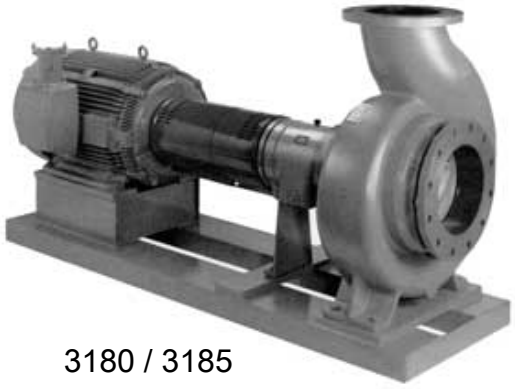
ITT

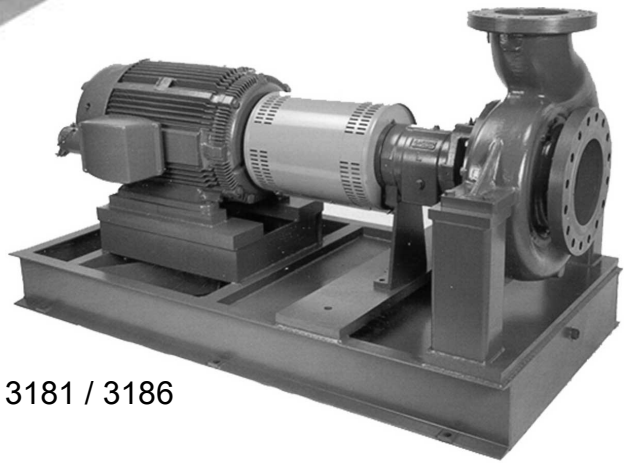
Goulds Pumps

Installation, Operation, and Maintenance Manual

Models 3180, 3181, 3185, and 3186



3180 / 3185



3181 / 3186

Engineered for life

Table of Contents

Introduction and Safety

Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance

CAUTION:

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

NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

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 identification code when requesting technical information or spare parts.

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.

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.

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 ITT 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.

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- Installation, Operation, and Maintenance manuals clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Do not change the service application without the approval of an authorized ITT representative.
- Never operate the pump below the minimum rated flow, when dry, or without prime.
- Never operate the pump without safety devices installed.
- Never operate the pump with the discharge valve closed.
- Never operate the pump with the suction valve closed.

Observe all safety messages highlighted in other sections of this manual.

Safety terminology and symbols

About safety messages

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

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

Hazard levels

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

Hazard categories

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

Electrical hazards are indicated by the following specific symbol:

Electrical Hazard:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

Environmental safety

The work area

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

Recycling guidelines

Always recycle according to these guidelines:

1. If the unit or parts are accepted by an authorized recycling company, then follow local recycling laws and regulations.
2. If the unit or parts are not accepted by an authorized recycling company, then return them to the nearest ITT representative.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Dispose appropriately of all waste.
- Handle and dispose of the pumped fluid 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.

Reference for electrical installation

For electrical installation requirements, consult your local electric utility.

User health and safety

Safety equipment

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

- Helmet
- Safety goggles (with side shields)
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection

The work area

Observe these regulations and warnings in the work area:

- 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.

Product and product positioning requirements

Observe these requirements for the product and the product positioning:

WARNING:

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

- Never operate a pump unless safety devices are installed.
- Never operate a pump unless a coupling guard is installed.
- Never force the piping in order to make a connection with a pump.
- Never start a pump without the proper priming.
- Never run a pump below the minimum rated flow or with any suction or discharge valve closed.

Electrical connections regulations

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

Observe these guidelines and warnings for electrical connections:

- Make sure that the product is isolated from the power supply and cannot be energized by mistake. This guideline also applies to the control circuit.
- Make sure that the thermal contacts are connected to a protection circuit according to the product approvals, and that they are in use.

Earthing (grounding)

All electric equipment must be earthed (grounded). This rule applies to pumps and mixers as well as monitoring equipment.

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.
- 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.

Precautions during work

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

Clean chemicals from the eyes

1. Hold your eyelids apart forcibly with your fingers.
2. Rinse the eyes for at least 15 minutes.
   Use an eyewash or running water.
3. Seek medical attention.

Clean chemicals from the body

1. Remove contaminated clothing.
2. Wash the skin with soap and water for at least one minute.
3. Seek medical attention, if required.

Safety regulations for Ex-approved products in potentially explosive atmospheres

Description of ATEX

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

General guidelines

ATEX compliance is only fulfilled when the pump is operated within its intended use, for example within its intended hydraulic range. The conditions of the service must not be changed without approval of an authorized ITT representative. When installing or maintaining ATEX-compliant pumps, follow these guidelines:

- Always install ATEX-approved equipment in compliance with the directive and applicable standards (IEC/EN 60079–14).
- Do not install FM-approved products in locations that are classified as hazardous in the national electric code, ANSI/NFPA 70–2005.

WARNING:

Installation, Operation, and Maintenance manuals clearly identify accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.

If there are any questions regarding these requirements, the intended use, or if the equipment requires modification, contact an ITT representative before you proceed.

Personnel requirements

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

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 and/or vapor present in hazardous areas.
- The maintenance operation for Ex-approved products must be made in conformity to the international or national standards (IEC/EN 60079-17).

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 stated on the nameplates.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Never start a pump without the proper priming.
- Before you start working with 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.
- 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.
- Make sure that the equipment is properly maintained:
  - Monitor the pump components and the end temperature of the liquid.
  - Maintain proper bearing lubrication.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that have been provided by an authorized ITT representative.

Equipment for monitoring

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

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

Product approval standards

Regular standards

All standard products are approved according to CSA standards in Canada and UL standards in USA. The drive unit degree of protection follows IP68. See the nameplate for maximum submersion, according to standard IEC 60529.

All electrical ratings and performance of the motors comply with IEC 600341.

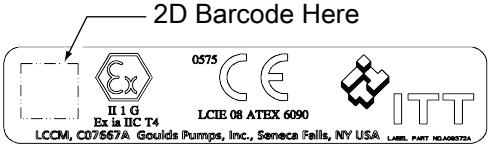
Explosion-proofing standards

All explosion-proof products for use in explosive atmospheres are designed in compliance with one or more of the following approvals:

- EN, ATEX Directive 94/9/EC
- FM According to NEC
  - Class 1 Div 1 Groups “C”, and “D”
  - Class 2 Div 1 Groups “E”, “F”, and “G”
  - Class 3 Div 1 Hazardous Locations

ATEX/IECEx:

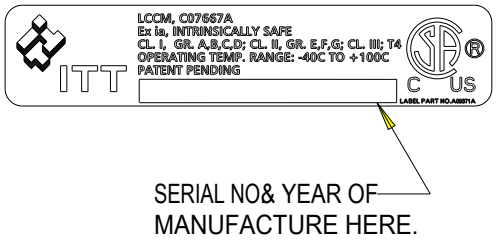
- Group: IIC
- Category: Ex ia
- Temperature Class: T4 (for ambients up to 100ºC)
- ATEX Marking: Ex II 1 G



CSA certification

Intrinsically safe for:

- Class I, Div. 1, Groups A, B, C, D
- Class II, Div. 1, Groups E, F, G
- Class III
- Certified to Canadian and US requirements



Certificates of conformance

CSA Certificate

CSA INTERNATIONAL

Certificate of Compliance

Certificate: 1992883 **Master Contract:** 236924

Project: 2254252 **Date Issued:** 2009/12/16

Issued to: **ITT Corporation**

240 Fall St
Seneca Falls, NY 13148
USA
Attention: Anthony Stavale

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

D. Simpson, Certifier

Issued by: D. Simpson, Certifier

PRODUCTS

CLASS 2258 03 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non - Incendive Systems - For Hazardous Locations

CLASS 2258 83 - PROCESS CONTROL EQUIPMENT-Intrinsically Safe and Non-Incendive - Systems-For Hazardous Locations-Certified to U.S. Standards

Class I, Division 1, Group A, B, C and D; Class II, Group E, F and G; Class III:

- Condition Monitor, Model LCCM, p/n C07667A, battery operated (non-replaceable, non-rechargeable), intrinsically safe, temperature code T4 (at max ambient of 100C).

APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No. 0-M91 - General Requirements – Canadian Electrical Code, Part II

CAN/CSA-C22.2 No.157-92 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations

UL Std No.913, Ed. 7 - Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous Locations

DQD 507 Rev. 2009-09-01

CSA INTERNATIONAL

Certificate: 1992883 **Master Contract:** 236924

Project: 2254252 **Date Issued:** 2009/12/16

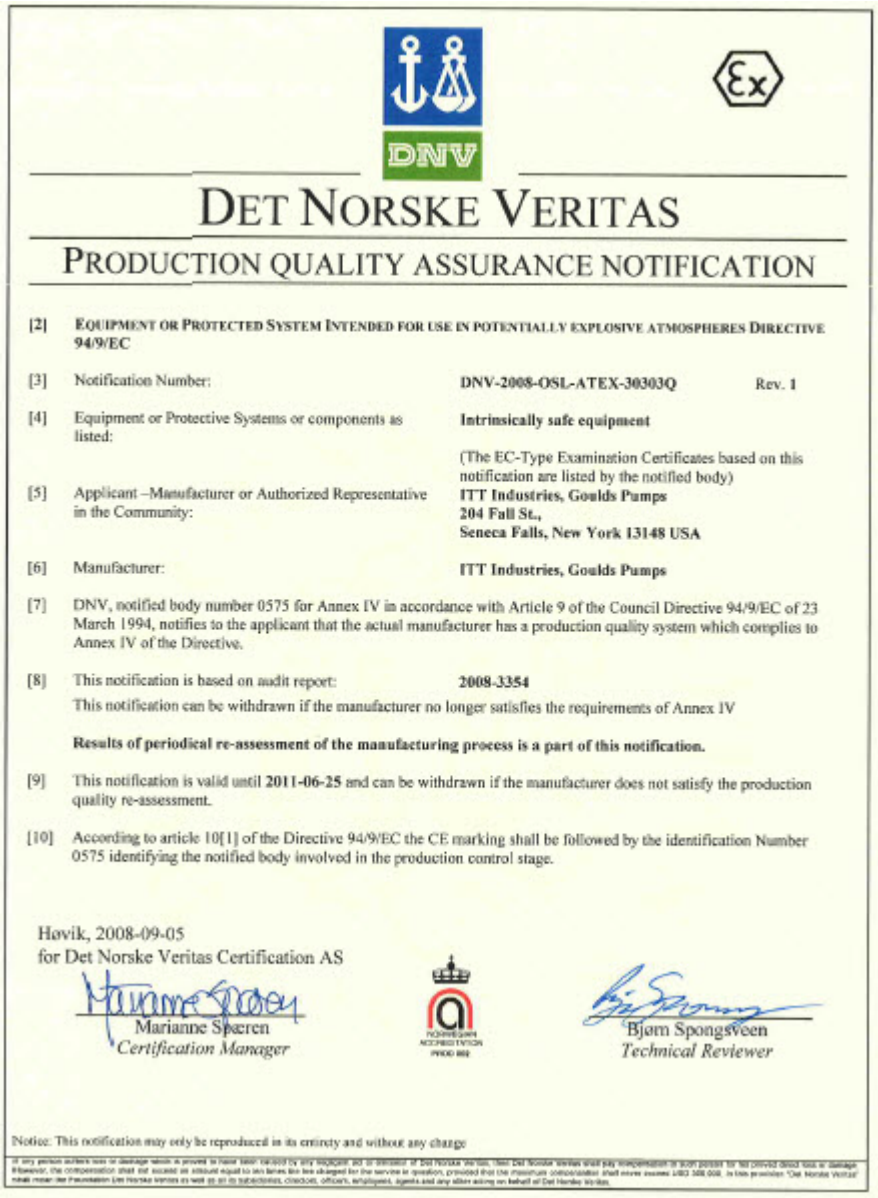
UL Std No. 969, 4th Edition - UL standard for safety marking and labeling systems

MARKINGS

- submittor's identification
- model designation
- date code or serial number
- Hazardous Location designations
- temperature code rating
- maximum ambient temperature
- the CSA Mark, with the C/US indicator
- the warning, WARNING: NOT FOR USE IN ATMOSPHERES CONTAINING ACETIC ACID
- the words "Ex ia" and "Intrinsically safe"

DQD 507 Rev. 2009-09-01

ATEX notification



DET NORSKE VERITAS

PRODUCTION QUALITY ASSURANCE NOTIFICATION

[2] EQUIPMENT OR PROTECTED SYSTEM INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES DIRECTIVE 94/9/EC

[3] Notification Number: **DNV-2008-OSL-ATEX-30303Q** Rev. 1

[4] Equipment or Protective Systems or components as listed: **Intrinsically safe equipment**

(The EC-Type Examination Certificates based on this notification are listed by the notified body)

[5] Applicant –Manufacturer or Authorized Representative in the Community: **ITT Industries, Goulds Pumps**
204 Fall St.,
Seneca Falls, New York 13148 USA

[6] Manufacturer: **ITT Industries, Goulds Pumps**

[7] DNV, notified body number 0575 for Annex IV in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, notifies to the applicant that the actual manufacturer has a production quality system which complies to Annex IV of the Directive.

[8] This notification is based on audit report: **2008-3354**
This notification can be withdrawn if the manufacturer no longer satisfies the requirements of Annex IV

Results of periodical re-assessment of the manufacturing process is a part of this notification.

[9] This notification is valid until **2011-06-25** and can be withdrawn if the manufacturer does not satisfy the production quality re-assessment.

[10] According to article 10[1] of the Directive 94/9/EC the CE marking shall be followed by the identification Number 0575 identifying the notified body involved in the production control stage.

Høvik, 2008-09-05
for Det Norske Veritas Certification AS

Marianne Spæren
Certification Manager

Bjørn Spongsveen
Technical Reviewer

Notice: This notification may only be reproduced in its entirety and without any change

IECEx Certificate of Conformity

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.: IECEx LCI 08.0038 issue No.:0 Certificate history:

Status: Current

Date of Issue: 2008-09-16 Page 1 of 3

Applicant:
ITT Corp.
Goulds pumps
240 Fall Street
Seneca Falls, NY 13148
United States of America

Electrical Apparatus: **Condition Monitor**
Optional accessory:

Type of Protection: ia

Marking:
ITT Corp.
Goulds pumps
240 Fall Street
Seneca Falls, NY 13148
U.S.A.
Condition Monitor
Type : LCCM, p/n C07667A
Ex ia IIC T4
Tamb : -40°C à 100°C

Approved for issue on behalf of the IECEx Certification Body: Marc Gillaux

Position: Ex Certification Manager

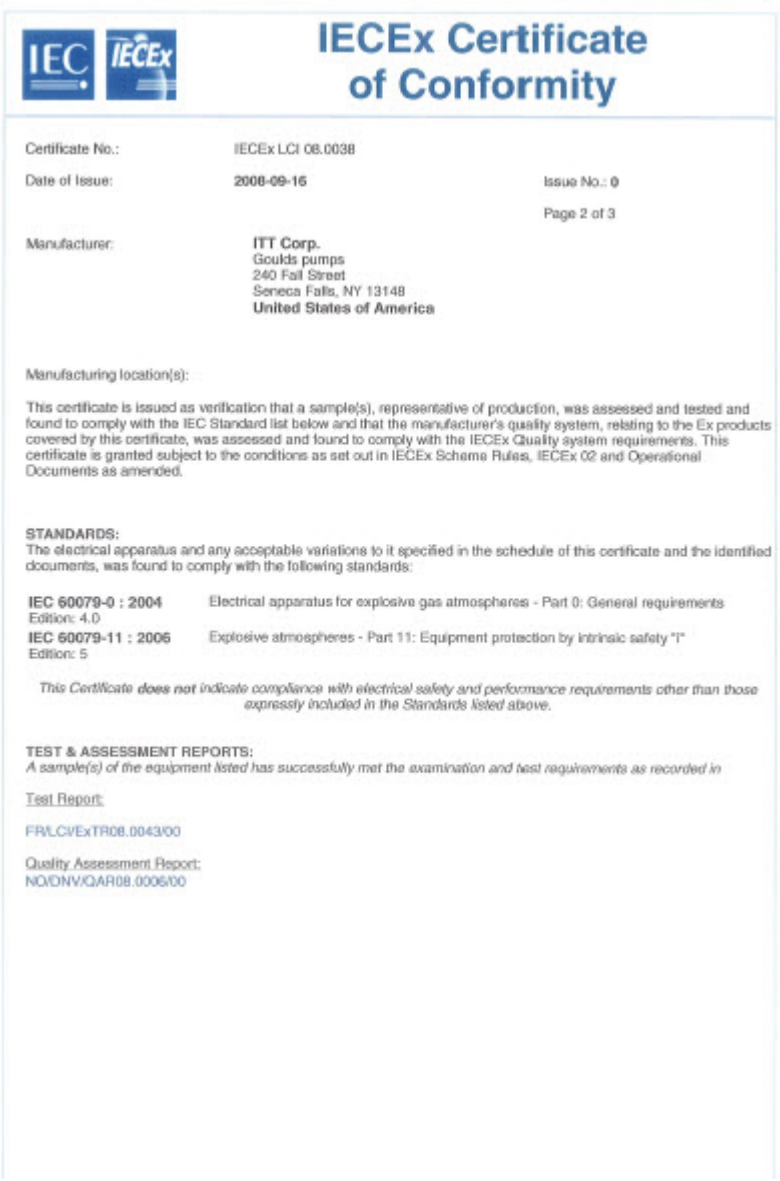
Signature: (for printed version)

Date: le 16 Septembre 2008

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

Laboratoire Central des Industries Electriques (LCIE)
33 Avenue du General Leclerc
FR-92260 Fontenay-aux-Roses
France



IECEx Certificate of Conformity

Certificate No.: IECEx LCI 08.0038

Date of Issue: 2008-09-16 Issue No.: 0

Page 2 of 3

Manufacturer: **ITT Corp.**
Goulds pumps
240 Fall Street
Seneca Falls, NY 13148
United States of America

Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2004 Edition: 4.0	Electrical apparatus for explosive gas atmospheres - Part 0: General requirements
IEC 60079-11 : 2006 Edition: 5	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

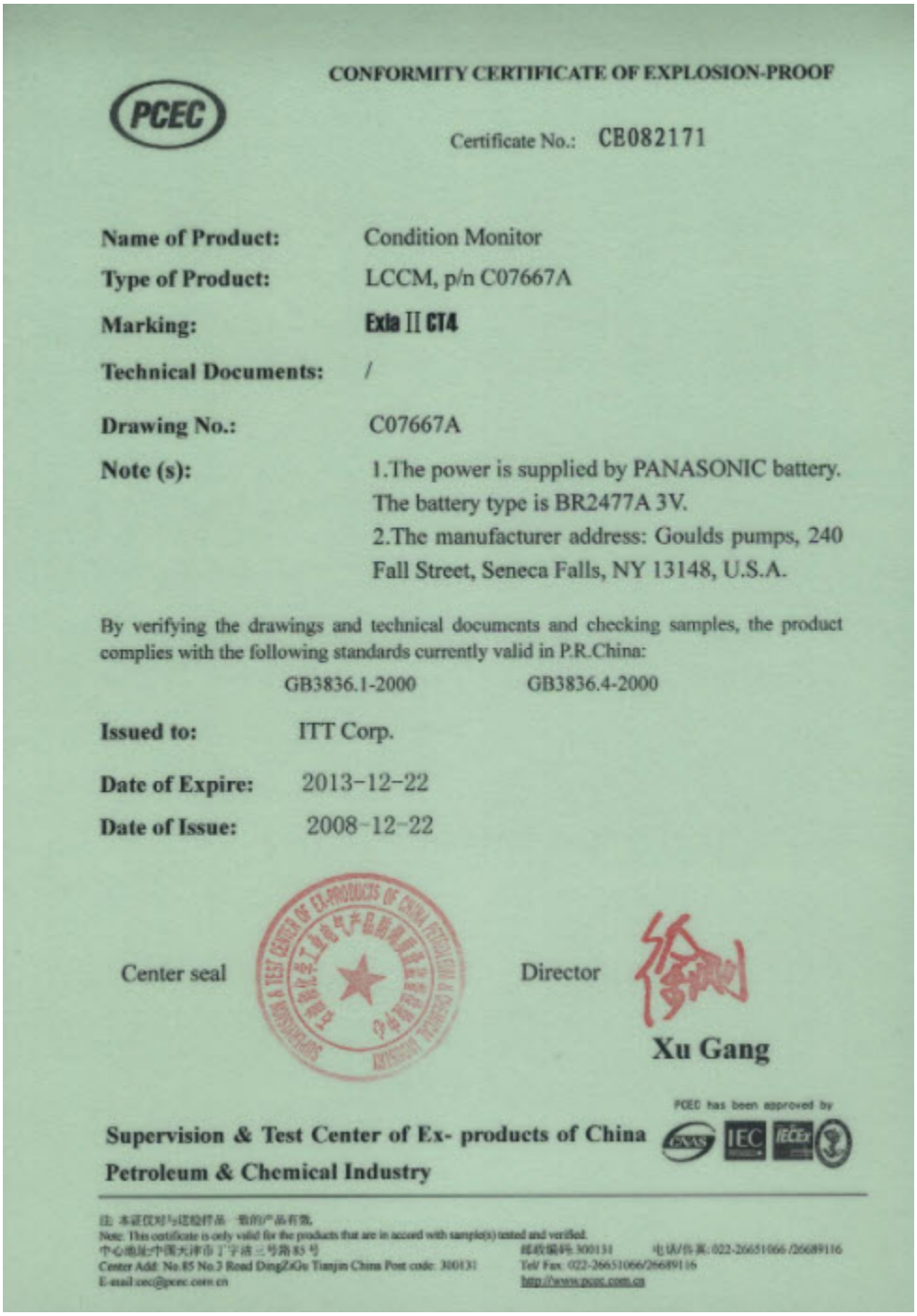
TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:

FR/LCI/ExTR08.0043/00

Quality Assessment Report:
NO/DNV/QAR08.0006/00

Chinese Certificate of Conformity



CONFORMITY CERTIFICATE OF EXPLOSION-PROOF

PCEC

Certificate No.: CE082171

Name of Product: Condition Monitor

Type of Product: LCCM, p/n C07667A

Marking: Exia II CT4

Technical Documents: /

Drawing No.: C07667A

Note (s): 1.The power is supplied by PANASONIC battery. The battery type is BR2477A 3V.
2.The manufacturer address: Goulds pumps, 240 Fall Street, Seneca Falls, NY 13148, U.S.A.

By verifying the drawings and technical documents and checking samples, the product complies with the following standards currently valid in P.R.China:

GB3836.1-2000 GB3836.4-2000

Issued to: ITT Corp.

Date of Expire: 2013-12-22

Date of Issue: 2008-12-22

Center seal

Director

Xu Gang

PCEC has been approved by

Supervision & Test Center of Ex- products of China Petroleum & Chemical Industry

注: 本证仅对与送检样品一致的产品有效
Note: This certificate is only valid for the products that are in accord with sample(s) tested and verified.
中心地址:中国天津市丁字沽三号路85号 邮政编码:300131 电话/传真:022-26651066/26689116
Center Add: No.85 No.3 Road DingZiGu Tianjin China Post code: 300131 Tel/ Fax: 022-26651066/26689116
E-mail:cec@pcec.com.cn http://www.pcec.com.cn

Transportation and Storage

Transportation guidelines

Precautions

WARNING:

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

Pump handling

WARNING:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- These pumps might use carbon or ceramic silicon carbide components. Do not drop the pump or subject it to shock loads as this can damage the internal ceramic components.

NOTICE: Use a forklift truck or an overhead crane with sufficient capacity to move the pallet with the pump unit on top. Failure to do so can result in equipment damage.

Lifting methods

WARNING:

- Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Do not attach sling ropes to shaft ends.

Table 1: Methods

Pump type	Lifting method
A bare pump without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A bare pump with lifting handles	Lift the pump by the handles.
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 the baseplate lifting lugs.

Examples

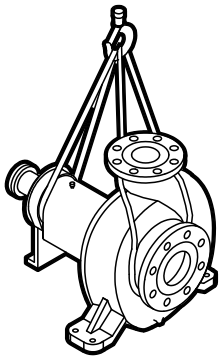
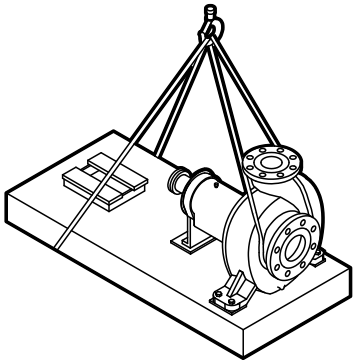


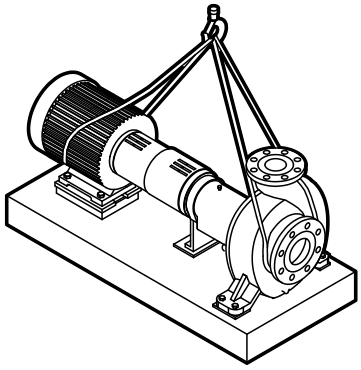
Figure 1: Example of a proper lifting method



NOTICE:

Do not use this lifting method to lift a Polyshield base with the pump and motor mounted. Doing so may result in equipment damage.

Figure 2: Example of a proper lifting method



NOTICE:

Do not use this lifting method to lift a Polyshield base with the pump and motor mounted. Doing so may result in equipment damage.

Figure 3: Example of a proper lifting method

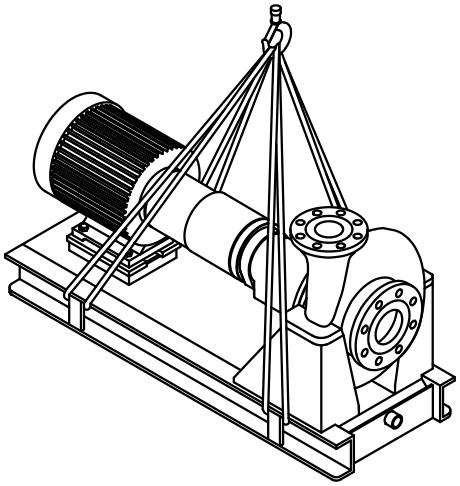


Figure 4: Example of a proper lifting method

NOTICE: When lifting a unit that does not have a way to secure the strap on the suction flange, you must secure the strap around the frame adapter. Failure to do so may result in equipment damage.

Storage guidelines

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.

Pump storage requirements

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

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 pump order or you can purchase it and apply it after the pumps are already in the field. Contact your local ITT sales representative.

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.

Product Description

General description

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

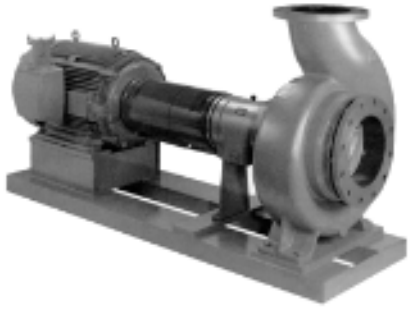


Figure 5: Model of 3180 and 3185

Figure 6: Model of 3181 and 3186

Part description

Casing

Feature	Description
Discharge	This discharge has top centerline for ease in handling air-entrained liquids.
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
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 (not available on XL1, XL2-S, and XL2)	• Provided as standard with models 3180 and 3185 (except on XL1, XL2-S, and XL2) • Provided as optional with models 3181 and 3186 • Available for all sizes of pumps (except on XL1, XL2-S, and XL2) • 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 locknut • Sealed by a Viton O-ring • Sealed on the sleeve side by a Teflon 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 O-ring
Enclosed with wear rings (standard on XL1, XL2-S, and XL2)	• Standard with the 3181 and 3186 • Optional with selected sizes of the S, M, L, and XL 3180 and 3185. Standard on XL1, XL2-S, and XL2 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, XL2-S, and XL2 sizes are through-bolted using a frame adapter to secure the stuffing box cover or seal chamber.

The table 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

Seal chamber option	Description
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 (not available on XL1, XL2-S, and XL2)	• Only used with the S, M, L, and XL 3180 and 3185 • 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, 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. • Grease lubrication and bearing frame cooling are not available. • The bearing locknut is in millimeters. • The coupling extension is in inches.
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 Teflon 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, 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 Teflon 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.

Hardware

All fasteners and tapped connections are metric.

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.

General description i-ALERT™ Condition Monitor

Description

The i-ALERT Condition Monitor is a compact, battery-operated monitoring device that continuously measures the vibration and temperature of the pump power end. The condition monitor uses blinking red LEDs to alert the pump operator when the pump exceeds pre-set vibration and temperature limits. This allows the pump operator to make changes to the process or the pump before a catastrophic failure occurs. The condition monitor is also equipped with a single green LED to indicate when it is operational and has sufficient battery life.

Alarm mode

The condition monitor enters alarm mode when either vibration or temperature limits are exceeded over two consecutive readings within a ten minute period. Alarm mode is indicated with two red flashing LEDs within two second intervals.

Temperature and vibration limits

Variable	Limit
Temperature	195°F (91°C)
Vibration	100% increase over the baseline level

Battery life

The i-ALERT Condition Monitor battery is not replaceable. You must replace the entire unit once the battery runs out of power.

The battery life is not covered as part of the standard five-year 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

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

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

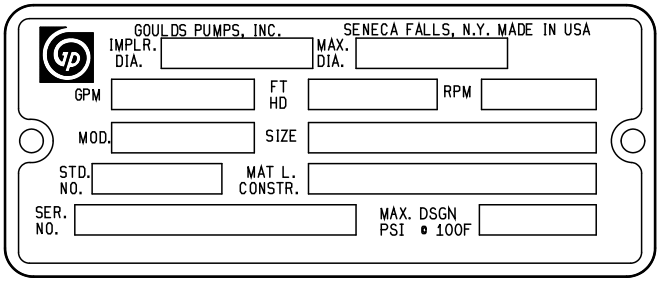


Table 2: Explanation of nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute
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 @ 100F	Maximum pressure at 100ºF according to the pump design

Nameplate on the pump casing using metric units

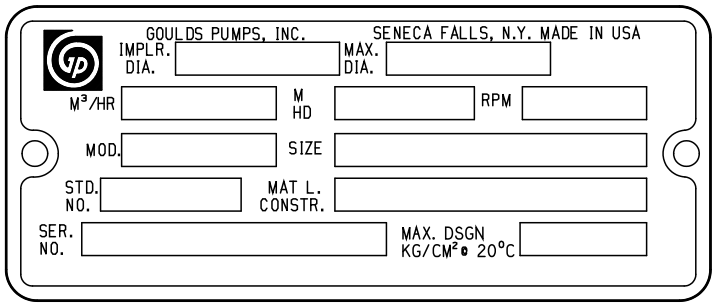


Table 3: Explanation of the nameplate on the pump casing

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

Nameplate field	Explanation
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

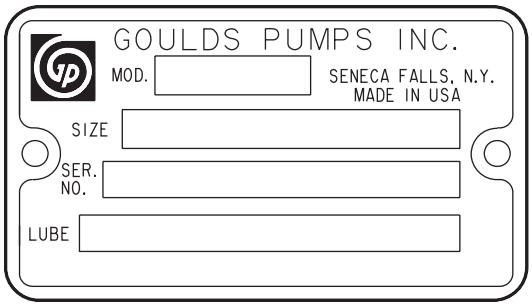


Table 4: Explanation of the nameplate on the bearing frame

Nameplate field	Explanation
MOD.	Pump model
SIZE	Size of the pump
SER. NO.	Serial number of the pump
LUBE	Lubricant, oil or grease

ATEX nameplate

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
T4	Temperature class

NOTICE: Make sure that the code classifications on the pump are compatible with the specific environment in which you plan to install the equipment. If they are not compatible, do not operate the equipment and contact your ITT representative before you proceed.

