
	18X18-22	0.028	0.7	0.087	2.2										
	6X10-25	0.028	0.7	0.087	2.2										
	6X10-25E	0.083	2.1	0.144	3.7										
	8X12-25	0.028	0.7	0.087	2.2										
	10X14-25	0.028	0.7	0.087	2.2										
	10X14-25E	0.093	2.4	0.154	3.9										
	10x16-25E	0.083	2.1	0.144	3.7										
	20X20-25	0.028	0.7	0.087	2.2										
XL1-S1	18X14-16E	0.047	1.2	0.108	2.7	0.02	0.51	0.023	0.58	0.025	0.64	0.027	0.69	0.031	0.79
XL1-S2	20X18-19E	0.072	1.8	0.133	3.4										
XL1	10X14-22E	0.135	3.4	0.188	4.8	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66

Table 8: Ambient Temperature Axial Clearance for the Closed Impeller

Group	Size	Total Axial Adjustment				Cold Axial Front Clearance Setting - Closed Impeller									
		Min.		Max.		122°F (50°C)		212°F (100°C)		302°F (150°C)		392°F (200°C)		446°F (230°C)	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
S	3X6-12	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	4X6-12	0.028	0.7	0.087	2.2										
	6X8-12	0.028	0.7	0.087	2.2										
	8X8-12	0.028	0.7	0.087	2.2										
	3X6-14	0.028	0.7	0.087	2.2										
	4X6-14	0.028	0.7	0.087	2.2										
	4X6-16	0.028	0.7	0.087	2.2										
M	6X8-14	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	8X8-14	0.028	0.7	0.087	2.2										
	10X10-14	0.028	0.7	0.087	2.2										
	12X12-14	0.028	0.7	0.087	2.2										
	6X8-16	0.028	0.7	0.087	2.2										
	4X6-19	0.028	0.7	0.087	2.2										
L	6X10-16	0.028	0.7	0.087	2.2	0.015	0.38	0.018	0.46	0.02	0.51	0.022	0.56	0.026	0.66
	8X10-16	0.028	0.7	0.087	2.2										
	4X8-19	0.028	0.7	0.087	2.2										
	6X10-19	0.028	0.7	0.087	2.2										
	8X10-19	0.028	0.7	0.087	2.2										
	6X10-22	0.028	0.7	0.087	2.2										
	10X12-16	0.028	0.7	0.087	2.2	0.02	0.51	0.023	0.58	0.025	0.64	0.027	0.69	0.031	0.79
	14X14-16	0.028	0.7	0.087	2.2										
	10X12-19	0.028	0.7	0.087	2.2										
	8X10-22	0.028	0.7	0.087	2.2										
XL	12X14-19	0.028	0.7	0.087	2.2	0.02	0.51	0.023	0.58	0.025	0.64	0.027	0.69	0.031	0.79
	16X16-19	0.028	0.7	0.087	2.2										
	10X12-22	0.028	0.7	0.087	2.2										
	12X14-22	0.028	0.7	0.087	2.2										
	14X16-22	0.028	0.7	0.087	2.2										
	18X18-22	0.028	0.7	0.087	2.2										
	6X10-25	0.028	0.7	0.087	2.2										
	8X12-25	0.028	0.7	0.087	2.2										
	10X14-25	0.028	0.7	0.087	2.2										
	20X20-25	0.028	0.7	0.087	2.2										
XL1	14X16-27														
XL1	24X24-27														
XL1	20X24-29														
XL1	28X24-29E	0.121	3.1	0.186	4.7	0.035	0.89	0.038	0.97	0.04	1.02	0.042	1.07	0.046	1.17
XL2-S	16X20-29E	0.131	3.3	0.196	5	0.035	0.89	0.038	0.97	0.04	1.02	0.042	1.07	0.046	1.17
XL2-S	20X24-31														
XL2	24X28-35E	0.133	3.4	0.202	5.1	0.03	0.76	0.033	0.84	0.035	0.89	0.037	0.94	0.041	1.04
XL2	24X30-35														
XL2	24X30-35A														

Group	Size	Total Axial Adjustment				Cold Axial Front Clearance Setting - Closed Impeller									
		Min.		Max.		122°F (50°C)		212°F (100°C)		302°F (150°C)		392°F (200°C)		446°F (230°C)	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
XL2	24X30-35N					0.03	0.76	0.033	0.84	0.035	0.89	0.037	0.94	0.041	1.04
XL2	30X30-41														

5.4.2 Check the Shearpeller™ axial clearance

The Shearpeller™ requires a large front clearance in order to handle stringy solids. The front clearance between the Shearpeller™ and the suction sideplate is 0.375 in. (9.50 mm). With this large clearance, the pump is not as sensitive to small changes in the front clearance. No cold setting is required with the Shearpeller™ option due to the large clearances.

1. Back the Shearpeller™ up until the back pump-out vanes contact the seal chamber.
2. Move the Shearpeller™ forward 0.062 in. (1.57 mm).

The total axial adjustment of the Shearpeller™ between the suction sideplate and the seal chamber is 0.437 in. (11.00 mm).

5.5 Impeller-clearance setting

Importance of a proper impeller clearance

A proper impeller clearance ensures that the pump runs at high performance.

NOTICE:
Set the impeller clearance according to Table 7: Ambient Temperature Axial Clearance for the Open Impeller on page 58 and Table 8: Ambient Temperature Axial Clearance for the Closed Impeller on page 60. Failure to do so may result in heat generation and equipment damage. Higher clearances are used above 93°C | 200°F to prevent the impeller from contacting the casing due to thermal expansion.

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 mechanical seal damage leading to breach of containment. If a cartridge mechanical seal is used, ensure that the set screws in the seal locking ring are loosened and that the centering clips have been installed prior to clearance adjustment.

The clearance is set at 0.4mm | 0.015 in – 0.5mm | 0.020 in depending on pump size and impeller configuration at the factory but could change due to piping attachment during installation. A change in pump performance may be noted over time by a drop in head or flow or an increase in power required.

Impeller clearance methods

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

- Dial indicator method
- Feeler gauge method

5.5.1 Set the impeller clearance - dial indicator method

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.

1. Remove the coupling guard.
2. Set the indicator so that the button contacts either the shaft end or the face of the coupling.
3. Loosen the jam nuts (423B) on the jack bolts (371A), and then back the bolts out about two turns.
4. Tighten the locking bolts evenly (370C), bringing the bearing housing (134A) towards the frame (228) until the impeller contacts the casing.
5. Turn the shaft to ensure that there is contact between the impeller and the sideplate or wear ring.
6. Set the indicator to zero and loosen the locking bolt (370C) about one turn.
7. Thread in the jack bolts (371A) until the jack bolts evenly contact the bearing frame.
8. Tighten the jack bolts evenly about one flat at a time, moving the bearing housing (134A) away from the bearing frame until the indicator shows the correct clearance.
   Refer to the impeller clearance table to determine the correct clearance.
9. Tighten the bolts evenly in this order:
   a) Tighten the locking bolts (370C).
   b) Tighten the jack bolts (371A).
   Make sure to keep the indicator reading at the proper setting.
10. Make sure the shaft turns freely.
11. Replace the coupling guard.
12. Check both the thrust (332A) and the radial (333A) labyrinth seals to make sure they are seated properly in the housing.
13. Wear insulated gloves to handle the coupling hub. The coupling hub will get hot and can cause physical injury.

5.5.2 Set the impeller clearance - feeler gauge method

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.

1. Lock out the driver power and remove the coupling guard.
2. Loosen the jam nuts (423B) on the jack bolts (371A), and then back the bolts out about two turns.

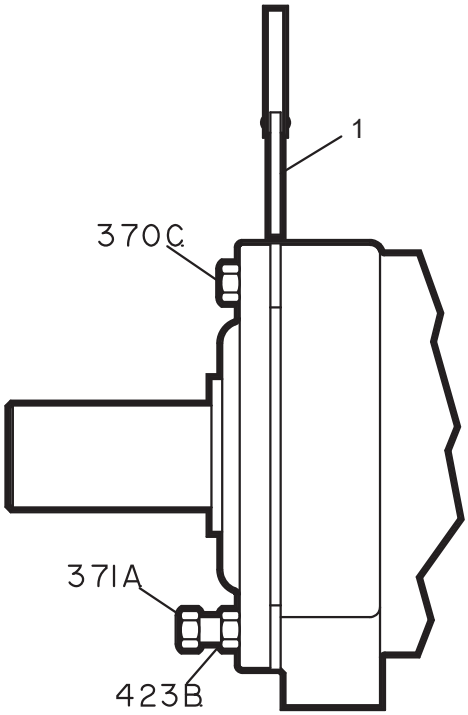


Figure 29: Loosen jam nuts

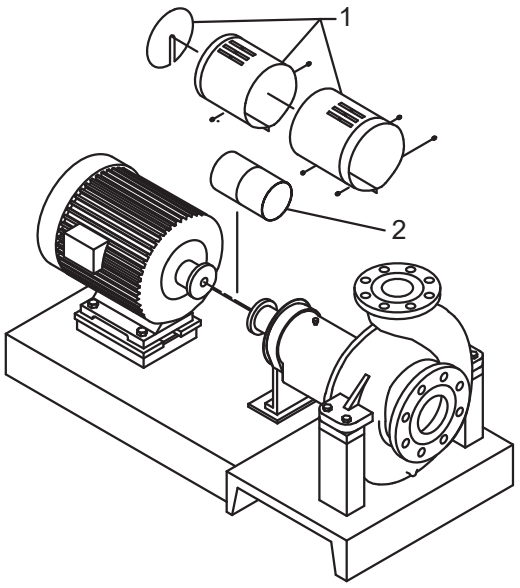
3. Evenly tighten the locking bolts (370C), bringing the bearing housing (134A) towards the frame (228) until the impeller contacts the casing.
4. Turn the shaft to ensure that there is contact between the impeller and the sideplate or wear ring.
5. With a set of feeler gauges, measure and record the gap between the bearing housing and the frame.
6. Turn back the locking bolt (370C) one turn.
7. Add the proper impeller clearances to the feeler gauge stack and back the housing away from the frame with the adjusters (371A) until the feeler gauge fits.
   Evenly tighten adjuster bolts (371A) (about one flat at a time) in making this adjustment.
8. Evenly tighten the locking bolts (370C) and then the adjuster bolts (371A) while keeping the indicator reading at the proper setting.
9. Make sure the shaft turns freely.
10. Replace the coupling guard.
11. Check both the thrust (332A) and radial (333A) labyrinth seals to make sure they are seated properly in the housing.
12. Wear insulated gloves to handle the coupling hub. The coupling hub will get hot and can cause physical injury.

5.6 Couple 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.

Couplings must have proper certification to be used in an Ex classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling. Refer to driver/coupling/gear manufacturers IOM for specific instructions and recommendations.



1. Coupling guard
2. Coupling

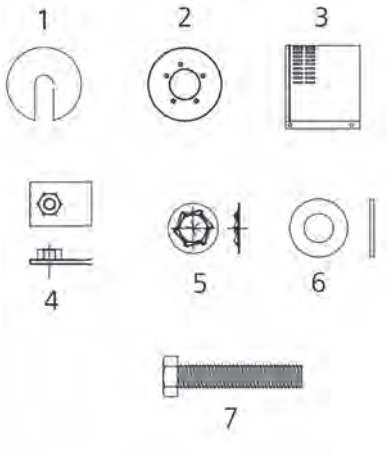
Figure 30: Coupling guard assembly

5.6.1 Install the coupling guard

WARNING:

- 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.

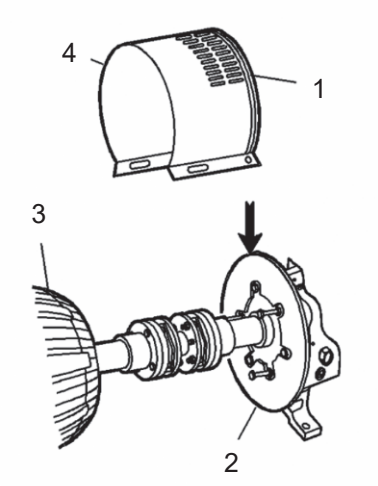
WARNING:
The machine guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.



Part No.	Description	Part no.	Description
1	Cover, driver	5	Retainer (Qty 3)
2	Cover, pump	6	Washer (Qty 4)
3	Guard (Qty 2)	7	Hex head bolt (Qty 3)
4	U-nut (Qty 3		

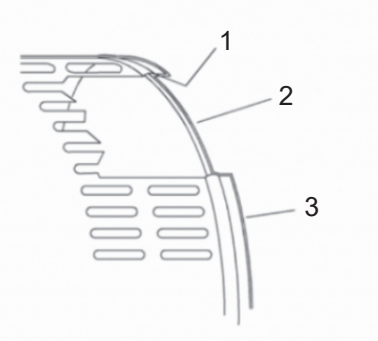
Figure 31: Required parts

1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
2. Put the pump-side end plate in place.
   If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.
3. Slightly spread the opening of the coupling guard half and place it over the pump end plate.
   a) The annular groove in the guard is located around the end plate.
   b) Position the opening (flange) so that it does not interfere with the piping but still allows for access when you install the bolts.



Item	Description
1.	Annular groove
2.	Pump-side end plate (234A)
3.	Driver
4.	Pump half of the coupling guard (501B)

Figure 32: Align pump end guard half with annular groove



Item	Description
1.	Annular groove
2.	Pump end plate (234A)
3.	Guard half (501B)

Figure 33: Annular groove in coupling guard

4. Place one washer over the bolt and insert the bolt through the round hole at the front end of the guard half.

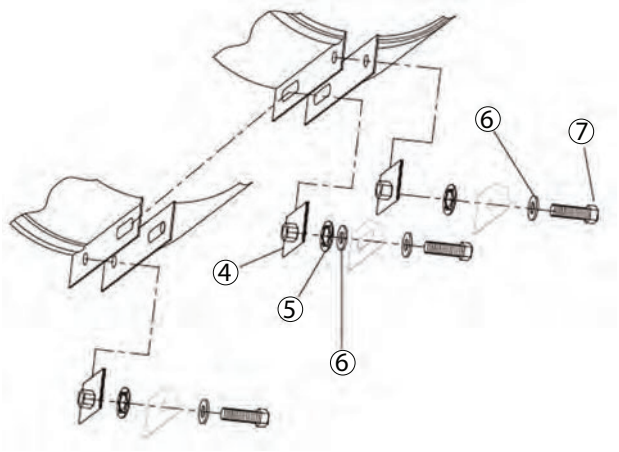


Figure 34: Captured hardware component assembly

5. Install the bolt retainer over the exposed end of the bolt, and the U-Nut into the slot in the coupling guard if it was not done from the factory.
6. Thread bolt into the U-Nut and tighten firmly.
7. Slightly spread the opening of the remaining coupling guard half and place it over the installed coupling guard half so that the annular groove in the remaining coupling guard half faces the motor.

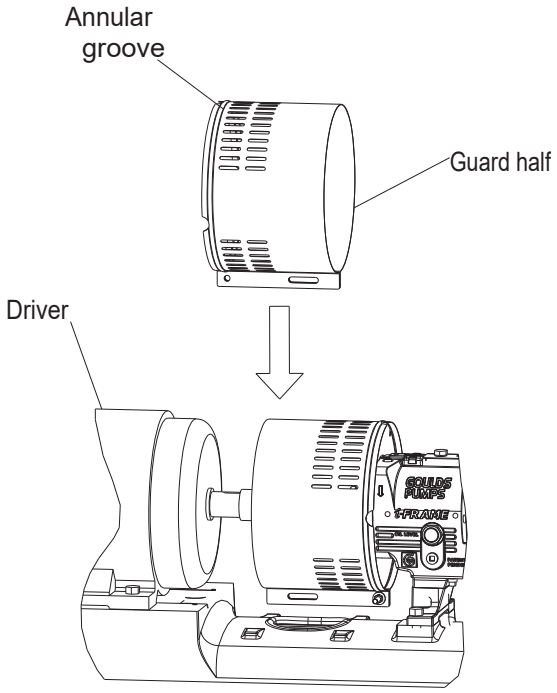


Figure 35: Placement of driver half of coupling guard

8. Place the end plate over the driver shaft and locate the end plate in the annular groove at the rear of the coupling guard half.

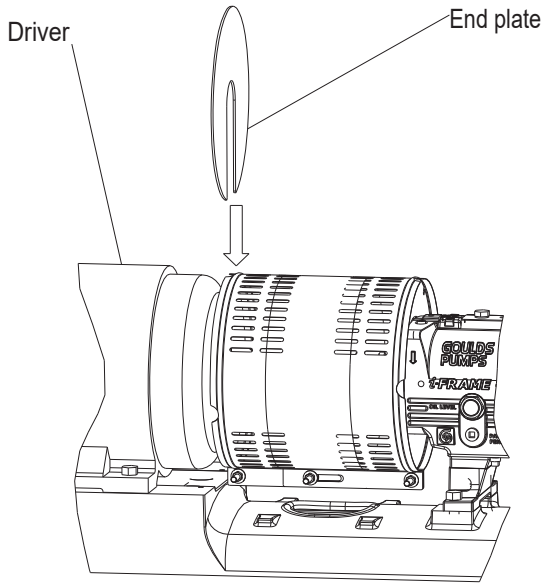


Figure 36: Placement of driver half of coupling guard

9. Hand-tighten only. Repeat Steps 4 through 6 for the rear end of the coupling guard half. The hole is located on the driver-side of the coupling guard half.
10. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.

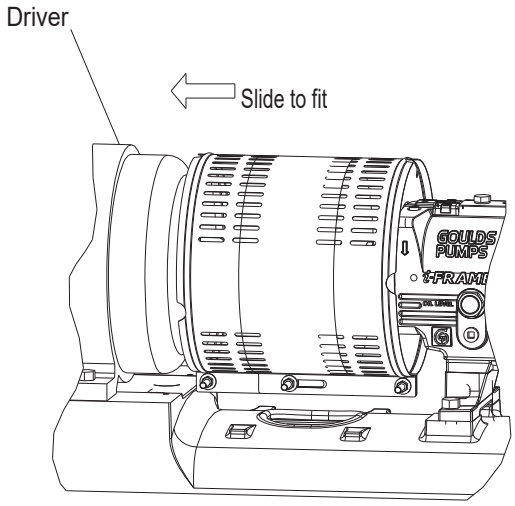


Figure 37: Slide driver-half of coupling guard towards motor

11. Repeat Steps 4 through 6 for the center slots in the coupling guard.
12. Tighten all nuts on the guard assembly.

5.7 Bearing lubrication

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

NOTICE:
Grease can settle in equipment left idle leaving bearings improperly lubricated. Check the greasing on a pump that has been out of service for a long period of time and re-grease if necessary.

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

Grease-lubricated bearings are lubricated at the factory.

The bearing manufacturer fills greased-for-life bearings with grease and seals them at the factory. You do not need to lubricate or seal these bearings.

On pure or purge-oil mist-lubricated units, remove the viewing port plugs to verify that oil mist is flowing properly. Replace the plugs.

5.7.1 Oil volumes

Oil volume requirements

Frame	Quarts	Liters
S	1.1	1.0
M	2.1	2.0
L	2.1	2.0
XL	3.2	3.0
XL1, XL1-S1, XL1-S2	12.2	11.6
XL2-S and XL2	24.0	22.7

5.7.2 Lubricating oil requirements

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

Lubricating oil requirements

	Bearing temperature below 82°C | 180°F	**Bearing temperature above 82°C | 180°F**
ISO grade	**ISO viscosity grade 68**	**ISO viscosity grade 100**
Approximate SSU at 38°C | 100°F	300	470
DIN 51517	C68	C100
Kinematic viscosity at 40°C | 105°F mm^2/sec	68	100

5.7.3 Acceptable oil for lubricating bearings

Acceptable lubricants

Table 9: Acceptable lubricants

Brand	Lubricant type
Chevron	GST Oil 68
Exxon	Teresstic EP 68
Mobil	DTE Heavy Medium
Phillips 66	Turbine Oil VG68 MM motor oil SAE 20-20W HDS motor oil SAE 20-20W
Gulf	Harmony 68
Dow Corning	High Vacuum Grease, NSF 61 compliant label
MOLYKOTE from Dow Corning	111, NSF 61 compliant label
Loctite	565 thread locker, NSF 61 compliant label

5.7.4 Lubricate the bearings with oil

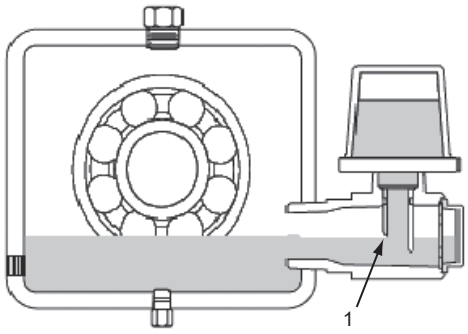
WARNING:

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

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

- Fill the bearing frame with oil:

If...	Then...
You do not have the constant level oiler option	Pour oil in the filler connection located on top of the bearing frame until the level reaches the mark in the middle of the sight glass. Use a high-quality turbine type oil with rust and oxidation inhibitors.
You do have the constant level oiler option	The Watchdog® oiler system was designed for use on closed system environments. The Inpro VBXX-D labyrinth seals used on these pumps can create a situation where unequal pressure causes the oiler to overfill. This might occur during intermittent operation. In order to eliminate the pressure differential that creates this problem, Watchdog supplies a breather with a filter. If plant environments or requirements are not suitable for vented bearing frames, then do not use the Watchdog oiler. Install the Watchdog oiler in the connection for the sight glass. The oiler does not require any setting dimensions.

If...	Then...
	 1. Control point that determines the level of the oil in the oiler

5.7.5 Greased-for-life bearing lubrication

The bearing manufacturer fills greased-for-life bearings with grease and seals them at the factory. You do not need to lubricate or seal these bearings. Refer to the Maintenance chapter for re-greasing and maintenance procedures for these bearings.

5.8 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
- Dynamic seal
- Packed-stuffing-box option

5.8.1 Mechanical seal options

Pumps are usually shipped with mechanical seals installed. If they are not, then refer to the mechanical seal manufacturer's installation instructions.

These are the mechanical seal options for this pump:

- Cartridge mechanical seal
- Conventional inside component mechanical seal

5.8.2 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 10: 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 seal flush/cooling piping diagrams.

5.8.3 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.

5.8.4 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.

5.8.5 Seal the shaft with a packed stuffing box

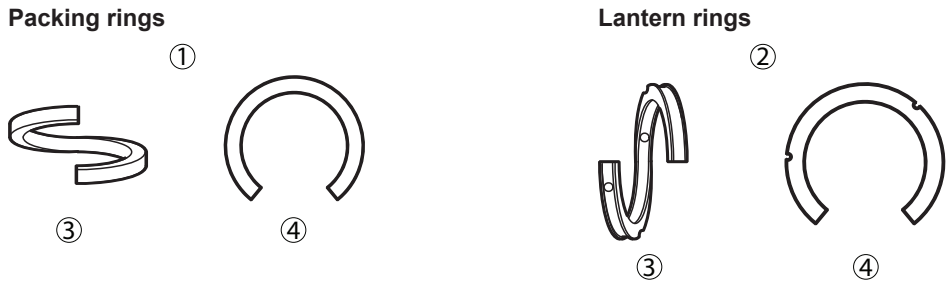
WARNING:

- 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.

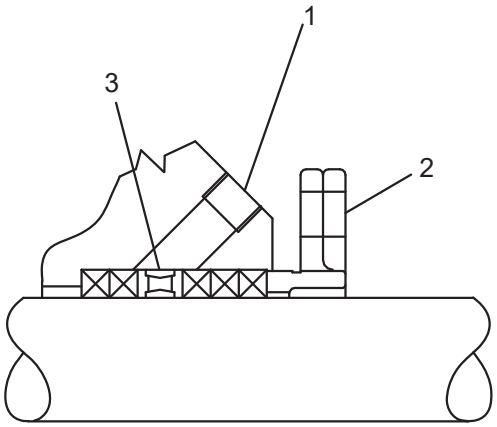
Pumps are shipped without the packing, lantern ring, or split gland installed. These parts are included with the box of fittings shipped with each pump and must be installed before startup.

1. Carefully clean the stuffing-box bore.
2. Twist the packing enough to get it around the shaft.



1. Packing rings
2. Lantern rings
3. Correct
4. Incorrect

Figure 38: Packing rings and lantern rings



1. Lantern ring flush connection
2. Split gland (non-quench)
3. Lantern ring

3. Insert the packing and stagger the joints in each ring by 90°.
   Install the stuffing-box parts in this order:
   a) Two packing rings
   b) One lantern ring (two-piece)
   c) Three packing rings

NOTICE:

Make sure that the lantern ring is located at the flushing connection to ensure that flush is obtained. Failure to do so may result in decreased performance.

4. Install the gland halves and evenly hand-tighten the nuts .

5.8.6 Dynamic-seal option (3180 and 3185 S, M, L, and XL groups only)

WARNING:
Dynamic seals are not allowed in an Ex-classified environment.

The dynamic seal consists of two parts:

- A repeller seal that prevents leaks during operation
- A secondary seal that prevents leaks when unit is off

Table 11: Dynamic seal part function

Part	Description and function
Repeller seal	A repeller seal prevents liquid from entering the stuffing box during operation. The repeller normally does not require a flush. Some services might require a flush if solids have built up on the repeller. The unit contains a flush tap for that purpose. The unit also contains a drain tap to drain the repeller chamber if there is a danger that the unit might freeze.
Secondary seal	The secondary seal prevents leaks during pump shutdown. The seal can be one of these types: • Graphite packing • Diaphragm seal

Table 12: Secondary seal part function

Secondary seal type	Description and operation
Graphite packing	Graphite packing provides adequate life running dry but can provide longer performance if lubricated with clean water or grease. • If you lubricate with clean water, then the repeller reduces both the quantity and pressure of seal water that is necessary. If the suction head is less than the repeller capability, then the stuffing box pressure is the same as the atmospheric pressure. Water pressure for the seal must be high enough to overcome static head when the pump is not operating to keep solids in the pumped fluid out of the packing. There must be enough flow to cool the packing. **NOTICE:** • WARNING • The pump must be completely filled with liquid before starting. The pump must not run dry in the hope it will prime itself. Serious damage to the pump may result if it is started dry. • If you lubricate with grease, then you must use spring-loaded grease lubricators in order to maintain a constant supply of grease.
Diaphragm seal	This is an elastomeric disk that seals against a follower when the pump is not operating. The position of the follower is set at the factory but should be checked prior to

Secondary seal type	Description and operation
	start-up. The step on the follower should line up with the face of the gland plate. Some adjustment might be required. Use the repeller flush connection if you need to flush the repeller. Never use more than 20 psig (1.4 kg/cm^2) with the diaphragm option. **NOTICE:** • WARNING • The pump must be completely filled with liquid before starting. The pump must not run dry in the hope it will prime itself. Serious damage to the pump may result if it is started dry.

5.9 Install the shaft guard - if provided

WARNING:

- 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.
- Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.

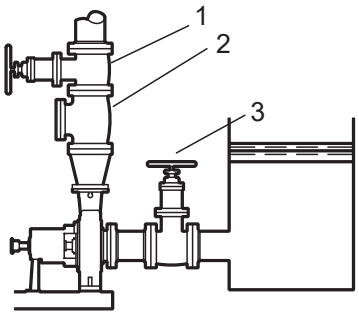
5.10 Pump priming

WARNING:
These pumps are not self priming and must be fully primed at all times during operation. Loss of prime can lead to excessive heat and severe damage to the pump and seal.

WARNING:
A build-up of gases within the pump, sealing system, or process piping system may result in an explosive environment. Make sure the process piping system, pump and sealing system are properly vented prior to operation.

5.10.1 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. (Also open casing vent on tangential discharge models).
3. Close the air vents.



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

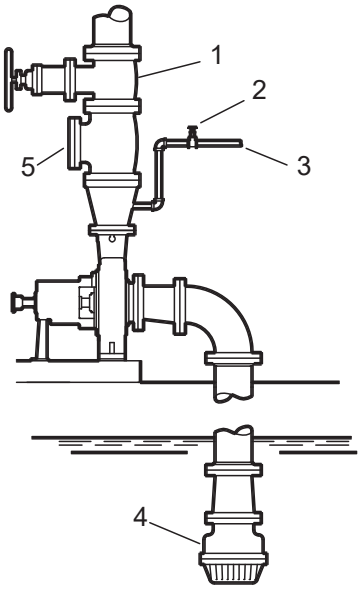
Figure 39: Suction supply above pump

5.10.2 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:

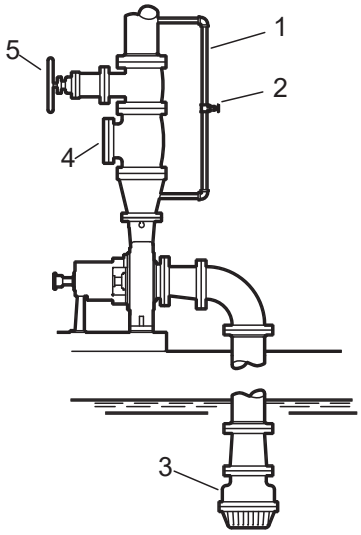
- A priming pump
- A pressurized discharge line
- Another outside supply

1. Close the discharge isolation valve.



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

Figure 40: 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 41: Pump priming with suction supply below pump with foot valve using bypass around check valve

5.10.3 Other methods of priming the pump

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

- Prime by ejector (ejector should be connected to casing vent on tangential models for complete casing priming)
- Prime by automatic priming pump (ensure casing vent is opened until only liquid escapes from the vent)

5.11 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.

- On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.

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.

5.12 i-ALERT® Equipment Health Monitor

WARNING:
Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

For all information refer to the i-ALERT® Equipment Health Monitor Installation, Operation and Maintenance manual. https://www.i-alert.com/support/

5.13 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.

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.
- Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
  - The specific gravity or viscosity of the fluid is greater than expected
  - The pumped fluid exceeds the rated flow rate.
- Do not operate pump past maximum flow. For maximum flow refer to pump performance curve.
- Do not operate pump below hydraulic or thermal minimum flow. For hydraulic minimum flows refer to technical manual and pump performance curves. To calculate thermal minimum flow, refer to HI Centrifugal Pump Design and Application ANSI/HI 1.3-2000.

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.

5.14 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.

5.15 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.
   See Remove the coupling guard in the Maintenance chapter.
4. Check the alignment while the unit is still hot.
   Refer to 4.4 Pump-to-driver alignment on page 40 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 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 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.

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.

Refer to driver/coupling/gear manufacturers' IOM for instructions and recommendations.

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.
Grease-lubricated bearings	Grease-lubricated bearings are initially lubricated at the factory.	Regrease bearings every 2000 operating hours or every three months.

