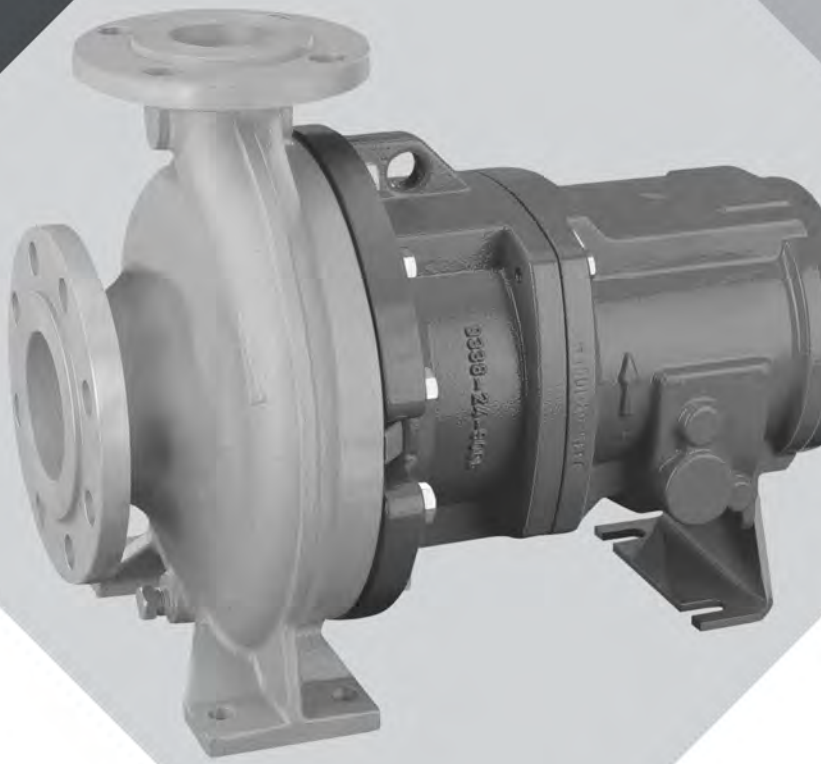
GOULDS PUMPS

Installation, Operation, and Maintenance Manual

Model ICM/ICMP Magnetic Drive Chemical Process Pump



ITT

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1 Introduction and Safety

1.1 Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance

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

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

1.1.1 Requesting other information

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

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

Specifications such as weights, dimensions or centers of gravity of the pump, pump unit or subassemblies are described in the supplier's applicable documentation.

1.1.2 Standard manufacturer

ITT Bornemann GmbH

Industriestr. 2

D-31683 Obernkirchen

GERMANY

The actual manufacturer is indicated on the name plate and the data sheet supplied.

1.2 Safety

WARNING:

- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.
- The operator must be aware of the pumpage and take appropriate safety precautions to prevent physical injury.
- Risk of serious injury or death. If any pressure-containing device is over-pressurized, it can explode, rupture, or discharge its contents. It is critical to take all necessary measures to avoid over-pressurization.

- Risk of death, serious personal injury, and property damage. Installing, operating, or maintaining the unit using any method not prescribed in this manual is prohibited. Prohibited methods include any modification to the equipment or use of parts not provided by ITT. If there is any uncertainty regarding the appropriate use of the equipment, please contact an ITT representative before proceeding.
- If the pump or motor is damaged or leaking, electric shock, fire, explosion, liberation of toxic fumes, physical harm, or environmental damage may result. Do not operate the unit until the problem has been corrected or repaired.
- Risk of serious personal injury or property damage. Dry running may cause rotating parts within the pump to seize to non-moving parts. Do not run dry.
- Risk of death, serious personal injury, and property damage. Heat and pressure build-up can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed. See specific information about safety devices in other sections of this manual.
- In the case of hot pumped media, ensure that personnel cannot touch hot surfaces on the pump and pipelines.

CAUTION:

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

1.2.1 Safety terminology and symbols

About safety messages

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

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

Hazard levels

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

Hazard categories

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

Electrical hazards are indicated by the following specific symbol:

ELECTRICAL HAZARD:

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

- Crush hazard
- Cutting hazard
- Arc flash hazard

1.2.1.1 The Ex symbol

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

1.2.2 Environmental safety

The work area

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

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

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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

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

Electrical installation

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

1.2.2.1 Recycling guidelines

Always follow local laws and regulations regarding recycling.

1.2.3 User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Safety equipment

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

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

Electrical connections

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

Provide LOTO procedures to prevent unexpected start-up.

Install an Emergency Stop that meets the requirements of EN ISO 13850. If it can be shown that a normal cut-off device functions as an Emergency Stop with the same efficiency this is admissible and it shall be marked as such.

Noise

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

Temperature

WARNING:
Equipment and piping surfaces may exceed 130ºF (54ºC) in operating process plants. Clear visual warnings or other indicators should alert personnel to surfaces that may reach a potentially unsafe temperature. Do not touch hot surfaces. Allow pumps operating at a high temperature to cool sufficiently before performing maintenance. If touching a hot

surface cannot be avoided, personnel should wear appropriate gloves, clothing, and other protective gear as necessary. Local law may provide specific guidance regarding exposure of personnel to unsafe temperatures.

1.2.3.1 Precautions before work

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

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

1.2.3.2 Precautions during work

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

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

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.
- For gas group IIA and IIB minimum brass material needs to be used for coupling guard. For gas group IIC stainless steel is required.

1.2.3.3 Magnetic precautions

WARNING:
Magnetic drive pumps contain very strong magnets that can pose health risks. Always observe these guidelines:

- Avoid working with, being in proximity of, or handling the magnets contained in this pump if you have any of these conditions:

- An artificial cardiac pacemaker
- An implanted defibrillator
- A metallic prosthetic heart valve
- Internal wound clips, from surgery
- Prosthetic joints
- Metallic wiring
- Any other type of metallic, prosthetic device

- Individuals who have had any surgery, especially to the chest or head, and do not know if metallic clips were surgically implanted need to avoid work on this unit unless their physician can confirm that no metallic devices exist.

1.2.4 Hazardous liquids

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

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

1.2.5 Wash the skin and eyes

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

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

1.3 Product warranty

Coverage

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

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

1.4 Ex Considerations and Intended Use

Special care must be taken in potentially explosive environments to ensure that the equipment is properly maintained. This includes but is not limited to:

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

Personnel requirements

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

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

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

Product and product handling requirements

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

- Only use the product in accordance with the approved operating range and permitted limits of use (see applicable documents, especially pump data sheet). Install safety and monitoring devices to ensure the operation in normal range.
- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Install safety and monitoring devices to ensure the correct liquid level at any time.
- A buildup of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.