Installation

Preinstallation

Precautions

WARNING:

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.

NOTICE: Supervision by an authorized ITT representative is recommended to ensure proper installation. Failure to do so may result in equipment damage or decreased performance.

Pump location guidelines

WARNING:

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.

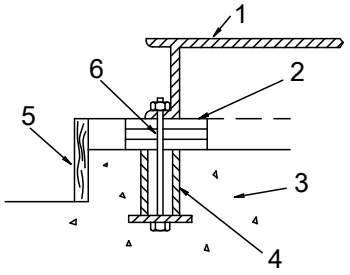
Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
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.
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.

Foundation requirements

Requirements

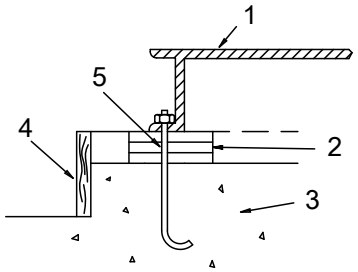
- The foundation must be able to absorb any type of vibration and form a permanent, rigid support for the pump unit.
- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three 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 and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.

Sleeve-type bolts



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

J-type bolts



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

Baseplate-mounting procedures

Prepare the baseplate for mounting

1. Remove all the attached equipment from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with an epoxy primer.

   Use an epoxy primer only if you used 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.

Install the baseplate using shims or wedges

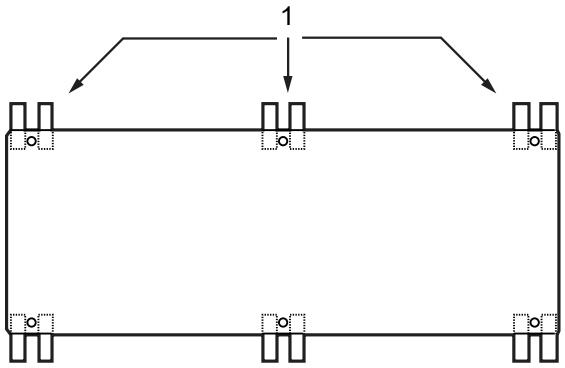
Required tools:

- 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.

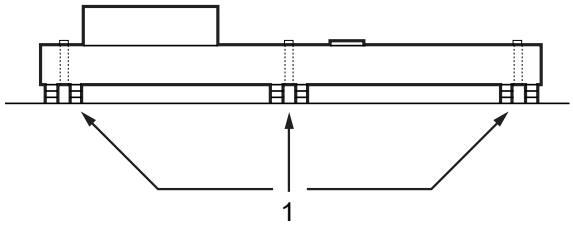
1. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt holes.
2. Put the sets of wedges or shims on each side of each foundation bolt.

   The sets of wedges should have a height of between 0.75 in. (19 mm) and 1.50 in. (38 mm).



1. Shims or wedges

Figure 7: Top view



1. Shims or wedges

Figure 8: 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 make sure that you achieve the correct leveling. 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 0.125 in. (3.2 mm) lengthwise
   - A maximum difference of 0.059 in. (1.5 mm) across

   You can use the baseplate-leveling worksheet when you take the readings.
6. Hand-tighten the nuts for the foundation.

Install the baseplate using jackscrews

Tools required:

- Anti-seize compound
- Jackscrews
- Bar stock

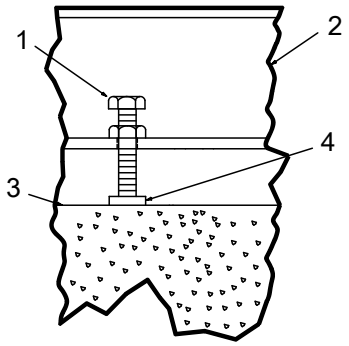
- Two machinist's levels
- Baseplate-leveling worksheet

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

1. Apply an anti-seize compound on the jackscrews.

   The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:
   a) Cut the plates from the bar stock and chamfer the edges of the plates in order to reduce stress concentrations.
   b) Put the plates between the jackscrews and the foundation surface.
   c) Use the four jackscrews in the corners in order to raise the baseplate above the foundation.

      Make sure that the distance between the baseplate and the foundation surface is between 0.75 in. (19 mm) and 1.50 in. (38 mm).
   d) Make sure that the center jackscrews do not touch the foundation surface yet.



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

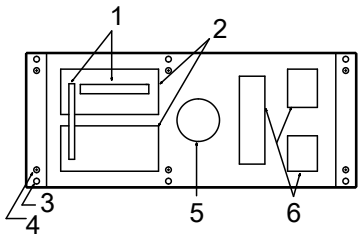
3. Level the driver mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. 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.



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

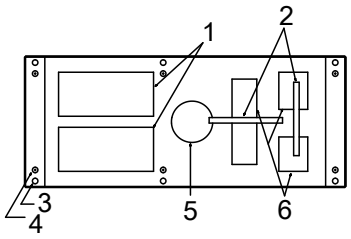
4. Turn the center jackscrews down so that they rest on their plates on the foundation surface.

5. Level the pump mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. 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.



1. Driver's mounting pads
2. Machinist's levels
3. Foundation bolts
4. Jackscrews
5. Grout hole
6. Pump's 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 0.002 in./ft (0.0167 mm/m).

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. You must support the suction and discharge piping 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).

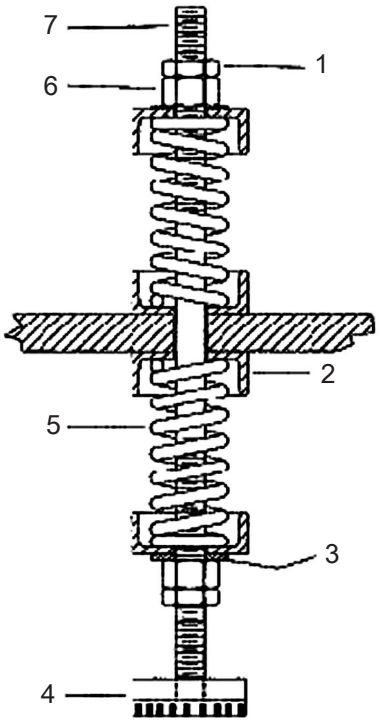
Install the baseplate using spring mounting (first generation)

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.

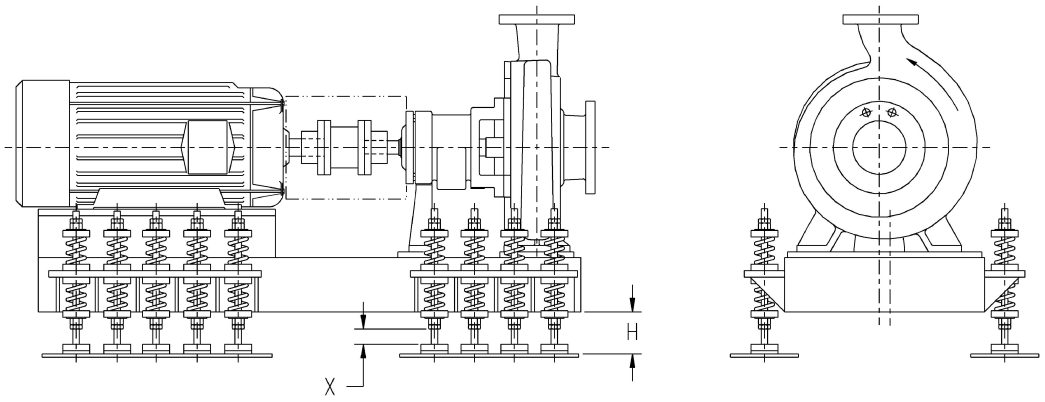


1. Hex jam nut
2. Follower
3. Flat washer
4. Bearing assembly
5. Spring
6. Hex nut
7. Stud

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.



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 baseplate below the pump	16 in. (406 mm)
11 in. (280 mm)	176 lbs/in.(30.82 newtons/mm)	Mounted under the baseplate below the motor	22 in. (559 mm)

1. Put the baseplate on a support above the foundation/floor.

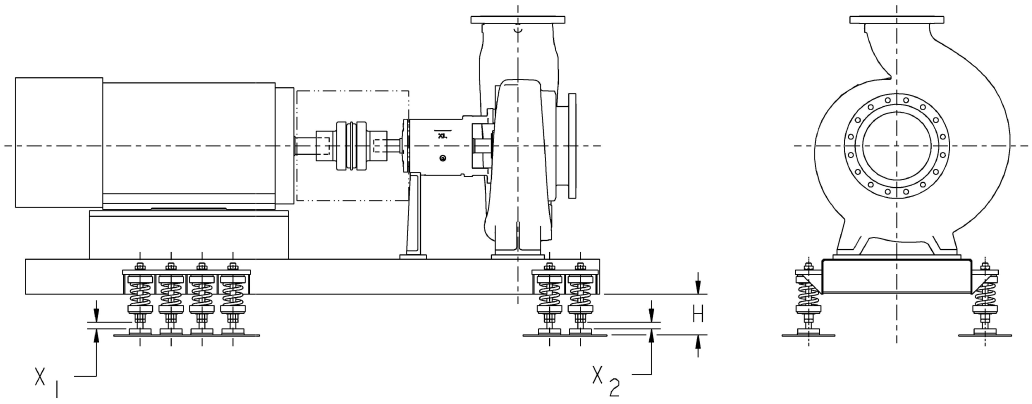
   Make sure that there is approximately 16 in. (406 mm) between the baseplate and the foundation/floor in order to provide enough space to install the spring assemblies.
2. Apply an anti-galling compound to the threads of the studs, nuts, and bearing pads.
3. Assemble the spring assemblies:
   a) Set a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

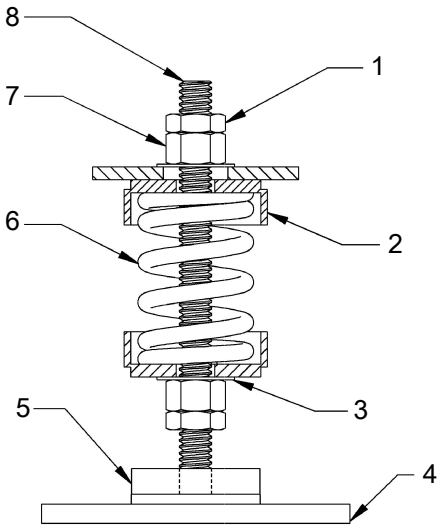
      The depth of the thread in the bearing pad is 1 in. (25 mm).
   i) Set the bottom adjusting nuts on the stud to the heights (X1 and X2) indicated on the certified GA dimension drawing.

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. Check the X1 and X2 dimensions again.
6. 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.



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

7. Level the baseplate and make the final height adjustments:
   a) Thread each of the upper hex nuts down to the baseplate mounting bracket.
   b) Turn the upper hex nuts on the studs that hold the larger springs under the motor. This allows you to compress each spring until the baseplate is level.
   c) Hand tighten the upper hex nuts on the studs that hold the smaller springs under the pump.

      Hand tighten only in cold setting.

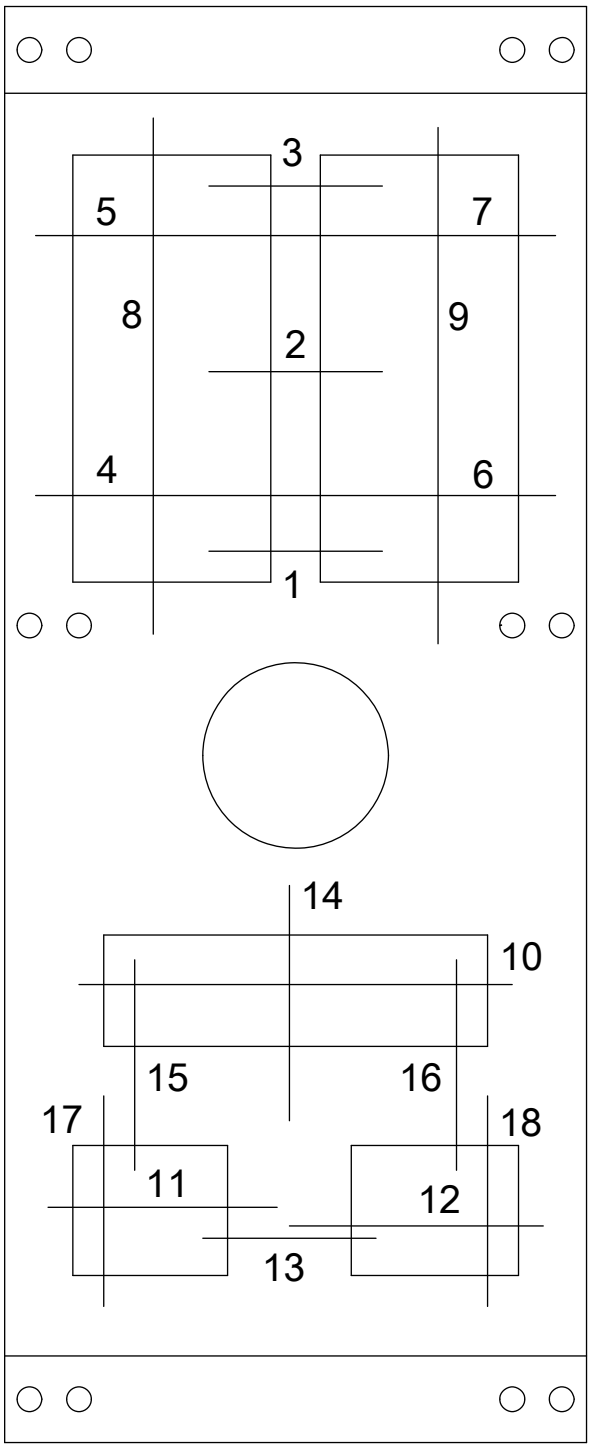
- Make sure the distance (H) from the bottom of the baseplate to the floor mounting pads is equal to the dimension shown on the certified GA dimension drawing.
- Make sure the height of the centerline of the suction flange is equal to the dimension shown on the certified GA dimension drawing
- In order to level the baseplate, the X1 and X2 dimensions can vary slightly from the dimensions shown on the certified GA dimension drawing.

8. Fasten the lower and upper hex jam nuts against the hex nuts on each spring assembly.

NOTICE: Do not cut off the additional length of the studs. The additional length is needed in order to remove the springs safely. Keep the additional threads lubricated with grease or a rust inhibitor.

Baseplate-leveling worksheet

Level measurements



1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

9)_____

10)_____

11)_____

12)_____

13)_____

14)_____

15)_____

16)_____

17)_____

18)_____

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.

Pump-to-driver alignment

Precautions

WARNING:

- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

NOTICE: Proper alignment is the responsibility of the installer and the user of the unit. Check the pump-to-driver alignment before you operate the unit. Failure to do so can result in equipment damage or decreased performance.

NOTICE: Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of frame-mounted units before you operate the unit. Failure to do so can result in equipment damage or decreased performance.

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.
Periodically	This follows the plant operating procedures.

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. You must use the correct tolerances. Failure to do so can result in misalignment and reduced pump reliability.

When dial indicators are used to check the final alignment, the pump and drive unit are correctly aligned when the total indicator runout is a maximum of 0.002 in. (0.05 mm) at operating temperature.

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.

Models 3181 and 3186 should be set at 50°F (10°C) for all temperatures due to the centerline-mounted casing.

Recommended settings for model 3180 and 3185

Pumped fluid temperature	Recommended setting for driver shaft
50°F (10°C)	0.002 in. (0.05 mm), low
150°F (65°C)	0.001 in. (0.03 mm), high
250°F (120°C)	0.005 in. (0.12 mm), high
350°F (175°C)	0.009 in. (0.23 mm), high
450°F (218°C)	0.013 in. (0.33 mm), high

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 feet are tight when you take indicator measurements.	This keeps the driver stationary since movement causes incorrect measurement.
Make sure that the hold-down bolts for the driver feet are loose before you make alignment corrections.	This makes it possible to move the driver when you make alignment corrections.
Check the alignment again after any mechanical adjustments.	This corrects any misalignments that an adjustment may have caused.

Attach the dial indicators for alignment

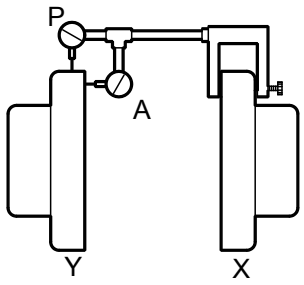
You must have two dial indicators in order to complete this procedure.

1. Attach two dial indicators on the pump coupling half (X):
   a) Attach one indicator (P) so that the indicator rod comes into contact with the perimeter of the driver coupling half (Y).

This indicator is used to measure parallel misalignment.

b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.

This indicator is used to measure angular misalignment.



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.

Pump-to-driver alignment instructions

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.

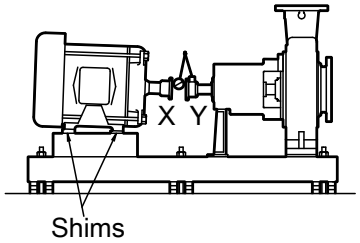


Figure 9: Side view of an incorrect vertical alignment

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

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.

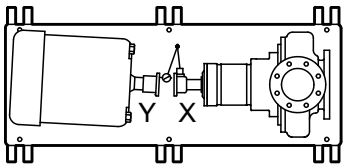


Figure 10: Top view of an incorrect horizontal alignment

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

Perform parallel alignment for a vertical correction

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 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

1. Set the parallel alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half.
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. Add shims of a thickness equal to half of the indicator reading value to each driver foot.

NOTICE:

You must use an equal amount of shims with each driver foot to prevent misalignment. Failure to do so can result in equipment damage or decreased performance.

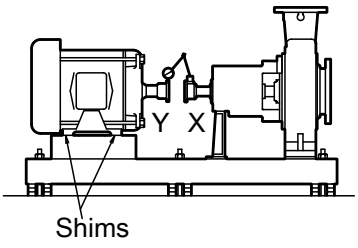


Figure 11: Side view of an incorrect vertical alignment

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

Perform parallel alignment for a horizontal correction

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

1. Set the parallel alignment indicator 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 is to the left of the pump coupling half.
Positive	The driver coupling half is to the right of the pump coupling half.

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.

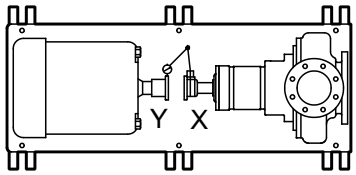


Figure 12: Top view of an incorrect horizontal alignment

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

Perform complete alignment for a vertical correction

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

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

Perform complete alignment for a horizontal correction

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

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

Grout the baseplate

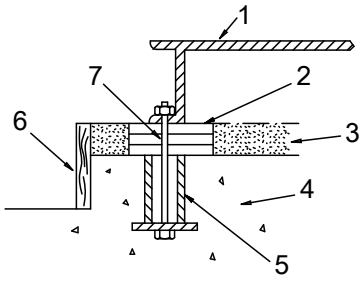
Required equipment:

- 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.

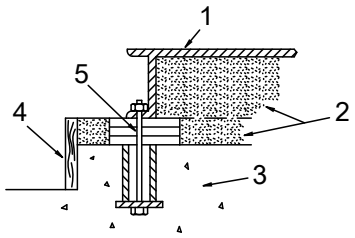
   When you pour the grout, remove air bubbles from it by using one of these methods:

   - Puddle with a vibrator.
   - Pump the grout into place.
5. Allow the grout to set.



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

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



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

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

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.

Piping checklists

General piping checklist

Precautions

CAUTION:

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

Piping guidelines

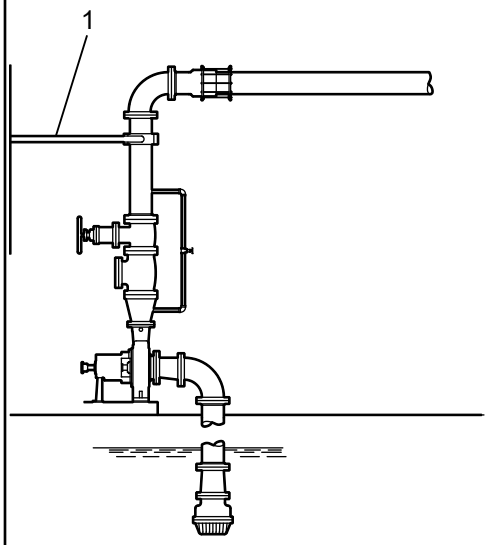
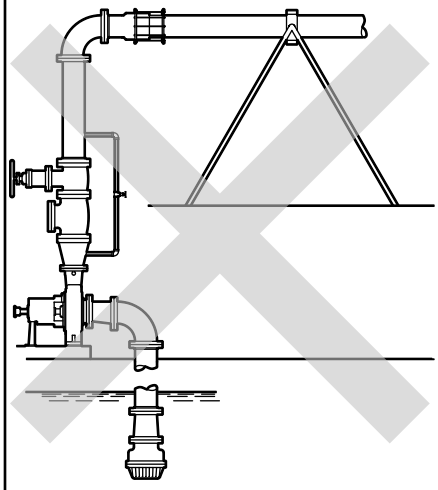
Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.	This helps to prevent: • Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings and the coupling • Wear on the pump bearings, seal, and shafting	
Keep the piping as short as possible.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: • The grout for the baseplate or sub-base 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.	—	

Check	Explanation/comment	Checked
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	

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: 

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 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	Explanation/comment	Checked
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.	
If suction strainers or suction bells are used, check that they are at least three times the area of the suction piping.	Suction strainers help to prevent clogging. Mesh holes with a minimum diameter of 1/16 in. (1.6 mm) are recommended.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	

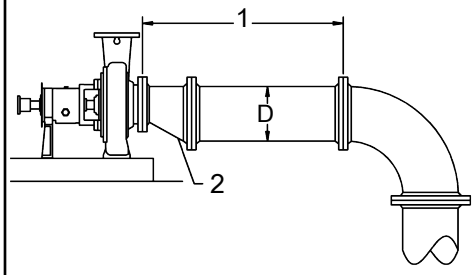
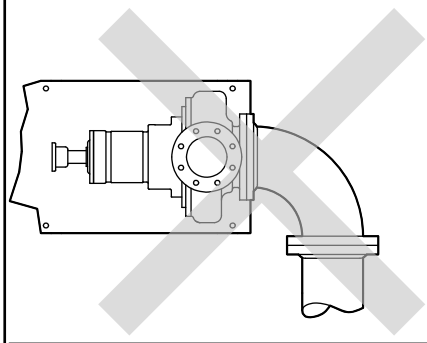
Liquid source below the pump

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.	

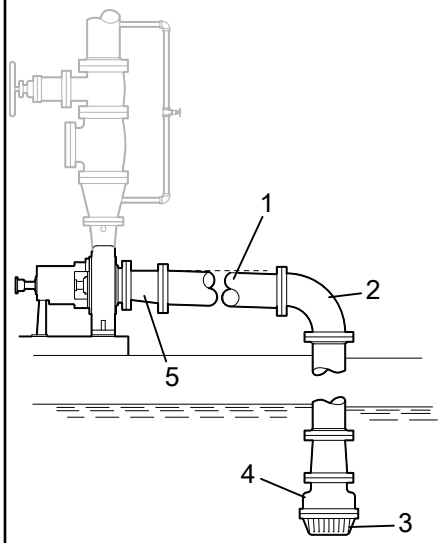
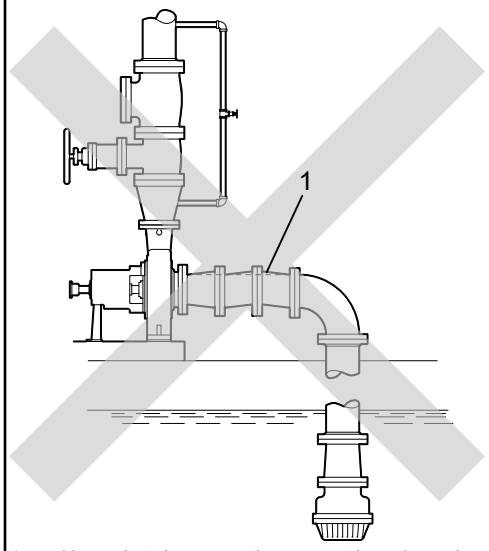
Liquid source above the pump

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.

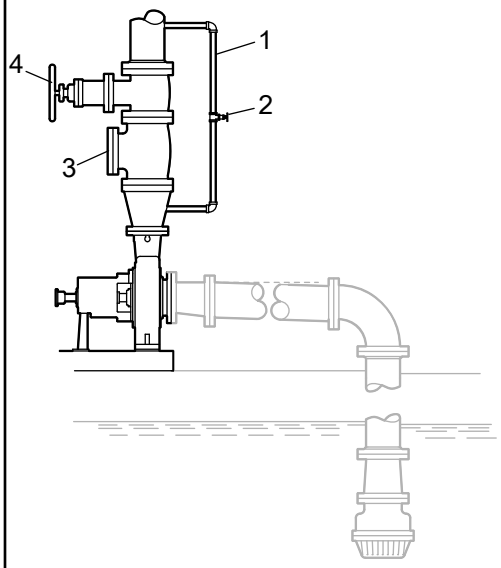
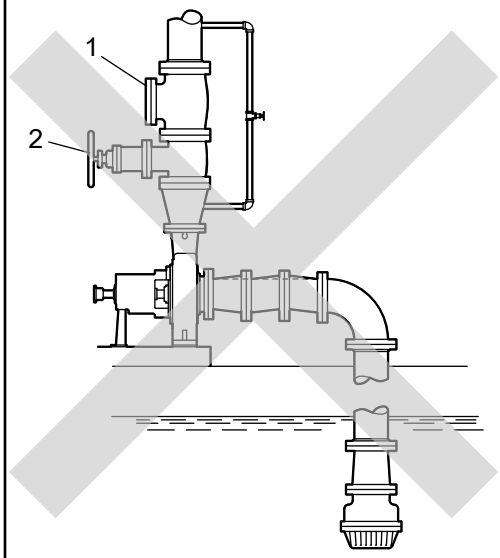
Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump	

Check	Explanation/comment	Checked
	See Example: Discharge piping equipment for illustrations.	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow. See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

Example: Discharge piping equipment

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

Auxiliary-piping checklist

Precautions

WARNING:

- Cooling systems such as those for bearing lubrication and mechanical-seal systems must be operating properly to prevent excess heat generation, sparks, and premature failure.
- 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.

NOTICE:

The mechanical seal must have an appropriate seal-flush system. Otherwise, excess heat generation and seal failure can occur.

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 1 gpm (4 lpm). If the bearing and seal chamber cover cooling are provided, then the auxiliary piping must flow at 2 gpm (8 lpm).	–	
Check that the cooling water pressure does not exceed 100 psig (7.0 kg/ cm^2).	–	

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.	

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

WARNING:

- Failure to follow these precautions before you start the pump will lead to serious personal injury and equipment failure.
- Do not operate the pump below the minimum rated flows or with the suction or discharge valves closed. These conditions can create an explosive hazard due to vaporization of pumped fluid and can quickly lead to pump failure and physical injury.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.

Precautions

NOTICE:

- Verify the driver settings before you start the pump.
- Make sure that the warm-up rate does not exceed 2.5°F (1.4°C) per minute.

You must follow these precautions before you start the pump:

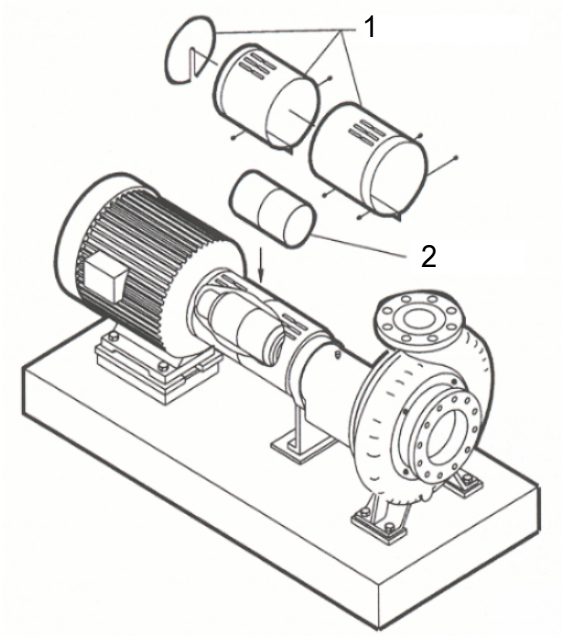
- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 100°F (38°C) of the fluid temperature.

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

Remove the coupling guard

1. Remove the nut, bolt, and washers from the slotted hole in the center of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.
3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver-side end plate.
5. Remove the driver half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.
6. Remove the remaining nut, bolt, and washers from the pump half of the coupling guard.
   It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.
7. Remove the pump half of the coupling guard:
   a) Slightly spread the bottom apart.

b) Lift upwards.



1. Coupling guard
2. Coupling

Check the rotation

WARNING:

- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

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.

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.

Impeller axial clearances

Total axial adjustment

The total axial adjustment of the impeller between the suction sideplate or case ring and the stuffing box cover should be between 0.028 in. and 0.087 in. (0.7 mm and 2.2 mm).

Cold temperature axial clearance for the open and closed impeller

For pumped liquid temperatures over 122°F (50°C), the cold setting must be increased to the values in this table. This prevents the impeller from contacting the suction sideplate or wear ring due to shaft expansion from the higher operating temperatures.

Temperature	Clearance
122°F (50°C)	0.015 in. (0.38 mm)
212°F (100°C)	0.018 in. (0.45 mm)
302°F (150°C)	0.020 in. (0.50 mm)
392°F (200°C)	0.022 in. (0.55 mm)
446°F (230°C)	0.026 in. (0.65 mm)

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).