6.2.1 Lubricating oil requirements

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

Lubricating oil requirements

	Bearing temperature below 82°C | 180°F	Bearing temperature above 82°C | 180°F
ISO grade	**ISO viscosity grade 68**	**ISO viscosity grade 100**
Approximate SSU at 38°C | 100°F	300	470
DIN 51517	C68	C100
Kinematic viscosity at 40°C | 105°F mm^2/sec	68	100

6.2.1.1 Oil volumes

Oil volume requirements

Frame	Quarts	Liters
S	1.1	1.0
M	2.1	2.0
L	2.1	2.0
XL	3.2	3.0
XL1, XL1-S1, XL1-S2	12.2	11.6

Frame	Quarts	Liters
XL2-S and XL2	24.0	22.7

6.2.1.2 Acceptable oil for lubricating bearings

Acceptable lubricants

Table 13: Acceptable lubricants

Brand	Lubricant type
Chevron	GST Oil 68
Exxon	Teresstic EP 68
Mobil	DTE Heavy Medium
Phillips 66	Turbine Oil VG68 MM motor oil SAE 20-20W HDS motor oil SAE 20-20W
Gulf	Harmony 68
Dow Corning	High Vacuum Grease, NSF 61 compliant label
MOLYKOTE from Dow Corning	111, NSF 61 compliant label
Loctite	565 thread locker, NSF 61 compliant label

6.2.2 Lubricating-grease requirements

Precautions

NOTICE:

- Avoid equipment damage or decreased performance. Never mix greases of different consistencies (NLGI 1 or 3 with NLGI 2) or with different thickeners. For example, never mix a lithium-based grease with a polyurea based grease. If it is necessary to change the grease type or consistency, remove the rotor and old grease from the housing before re-greasing.

Bearing temperature

Bearing temperatures are generally about 25°C | 45°F greater than bearing-housing outer surface temperatures.

This table shows the type of grease required for the operating temperature of the pump.

Bearing temperature	Type of grease
-15°C to 110°C | 5°F to 230°F	Use a lithium-based mineral-oil grease with a consistency of NLGI 2.
Exceed 110°C | 230°F	Use a high-temperature grease. Mineral-oil greases should have oxidation stabilizers and a consistency of NGLI 3.

Grease recommendations based on temperature

This table shows which brand of grease to use when lubricating the pump.

Brand	When temperature of pumped fluid is less than 110°C | 230°F NLGI consistency 2	When temperature of pumped fluid is greater than110°C | 230°F NLGI consistency 3
Mobil	Mobilux EP2	N/A
Exxon	Unirex N2	Unirex N3

Brand	When temperature of pumped fluid is less than 110°C | 230°F NLGI consistency 2	When temperature of pumped fluid is greater than110°C | 230°F NLGI consistency 3
Sunoco	Mutipurpose 2EP	N/A
SKF	LGMT 2	LGMT 3
Texaco	Multifak 2	N/A
Shell	Alvania 2 EP Grease 2	N/A

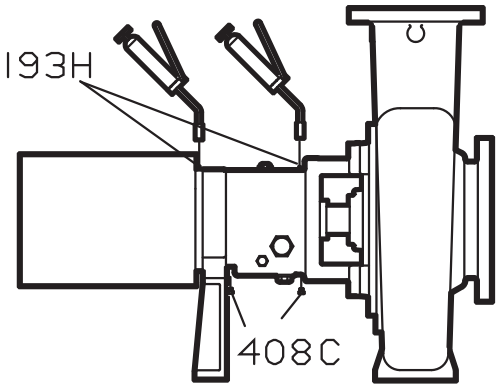
Grease amounts

Frame	Initial grease in grams | ounces		Regrease[1] in grams | ounces	
	Thrust (angular contact)	Radial (cylindrical roller)	Thrust (angular contact)	Radial (cylindrical roller)
S	185 | 7	6 (165)	70.0 | 2.5	70.0 | 2.5
M	290 | 10	7 (180)	115 | 4	70.0 | 2.5
L	475 | 17	10 (280)	200 | 7	115 | 4
XL	800 | 28	16 (450)	345 | 12	190.0 | 6.5
XL1, XL1-S1, XL1-S2	2,390 | 84	710 | 25	1000 | 35	290 | 10
XL2	3500 | 123	1020 | 36	1470 | 52	430 | 15
XL2-S	3500 | 123	1020 | 36	1470 | 52	430 | 15

[1] The regrease amount is based on purging half of the old grease from the housing reservoir.

6.2.2.1 Regrease the grease-lubricated bearings

NOTICE:
Risk of equipment damage. Ensure that the grease container, the greasing device, and the fittings are clean. Failure to do so can result in impurities entering the bearing housing while re-greasing the bearings.



1. Wipe dirt from the grease fittings.
2. Remove the two grease-relief plugs from the bottom of the frame.
3. Fill both of the grease cavities through the fittings with a recommended grease until the fresh grease comes out of the relief holes.
4. Make sure that the frame seals are seated in the bearing housing.
   If they are not, press them in place with the drains located at the bottom.
5. Run the pump for about 30 minutes or until grease no longer comes out of the housing.
6. Reinstall the grease-relief plugs.
7. Wipe off any excess grease.
8. Recheck the alignment.

The bearing temperature usually rises after you regrease due to an excess supply of grease. Temperatures return to normal in about two to four operating hours as the pump runs and purges the excess grease from the bearings.

6.2.3 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.
3. Refer to *Reassembly* section for proper bearing greasing procedure.

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.

Mechanical seal life

The life of a mechanical seal depends on the cleanliness of the pumped fluid. Due to the diversity of operating conditions, it is not possible to give definite indications as to the life of a mechanical seal.

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.

6.3.3 Dynamic seal maintenance (3180 and 3185 S, M, L, and XL groups only)

Precautions

WARNING:

- Packed stuffing boxes are not allowed in an Ex-classified environment.
- Dynamic seals are not allowed in an Ex-classified environment.

Dynamic seal parts

Dynamic seal parts normally do not wear enough to affect operation unless the service is particularly abrasive. The dynamic seal consists of two parts:

- The repeller seal prevents leakage during operation.
- The secondary seal prevents or minimizes leakage during shutdown of the unit. The seal can be either one of these types:
  - Graphite packing, provides adequate life when it runs dry but can provide longer performance if it is lubricated with clean water (Flush) or grease via a spring loaded grease cup.
  - Diaphragm seal, which is an elastomeric disk that seals against a follower when the pump is not operating.

Repeller seal maintenance

Some services might require a flush if solids have built up on the repeller. The unit contains a flush tap for that purpose. The unit also contains a drain tap in order to drain the repeller chamber if there is a danger that the unit might freeze.

Graphite packing maintenance

Graphite packing requires the same maintenance as any other packing. When adjustments can no longer be made with the gland because it contacts the box face, perform these maintenance tasks:

- Shut down the pump.
- Relieve the pressure.
- Add another ring of packing to the box.

If the lantern ring connection is used but no longer lines up with the flush port, you need to clean and repack the stuffing box. The repacking procedure is the same as the procedure outlined in the Commissioning, Startup, Operation, and Shutdown chapter except this is the arrangement:

- One ring of packing
- The lantern ring
- Two rings of packing

Diaphragm seal maintenance

The diaphragm seal normally does not require maintenance because the seal is non-contacting during operation. If the seal is short-lived, it is due to one of four factors:

- The pump was assembled improperly.
- The suction head is higher than the repeller sealing capability.
- The follower is not set properly.
- The box is bound with foreign material.

Acceptable leaks

Slight leaks can be considered normal, but excessive dripping or spray indicates a problem. You can usually obtain extra life by resetting the follower towards the diaphragm by 0.040 in (1 mm.) increments and allowing the diaphragm to reseat during operation. If this is not successful, replace the diaphragm and follower (if scored).

Stuffing box cover

The stuffing box cover used with the dynamic seal option is equipped with two lantern ring connections:

- One repeller flush connection
- One repeller drain connection

The lantern ring connection can be used to inject flush liquid or grease when required on specific applications, but not when using a diaphragm seal.

NOTICE:
Do not flush the stuffing box through the lantern ring connection when a diaphragm static seal is used. This may cause premature seal failure.

Drain tap

The drain tap allows you to drain the liquid that remains in the repeller chamber upon pump shutdown. Consider removing this liquid before you service the pump in order to prevent it from hardening, or protect the pump during freezing weather. The flush tap allows injection of water or steam directly into the repeller chamber near the base of the repeller vanes.

Injected liquid

During operation, the injected liquid can prevent de-watering of stock or similar problems. On shutdown, it can be used in conjunction with the drain in order to flush the chamber of solids or potentially harmful liquids.

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:

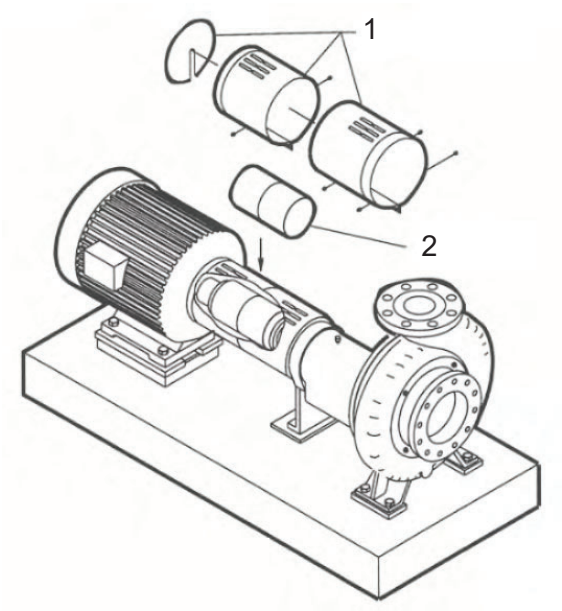
- Allen wrenches
- Cleaning agents and solvents
- Chisel
- Dial indicators
- Feeler gauges
- Hoist and strap
- Induction heater
- Pry bars
- Sockets
- Soft face hammer
- Spanner wrench
- Torque wrench
- Wrenches
- Lifting eyebolt (dependent on pump / motor size)

6.4.3 Drain the pump

CAUTION:

- Risk of physical injury. Allow all system and pump components to cool before handling.
- 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. Close the isolation valves on the suction and discharge sides of the pump.
   You must drain the system if no valves are installed.
2. Open the drain valve.
   Do not proceed until liquid stops coming out of the drain valve. If liquid continues to flow from the drain valve, the isolation valves are not sealing properly and you must repair them before you proceed.
3. Leave the suction pipe drain valve open to drain the pump casing as much as possible.
4. 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.
5. Drain the liquid from the piping and flush the pump if it is necessary.
6. Disconnect all auxiliary piping and tubing.
7. Remove the coupling guard.
8. Remove the coupling guard.
9. Disconnect the coupling.



1. Coupling guard
2. Coupling

10. If the pump is oil lubricated, drain the oil from the bearing frame.

6.4.4 Remove the back pull-out assembly

1. Place a sling from the hoist through the bearing frame (228) arms above the pump shaft.

WARNING:

- Risk of severe physical injury or death from explosion of trapped liquid. Never use heat to remove parts unless explicitly stated in this manual.
- 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.

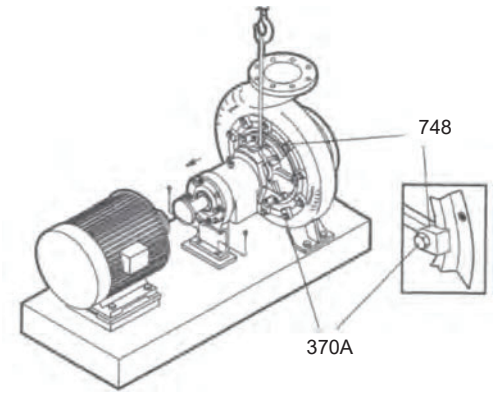


Figure 42: 3180 and 3185 S, M, L, and XL group

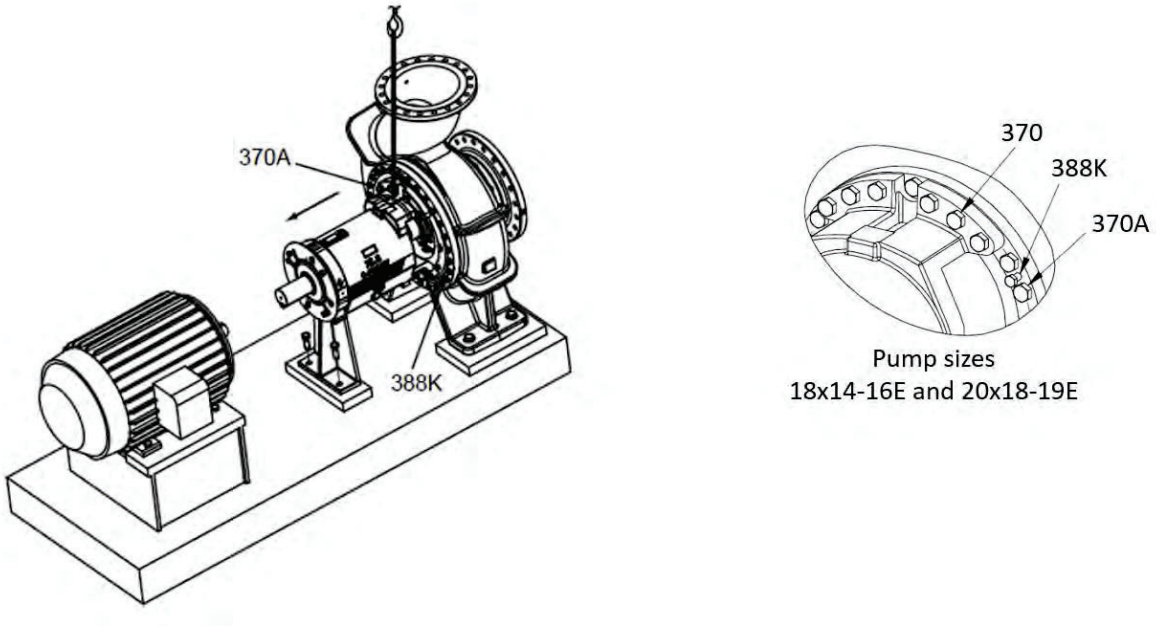


Figure 43: 3180 and 3185 XL1, XL1-S1, XL1-S2, XL2-S, and XL2 group

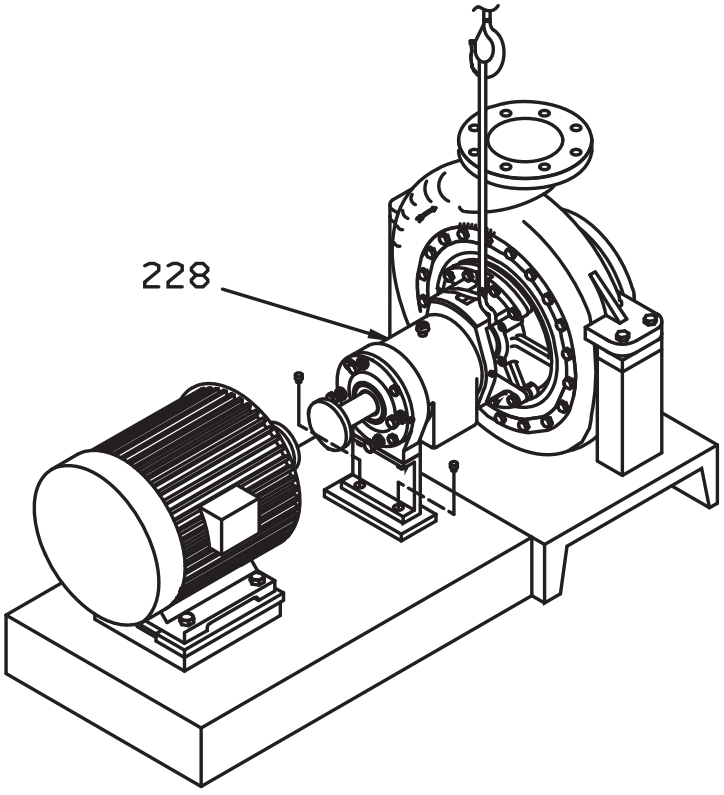


Figure 44: 3181 and 3186 Pump

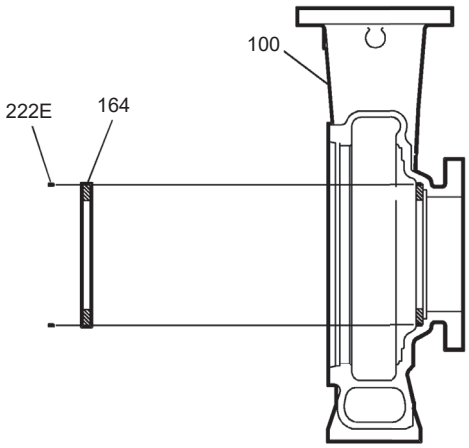
2. Remove the hold-down bolts of the bearing frame.
3. Remove the back pull-out assembly from the casing:

If your pump model is...	Then...
3180 or 3185 S, M, L, or XL group	1. Loosen the casing bolts (370A) enough to turn the casing lugs (748) 180° out of the way. Use your hand to keep the lug in place. 2. Remove two sets of bolts and lugs and thread them into the two holes provided in the cover for use as a jack. 3. Tighten the bolts until they are bottomed out. 4. Remove the back pull-out assembly by hand if it is loose enough. If it is not loose enough, loosen the jack and place a shim 0.25 in. (6 mm) between the lug and the casing and then re-tighten.
3181 or 3186 or; 3180 or 3185 XL1, XL1-S1, XL1-S2, XL2-S, or XL2 group	1. Remove the casing bolts (370A). On sizes 18x14-16E and 20x18-19E also remove the qty. 12 frame to casing bolts (370). 2. Evenly tighten the jacking bolts (388K) until the back pull-out assembly is free enough to remove from the casing.

6.4.5 Remove the casing wear ring (S, M, L, and XL)

This procedure only applies to pumps with an enclosed impeller.

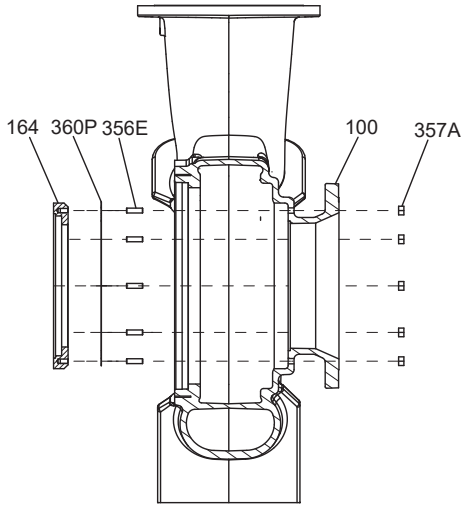
1. Remove the set screws (222E) from the casing wear ring (164).
2. Remove the wear ring (164) from the casing (100) using a pry bar in the slot provided, if necessary.



6.4.6 Remove the casing wear ring (for XL1, XL1-S1, XL1-S2, XL2-S, XL2)

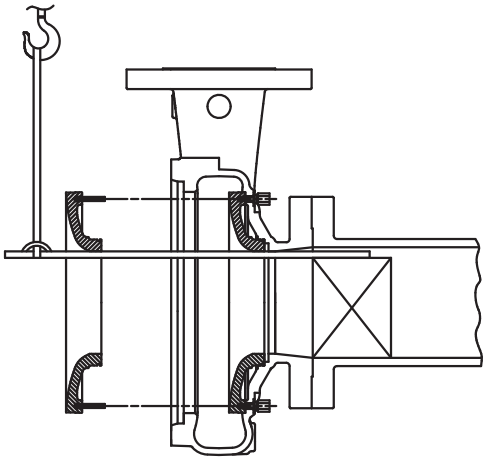
This procedure only applies to pumps with an enclosed impeller.

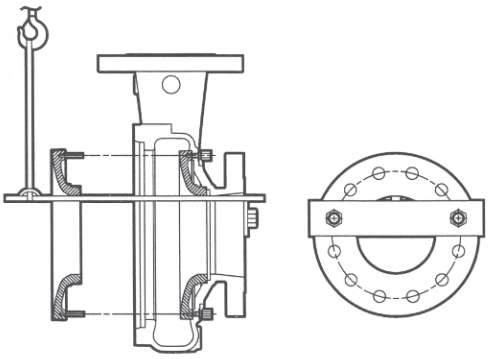
1. Remove the hex nuts (357A) from the casing wear ring studs (356E).
2. Remove the casing wear ring (164) from the casing (100) using a pry bar in the slot provided, if necessary.
3. Remove the casing wear ring gasket (360P).



6.4.7 Remove the suction sideplate

WARNING:
Sideplates are heavy. Use the proper support to avoid personal injury.

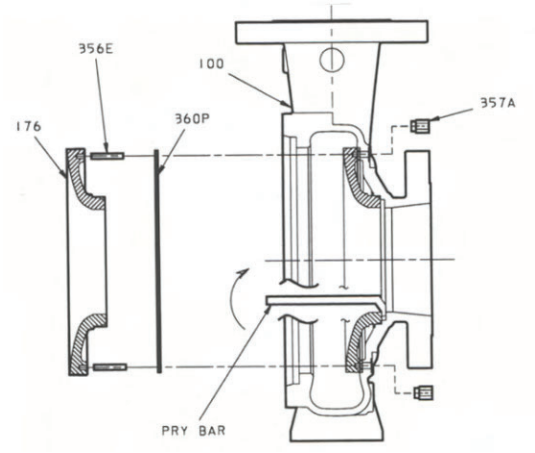




This procedure only applies to models that have an open impeller or a Shearpeller™.

1. Remove the hex nuts (357A) from the sideplate studs (356E).
2. Remove the sideplate (176) from the casing (100) using a pry bar in the provided slot.

3. Remove the O-ring (412C) from the groove and gasket (360P).



6.4.8 Impeller removal

WARNING:
Risk of severe physical injury or death from explosion of trapped liquid. Never use heat to remove parts unless explicitly stated in this manual.

CAUTION:
Risk of physical injury from sharp edges. Wear heavy work gloves when handling impellers.

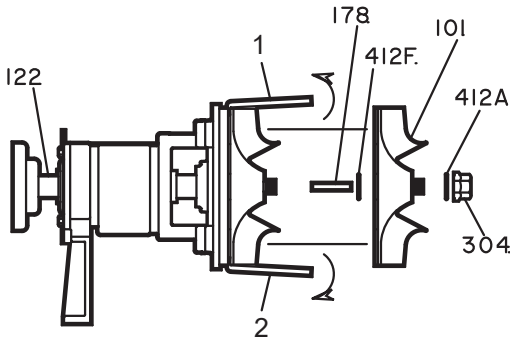
NOTICE:
Be sure to align the pry bars with the impeller vanes in order to prevent damage to the impeller.

The pump has one of these impellers. Choose the removal procedure that applies to the impeller in the pump:

- Open impeller
- Enclosed impeller
- Shearpeller™

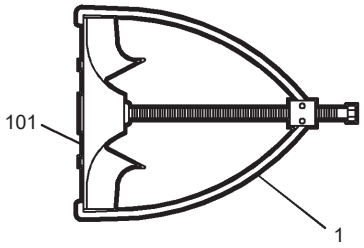
6.4.8.1 Remove an open impeller

1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the impeller nut (304) and O-ring (412A).



1. Pry bar (above)
2. Pry bar (below)

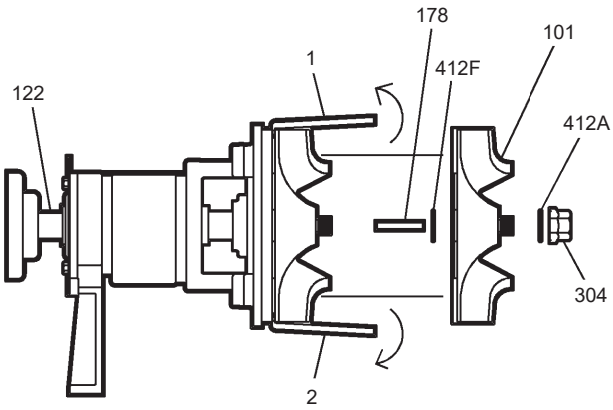
4. Pry the impeller off of the shaft using two bars opposite of each other. Place the pry bars between the cover and the impeller.
   You can also use an impeller puller.



1. Impeller puller

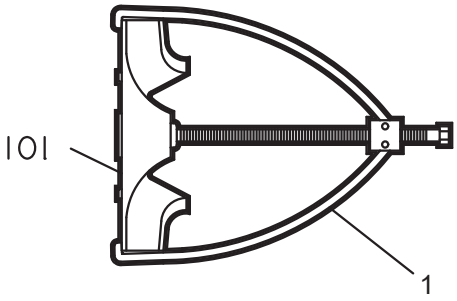
6.4.8.2 Remove an enclosed impeller

1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the impeller nut (304) and O-ring (412A).



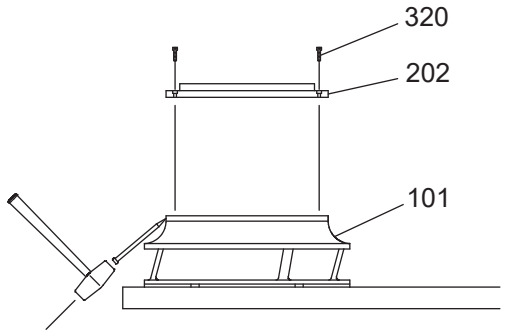
1. Pry bar (above)
2. Pry bar (below)

4. Pry the impeller off of the shaft using two bars opposite of each other. Place them between the cover and the impeller shroud.
   You can also use an impeller puller.



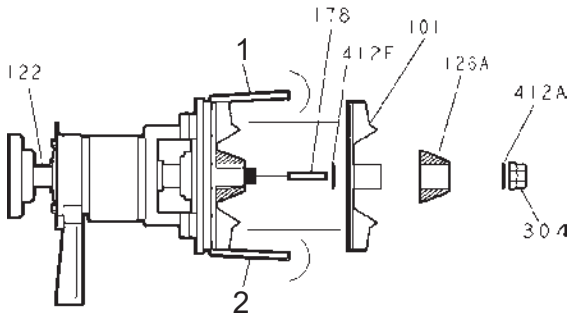
1. Impeller puller

5. Remove the socket head capscrews (320) from the impeller wear ring (202).
   You might have to drill the heads of the socket head capscrews (320) off using a 3/8 in (10.0 mm) drill bit if the heads are worn. Remove the remaining shank with locking pliers.
6. For the S, M, L, and XL groups, remove the wear ring (202) from the impeller by striking it with a chisel.
   The wear ring is usually loose, but corrosion might cause it to bind.



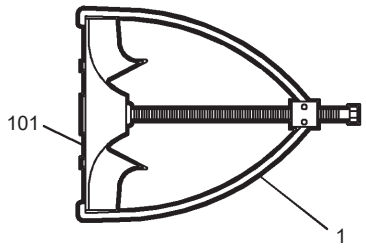
6.4.8.3 Remove a Shearpeller™

1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the Shearpeller nut (304), O-ring (412A), and Shearpeller sleeve (126A).



1. Pry bar (above)
2. Pry bar (below)

4. Pry the Shearpeller^{TM} off of the shaft using two bars opposite of each other, placed between the cover and the Shearpeller^{TM} shroud.
   You can also use an impeller puller.

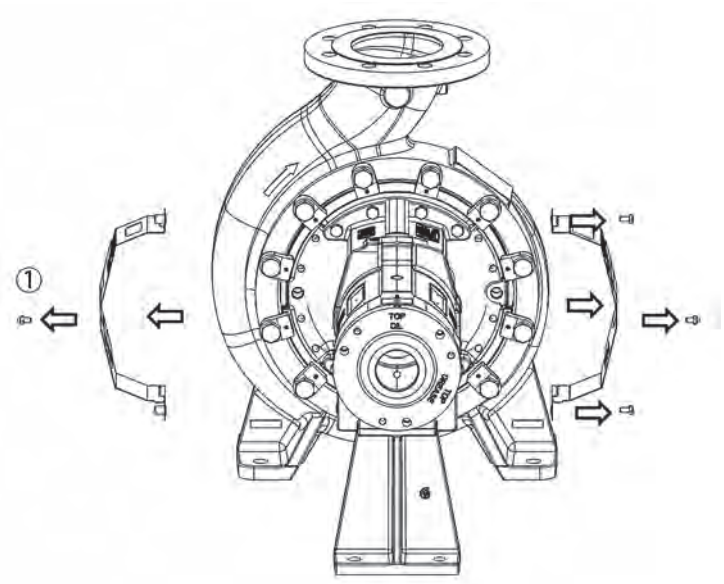


1. Impeller puller

6.4.9 Shaft guard removal (if provided)

6.4.9.1 Remove the shaft guard

1. Remove the bolt for each shaft guard half that mounts the halves to each side of the frame.
2. Do not remove the clip that retains the bolt on the guard to maintain a captive fastener.
3. Retain each guard half with fasteners for reinstallation.



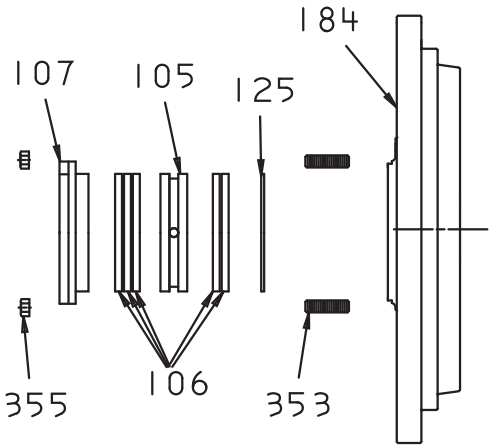
Item	Description
1.	Mounting bolt

Figure 45: Shaft guard removal

6.4.10 Remove the stuffing box cover

WARNING:
Stuffing box covers are heavy. Use proper support to avoid personal injury.

1. Remove the packing gland halves (107), packing (106), lantern ring (105), and throttle bushing (125).



2. Thread an eye bolt (10mm, 12mm or 16mm as required) into the tapped hole provided in the cover (184) and sling to a hoist. Larger seal chambers will require two eye bolts.
3. Remove the hex head bolts or hex nuts:

If your pump group is...	Then...
S, M, L, and XL	Remove the eight hex head bolts (370B) from the cover (184).
XL1, XL2-S, and XL2	Remove the two hex head bolts (370H) from the frame adapter (108).
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Remove the two hex nuts (357K) from the frame adapter (108).

4. Remove the cover:

If your pump group is...	Then...
S, M, L, and XL	Remove the eight hex head bolts (370B) from the cover (184). Gently tap the cover from the frame using a soft-blow hammer on the dry side of the cover.
XL1, XL2-S, and XL2	Evenly tighten the two jacking bolts (418) until the cover is free enough to remove from the frame adapter. If required, gently tap the cover from the frame adapter using a soft-blow hammer on the dry side of the cover.
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Using a pry bar, gently pry the cover (184) away from the frame adapter (108) until the cover is free enough to remove from the frame adapter. If required, gently tap the cover from the frame adapter using a soft-blow hammer on the dry side of the cover.