- Do not apply additional paint or coatings to the pump when in an ATEX enviroment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
- Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.
- Do not operate the pump in processes that can cause shock waves or adiabatic compression (e.g. high pressure gases or oxidizing gases).
- Operate the pump with mounted suction strainers with mesh size according to pump size.
- Inspect the pump housing for corrosion and gaps in sealing for wear regularly. If the gaps exceed the defined tolerance limits replace the worn parts.
- Operate the pump within the maximum permitted design pressure according to the name plate.
- Check coupling regularly for wear. Change coupling if coupling is used for more than 3 years.
- Keep housing surfaces dust-free. Clean surfaces carefully so that no potentially explosive atmosphere can occur.
- If using a casing heating, ensure that the maximum temperature of the heating medium is at least 15 K lower than the permitted temperature class of the pump.
- Make sure that supplied electric and non-electric equipment correspond to the specific pump application in the potentially explosive atmosphere (e.g. zone, category, temperature class). Check declaration of conformity of the supplier.
- If using a motor speed control (hydrovar), install device outside of the potentially explosive atmosphere. Transmitters used in the potentially explosive atmosphere must be designed in the appropriate ignition protection type. Check declaration of conformity of the supplier.

Description of Ex-Directives

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

The ATEX directives are a specification enforced in only Europe. The UK Ex directives are a specification enforced in only the United Kingdom.

Explosive directives in other regions and countries depend on local regulations.

The preventive maintenance section must be adhered to in order to keep the applicable Ex classification of the equipment. Failure to follow these procedures will void the Ex classification for the equipment. Bearing replacement intervals are given in the specific pump model IOM.

Guidelines for compliance

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

1. Monitoring the pump frame liquid end temperature.

2. Maintaining proper bearing lubrication.
3. Ensuring that the pump is operated in the intended hydraulic range.

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

Current IOMs are available at https://www.gouldspumps.com/en-US/Tools-and-Resources/Literature/IOMs/ or from your local ITT Goulds Pumps Sales representative.

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

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

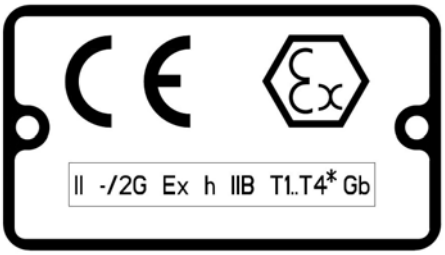


Figure 1: Typical ATEX nameplate

Figure 2: Typical UKCA ATEX nameplate

II - Group – Non Mining Equipment

2G – Category – Category 2 – Gas

Ex – required by ISO 80079 – 36:2016

h – h indicates mechanical equipment

IIB – Gas Group

T1 – T4 – Permitted Maximum Surface Temperature

Gb – Atmosphere + Equipment Protection Level

Table 1: Temperature class definitions

Code	Maximum permissible surface temperature in °C | °F	Maximum permissible liquid temperature in °C | °F
T1	440 | 824	372 | 700
T2	290 | 554	267 | 513
T3	195 | 383	172 | 342
T4	130 | 266	107 | 225
T5	Option not available	Option not available
T6	Option not available	Option not available

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

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

ISO 80079-37:2016 Section 5.7

Recommended bearing replacement interval (based on L10 life) = 17,500 hours of operation.

Equipment for monitoring

For process monitoring, condition-monitoring devices may be utilized. Condition-monitoring devices include but are not limited to these devices:

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

WARNING:

- When pumping unit is installed in a potentially explosive atmosphere, the instructions after the Ex symbol must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed. If there is any question regarding these requirements or if the equipment is to be modified, please contact a Goulds representative before proceeding.
- If equipment is to be installed in a potentially explosive atmosphere and these procedures are not followed, personal injury or equipment damage from an explosion may result.
- Particular care must be taken when the electrical power source to the equipment is energized.
- Improper impeller adjustment could cause contact between the rotating and stationary parts, resulting in a spark and heat generation.
- Lock out driver power to prevent electric shock, accidental start-up and physical injury.
- NEVER start pump without proper prime (all models).
- All equipment being installed must be properly grounded to prevent unexpected static electric discharge. If not, a static electric discharge may occur when the pump is drained and disassembled for maintenance purposes.
- Alignment procedures must be followed to prevent unintended contact of rotating parts. Follow coupling manufacturer's installation and operation procedures.
- When installing in a potentially explosive environment, ensure that the motor and accessories are properly certified.
- The impeller clearance setting procedure must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
- The impeller and wear ring clearance setting procedures must be followed. Improperly setting the clearance or not following any of the proper procedures can result in sparks, unexpected heat generation and equipment damage.
- Service temperature in an Ex classified environment is limited to the area classification specified on the Ex tag affixed to the pump (Refer to Table 1: Temperature class definitions on page 12 for Ex classifications).
- The coupling used in an Ex classified environment must be properly certified. The coupling guard used in an Ex classified environment must be constructed from a spark-resistant material. For gas group IIA and IIB minimum brass material needs to be used for coupling guard. For gas group IIC stainless steel is required.

- Bearings must be lubricated properly in order to prevent excess heat generation, sparks and premature failure.
- The mechanical seal used in an Ex classified environment must be properly certified.
- If the pump is equipped with a seal flushing system, the proper function of the seal flushing system must be ensured. Failure to do so will result in excess heat generation and seal failure.
- Packed stuffing boxes are not allowed in an Ex classified environment.
- Dynamic seals are not allowed in an Ex classified environment.
- Pumps must be fully primed at all times during operation.
- The preventive maintenance section must be adhered to in order to keep the applicable Ex classification of the equipment. Failure to follow these procedures will void the Ex classification for the equipment. Bearing replacement intervals are given in the specific pump model IOM.
- Inspection intervals should be shortened appropriately if the pumpage is abrasive and/or corrosive, or if the environment is classified as potentially explosive.
- Throughout this section on bearing lubrication, different pumpage temperatures are listed. If the equipment is Ex certified and the listed temperature exceeds the applicable value shown in Table 1: Temperature class definitions on page 12, then that temperature is not valid. Should this situation occur, please consult with your ITT/Goulds representative.
- Cooling systems, such as those for bearing lubrication, mechanical seal systems, etc., where provided, must be operating properly to prevent excess heat generation, sparks and premature failure.
- Rotate shaft by hand to ensure it rotates smoothly and there is no rubbing which could lead to excess heat generation, sparks and premature failure.
- Flange loads from the piping system, including those from thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts which can result in excess heat generation, sparks and premature failure.
- Ensure that pump and systems are free of foreign objects before operating and that objects cannot enter the pump during operation. Foreign objects in the pumpage or piping system can cause blockage of flow which can result in excess heat generation, sparks and premature failure.
- Do not insulate or allow the bearing housings to accumulate a dust layer as this can result in excess heat generation, sparks and premature failure.
- Check for magnetism on the pump shaft and demagnetize the shaft if there is any detectable magnetism. Magnetism will attract ferritic objects to the impeller, seals and bearings which can result in excess heat generation, sparks and premature failure.
- Leakage of process liquid may result in creation of an explosive atmosphere. Ensure the materials of the pump casing, impeller, shaft, sleeves, gaskets and seals are compatible with the process liquid. Follow all pump and seal assembly procedures.
- A buildup of gases within the pump, sealing system and or process piping system may result in an explosive environment within the pump or process piping system. Ensure process piping system, pump and sealing system are properly vented prior to operation.
- Sealing systems that are not self purging or self venting, such as plan 23, require manual venting prior to operation. Failure to do so will result in excess heat generation and seal failure.
- Do not apply additional paint or coatings to the pump when in an Ex environment. Static electric discharge can be initiated when contacting or rubbing surfaces with excessive coating thickness.
- Potential electrostatic charging hazard. Do not rub, clean, or blast equipment with dry cloth or dry media.
- Stray electrical currents may ignite explosive atmospheres. Ensure drives are certified for variable frequency drive operation by the manufacturer.