Impeller-clearance setting

Importance of a proper impeller clearance

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

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.
- If you use a cartridge mechanical seal, you must install the centering clips and loosen the set screws before you set the impeller clearance. Failure to do so could result in sparks, heat generation, and mechanical seal damage.

The clearance is set at 0.015 in. (0.4 mm) 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

Set the impeller clearance - dial indicator method

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

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

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.

Set the impeller clearance - feeler gauge method

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

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.
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.

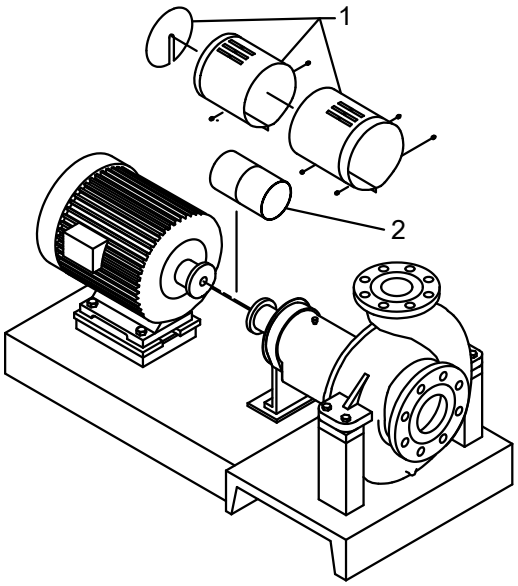
   Evenly tighten adjuster bolts (371A) (about one flat at a time) in making this adjustment.
8. Evenly tighten the locking bolts (370C) and then the adjuster bolts (371A) while keeping the indicator reading at the proper setting.
9. Make sure the shaft turns freely.
10. Replace the coupling guard.
11. Check both the thrust (332A) and radial (333A) labyrinth seals to make sure they are seated properly in the housing.

Couple the pump and driver

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

Couplings must have proper certification to be used in an ATEX classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling.



1. Coupling guard
2. Coupling

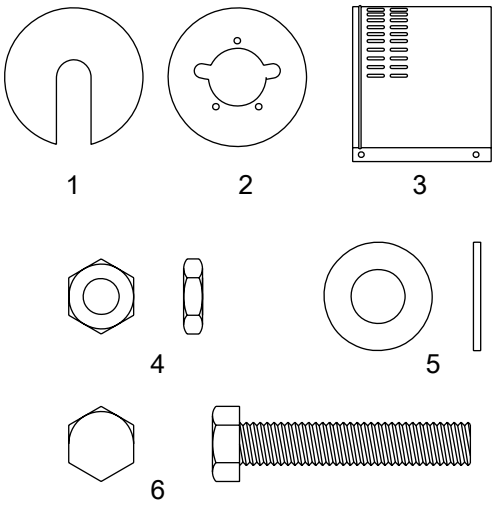
Figure 13: Coupling guard assembly

Install the coupling guard

WARNING:

- Never operate a pump without a properly installed coupling guard. Personal injury will occur if you run the pump without a coupling guard.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- The coupling used in an Ex-classified environment must be properly certified and must be constructed from a non-sparking material.

Required parts:

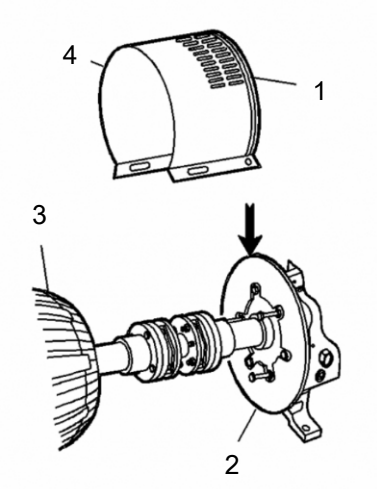


1. End plate, drive end
2. End plate, pump end
3. Guard half, 2 required
4. 3/8-16 nut, 3 required

5. 3/8 in. washer
6. 3/8-16 x 2 in. hex head bolt, 3 required

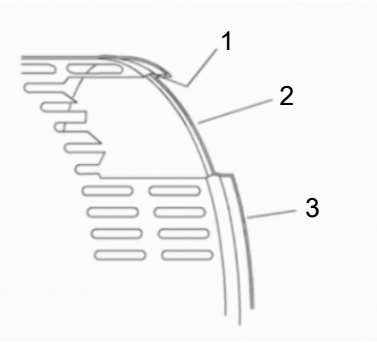
1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
2. Put the pump-side end plate in place.

   If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.
3. Put the pump-half of the coupling guard in place:
   a) Slightly spread the bottom apart.
   b) Place the coupling guard half over the pump-side end plate.



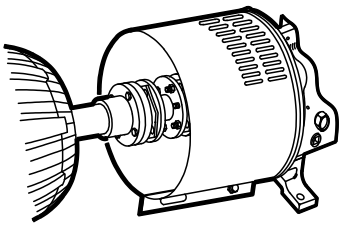
1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

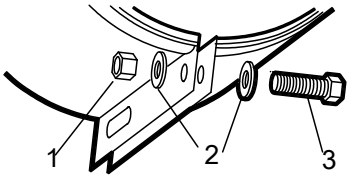
The annular groove in the coupling guard half must fit around the end plate.



1. Annular groove
2. End plate (pump end)
3. Guard half

4. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Tighten securely.





1. Nut
2. Washer
3. Bolt

5. Put the driver half of the coupling guard in place:
   a) Slightly spread the bottom apart.
   b) Place the driver half of the coupling guard over the pump half of the coupling guard.
      The annular groove in the coupling guard half must face the motor.
6. Place the driver-side end plate over the motor shaft.
7. Place the driver-side end plate in the annular groove of the driver-half of the coupling guard.
8. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Hand-tighten only.
   The hole is located on the driver-side of the coupling guard half.
9. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.
10. Use a nut, a bolt, and two washers to secure the coupling guard halves together.
11. Tighten all nuts on the guard assembly.

WARNING:
Never operate the pump without the coupling guard correctly installed.

Bearing lubrication

WARNING:
Make sure to properly lubricate the bearings. Failure to do so can result in excess heat generation, sparks, and premature failure.

NOTICE: Be certain to 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.

Oil volumes

Oil volume requirements

This table shows the required amount of oil for oil-lubricated bearings.

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

Lubricating oil requirements

Quality requirements

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

Lubricating oil requirements

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

Acceptable oil for lubricating bearings

Acceptable lubricants

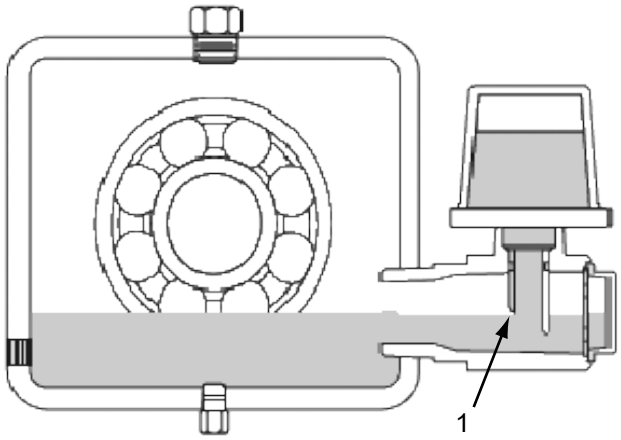
Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Mobil	DTE 26 300 SSU @ 100°F (38°C)
Philips	Mangus Oil 315 MM motor oil SAE 20-20W HDS motor oil SAE 20-20W
Gulf	Harmony 68

Lubricate the bearings with oil

WARNING:

Make sure to properly lubricate the bearings. Failure to do so can result in excess heat generation, sparks, and premature failure.

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

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.

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

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

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

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.
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 5 to 15 psi (0.35 to 1.01 kg/cm^2) greater than the seal chamber pressure. The injection rate must be 0.5 to 2 gpm (2 to 8 lpm).
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.

Packed stuffing box option

WARNING:

Packed stuffing boxes are not allowed in an ATEX-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.

Connection of sealing liquid for a packed stuffing box

WARNING:

Packed stuffing boxes are not allowed in an ATEX-classified environment.

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

If...	Then...
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.

If...	Then...
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 15 psi (1.01 kg/cm^2) above the stuffing box pressure.

Seal the shaft with a packed stuffing box

WARNING:

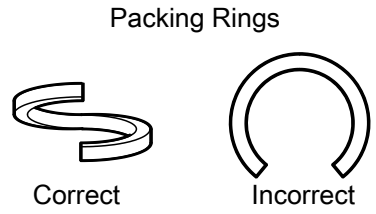
Packed stuffing boxes are not allowed in an ATEX-classified environment.

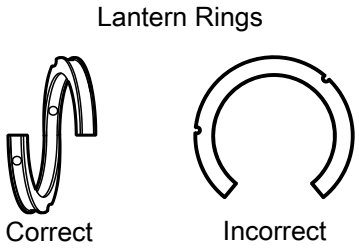
CAUTION:

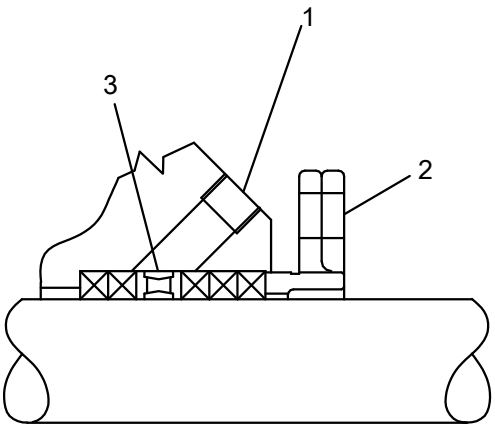
Never replace the packing until the driver is properly locked out and the coupling spacer is removed.

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. 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.

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

WARNING:

Dynamic seals are not allowed in an ATEX-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 5: 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: • Graphic packing • Diaphragm seal

Table 6: Secondary seal part function

Secondary seal type	Description and operation
Graphic 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. • 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 start-up. The step on the follower should line up with the face of the gland plate. Some adjustment might be required. This seal is non-contacting during operation so no flush is required. **NOTICE:** Do not flush the box through the lantern ring connection. If the box becomes pressurized during operation from a flush or excessive suction pressures, this will cause the diaphragm to contact the follower and destroy the diaphragm. 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.

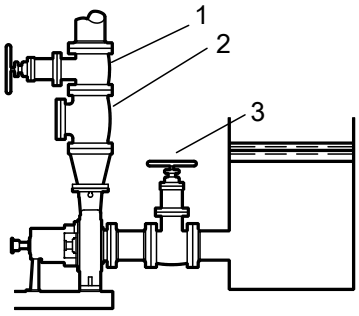
Pump priming

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.

Prime the pump with the suction supply above the pump

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



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

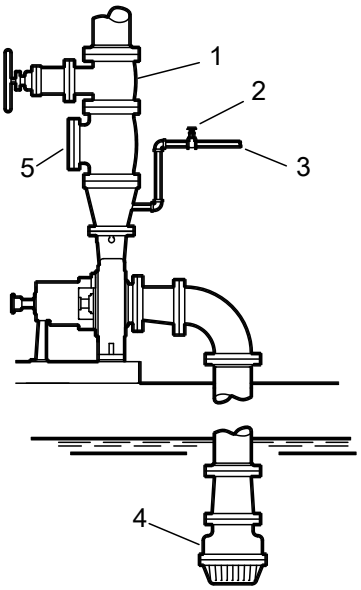
Prime the pump with the suction supply below the pump

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

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

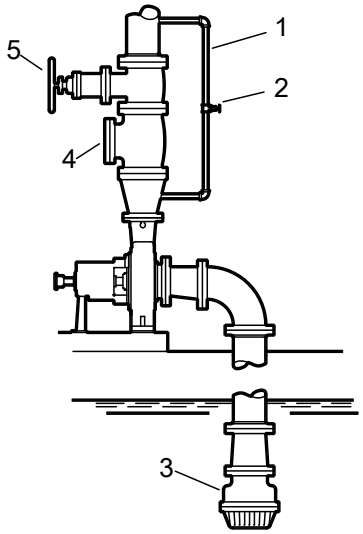
1. Close the discharge isolation valve.
2. Open the air vent valves in the casing.
3. Open the valve in the outside supply line until only liquid escapes from the vent valves.
4. Close the vent valves.
5. Close the outside supply line.

This illustration is an example of priming the pump with a foot valve and an outside supply:



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

This illustration is an example of priming the pump with a foot valve using a bypass around the check valve:



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

Other methods of priming the pump

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

- Prime by ejector
- Prime by automatic priming pump

Start the pump

CAUTION:

- Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart the pump.
- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.

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.

Activate the i-ALERT™ Condition Monitor

WARNING:

Never heat the condition monitor to temperatures in excess of 300°F (149°C). Heating to these temperatures could result in death or serious injury.

CAUTION:

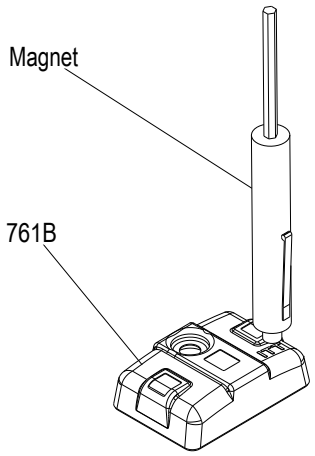
Always wear protective gloves. The pump and condition monitor can be hot.

NOTICE:

Do not use the condition monitor in atmospheres containing acetic acid.

The condition monitor is ready for activation when the pump is running and has reached a steady flow, pressure, and temperature. This process only takes a few minutes.

Place a small magnet on the condition monitor over the ITT logo and then remove it, as this example shows.



When the condition monitor is activated it:

1. Displays a series of red LEDs followed by a solid green LED.
2. Collects eight samples that are spaced one second apart.
3. Averages these readings to establish the baseline vibration level.
4. Flashes a green LED after approximately twelve seconds.

For the first ten minutes, the green LED flashes every second for five consecutive flashes and then pauses to take a vibration reading. More frequent measurements (every six seconds) are taken in this startup period so that an alarm can be immediately detected.

i-ALERT™ Condition Monitor routine operation

Measurement interval

This table shows the measurement intervals for the condition monitor during normal operation and when the monitor is in alarm mode.

Mode	Measurement interval
Normal operating mode	Five minutes
Alarm mode	Two minutes

When the condition monitor measures a reading beyond the specified temperature and vibration limits, the appropriate red LED flashes. After the process or pump condition that causes the alarm is corrected, the condition monitor returns to normal mode after one normal-level measurement.

Alarm mode

When the condition monitor is in alarm mode, you should investigate the cause of the condition and make necessary corrections in a timely manner.

Magnetic device considerations

Be careful when you use magnetic devices in close proximity of the condition monitor, such as magnetic vibration-monitoring probes or dial indicators. These magnetic devices can accidentally activate or deactivate the condition monitor resulting in improper alarm levels or loss of monitoring.

Pump operation precautions

General considerations

CAUTION:

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

Operation at reduced capacity

WARNING:

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

CAUTION:

- Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
- Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
- Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that is inside the pump and the cooling coils. Failure to do so can cause liquid to freeze and damage the pump.

Shut down the pump

WARNING:

The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

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

Deactivate the i-ALERT™ Condition Monitor

NOTICE: Always deactivate the condition monitor when the pump is going to be shut down for an extended period of time. Failure to do so will result in reduced battery life.

1. Touch and hold a small magnet to the condition monitor over the ITT logo until the red LEDs blink three times.

   This should take 10-15 seconds if the condition monitor is in normal operating mode and approximately five seconds if the condition monitor is in alarm mode.
2. Remove the magnet.

If the deactivation is successful, solid red LEDs will be displayed.

Reset the i-ALERT™ Condition Monitor

NOTICE: Always reset the condition monitor when the pump is started after maintenance, system change, or down-time. Failure to do so may result in false baseline levels that could cause the condition monitor to alert in error.

Touch a magnet to the condition monitor over the ITT logo to turn the power on.

The condition monitor begins to establish a new baseline vibration level.

Make the final alignment of the pump and driver

WARNING:

- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.

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.

   See Pump-to-driver alignment in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

Maintenance

Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.

Routine inspections

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

- 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.
  - Change the oil more often if there are adverse atmospheric or other conditions that might contaminate or break down the oil.
- 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.

Bearing maintenance

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

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.

Lubricating oil requirements

Quality requirements

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

Lubricating oil requirements

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

Oil volumes

Oil volume requirements

This table shows the required amount of oil for oil-lubricated bearings.

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

Acceptable oil for lubricating bearings

Acceptable lubricants

Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	Teresstic EP 68
Mobil	DTE 26 300 SSU @ 100°F (38°C)
Philips	Mangus Oil 315 MM motor oil SAE 20-20W HDS motor oil SAE 20-20W

Brand	Lubricant type
Gulf	Harmony 68

Lubricating-grease requirements

Precautions

NOTICE:

- 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. Doing so may result in decreased performance.
- Remove the bearings and old grease if you need to change the grease type or consistency. Failure to do so may result in equipment damage or decreased performance.

Bearing temperature

Bearing temperatures are generally about 45°F (25°C) 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
5°F to 230°F (-15°C to 110°C)	Use a lithium-based mineral-oil grease with a consistency of NLGI 2.
Exceed 230°F (110°C)	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 230°F (110°C) - NLGI consistency 2	When temperature of pumped fluid is greater than230°F (110°C) - NLGI consistency 3
Mobil	Mobilux EP2	N/A
Exxon	Unirex N2	Unirex N3
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

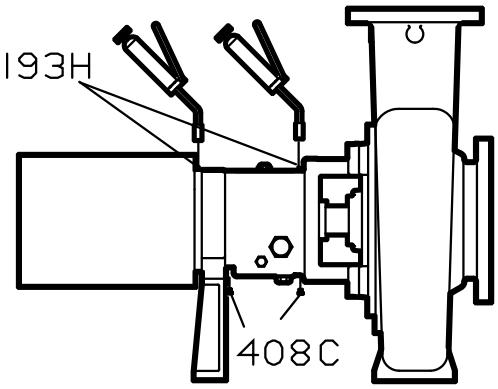
Frame	Initial grease in ounces (grams)		Regrease[1] in ounces (grams)	
	Thrust (angular contact)	Radial (cylindrical roller)	Thrust (angular contact)	Radial (cylindrical roller)
S	7 (185)	6 (165)	2.5 (70.0)	2.5 (70.0)
M	10 (290)	7 (180)	4 (115)	2.5 (70.0)
L	17 (475)	10 (280)	7 (200)	4 (115)
XL	28 (800)	16 (450)	12 (345)	6.5 (190.0)

[1] The regrease amount is based on purging half of the old grease from the housing reservoir. Not available on the XL1, XL2-S, and XL2 sizes.

Regrease the grease-lubricated bearings

NOTICE:

Make sure that the grease container, the greasing device, and the fittings are clean. Failure to do this can result in impurities entering the bearing housing when you regrease 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.

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.

Shaft-seal maintenance

Mechanical-seal maintenance

WARNING:

The mechanical seal used in an Ex-classified environment must be properly certified. Prior to startup, make sure that all areas that could leak pumped fluid to the work environment are closed.

CAUTION:

Never operate the pump without liquid supplied to mechanical seal. If you run a mechanical seal dry, even for a few seconds, this can cause seal damage. Physical injury can occur if a mechanical seal fails.

NOTICE:

- The mechanical seal must have an appropriate seal flush system or excess heat generation and seal failure can occur.

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.

Packed stuffing-box maintenance

WARNING:

- Never attempt to replace the packing until the driver is properly locked out and the coupling spacer is removed.

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 minute.

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 minute 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.

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

Precautions

WARNING:

- Packed stuffing boxes are not allowed in an ATEX-classified environment.
- Dynamic seals are not allowed in an ATEX-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, which provides adequate life when it runs dry but can provide longer performance if it is lubricated with clean water or grease.
  - 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.

Disassembly

Disassembly precautions

WARNING:

- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, open vent or drain valves, or disconnect the piping.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

NOTICE:

Make sure that all replacement parts are available before you disassemble the pump for overhaul.

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

Drain the pump

CAUTION:

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

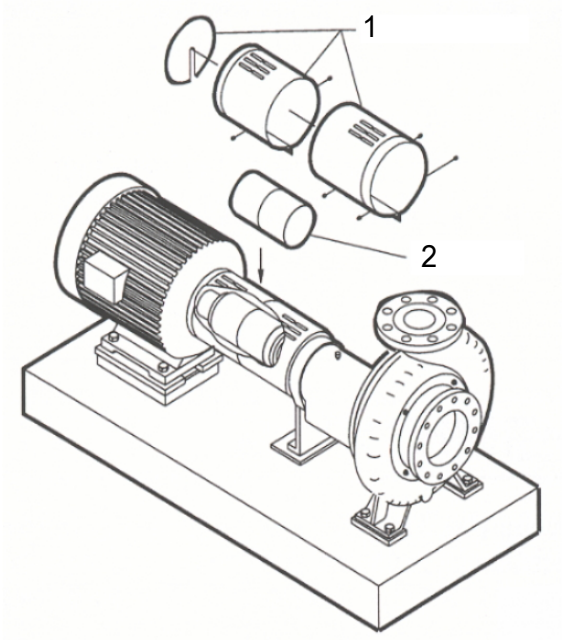
1. Close the isolation valves on the suction and discharge sides of the pump.

   You must drain the system if no valves are installed.
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 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.

4. Drain the liquid from the piping and flush the pump if it is necessary.
5. Disconnect all auxiliary piping and tubing.
6. Remove the coupling guard.
7. Disconnect the coupling.



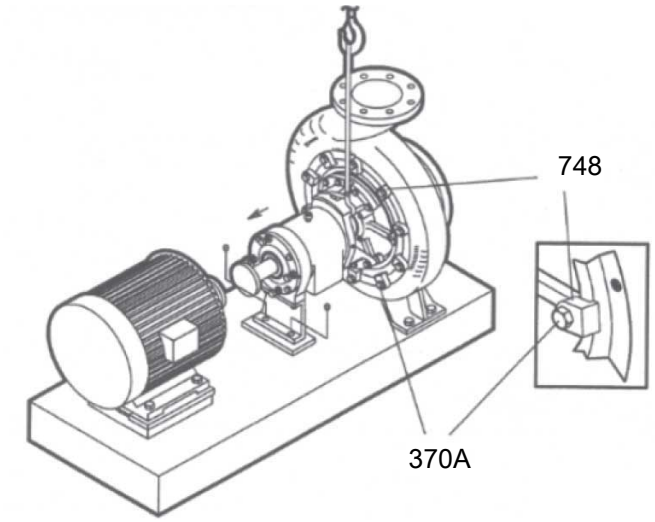
1. Coupling guard
2. Coupling

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

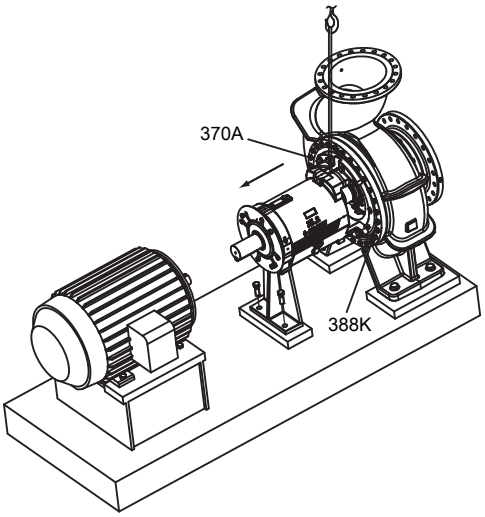
Remove the back pull-out assembly

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

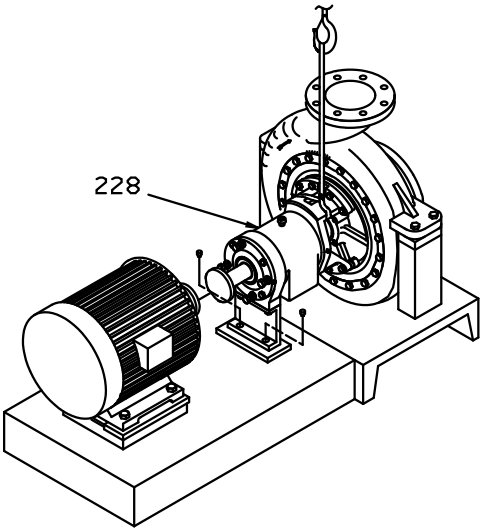
This example shows the 3180 and 3185 S, M, L, and XL group pump:



This example shows the 3180 and 3185 XL1, XL2-S, and XL2 group pump:



This example shows the 3181 and 3186 pump:



2. Remove the hold-down bolts of the bearing frame.

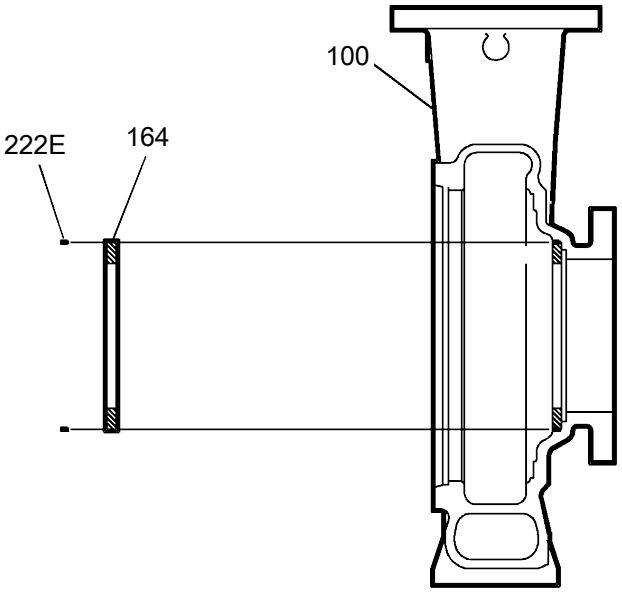
3. Remove the back pull-out assembly from the casing:

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 the 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, XL2-S, or XL2 group	1. Remove the casing bolts (370A). 2. Evenly tighten the jacking bolts (388K) until the back pull-out assembly is free enough to remove from the casing.

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

This procedure only applies to pumps with an enclosed impeller.

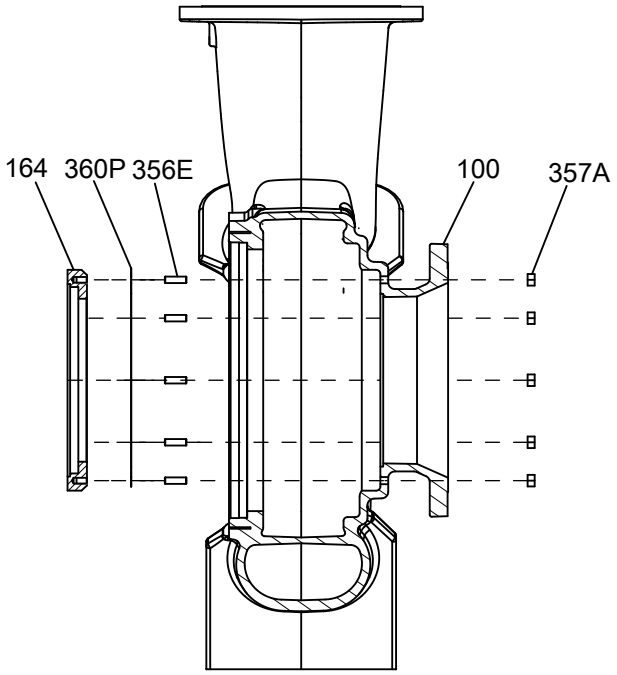
1. Remove the set screws (222E) from the casing wear ring (164).
2. Remove the wear ring (164) from the casing (100) using a pry bar, if necessary.



Remove the casing wear ring (for XL1, XL2-S, and XL2)

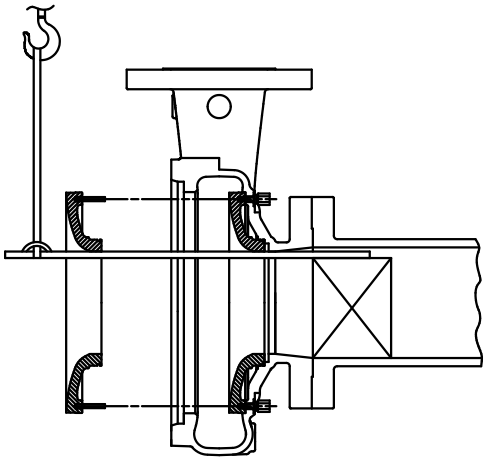
This procedure only applies to pumps with an enclosed impeller.

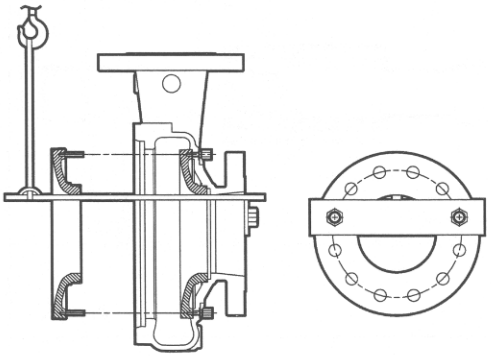
1. Remove the hex nuts (357A) from the casing wear ring studs (356E).
2. Remove the casing wear ring (164) from the casing (100) using a pry bar in the slot provided.
3. Remove the casing wear ring gasket (360P).



Remove the suction sideplate

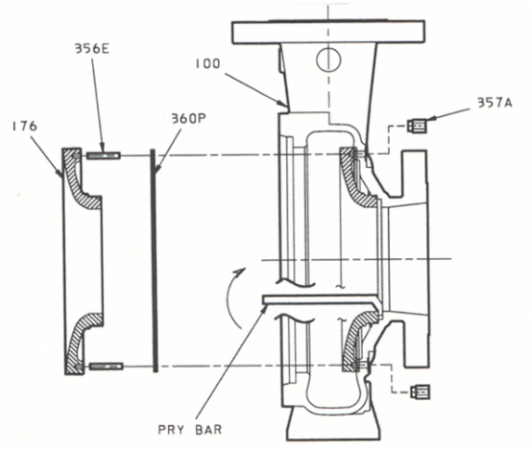
WARNING:
Sideplates are heavy. Use the proper support to avoid personal injury.





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).



Impeller removal

WARNING:

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

CAUTION:

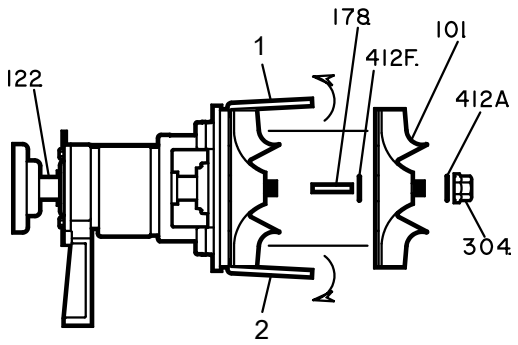
Use pry points under the impeller vanes to prevent impeller damage.