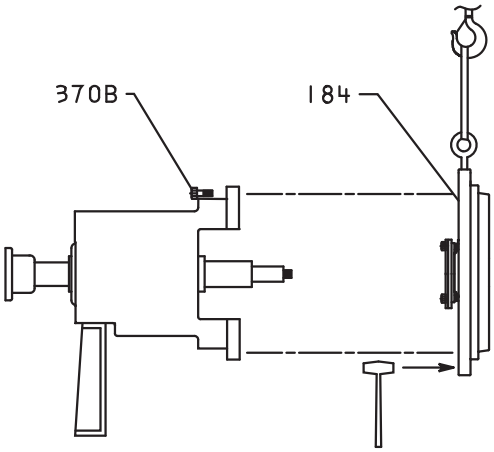


Figure 46: S, M, L, and XL

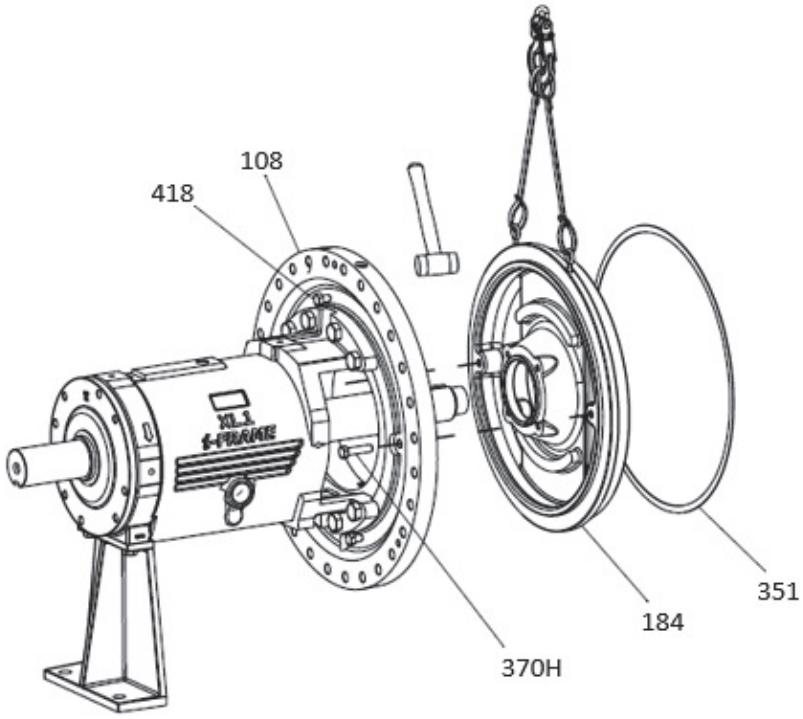


Figure 47: XL1, XL2-S, and XL2

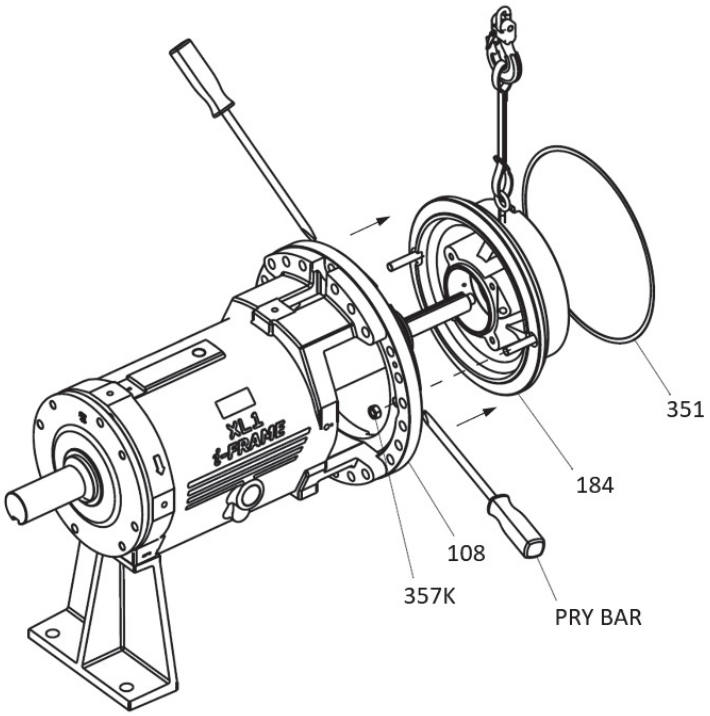
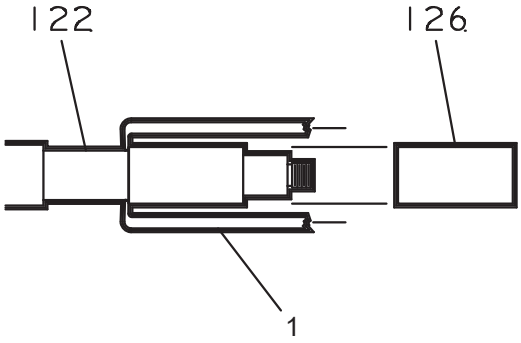


Figure 48: XL1-S1 and XL1-S2 (Sizes: 18x14-16E, 20x18-19E)

5. Remove the shaft sleeve (126).
   Use a puller if necessary.

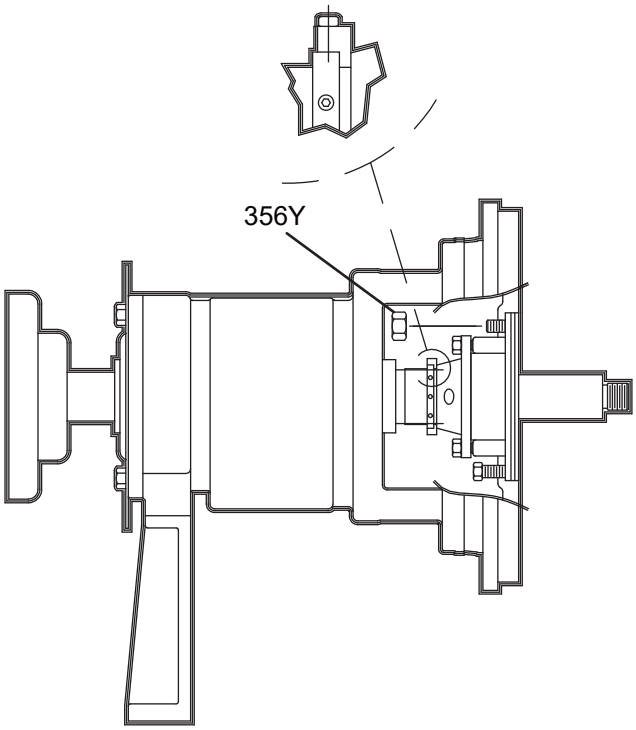


1. Sleeve puller.

6.4.11 Remove the TaperBore PLUS™ seal chamber

WARNING:
Seal chambers are heavy. Use proper support to avoid personal injury.

1. Re-engage the setting clips on the mechanical seal.



2. Thread an eye bolt (10mm, 12mm or 16mm as required) into the tapped hole provided in the cover (184) and sling to a hoist. Larger seal chambers will require two eye bolts.
3. Remove the hex head bolts or hex nuts:

If your pump group is...	**Then...**
S, M, L, and XL	Remove the eight hex head bolts (370B) from the cover (184).
XL1, XL2-S, and XL2	Remove the two hex head bolts (370H) from the frame adapter (108).
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Remove the two hex nuts (357K) from the frame adapter (108).

4. Remove the cover:

If your pump group is...	**Then...**
S, M, L, and XL	Remove the eight hex head bolts (370B) from the cover (184). Gently tap the cover from the frame using a soft-blow hammer on the dry side of the cover.
XL1, XL2-S, and XL2	Evenly tighten the two jacking bolts (418) until the cover is free enough to remove from the frame adapter. If required, gently tap the cover from the frame adapter using a soft-blow hammer on the dry side of the cover.
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Using a pry bar, gently pry the cover (184) away from the frame adapter (108) until the cover is free enough to remove from the frame adapter. If required, gently tap the cover from the frame adapter using a soft-blow hammer on the dry side of the cover.

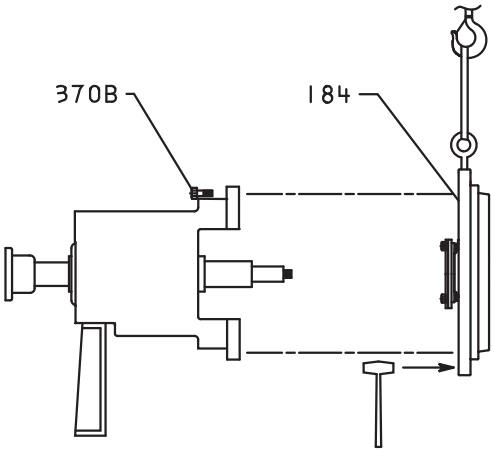


Figure 49: S, M, L, and XL

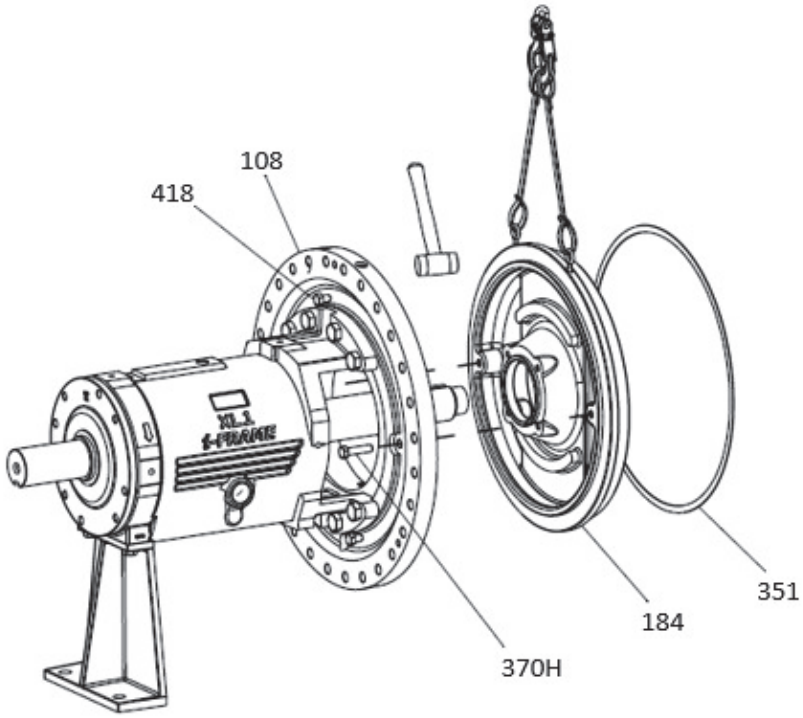


Figure 50: XL1, XL2-S, and XL2

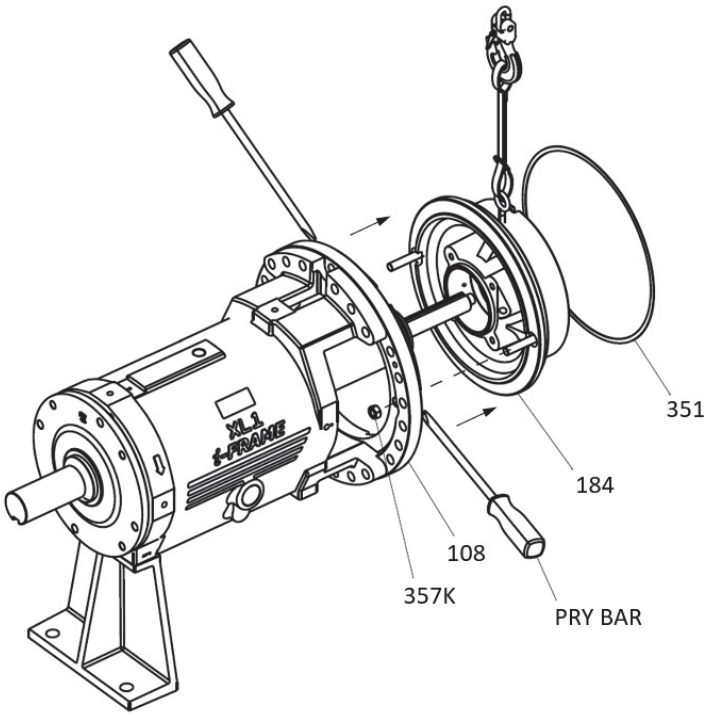


Figure 51: XL1-S1 and XL1-S2 (Sizes: 18x14-16E, 20x18-19E)

5. Remove the four hex nuts (355) from the seal gland plate.
6. Loosen the set screws on the seal drive collar and slide the sleeve out of the seal.
7. Service according to the seal manufacturer's instructions.

6.4.11.1 Remove the Spacer Ring (if provided)

Select sizes are furnished with a spacer ring that is bolted to the stuffing box cover or TaperBore PLUS™ seal chamber. The spacer ring should only be removed if necessary. To remove the spacer ring:

1. Lay the stuffing box cover or seal chamber (184) down on a clean flat surface with the spacer ring (217) facing up.
2. Remove the qty. 2 socket head caps screws (268A) that hold the spacer ring (217) to the cover or seal chamber (184).
3. If the spacer ring (217) is not loose, gently tap the sides of the ring with a soft-blow hammer until loose.
4. Lift off the spacer ring (217).

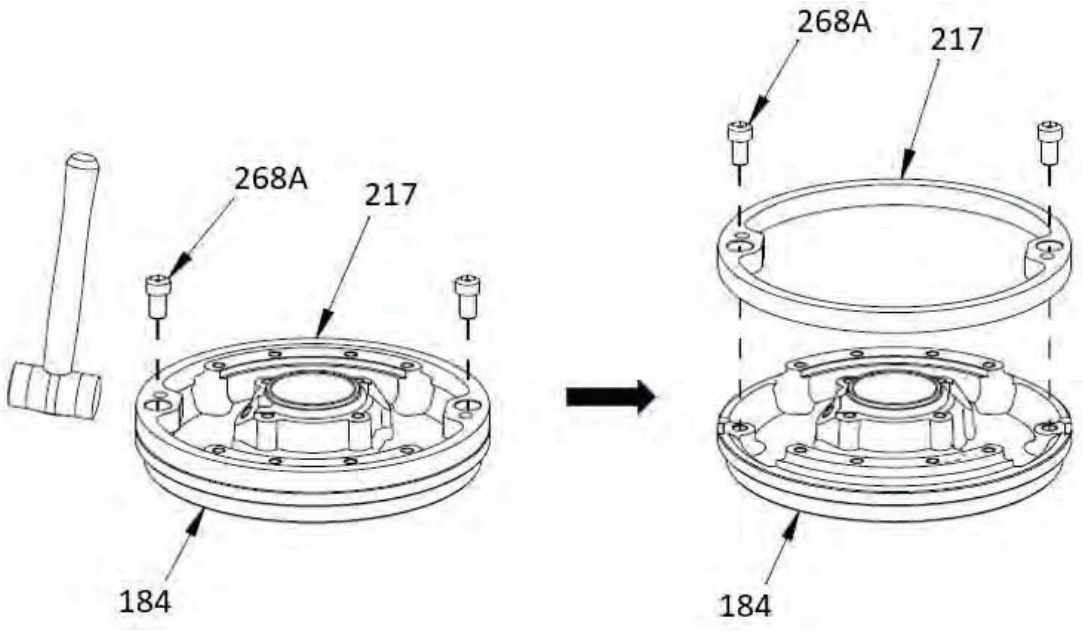


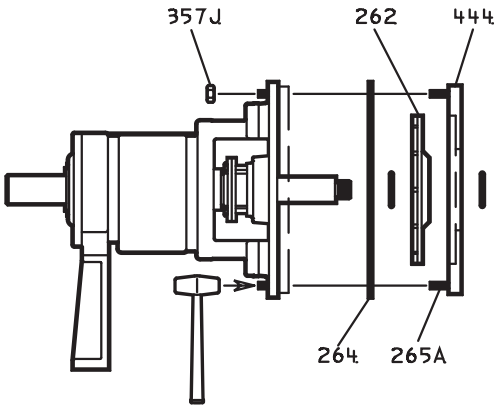
Figure 52: Spacer ring removal

6.4.12 Remove the dynamic seal

WARNING:
Covers are heavy, use the proper support to avoid personal injury.

This procedure only applies to the 3180 and 3185 pump models.

1. Remove box-to-backplate nuts (357J).
2. Remove the backplate (444) by tapping on the end of the studs with soft-faced hammer.

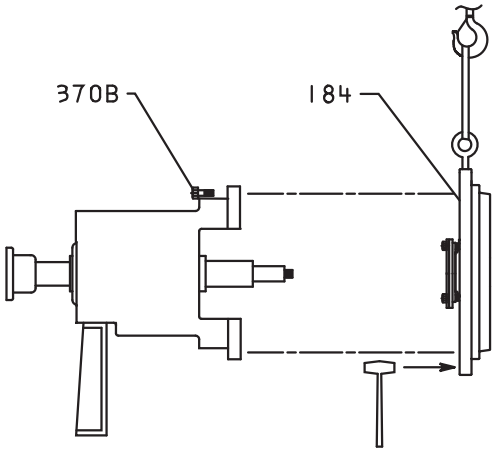


3. Remove the repeller (262):
   a) Use two bars that are 180° apart to pry between the repeller and shroud and the cover.
   b) Make sure that the gasket surfaces are not damaged.
4. Remove the secondary seal:

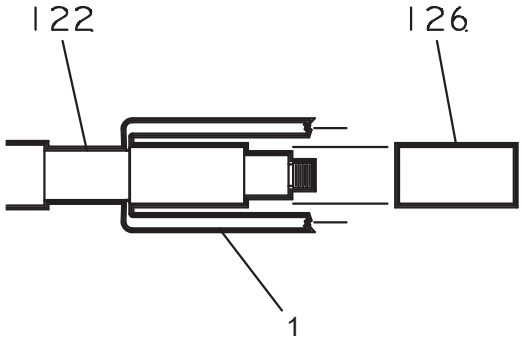
If your secondary seal is a...	Then...
Packed box	Remove the packing gland halves, the packing (106), lantern ring (105), and throttle bushing (125).

If your secondary seal is a...	Then...
Diaphragm seal	Remove the gland (107) and the diaphragm (146) from the stuffing box.

5. Thread a 10 mm eye bolt into the tapped hole provided in the cover (184) and sling to a hoist.
6. Remove eight hex head bolts (370B) from the cover (184).
7. Gently tap the cover from the frame using a soft-blow hammer on the dry side of the cover.



8. Remove the shaft sleeve (126).
   Use a puller if necessary.



1. Sleeve puller.

6.4.13 Remove the frame adapter from the frame (XL1, XL1-S1, XL1-S2, XL2-S, and XL2)

Frame groups XL1, XL1-S1, XL1-S2, XL2-S, and XL2 are furnish with a frame adapter (108). To remove frame adapter (108):

On frame groups XL1, XL2-S and XL2

1. Thread two eye bolts (12mm, 16mm or 20 mm as required) into the tapped holes provided at the top of the frame adapter (108) and sling to a hoist. Smaller frame adapters may have only one tapped hole and require only one eye bolt.
2. Remove the eight hex head bolts (370B) from the frame adapter (108).
3. Gently tap the frame adapter from the frame (228) using a soft-blow hammer on the dry side of the frame adapter.

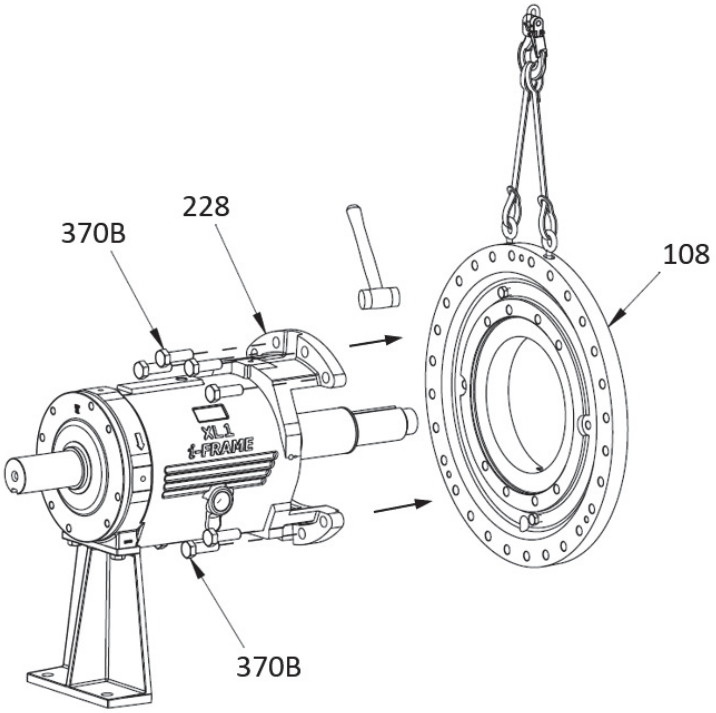


Figure 53: XL1, XL2-S and XL2

On frame groups XL1-S1 and XL1-S2 (pump sizes 18x14-16E, 20x18-19E)

1. Thread a 10mm eye bolt into the tapped hole provided at the top of the frame adapter (108) and sling to a hoist.
2. Remove the four hex head bolts (370B) from the frame adapter (108).
3. Gently tap the frame adapter from the frame (228) using a soft-blow hammer on the dry side of the frame adapter.

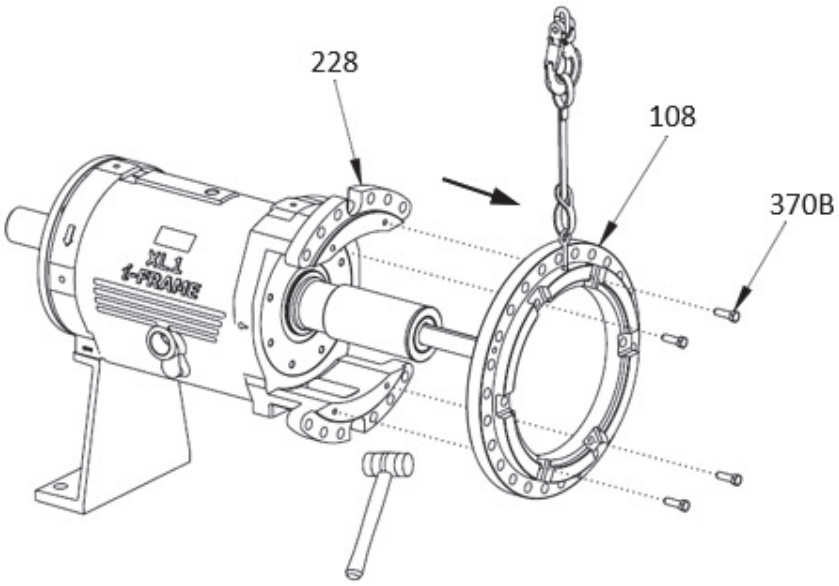
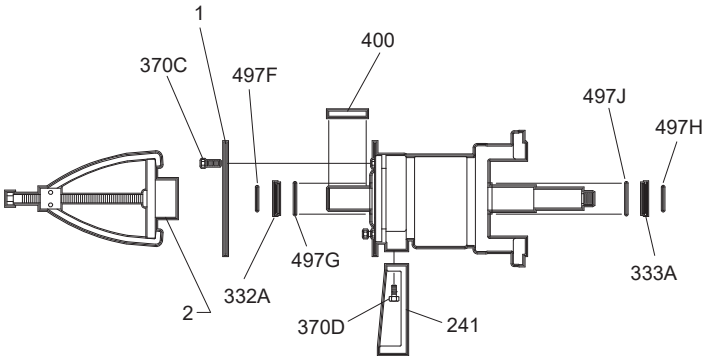


Figure 54: XL1-S1 and XL1-S2 (pump sizes 18x14-16E, 20x18-19E)

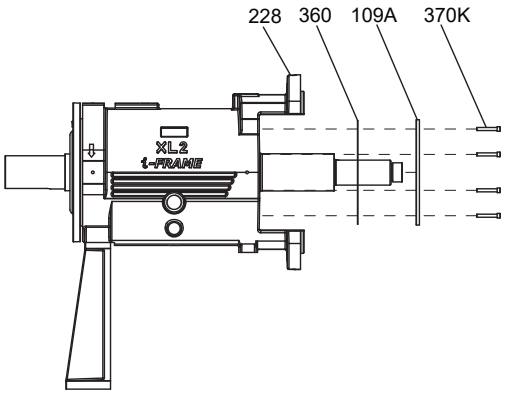
6.4.14 Disassemble the bearing frame

1. Secure the bearing-frame assembly firmly to a workbench.
2. Remove the coupling hub from the shaft by loosening the set screw (if provided) and using a puller.
3. Remove the coupling key (400).
4. Remove the coupling guard end plate by removing the bearing-housing adjuster screws (370C).
5. Remove the labyrinth shaft-seal assemblies (332A and 333A) from each end of the frame.

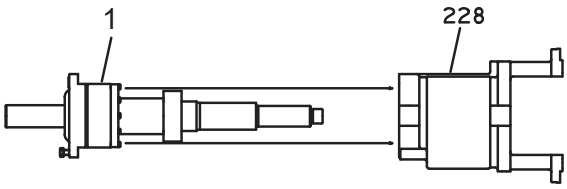


1. Coupling guard end plate
2. Coupling hub

6. For the XL1, XL2-S, and XL2 groups, remove the radial end cover (109A) and radial end-cover gasket (360) from the bearing frame (228) by removing the eight socket-head capscrews (370K).
   For the S, M, L, and XL groups the radial end cover is installed permanently at the factory and does not require removal.

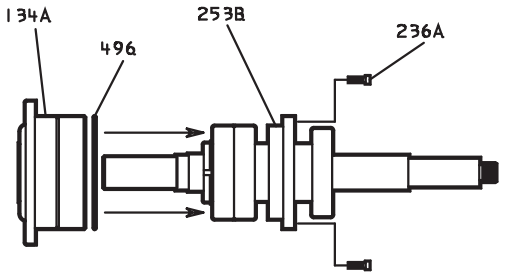


7. Slide the rotating element out of the frame (228).
   Tap the impeller end of the shaft with a soft-face hammer to assist in removal.

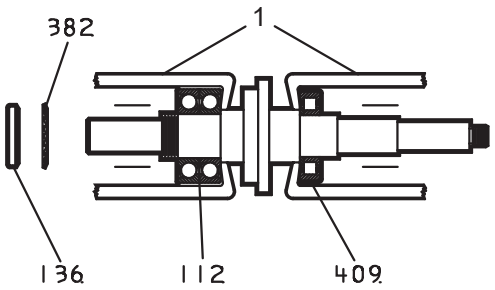


1. Rotating element.

8. Remove the thrust-bearing retainer ring (253B) by removing the socket-head cap screws (236A)
9. Slide the thrust-bearing housing (134A) off of the thrust bearings.



10. Disengage the thrust-bearing lockwasher (382) from the lock nut (136) and remove both from the shaft.
11. Remove the bearings (112 and 409) from the shaft using a suitable puller that only contacts the inner races of the bearings.



1. Bearing pullers.

6.4.15 Guidelines for i-ALERT® Equipment Health Monitor disposal

Precautions

WARNING:

- Explosive hazard and risk of personal injury. Heating to high temperatures could cause combustion of the condition monitor. Never heat the condition monitor to temperatures in excess of 149°C | 300°F or dispose of in a fire.

Guidelines

The battery contained in the condition monitor does not contain enough lithium to qualify as reactive hazardous waste. Use these guidelines when disposing of the condition monitor.

- The condition monitor is safe for disposal in the normal municipal waste stream.
- Adhere to local laws when you dispose of the condition monitor.

6.4.16 Disassemble the spring-mounted baseplate (first generation)

1. Raise or support the baseplate above the foundation/floor. Be sure to allow enough room under the baseplate to install the spring assemblies.
2. Set the bottom adjusting nuts on each spring stud to height indicated on the certified dimensional drawing.
3. Insert a washer between the bottom adjusting nut and the spring follower. Install a spring and another follower. Install this subassembly from the bottom of the baseplate.
4. Install the upper half of the spring assembly consisting of a follower, a spring, another follower, and a flat washer. Now install the top adjusting nut and jam nut. Tighten finger tight.
5. Repeat steps one through four for all the spring assemblies.
6. Once all the springs have been installed, lower the unit on to the foundation pads.

The foundation pads are supplied by the customer. They are to be 16-20 micro-inch surface finish 315 stainless steel plate.

7. Level the baseplate while making final height adjustments. Adjust the baseplate height by loosening the top jam nut and adjusting nut. Change the height by moving the lower adjusting nut. When the baseplate is level, tighten the top adjusting nuts just enough to make sure the top springs are not loose in their followers and then snug the lower and upper jam nuts.

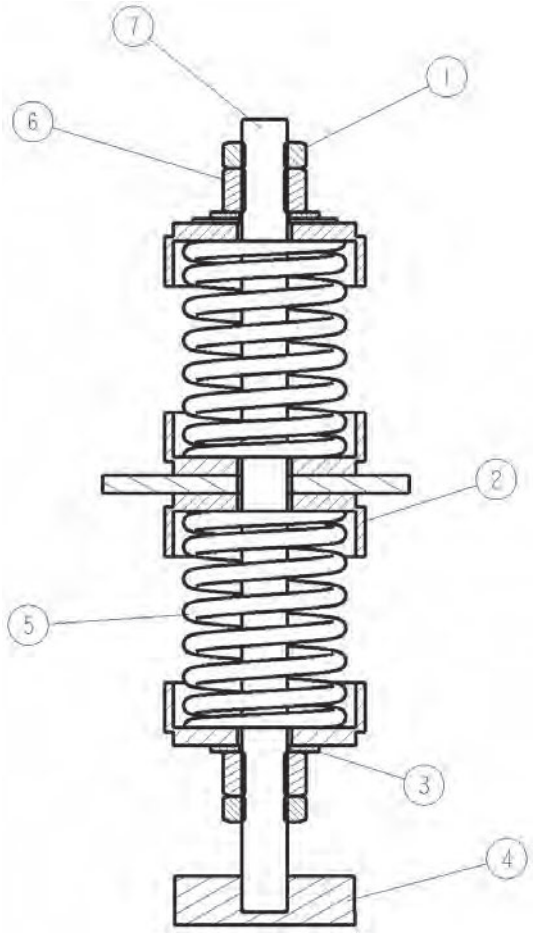


Figure 55: Exploded view of the spring assembly

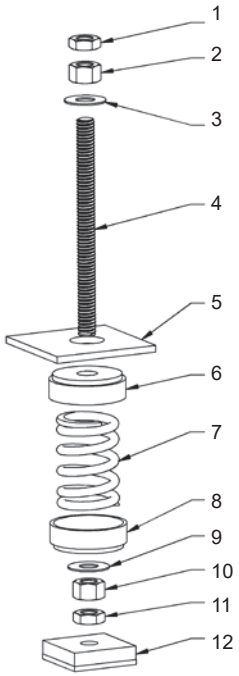
6.4.17 Disassemble the spring-mounted baseplate (second generation)

WARNING:
Springs can store energy that can launch parts at a high velocity. Before you perform any tasks, make sure that all springs are positively locked against free expansion.

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.

1. Remove the pump and motor from the baseplate in order to remove the springs.
2. Make sure all the springs are positively locked against free expansion.
3. Raise the baseplate and support it so the mounting brackets for the spring assemblies are approximately 16 in. (406 mm) above the foundation/floor.

4. Remove the upper hex jam nuts from each stud.
5. Carefully unthread the upper nuts, and allow the springs to expand slowly until the springs are loose between the followers.
   Leave the upper hex nuts on the studs.
6. Unthread and remove the studs from the bearing pads.
7. Unthread and remove the lower hex jam nuts from the studs.
8. Remove the lower hex nuts and lower followers.
9. Remove the springs.
10. Remove the upper followers.
11. Inspect studs, springs, followers, and nuts for any wear, damage, or corrosion.
    Replace when necessary.
12. Inspect each Lubrite pad for excessive wear.
    Replace when necessary.



1. Hex jam nut
2. Hex nut
3. Plain washer
4. Stud
5. Baseplate mounting bracket
6. Follower
7. Spring
8. Follower
9. Plain washer
10. Hex nut
11. Hex jam nut
12. Bearing pad assembly

Figure 56: Exploded view of the spring assembly

6.5 Preassembly inspections

6.5.1 Replacement guidelines

Casing check and replacement

WARNING:
Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Inspect and ensure gasket sealing surfaces are not damaged and repair or replace as necessary.