- User shall observe necessity of using a safety device, such as a flame arrestor, to prevent flame entering or leaving the pump sump, tank, or barrel when applicable.
- For variable speed motor applications, the electric motor must be specified with shaft grounding and used with a conductive type coupling suitable for the area classification.
- In plants or pumps with cathodic corrosion protection, a small current constantly flows through the construction. This is not permissible on the complete pump or partially-assembled machinery without further precautions being taken. ITT should be consulted in this context.
- Move equipment to a safe/non Ex environment for repairs/adjustments or use spark resistant tools and work methods.

2 Transportation and Storage

2.1 Inspect the delivery

2.1.1 Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Inspect the unit

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

2.2 Transportation guidelines

2.2.1 Pump handling and lifting

Precautions for moving the pump

Use care when moving pumps. Consult with a lifting and rigging specialist before lifting or moving the pump to avoid possible damage to the pump or injury to personnel.

WARNING:

- Dropping, rolling or tipping units, or applying other shock loads, can cause property damage and/or personal injury. Ensure that the unit is properly supported and secure during lifting and handling.
- The pump or the unit must be transported properly. It must be ensured that during transport the pump/unit remains in the horizontal position and does not slip out of the transport suspension points.

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

Keep the pump unit in the same position in which it was shipped from the factory.

Close the suction and discharge ends of the pump with plugs for transport and storage.

Precautions for lifting the pump

WARNING:

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

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

NOTICE:

- Make sure that the lifting equipment supports the entire assembly and is only used by authorized personnel.
- Do not attach sling ropes to shaft ends.

Lifting the pump

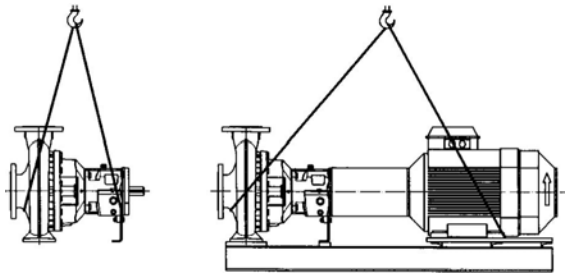


Figure 3: Example of proper lifting method

2.3 Storage guidelines

2.3.1 Short-term storage

Storage requirements short-term (less than six month).

Store in a covered and dry location.

2.3.2 Long-term storage

If the unit is stored for more than 6 months, these requirements apply:

- 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 the drive unit and coupling manufacturers for their long-term storage procedures.

For questions about possible long-term storage treatment services, please contact your local ITT sales representative.

3 Product Description

3.1 General description

The housing dimensions of the pump model ICM comply with ISO 2858 / DIN EN 22858.

The technical requirements and nominal ratings of the pump models comply with ISO 2858 / DIN EN 22858 / ISO 15783 / DIN ISO 5199.

The sectional drawing shows the pump set-up. See Sectional drawing.

- The metal housing (100) has an axial suction nozzle and radial discharge nozzle. The housing drain screw 103 permits the entire pump including the can interior to be drained.
- The impeller (230) is of closed design. The back vanes serve to offset the axial thrust. The impeller is attached to the magnet assembly shaft by an impeller nut (231) and key (940/1) and rests against the distance washer (551/1).
- The plain bearing pedestal (339) has flushing bores which serve to dissipate the heat on the can and lubricate the plain bearing cartridge (310). Depending on the pump design, connection tapped bores can be provided on the plain bearing pedestal to permit access to the pump interior (e.g. for monitoring devices or external flushing).
- The plain bearing cartridge (310) encapsulates all the individual parts of the bearing system and permits the exchange of the complete unit in one piece. It is attached to the plain bearing pedestal with hex. screws (901/2). The inner magnet assembly (859) is fitted with permanent magnets. These magnets of the inner magnet assembly are protected against the medium by a corrosion-resistant metallic cover. The inner magnet assembly and shaft are one piece.
- The inner magnet assembly accommodates axial vanes to promote the flushing flow.
- The metallic can (159) seals the pump interior against the atmosphere to ensure it is leak-proof.
- The lantern (344) is screwed against the housing with hex. screws (901/1) and washers (544/1). Both the housing gasket (401) and the can gasket (406) are tightly sealed through the direct action of the bolting force.
- The lantern has a safety rubbing surface which protects the can against damage from the drive magnet assembly if the rolling bearings become defective.
- The hex. screws (901/3) prevent the individual parts from falling apart when the entire slide-in unit is being removed from the pump housing. These screws are not provided in some pump sizes. Instead the setscrews (901/1) perform this function.
- The bearing pedestal 330 contains grease-lubricated radial ball bearings 321 which cannot be regreased. They are sealed on both sides. The wavy spring washer 953/1 exerts an axial preload on the radial ball bearings and rests against the rear bearing cover 361. The torque is transmitted to the drive magnet assembly 858 by the key 940/2 and the drive shaft 213. The magnets are glued into the drive magnet assembly which is axially secured by the hex. socket screw 914/1.
- The bearing pedestal 330 contains radial ball bearings 321 and lubrication is provided by an oil bath. The oil bath is sealed against the atmosphere by two rotary shaft seals 421 and a cover gasket 403. They are sealed on both sides. The wavy spring washer 953/1 exerts an axial preload on the radial ball bearings and rests against the rear bearing cover 361. The torque is transmitted to the drive magnet assembly 858 by the key 940/2 and the drive shaft 213.The magnets are glued into the drive magnet assembly which is axially secured by the hex. socket screw 914/1.

  (Pumps with oil lubrication)
- Should the can become defective, the flat gasket (400/1) at least seals the medium against the atmosphere for a short period.
- The flushing/cooling flow is fed into the can chamber through the flushing bores in the plain bearing pedestal. The flushing flow passes through the plain bearings back into the housing. The rotating magnets generate an eddy current in the can which heats the flushing/cooling flow.

Design details are provided in the sectional drawing, 8.1 Parts List and Cross-Sectional Drawings on page 79. Additional information is also contained in the Brochure and Pricebook.

3.2 Technical data

The model ICM/ICMB is a metallic magnetic drive chemical process pump made of Ductile Iron, 316 Stainless Steel, Duplex SS, Alloy 20, Hastelloy and Titanium designed for normal and demanding chemical process applications.