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

- Open impeller
- Enclosed impeller
- Shearpeller™

Remove an open impeller

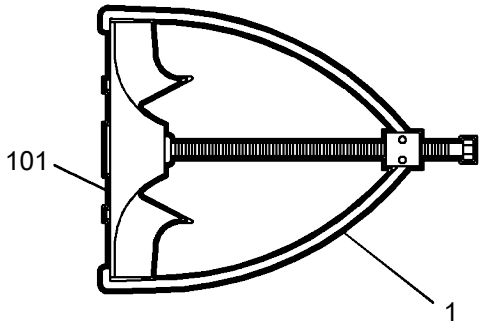
1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the impeller nut (304) and O-ring (412A).



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.

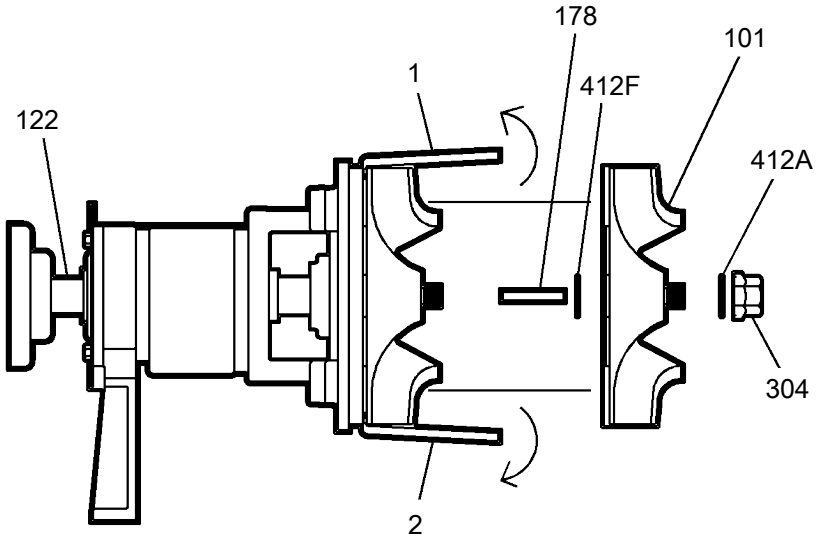
   You can also use an impeller puller.



1. Impeller puller

Remove an enclosed impeller

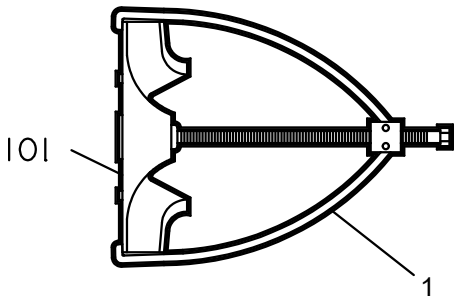
1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the impeller nut (304) and O-ring (412A).



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.



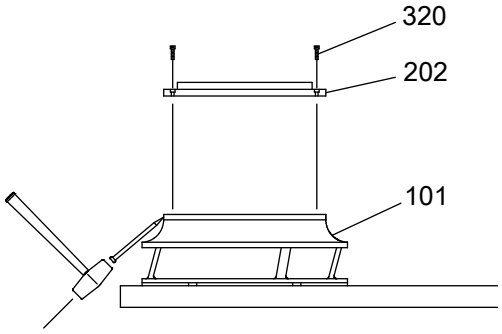
1. Impeller puller

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.

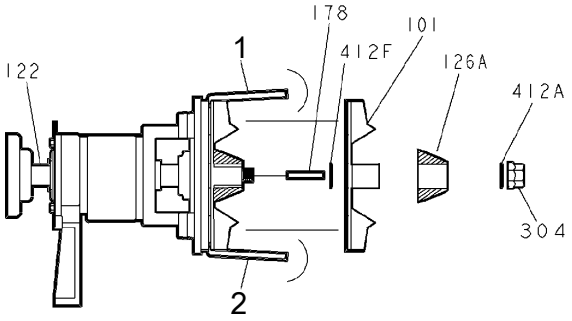
6. For the S, M, L, and XL groups, remove the wear ring (202) from the impeller by striking it with a chisel.

   The wear ring is usually loose, but corrosion might cause it to bind.



Remove a Shearpeller™

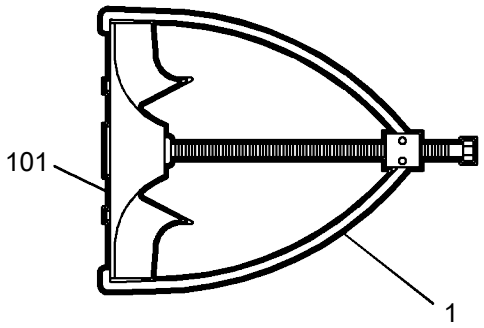
1. Secure the back pull-out assembly firmly to the workbench.
2. Lock the shaft (122) to prevent turning.
3. Remove the Shearpeller nut (304), O-ring (412A), and Shearpeller sleeve (126A).



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

4. Pry the Shearpeller™ off of the shaft using two bars opposite of each other, placed between the cover and the Shearpeller™ shroud.

   You can also use an impeller puller.

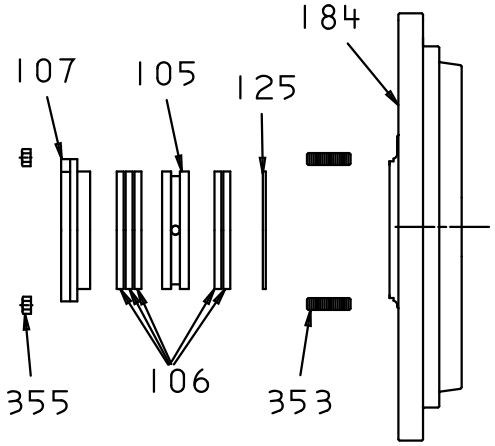


1. Impeller puller

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).



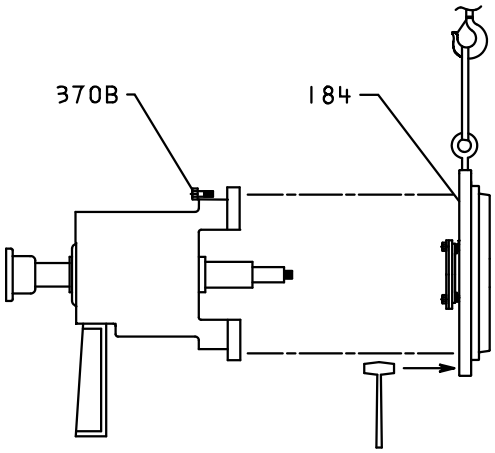
2. Thread a 10 mm eye bolt into the tapped hole provided in the cover (184) and sling to a hoist.
3. Remove the hex head bolts:

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).

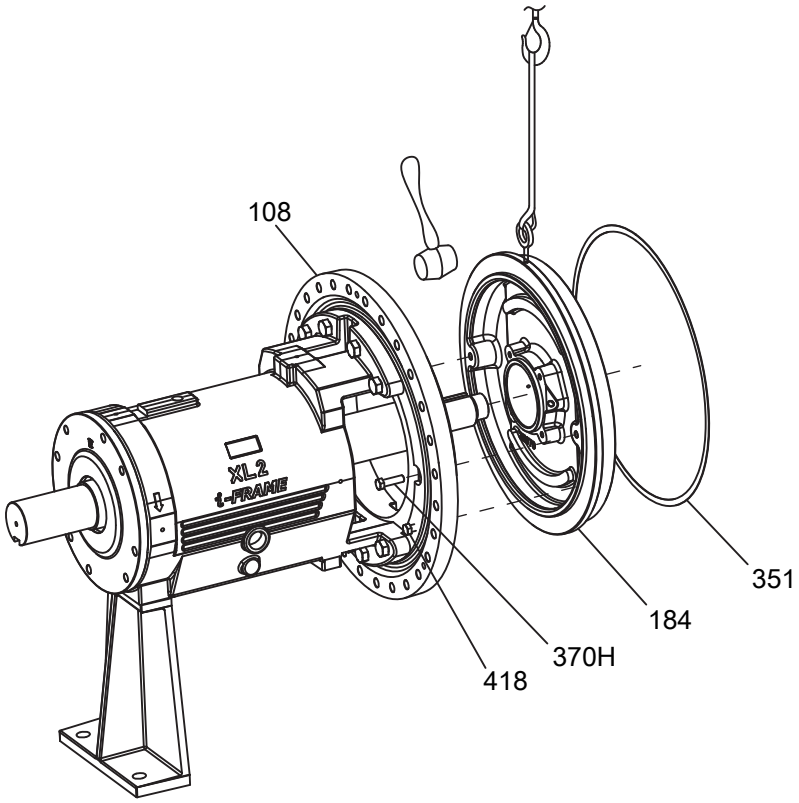
4. Remove the cover:

If your pump group is...	Then...
S, M, L, and XL	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.

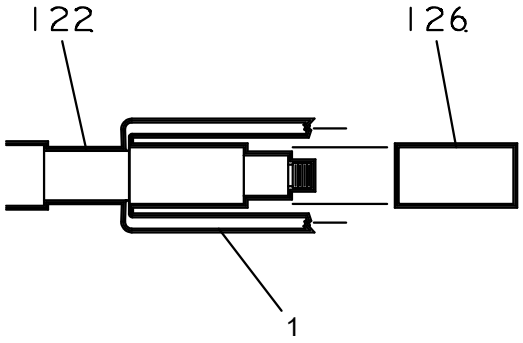
This example shows S, M, L, and XL:



This example shows XL1, XL2-S, and XL2:



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

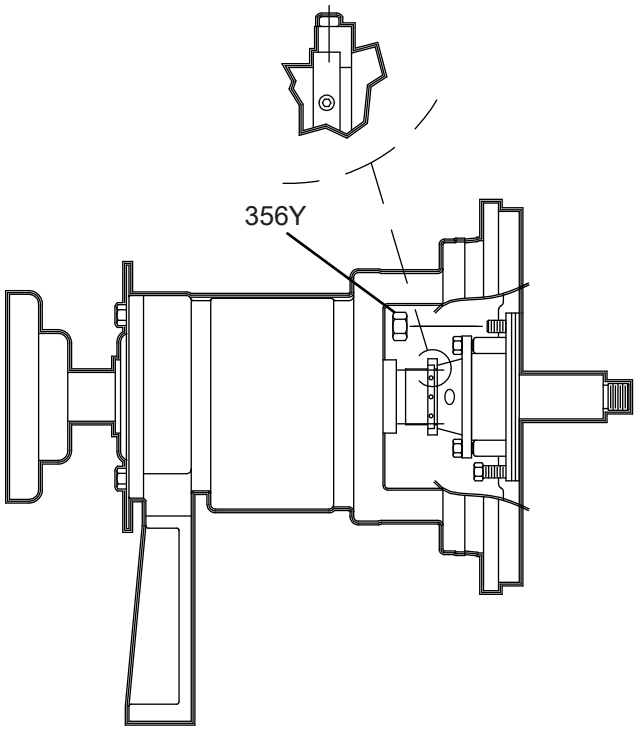


1. Sleeve puller.

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 a 10 mm eye bolt into the tapped hole provided in the seal chamber (184) and sling to a hoist.
3. Remove the hex head bolts:

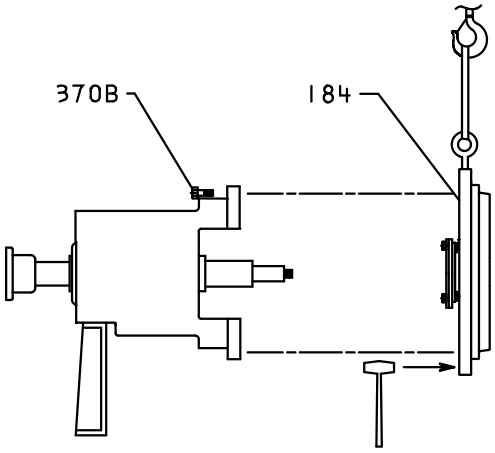
If your pump group is...	Then...
S, M, L, and XL	Remove the eight hex head bolts (370B) from the cover (184).
XL1, XL2-S, and XL2	Remove the two hex head bolts (370H) from the frame adapter (108).

4. Remove the cover:

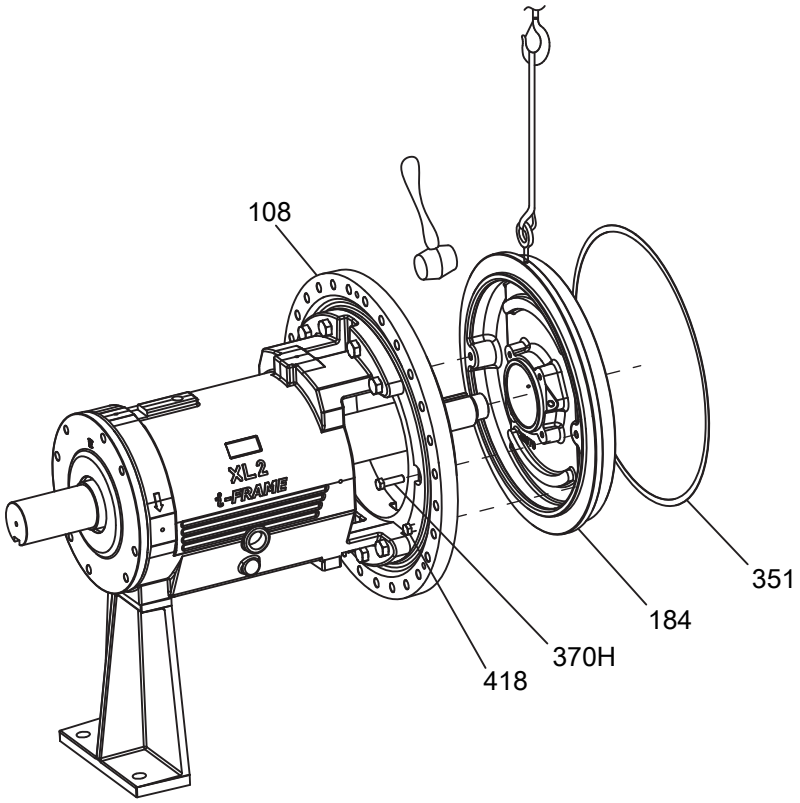
If your pump group is...	Then...
S, M, L, and XL	Gently tap the cover from the frame using a soft-blow hammer on the dry side of the cover.

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

This example shows the S, M, L, and XL:



This example shows the XL1, XL2-S, and XL2:



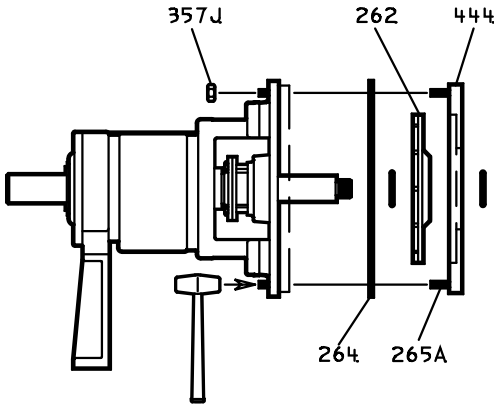
5. Remove the four hex nuts (355) from the seal gland plate.
6. Loosen the set screws on the seal drive collar and slide the sleeve out of the seal.
7. Service according to the seal manufacturer's instructions.

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.

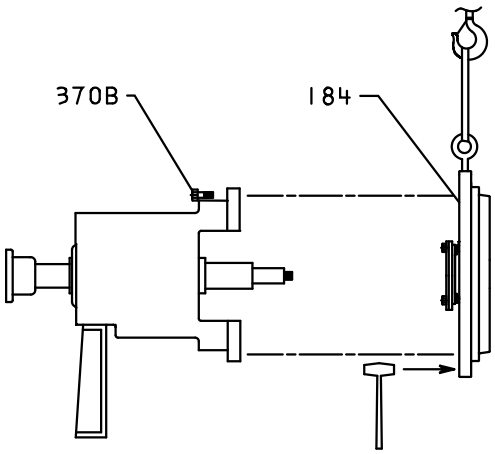
1. Remove box-to-backplate nuts (357J).
2. Remove the backplate (444) by tapping on the end of the studs with soft-faced hammer.



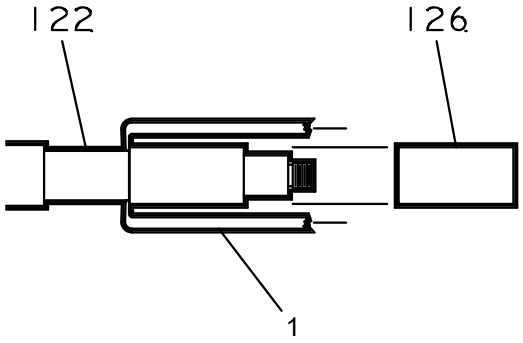
3. Remove the repeller (262):
   a) Use two bars that are 180° apart to pry between the repeller and shroud and the cover.
   b) Make sure that the gasket surfaces are not damaged.
4. Remove the secondary seal:

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



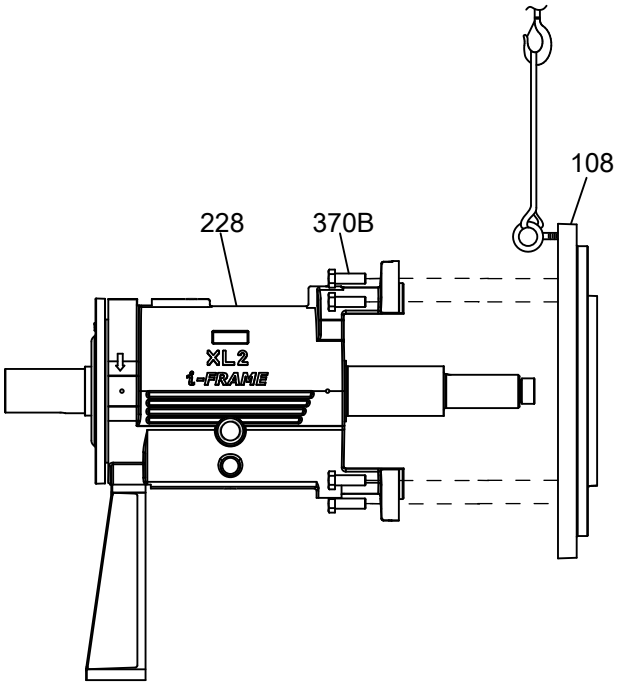
8. Remove the shaft sleeve (126).
   Use a puller if necessary.



1. Sleeve puller.

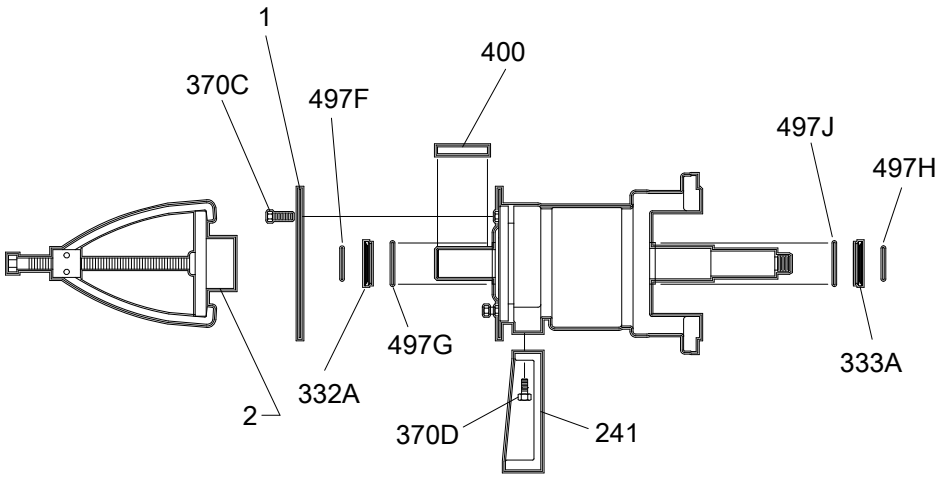
Remove the frame adapter from the frame (XL1, XL2-S, and XL2)

1. Thread a 20 mm eye bolt into the tapped hole provided at the top of the frame adapter (108) and sling to a hoist.
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.



Disassemble the bearing frame

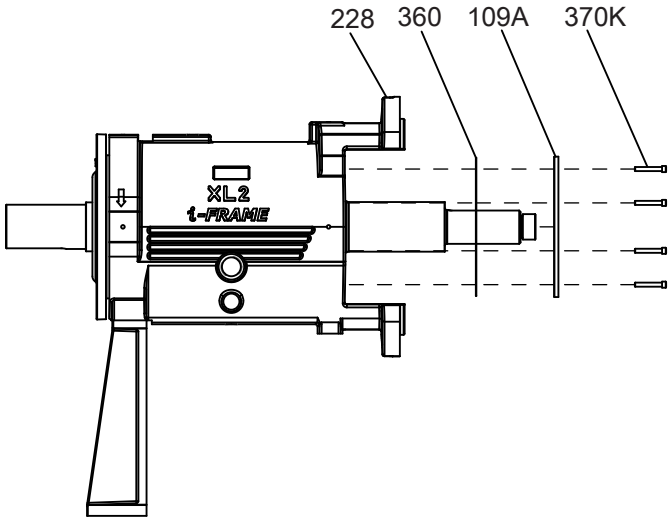
1. Secure the bearing-frame assembly firmly to a workbench.
2. Remove the coupling hub from the shaft by loosening the set screw (if provided) and using a puller.
3. Remove the coupling key (400).
4. Remove the coupling guard end plate by removing the bearing-housing adjuster screws (370C).
5. Remove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



1. Coupling guard end plate
2. Coupling hub

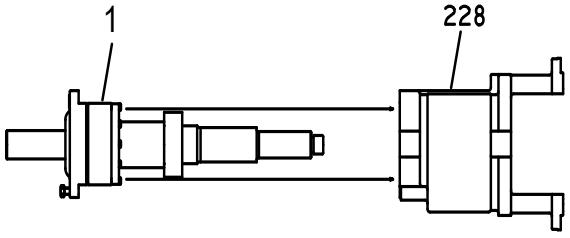
6. For the XL1, XL2-S, and XL2 groups, remove the radial end cover (109A) and radial end-cover gasket (360) from the bearing frame (228) by removing the eight socket-head capscrews (370K).

   For the S, M, L, and XL groups the radial end cover is installed permanently at the factory and does not require removal.



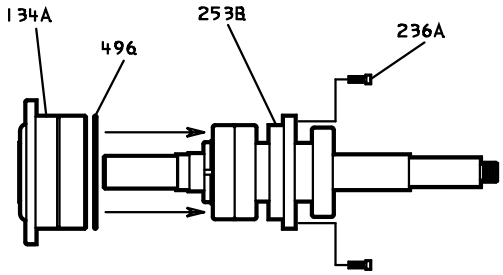
7. Slide the rotating element out of the frame (228).

   Tap the impeller end of the shaft with a soft-face hammer to assist in removal.

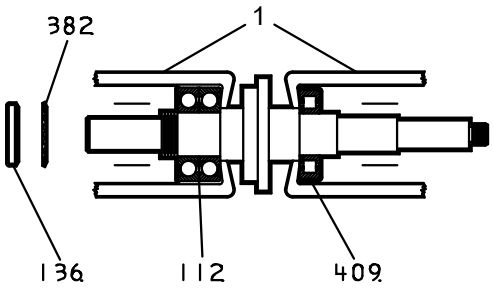


1. Rotating element.

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.

Guidelines for i-ALERT™ Condition Monitor disposal

Precautions

WARNING:

- Never heat the condition monitor to temperatures in excess of 300°F (149°C). Heating to these temperatures could result in death or serious injury.
- Never dispose of the condition monitor in a fire. This could result in death or serious injury.

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.

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. You must support the suction and discharge piping individually. Failure to do so may result in equipment damage.

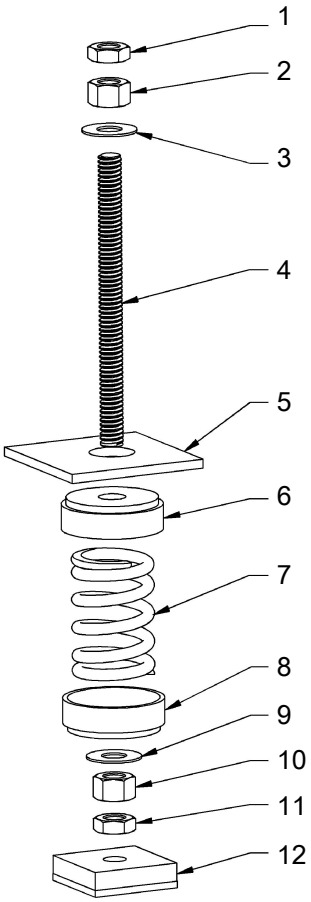
1. Remove the pump and motor from the baseplate in order to remove the springs.
2. Make sure all the springs are positively locked against free expansion.
3. Raise the baseplate and support it so the mounting brackets for the spring assemblies are approximately 16 in. (406 mm) above the foundation/floor.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

Preassembly inspections

Replacement guidelines

Casing check and replacement

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 1/8 in. (3.2 mm) deep
- Pitting that is greater than 1/8 in. (3.2 mm) deep
- Irregularities in the casing-gasket seat surface

Impeller replacement

This table shows the criteria for replacing the impeller:

Impeller parts	When to replace
Vane edges	When you see cracks, pitting, or corrosion damage
Keyway and bores	When you see damage

Gaskets, O-rings, and seats replacement

- Replace all gaskets and O-rings at each overhaul and disassembly.
- Inspect the seats. They must be smooth and free of physical defects.
- Replace parts if the seats are defective.

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.

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.

Reassembly

Assemble the bearing frame

WARNING:

Do not use a flame to heat bearings. This will damage the bearing surfaces.

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.

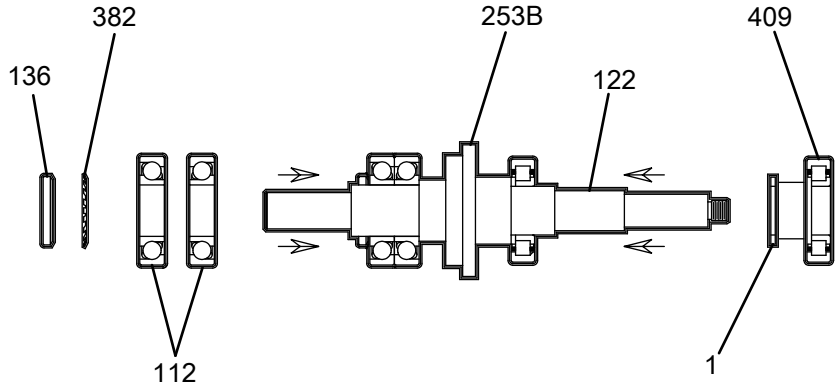
e) Slide the angular contact duplex bearings (112) onto the shaft while you maintain the correct orientation.

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.

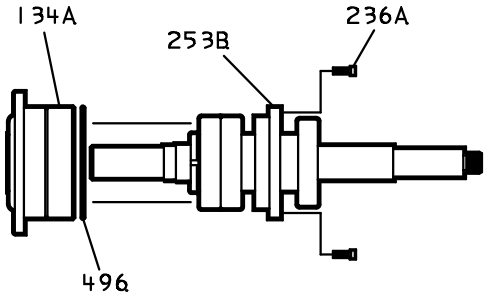
3. Lubricate and install the O-ring (496) on the thrust bearing housing (134A):

a) Slide the thrust bearing housing over the bearings.

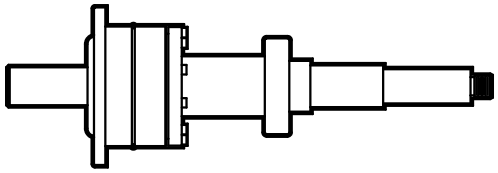
b) Attach the thrust-bearing retaining ring (253B) to the thrust bearing housing with socket head capscrews (236A).

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.

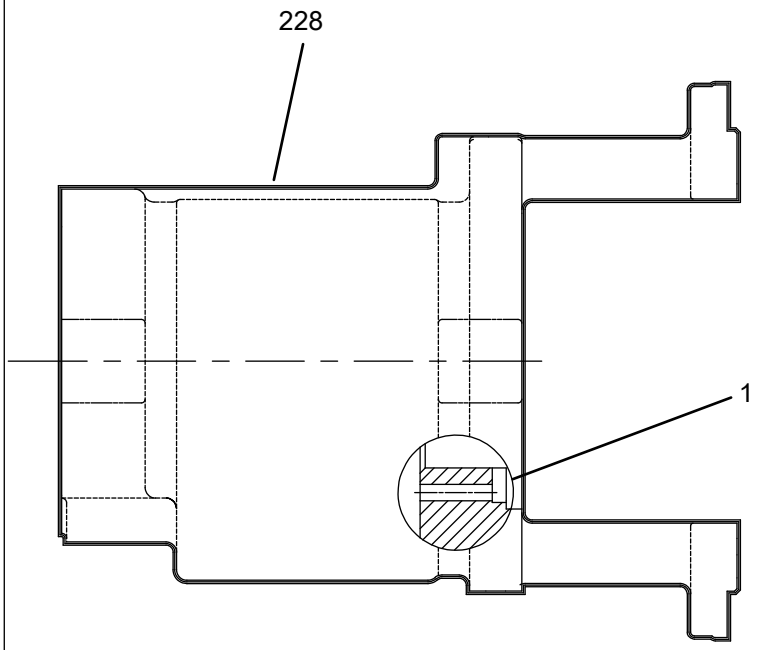
For the S, M, L, and XL groups:	**For the XL1, XL2-S, and XL2 groups:**
There will be a gap of approximately 0.12 to 0.16 in. (3.05 to 4.06 mm) between the retaining ring and bearing housing.	There will be a gap of approximately 0.16 to 0.21 in. (4.06 to 5.33 mm) between the retaining ring and bearing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

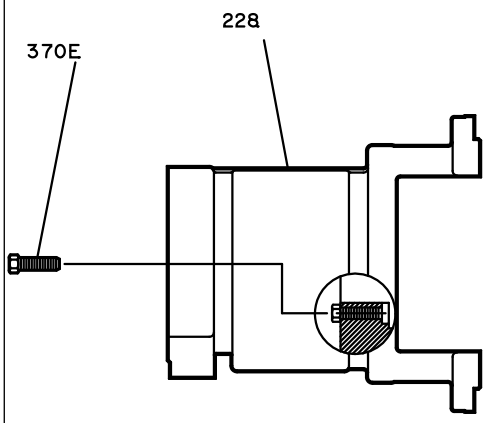


Assembled rotating element:



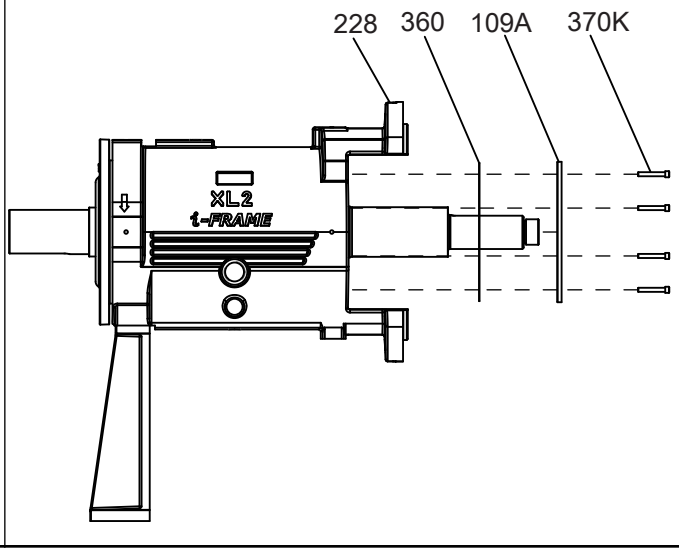
4. Prepare the bearing frame for either grease or oil lubrication.