Inspect the casing for cracks and excessive wear or pitting. Thoroughly clean gasket surfaces and alignment fits in order to remove rust and debris.

- Localized wear or grooving that is greater than 3.2 mm | 1/8 in. deep
- Pitting that is greater than 3.2 mm | 1/8 in. deep
- Irregularities in the casing-gasket seat surface

Casing areas to inspect

The arrows point to the areas to inspect for wear on the casing:

Gaskets, O-rings, and seats replacement

WARNING:
Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Replace all gaskets and O-rings at each overhaul or disassembly.

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.

Wear rings or suction sideplate checks

Check the surfaces for pitting, and excessive wear or corrosion damage.

Stuffing box cover and seal chamber replacement

- Thoroughly clean the gasket surfaces and fits to remove rust and debris.
- Inspect surfaces for pitting, and excessive wear or corrosion damage.

6.5.2 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.

6.5.3 Bearing-frame inspection

Checklist

Check the bearing frame for these conditions:

- Visually inspect the bearing frame and frame foot for cracks.
- Check the inside surfaces of the frame for rust, scale, or debris. Remove all loose and foreign material.
- Make sure that all lubrication passages are clear.
- If the frame has been exposed to pumped fluid, inspect the frame for corrosion or pitting.
- Inspect the inboard bearing bores. If any bores are outside the measurements in the Bearing fits and tolerances table, replace the bearing frame.
- Inspect the shafts and sleeves for wear.
- Inspect the labyrinth seal O-rings for cuts and cracks.

6.6 Reassembly

6.6.1 Assemble the bearing frame

WARNING:
Do not use a flame to heat bearings. This will damage the bearing surfaces.
Wear insulated gloves when you use a bearing heater. Bearings get hot and can cause physical injury.

1. Install the bearings on the shaft:

   a) Use an induction bearing heater in order to heat the bearings to approximately 250°F (121°C). This expands the bearings to ease their installation on the shaft.

   b) Install the radial bearing (409) onto the shaft (122). For the S, M, L, and XL groups, make sure that the spacer ring is placed between the shaft shoulder and inner race.

   Care must be taken to keep the inner race together with the roller assembly during installation.

   c) Place the thrust-bearing retainer ring (253B) on the shaft between the bearing fits with a small diameter-facing coupling end.

   d) Determine the orientation of the angular contact thrust bearings (112) for back-to-back mounting.

   This is with the thick shoulders of the outer races together.

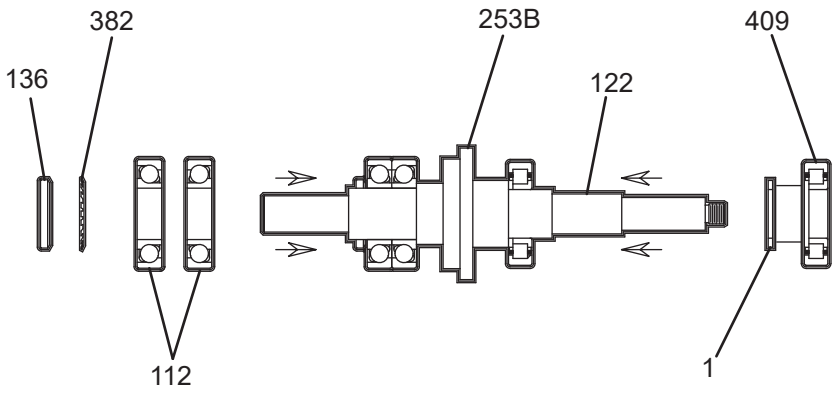
   e) Slide the angular contact duplex bearings (112) onto the shaft while you maintain the correct orientation.

   f) Push the inner races firmly together against the shoulders until they cool and lock into place.

   g) After the bearings have cooled, place the lockwasher (382) on the shaft and install the bearing locknut (136).

   h) Tighten the bearing locknut firmly with a spanner wrench while you clamp the bearing set against the shaft shoulder.

   i) Bend the tang of lockwasher into a slot on the bearing locknut.



1. Spacing ring.

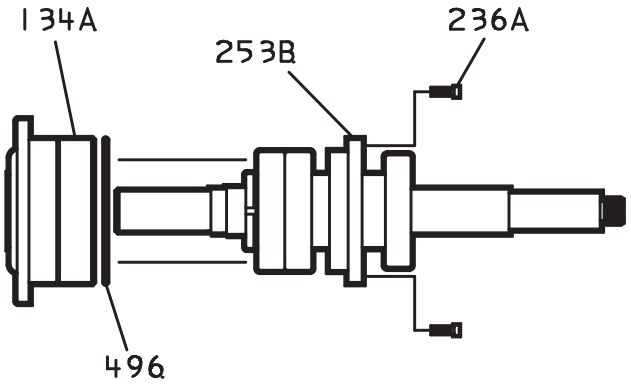
2. If the frame is grease lubricated, hand pack all three bearings with grease.
3. Lubricate and install the O-ring (496) on the thrust bearing housing (134A):

   a) Slide the thrust bearing housing over the bearings.

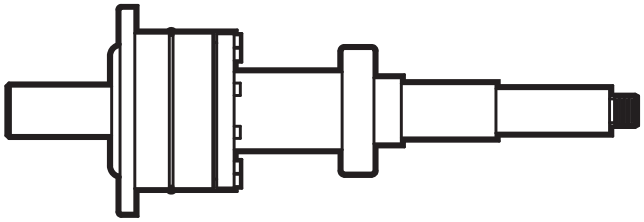
   b) Attach the thrust-bearing retaining ring (253B) to the thrust bearing housing with socket head capscrews (236A).

   Tighten firmly in a crossing sequence in order to make sure there is even contact with the bearing races. See Maximum torque values for fasteners.

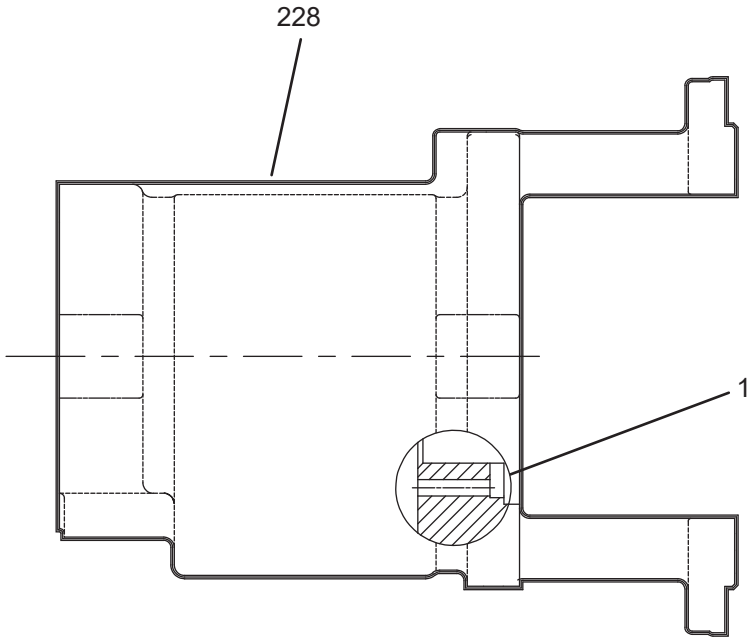
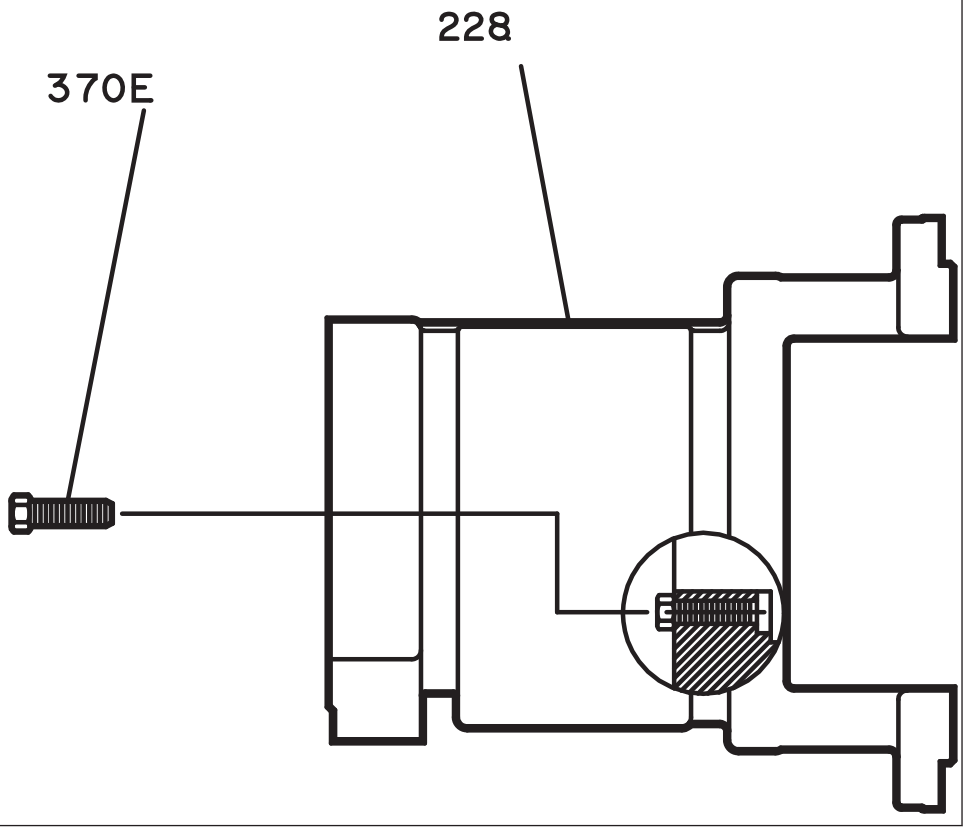
For the S, M, L, and XL groups:	For the XL1, XL2-S, and XL2 groups:
There will be a gap of approximately 0.12 to 0.16 in. (3.05 to 4.06 mm) between the retaining ring and bearing housing.	There will be a gap of approximately 0.16 to 0.21 in. (4.06 to 5.33 mm) between the retaining ring and bearing housing.



Assembled rotating element:

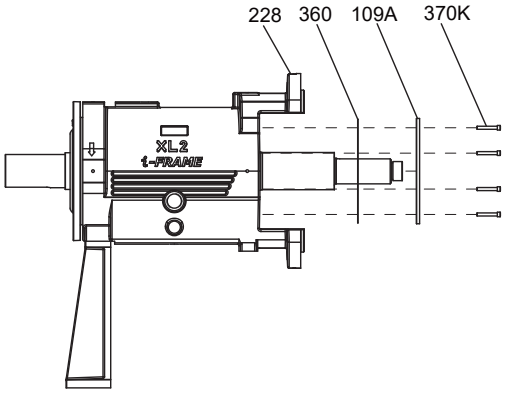


4. Prepare the bearing frame for either grease or oil lubrication.

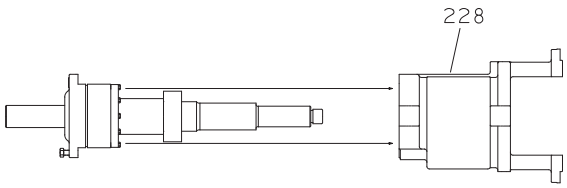
If your bearing frame is...	Then...
Oil lubricated	Make sure that the oil return is fully open (no plug).  1. Oil return
Grease lubricated	Make sure that the plug (370E) is installed in the radial end oil return. 

If you are changing the lubrication from grease to oil, remove the accumulated grease from the oil return after you remove the plug.

5. Complete these steps if you removed the radial end cover (109A):

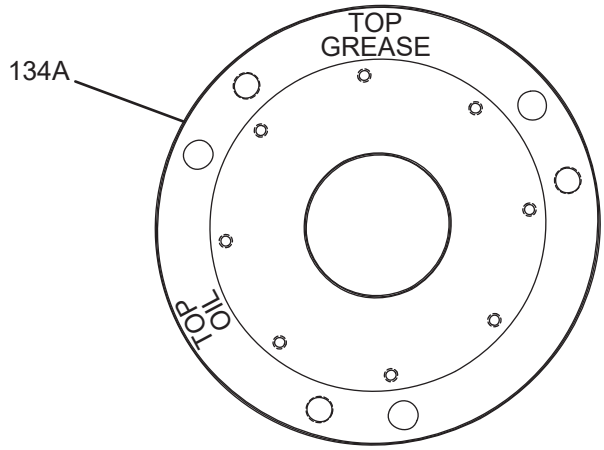
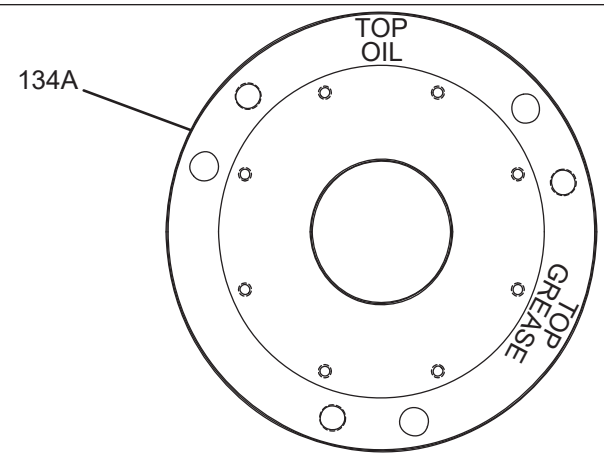
If your pump group is...	Then...
S, M, L, and XL	1. Degrease the surfaces and those in the frame. 2. Apply Loctite 518 to the outer diameter of the cover. 3. Tap the cover in place using a soft blow hammer.
XL1, XL1-S1, XL1-S2, XL2-S, and XL2	1. Degrease the surfaces and those in the frame. 2. Install the radial end cover gasket (360). 3. Install the radial end cover (109A) using the eight socket-head capscrews (370K) into the frame (228). 

6. Lightly lubricate the bearing bores (outer diameter of radial bearing), thrust bearing housing, and O-ring with grease or light oil. Carefully insert the rotating element into the bearing frame.



1. Rotating element

7. Orient the bearing housing depending on the lubrication.

If the pump uses this kind of lubrication...	Then, these words should appear on top...	And, the bearing housing looks like this...
Grease lubrication	"TOP GREASE"	
Oil lubrication	"TOP OIL"	

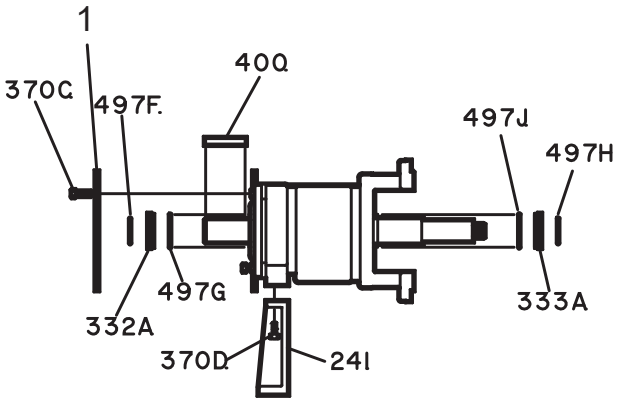
8. Assemble the end plate of the coupling guard to the bearing housing:

   a) Align the coupling guard end plate to the bearing housing frame holes in the thrust bearing housing and install the hex cap bolts (370C).

   b) Adjust the housing so that there is a gap of approximately 0.12 in. (3.05 mm) between the housing and the frame.

   These measurements show the gap after you set the impeller:

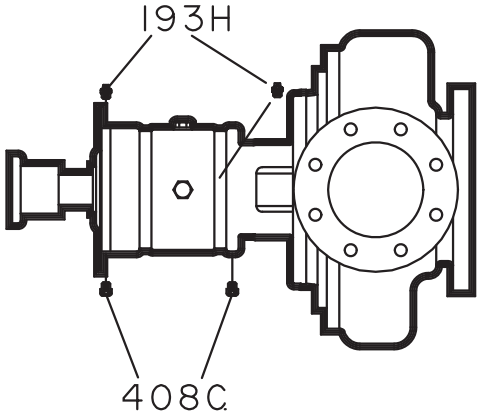
   - 0.25 in. (6.35 mm) on the S and M frames
   - 0.38 in. (9.65 mm) on the XL1, XL1-S1, XL1-S2, XL2-S, and XL2 frames

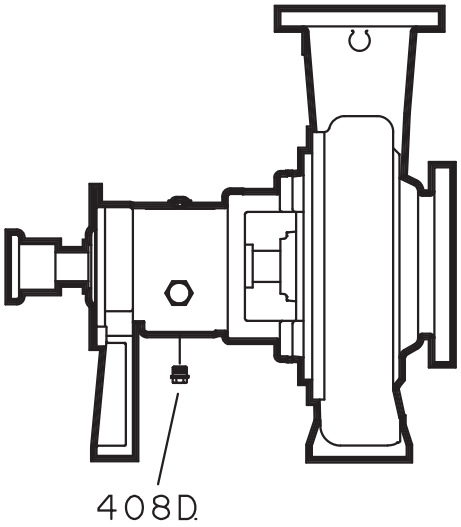


1. Coupling guard end plate.

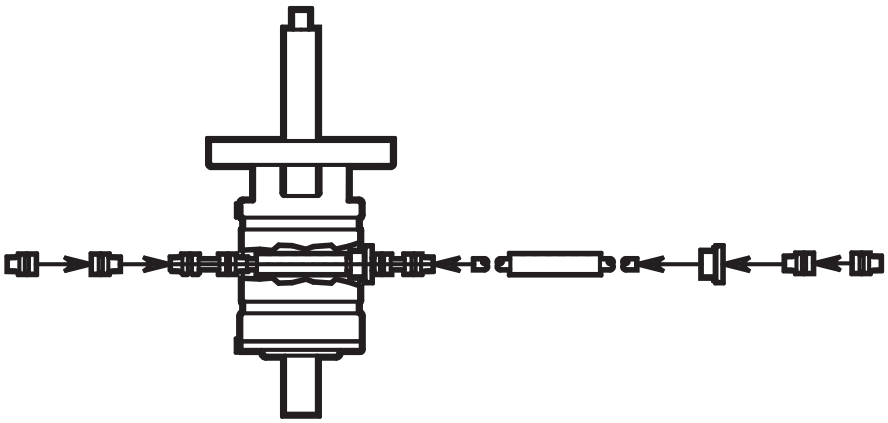
9. Lubricate the O-rings on the labyrinth oil seals.
10. Install the seal assembly into the bearing frame until the shoulders seat against the bearing frame.
11. Install these items on the bearing frame:
    - Oil fill plug (408H)
    - Shaft key (400)
    - Coupling hub
    - Frame foot (241)
12. Lubricate the bearing frame for grease or oil:

If you lubricate with...	Then...
Oil	1. Install these four plugs (408C) as viewed from the coupling end: • One on the left side of the frame (228) • Two on the right side of the coupling end • One at the stuffing box end at the top of the frame (228) 2. Install the oil level sight glass (319) on the right side of the frame (228). 3. If installing a sight oiler (251), install it on the left side of the frame as viewed from the coupling end. Refer to separate instruction for sight oiler installation.
Grease	1. Install two grease fittings (193H) as viewed from the coupling end: • One on the left side of the frame (228) • One at the stuffing box end at the top of the frame 2. Install two plugs (408C and 408D) on the right side of the frame (228).





13. If your pump is equipped with an oil cooler, install the cooler assembly as follows (as viewed from the coupling end):
    a) Install one tube fitting with a straight bore on the left side of the frame in the tapped opening provided.
    b) Slide the finned tube through the hole on the right side of the frame.
    c) Install the reducer bushing on the right side of the frame and thread a second tube fitting (with a straight bore) into the reducer bushing.
    d) Center the tube in the frame and tighten the ferrule nuts on the tube fittings.
    e) Install one tube fitting with a stepped bore on each end of the tube and tighten the ferrule nuts.



6.6.2 Assemble the frame adapter to the frame

Frame groups XL1, XL1-S1, XL1-S2, XL2-S, and XL2 are furnished with a frame adapter (108). To assemble the frame adapter (108):

On frame groups XL1, XL2-S and XL2

1. Thread two eye bolts into the tapped holes provided at the top of the frame adapter (108) and sling to a hoist. Smaller frame adapters may have only one tapped hole and require only one eye bolt.
2. Install the frame adapter (108) to the frame using eight hex head bolts (370B) as shown below.

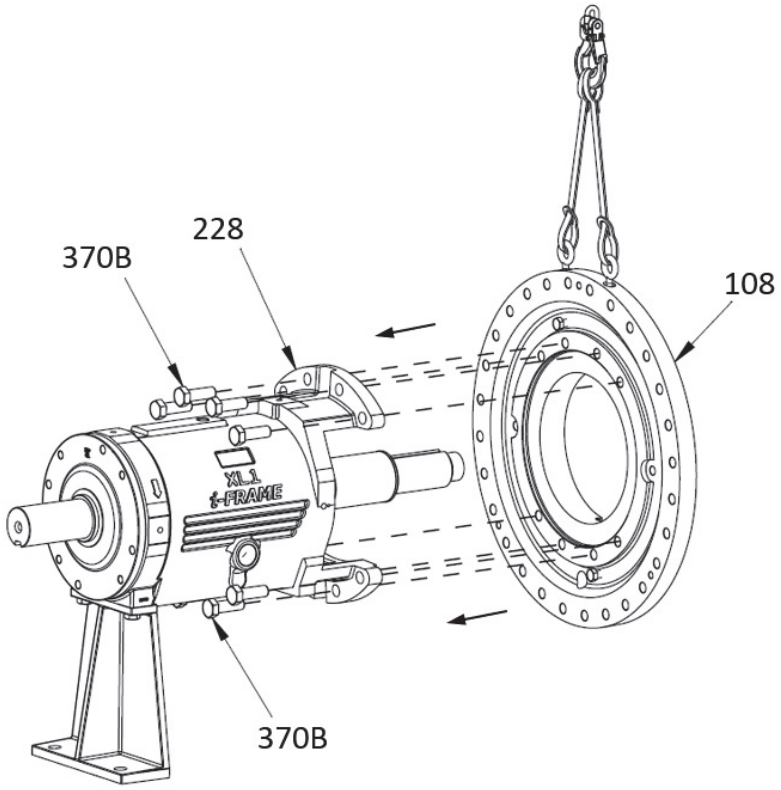


Figure 57: XL1, XL2-S and XL2

On frame groups XL1-S1 and XL1-S2 (pump sizes 18x14-16E, 20x18-19E)

1. Thread a 10mm eye bolt into the tapped hole provided at the top of the frame adapter (108) and sling to a hoist.
2. Install the frame adapter (108) to the frame using four hex head bolts (370B) as shown below.

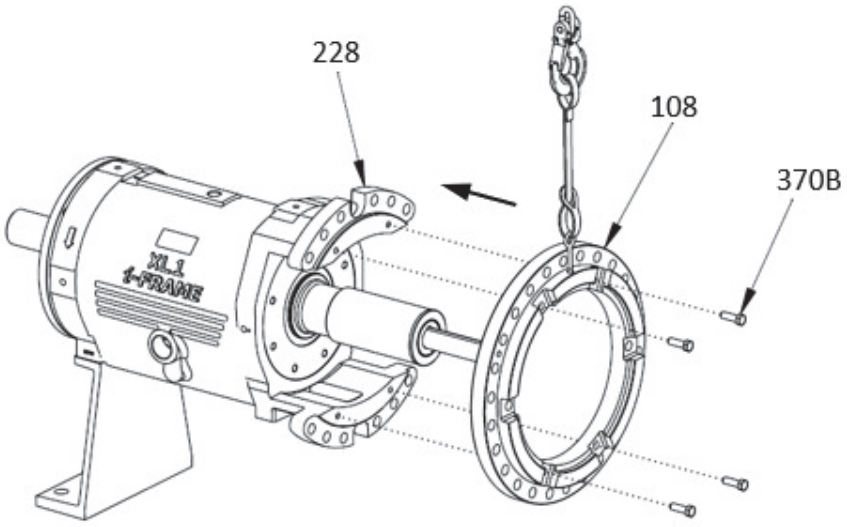


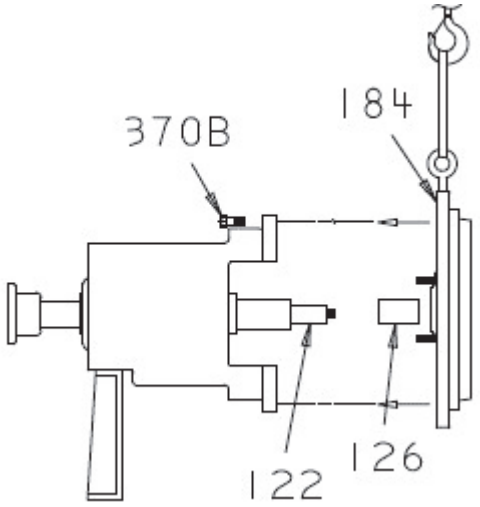
Figure 58: XL1-S1 and XL1-S2 (pump sizes 18x14-16E, 20x18-19E)

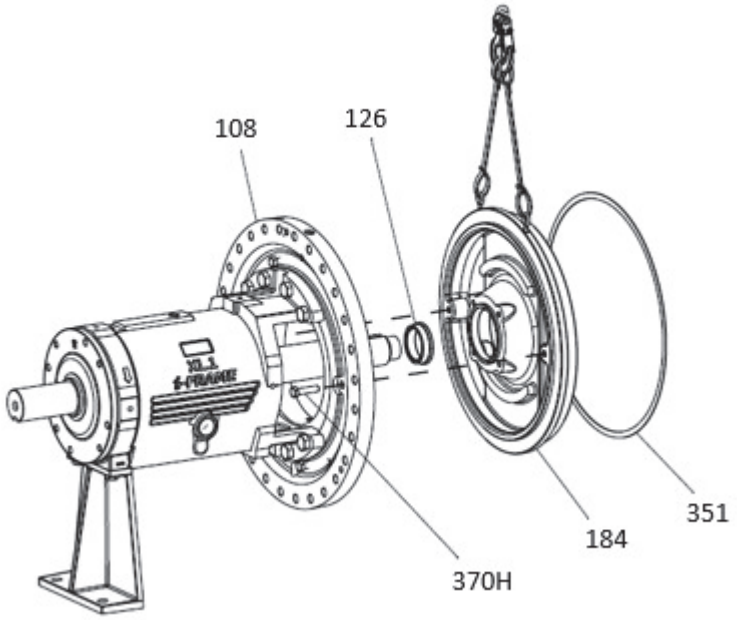
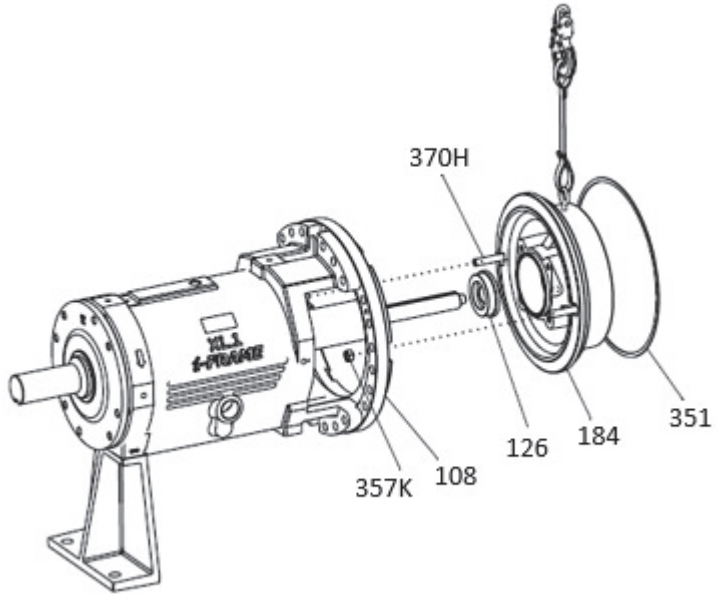
6.6.3 Assemble the TaperBore PLUS™ seal chamber

1. Apply a liberal amount of an anti-galling compound, such as Loctite Nickel Anti-seize, to the shaft sleeve (126) bore and shaft (122).
2. Install the sleeve and cartridge seal:

If your pump group is...	Then...
S, M, L, and XL	• Slide the sleeve (126) onto the shaft (122). • Slide the cartridge seal onto the sleeve (126).
XL1, XL1-S1, XL1-S2, XL2-S, and XL2	• Slide the cartridge seal onto the shaft (122). • Slide the stub sleeve (126) onto the shaft (122)

3. Thread an eye bolt (10mm, 12mm or 16mm as required) into the tapped hole provided in the cover (184) and sling to a hoist. Larger seal chambers will require two eye bolts.
4. Install the seal chamber (184):

If your pump group is...	Then...
S, M, L, and XL	Assemble the seal chamber (184) to the bearing frame using eight hex head bolts (370B). 
XL1, XL2-S, and XL2	Assemble the seal chamber (184) to the frame adapter (108) using two hex head bolts (370H).

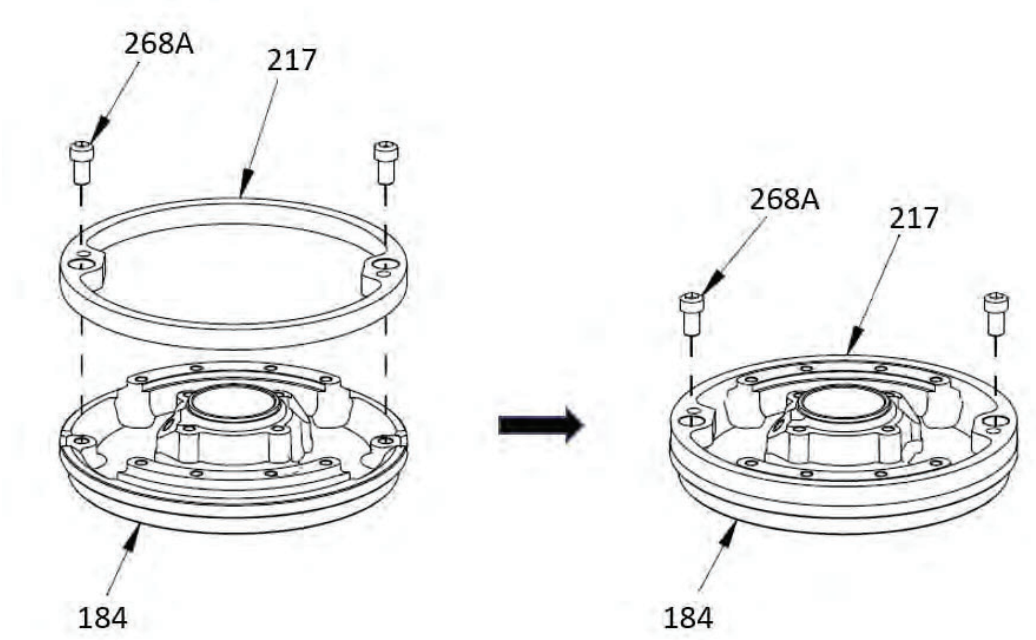
If your pump group is...	Then...
	
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Thread two studs (370H) into the seal chamber (184) mounting holes. Assemble the seal chamber (184) to the frame adapter (108) using two hex nuts (357K). 

5. Slide the cartridge seal on the gland studs and make sure that the tap connections are in the correct orientation.
6. Hand-tighten the gland nuts.
7. Install the impeller and set the clearance.
8. Set the seal:
   a) Tighten the set screws in the drive collar while the setting clips are engaged.
   b) Tighten the gland nuts (355) evenly.
   c) Disengage the setting clips.