The ICM metallic magnetic drive process pump safely and reliably handles difficult fluids such as corrosives, toxic, and ultra pure liquids. Complies with ISO 2858, 5199, and 15783.

Casing

- Minimum corrosion allowance: 3mm
- Standard 3/8” housing drain connection
- Replaceable housing wear ring (optional)
- Integrated connections for pressure and temperature monitors
- Jacketed housing for media heating or cooling on request

Impeller

- Precision-cast stainless steel, optionally Hastelloy and other material
- Back vanes or balance holes reduce axial thrust
- Optional suction inducer:
  - reduces the NPSHr by 35-50%
  - permits smaller pumps at higher speeds = lower costs
  - is advantageous for media with gas content

Bearing cartridge

- Standard Pure Silicon Carbide SiC (SSiC), highly abrasionresistant, with universal chemical resistance
- Cartridge design eliminates measurements and fitting for simplified maintenance
- Optional Dryguard PLUS dry-running bearing system provide added safety during upset conditions

Inner magnet assembly

- Inner magnet assembly with encapsulated magnets
- Integral axial vanes assure positive pressurized flushing flow to both lubricate and cool the plain bearings

Drive magnet assembly with highperformance permanent magnets

- Coupling ratings of up to 330 Nm (100 kW at 2900 rpm), variable through modular design
- Integral outer thrust ring prevents against contact with the can in the event of a roller bearing failure, Spark-free as an option

Can

- Hastelloy C4 (2.4610) as standard
- Non-welded, deep-drawn one-piece construction
- Rated for an operating pressure of 25 bar (360 psi), burst pressure > 150 bar (2175 psi)

Sturdy frame

- Grease-for-life bearings
- Flood oil lubrication with extra large oil volume, oil sump cooling, labyrinth oil seals

Designation

Model ICM	Magnetic Chemical Process Pump, bearing lubrication: grease.
Model ICMP	Magnetic Chemical Process Pump for high pressure / high temperature applications, with center-line mounted casing, bearing lubrication: grease.

Technical specifications to ISO 15783 and DIN ISO 5199.

Connecting dimensions to ISO 2858 / DIN EN 22858

Flange connecting dimensions :

DIN EN 1092-2, type B

(ISO 7005-2, type B) PN 16

ATEX 100a: Directive 94/9/EC

Machine Directive: 2006/42/EC

Housing materials

Standard ICM/ICMP:	Stainless steel (1.4408)
Optional ICM:	Ductile cast iron/ cast steel, Duplex, Hastelloy C, titanium

Flow rates

up to 340 m^3/h (at 2900 rpm)

Delivery heads

up to 150 mLC (at 2900 rpm)

Housing discharge pressure

ICM	16 bar (max. 25 bar with 65-40-315, 50-32-315 and 80-50-315)
ICMP	25 bar

Temperature range

-40° C to +280° C

NOTICE:
Consult the manufacturer for higher pressures and lower or higher temperatures.

Temperature classes

Refer to Table 1: Temperature class definitions on page 12.

Sizes

Group 1	Group 2.1	Group 2.2
40-25-160*	100-65-160	40-25-250*
50-32-160	125-80-160	50-32-250
65-40-160	100-65-200	65-40-250
80-50-160	125-80-200	80-50-250
40-25-200*	125-100-200	100-65-250
50-32-200		125-80-250
65-40-200		50-32-315*
80-50-200		65-40-315
		80-50-315

* Low-Flow sizes : not included in ISO 2858 / DIN EN 22858 not as model ICMP

3.3 Nameplate information

Pump nameplate

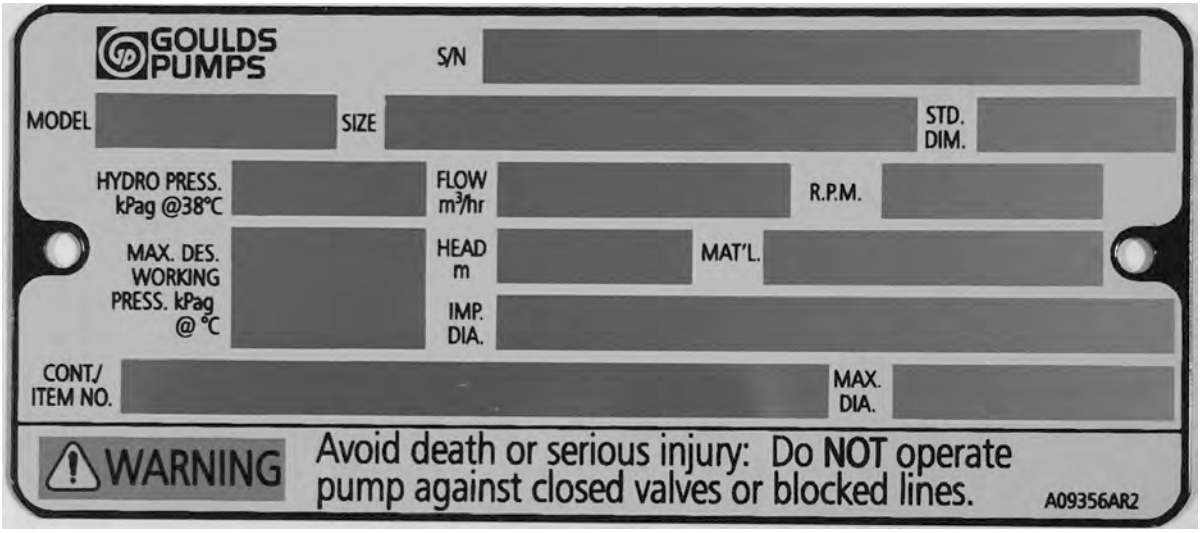


Figure 4: Pump nameplate

Nameplate Field	Explanation
S/N	Serial number of the pump
MODEL	Pump Model
SIZE	Size of Pump
STD DIM	ANSI Std designation – Not applicable ISO Pumps
HYDRO PRESS	Pump Test Pressure in kPag
FLOW	Rated pump flow in cubic metres per hour
RPM	Rated pump speed in revolutions per minute
MAX DESIGN WORKING PRESS	Maximum Design pressure in kPag at rated temperature in degrees Centigrade
HEAD	Rated pump head in metres
MATL	Material of which the pump is constructed
IMP DIA	Impeller diameter fitted
CONT/ITEM NO	Contract or tag number
MAX DIA	Maximum impeller diameter

4 Installation

4.1 Pre-installation

Precautions

WARNING:

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

NOTICE:

- Electrical connections must be made by certified electricians in compliance with all international, national, state and local regulations.
- Supervision by an authorized ITT representative is recommended to ensure proper installation. Improper installation may result in equipment damage or decreased performance.
- Install and operate electrical equipment for a pump unit according to the suppliers' instructions.

4.1.1 Pump location guidelines

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

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 swivel hoist rings, shackles, 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 and safely remove and relocate the components to a safe location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.