If your bearing frame is...	Then...
Oil lubricated	Make sure that the oil return is fully open (no plug).  1. Oil return

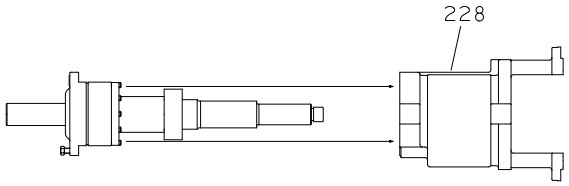
If your bearing frame is...	Then...
Grease lubricated	Make sure that the plug (370E) is installed in the radial end oil return. 

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):

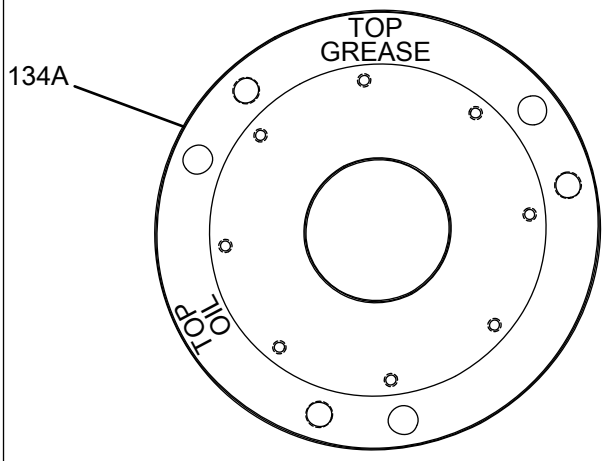
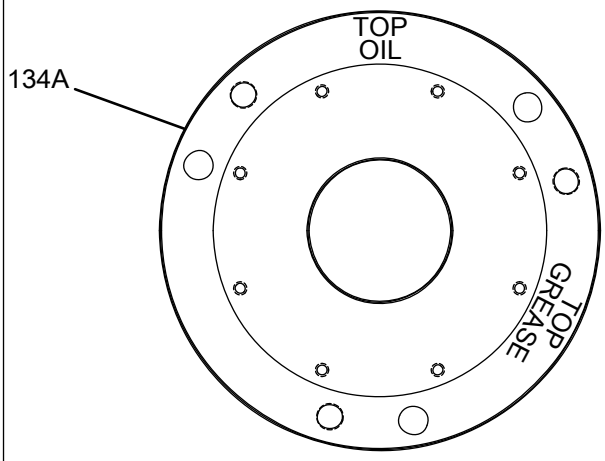
If your pump group is...	Then...
S, M, L, and XL	1. Degrease the surfaces and those in the frame. 2. Apply Loctite 518 to the outer diameter of the cover. 3. Tap the cover in place using a soft blow hammer.
XL1, XL2-S, and XL2	1. Degrease the surfaces and those in the frame. 2. Install the radial end 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

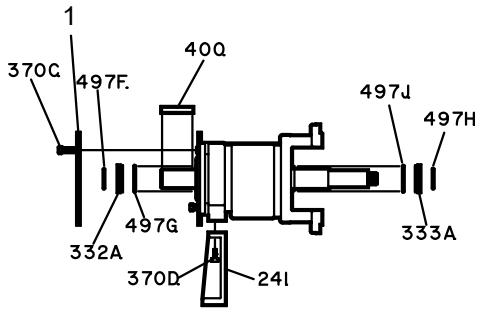
7. Orient the bearing housing depending on the lubrication.

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:

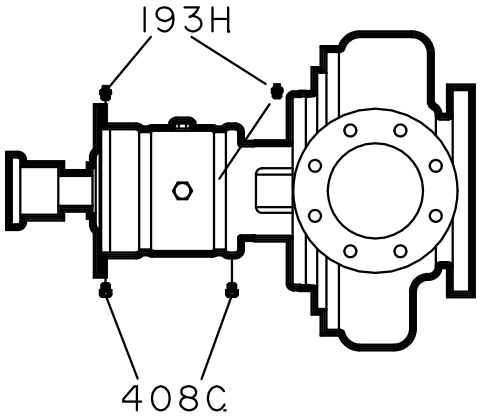
      - 0.25 in. (6.35 mm) on the S and M frames
      - 0.38 in. (9.65 mm) on the L, XL, XL1, XL2-S, and XL2 frames

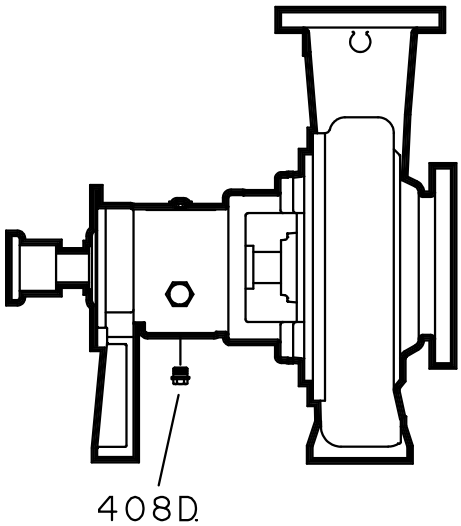


1. Coupling guard end plate.

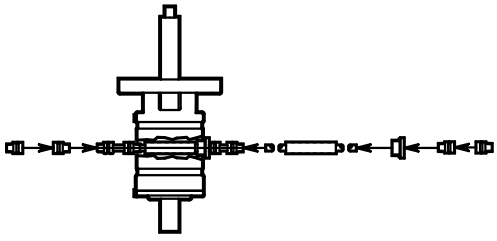
9. Lubricate the O-rings on the labyrinth oil seals.
10. Install the seal assembly into the bearing frame until the shoulders seat against the bearing frame.
11. Install these items on the bearing frame:
    - Oil fill plug (408H)
    - Shaft key (400)
    - Coupling hub
    - Frame foot (241)
12. Lubricate 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 (not available for the XL1, XL2-S, and XL2 groups)	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).



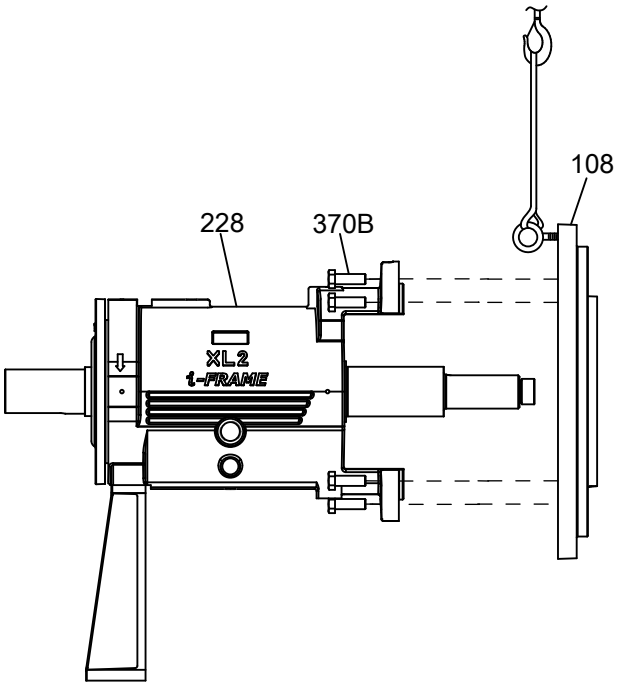


13. If your pump is equipped with an oil cooler, install the cooler assembly as follows (as viewed from the coupling end):
    a) Install one tube fitting with a straight bore on the left side of the frame in the tapped opening provided.
    b) Slide the finned tube through the hole on the right side 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.



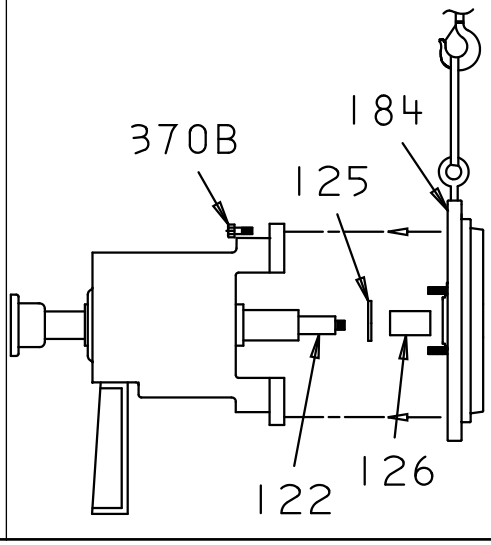
Assemble the frame adapter to the frame (XL1, XL2-S, and XL2)

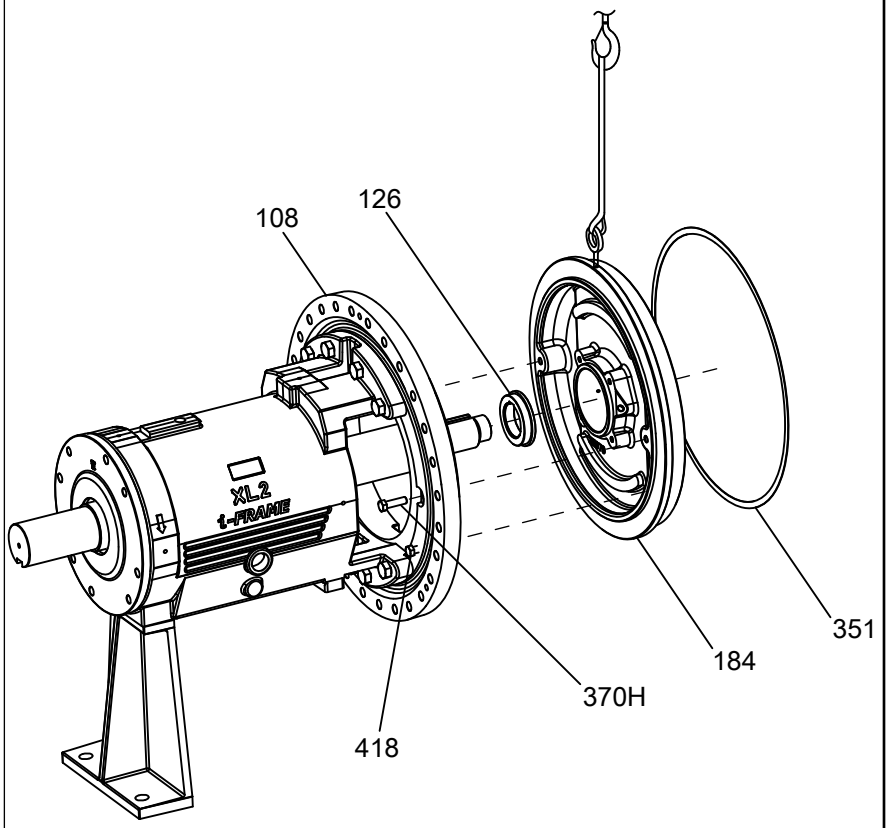
1. Thread a 20 mm eye bolt into the tapped hole provided at the top of the frame adapter (108) and sling to a hoist.
2. Install the frame adapter (108) to the frame using eight hex head bolts (370B).



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. Slide the sleeve onto the shaft.
3. Install the cartridge seal on the sleeve.
4. Use an eye bolt, strap, and sling as required.
5. Install the seal chamber (184):

If your pump group is...	Then...
S, M, L, and XL	Install the seal chamber (184) and hex head bolts (370B) on the bearing frame (228). 

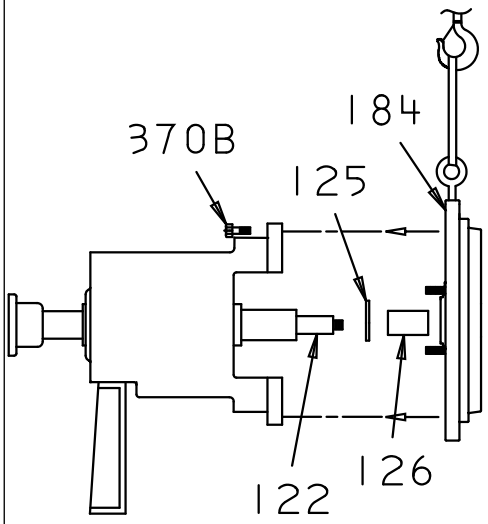
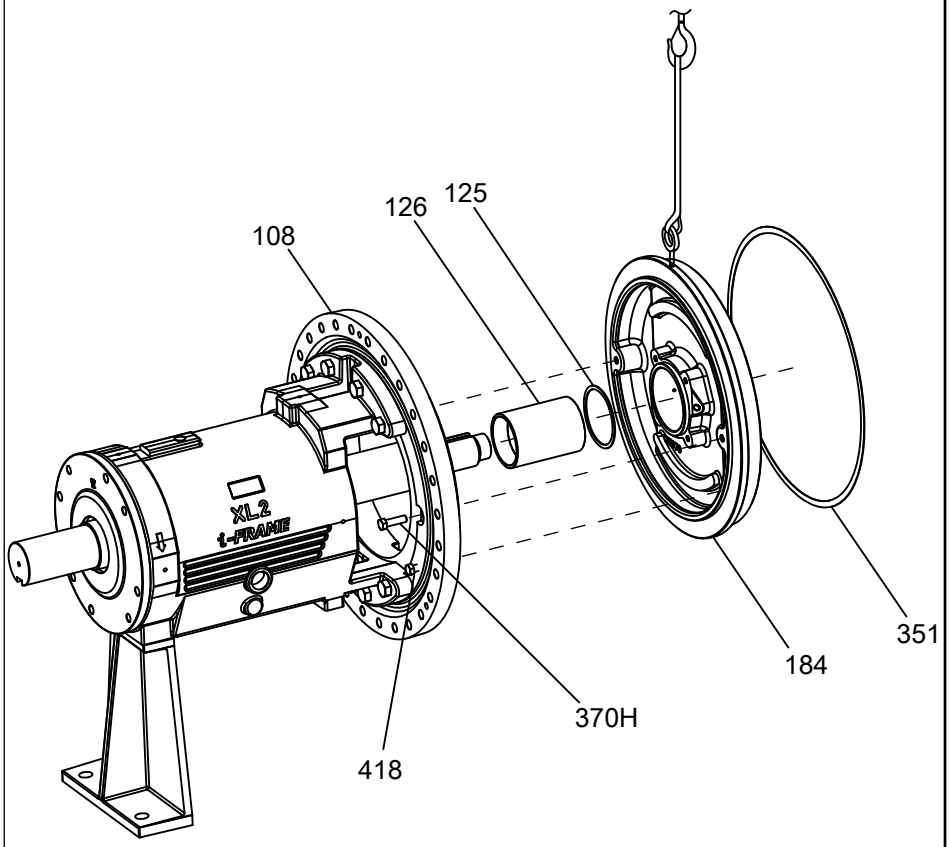
If your pump group is...	Then...
XL1, XLS-2, and XL2	Install the seal chamber (184) and hex head bolts (370H) on the frame adapter (108). 

6. Slide the cartridge seal on the gland studs and make sure that the tap connections are in the correct orientation.
7. Hand-tighten the gland nuts.
8. Install the impeller and set the clearance.
9. 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.

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 bore of the sleeve (126) and on the shaft (122).
2. Slide the sleeve onto the shaft.
3. Slide the throttle bushing (125) to the back of the shaft sleeve.
4. Use an eye bolt, strap, and sling as required.
5. Install the seal chamber (184):

If your pump group is...	Then...
S, M, L, and XL	Install the seal chamber (184) and hex head bolts (370B) on the bearing frame (228). 
XL1, XLS-2, and XL2	Install the seal chamber (184) and hex head bolts (370H) on the frame adapter (108). 

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.

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.

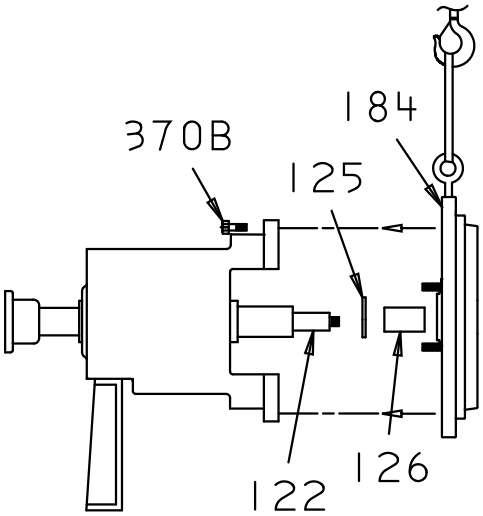
1. Apply a liberal amount of a anti-galling compound, such as Loctite Nickel Anti-seize, to the shaft sleeve (126) bore and shaft (122).
2. Install the sleeve on the shaft.
3. Perform these steps based on your dynamic seal configuration:

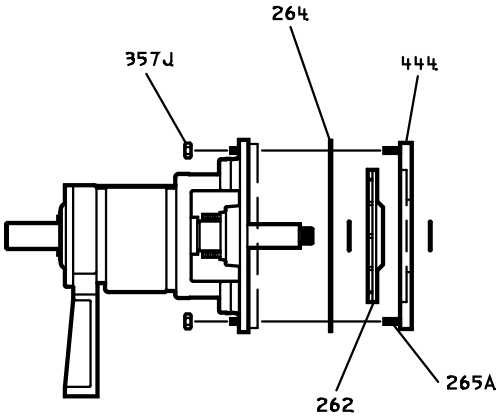
If your dynamic seal is a...	Then...
Diaphragm seal	1. Place an O-ring in the groove at the inner diameter of the follower (385) and slide the assembly to the back of the sleeve. 2. Place a gland plate over the follower (385) and slide the diaphragm (146) over the sleeve to the face of the seat. 3. Install 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). 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.

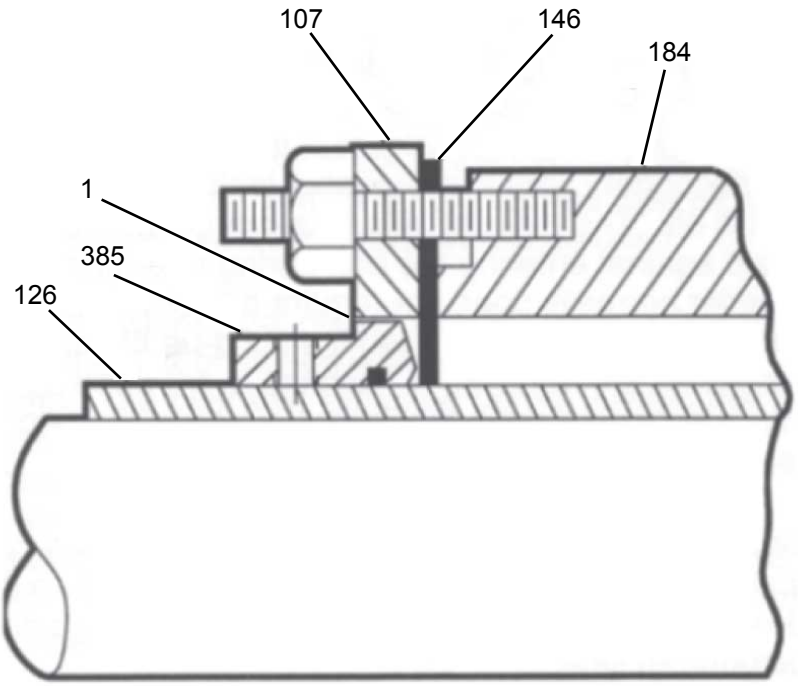
4. Keep the repeller and sleeve assembly shouldered to the shaft, and adjust the rotating element until the repeller-to-cover clearance is approximately 0.015 in. (0.4 mm).
5. Fit the gasket (264) on the backplate (444).
6. Install the backplate on the cover and tighten the nuts (357J) on the backplate 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.

If your dynamic seal is a...	Then...
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.







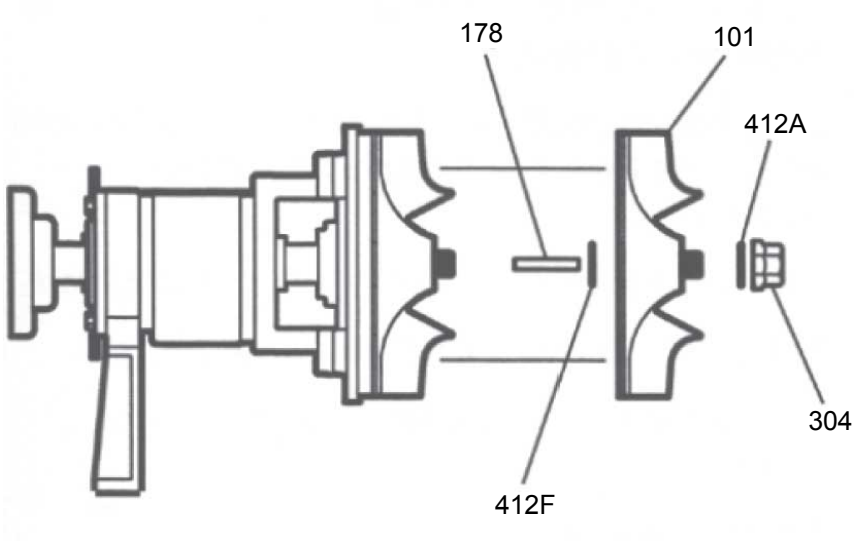
1. Alignment of step on follower with exposed face of gland.

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™.

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.



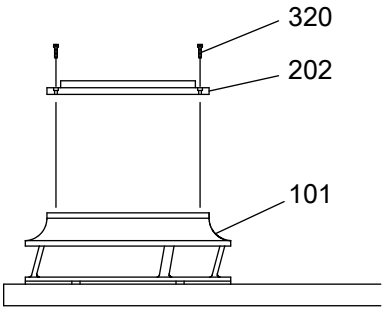
7. Prevent the coupling end of the shaft from turning and torque the impeller nut to the specified amount in the Maximum torque values for fasteners table in the Reassembly section of the Maintenance chapter.

CAUTION:

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

Install an enclosed impeller

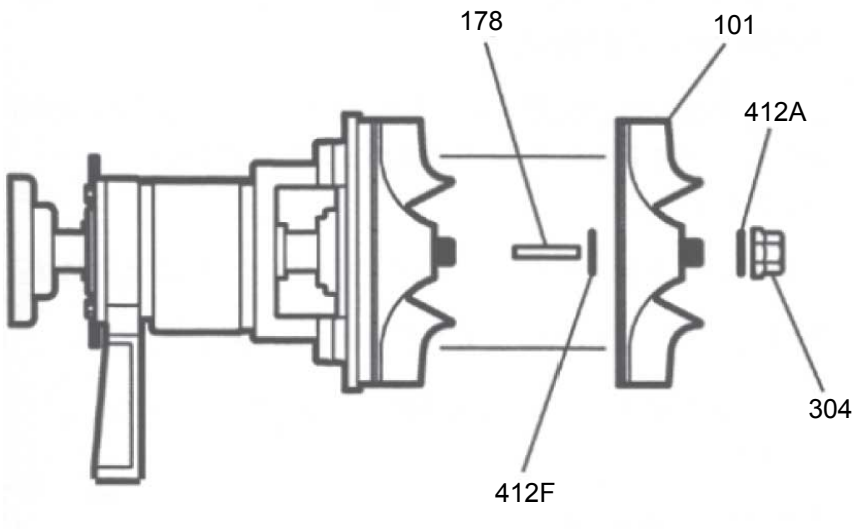
1. For the S, M, L, and XL sizes, install the wear ring (202) on the impeller and align the holes.



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.



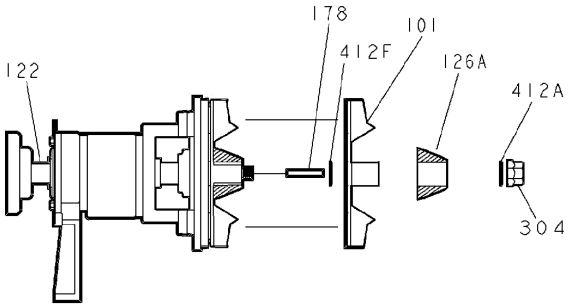
10. Prevent the coupling end of the shaft from turning and torque the impeller nut to the specified amount in the Maximum torque values for fasteners table in the Reassembly section of the Maintenance chapter.

CAUTION:

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

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.

Install the suction sideplate

WARNING:

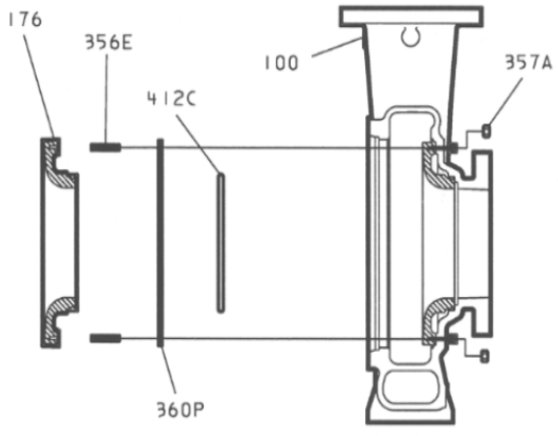
Sideplates are heavy. Use the proper support to avoid personal injury.

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™.

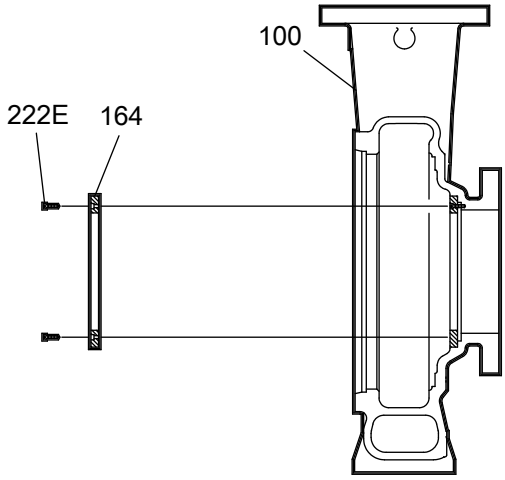
1. Install the sideplate studs (356E).
2. Install the gasket (360P) on the sideplate studs (356E).
3. Lubricate and fit the O-ring (412C) in the sideplate groove.
4. Align the sideplate studs (356E) with the casing holes, and install the sideplate (176).
   Tap the sideplate with a block of wood to assist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



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

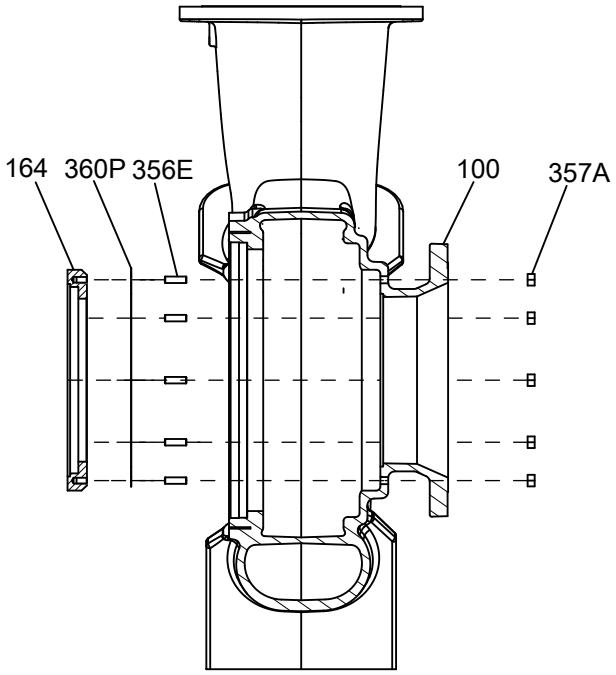
This procedure applies to the maintenance of an enclosed impeller.

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.



Install the casing wear ring (XL1, 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.



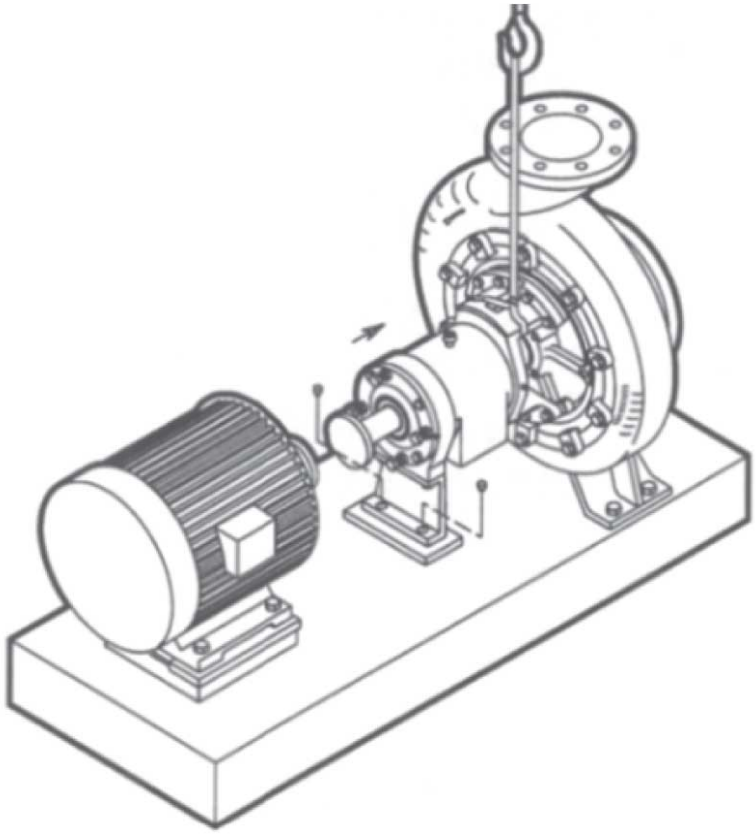
Install the back pull-out assembly

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.