6.6.4 Assemble the Spacer Ring (if provided)

Select sizes are furnished with a spacer ring that is bolted to the stuffing box cover or TaperBore PLUS™ seal chamber. To assemble the spacer ring:

1. Lay the stuffing box cover or seal chamber (184) down on a clean flat surface with the bolt holes facing up.
2. With the counter-bored holes facing up, lower the spacer ring (217) onto the stuffing box cover or TaperBore PLUS™ seal chamber (184).
3. Ensure the bottom face of the spacer ring (217) is fully seated on the outer top face of the stuffing box cover or TaperBore PLUS™ seal chamber (184).
4. Insert qty. 2 socket head caps screws (268A) into the counter-bored holes of the spacer ring (217) and tighten to secure it to the stuffing box cover or TaperBore PLUS™ seal chamber (184).

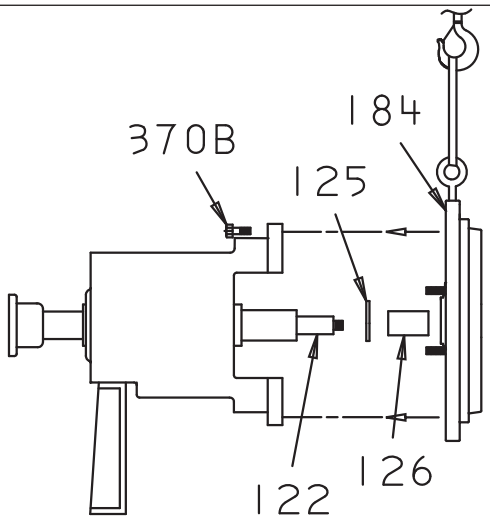
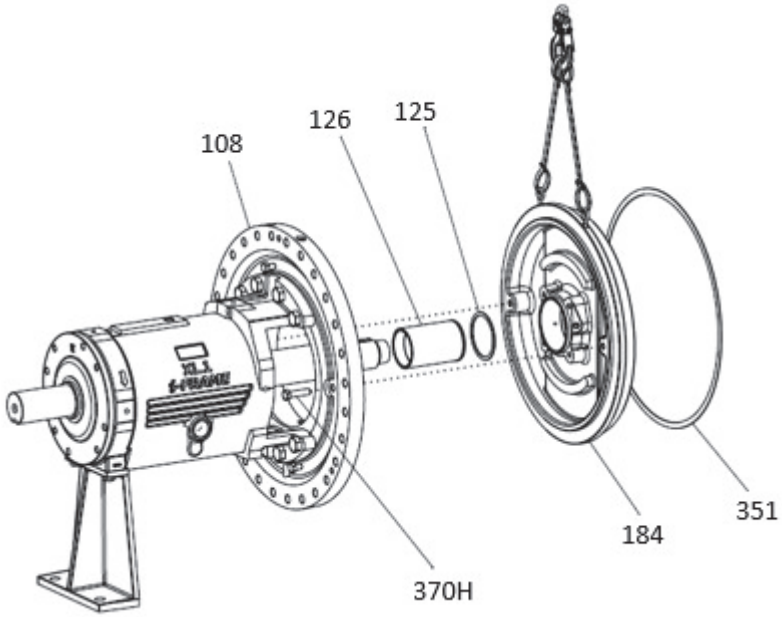


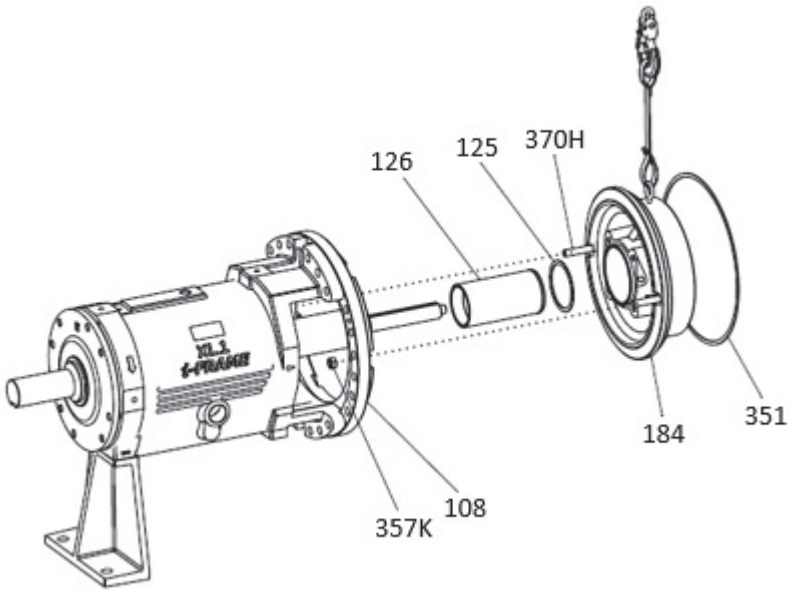
6.6.5 Assemble the stuffing-box cover

WARNING:
Do not use packing that contains asbestos, it may cause personal injury.

1. Apply a liberal amount of an anti-galling compound, such as Loctite Nickel Anti-seize, to the shaft sleeve (126) bore and shaft (122).
2. Slide the sleeve onto the shaft.
3. Slide the throttle bushing (125) to the back of the shaft sleeve.
4. Thread an eye bolt (10mm, 12mm or 16mm as required) into the tapped hole provided in the cover (184) and sling to a hoist. Larger seal chambers will require two eye bolts
5. Install the seal chamber (184):

If your pump group is...	Then...
S, M, L, and XL	Assemble the seal chamber (184) to the bearing frame using eight hex head bolts (370B).

If your pump group is...	Then...
	
XL1, XLS-2, and XL2	Assemble the seal chamber (184) to the frame adapter (108) using two hex head bolts (370H). 
XL1-S1 and XL1-S2 Sizes: 18x14-16E 20x18-19E	Thread two studs (370H) into the seal chamber (184) mounting holes. Assemble the seal chamber (184) to the frame adapter (108) using two hex nuts (357K).

If your pump group is...	Then...
	

6. Install and adjust the packing after the impeller is installed and the clearance is set.
   If you use conventional component seals, install them according to the instructions from the seal manufacturer and the installation drawings.

6.6.6 Install the dynamic seal (S, M, L, and XL)

WARNING:
Do not use packing that contains asbestos, it may cause personal injury.

This procedure only applies to the 3180 and 3185 pumps.

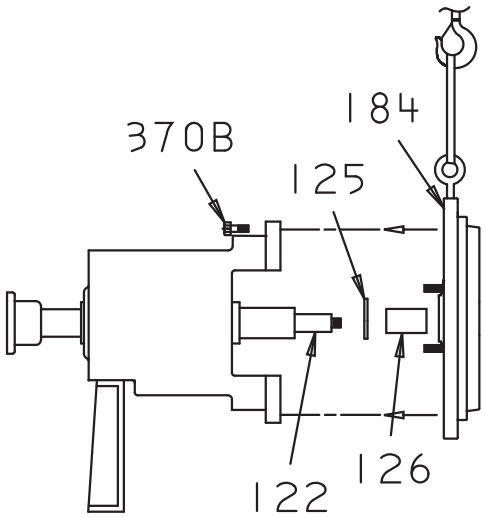
1. Apply a liberal amount of a anti-galling compound, such as Loctite Nickel Anti-seize, to the shaft sleeve (126) bore and shaft (122).
2. Install the sleeve on the shaft.
3. Perform these steps based on your dynamic seal configuration:

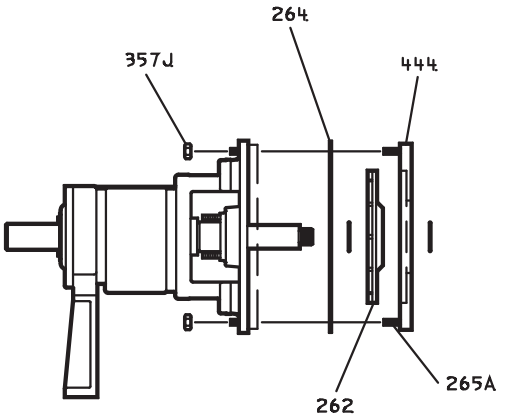
If your dynamic seal is a...	Then...
Diaphragm seal	1. Place an O-ring in the groove at the inner diameter of the follower (385) and slide the assembly to the back of the sleeve. 2. Place a gland plate over the follower (385) and slide the diaphragm (146) over the sleeve to the face of the seat. 3. Install four gland studs (353) in the stuffing box cover (184). 4. Use the eye bolt, strap, and sling as required. 5. Install the cover on the bearing frame (228) with eight hex bolts (370B). 6. Fit the sleeve O-ring (412U) on the shaft sleeve. 7. Install the repeller (262) tight against the sleeve and make sure that the O-ring stays in the groove.
Packed box	1. Slide the throttle bushing (125) to the back of the sleeve. 2. Install two gland studs (353) in the stuffing box cover (184). 3. Install the cover on the bearing frame (228) with eight hex bolts (370B).

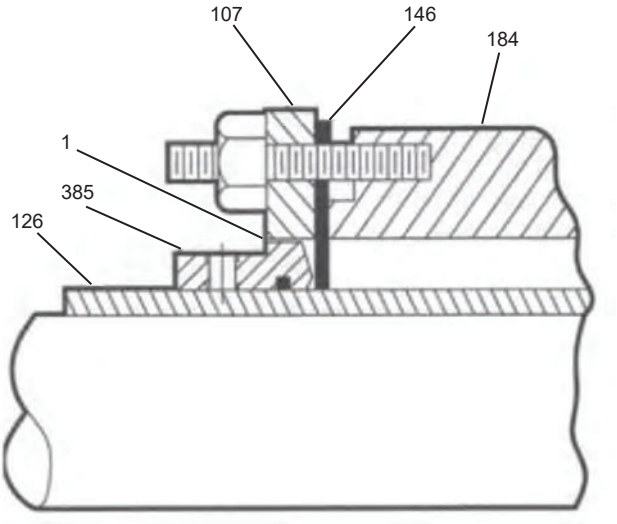
If your dynamic seal is a...	Then...
	4. Use the eye bolt, strap, and sling as required. 5. Fit the repeller O-ring (412U) on the shaft sleeve and install the repeller (262) tight against the sleeve. 6. Make sure that the O-ring stays in the groove.

4. Keep the repeller and sleeve assembly shouldered to the shaft, and adjust the rotating element until the repeller-to-cover clearance is approximately 0.015 in. (0.4 mm).
5. Fit the gasket (264) on the backplate (444).
6. Install the backplate on the cover and tighten the nuts (357J) on the backplate studs (265A).
7. Perform these steps based on your seal:

If your dynamic seal is a...	Then...
Diaphragm seal	1. Slide the diaphragm (146) over the gland studs (353) and up against the face of the stuffing box. 2. Slide the gland plate (107) over the gland studs (353) and up against the diaphragm (146). 3. Thread the gland nuts (355) on and tighten evenly in a crossing pattern. 4. Install the impeller and set the clearance per the instructions in the Commissioning, Start-up, Operations, and Shut-down chapter. 5. Slide the follower (385) through the gland (107) until the step on the seal is aligned with the exposed face of the gland.
Packed box	1. Install the impeller and set the clearance according to the instructions in the Commissioning, Start-up, Operations, and Shut-down chapter. 2. Install and adjust the packing.







1. Alignment of step on follower with exposed face of gland.

6.6.7 Shaft guard installation (if provided)

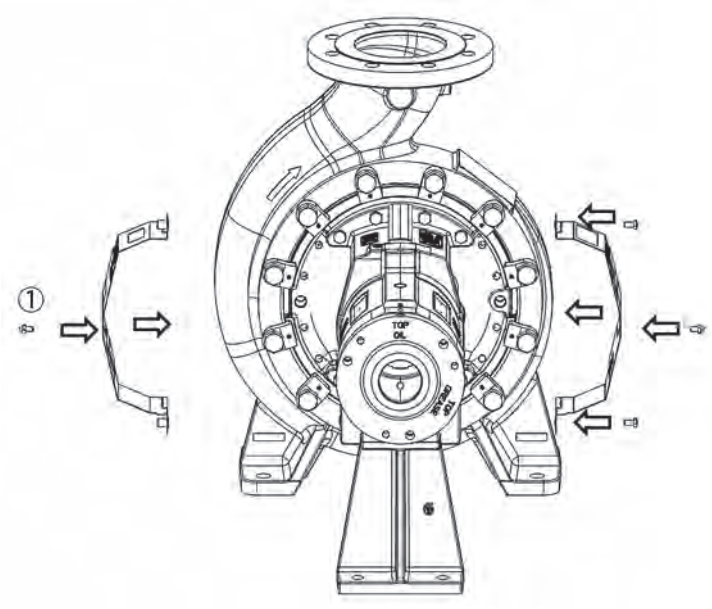
6.6.7.1 Install the shaft guard

WARNING:

- 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.
- Exposed rotating shaft between pump seal and bearing frame. Avoid contact and/or install proper guarding. If guarding is not provided with the pump, contact Goulds for price and availability of proper guarding.

1. Ensure that the mounting bolt for each shaft guard half is inserted with the bolt retainer in place for captive hardware.

2. Assemble a guard half from each side of the pump and fasten to the bearing frame.
3. Ensure that adequate coverage is maintained for rotating components.



Item	Description
1.	Mounting bolt

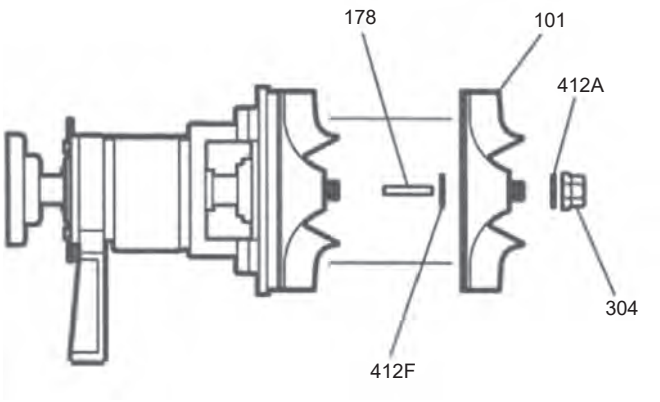
Figure 59: Shaft guard assembly

6.6.8 Impeller installation

If your pump uses this type of impeller...	Then refer to this installation procedure...
Enclosed impeller	Install an enclosed impeller.
Open impeller	Install an open impeller.
Shearpeller™	Install a Shearpeller™.

6.6.8.1 Install an open impeller

1. Install the shaft key (178) on the shaft (122).
2. Fit the sleeve O-ring (412F) on the shaft sleeve (126).
3. Apply a liberal coating of an anti-galling compound, such as Loctite Nickel Anti-seize, to the impeller bore and shaft.
4. Apply a coating of Loctite 272 approximately 1/8 in. wide along the entire thread length.
5. Slide the impeller (101) onto the shaft and make sure that the sleeve O-ring (412F) stays in the groove.
6. Fit the O-ring (412A) into the impeller nut (304) and install it on the shaft.



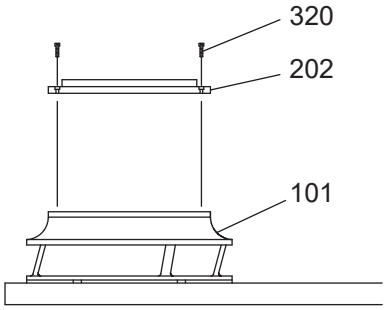
7. Prevent the coupling end of the shaft from turning and torque the impeller nut to the specified amount in the Maximum torque values for fasteners table in the Reassembly section of the Maintenance chapter.

CAUTION:

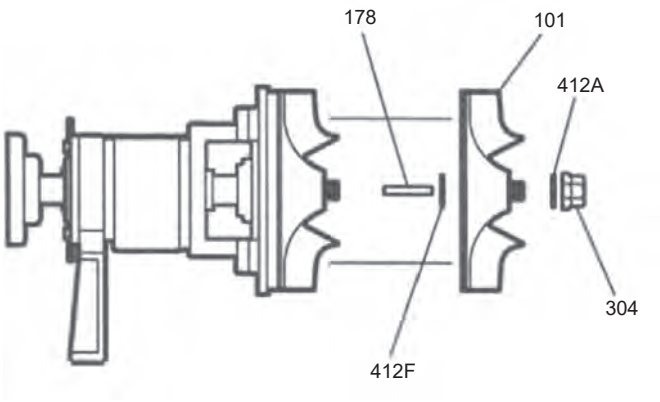
Failure to torque the impeller nut can result in serious mechanical damage.

6.6.8.2 Install an enclosed impeller

1. For the S, M, L, and XL sizes, install the wear ring (202) on the impeller and align the holes.



2. Apply an anti-galling compound, such as Loctite Nickel Anti-seize, to the socket head capscrews (320), and install and tighten.
   For the S, M, L, and XL sizes, thread sealer is used to ease future disassembly.
3. Turn the impeller ring OD to the dimensions shown in Radial ring clearances for enclosed impellers, found in the Commissioning, Startup, Operation, and Shutdown chapter.
   For the S, M, L, and XL sizes, it might be necessary to drill and tap new holes for wear ring screws. In this case, use the wear ring as a drilling template and offset (rotate) away from any previous holes.
4. Install the shaft key (178) on the shaft (122).
5. Fit the sleeve O-ring (412F) on the shaft sleeve (126).
6. Apply a liberal coating of an anti-galling compound, such as Loctite Nickel Anti-seize, to the impeller bore and shaft.
7. Apply a coating of Loctite 272 approximately 1/8 in. wide along the entire thread length.
8. Slide the impeller (101) onto the shaft and make sure that the sleeve O-ring (412F) stays in the groove.
9. Fit the O-ring (412A) into the impeller nut (304) and install it on the shaft.



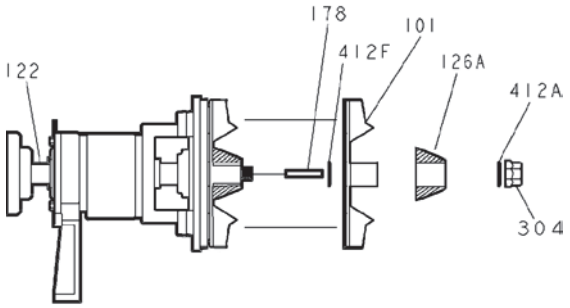
10. Prevent the coupling end of the shaft from turning and torque the impeller nut to the specified amount in the Maximum torque values for fasteners table in the Reassembly section of the Maintenance chapter.

CAUTION:

Failure to torque the impeller nut can result in serious mechanical damage.

6.6.8.3 Install a Shearpeller™

1. Install the shaft key (178) on the shaft (122).
2. Fit the sleeve O-ring (412F) on the shaft sleeve (126).
3. Apply a liberal coating of an anti-galling compound, such as Loctite Nickel Anti-seize, to the impeller bore and shaft.
4. Apply Loctite 272 approximately 1/8 in. wide along the entire thread length.
5. Slide the impeller (101) onto the shaft and make sure that the sleeve O-ring (412F) stays in the groove.
6. Install the Shearpeller™ sleeve (126A) on the shaft.
7. Fit the.O-ring (412A) into the Shearpeller™nut (304) and install it on the shaft.



8. Prevent the coupling end of the shaft from turning and torque the Shearpeller™ nut to the specified amount in the Maximum torque values for fasteners table in the Reassembly section of the Maintenance chapter.

CAUTION:

Failure to torque the impeller nut can result in serious mechanical damage.

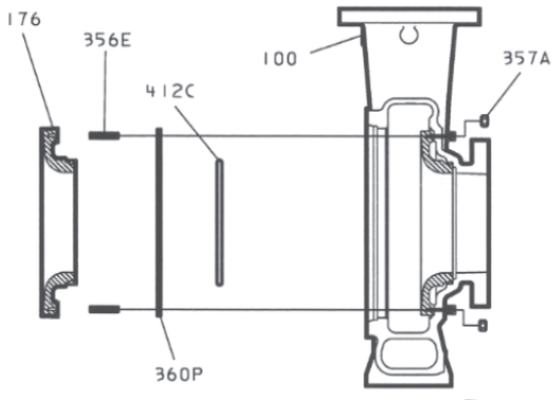
6.6.9 Install the suction sideplate

WARNING:
Sideplates are heavy. Use the proper support to avoid personal injury.

NOTICE:
Ensure that the gasket is not pinched between the sideplate outer diameter and bore in the casing or the sideplate will not seat properly.

This procedure only applies to the open impeller and Shearpeller™.

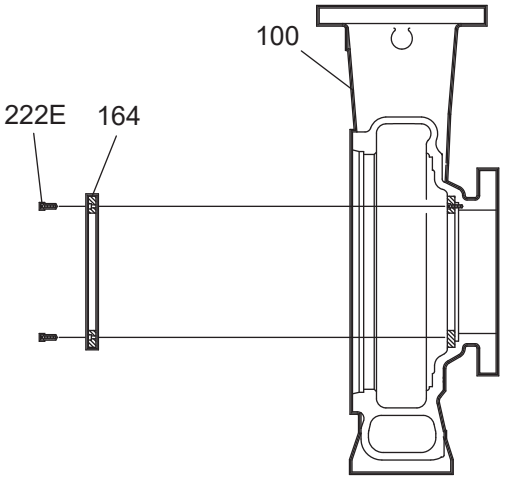
1. Install the sideplate studs (356E).
2. Install the gasket (360P) on the sideplate studs (356E).
3. Lubricate and fit the O-ring (412C) in the sideplate groove.
4. Align the sideplate studs (356E) with the casing holes, and install the sideplate (176). Tap the sideplate with a block of wood to assist seating the O-ring in the casing bore.
5. Install the hex nuts (357A) on the sideplate studs (356E) and tighten in a crossing pattern.



6.6.10 Install the casing wear ring (S, M, L, and XL enclosed impeller)

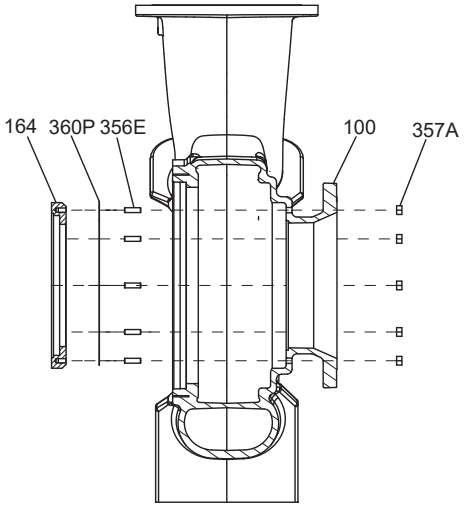
This procedure applies to the maintenance of an enclosed impeller.

1. Install the wear ring (164) in the casing.
2. If necessary, locate, drill, and tap three new setscrew holes, spacing them equally between the ring and the ring-seat area.
3. Install the setscrews and upset threads.



6.6.11 Install the casing wear ring (XL1, XL1-S1, XL1-S2, XL2-S, and XL2 enclosed impeller)

1. Install the casing wear ring studs (356E) into the casing wear ring (164).
2. Install the casing wear ring gasket (360P) on the casing wear ring studs (356E).
3. Align the casing wear ring studs (356E) with the holes in the casing (100), and install the casing wear ring (164).
4. Install the hex nuts (357A) on the casing wear ring studs (356E) and tighten in a crossing pattern.



6.6.12 Install the back pull-out assembly

1. Adjust the impeller so that the gap between the back pump-out vanes and the cover is approximately 0.02 in. (0.50 mm).
2. Place the casing gasket (351) on the stuffing-box cover (184).
3. Place a sling from the hoist through the frame arms above the pump shaft.
4. On a flat surface, such as a baseplate or a sturdy workbench, install the back pull-out assembly into the casing.
   Make sure that the casing and frame feet are flat on the surface.
5. Hand-tighten the casing bolts (370A) and seat the back pull-out assembly into the casing. On sizes 18x14-16E and 20x18-19E also hand-tighten the qty. 12 frame to casing bolts (370).
   Do not torque the bolts at this time.

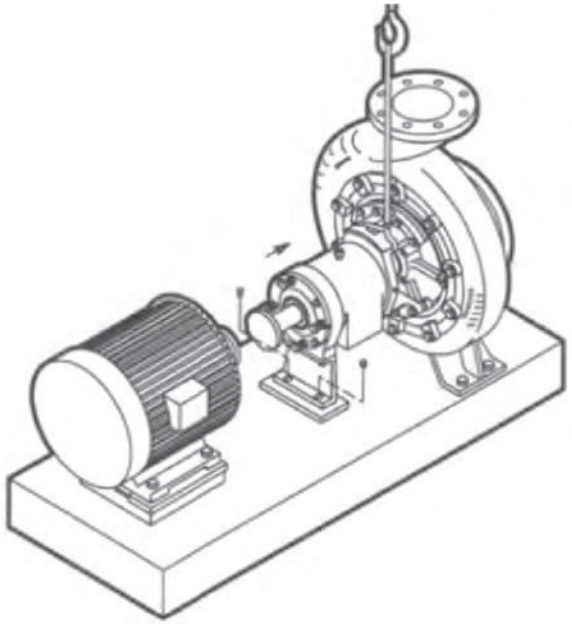


Figure 60: 3180 and 3185 XL1, XL1-S1, XL1-S2, XL2-S, and XL2 group

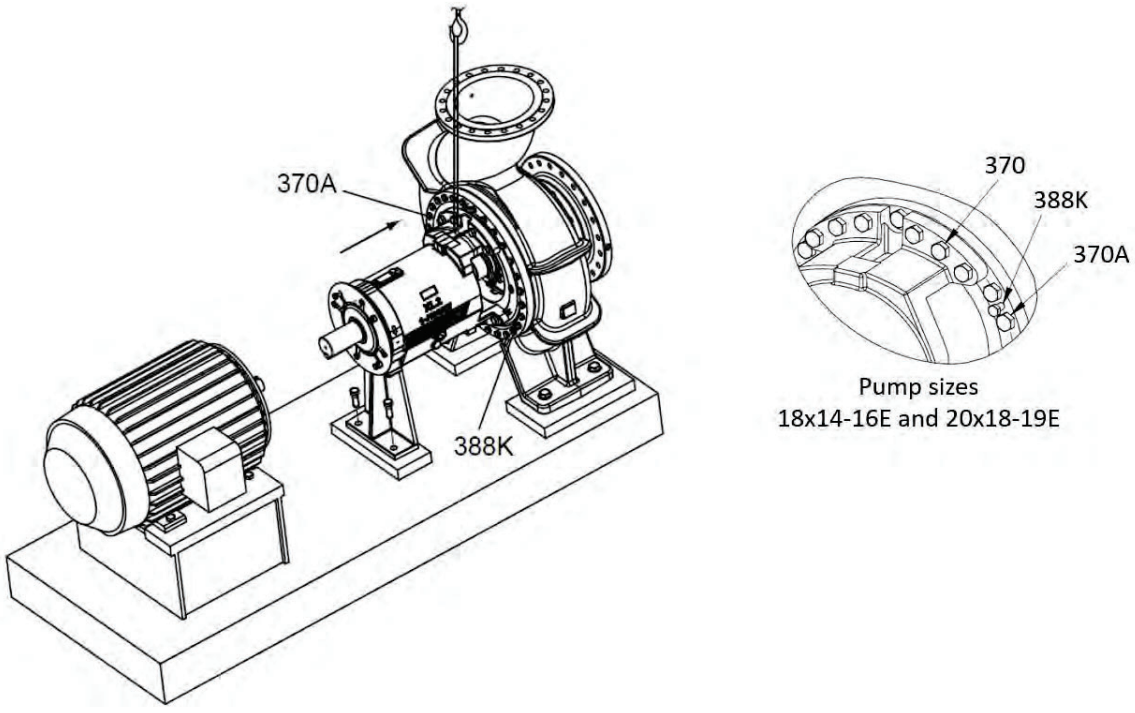


Figure 61: 3180 and 3185 XL1, XL1-S1, XL1-S2, XL2-S, and XL2 group

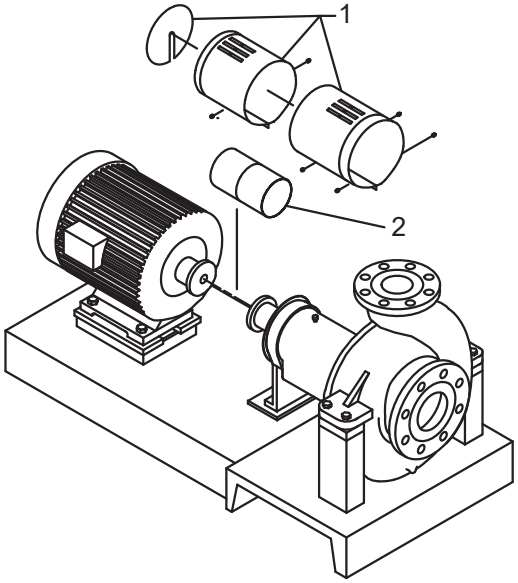
6. Check the total travel of the impeller in the casing.

   Assuming new parts are used, acceptable values for the total axial adjustment are found in5.4.1 Impeller axial clearances on page 58.

If the total travel distance is...	Then...
Within the acceptable values	Tighten the remaining casing bolts and torque to the specified value in a crossing pattern.

If the total travel distance is...	Then...
Outside of the acceptable values	One of the following is present: • Worn parts • Improper installation • Too much pipe strain Determine the cause and correct the set front clearance. See the Cold temperature axial clearances for various service temperatures table in the Commissioning, Startup, Operations, and Shut-down chapter.

7. Determine the gap, if any, between the frame foot and baseplate with feeler guages and shim accordingly.
8. Install the frame foot hold-down bolts and tighten.
9. Lubricate the bearing frame with grease or oil.
10. Rotate the pump shaft by hand to make sure it rotates freely.
11. Reinstall the coupling hub and align the pump.
12. Reconnect the coupling.
13. Install the coupling guard and reconnect all auxiliary piping.



1. Coupling guard
2. Coupling

NOTICE:
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.