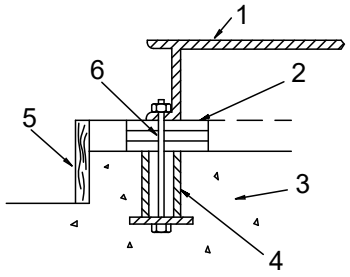
Guideline	Explanation/comment
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: • Pressure relief valves • Compression tanks • Pressure controls • Temperature controls • Flow controls If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.
If the pump location is overhead, undertake special precautions to reduce possible noise transmission.	Consider a consultation with a noise specialist.

4.1.2 Foundation requirements

Requirements

- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three times the weight of the pump.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.
- Sleeve-type and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.
- The concrete foundation must have sufficient firmness according to DIN 1045 or equal standard.

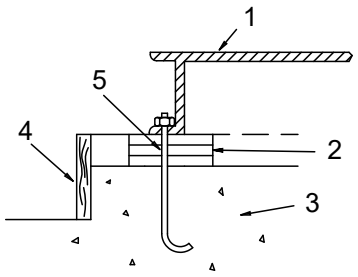
Sleeve-type bolts



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

Figure 5: Sleeve type bolts

J-type bolts



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

Figure 6: J-type bolts

4.2 Baseplate-mounting procedures

4.2.1 Prepare the baseplate for mounting

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

4.2.2 Prepare the foundation for mounting

1. Chip the top of the foundation to a minimum of 25.0 mm | 1.0 in. in order to remove porous or low-strength concrete.
   If you use a pneumatic hammer, make sure that it does not contaminate the surface with oil or other moisture.

   NOTICE:

   Do not chip the foundation using heavy tools such as jackhammers. This can damage the structural integrity of the foundation.

2. Remove water or debris from the foundation bolt holes or sleeves.
3. If the baseplate uses sleeve-type bolts, then fill the sleeves with a non-binding, moldable material. Seal the sleeves in order to prevent the grout from entering.
4. Coat the exposed portion of the anchor bolts with a non-bonding compound such as paste wax in order to prevent the grout from adhering to the anchor bolts.
   Do not use oils or liquid wax.
5. If recommended by the grout manufacturer, coat the foundation surface with a compatible primer.

4.2.3 Install the baseplate using shims or wedges

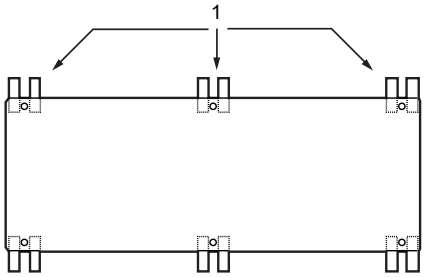
Required tools:

- Two sets of shims or wedges for each foundation bolt

- Two machinist's levels
- Baseplate-leveling worksheet

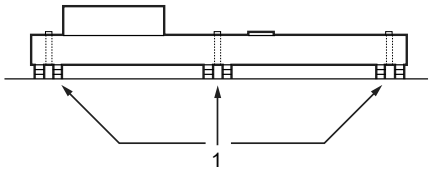
This procedure is applicable to cast iron and fabricated steel baseplates.

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



1. Shims or wedges

Figure 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 ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

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

   These are the leveling tolerances:

   You can use the 4.2.7 Baseplate-leveling worksheet on page 31 when you take the readings.
6. Hand-tighten the nuts for the foundation.

4.2.4 Install the baseplate using jackscrews

Tools required:

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

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

1. Apply an anti-seize compound on the jackscrews.
   The compound makes it easier to remove the screws after you grout.

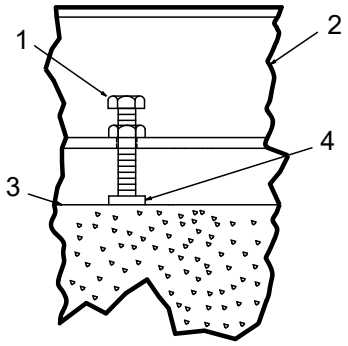
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:

   a) Cut the plates from the bar stock and chamfer the edges of the plates in order to reduce stress concentrations.

   b) Put the plates between the jackscrews and the foundation surface.

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

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



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

Figure 9: Jackscrews

3. Level the driver mounting pads:

NOTICE:

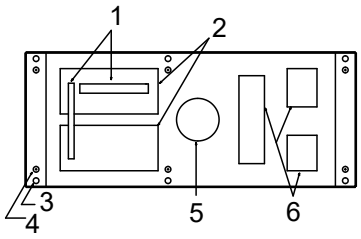
Remove all dirt from the mounting pads in order to ensure that the correct leveling is achieved. Failure to do so can result in equipment damage or decreased performance.

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

   b) Put the other machinist's level across the ends of the two pads.

   c) Level the pads by adjusting the four jackscrews in the corners.
Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.

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



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

Figure 10: Level driver mounting pads

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

NOTICE:

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

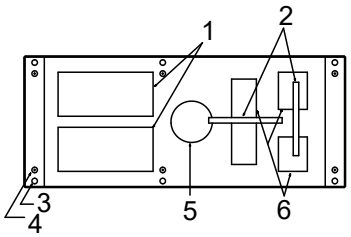
---

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

b) Put the other level across the center of the two pads.

c) Level the pads by adjusting the four jackscrews in the corners.

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



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

Figure 11: Level pump mounting pads

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

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

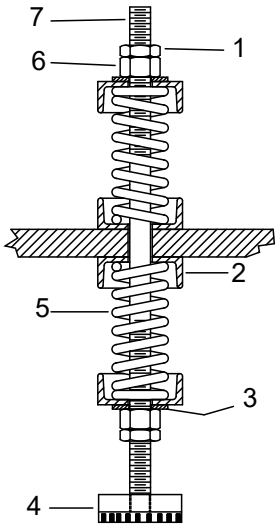
4.2.5 Install the baseplate using spring mounting

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

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

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

1. Put the baseplate on a support above the foundation/floor.
   Make sure that there is enough space between the baseplate and the foundation/floor in order to install the spring assemblies.
2. Install the lower part of the spring assembly:
   a) Screw the lower jam nut onto the spring stud.
   b) Screw the lower adjusting nut onto the spring-stud, on top of the jam nut.
   c) Set the lower adjusting nut to the correct height.
   The correct height depends on the required distance between the foundation/floor and the baseplate.
   d) Put a washer, a follower, a spring, and one more follower onto the lower adjusting nut.
3. Install the spring assembly on the baseplate:
   a) Insert the spring assembly into the baseplate's anchorage hole from below.
   b) Put a follower, a spring, another follower, and a washer onto the spring stud.
   c) Fasten the spring assembly with the upper adjusting nut by hand.
4. Thread the upper jam nut onto the spring stud by hand.
5. Repeat steps 2 through 4 for all the spring assemblies.
6. Lower the baseplate so that the spring assemblies fit into the foundation pads.
7. Level the baseplate and make the final height adjustments:
   a) Loosen the upper jam nuts and adjusting nuts.
   b) Adjust the height and level the baseplate by moving the lower adjusting nuts.
   c) When the baseplate is level, tighten the top adjusting nuts so that the top springs are not loose in their followers.
8. Fasten the lower and upper jam nuts on each spring assembly.