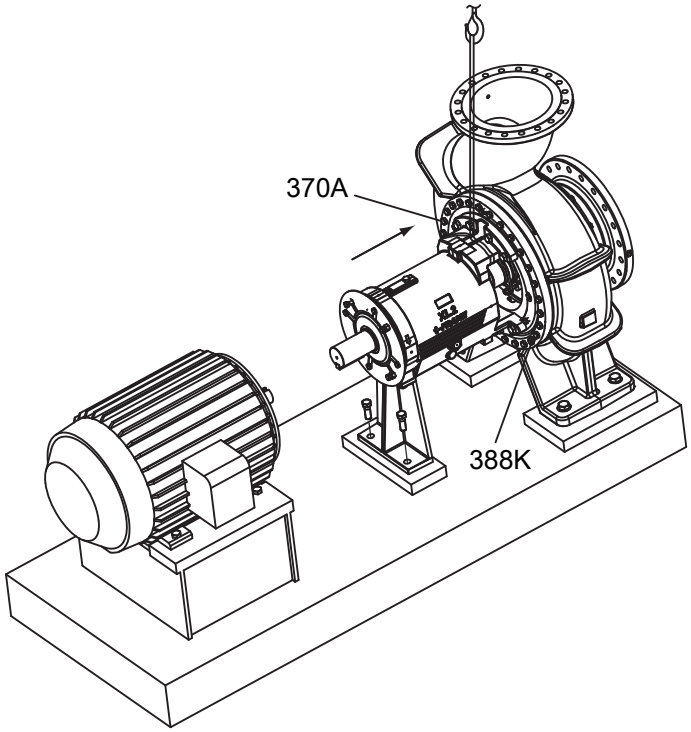
   Make sure that the casing and frame feet are flat on the surface.
5. Hand-tighten the casing bolts (370A) and seat the back pull-out assembly into the casing.

   Do not torque the bolts at this time.

This example shows the 3180 and 3185 S, M, L, and XL group pumps:



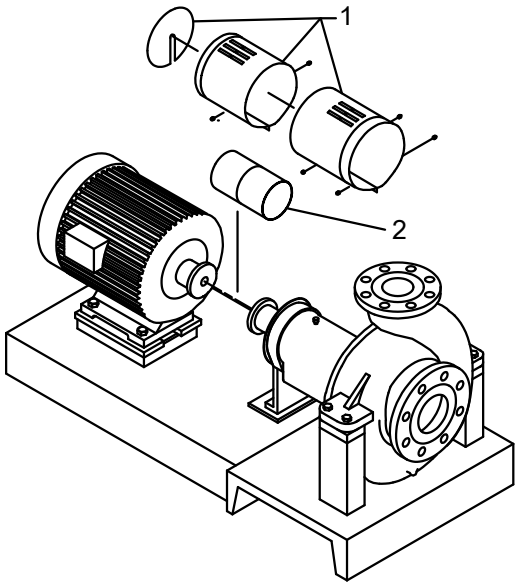
This example shows the 3180 and 3185 XL1, XL2-S, and XL2 group pumps:



6. Check the total travel of the impeller in the casing.
   Assuming new parts are used, acceptable values are 0.028 in. to 0.082 in. (0.7 mm to 2.2 mm).

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.
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

Attach the i-ALERT™ Condition Monitor to the pump

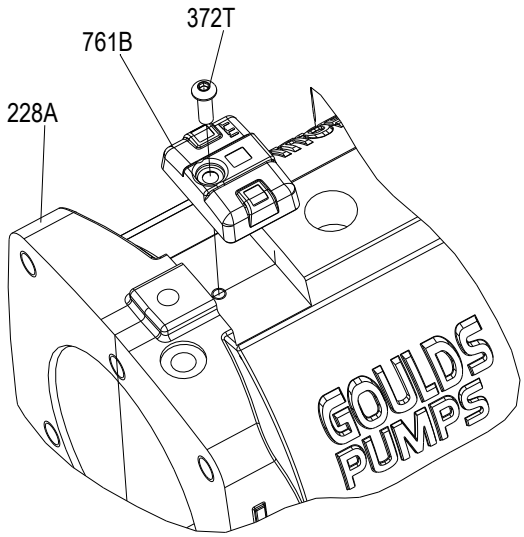
CAUTION:

Always wear protective gloves. The pump and condition monitor can be hot.

Tools required:

- 5/32 inch hex wrench

1. Attach the condition monitor (761B) to the bearing frame (228A) using the hex-head screw (372T) provided.



2. Tighten the hex-head screw with a 5/32 inch hex wrench to 6 ft-lbs (8 Nm).

Post-assembly checks

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

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

Assembly references

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)

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
—	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	10 (15)
370A	Screw, lug to casing	12 in. to 19 in. 22 in. to 25 in.	A02818A-143 A02818A-162	M22 x 2.5 M24 x 3.0	Hex head capscrew	30 mm 36 mm	125 (170) 200 (270)
	Screw, casing to adapter	24 x 24-27	A02818A187	M24 x 3.0	Hex head capscrew	36 mm	200 (270)
		20 x 24-29					
		20 x 24-31					
		24 x 30-35					
		30 x 30-41	A02818A189	M27 x 3.0		41 mm	243 (330)
372V	Stud, casing foot to baseplate	24 x 24-27	A02815A87	M42 x 4.5	Stud	N/A	—
		20 x 24-29	A02815A86				
		20 x 24-31	A02815A88				
		24 x 30-35	A02815A89				
		30 x 30-41	A02815A90				
427A	Nut, casing foot to baseplate	XL1, XL2-S, and XL2	A02089A42	M42 x 4.5	Hex nut	65 mm	162 (220)
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)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
—	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 L	A02818A-144 A02818A-145	M20 x 2.5	Hex head capscrew	30 mm	80 (110)
		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 sideplate to case	24 in. to 16 in. 19 in. to 25 in.	A02815A-37 A02815A-38	M10 x 1.5 M12 x 1.75	Stud	N/A	—
	Stud, casing wear ring to case	24 x 24-27 20 x 24-29 20 x 24-31 24 x 30-35 30 x 30-41	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	10 (15) 20 (25)
	Nut, casing wear ring	24 x 24-27 20 x 24-29 20 x 24-31 24 x 30-35 30 x 30-41	A02089A20	M20 x 2.5	Hex nut	30 mm	55 (75)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
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 6 x 10-16 4 x 6-19 6 x 10-19 6 x 10-22	A03723A-41	M6 x 1.0	Setscrew	Internal 5 mm	5 (7)
		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				
		XL1	B05526A01	M75 x 1.5		118 mm	1,180 (1,600)
		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				

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
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 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)
		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)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
370H	Screw, cover to adapter	24 x 24-27	A02818A149	M20 x 2.5	Hex head capscrew	30 mm	22 (30)
		20 x 24-29					
		20 x 24-31					
		24 x 30-35					
		30 x 30-41	A02818A148				
370K	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	24 x 24-27	A02818A149	M20 x 2.5	Hex head capscrew	30 mm	22 (30)
		20 x 24-29					
		20 x 24-31	A02818A151				
		24 x 30-35	A02818A148				
		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)

Item number	Part name	Pump size	Part number	Thread size	Type	Hex size	Torque value
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			
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)

Bearing fits and tolerances

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

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

Size	Impeller Ring OD - in. (mm)	Casing Ring ID - in. (mm)	Clearance - in. (mm)
3 x 6-14	4.4811 (164.62) 4.4771 (164.52)	6.5111 (165.38) 6.5151 (165.48)	0.030 (0.76) 0.038 (0.97)
4 x 6-14	7.3078 (185.62) 7.3038 (185.52)	7.3378 (186.38) 7.3418 (186.48)	0.030 (0.76) 0.038 (0.97)
4 x 6-16	7.7015 (195.62) 7.6975 (195.52)	7.7315 (196.38) 7.7355 (196.48)	0.030 (0.76) 0.038 (0.97)
6 x 8-14	8.2187 (208.75) 8.2147 (208.65)	8.2487 (209.52) 8.2527 (209.62)	0.030 (0.76) 0.038 (0.97)
8 x 8-14	9.2360 (234.59) 9.2320 (234.49)	9.2660 (235.36) 9.2700 (235.46)	0.030 (0.76) 0.038 (0.97)
10 x 10-14	10.5062 (266.86) 10.5022 (266.76)	10.5362 (267.62) 10.5402 (267.72)	0.030 (0.76) 0.038 (0.97)
6 x 8-16	8.2187 (208.75) 8.2147 (208.65)	8.2487 (209.52) 8.2527 (209.62)	0.030 (0.76) 0.038 (0.97)
4 x 6-19	8.2187 (208.75) 8.2147 (208.65)	8.2487 (209.52) 8.2527 (209.62)	0.030 (0.76) 0.038 (0.97)
8 x 10-16	10.7308 (272.56) 10.7268 (272.46)	10.7653 (273.44) 10.7693 (272.54)	0.0345 (0.88) 0.0425 (1.08)
10 x 12-16	12.3843 (314.56) 12.3803 (314.46)	12.4229 (315.54) 12.4189 (315.44)	0.0345 (0.88) 0.0425 (1.08)
14 x 14-16	13.5654 (344.56) 13.5614 (344.46)	13.6040 (345.54) 13.6000 (345.44)	0.0345 (0.88) 0.0425 (1.08)

Size	Impeller Ring OD - in. (mm)	Casing Ring ID - in. (mm)	Clearance - in. (mm)
6 x 10-19	9.3551 (237.62) 9.3511 (237.52)	9.3851 (238.38) 9.3891 (238.48)	0.030 (0.76) 0.038 (0.97)
8 x 10-19	10.7308 (272.56) 10.7268 (272.46)	10.7653 (273.44) 10.7693 (273.54)	0.0345 (0.88) 0.0425 (1.08)
10 x 12-19	12.7780 (324.56) 12.7740 (324.46)	12.8125 (325.44) 12.8165 (325.44)	0.0345 (0.88) 0.0425 (1.08)
6 x 10-22	9.9456 (252.62) 9.9416 (252.52)	9.9756 (253.38) 9.9796 (253.48)	0.030 (0.76) 0.038 (0.97)
8 x 10-22	11.4001 (289.56) 11.3961 (289.46)	11.4346 (290.44) 11.4386 (290.54)	0.0645 (0.88) 0.0425 (1.08)
12 x 14-19	13.9591 (354.56) 13.9551 (354.46)	13.9936 (355.44) 13.9976 (355.54)	0.0345 (0.88) 0.0425 (1.08)
16 x 16-19	15.2579 (387.55) 15.2539 (387.45)	15.2924 (388.43) 15.2964 (388.53)	0.0345 (0.88) 0.0425 (1.08)
10 x 12-22	12.7780 (324.56) 12.770 (324.46)	12.8125 (325.44) 12.8165 (325.54)	0.0345 (0.88) 0.0425 (1.08)
12 x 14-22	14.6300 (371.60) 14.6260 (371.50)	14.6645 (372.48) 14.6685 (372.58)	0.0345 (0.88) 0.0425 (1.08)
14 x 16-22	16.5575 (420.56) 16.5961 (420.46)	16.5921 (421.44) 16.5961 (421.54)	0.0345 (0.88) 0.0425 (1.08)
24x24-27 *	21.937 (557.20) 21.927 (556.94)	21.983 (558.37) 21.993 (558.63)	0.046 (1.17) 0.066 (1.69)
20x24-29 *	22.528 (572.21) 22.518 (571.95)	22.594 (573.88) 22.604 (574.14)	0.066 (1.67) 0.086 (2.19)
20x24-31 *	22.643 (575.13) 22.633 (574.87)	22.689 (576.30) 22.699 (576.56)	0.046 (1.17) 0.066 (1.69)
24x30-35 *	27.825 (706.76) 27.813 (706.44)	27.854 (707.49) 27.864 (707.75)	0.029 (0.73) 0.051 (1.31)
30x30-41 *	32.094 (815.18) 32.080 (814.82)	32.142 (816.40) 32.152 (816.66)	0.048 (1.22) 0.072 (1.84)
* - These sizes do not have impeller wear rings. The dimension shown is the impeller turn OD.			

Troubleshooting

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.

Symptom	Cause	Remedy
The stuffing box is leaking excessively.	The packing gland is not adjusted properly.	Tighten the gland nuts.
	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 shaftor 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.

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.

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.
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 seal chamber or stuffing-box cover runout.	The seal chamber or the stuffing-box cover is not properly seated in the bearing frame.	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.

i-ALERT™ Condition Monitor troubleshooting

Symptom	Cause	Remedy
There are no green or red flashing LEDs.	The battery is dead.	Replace the condition monitor.
	The unit is deactivated.	Activate the condition monitor.
	The unit is malfunctioning.	Consult your ITT representative for a warranty replacement.
The red LEDs are flashing, but the temperature and vibration are at acceptable levels.	The baseline is bad.	Check the temperature and vibration levels and reset the condition monitor.
	The unit is malfunctioning.	Consult your ITT representative for a warranty replacement.

Parts Listings and Cross-sectional Drawings

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 7-10

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
3. One plug for a lantern ring connection is standard.

   Optional connections require one extra plug for a packed box cover and three extra plugs for a dynamic seal cover.
4. Shearpeller™ is available only in Duplex 2205 (Code 3265).
5. There is no impeller wear ring on the XL1, XL2-S, and XL2 sizes.
6. The dynamic seal option is not available on the XL1, XL2-S, and XL2 sizes.
7. The Shearpeller™ option is not available on the XL1, XL2-S, and XL2 sizes.
8. The open impeller option is not available on the XL1, XL2-S, and XL2 sizes.
9. The grease lubrication option is not available on the XL1, XL2-S, and XL2 sizes.
10. The casing wear rings are not mounted with setscrews on the XL1, XL2-S, and XL2 sizes.
11. Casing lugs are not required on the XL1, XL2-S, and XL2 sizes.

Table 7: Parts list for 3180 and 3185 S, M, L, and XL groups (stainless steel or iron with stainless steel trim)

Item	Quantity	Part name	AI/316 SS trim	All 316 SS	316L SS	317 SS	317L SS
100	1	Casing	1000	1203	1219	1209	1225

Item	Quantity	Part name	AI/316 SS trim	All 316 SS	316L SS	317 SS	317L SS
101	1	Impeller (see note 4)	1203	1203	1219	1209	1225
105	1	Lantern ring	Teflon				
106	1 set	Packing, packed box	Non-asbestos braid				
106	1 set	Packing, dynamic seal	Die-formed graphite				
107	2	Gland half	1203	1203	1203	1209	1225
109A	1	Bearing end cover	1001				
112	1	Bearing (thrust)	Duplex angular contact (back to back)				
122	1	Shaft	2249				
125	1	Throttle bushing	3211	3211	2256	2232	2260
126	1	Shaft sleeve	1226	1226	2256	2232	2260
126A	1	Shearpeller™ sleeve	n/a	Carbon-filled Teflon	n/a	n/a	n/a
134A	1	Bearing housing	1000				
136	1	Bearing locknut	Steel				
164	1	Casing wear ring (enclosed impeller)	1203	1203	1219	1209	1225
176	1	Sideplate (open impeller)	1001	1203	1219	1209	1225
178	1	Impeller key	2213				
184	1	Stuffing box cover/seal chamber	1000	1203	1219	1209	1225
193H	2	Grease fitting (grease lube)	Steel				
202	1	Impeller wear ring (for enclosed impeller)	1203	1203	1219	1209	1225
222E	3	Set screw, casing wear ring	2210	2229	2256	2232	2260
228	1	Bearing frame	1000				
230C	1	Vane particle ejector (VPE) ring	1362				
236A	See note 1	Screw, bearing retainer to housing	2239				
241	1	Frame foot	1001				
251	1	Sight oiler (optional)	Steel/glass				
253B	1	Bearing retainer	1000				
262	1	Repeller	1203	1203	1219	1209	1225
264	1	Gasket, backplate	Non-asbestos aramid fiber				
265A	1	Stud, box to backplate	2226				
304	1	Impeller nut	1203	1203	1219	1209	1225
319	1	Sight window (oil lube)	2226				
320	3	Socket head capscrew, impeller wear ring	2210	2229	2256	2232	2260
332A	1	Labyrinth seal assembly (thrust)	Bronze with Viton O-rings				
333A	1	Labyrinth seal assembly (radial)	Bronze with Viton O-rings				

Item	Quantity	Part name	AI/316 SS trim	All 316 SS	316L SS	317 SS	317L SS
351	1	Gasket, casing	Non-asbestos aramid fiber				
353	See note 2	Stud, gland	2226				
355	See note 2	Nut, gland	2228				
356E	See note 1	Studs, sideplate	2226				
357A	See note 1	Nuts, sideplate	2228				
357J	See note 1	Nut, box to backplate	2228				
358	1	Plugs (casing drain, optional)	2210	2229	2256	2232	2260
358M	3	Plugs (casing gauge, optional)	2210	2229	2256	2232	2260
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber				
370A	See note 1	Screw, hex head lug to casing	2239				
370B	8	Screw, hex (frame to box)	2210				
370C	See note 1	Screw, housing to frame	2210				
370D	2	Screw, frame foot to frame	2210				
370E	1	Screw, oil return (grease lube)	2210				
371A	See note 1	Bolt, adjusting	2210				
382	1	Bearing lockwasher	Steel				
383	1	Mechanical seal	Material varies				
400	1	Coupling key	2213				
408B	1	Plug (oil drain)	2210				
408C	2	Plug (grease relief)	2210				
408D	1	Plug (grease lube)	2210				
408E	4	Plug (oil lube)	2210				
408H	See note 3	Plug (stuffing box)	2210	2229	2260	2256	2380
409	1	Bearing (radial)	Cylindrical roller, steel				
412A	1	O-ring, impeller	Teflon				
412C	1	O-ring, sideplate to casing	Viton				
412F	1	O-ring, sleeve	Teflon				
412U	1	O-ring, repeller	Teflon				
423B	See note 1	Nut, jam	2210				
444	1	Backplate	1000	1203	1219	1209	1225
494	1	Cooler assembly	SS tube, brass fittings				
496	1	O-ring, housing	Buna N				
748	See note 1	Lug, casing	1011				

Table 8: Parts list for 3180 and 3185 S, M, L, and XL groups (non-stainless steel)

Item	Quantity	Part name	CD4 MCuN	Ferralium	A743 CK3MCuN (6% to 7% Moly)	Alloy 20	Hastelloy B	Hastelloy C
100	1	Casing	1216	1040	1605	1204	1217	1215
101	1	Impeller (see note 4)	1216	1040	1605	1204	1217	1215
105	1	Lantern ring	Teflon					
106	1 set	Packing, packed box	Non-asbestos braid					
106	1 set	Packing, dynamic seal	Die-formed graphite					
107	2	Gland half	1203	1203	1605	1204	1217	1215
109A	1	Bearing end cover	1001					
112	1	Bearing (thrust)	Duplex angular contact (back to back)					
122	1	Shaft	2249					
125	1	Throttle bushing	3211	2380	2379	2230	2247	2248
126	1	Shaft sleeve	1226	2380	2379	2230	2247	2248
126A	1	Shearpeller™ sleeve	n/a	n/a	n/a	n/a	n/a	n/a
134A	1	Bearing housing	1000					
136	1	Bearing locknut	Steel					
164	1	Casing wear ring (for enclosed impeller option)	1216	1040	1605	1204	1217	1215
176	1	Sideplate (open impeller)	1216	1040	1605	1204	1217	1215
178	1	Impeller key	2213					
184	1	Stuffing box cover/ seal chamber	1216	1040	1605	1204	1217	1215
193H	2	Grease fitting (grease lube)	Steel					
202	1	Impeller wear ring (for enclosed impeller option)	1216	1040	1605	1204	1217	1215
222E	3	Set screw, casing wear ring	2230	2380	2379	2230	2247	2248
228	1	Bearing frame	1000					
230C	1	Vane particle ejector (VPE) ring	1362					
236A	See note 1	Screw, bearing retainer to housing	2239					
241	1	Frame foot	1001					
251	1	Sight oiler (optional)	Steel/glass					
253B	1	Bearing retainer	1000					
262	1	Repeller	1216	1040	1605	1204	1217	1215
264	1	Gasket, backplate	Non-asbestos aramid fiber					
265A	1	Stud, box to backplate	2226					
304	1	Impeller nut	1216	1040	1605	1204	1217	1215

Item	Quantity	Part name	CD4 MCuN	Ferralium	A743 CK3MCuN (6% to 7% Moly)	Alloy 20	Hastelloy B	Hastelloy C
319	1	Sight window (oil lube)	2226					
320	3	Socket head screw, impeller wear ring	2230	2380	2379	2230	2247	2248
332A	1	Labyrinth seal assembly (thrust)	Bronze with Viton O-rings					
333A	1	Labyrinth seal assembly (radial)	Bronze with Viton O-rings					
351	1	Gasket, casing	Non-asbestos aramid fiber					
353	See note 2	Stud, gland	2226					
355	See note 2	Nut, gland	2228					
356E	See note 1	Studs, sideplate	2226					
357A	See note 1	Nuts, sideplate	2228					
357J	See note 1	Nut, box to backplate	2228					
358	1	Plugs (casing drain, optional)	2230	2380	2379	2230	2247	2248
358M	3	Plugs (casing gauge, optional)	2230	2380	2379	2230	2247	2248
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber					
370A	See note 1	Screw, hex head lug to casing	2239					
370B	8	Screw, hex (frame to box)	2210					
370C	See note 1	Screw, housing to frame	2210					
370D	2	Screw, frame foot to frame	2210					
370E	1	Screw, oil return (grease lube)	2210					
371A	See note 1	Bolt, adjusting	2210					
382	1	Bearing lockwasher	Steel					
383	1	Mechanical seal	Material varies					
400	1	Coupling key	2213					
408B	1	Plug (oil drain)	2210					
408C	2	Plug (grease relief)	2210					
408D	1	Plug (grease lube)	2210					
408E	4	Plug (oil lube)	2210					
408H	See note 3	Plug (stuffing box)	2230	2379	2230	2230	2247	2248
409	1	Bearing (radial)	Cylindrical roller, steel					
412A	1	O-ring, impeller	Teflon					
412C	1	O-ring, sideplate to casing	Viton					
412F	1	O-ring, sleeve	Teflon					

Item	Quantity	Part name	CD4 MCuN	Ferralium	A743 CK3MCuN (6% to 7% Moly)	Alloy 20	Hastelloy B	Hastelloy C
412U	1	O-ring, repeller	Teflon					
423B	See note 1	Nut, jam	2210					
444	1	Backplate	1216	1040	1605	1204	1217	1215
494	1	Cooler assembly	SS tube, brass fittings					
496	1	O-ring, housing	Buna N					
748	See note 1	Lug, casing	1011					

Table 9: Parts list for 3180 and 3185 XL1, XL2-S, and XL2 groups

Item	Quantity	Part name	All 316SS	All CD4MCuN	Super Duplex A890 5A
100	1	Casing	1203	1216	1361
101	1	Impeller	1203	1216	1361
103	See note 5	Impeller wear ring (enclosed impeller)	N/A		
105	1	Lantern ring	Teflon		
106	Set	Packing, packed box	Non-asbestos braid		
106	See note 6	Packing, dynamic seal	N/A		
107	2	Gland half	1203		N/A
108	1	Frame adapter	1011		
109A	1	Bearing end cover	3201		
112	2	Bearing, thrust	Duplex Angular Contact (Back to Back)		
122	1	Shaft	2249		
125	1	Throttle bushing, packed box	3211		N/A
126	1	Shaft sleeve / stub sleeve	1203	1216	1361
126A	See note 7	Shearpeller sleeve	N/A		
134A	1	Bearing housing	1003		
136	1	Bearing locknut	Steel		
164	1	Case wear ring, enclosed impeller	1203	1216	1361
176	See note 8	Sideplate, open Impeller	N/A		
178	1	Impeller key	2213		
184	1	Stuffing box cover, seal chamber	1203	1216	1361
184	See note 6	Stuffing box cover, dynamic seal	N/A		
193H	See note 9	Grease fitting, grease lube	N/A		
222E	See note 5	Setscrew, impeller wear ring	N/A		
228	1	Bearing frame	1003		

Item	Quantity	Part name	All 316SS	All CD4MCuN	Super Duplex A890 5A
230C	1	Vane particle ejector (VPE) ring	1362		1361
236A	12	Screw, bearing retainer to housing	2239		
241	1	Frame foot	1003		
253B	1	Bearing retainer	1003		
262	See note 6	Repeller	N/A		
264	See note 6	Gasket, backplate	N/A		
265A	See note 6	Stud, box to backplate	N/A		
304	1	Impeller nut	1203	1216	1361
319	1	Sight window	Glass		
320	See note 10	Setscrew, casing wear ring	N/A		
332A	1	Laby seal, thrust	Bronze / Viton		
333A	1	Laby seal, radial	Bronze / Viton		
351	1	Casing gasket	Non-asbestos		
352B	3	Setscrew, VPE ring	2229		3280
353	See note 2	Stud, gland	2441		
355	See note 2	Nut, gland	2441		
356E	See note 1	Stud, casing wear ring to casing	2441		
357A	See note 1	Nuts, casing wear ring to casing	2441		
357J	See note 6	Nut, box to backplate	N/A		
358	1	Plug, casing drain (optional)	2229	2230	3280
358M	3	Plug , casing gauge (optional)	2229	2230	3280
360	1	Gasket, end cover	5163		
360P	1	Gasket, wear ring to casing	Non-asbestos		
370A	See note 1	Hex capscrew, adapter to casing	2442		
370B	8	Hex capscrew, frame to adapter	2442		
370C	4	Hex capscrew, housing to frame	2442		
370D	2	Hex capscrew, frame to frame foot	2442		
370E	See note 9	Screw, oil return	N/A		
370H	2	Hex capscrew, cover to adapter	2442		
370K	4	Screw, end cover to frame	2442		

Item	Quantity	Part name	All 316SS	All CD4MCuN	Super Duplex A890 5A
371A	4	Hex tap bolt, adjusting	2442		
372T	1	Screw, monitor	2367		
382	1	Bearing lockwasher	Steel		
383	1	Mechanical seal	Material varies		
388K	3	Hex capscrew, casing to adapter, jacking	2442		
400	1	Coupling key	2213		
408B	1	Plug, oil drain	2210		
408C	See note 9	Plug, grease relief	N/A		
408D	See note 9	Plug, grease lube	N/A		
408E	See note 9	Plug, grease relief	N/A		
408H	1	Plug, oil fill	2210		
409	1	Bearing, radial	Deep groove ball		
412A	1	O-ring, impeller	Teflon		
412C	See note 8	O-ring, sideplate to casing	N/A		
412F	1	O-ring, sleeve	Teflon		
412U	See note 6	O-ring, repeller	N/A		
418	2	Hex capscrew, cover to adapter, jacking	2442		
423B	4	Nut, jam	2442		
444	See note 6	Backplate	N/A		
494	1	Cooler assembly	SS tube, brass fittings		
496	1	O-ring, housing	Buna-N		
748	See note 11	Lug, casing	N/A		
761B	1	LCCM, vib/temp monitor	Stainless steel		

Table 10: Parts list for 3181 and 3186

Item	Quantity	Part name	316SS	Duplex SS
100	1	Casing	1203	1362
101	1	Impeller	1203	1362
105	1	Lantern ring	Teflon	
106	1 set	Pack, packed box	Non-asbestos braid	
107	2	Gland half	1203	
109A	1	Bearing end cover	1001	
112	1	Bearing (thrust)	Duplex angular contact (back to back)	
122	1	Shaft	2249	
125	1	Throttle bushing	3211	3211
126	1	Shaft sleeve	1226	1226
134A	1	Bearing housing	1000	
136	1	Bearing locknut	Steel	

Item	Quantity	Part name	316SS	Duplex SS
164	1	Casing wear ring (enclosed impeller)	1203	1216
176	1	Sideplate (open impeller)	1203	1362
178	1	Impeller key	2213	
184	1	Stuffing box cover/seal chamber	1203	1362
193H	2	Grease fitting	Steel	
202	1	Impeller wear ring (for enclosed impeller option)	1203	1362
222E	3	Set screw, casing wear ring	2229	2230
228	1	Bearing frame	1000	
230C	1	Vane particle ejector (VPE) ring	1362	
236A	See note 1	Screw, bearing retainer to housing	2239	
241	1	Frame foot	1001	
251	1	Sight oiler (opt.)	Steel/glass	
253B	1	Bearing retainer	1000	
304	1	Impeller nut	1203	1216
319	1	Sight glass	2226	
320	3	Socket head screw, impeller wear ring	2229	2230
332A	1	Labyrinth seal assembly (thrust)	Bronze with Viton O-rings	
333A	1	Labyrinth seal assembly (radial)	Bronze with Viton O-rings	
351	1	Gasket, casing	Non-asbestos aramid fiber	
353	See note 2	Stud, gland	2226	
355	See note 2	Nut, gland	2228	
356E	See note 1	Studs, sideplate	2226	
357A	See note 1	Nuts, sideplate	2228	
358	1	Plugs (casing drain, optional)	2229	2230
358M	3	Plug (casing gauge, optional)	2229	2230
360P	1	Gasket, sideplate to casing	Non-asbestos aramid fiber	
370A	See note 1	Screw, hex head (cover to case)	2443	
370B	8	Screw, hex (frame to box)	2210	
370C	See note 1	Screw, housing to frame	2210	
370D	2	Screw, frame foot to frame	2210	
370E	1	Screw, oil return	2210	
371A	See note 1	Bolt, adjusting	2210	
382	1	Bearing lockwasher	Steel	
383	1	Mechanical seal	Material varies	
388K	3	Bolt, hex packing case to cover	2442	
400	1	Coupling key	2213	
408B	1	Plug (oil drain)	2210	
408C	2	Plug (grease relief)	2210	
408D	1	Plug (grease lube)	2210	
408E	4	Plug (oil lube)	2210	
408H	See note 3	Plug (stuffing box)	2229	2230

Item	Quantity	Part name	316SS	Duplex SS
409	1	Bearing (radial)	Cylindrical roller, steel	
412A	1	O-ring, impeller	Teflon	
412C	1	O-ring, sideplate to casing	Viton	
412F	1	O-ring, sleeve	Teflon	
423B	See note 1	Nut, jam	2210	
494	1	Cooler assembly	SS tube, brass fittings	
496	1	O-ring, housing	BUNA	

Table 11: 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	—	—	—
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