6.6.13 Post-assembly checks

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

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

6.6.14 Assembly references

6.6.14.1 Spare parts

Recommended spare parts

In order to prevent a long and costly downtime period, especially on critical services, it is advisable that you have these spare parts on hand:

- Back pull-out assembly, this is a group of assembled parts which includes all parts except casing and sideplate or casing wear ring.
- Bearings (112 and 409)
- Bearing locknut (136)
- Bearing lockwasher (382)
- Impeller key (178)
- Impeller nut (304)
- Maintenance kit that includes all gaskets and O-rings required for one pump
- Mechanical seal (where applicable) (383)
- Shaft (122)
- Shaft sleeve (126)
- Sideplate (where applicable) (176)
- Stuffing box bushing (where applicable) (125)
- Stuffing box packing (where applicable) (106)
- Wear rings (where applicable) (202 and 164)

6.6.14.2 Maximum torque values for fasteners

3180 and 3185 torque values in ft-lb (Nm)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
217	Screw, coupling guard	All	A02818A-89	M10 x 1.5	Hex head capscrew	17 mm	10 (15)
268A	Nut, coupling guard	All	A02089A-10	M10 x 1.5	Hex nut	17 mm	10 (15)
370A	Screw, lug to casing	12 in. to 19 in.	A02818A-143	M22 x 2.5	Hex head capscrew	30 mm	125 (170)
		22 in. to 25 in.	A02818A-162	M24 x 3.0		36 mm	200 (270)
	Screw, casing to adapter	14 x 16-27	A02818A187	M24 x 3.0	Hex head capscrew	36 mm	200 (270)
		24 x 24-27					
		20 x 24-29					
		20 x 24-31					
		24 x 30-35					
		24 x 30-35A					
		24 x 30-35N					
		30 x 30-41	A02818A189	M27 x 3.0		41 mm	243 (330)
372V	Stud, casing foot to baseplate	14 x 16-27	A02815A110	M27 x 3.0	Stud	N/A	—
		24 x 24-27	A02815A87	M42 x 4.5			
		20 x 24-29	A02815A86				

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
		20 x 24-31	A02815A88				
		24 x 30-35	A02815A89				
		24 x 30-35A					
		24 x 30-35N					
		30 x 30-41	A02815A90				
427A	Nut, casing foot to baseplate	14 x 16-27	A02089A27	M27 x 3.0	Hex nut	41 mm	162 (220)
		24 x 24-27	A02089A42	M42 x 4.5		65 mm	
		20 x 24-29					
		26 x 24-31					
		24 x 30-35					
		24 x 30-35A					
		24 x 30-35N					
		30 x 30-41					
372W	Screw, frame foot to baseplate	XL1	A02818A169	M30 x 3.5	Hex head capscrew	46 mm	162 (220)
		XL2-S and XL2	A02818A175	M36 x 4.0		55 mm	162 (220)
—	Screw, casing foot to baseplate	3 x 6-12 4 x 6-12 3 x 6-14	A02818A-126	M16 x 2.0	Hex head capscrew	24 mm	50 (65)
		6 x 8-12 8 x 8-12 4 x 6-14 4 x 6-16	A02818A-144	M20 x 2.5	Hex head capscrew	30 mm	80 (110)
		M	A02818A-144	M20 x 2.5	Hex head capscrew	30 mm	80 (110)
		L	A02818A-145				
		12 x 14-19 10 x 12-22 12 x 14-22 14 x 16-22 6 x 10-25 8 x 12-25 10 x 14-25	A02818A-145	M20 x 2.5	Hex head capscrew	30 mm	80 (110)
		16 x 16-19 18 x 18-22 20 x 20-25	A02818A-164	M24 x 3.0	Hex head capscrew	36 mm	80 (110)
—	Screw, frame foot to baseplate	S	A02818A-105	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		M	A02818A-126	M16 x 2.0		24 mm	50 (65)
		L	A02818A-145	M 20 x 2.5		30 mm	80 (110)
		XL					
356E	Stud, suction side-plate to case	12 in. to 16 in. 19 in. to 25 in.	A02815A-37 A02815A-38	M10 x 1.5 M12 x 1.75	Stud	N/A	—

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
	Stud, casing wear ring to case	14 x 16-27 24 x 24-27 20 x 24-29 20 x 24-31 24 x 30-35 24 x 30-35A 24 x 30-35N 30 x 30-41	A02815A106 A02815A36	M20 x 2.5	Stud	N/A	—
357A	Nut, suction sideplate	12 in. to 16 in. 19 in. to 25 in.	A02089A-10 A02089A-12	M10 x 1.5 M12 x 1.75	Hex nut	17 mm 19 mm	23 (31) 30 (40)
	Nut, casing wear ring	14 x 16-27 24 x 24-27 20 x 24-29 20 x 24-31 24 x 30-35 24 x 30-35A 24 x 30-35N 30 x 30-41	A02089A20	M20 x 2.5	Hex nut	30 mm	55 (75)
320	Screw, impeller wear ring	4 x 6-12 4 x 6-14 4 x 6-16 3 x 6-12 3 x 6-14 6 x 10-16 4 x 6-19 4 x 8-19 6 x 10-19 8 x 10-19 6 x 10-22 8 x 10-22 10 x 12-22 6 x 10-25 8 x 12-25 10 x 14-25	A02819A	M6 x 1.0	Socket head setscrew	Internal 5 mm	5 (7)
222E	Screw, casing wear ring	3 x 6-12 4 x 6-12 3 x 6-14 4 x 6-14 4 x 6-16	A03723A-41	M6 x 1.0	Setscrew	Internal 5 mm	5 (7)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
		6 x 10-16 4 x 6-19 6 x 10-19 6 x 10-22					
		4 x 8-19 8 x 10-19 8 x 10-22 10 x 12-22 6 x 10-25 8 x 12-25 10 x 14-25	A03723A-58	M8 x 1.25	Setscrew	Internal 6 mm	7 (10)
304	Nut, impeller	S	B02151A03	M27 x 3.0	Special	40.5 mm	240 (325)
		M	B02151A04				
		L	B02152A03	M42 x 4.5	Special	63 mm	600 (800)
		XL	B02152A04				
		14 x 16-27	B05526A02	M75 x 1.5		118 mm	1,180 (1,600)
		XL1	B05526A01				
		XL2-S	B05526A02				
		XL2	B05904A	M100 x 2.0		132 mm	1,475 (2,000)
370B	Screw, frame to stuffing box	S and M	A02818A-104	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		L and XL	A02818A-128	M16 x 2.0		24 mm	50 (65)
	Screw, frame to adapter	XL1	A02818A170	M30 x 3.5		46 mm	419 (568)
		XL2-S and XL2	A02818A171				
353	Stud, gland to stuffing box	S and M	A02815A-39	M12 x 1.75	Stud	N/A	—
		L and XL	A02815A-40	M16 x 2.0	Stud	N/A	—
		XL1, XL2-S, and XL2	A02815A46	M16x2.0	Stud	N/A	—
355	Nut, gland to stuffing box	S and M	A02089A-12	M12 x 1.75	Hex nut	19 mm	15 (20)
		L, XL, XL1, XL2-S, and XL2	A02089A-16	M16 x 2.0		24 mm	25 (35)
388K	Jackbolt, stuffing box to case	S, M, L, and XL	A02818A-109	M12 x 1.75	Hex head capscrew	19 mm	10 (15)
	Jackbolt, casing to adapter	XL1, XL2-S, and XL2	A02818A151	M20 x 2.5		30 mm	22 (30)
371A	Screw, bearing housing adjustment	S and M	A02818A-106	M12 x 1.75	Hex head capscrew	19 mm	—
		L and XL	A02818A-128	M16 x 2.0		24 mm	
		XL1	A02818A147	M20 x 2.5		30 mm	
		XL2-S and XL2	A02818A165	M24 x 3.0		36 mm	
423B	Nut, bearing	S and M	A02089A-12	M12 x 1.75	Hex nut	19 mm	10 (15)
		L and XL	A02089A-16	M16 x 2.0		24 mm	15 (20)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
	adjustment lock	XL1	A02089A20	M20 x 2.5		30 mm	22 (30)
		XL2-S and XL2	A02089A24	M24 x 3.0		36 mm	30 (40)
370C	Screw, housing to frame	S and M	A02817A-72	M12 x 1.75	Hex head capscrew	19 mm	10 (15)
		L and XL	A02818A-128	M16 x 2.0		24 mm	15 (20)
		XL1	A02818A148	M20 x 2.5		30 mm	22 (30)
		XL2-S and XL2	A02818A187	M24 x 3.0		36 mm	30 (40)
370D	Screw, foot to frame	S and M	A02818A-102	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		L and XL	A02818A-124	M16 x 2.0		24 mm	50 (65)
		XL1	A02818A161	M24 x 3.0		36 mm	211 (286)
		XL2-S and XL2	A02818A166	M30 x 3.5		46 mm	419 (568)
236A	Screw, bearing retainer to housing	S and M	A03723A-48	M6 x 1.0	Socket head capscrew	Internal 5 mm	15 (20)
		L and XL	A03723A-82	M10 x 1.5		Internal 8 mm	20 (25)
		XL1	A03723A113	M16 x 2.0		Internal 14 mm	24 (33)
		XL2-S and XL2	A03723A115				
370E	Screw, oil return plug	All	A02818A-99	M12 x 1.75	Hex head capscrew	19 mm	10 (15)
370H	Screw, cover to adapter	14 x 16-27	A02818A149	M20 x 2.5	Hex head capscrew	30 mm	22 (30)
		24 x 24-27					
		20 x 24-29					
		20 x 24-31					
		24 x 30-35					
		24 x 30-35A					
		24 x 30-35N					
		30 x 30-41	A02818A148				
370P	Screw, end cover to frame	XL1	A03723A92	M12 x 1.75	Socket head capscrew	Internal 10 mm	24 (33)
		XL2-S and XL2	A03723A93				
372T	Screw, button head	XL1, XL2-S, and XL2	A09270A209	¼ - 28	Button head socket cap screw	5/32	6 (8)
418	Jackbolt, cover to adapter	14 x 16-27	A02818A149	M20 x 2.5	Hex head capscrew	30 mm	22 (30)
		24 x 24-27					
		20 x 24-29					
		20 x 24-31	A02818A151				
		24 x 30-35	A02818A148				
		24 x 30-35A					
		24 x 30-35N					
		30 x 30-41					

3181 and 3186 torque values in ft-lb (Nm)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
—	Screw, coupling guard	All	A02818A-89	M10 x 1.5	Hex head capscrew	17 mm	10 (15)
—	Nut, coupling guard	All	A02089A-10	M10 x 1.5	Hex nut	17 mm	—
370A	Screw, stuffing box to casing	14 in.	A02818A-163	M24 x 3.0	Hex head capscrew	36 mm	600 (800)
		16 in.	A02818A-145	M20 x 2.5		30 mm	375 (500)
		19 in.	A02818A-145	M20 x 2.5		30 mm	375 (500)
		22 in.	A02818A-165	M24 x 3.0		36 mm	600 (800)
—	Screw, casing foot to baseplate	S and M	A02818A-146	M20 x 2.5	Hex head capscrew	30 mm	125 (170)
		L and XL	A02818A-148	M20 x 2.5		30 mm	125 (170)
		14 x 16-22	A02818A-165	M24 x 3.0		36 mm	200 (270)
			A02817A-112				
—	Screw, frame foot to baseplate	S-group	A02818A-105	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		M-group	A02818A-126	M16 x 2.0		24 mm	50 (65)
		L and XL	A02818A-145	M 20 x 2.5		30 mm	80 (110)
356E	Stud, sideplate to casing	14 in. to 16 in.	A02815A-37	M10 x 1.5	Stud	N/A	—
		19 in. to 22 in.	A02815A-38	M12 x 1.75			—
357A	Cap nut, sideplate to casing	14 in. to 16 in.	A06245A	M10 x 1.5	Hex nut	22.2 mm	10 (15)
		19 in. to 22 in.	A06245A	M12 x 1.75		25.4 mm	20 (25)
320	Screw, impeller wear ring	S and M	A03723A-41	M6 x 1.0	Socket head capscrew	Internal 5 mm	5 (7)
		6 x 10-19					
		8 x 10-16					
		6 x 10-22					
		8 x 10-19	A03723A-58	M8 x 1.25	Socket head capscrew	Internal 6 mm	7 (10)
		8 x 10-22					
		10 x 12-16					
		10 x 12-19					
		14 x 14-16					
		XL					
222E	Screw, casing wear ring	All	A02819A-47	M6 x 1.0	Setscrew	Internal 5 mm	5 (7)
304	Nut, impeller	S-group	B2151A-03	M27 x 3.0	Special	40.5 mm	240 (325)
		M-group	B2151A-04				
		L-group	B2152A-03	M42 x 4.5		63 mm	600 (800)
		XL-group	B2152A-04				
370B	Screw, frame to box	S and M	A02818A-104	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		L and XL	A02818A-128	M16 x 2.0		24 mm	50 (65)
353	Stud, gland to box	S and M	A02815A-39	M12 x 1.75	Stud	N/A	—
		L and XL	A02815A-40	M16 x 2.0			

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
355	Nut, gland to box	S and M	A02089A-12	M12 x 1.75	Hex nut	19 mm	85 (115)
		L and XL	A02089A-16	M16 x 2.0		24 mm	175 (235)
388K	Jackbolt, stuffing box to case	All	A02818A-109	M12 x 1.75	Hex head capscrew	19 mm	10 (15)
371A	Screw, bearing housing adjustment	S and M	A02818A-106	M12 x 1.75	Hex head capscrew	19 mm	—
		L and XL	A02818A-128	M16 x 2.0		24 mm	
423B	Nut, bearing adjustment lock	S and M	A02089A-12	M12 x 1.75	Hex nut	19 mm	10 (15)
		L and XL	A02089A-16	M16 x 2.0		24 mm	15 (20)
370C	Screw, housing to frame	S and M	A02817A-72	M12 x 1.75	Hex head capscrew	19 mm	10 (15)
		L and XL	A02818A-128	M16 x 2.0		24 mm	15 (20)
370D	Screw, foot to frame	S and M	A02818A-102	M12 x 1.75	Hex head capscrew	19 mm	30 (40)
		L and XL	A02818A-124	M16 x 2.0		24 mm	50 (65)
236A	Screw, bearing retainer to housing	S and M	A03723A-48	M6 x 1.0	Socket head capscrew	Internal 5 mm	15 (20)
		L and XL	A03723A-82	M10 x 1.5		Internal 8 mm	20 (25)
370E	Screw, oil return plug	All	A02818A-99	M12 x 1.75	Hex head capscrew	19 mm	10 (15)

6.6.14.3 Bearing bore fits and tolerances

Group	Bearing	Maximum bearing frame bores in millimeters | inches	Maximum bearing housing bore in millimeters | inches
S	Thrust	160.02 | 6.3002	120.02 | 4.7253
	Radial	120.02 | 4.7253	
M	Thrust	160.02 | 6.3002	130.03 | 5.1191
	Radial	130.03 | 5.1191	
L	Thrust	200.03 | 7.8752	160.02 | 6.3002
	Radial	150.03 | 5.9065	
XL	Thrust	240.03 | 9.4500	190.03 | 7.4815
	Radial	180.03 | 7.0876	
XL1, XL1-S1 and XL1-S2	Thrust	346.085 | 13.6253	280.032 | 11.0248
	Radial	280.032 | 11.0249	N/A
XL2-S and XL2	Thrust	421.082 | 16.5779	320.036 | 12.5998
	Radial	320.036 | 12.5998	N/A

6.6.14.4 Radial ring clearances for enclosed impellers

Reasons for performing impeller clearance checks

Enclosed impellers require a close radial clearance between the impeller and case wear rings in order for the pump to operate at maximum efficiency. Over time, pump performance may degrade due to normal wear in this area. If an individual part is out of specification, it should be replaced.

Radial ring clearances

Table 14: Radial Ring Clearances

Size	Impeller Ring OD - mm | in.	Casing Ring ID - mm | in.	Clearance - mm | in.
3 x 6-12	164.37 | 6.4711	165.38 | 6.5111	1.02 | 0.040
	164.27 | 6.4671	165.48 | 6.5151	1.22 | 0.048
3 x 6-14	164.37 | 6.4711	165.38 | 6.5111	1.02 | 0.040
	164.26 | 6.4671	165.48 | 6.5151	1.22 | 0.048
4 x 6-12	185.36 | 7.2978	186.38 | 7.3378	1.02 | 0.040
	185.26 | 7.2938	186.47 | 7.3415	1.22 | 0.048
4 x 6-14	185.36 | 7.2978	186.38 | 7.3378	1.02 | 0.040
	185.26 | 7.2938	186.48 | 7.3418	1.22 | 0.048
4 x 6-16	195.36 | 7.6915	196.38 | 7.7315	1.02 | 0.040
	195.26 | 7.6875	196.48 | 7.7355	1.22 | 0.048
6 x 8-14	208.50 | 8.2087	209.52 | 8.2487	1.02 | 0.040
	208.40 | 8.2047	209.62 | 8.2527	1.22 | 0.048
8 x 8-14	234.34 | 9.2260	235.36 | 9.2660	1.02 | 0.040
	234.24 | 9.2220	235.46 | 9.2700	1.22 | 0.048
6 x 10-16	237.37 | 9.3451	238.38 | 9.3850	1.02 | 0.040
	237.26 | 9.3411	238.48 | 9.3891	1.22 | 0.048
10 x 10-14	266.60 | 10.4962	267.62 | 10.5362	1.02 | 0.040
	266.50 | 10.4922	267.72 | 10.5402	1.22 | 0.048
6 x 8-16	208.50 | 8.2087	209.52 | 8.2487	1.02 | 0.040
	208.40 | 8.2047	209.62 | 8.2527	1.22 | 0.048
4 x 6-19	208.50 | 8.2087	209.52 | 8.2487	1.02 | 0.040
	208.40 | 8.2047	209.62 | 8.2527	1.22 | 0.048
4 x 8-19	214.37 | 8.4396	215.38 | 8.4796	1.02 | 0.040
	214.26 | 8.4356	215.48 | 8.4836	1.22 | 0.048
8 x 10-16	272.42 | 10.7253	273.44 | 10.7653	1.02 | 0.040
	272.32 | 10.7213	273.54 | 10.7693	1.22 | 0.048
10 x 12-16	314.28 | 12.3734	315.44 | 12.4189	1.16 | 0.046
	314.18 | 12.3694	315.54 | 12.4229	1.36 | 0.054
14 x 14-16	344.16 | 13.5497	345.44 | 13.6000	1.28 | 0.050
	344.06 | 13.5457	345.54 | 13.6040	1.48 | 0.058
6 x 10-19	237.37 | 9.3451	238.38 | 9.3851	1.02 | 0.040
	237.26 | 9.3411	238.48 | 9.3891	1.22 | 0.048
8 x 10-19	272.42 | 10.7253	273.44 | 10.7653	1.02 | 0.040
	272.32 | 10.7213	273.54 | 10.7693	1.22 | 0.048
10 x 12-19	324.24 | 12.7654	325.44 | 12.8125	1.20 | 0.047
	324.14 | 12.7614	325.54 | 12.8165	1.40 | 0.055
6 x 10-22	252.36 | 9.9356	253.38 | 9.9756	1.02 | 0.040
	252.26 | 9.9316	253.48 | 9.9796	1.22 | 0.048
6 x 10-25	281.42 | 11.0794	282.44 | 11.1197	1.02 | 0.040

Size	Impeller Ring OD - mm | in.	Casing Ring ID - mm | in.	Clearance - mm | in.
	281.31 | 11.0754	282.54 | 11.1237	1.22 | 0.048
8 x 10-22	289.38 | 11.3930	290.44 | 11.4346	1.06 | 0.042
	289.28 | 11.3890	290.54 | 11.4386	1.26 | 0.050
12 x 14-19	354.12 | 13.9418	355.44 | 13.9936	1.32 | 0.052
	354.02 | 13.9378	355.54 | 13.9976	1.52 | 0.060
16 x 16-19	386.98 | 15.2354	388.43 | 15.2924	1.45 | 0.057
	386.88 | 15.2314	388.53 | 15.2964	1.65 | 0.065
10 x 12-22	324.24 | 12.7654	325.44 | 12.8125	1.21 | 0.047
	324.14 | 12.7614	325.54 | 12.8165	1.40 | 0.055
8 x 12-25	324.24 | 12.7654	325.44 | 12.8125	1.21 | 0.047
	324.14 | 12.7614	325.54 | 12.8165	1.40 | 0.055
10 x 14-25	354.12 | 13.9418	355.44 | 13.9936	1.32 | 0.052
	354.02 | 13.9378	355.54 | 13.9976	1.52 | 0.060
12 x 14-22	371.09 | 14.6100	372.48 | 14.6645	1.39 | 0.055
	370.99 | 14.6060	372.58 | 14.6685	1.59 | 0.063
14 x 16-22	419.86 | 16.5299	421.44 | 16.5921	1.58 | 0.062
	419.76 | 16.5259	421.54 | 16.5961	1.78 | 0.070
14 x 16-27*1	445.14 | 17.525	446.76 | 17.589	1.63 | 0.064
	444.88 | 17.515	447.01 | 17.599	2.13 | 0.084
16x20-29E *1	511.30 | 20.130	514.99 | 20.275	3.68 | 0.145
	511.05 | 20.120	515.24 | 20.285	4.19 | 0.165
20x24-29*1	572.21 | 22.528	575.89 | 22.673	3.68 | 0.145
	571.96 | 22.518	576.15 | 22.683	4.19 | 0.165
28x24-29E *1	628.78 | 24.755	632.46 | 24.900	3.68 | 0.145
	628.52 | 24.745	632.71 | 24.910	4.19 | 0.165
20x24-31*1	575.13 | 22.643	578.69 | 22.783	3.56 | 0.140
	574.88 | 22.633	578.94 | 22.793	4.06 | 0.160
24x28-35E*1	706.76 | 27.825	709.52 | 27.934	2.77 | 0.109
	706.45 | 27.813	709.78 | 27.944	3.33 | 0.131
30x 30-41*1	815.19 | 32.094	817.93 | 32.202	2.74 | 0.108
	814.83 | 32.080	818.18 | 32.212	3.35 | 0.132

*1 These sizes do not have impeller wear rings. The dimension shown is the impeller turn OD.

7 Troubleshooting

7.1 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.
	The clearance between the impeller and the pump casing is excessive.	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.

Symptom	Cause	Remedy
	The stuffing box is not packed properly.	Check the packing and repack the box.
	The mechanical seal parts are worn.	Replace the worn parts.
	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.

7.2 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.
Vertical (top-to-bottom) alignment cannot be obtained (angular or parallel).	The baseplate is not leveled properly and is probably bowed.	1. Determine if the center of the baseplate should be raised or lowered. 2. Level screws equally at the center of the baseplate. 3. Realign the pump and driver.

7.3 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.

Symptom	Cause	Remedy
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.

8 Parts Listings and Cross-sectional Drawings

8.1 Parts list

Second-generation spring-mounted baseplate

Refer to the Serial Number Record for the correct part numbers and quantity of each component.

Item	Part name	Material code
91786 352	Stud 1.25 in.–22 in. C.S.	2210
91786 352	Stud 1.25 in.–22 in. G.S.	6951
91786 350	Stud 1.25 in.–16 in. C.S.	2210
91786 350	Stud 1.25 in.–16 in. G.S.	6951
49507 15	Nut, hex 1.25 in. C.S.	2210
49507 15	Nut, hex 1.25 in. G.S.	6951
49507 65	Jam nut, hex 1.25 in. C.S.	2210
49507 65	Jam nut, hex 1.25 in. G.S.	6951
49519 13	Washer, plain 1.25 in. C.S.	2210
49519 13	Washer, plain 1.25 in. G.S.	—
A07321A	Spring, 885 lb/in. steel	—
A08078A	Spring, 176 lb/in. steel	—
A07314A	Spring, 885 lb/in. PVC coated	—
A08077A	Spring, 176 lb/in. PVC coated	—
A07313A	Follower, spring C.S.	3201
A07313A	Follower, spring G.S.	3211
076309	Bearing assembly pad	—

Notes for parts tables 16-19

The note references in the table columns refer to the following:

1. Dependent on pump or frame size
2. Packed box = 2; Mechanical seal = 4

Table 15: Parts list for 3180 and 3185 S, M, L, and XL groups: (Iron/CD4, all CD4, CS/CD4, DI/CD4 & 316SS)

Item	Qty	Part Name	Iron Casing[E]/ CD4 Impeller	CD4MCuN	CarbSteel/ CD4 Impeller	Ductile Iron[E] CD4 Impeller	316 SS
100	1	Casing	Cast Iron	CD4	CarbonSteel	Ductile Iron	316 SS
101	1	Impeller	CD4	CD4	CD4	CD4	316 SS
105	1	Lantern ring	25% Glass Filled PTFE				
106	1 set	Packing, packed box	Non-asbestos braid				
106	1 set	Packing, dynamic seal	Die-formed graphite				
107	2	Gland half	316 SS	CD4	316 SS		
109A	1	Bearing end cover	Cast Iron				
112	1	Bearing (thrust)	Duplex angular contact (back to back)				

Item	Qty	Part Name	Iron Casing[E]/ CD4 Impeller	CD4MCuN	CarbSteel/ CD4 Impeller	Ductile Iron[E] CD4 Impeller	316 SS
122	1	Shaft	Carbon Steel				
125	1	Throttle bushing	316 SS	Duplex	316 SS		
126	1	Shaft sleeve	Duplex				
126A	1	Shearpeller™ sleeve	N/A	Carbon-filled PTFE	N/A	N/A	N/A
134A	1	Bearing housing	Cast Iron				
136	1	Bearing locknut	Steel				
164	1	Casing wear ring (enclosed impeller)	CD4				316 SS
176	1	Sideplate (open impeller)	Cast Iron	CD4	Carbon Steel	CD4	316 SS
178	1	Impeller key	Carbon Steel				
184	1	Stuffing box cover/ seal chamber	Cast Iron	CD4	Carbon Steel	Ductile Iron	316 SS
184	1	Stuffing box cover, dynamic seal	CD4				
202	1	Impeller wear ring (for enclosed impeller)	CD4				316 SS
217	1	Spacer Ring	3201				
222E	3	Set screw, casing wear ring	316SS	Alloy 20	316 SS		
228	1	Bearing frame	Cast Iron				
230C	1	Vane particle ejector (VPE) ring	Duplex				
236A	see Note 1	Screw, bearing retainer to housing	Carbon Steel				
241	1	Frame foot	Cast Iron				
251	1	Sight oiler (optional)	Steel/glass				
253B	1	Bearing retainer	Cast Iron				
262	1	Repeller	CD4				
264	1	Gasket, backplate	Non-asbestos aramid fiber				
265A	1	Stud, box to backplate	303 SS				
268A	2	Screw, Socket Head	2442				
304	1	Impeller nut	CD4				
319	1	Sight window (oil lube)	303 SS				
320	3	Socket head capscrew, impeller wear ring	316 SS	Alloy 20	316 SS		
332A	1	Labyrinth seal assembly (thrust)	Bronze with PTFE O-rings				
333A	1	Labyrinth seal assembly (radial)	Bronze with PTFE O-rings				
351	1	Gasket, casing	Non-asbestos aramid fiber				
353	see note 2	Stud, gland	Stainles Steel				

Item	Qty	Part Name	Iron Casing[E]/ CD4 Impeller	CD4MCuN	CarbSteel/ CD4 Impeller	Ductile Iron[E] CD4 Impeller	316 SS
355	see note 2	Nut, gland	Stainles Steel				
357A	see note 1	Nuts, sideplate	Stainles Steel				
357J	See note 1	Nut, box to back-plate	Stainles Steel				
358	1	Plugs (casing drain, optional)	Carbon Steel	Duplex	Carbon Steel		316 SS
358D	1	Plug, casing vent (pumps with tangen-tial discharge)	Carbon Steel	Duplex	Carbon Steel		316 SS
358M	3	Plugs (casing gauge, optional)	Carbon Steel	Duplex	Carbon Steel		316 SS
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber				
370	12	Screw, Socket Head	2239				
370A	See note 1	Screw, hex head lug to casing	High Strength Steel				
370B	8	Screw, hex (frame to box)	Carbon Steel				
370C	See note 1	Screw, housing to frame	Carbon Steel				
370D	2	Screw, frame foot to frame	Carbon Steel				
370E	1	Screw, oil return (grease lube)	Carbon Steel				
371A	See note 1	Bolt, adjusting	Carbon Steel				
382	1	Bearing lockwasher	Steel				
383	1	Mechanical seal	Material varies				
400	1	Coupling key	Carbon Steel				
408B	1	Plug (oil drain)	Carbon Steel				
408C	2	Plug (grease relief)	Carbon Steel				
408D	1	Plug (grease lube)	Carbon Steel				
408E	4	Plug (oil lube)	Carbon Steel				
408H	1	Plug (stuffing box)	Carbon Steel				
409	1	Bearing (radial)	Cylindrical roller, steel				
412A	1	O-ring, impeller	PTFE				
412C	1	O-ring, sideplate to casing	PTFE				
412F	1	O-ring, sleeve	PTFE				
412U	1	O-ring, repeller	PTFE				
423B	see note 1	Nut, jam	Carbon Steel				
444	1	Backplate	CD4				
494	1	Cooler assembly	SS tube, brass fittings				
496	1	O-ring, housing	Buna N				
748	see note 1	Lug, casing	Ductile Iron				

Table 16: Parts list for 3180 and 3185 S, M, L, and XL groups 316L, 317SS, 317LSS, Ferralium, Avesta 254SMO

Item	Qty	Part Name	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
100	1	Casing	316L SS	317 SS	317L SS	Ferralium	254 SMO
101	1	Impeller (see note 4)	316L SS	317 SS	317L SS	Ferralium	254 SMO
105	1	Lantern ring	25% Glass Filled PTFE	N/A			
106	1	Packing, packed box	Non-asbestos braid				
106	1	Packing, dynamic seal	Die-formed graphite	N/A			
107	1	Gland half	316L SS	N/A			
109A	1	Bearing end cover	Cast Iron				
112	1	Bearing (thrust)	Duplex angular contact (back to back)				
122	1	Shaft	Carbon Steel				
125	1	Throttle bushing	316L SS	N/A			
126	1	Shaft sleeve	Duplex (F)	N/A			
126A	1	Shearpeller™ sleeve	n/a	Carbon-filled PTFE	N/A	N/A	N/A
134A	1	Bearing housing	Cast Iron				
136	1	Bearing locknut	Steel				
164	1	Casing wear ring (en- closed impeller)	316L SS	317 SS	317L SS	Ferralium	254 SMO
176	1	Sideplate (open impeller)	316L SS	317 SS	317L SS	Ferralium	254 SMO
178	1	Impeller key	Carbon Steel				
184	1	Stuffing box cover/ seal chamber	316L SS	317 SS	317L SS	Ferralium	254 SMO
202	1	Impeller wear ring (for enclosed impeller)	316L SS	317 SS	317L SS	Ferralium	254 SMO
222E	3	Set screw, casing wear ring	316L SS	317 SS	317L SS	Ferralium	254 SMO
228	1	Bearing frame	Cast Iron				
230C	1	Vane particle ejector (VPE) ring	Duplex				
236A	see note 1	Screw, bearing retainer to housing	Carbon Steel				
241	1	Frame foot	Cast Iron				
251	1	Sight oiler (optional)	Steel/glass				
253B	1	Bearing retainer	Cast Iron				
262	1	Repeller	CD4	N/A			
264	1	Gasket, backplate	Non-asbestos aramid fiber	N/A			
265A	1	Stud, box to backplate	303 SS				
304	1	Impeller nut	316L SS	317 SS	317L SS	Ferralium	254 SMO
319	1	Sight window (oil lube)	303 SS				

Item	Qty	Part Name	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
320	3	Socket head cap-screw, impeller wear ring	316 SS	Alloy 20	317L SS	Ferralium	Avesta 254
332A	1	Labyrinth seal assembly (thrust)	Bronze with PTFE O-rings				
333A	1	Labyrinth seal assembly (radial)	Bronze with PTFE O-rings				
351	1	Gasket, casing	Non-asbestos aramid fiber				
353	1	Stud, gland	Stainles Steel	N/A			
355	1	Nut, gland	Stainles Steel	N/A			
356E	See note 1	Studs, sideplate	Stainles Steel				
357A	See note 1	Nuts, sideplate	Stainles Steel				
357J	1	Nut, box to back-plate	Stainles Steel				
358	1	Plugs (casing drain, optional)	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
358D	1	Plug, casing vent (pumps with tangential discharge)	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
358M	3	Plugs (casing gauge, optional)	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber				
370A	see note 1	Screw, hex head lug to casing	High Strength Steel				
370B	1	Screw, hex (frame to box)	Carbon Steel	N/A			
370C	see note 1	Screw, housing to frame	Carbon Steel				
370D	2	Screw, frame foot to frame	Carbon Steel				
370E	1	Screw, oil return (grease lube)	Carbon Steel				
371A	see note 1	Bolt, adjusting	Carbon Steel				
382	1	Bearing lockwasher	Steel				
383	1	Mechanical seal	Material varies				
400	1	Coupling key	Carbon Steel				
408B	1	Plug (oil drain)	Carbon Steel				
408C	2	Plug (grease relief)	Carbon Steel				
408D	1	Plug (grease lube)	Carbon Steel				
408E	4	Plug (oil lube)	Carbon Steel				
408H	1	Plug (stuffing box)	Carbon Steel				
409	1	Bearing (radial)	Cylindrical roller, steel				
412A	1	O-ring, impeller	PTFE				
412C	1	O-ring, sideplate to casing	PTFE				
412F	1	O-ring, sleeve	PTFE	N/A			