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

Figure 12: Example of an installed spring assembly

4.2.6 Install the baseplate using stilt mounting

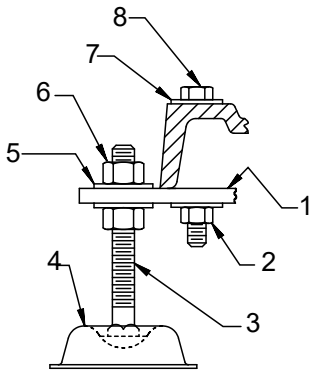
NOTICE:
The stilt-mounted baseplate is not designed to support static piping loads. Ensure that the suction and discharge piping are supported individually. Failure to do so may result in equipment damage.

1. Put the baseplate on a support above the foundation/floor.
   Make sure that there is enough space between the baseplate and the foundation/floor to install the stilts.
2. Install the lower part of the stilt assembly:
   a) Screw the lower jam nut and adjusting nut onto the stilt.
   b) Set the lower adjusting nut to the correct height.
   The correct height depends on the required distance between the foundation/floor and the baseplate.
   c) Put a washer onto the lower adjusting- nut.
3. Install the stilt assembly on the baseplate:
   a) Insert the stilt assembly into the baseplate's anchorage hole from below.
   b) Put a washer onto the stilt.
   c) Fasten the stilt assembly with the upper adjusting nut by hand.
4. Screw the upper jam nut onto the stilt by hand.
5. Repeat steps 2 through 4 for all the stilt assemblies.
6. Lower the baseplate so that the stilts fit into the foundation cups.
7. Level the baseplate and make the final height adjustments:
   a) Loosen the upper jam nuts and adjusting nuts.

b) Adjust the height and level the baseplate by moving the lower adjusting nuts.

c) When the baseplate is level, tighten the top adjusting nuts.

8. Fasten the lower and upper jam nuts on each stilt.

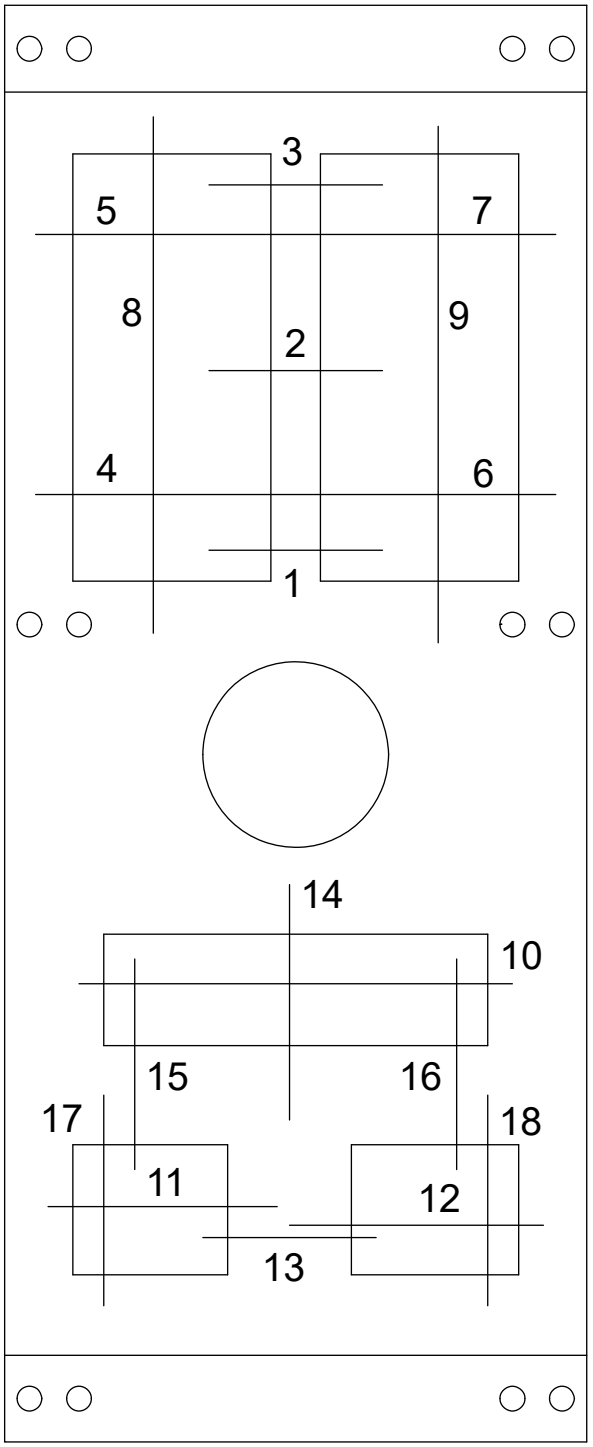


1. Mounting plate
2. Mounting nut
3. Stilt bolt
4. Foundation cups
5. Washer
6. Upper adjustment nut
7. Mounting washer
8. Mounting bolt

Figure 13: Example of an installed stilt assembly

4.2.7 Baseplate-leveling worksheet

Level measurements



1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

9)_____

10)_____

11)_____

12)_____

13)_____

14)_____

15)_____

16)_____

17)_____

18)_____

4.3 Install the pump, driver, and coupling

1. Mount and fasten the pump on the baseplate. Use applicable bolts.

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

4.4 Pump-to-driver alignment

Precautions

WARNING:

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

4.4.1 Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

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

Types of alignment checks

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

Initial alignment (cold alignment) checks

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

Final alignment (hot alignment) checks

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

4.4.2 Permitted indicator values for alignment checks

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

IMPORTANT

- For electric motors, the motor shaft initial (cold) parallel vertical alignment setting should be 0.05 to 0.10 mm | 0.002 to 0.004 in. lower than the pump shaft.
- For other drivers such as turbines and engines, follow the driver manufacturer's recommendations.
- The driver shaft initial (cold) parallel vertical alignment setting should be lower than the pump shaft. Follow the driver manufacturer's recommendations.

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

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

4.4.2.1 Cold settings for parallel vertical alignment

Introduction

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

NOTICE:
For electric motors, the motor shaft setting should be 0.05–0.1 mm | 0.002–0.004 in lower than the pump shaft. For other drivers, follow the driver manufacturer's recommendations.

Recommended settings

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

4.4.3 Alignment measurement guidelines

Guideline	Explanation
Rotate the pump coupling half and the driver coupling half together so that the indicator rods have contact with the same points on the driver coupling half.	This prevents incorrect measurement.
Move or shim only the driver in order to make adjustments.	This prevents strain on the piping installations.