Goulds Pumps Material Code	Material	ASTM	DIN	ISO	JIS
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	—	—

Assembly drawings (exploded views)

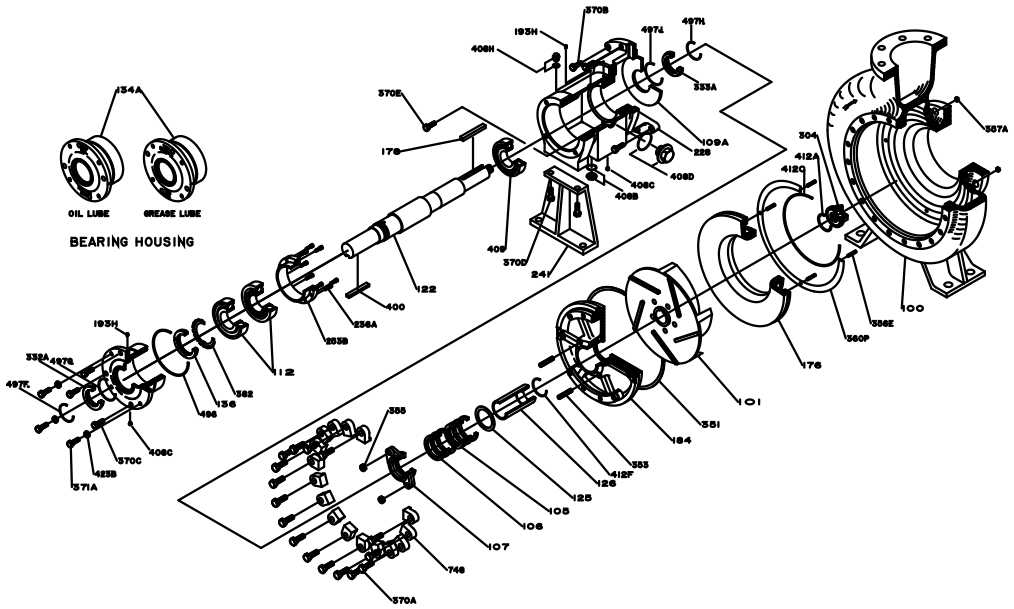


Figure 15: Exploded view of 3180 and 3185 S, M, L, and XL groups

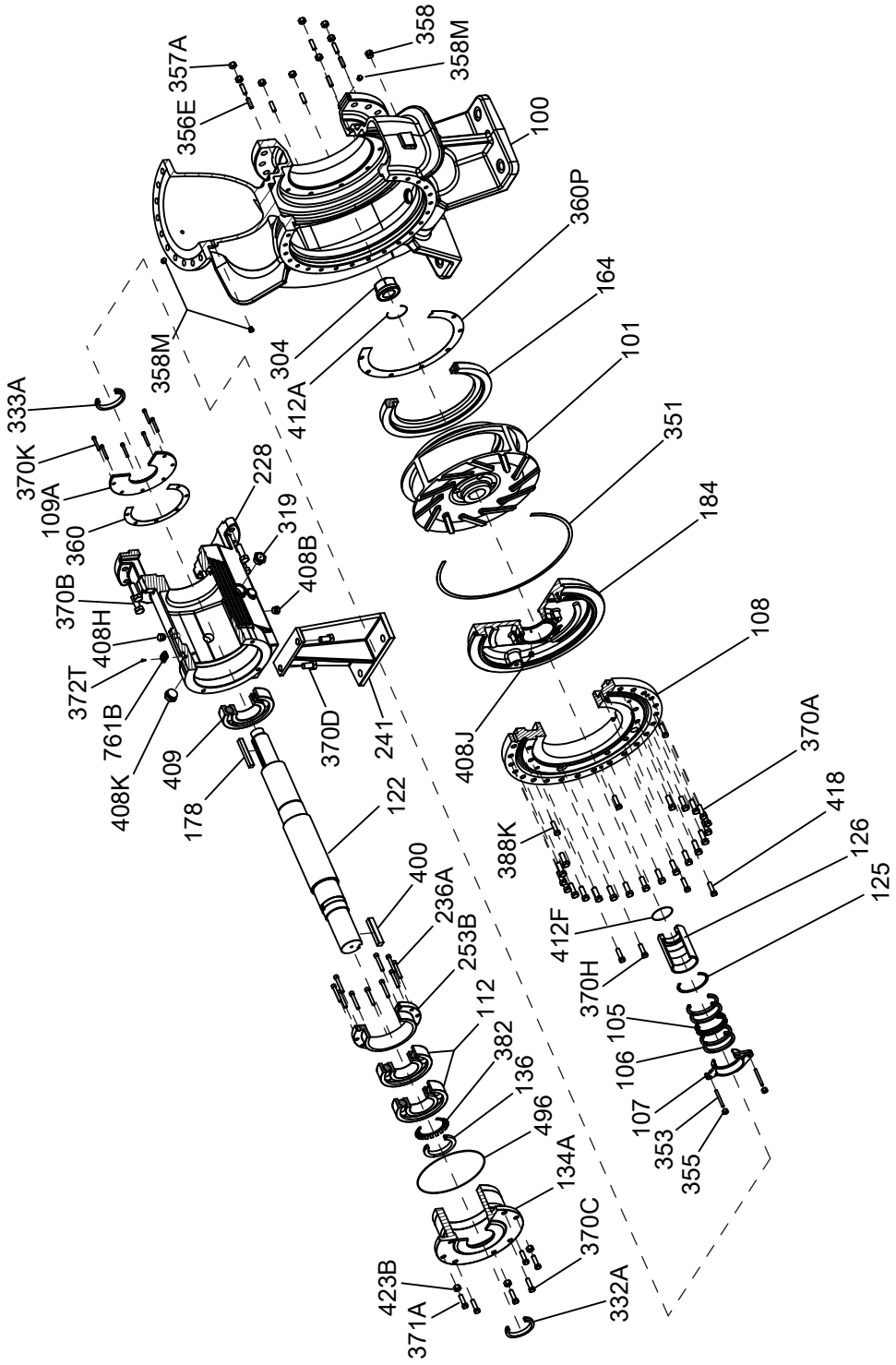


Figure 16: Exploded view of 3180 and 3185 XL1, XL2-S, and XL2 groups

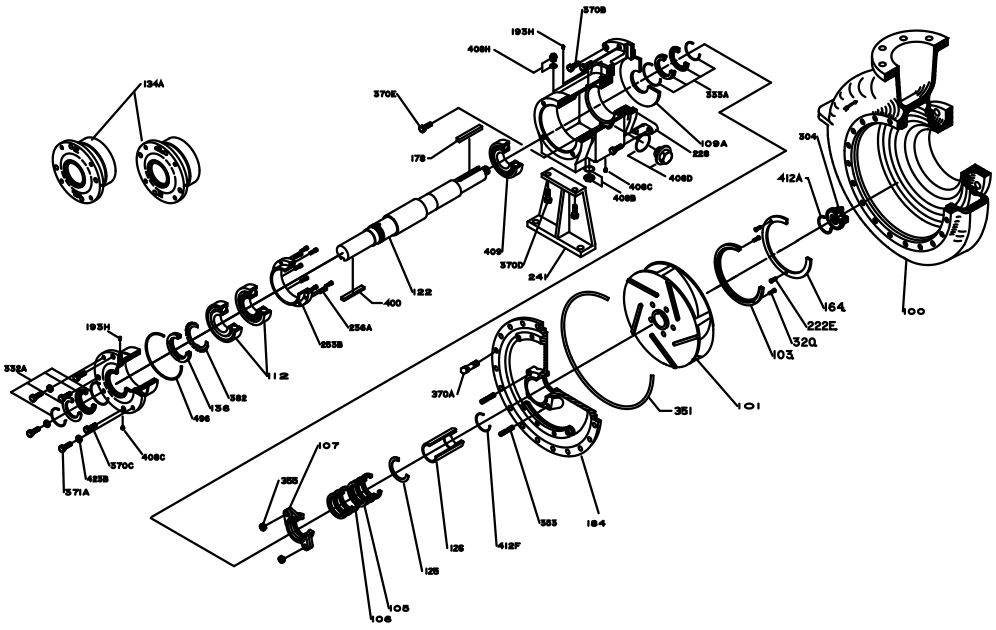


Figure 17: Exploded view of 3181 and 3186

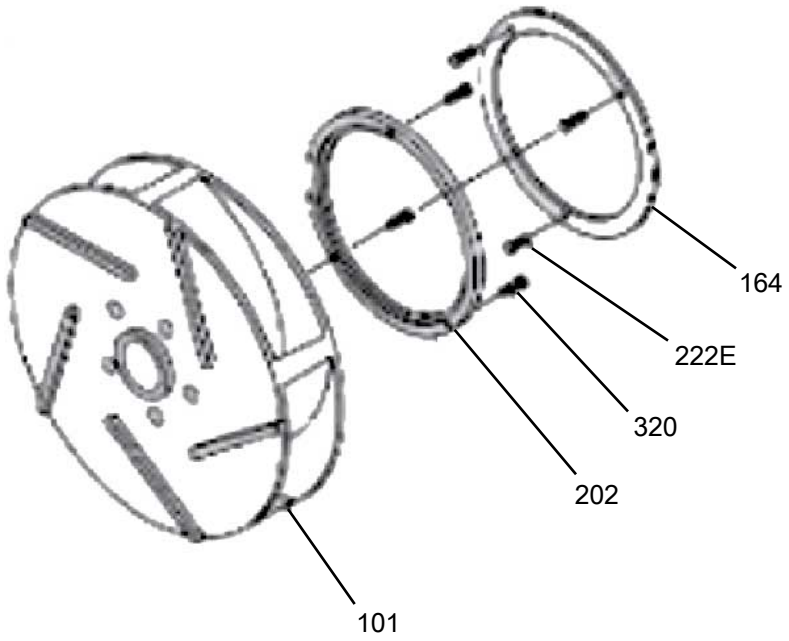


Figure 18: Enclosed impeller option for the S, M, L, and XL groups

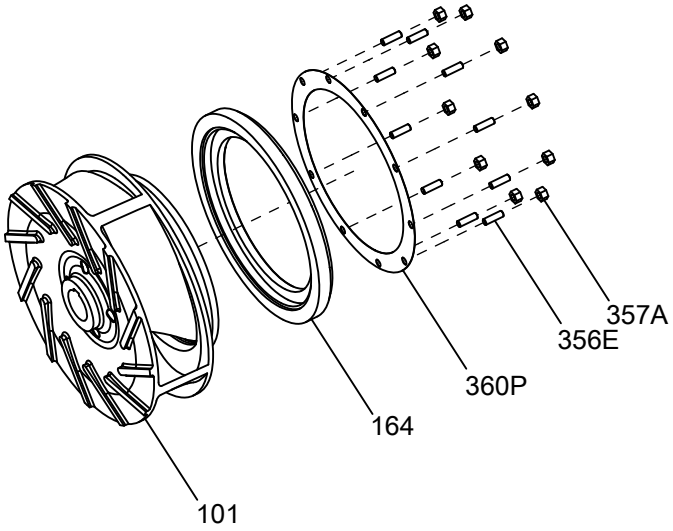


Figure 19: Enclosed impeller option for the XL1, XL2-S and XL2groups

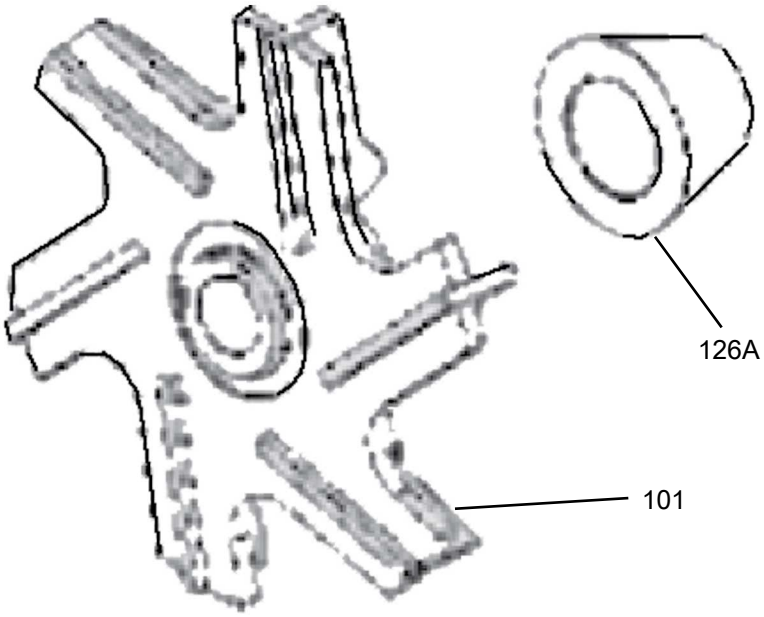


Figure 20: Shearpeller™

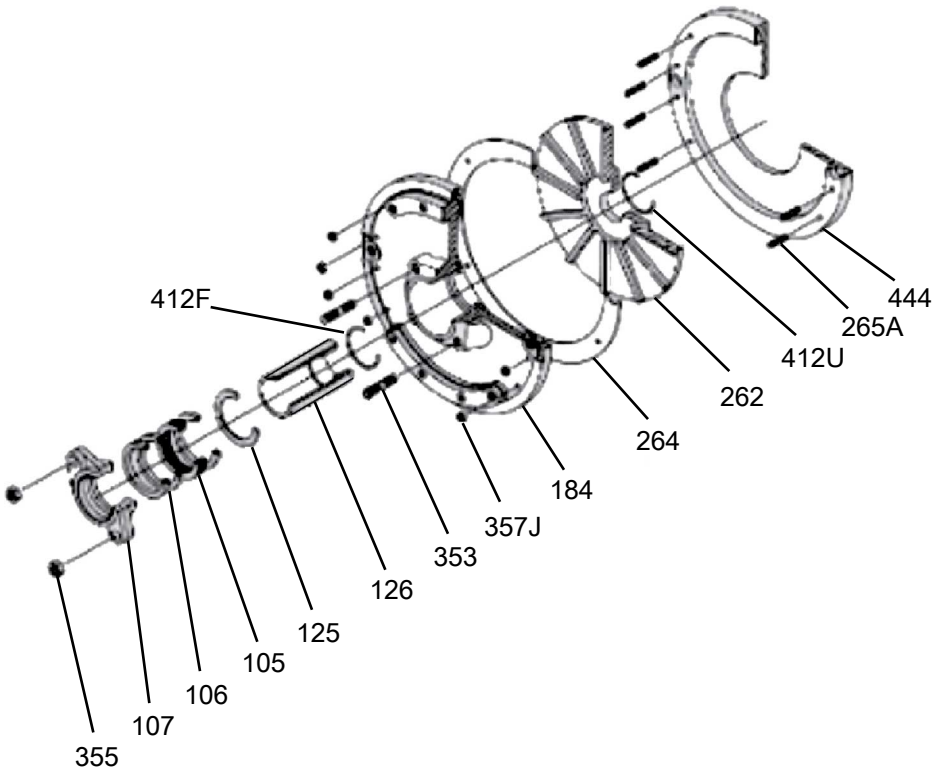


Figure 21: Dynamic seal option (3180/3185 S, M, L, and XL group only)

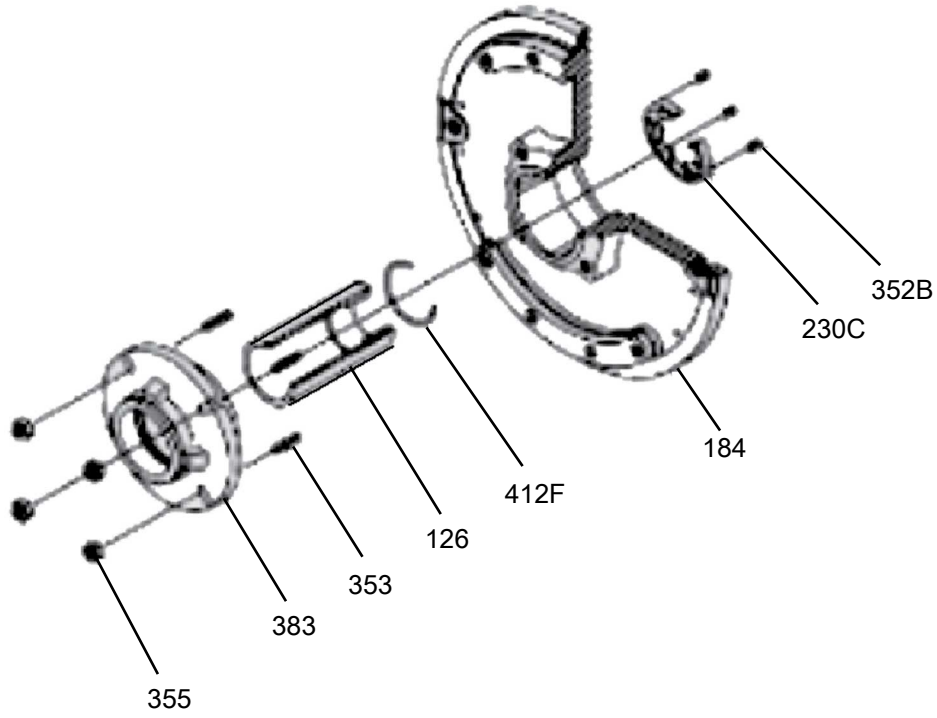


Figure 22: TaperBore™ PLUS seal chamber with VPE ring

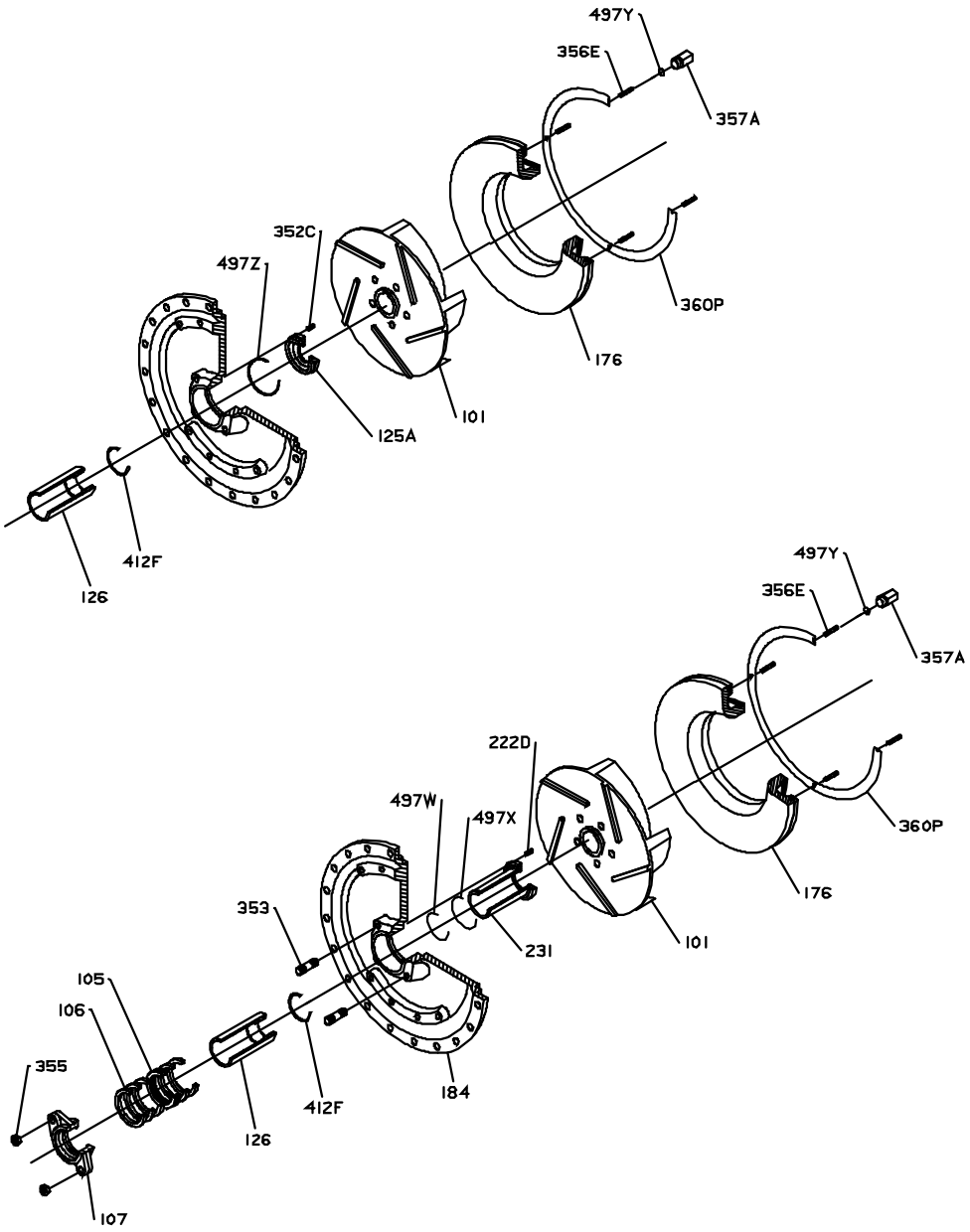
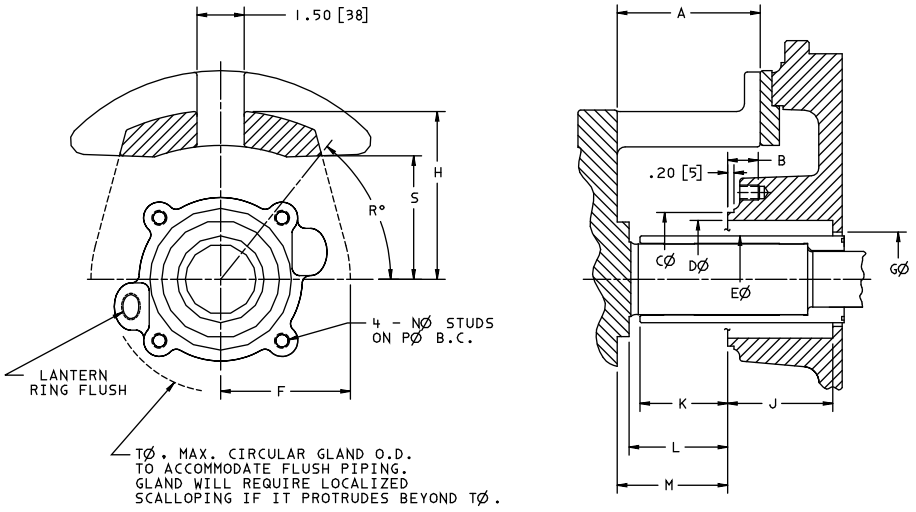


Figure 23: Throat bushing option and conversion packing option for 3181 and 3186

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 24: 3180/3185 S, M, L, and XL packed stuffing box, drawing C03346A, revision 4, issue 0

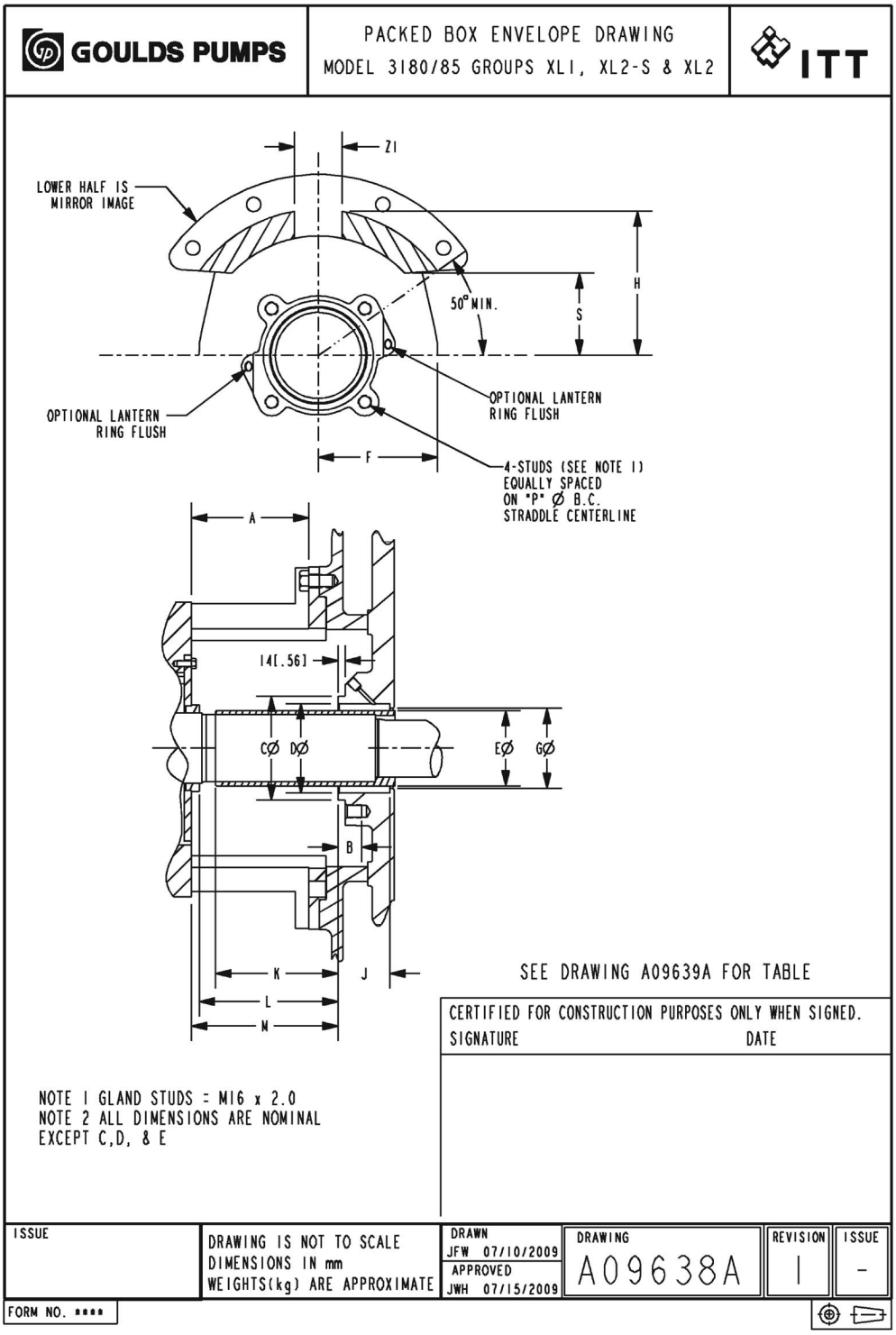


Figure 25: 3180/3185 XL1, XL2-S, and XL2 packed stuffing box, drawing A09638A, revision 1, issue -

GOULDS PUMPS

PACKED BOX ENVELOPE DRAWING
MODEL 3180/85 GROUPS XL1, XL2-S & XL2

ITT

GROUP	A	B	C	D	E	F	G	H
XL1 (INCH)	5.12	1.86	7.484 7.480	6.302 6.299	5.315 5.313	8.29	5.59	10.04
XL2-S & XL2 (INCH)	5.75	1.86	8.665 8.661	7.484 7.480	6.496 6.494	9.83	6.77	12.07

GROUP	J	K	L	M	P	S	Z1	
XL1 (INCH)	3.54	3.95	7.33	8.00	9.25	7.28	2.17	
XL2-S & XL2 (INCH)	3.54	4.93	8.70	9.23	10.39	8.94	2.66	

GROUP	A	B	C	D	E	F	G	H
XL1 (MM)	130	47	190h9	160h9	135h8	210	142	255
XL2-S & XL2 (MM)	146	47	220h9	190h9	165h8	225	172	306

GROUP	J	K	L	M	P	S	Z1	
XL1 (MM)	90	100	186	203	235	185	55	
XL2-S & XL2 (MM)	90	125	221	234	264	227	67.5	

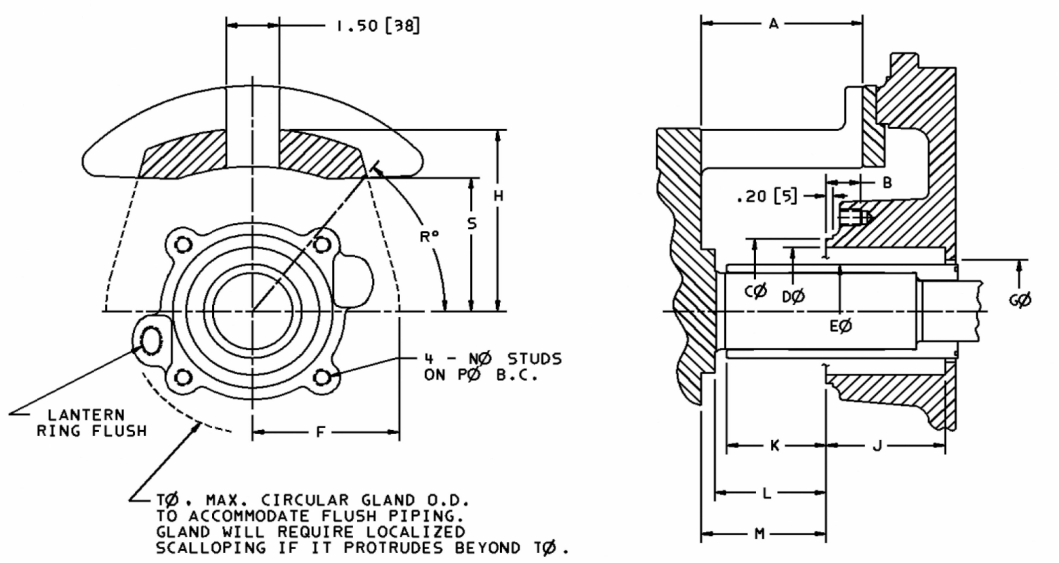
SEE DRAWING A09638A FOR DIMENSIONS

CERTIFIED FOR CONSTRUCTION PURPOSES ONLY WHEN SIGNED.
SIGNATURE DATE

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

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN mm WEIGHTS(kg) ARE APPROXIMATE	DRAWN JFW 07/10/2009 APPROVED JWH 07/15/2009	DRAWING A09639A	REVISION 1	ISSUE -

FORM NO. ****



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 26: 3180/3185 S, M, L, and XL mechanical seal, drawing C03494A, revision 5, issue 0