Item	Qty	Part Name	316L SS	317 SS	317L SS	Ferralium	Avesta 254SMO
412U	1	O-ring, repeller	PTFE	N/A			
423B	see note 1	Nut, jam	Carbon Steel				
444	1	Backplate	CD4	N/A			
494	1	Cooler assembly	SS tube, brass fittings				
496	1	O-ring, housing	Buna N				
748	see note 1	Lug, casing	Ductile Iron				

Table 17: Parts list for 3180 and 3185 S, M, L, and XL groups 904L, Alloy 20, Hast B, Hast C, Titanium

Item	Qty	Part Name	904L	Alloy 20	Hastelloy B	Hastelloy C	Titanium
100	1	Casing	904L	Alloy 20	Hast B	Hast C	Titanium
101	1	Impeller	904L	Alloy 20	Hast B	Hast C	Titanium
105	1	Lantern ring	N/A				
106	1 set	Packing, packed box	Non-asbestos braid				
106	1	Packing, dynamic seal	Die-formed graphite	N/A			
107	1	Gland half	904L	Alloy 20	Hast B	Hast C	N/A
109A	1	Bearing end cover	Cast Iron				
112	1	Bearing (thrust)	Duplex angular contact (back to back)				
122	1	Shaft	Carbon Steel				
125	1	Throttle bushing	N/A				
126	1	Shaft sleeve	904L	Alloy 20	Hast B	Hast C	N/A
126A	1	Shearpeller™ sleeve	n/a	Carbon-filled PTFE	N/A	N/A	N/A
134A	1	Bearing housing	Cast Iron				
136	1	Bearing locknut	Steel				
164	1	Casing wear ring (enclosed impeller)	904L	Alloy 20	Hast B	Hast C	N/A
176	1	Sideplate (open impeller)	904L	Alloy 20	Hast B	Hast C	Titanium
178	1	Impeller key	Carbon Steel				
184	1	Stuffing box cover/ seal chamber	904L	Alloy 20	Hast B	Hast C	Titanium
202	1	Impeller wear ring (for enclosed impeller)	904L	Alloy 20	Hast B	Hast C	N/A
222E	3	Set screw, casing wear ring	904L	Alloy 20	Hast B	Hast C	N/A
228	1	Bearing frame	Cast Iron				
230C	1	Vane particle ejector (VPE) ring	904L	Alloy 20	Hast B	Hast C	N/A
236A	see note 1	Screw, bearing retainer to housing	Carbon Steel				
241	1	Frame foot	Cast Iron				
251	1	Sight oiler (optional)	Steel/glass				
253B	1	Bearing retainer	Cast Iron				

Item	Qty	Part Name	904L	Alloy 20	Hastelloy B	Hastelloy C	Titanium
304	1	Impeller nut	904L	Alloy 20	Hast B	Hast C	Titanium
319	1	Sight window (oil lube)	303 SS				
320	3	Socket head cap-screw, impeller wear ring	316 SS	Alloy 20	Hast B	Hast C	N/A
332A	1	Labyrinth seal assembly (thrust)	Bronze with PTFE O-rings				
333A	1	Labyrinth seal assembly (radial)	Bronze with PTFE O-rings				
351	1	Gasket, casing	Non-asbestos aramid fiber				
356E	See note 1	Studs, sideplate	Stainles Steel				
357A	see note 1	Nuts, sideplate	Stainles Steel				
358	1	Plugs (casing drain, optional)	904L	Alloy 20	Hast B	Hast C	Titanium
358D	1	Plug, casing vent (pumps with tangential discharge)	904L	Alloy 20	Hast B	Hast C	Titanium
358M	3	Plugs (casing gauge, optional)	904L	Alloy 20	Hast B	Hast C	Titanium
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber				
370A	see note 1	Screw, hex head lug to casing	High Strength Steel				
370C	see note 1	Screw, housing to frame	Carbon Steel				
370D	2	Screw, frame foot to frame	Carbon Steel				
370E	1	Screw, oil return (grease lube)	Carbon Steel				
371A	see note 1	Bolt, adjusting	Carbon Steel				
382	1	Bearing lockwasher	Steel				
383	1	Mechanical seal	Material varies				
400	1	Coupling key	Carbon Steel				
408B	1	Plug (oil drain)	Carbon Steel				
408C	2	Plug (grease relief)	Carbon Steel				
408D	1	Plug (grease lube)	Carbon Steel				
408E	4	Plug (oil lube)	Carbon Steel				
408H	See note 3	Plug (stuffing box)	Carbon Steel				
409	1	Bearing (radial)	Cylindrical roller, steel				
412A	1	O-ring, impeller	PTFE				
412C	1	O-ring, sideplate to casing	PTFE				
412F	1	O-ring, sleeve	PTFE	N/A			
423B	see note 1	Nut, jam	Carbon Steel				
494	1	Cooler assembly	SS tube, brass fittings				

Item	Qty	Part Name	904L	Alloy 20	Hastelloy B	Hastelloy C	Titanium
496	1	O-ring, housing	Buna N				
748	see note 1	Lug, casing	Ductile Iron				

Table 18: Parts list for 3180 and 3185 XL1, XL2-S, and XL2 groups

Item	Qty	Part Name	Carbon Steel/CD4	All CD4MCuN	All 316SS	Super Duplex A890 5A
100	1	Casing	Carbon Steel	CD4	316 SS	Super Duplex A890 5A
101	1	Impeller	CD4	CD4	316SS	Super Duplex A890 5A
105	1	Lantern ring	PTFE			
106	Set	Packing, packed box	Non-asbestos braid			
107	2	Gland half	316 SS			Super Duplex A890 5A
108	1	Frame adapter	Ductile Iron			
109A	1	Bearing end cover	Carbon Steel			
112	2	Bearing, thrust	Duplex Angular Contact (Back to Back)			
122	1	Shaft	Gr 4340 Alloy Steel			
125	1	Throttle bushing, packed box	316 SS			N/A
126	1	Shaft sleeve / stub sleeve	Duplex	CD4	316 SS	Super Duplex A890 5A
134A	1	Bearing housing	Cast Iron			
136	1	Bearing locknut	Steel			
164	1	Case wear ring, enclosed impeller	Carbon Steel	1216	1203	Super Duplex A890 5A
178	1	Impeller key	Carbon Steel			
193H		Grease fitting, grease lube	Steel			
228	1	Bearing frame	Cast Iron			
230C	1	Vane particle ejector (VPE) ring	Duplex		316 SS	Super Duplex A890 5A
234B	1	Guard, Endplate	Steel			
236A	12	Screw, bearing retainer to housing	Carbon Steel			
241	1	Frame foot	Cast Iron			
253B	1	Bearing retainer	Cast Iron			
304	1	Impeller nut	CD4		316SS	Super Duplex A890 5A
319	1	Sight window	Glass			
332A	1	Laby seal, thrust	Bronze / PTFE			
333A	1	Laby seal, radial	Bronze / PTFE			
351	1	Casing gasket	Non-asbestos			
352B	3	Setscrew, VPE ring	316 SS			Super Duplex (S32750)
353	see note 2	Stud, gland	Stainless Steel			

Item	Qty	Part Name	Carbon Steel/CD4	All CD4MCuN	All 316SS	Super Duplex A890 5A
355	see note 2	Nut, gland	Stainless Steel			
356E	see note 1	Stud, sideplate to casing	Stainless Steel			
357A	see note 1	Nut, sideplate to casing	Stainless Steel			
358	1	Plug, casing drain (optional)	Carbon Steel	Duplex	316 SS	Super Duplex (S32750)
358M	3	Plug , casing gauge (optional)	Carbon Steel	Duplex	316 SS	Super Duplex (S32750)
360	1	Gasket, end cover	Nitrile Rubber			
360P	1	Gasket, wear ring to casing	Non-asbestos			
370	12	Hex cap screw, frame to casing	Carbon Steel			
370A	see note 1	Hex capscrew, adapter to casing	Carbon Steel			
370B	8	Hex capscrew, frame to adapter	Carbon Steel			
370C	4	Hex capscrew, housing to frame	Carbon Steel			
370D	2	Hex capscrew, frame to frame foot	Carbon Steel			
370H	2	Hex capscrew, cover to adapter	Carbon Steel			
370P	4	Screw, end cover to frame	Carbon Steel			
371A	4	Hex tap bolt, adjusting	Carbon Steel			
372T	1	Screw, monitor	Stainless steel			
372V	4	Stud, casing to base	Carbon Steel			
372W	2	Hex cap screw, frame foot to base	Carbon Steel			
382	1	Bearing lockwasher	Steel			
383	1	Mechanical seal	Material varies			
388K	3	Hex capscrew, casing to adapter, jacking	Carbon Steel			
400	1	Coupling key	Carbon Steel			
408B	1	Plug, oil drain	Carbon Steel			
408H	see note 1	Plug, oil fill	Carbon Steel			
409	1	Bearing, radial	Deep groove ball			
412A	1	O-ring, impeller	Polyterafluorethylene (PTFE) - Grade 6C			
412C	see note 1	O-ring, sideplate to casing	N/A			
412F	1	O-ring, sleeve	Polyterafluorethylene (PTFE) - Grade 6C			
418	2	Hex capscrew, cover to adapter, jacking	Carbon Steel			
423B	4	Nut, jam	Carbon Steel			

Item	Qty	Part Name	Carbon Steel/CD4	All CD4MCuN	All 316SS	Super Duplex A890 5A
494	1	Cooler assembly	SS tube, brass fittings			
496	1	O-ring, housing	Buna-N			
497K	1	O-ring, radial laby ID	Fluorocarbon			
497L	1	O-ring, thrust laby ID	Fluorocarbon			
497M	1	O-ring, radial laby OD	Fluorocarbon			
497N	1	O-ring, thrust laby OD	Fluorocarbon			
748	see note 1	Lug, casing	N/A			
761B	1	LCCM, vib/temp monitor	Stainless Steel			

NOTICE:

The following items are not available or are not options on the XL1, XL2-S and XL2 sizes:

- Dynamic seal, impeller wear rings, shearpeller and grease lubrication.
- Open impellers are available on select sizes only. Refer to ETM.
- Casing wear rings are not mounted with set screws.
- Casing lugs are not required.

Table 19: Materials cross-reference chart

Goulds Pumps Material Code	Material	ASTM	DIN	ISO	JIS
1000	Cast iron	A48 Class 25	—	—	—
1001	Cast iron	A48 Class 25B	—	—	—
1003	Cast iron	A48 Class 30B	0.6020	DR185/Gr200	G5501 (FC20)
1011	Ductile iron	A536 GR 60-40-18	0.7040	R1083/400-12	G5502 (FCD40)
1040	Ferralium	-	—	—	—
1203	316 SS	A743 CF-8M	1.4408	—	G5121 (SC514)
1204	Alloy 20	A743 CN-7M	1.4500	—	—
1209	317 SS	A743 CG-8M	1.4448	—	—
1215	Hastelloy C	A494 CW-7M	—	—	—
1216	CD4MCuN	A890 GR 1B	—	—	—
1217	Hastelloy B	A494 N-7M	—	—	—
1219	316L SS	A743 CF-3M	—	—	—
1220	Titanium	B367 Gr C-3	—	—	—
1225	317L SS	A73 CG3M	—	—	—
1226	316 SS	A743 CR-8M	—	—	—
1233	904L SS	-	—	—	—
1361	Super duplex (cast)	A890 GR 5A	1.4469	—	—
1362	Duplex SS	A890 GR 3A	—	—	—
1605	6% to 7% Moly Duplex	A743 CK3NCuN	—	—	—

Goulds Pumps Material Code	Material	ASTM	DIN	ISO	JIS
2210	Carbon steel	A108 GR 1213	—	—	—
2213	Carbon steel	A108 GR 1018-B1112	—	—	—
2229	316SS	A276 Type 316	1.4462	—	—
2230	Carpenter 20	B473 (N08020)	—	—	—
2239	4140 steel	A193 GR B7	1.7225	—	64107, Class 2, SNB7
2247	Alloy B-2	B335 (N10665)	—	—	—
2248	Alloy C-276	B574 (N10276)	—	—	—
2249	Carbon steel	A322 GR 4340	—	—	—
2255	17-4PH	A564, Type 630	1.4542	(SUS630)	(SUS630)
2256	316L SS	A276 316L	1.4542	—	SUS630
2260	317L SS	—	1.4404	—	SUS316L
2344	904L	—	1.4438	—	SUS317L
2379	6% to 7% Moly Duplex	A4709 (S31254)	—	—	—
2380	Ferralium	—	—	—	—
2441	Stainless steel	F738M	—	A1-50	—
2442	Carbon steel	—	—	898-1 Class 8.8	—
3201	Carbon steel (plate)	A283 GR D	—	—	—
3211	316SS	A240 Type 316	—	—	—
3265	Alloy 2205	A240	1.4462	—	—
3280	Alloy 2507	A479/A479M	1.4501	—	—

8.2 Assembly drawings (exploded views)

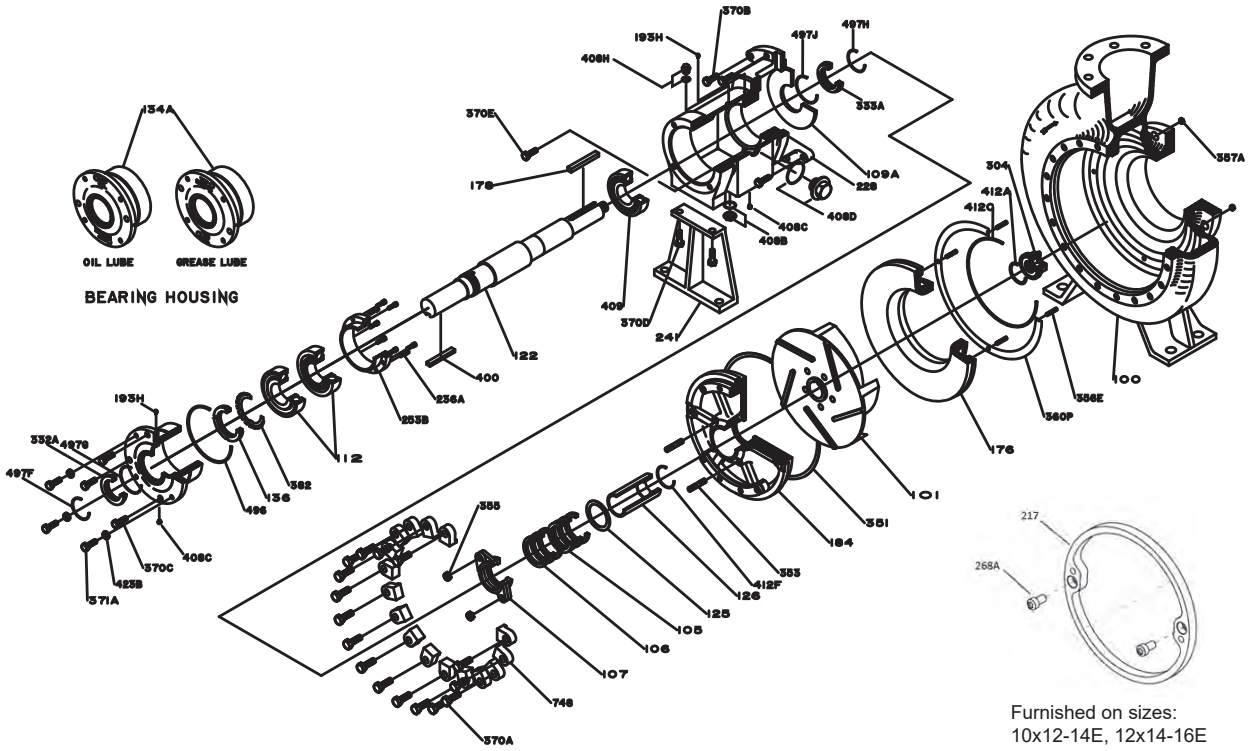


Figure 62: Exploded view of 3180 and 3185 S, M, L, and XL groups

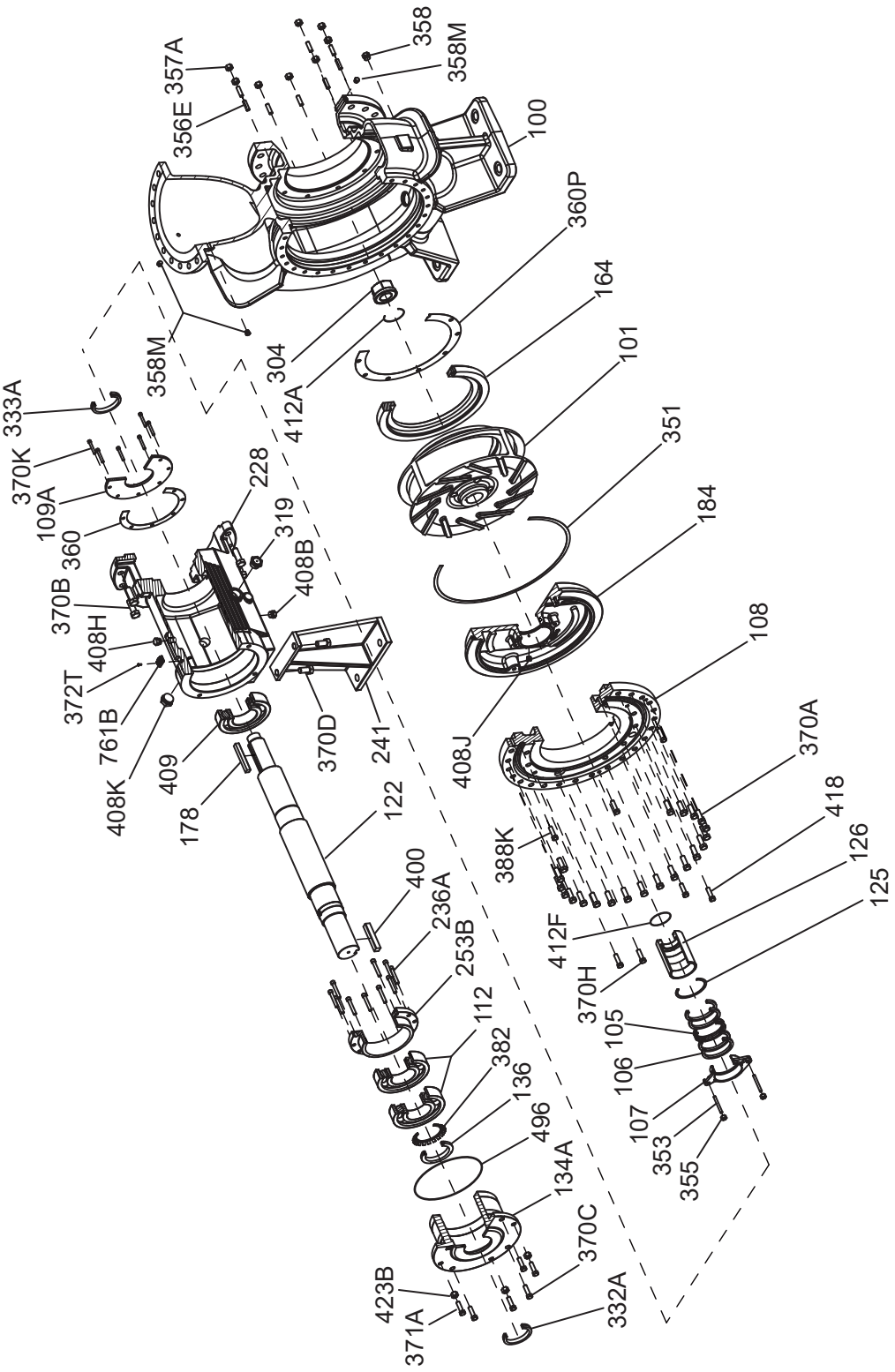


Figure 63: Exploded view of 3180 and 3185 XL1, XL2-S, and XL2 groups

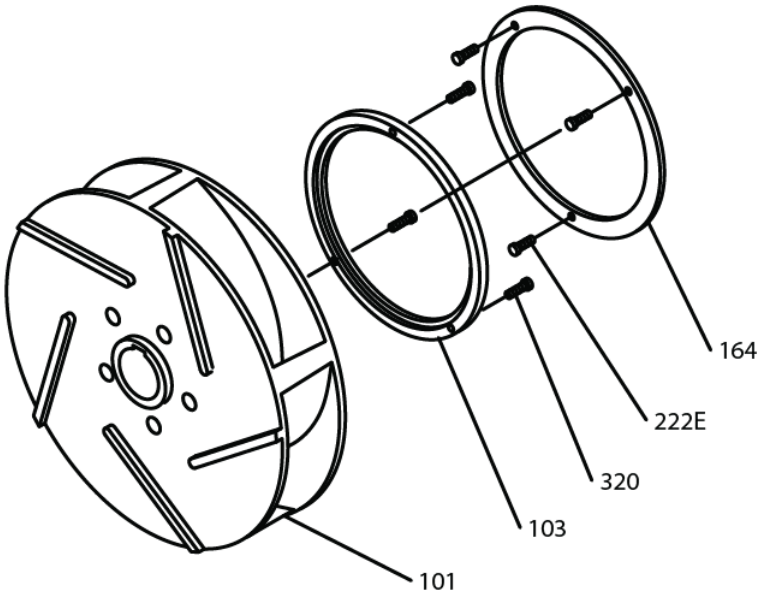


Figure 64: Enclosed impeller option for the S, M, L, and XL groups

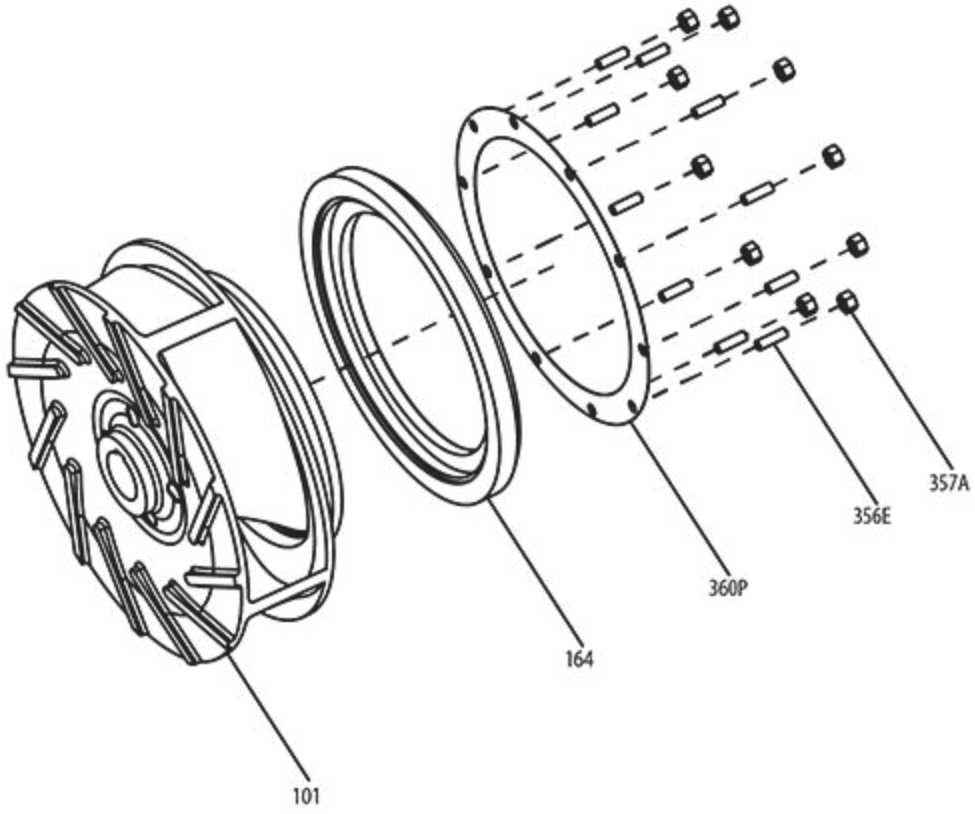


Figure 65: Enclosed impeller option for the XL1, XL2-S and XL2groups

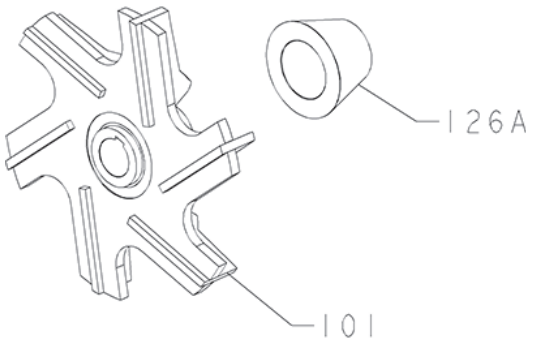


Figure 66: Shearpeller™

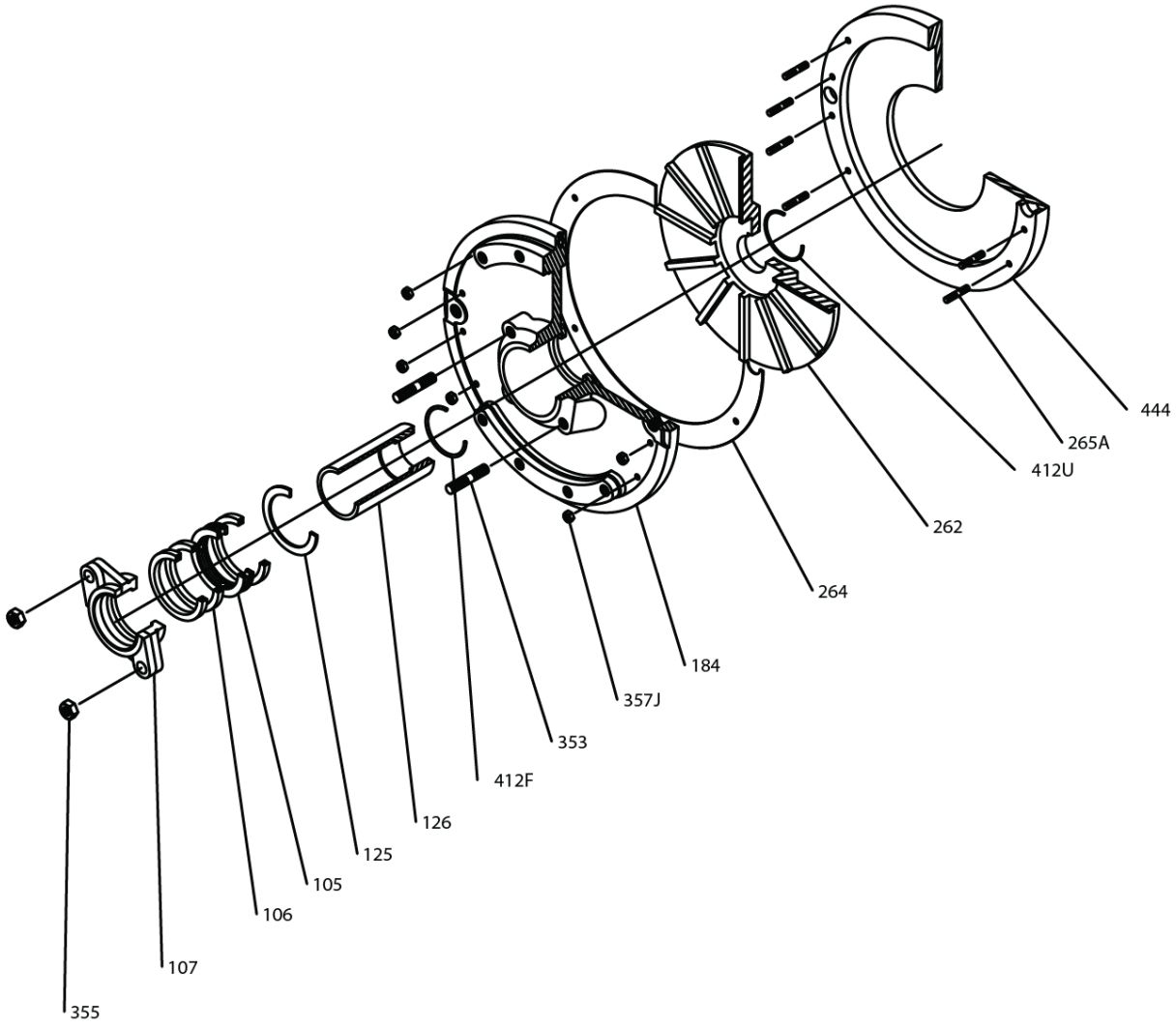


Figure 67: Dynamic seal option (3180/3185 S, M, L, and XL group only)

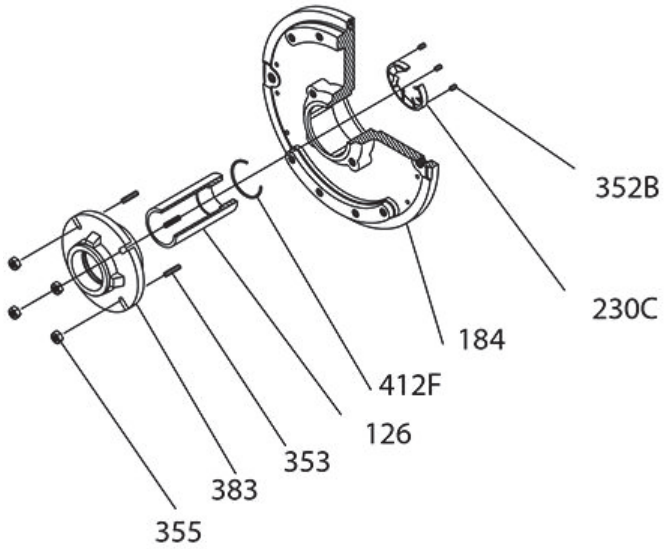
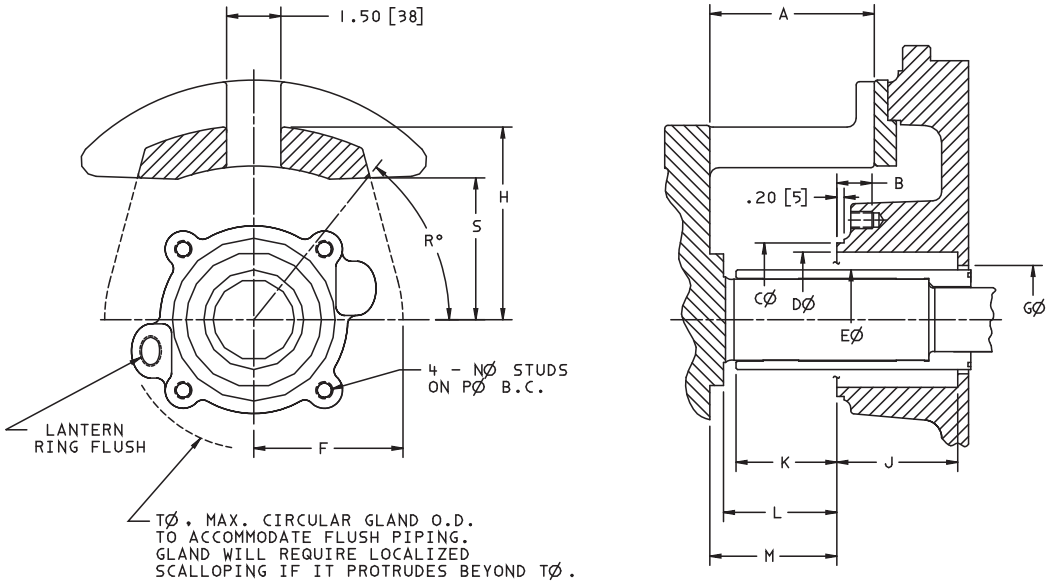


Figure 68: TaperBore™ PLUS seal chamber with VPE ring

8.3 Envelope drawings for packed box and seal chamber



NOTE 1 - TWO (2) STUDS ARE PROVIDED FOR PACKED BOX.
NOTE 2 - ALL DIMENSIONS ARE NOMINAL EXCEPT SLEEVE DIAMETER (EØ).