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

4.4.4 Attach the dial indicators for alignment

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

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

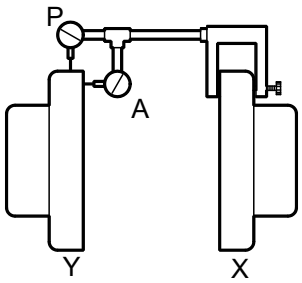


Figure 14: Dial indicator attachment

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

4.4.5 Pump-to-driver alignment instructions

4.4.5.1 Perform angular alignment for a vertical correction

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

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

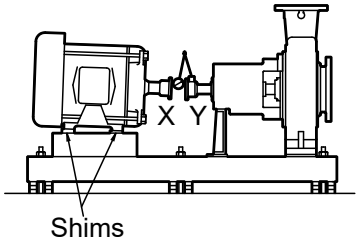


Figure 15: Side view of an incorrect vertical alignment

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

4.4.5.2 Perform angular alignment for a horizontal correction

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

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the left. • Slide the opposite end to the right.
Positive	The coupling halves are closer together on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the right. • Slide the opposite end to the left.

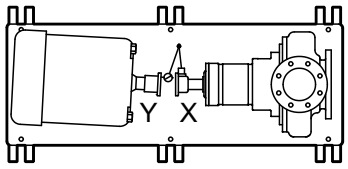


Figure 16: Top view of an incorrect horizontal alignment

4.4.5.3 Perform parallel alignment for a vertical correction

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

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

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

Recommended settings

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

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

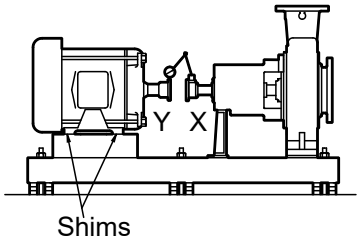


Figure 17: Side view of an incorrect vertical alignment

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

NOTICE:

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

4.4.5.4 Perform parallel alignment for a horizontal correction

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

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

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

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

4. Slide the driver carefully in the appropriate direction.

NOTICE:

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

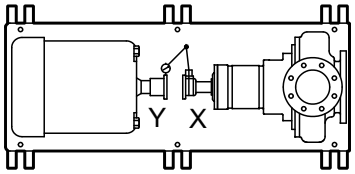


Figure 18: Top view of an incorrect horizontal alignment

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

NOTICE:

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

4.4.5.5 Perform complete alignment for a vertical correction

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

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

4.4.5.6 Perform complete alignment for a horizontal correction

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

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

4.5 Grout the baseplate

Required equipment:

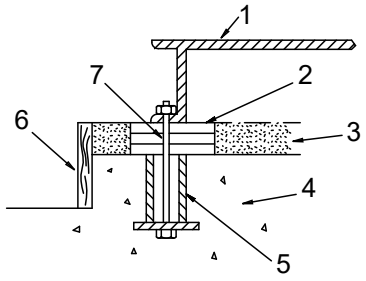
- Cleaners: Do not use an oil-based cleaner because the grout will not bond to it. See the instructions provided by the grout manufacturer.
- Grout: Non-shrink grout is recommended.

NOTICE:

It is assumed that the installer who grouts the baseplate has knowledge of acceptable methods. More detailed procedures are described in various publications, including API Standard 610, latest edition, Appendix L; API RP 686, Chapter 5; and other industry standards.

1. Clean all the areas of the baseplate that will come into contact with the grout.
2. Build a dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.

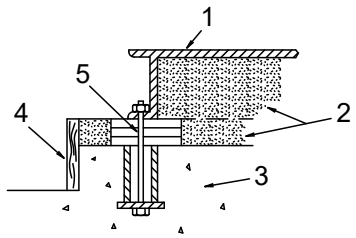
4. Pour grout through the grout hole into the baseplate up to the level of the dam.
   When you pour the grout, remove air bubbles from it by using one of these methods:
   - Puddle with a vibrator.
   - Pump the grout into place.
5. Allow the grout to set.



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

Figure 19: Pour grout into baseplate

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



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

Figure 20: Fill remainder of baseplate with grout

7. Remove the leveling jackscrews after the grout hardens in order to remove any stress points.
8. Tighten the foundation bolts.
9. Make sure that treatment of the concrete is in accordance with DIN 1045.

4.6 Piping checklists

4.6.1 General piping checklist

Precautions

WARNING:

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

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

CAUTION:
Never draw piping into place 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.

Ex Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump. Casing deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.

NOTICE:
Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

Piping guidelines

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

Checklist

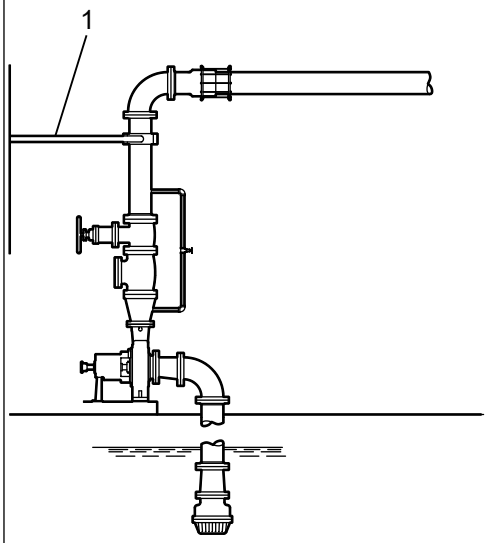
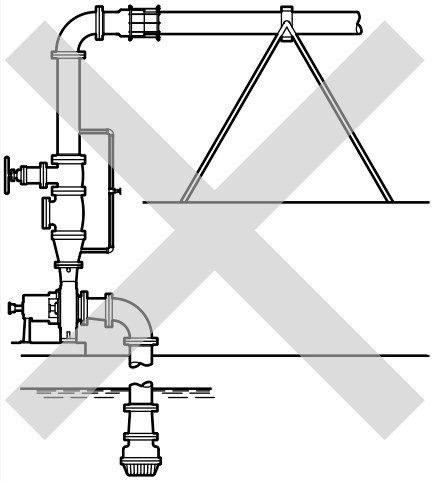
Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange.		

Check	Explanation/comment	Checked
Keep the piping as short as possible.	This helps to minimize friction losses.	
Keep the piping as straight as possible. Avoid unnecessary bends. Use 45° or long radius 90° fittings where necessary.	This helps to minimize friction losses.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Make sure that the inside diameters match properly when you use flange joints.	—	
Do not connect the piping to the pump until: • The grout for the baseplate or sub-base becomes hard. • The grout for the pit cover becomes hard. • The hold-down bolts for the pump and the driver are tightened.	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping.	
Make sure that all piping components, valves and fittings, and pump branches are clean prior to assembly.	—	
Make sure that the isolation and check valves are installed in the discharge line.	Locate the check valve between the isolation valve and the pump. This will permit inspection of the check valve. The isolation valve is required for regulation of flow, and for inspection and maintenance of the pump. The check valve prevents pump or seal damage due to reverse flow through the pump when the driver is turned off.	
Use cushioning devices.	This protects the pump from surges and water hammer if quick-closing valves are installed in the system.	
In no case should loads on the pump flanges exceed the limits stated in API Standard 610, 11th Edition (ISO 13709).	Bottom of casing should be supported by a solid foundation or casing feet should be used.	