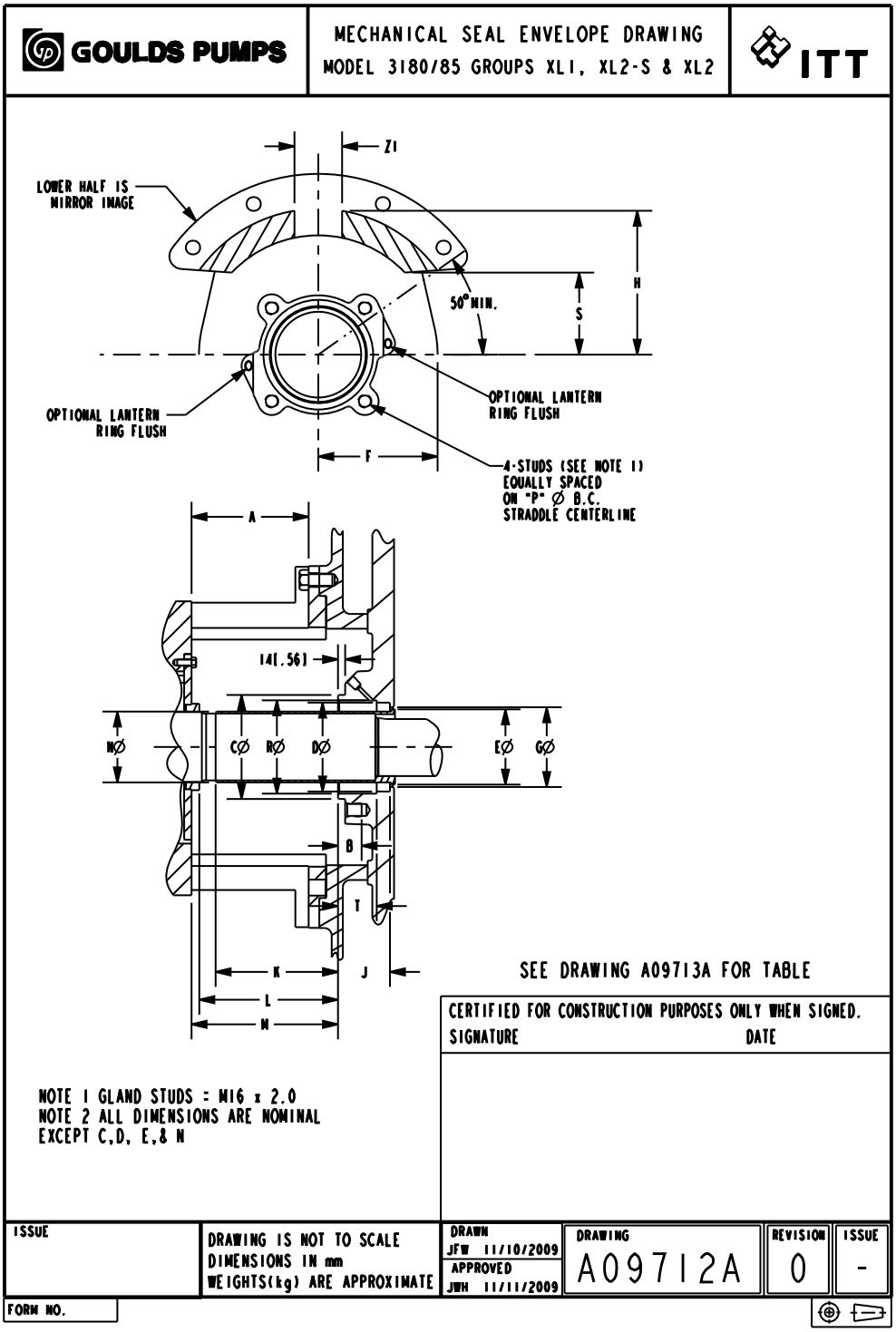


Figure 27: 3180/3185 XL1, XL2-S, and XL2 mechanical seal, drawing A09712AA, revision 0, issue —

GOULDS PUMPS

MECHANICAL SEAL ENVELOPE DRAWING
MODEL 3180/85 GROUPS XL1, XL2-S & XL2

ITT

GROUP	A	B	C	D	E	F	G	H	J
XL1 (INCH)	5.12	1.86	7.484 7.480	6.627 6.625	5.315 5.313	8.29	5.59	10.04	3.54
XL2-S & XL2 (INCH)	5.75	1.86	8.665 8.661	7.752 7.750	6.496 6.494	9.83	6.77	12.07	3.54

GROUP	K	L	M	N	P	R	S	T	Z1
XL1 (INCH)	3.95	7.33	8.00	5.250 5.248	9.25	6.752	7.28	3.062	2.17
XL2-S & XL2 (INCH)	4.93	8.70	9.23	6.250 6.248	10.39	7.874	8.94	3.156	2.66

GROUP	A	B	C	D	E	F	G	H	J
XL1 (MM)	130	47	190h9	168.28 168.23	135h8	210	142	255	90
XL2-S & XL2 (MM)	146	47	220h9	196.90 196.85	165h8	225	172	306	90

GROUP	K	L	M	N	P	R	S	T	Z1
XL1 (MM)	100	186	203	133.35 133.30	235	171.50	185	77.8	55
XL2-S & XL2 (MM)	125	221	234	158.75 158.70	264	200	227	80.2	67.5

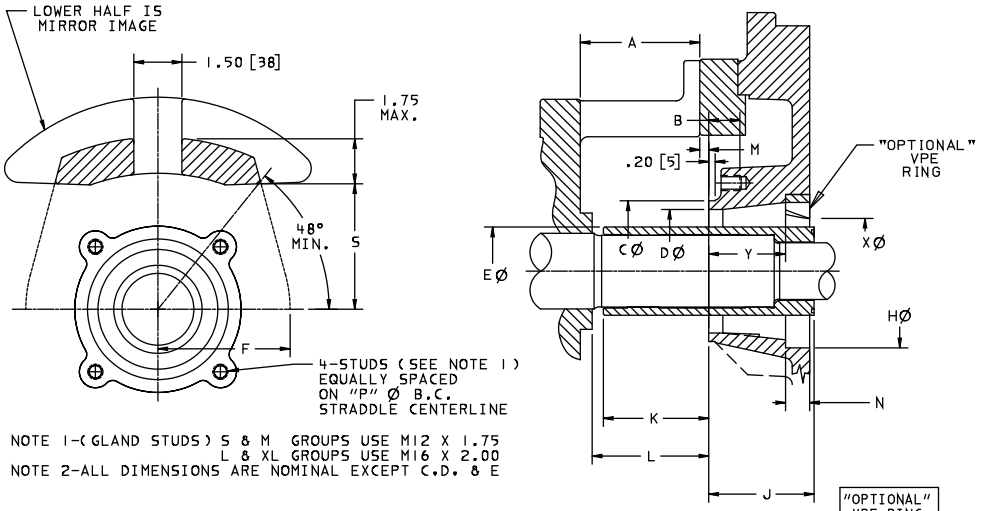
SEE DRAWING A09712A FOR DIMENSIONS

CERTIFIED FOR CONSTRUCTION PURPOSES ONLY WHEN SIGNED.
SIGNATURE DATE

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

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN mm WEIGHTS(kg) ARE APPROXIMATE	DRAWN JFW 11/10/2009 APPROVED JWH 11/11/2009	DRAWING A09713A	REVISION 0	ISSUE -

FORM NO.



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 28: 3180/3185 S, M, L, and XL TaperBore™ PLUS seal, drawing A06755A, revision 1, issue —

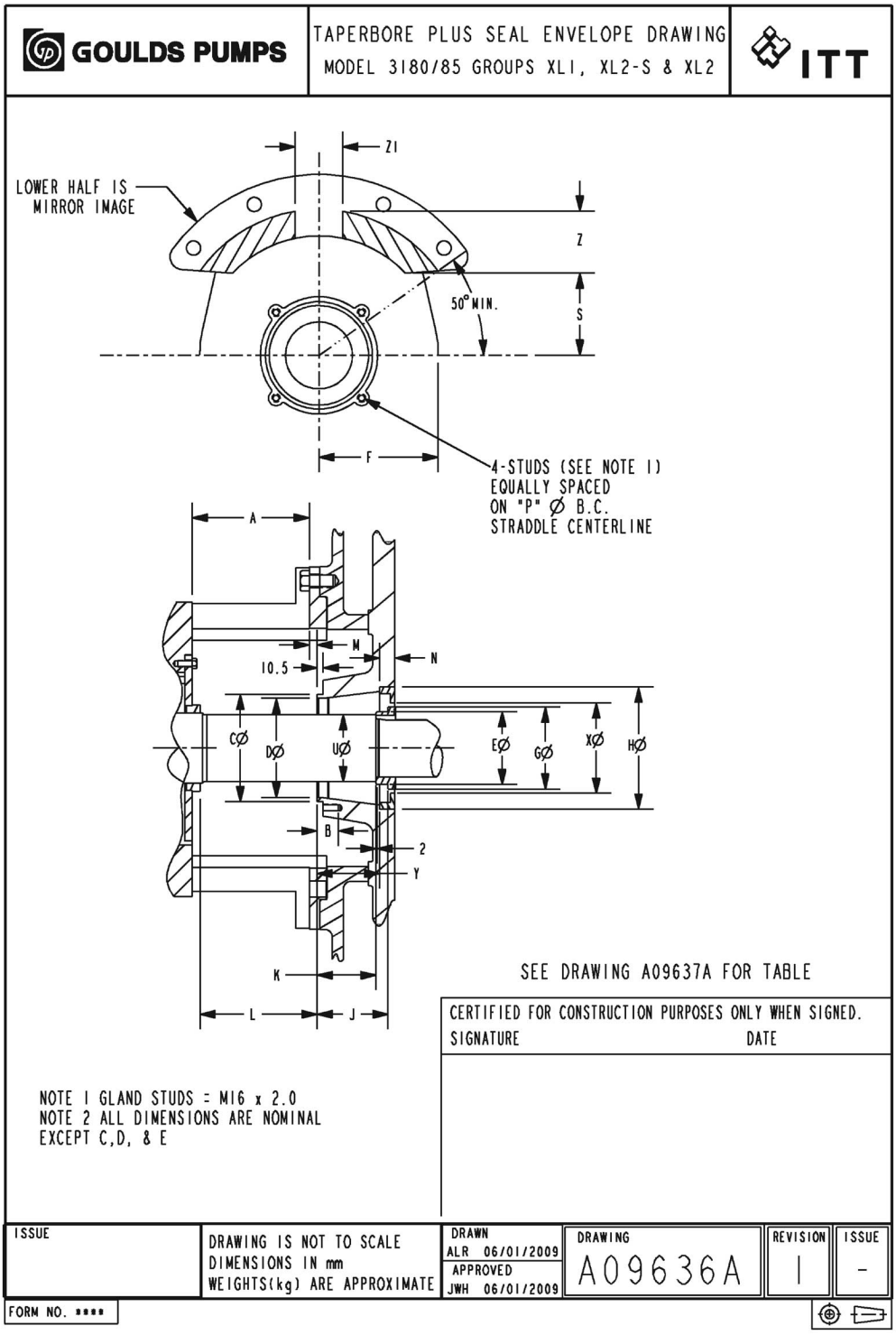


Figure 29: 3180/3185 XL1, XL2-S, and XL2 TaperBore™ PLUS seal, drawing A09636A, revision 1, issue —

GOULDS PUMPS

TAPERBORE PLUS SEAL ENVELOPE DRAWING
MODEL 3180/85 GROUPS XL1, XL2-S & XL2

ITT

GROUP	A	B	C	D	E	F	G	H	J	K
XL1 (INCH)	5.12	1.69	7.717 7.713	6.696 6.693	4.875 4.873	8.29	5.35	11.630	4.92	3.99
XL2-S (INCH)	5.75	1.69	8.898 8.894	7.878 7.874	6.000 5.998	9.83	6.50	13.151	5.42	4.50
XL2 (INCH)							8.07			

GROUP	L	M	N	P	S	X	U	Y	Z	Z1
XL1 (INCH)	6.10	1.50	1.26	9.25	7.28	8.30	4.625 4.623	4.00	2.75	2.17
XL2-S (INCH)	6.82	1.63	1.26	10.39	8.94	9.84	5.750 5.748	4.50	3.13	2.66
XL2 (INCH)										

GROUP	A	B	C	D	E	F	G	H	J	K
XL1 (MM)	130	43	196h9	170h9	123.8g7	210	136	295.40	124.9	101.3
XL2-S (MM)	146	43	226h9	200h9	152.4g7	225	165	334.04	137.7	114.2
XL2 (MM)							205			

GROUP	L	M	N	P	S	X	U	Y	Z	Z1
XL1 (MM)	154.94	38	32	235	185	211	117.48g7	101.3	70	55
XL2-S (MM)	173.2	41.4	32	264	227	250	146.05g7	114	79.5	67.5
XL2 (MM)										

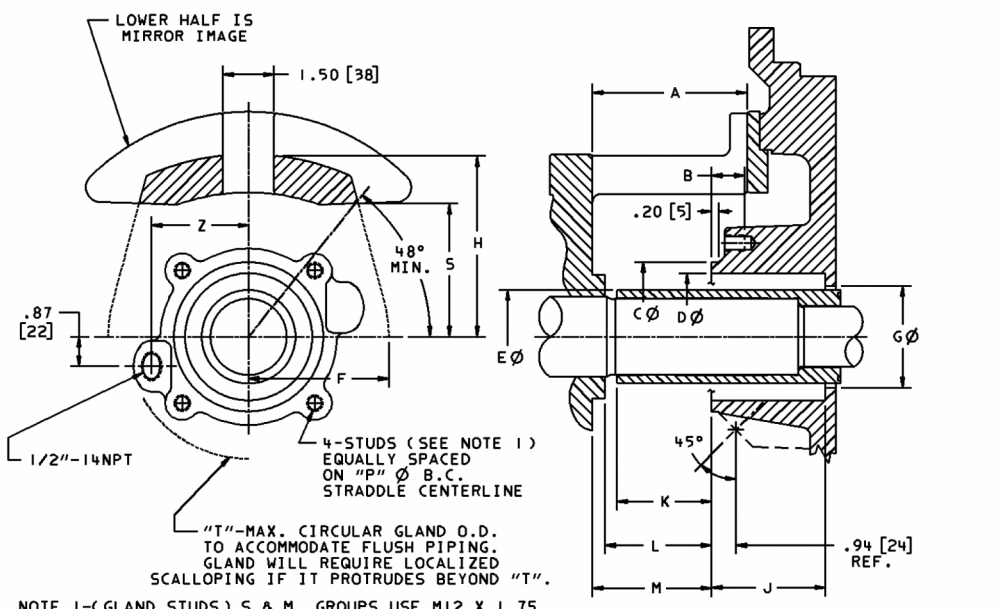
SEE DRAWING A09636A FOR DIMENSIONS

CERTIFIED FOR CONSTRUCTION PURPOSES ONLY WHEN SIGNED.
SIGNATURE DATE

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

ISSUE	DRAWING IS NOT TO SCALE DIMENSIONS IN mm WEIGHTS(kg) ARE APPROXIMATE	DRAWN ALR 06/01/2009 APPROVED JWH 06/01/2009	DRAWING A09637A	REVISION 1	ISSUE -

FORM NO. ****



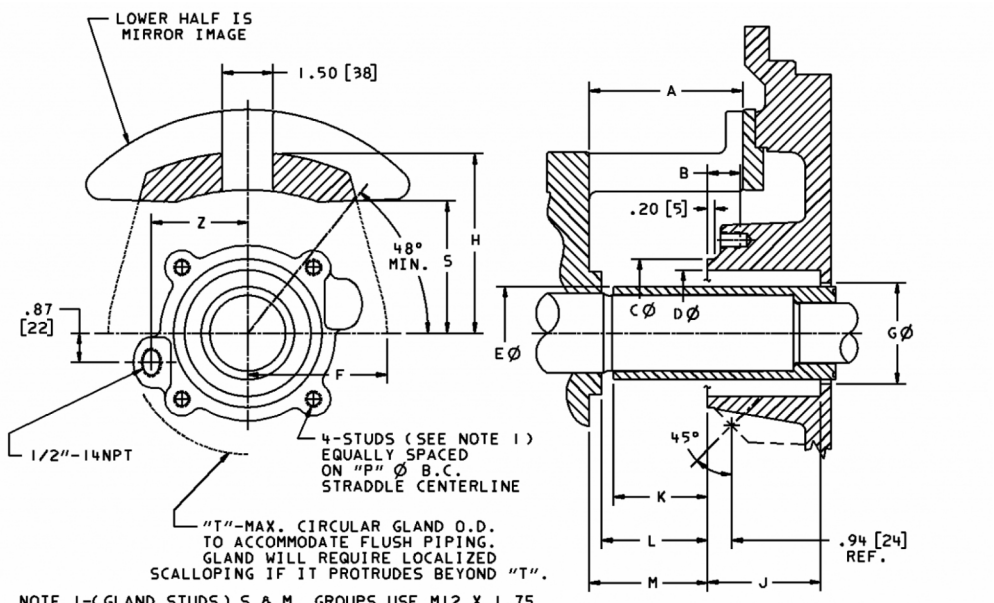
NOTE 1-(GLAND STUDS) S & M GROUPS USE M12 X 1.75
L & XL GROUPS USE M16 X 2.00
NOTE 2-ALL DIMENSIONS ARE NOMINAL EXCEPT C.D. & E

MODEL/ GROUPS		A	B	CØ	DØ	EØ	F	GØ	H	J	K	L	M	PØ	S	TØ	FLUSH TAP Z
3181 (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	4.72	3.35	6.14	2.62
	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	5.83	3.90	6.61	2.90
	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	6.34	4.80	7.48	3.29
	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	6.77	5.08	8.07	3.62
3186 (MM)	S	81	25	97_{h9}	85^{H9}	60_{h8}	105	66	117	85	52.5	57.3	66.8	120	85	156	67
	M	115	25	106_{h9}	95^{H9}	70_{h8}	105	76	137	85	70.8	79.7	89.1	148	99	168	74
	L	94	34	117_{h9}	105^{H9}	80_{h8}	132	86	162	90	62.4	70.1	79.8	161	122	190	84
	XL	106	34	132_{h9}	120^{H9}	95_{h8}	152	102	171	90	75.4	82.3	91.8	172	129	205	92

3186 SHAFT SLEEVE DRAWINGS

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

Figure 30: 3181/3186 stuffing box, drawing C05279A, revision 1, 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	GØ	H	J	K	L	M	PØ	S	TØ	FLUSH TAP Z
3181 (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	4.72	3.35	6.14	2.62
	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	5.83	3.90	6.61	2.90
	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	6.34	4.80	7.48	3.29
	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	6.77	5.08	8.07	3.62
3186 (MM)	S	81	25	97_{h9}	85^{H9}	60_{h8}	105	66	117	85	52.5	57.3	66.8	120	85	156	67
	M	115	25	106_{h9}	95^{H9}	70_{h8}	105	76	137	85	70.8	79.7	89.1	148	99	168	74
	L	94	34	117_{h9}	105^{H9}	80_{h8}	132	86	162	90	62.4	70.1	79.8	161	122	190	84
	XL	106	34	132_{h9}	120^{H9}	95_{h8}	152	102	171	90	75.4	82.3	91.8	172	129	205	92

3181 SHAFT SLEEVE DRAWINGS

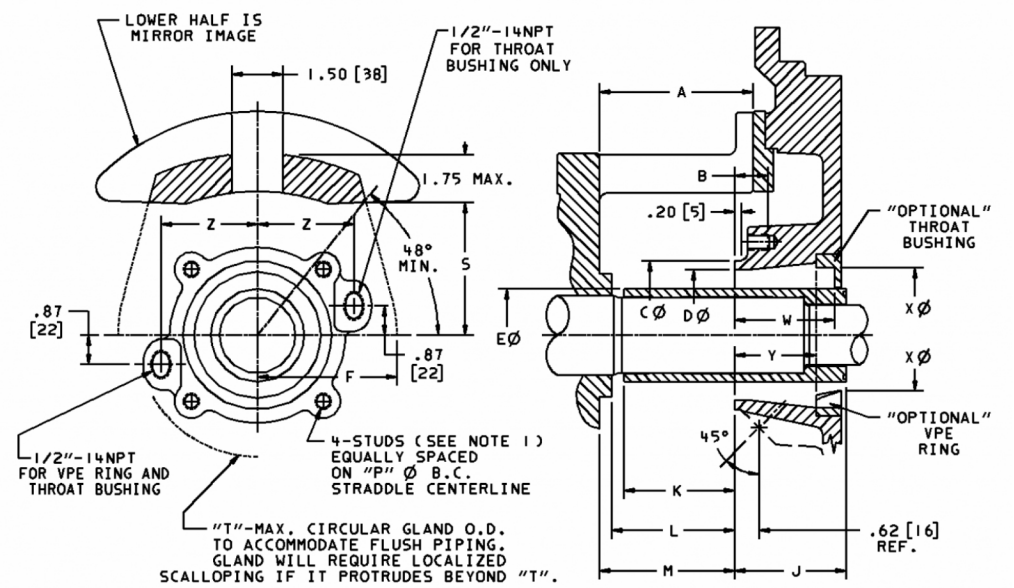
S GRP.- C03310A
M GRP.- C03311A
L GRP.- C03312A
WL GRP.- C03313A

3186 SHAFT SLEEVE DRAWINGS

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

FOR STUFFING BOX./ PACKING SLEEVE DIM. PLEASE SEE DWG. # C05279A

Figure 31: 3181/3186 mechanical seal, drawing A07209A, revision 1, 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	J	K	L	M	PØ	S	TØ	"OPTIONAL" BUSHING/VPE RING W	"OPTIONAL" BUSHING/VPE RING XØ	"OPTIONAL" BUSHING/VPE RING Y	FLUSH TAP Z
3181 (IN.)	S	3.19	.88	3.937 3.934	3.386 3.389	2.375 2.373	4.12	2.56	2.70	2.89	3.26	4.72	3.35	6.14	2.36	3.39	1.81	2.91
	M	4.53	.88	4.409 4.406	3.858 3.862	2.750 2.748	4.12	3.15	3.30	3.65	4.02	5.83	3.90	6.61	2.95	3.86	2.40	3.11
	L	3.69	1.04	5.039 5.035	4.488 4.492	3.250 3.248	5.19	3.15	3.17	3.47	3.85	6.34	4.80	7.48	2.95	4.49	2.15	3.66
	XL	4.19	1.04	5.591 5.587	5.039 5.043	3.750 3.748	6.00	3.15	3.68	3.95	4.32	6.77	5.08	8.07	2.95	5.04	2.15	4.02
3186 (MM)	S	81	22	100_{h9}	86^{H9}	60_{h8}	105	65	68.5	73.3	83.8	120	85	156	60	86	46	74
	M	115	22	112_{h9}	98^{H9}	70_{h8}	105	80	83.8	92.7	102	148	99	168	75	98	61	79
	L	94	26	128_{h9}	114^{H9}	80_{h8}	132	80	80.4	88.1	97.8	161	122	190	75	114	54.6	93
	XL	106	26	142_{h9}	128^{H9}	95_{h8}	152	80	94.3	100	110	172	129	205	75	128	54.6	102

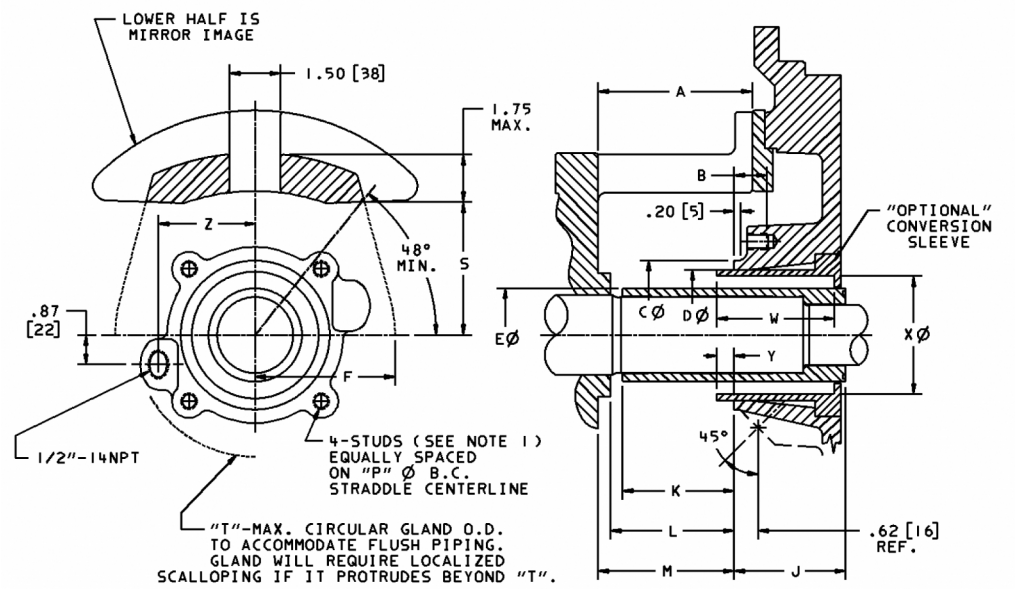
3181 SHAFT SLEEVE DRAWINGS

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

3186 SHAFT SLEEVE DRAWINGS

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

Figure 32: 3181/3186 TaperBore™ PLUS seal, drawing C05209A, revision 2, 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	J	K	L	M	PØ	S	TØ	"OPTIONAL" CONVERSION SLEEVE W	"OPTIONAL" CONVERSION SLEEVE XØ	"OPTIONAL" CONVERSION SLEEVE Y	FLUSH TAP Z
3181 (IN.)	S	3.19	.88	3.937 3.934	3.386 3.389	2.375 2.373	4.12	2.56	2.70	2.89	3.26	4.72	3.35	6.14	2.68	2.990 2.994	.31	2.91
	M	4.53	.88	4.409 4.406	3.858 3.862	2.750 2.748	4.12	3.15	3.30	3.65	4.02	5.83	3.90	6.61	2.82	3.502 3.506	.04	3.11
	L	3.69	1.04	5.039 5.035	4.488 4.492	3.250 3.248	5.19	3.15	3.17	3.47	3.85	6.34	4.80	7.48	3.54	4.134 4.137	.71	3.66
	XL	4.19	1.04	5.591 5.587	5.039 5.043	3.750 3.748	6.00	3.15	3.68	3.95	4.32	6.77	5.08	8.07	2.82	4.486 4.490	.04	4.02
3186 (MM)	S	81	22	100_{h9}	86^{H9}	60_{h8}	105	65	68.5	73.3	83.8	120	85	156	68	$76^{\pm.05}$	8	74
	M	115	22	112_{h9}	98^{H9}	70_{h8}	105	80	83.8	92.7	102	148	99	168	72	$89^{\pm.05}$	1	79
	L	94	26	128_{h9}	114^{H9}	80_{h8}	132	80	80.4	88.1	97.8	161	122	190	90	$105^{\pm.05}$	18	93
	XL	106	26	142_{h9}	128^{H9}	95_{h8}	152	80	94.3	100	110	172	129	205	72	$114^{\pm.05}$	1	102

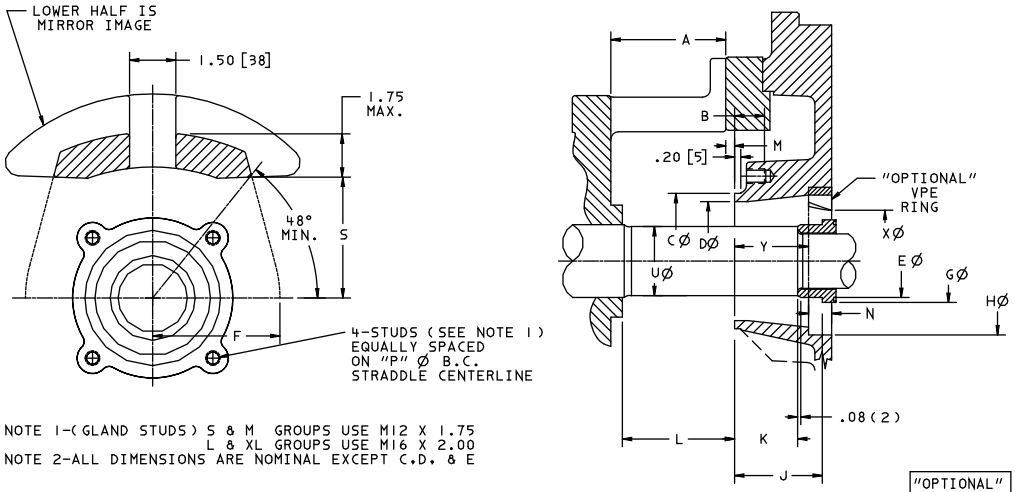
3181 SHAFT SLEEVE DRAWINGS

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

3186 SHAFT SLEEVE DRAWINGS

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

Figure 33: 3181/3186 TaperBore™ PLUS with conversion seal, drawing C05278A, revision 1, 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	GØ	HØ	J	K	L	M	N	PØ	S	UØ	"OPTIONAL" VPE RING XØ	"OPTIONAL" VPE RING Y
3180 (IN.)	S	3.19	.88	3.937 3.934	3.386 3.389	2.086 2.085	4.12	2.36	5.373 5.375	2.22	1.530 1.470	2.89	.07	.75	4.72	3.35	1.968 1.967	3.39	1.81
	M	4.53	.88	4.409 4.406	3.858 3.862	2.401 2.400	4.12	2.76	5.943 5.945	2.81	2.060 2.000	3.65	*-.51	.75	5.83	3.90	2.283 2.282	3.87	2.40
	L	3.69	1.04	5.039 5.035	4.488 4.492	2.913 2.912	5.19	3.15	6.691 6.693	2.81	1.660 1.600	3.47	.16	1.00	6.34	4.80	2.677 2.676	4.51	2.15
	XL	4.19	1.04	5.591 5.587	5.039 5.043	3.346 3.345	6.00	3.74	7.203 7.205	2.81	1.920 1.860	3.95	13	1.00	6.77	5.08	3.149 3.148	5.06	2.15
3185 (MM)	S	81	22	100_{h9}	86^{H9}	53_{h8}	105	60	(-.05) 136.5	56.4	38.9 37.4	73.3	2.8	19	120	85	50_{g7}	86	46
	M	115	22	112_{h9}	98^{H9}	61_{h8}	105	70	(-.05) 151	71.4	52.3 50.8	92.7	*-13	19	148	99	58_{g7}	98	61
	L	94	26	128_{h9}	114^{H9}	74_{h8}	132	80	(-.05) 170	71.4	42.2 40.7	88.1	4	25.4	161	122	68_{g7}	115	54.6
	XL	106	26	142_{h9}	128^{H9}	85_{h8}	152	95	(-.05) 183	71.4	48.8 47.3	100	4	25.4	172	129	80_{g7}	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

3180/3185 SHAFT SLEEVE DRAWINGS

S GRP.- C03454A
M GRP.- C03444A
L GRP.- C03455A
XL GRP.- C03456A

Figure 34: 3181/3186 TaperBore™ PLUS with stub sleeve, drawing A06756A, revision 2, issue —

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