MODEL	GROUP	A	B	CØ	DØ	EØ	F	GØ	H	J	K	L	M	N	PØ	R°	S	TØ
3180 (IN.)	S	3.19	1.00	3.819 3.816	3.346 3.350	2.362 2.360	4.12	2.60	4.62	3.35	2.07	2.26	2.63	M12 X 1.75	4.72	48°	3.35	6.14
	M	4.53	1.00	4.173 4.170	3.740 3.744	2.756 2.754	4.12	2.99	5.38	3.35	2.79	3.14	3.51	M12 X 1.75	5.83	51°	3.90	6.61
	L	3.69	1.35	4.606 4.603	4.134 4.137	3.150 3.148	5.19	3.38	6.38	3.54	2.46	2.76	3.14	M16 X 2.00	6.34	52°	4.80	7.48
	XL	4.19	1.35	5.197 5.193	4.724 4.728	3.738 3.740	6.00	4.01	6.75	3.54	2.97	3.24	3.61	M16 X 2.00	6.77	50°	5.08	8.07
3185 (mm)	S	81	25	97_{h9}	85^{H9}	60_{h8}	105	66	117	85	52.5	57.3	66.8	M12 X 1.75	120	48°	85	156
	M	115	25	106_{h9}	95^{H9}	70_{h8}	105	76	137	85	70.8	79.7	89.1	M12 X 1.75	148	51°	99	168
	L	94	34	117_{h9}	105^{H9}	80_{h8}	132	86	162	90	62.4	70.1	79.8	M16 X 2.00	161	52°	122	190
	XL	106	34	132_{h9}	120^{H9}	95_{h8}	152	102	171	90	75.4	82.3	91.8	M16 X 2.00	172	50°	129	205

3180/3185 SHAFT
SLEEVE DRAWINGS

S GRP.- C03173A
M GRP.- C03174A
L GRP.- C03231A
XL GRP.- C03241A

Figure 69: 3180/3185 S, M, L, and XL packed stuffing box, drawing C03346A, revision 4, issue 0

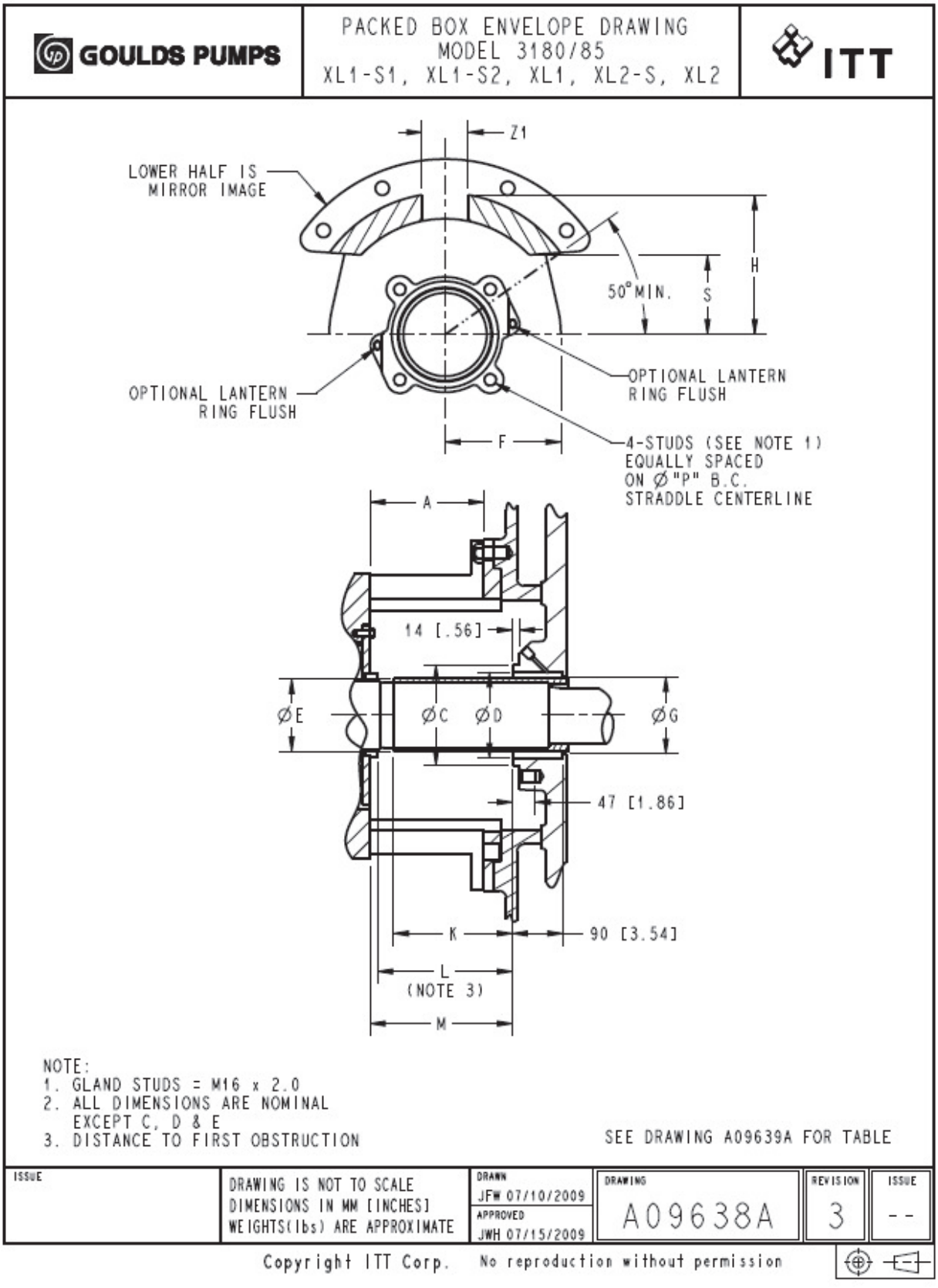


Figure 70: 3180/3185 XL1-S1, XL1-S2, XL1, XL2-S, XL2 packed stuffing box, drawing A09638A, revision 3

GOULDS PUMPS

PACKED BOX ENVELOPE DRAWING
MODEL 3180/85
XL1-S1, XL1-S2, XL1, XL2-S, XL2

ITT

INCHES

GROUP	A	C	D	E	F	G	H
XL1-S1, XL1-S2, XL1	5.12	7.484 7.480	6.302 6.299	5.315 5.313	8.29	5.59	10.04
XL2-S, XL2	5.75	8.665 8.661	7.484 7.480	6.496 6.494	9.83	6.77	12.07

GROUP	K	L	M	P	S	Z1	
XL1	3.94	7.05	8.00	9.25	7.28	2.17	
XL1-S1 18X14-16E		7.75					
XL1-S2 20X18-19E		7.75					
XL1 10X14-22E		6.71	6.95				
XL2-S & XL2	4.93	8.44	9.23	10.39	8.94	2.66	

MILLIMETERS

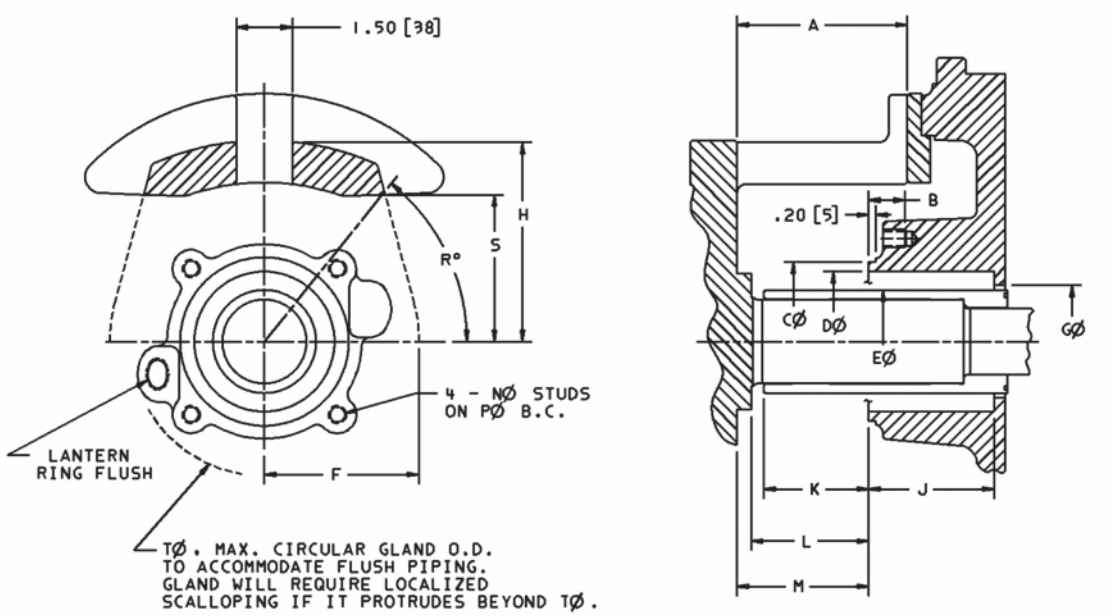
GROUP	A	C	D	E	F	G	H
XL1-S1, XL1-S2, XL1	130	190 h9	160 h9	135 h8	210	142	255
XL2-S & XL2	146	220 h9	190 h9	165 h8	225	172	306

GROUP	K	L	M	P	S	Z1	
XL1	100	179	203	235	185	55	
XL1-S1 18X14-16E		197					
XL1-S2 20X18-19E		197					
XL1 10X14-22E		170	177				
XL2-S & XL2	125	214	234	264	227	67.5	

NOTE:
1. GLAND STUDS = M16 x 2.0
2. ALL DIMENSIONS ARE NOMINAL EXCEPT C, D & E

SEE DRAWING A09638A FOR DIMENSIONS

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN UNITS SHOWN	DRAWN JFW 07/10/2009 APPROVED JWH 07/15/2009	DRAWING A09639A	REVISION 3	ISSUE --



NOTE 1 - FOUR (4) STUDS ARE PROVIDED FOR MECH. SEAL GLAND.
NOTE 2 - ALL DIMENSIONS ARE NOMINAL EXCEPT SLEEVE DIAMETER (EØ).

MODEL	GROUP	A	B	CØ	DØ	EØ	F	GØ	H	J	K	L	M	N	PØ	R°	S	TØ
3180 (IN.)	S	3.19	1.00	3.819 3.816	3.346 3.350	2.375 2.373	4.12	2.60	4.62	3.35	2.07	2.26	2.63	M12 X 1.75	4.72	48°	3.35	4.62
	M	4.53	1.00	4.173 4.170	3.740 3.744	2.750 2.748	4.12	2.99	5.38	3.35	2.79	3.14	3.51	M12 X 1.75	5.83	51°	3.90	5.12
	L	3.69	1.35	4.606 4.603	4.134 4.137	3.250 3.248	5.19	3.38	6.38	3.54	2.46	2.76	3.14	M16 X 2.00	6.34	52°	4.80	6.25
	XL	4.19	1.35	5.197 5.193	4.724 4.728	3.750 3.748	6.00	4.01	6.75	3.54	2.97	3.24	3.61	M16 X 2.00	6.77	50°	5.08	6.94
3185 (mm)	S	81	25	97_{h9}	85^{H9}	60_{h8}	105	66	117	85	52.5	57.3	66.8	M12 X 1.75	120	48°	85	117
	M	115	25	106_{h9}	95^{H9}	70_{h8}	105	76	137	85	70.8	79.7	89.1	M12 X 1.75	148	51°	99	130
	L	94	34	117_{h9}	105^{H9}	80_{h8}	132	86	162	90	62.4	70.1	79.8	M16 X 2.00	161	52°	122	159
	XL	106	34	132_{h9}	120^{H9}	95_{h8}	152	102	171	90	75.4	82.3	91.8	M16 X 2.00	172	50°	129	176

3180 SHAFT SLEEVE DRAWINGS

S GRP.- C03310A
M GRP.- C03311A
L GRP.- C03312A
XL GRP.- C03313A

3180/3185 SHAFT SLEEVE DRAWINGS

S GRP.- C03173A
M GRP.- C03174A
L GRP.- C03231A
XL GRP.- C03241A

FOR STUFFING BOX./ PACKING SLEEVE DIM. PLEASE SEE DWG. # C03346A

Figure 71: 3180/3185 S, M, L, and XL mechanical seal, drawing C03494A, revision 5, issue 0

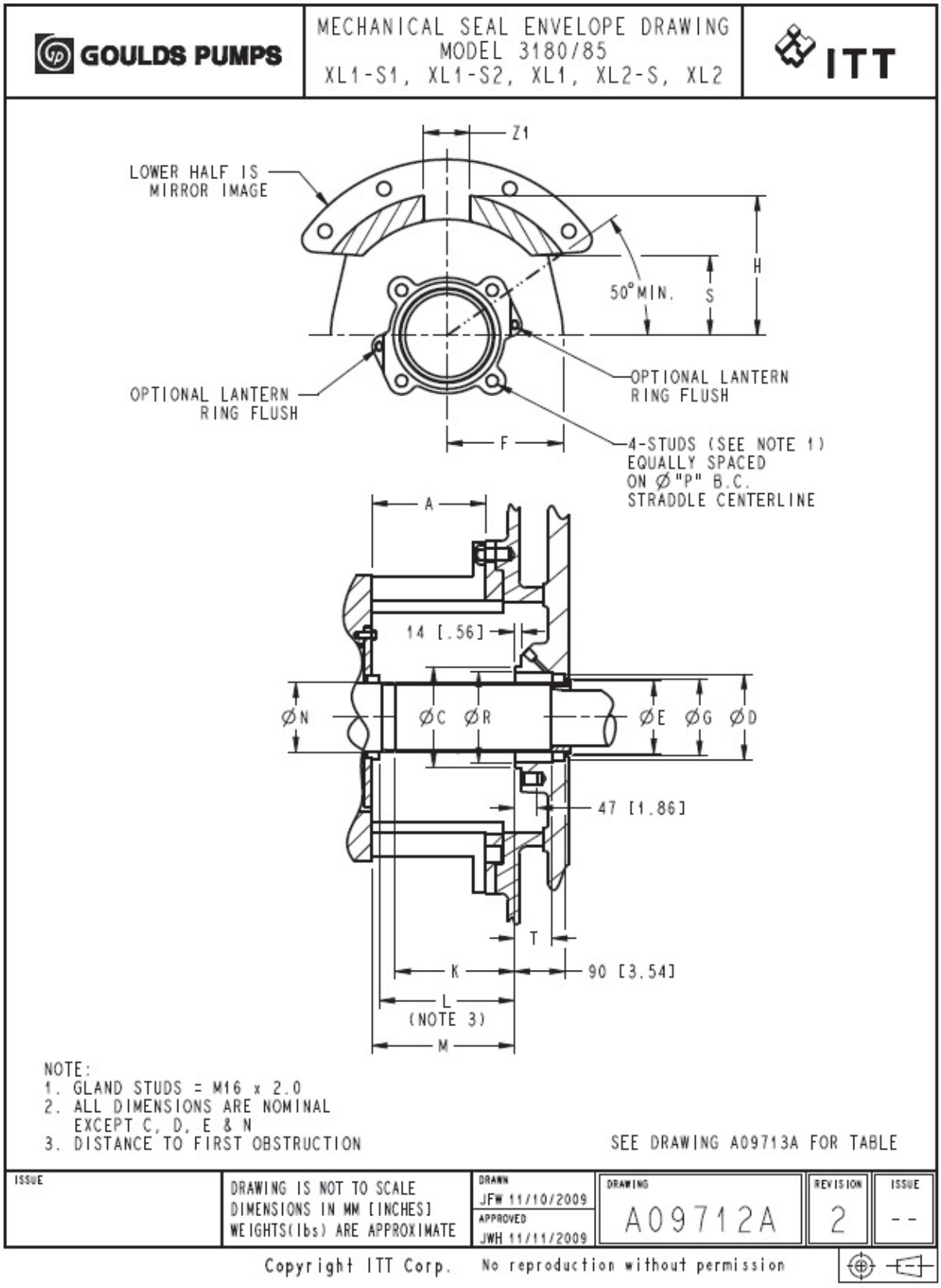


Figure 72: 3180/3185 XL1-S1, XL1-S2, XL1, XL2-S, XL2 mechanical seal, drawing A09712AA, revision 2

GOULDS PUMPS

MECHANICAL SEAL ENVELOPE DRAWING
MODEL 3180/85
XL1-S1, XL1-S2, XL1, XL2-S, XL2

ITT

MODEL 3180 - INCHES

GROUP	A	C	D	E	F	G	H	K
XL1-S1, XL1-S2, XL1	5.12	7.484 7.480	6.627 6.625	5.315 5.313	8.29	5.59	10.04	3.94
XL2-S & XL2	5.75	8.665 8.661	7.752 7.750	6.496 6.494	9.83	6.77	12.07	4.93

GROUP	L	M	N	P	R	S	T	Z1
XL1	7.05	8.00	5.250 5.248	9.25	6.752	7.28	3.062	2.17
XL1-S1 18X14-16E	7.75							
XL1-S2 20X18-19E	7.75							
XL1 10X14-22E	6.71	6.95						
XL2-S & XL2	8.44	9.23	6.250 6.248	10.39	7.874	8.94	3.156	2.66

MODEL 3185 - MILLIMETERS

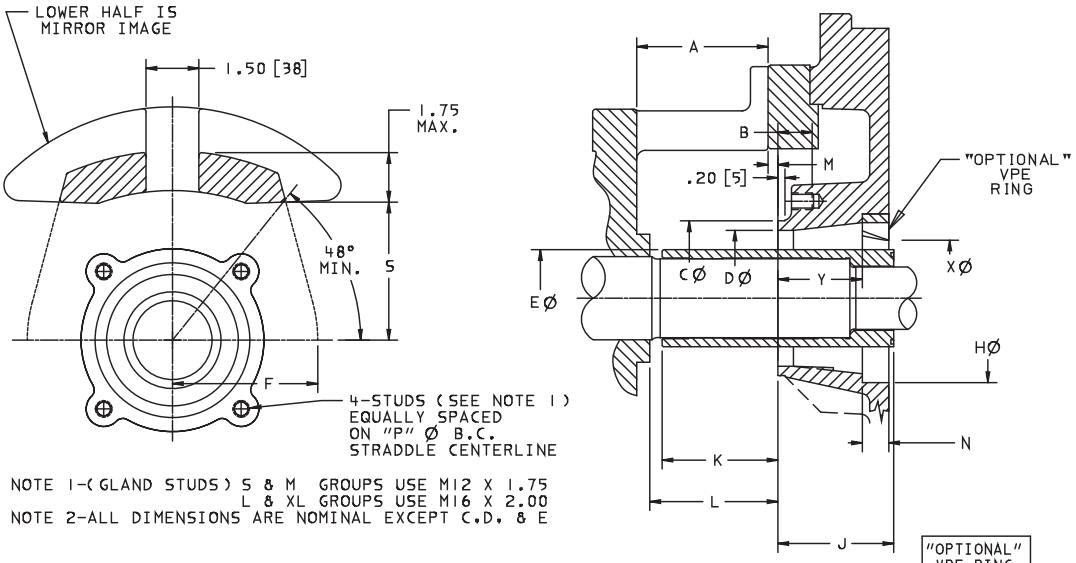
GROUP	A	C	D	E	F	G	H	K
XL1-S1, XL1-S2, XL1	130	190 h9	168.28 168.23	135 h8	210	142	255	100
XL2-S & XL2	146	220 h9	196.90 196.85	165 h8	225	172	306	125

GROUP	L	M	N	P	R	S	T	Z1
XL1	179	203	135 h8	235	171.5	185	77.8	55
XL1-S1 18X14-16E	197							
XL1-S2 20X18-19E	197							
XL1 10X14-22E	170	177						
XL2-S & XL2	214	234	160 h8	264	200	227	80.2	67.5

NOTE:
1. GLAND STUDS = M16 x 2.0
2. ALL DIMENSIONS ARE NOMINAL EXCEPT C, D, E & N

SEE DRAWING A09712A FOR DIMENSIONS

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN UNITS SHOWN	DRAWN JFW 11/10/2009 APPROVED JWH 11/11/2009	DRAWING A09713A	REVISION 3	ISSUE --



NOTE 1-(GLAND STUDS) S & M GROUPS USE M12 X 1.75
L & XL GROUPS USE M16 X 2.00
NOTE 2-ALL DIMENSIONS ARE NOMINAL EXCEPT C.D. & E

MODEL/ GROUPS		A	B	CØ	DØ	EØ	F	HØ	J	K	L	M	N	PØ	S	"OPTIONAL" VPE RING XØ	"OPTIONAL" VPE RING Y
3180 (IN.)	S	3.19	.88	3.937 3.934	3.386 3.389	2.375 2.373	4.12	5.373 5.375	2.56	2.70	2.89	.07	.75	4.72	3.35	3.39	1.81
	M	4.53	.88	4.409 4.406	3.858 3.862	2.750 2.748	4.12	5.943 5.945	3.15	3.30	3.65	* -.51	.75	5.83	3.90	3.87	2.40
	L	3.69	1.04	5.039 5.035	4.488 4.492	3.250 3.248	5.19	6.691 6.693	3.15	3.17	3.47	.16	1.00	6.34	4.80	4.51	2.15
	XL	4.19	1.04	5.591 5.587	5.039 5.043	3.750 3.748	6.00	7.203 7.205	3.15	3.68	3.95	.13	1.00	6.77	5.08	5.06	2.15
3185 (MM)	S	81	22	100_{h9}	86^{H9}	60_{h8}	105	(-.05) 136.5	65	68.5	73.3	2.8	19	120	85	86	46
	M	115	22	112_{h9}	98^{H9}	70_{h8}	105	(-.05) 151	80	83.8	92.7	* -13	19	148	99	98	61
	L	94	26	128_{h9}	114^{H9}	80_{h8}	132	(-.05) 170	80	80.4	88.1	4	25.4	161	122	115	54.6
	XL	106	26	142_{h9}	128^{H9}	95_{h8}	152	(-.05) 183	80	94.3	100	4	25.4	172	129	129	54.6

* "M" DIMENSION FOR THE M GROUP IS NEGATIVE BECAUSE THE SEAL CHAMBER GLAND FACE EXTENDS TO THE LEFT OF THE FRAME TO SEAL CHAMBER BOLTING FLANGE

3180 SHAFT SLEEVE DRAWINGS	
S	GRP.- C03310A
M	GRP.- C03311A
L	GRP.- C03312A
XL	GRP.- C03313A

3185 SHAFT SLEEVE DRAWINGS	
S	GRP.- C03173A
M	GRP.- C03174A
L	GRP.- C03231A
XL	GRP.- C03241A

Figure 73: 3180/3185 S, M, L, and XL TaperBore™ PLUS seal, drawing A06755A, revision 1, issue —

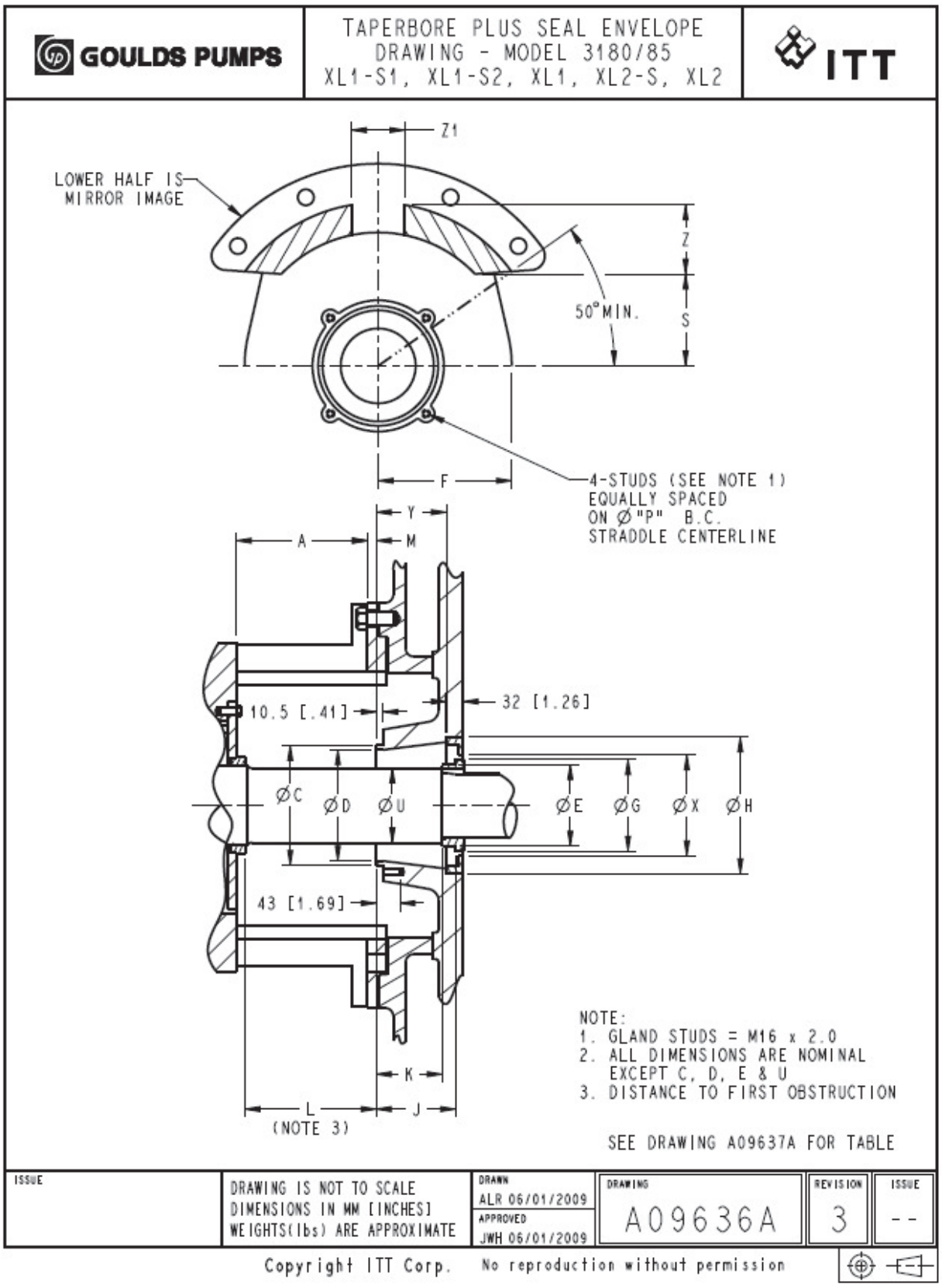


Figure 74: 3180/3185 XL1-S1, XL1-S2, XL1, XL2-S, XL2 TaperBore™ PLUS seal, drawing A09636A, revision 3

GOULDS PUMPS

TAPERBORE PLUS SEAL ENVELOPE
DRAWING - MODEL 3180/85
XL1-S1, XL1-S2, XL1, XL2-S, XL2

ITT

INCHES

GROUP	A	C	D	E	F	G	H	J	K
XL1	5.12	7.717 7.713	6.696 6.693	4.875 4.873	8.29	5.35	11.630	4.92	3.99
XL1-S1 18X14-16E								5.68	4.75
XL1-S2 20X18-19E									
XL1 10X14-22E								4.92	3.99
XL2-S	5.75	8.898 8.894	7.878 7.874	6.000 5.998	9.83	6.50	13.151	5.42	4.50
XL2						8.07			

GROUP	L	M	P	S	X	U	Y	Z	Z1
XL1	6.10	1.50	9.25	7.28	8.30	4.625 4.623	4.00	2.75	2.17
XL1-S1 18X14-16E	7.74	2.82							
XL1-S2 20X18-19E	6.36	1.45							
XL1 10X14-22E	5.33	0.42							
XL2-S	6.82	1.63	10.39	8.94	9.84	5.750 5.748	4.50	3.13	2.66
XL2									

MILLIMETERS

GROUP	A	C	D	E	F	G	H	J	K
XL1	130	196 h9	170 h9	123.8 g7	210	136	295.40	124.9	101.3
XL1-S1 18X14-16E								144.3	120.7
XL1-S2 20X18-19E									
XL1 10X14-22E								125.0	101.3
XL2-S	146	226 h9	200 h9	152.4 g7	225	165	334.04	137.7	114.2
XL2						205			

GROUP	L	M	P	S	X	U	Y	Z	Z1
XL1	154.9	38.0	235	185	211	117.48 g7	101.3	70	55
XL1-S1 18X14-16E	196.6	71.6							
XL1-S2 20X18-19E	161.5	36.8							
XL1 10X14-22E	135.4	10.7							
XL2-S	173.2	41.4	264	227	250	146.05 g7	114	79.5	67.5
XL2									

NOTE:
1. GLAND STUDS = M16 x 2.0
2. ALL DIMENSIONS ARE NOMINAL EXCEPT C, D, E & U

SEE DRAWING A09636A FOR DIMENSIONS

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN UNITS SHOWN	DRAWN ALR 06/01/2009 APPROVED JWH 06/01/2009	DRAWING A09637A	REVISION 3	ISSUE --

9 Decommissioning

9.1 Putting pump out of operation

This chapter contains information on decommissioning the pump. Decommissioning must be performed in the following situations:

- Before maintenance and servicing work
- Before removing the pump from the plant

Emptying

1. Switch the drive system off and secure it to prevent a restart/being switched on again
2. Make sure that all interfaces for the pumping process are securely closed.
3. Relieve the pump suction and discharge side pipelines of pressure in the safe area.

NOTICE:
Always safely collect any pumped medium that leaks out and dispose of this in accordance with applicable local regulations.

Empty the pump suction and discharge side pipelines completely in the safe area.

Clean

The following prerequisites for cleaning must be fulfilled:

- All interfaces for the pumping process are securely closed.
- The system is completely emptied and pressure-free.
    - Clean the pump thoroughly

9.2 Disposal

This chapter contains information on proper disposal. Ensure that the pump has been decommissioned properly prior to disposal

1. Drain lubricating oil from the bearing casing and collect it safely.
2. Thoroughly clean components and disassemble these in compliance with applicable local occupational safety and environmental protection regulations.