Alignment criteria for pump flanges

Type	Criteria
Axial	The flange gasket thickness ±0.8 mm | 0.03 in.
Parallel	Align the flange to be within
Concentric	You can easily install the flange bolts by hand.

Example: Installation for expansion

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

4.6.2 Permitted nozzle loads and torques at the pump nozzles

Designing suction and discharge piping

The suction and discharge piping must be designed so that a minimum of forces affect the pump. Do not exceed the force and torque values as shown in the following table. The values are valid for when the pump is operating or when it is idle.

Permitted nozzle loads and torques at the pump nozzles

These nozzle loads and torques follow the Europump recommendations for this pump according to ISO 5199.

Table notes:

- The data for forces and torques are only valid for static piping loads.
- The values in these tables are valid for pump units with standard IC-base frames (not grouted).
- All values for forces and torques refer to standard materials EN-GJS400-18LT and 1.4408.

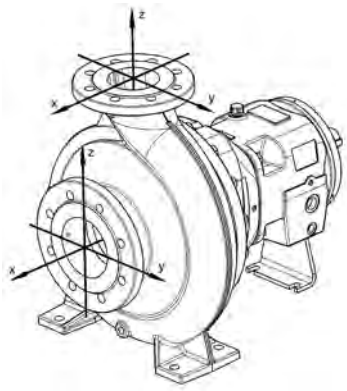


Figure 21: External Forces and Moments on Nozzles

Table 2: Suction nozzle (ICM)

Diameter	Forces in N | lbf				Torques in Nm | ft-lb			
DN	Fx	Fy	Fz	ΣF	Mx	My	Mz	ΣM
40	880 | 198	770 | 173	700 | 157	1,370 | 308	900 | 663	630 | 465	740 | 546	1,330 | 981
50	1,150 | 259	1,050 | 236	950 | 214	1,820 | 409	980 | 723	700 | 516	800 | 590	1,450 | 1,069
65	1,470 | 330	1,300 | 292	1,200 | 270	2,300 | 517	1,050 | 774	770 | 568	840 | 620	1,550 | 1,143
80	1,750 | 393	1,580 | 355	1,440 | 324	2,760 | 620	1,120 | 826	800 | 590	910 | 671	1,650 | 1,217
100	2,350 | 528	2,100 | 472	1,900 | 427	3,670 | 825	1,230 | 907	880 | 649	1,020 | 752	1,820 | 1,342
125	2,765 | 622	2,485 | 559	2,240 | 504	4,350 | 978	1,470 | 1,084	1,050 | 774	1,330 | 981	2,140 | 1,578
150	3,500 | 787	3,150 | 708	2,850 | 641	5,500 | 1,236	1,750 | 1,291	1,230 | 907	1,450 | 1,069	2,560 | 1,888
200	4,700 | 1,057	4,200 | 944	3,780 | 850	7,350 | 1,652	2,280 | 1,682	1,610 | 1,187	1,850 | 1,364	3,350 | 2,471

Table 3: Discharge nozzle (ICM)

Diameter	Forces in N | lbf				Torques in Nm | ft-lb			
DN	Fx	Fy	Fz	ΣF	Mx	My	Mz	ΣM
25	530 | 119	490 | 110	600 | 135	920 | 207	630 | 465	420 | 310	490 | 361	920 | 679
32	630 | 142	600 | 135	740 | 166	1,160 | 261	770 | 568	530 | 391	600 | 443	1,120 | 826
40	770 | 173	700 | 157	880 | 198	1,370 | 308	900 | 664	630 | 465	740 | 546	1,330 | 981
50	1,050 | 236	950 | 214	1,150 | 259	1,820 | 409	980 | 723	700 | 516	800 | 590	1,450 | 1,069
65	1,300 | 292	1,200 | 270	1,470 | 330	2,300 | 517	1,050 | 774	770 | 568	840 | 620	1,550 | 1,143
80	1,580 | 355	1,440 | 324	1,750 | 393	2,760 | 620	1,120 | 826	800 | 590	910 | 671	1,650 | 1,217
100	2,100 | 472	1,900 | 427	2,350 | 528	3,670 | 825	1,230 | 907	880 | 649	1,020 | 752	1,820 | 1,342
125	2,500 | 562	2,240 | 504	2,750 | 618	4,350 | 978	1,470 | 1,084	1,050 | 774	1,330 | 981	2,140 | 1,578
150	3,150 | 708	2,850 | 641	3,500 | 787	5,500 | 1,236	1,750 | 1,291	1,230 | 907	1,450 | 1,069	2,560 | 1,888

Table 4: Suction nozzle (ICMP)

Diameter DN	Force N				Moment N-m			
	Fy	Fz	Fx	ΣF	My	Mz	Mx	ΣM
50	1 500 | 337	1 350 | 303	1 650 | 371	2 600 | 585	1 000 | 738	1 150 | 848	1 400 | 1033	2 050 | 1512
65	1 850 | 416	1 700 | 382	2 100 | 472	3 300 | 742	1 100 | 811	1 200 | 885	1 500 | 1106	2 200 | 1623
80	2 250 | 506	2 050 | 461	2 500 | 562	3 950 | 888	1 150 | 848	1 300 | 959	1 600 | 1180	2 350 | 1733
100	3 000 | 674	2 700 | 607	3 350 | 753	5 250 | 1180	1 250 | 922	1 450 | 1070	1 750 | 1291	2 600 | 1918
125	3 550 | 798	3 200 |	3 950| 888	6 200 | 1394	1 500 | 1106	1 900 | 1401	2 100 | 1549	3 050 | 2250
150	4 500 | 1012	4 050 | 910	5 000 | 1124	7 850 | 1765	1 750 | 1291	2 050 | 1512	2 500 | 1844	3 650 | 2692
200	6 000 | 1349	5 400 | 1214	6 700 | 1506	10 450 | 2349	2 300 | 1696	2 650 | 1955	3 250 | 2397	4 800 | 3540

Table 5: Discharge nozzle (ICMP)

Diameter DN	Force N				Moment N-m			
	Fy	Fz	Fx	ΣF	My	Mz	Mx	ΣM
32	850 | 191	1 050 | 236	900 | 202	1 650 | 371	750 | 553	850 | 627	1 100 | 811	1 600 | 1180
40	1 000 | 225	1 250 | 281	1 100 | 247	1 950 | 438	900 | 664	1 050 | 774	1 300 | 959	1 900 | 1401
50	1 350 | 303	1 650 | 371	1 500 | 337	2 600 | 585	1 000 | 738	1 150 | 848	1 400 | 1033	2 050 | 1512
65	1 700 | 382	2 100 | 472	1 850 | 416	3 300 | 742	1 100 | 811	1 200 | 885	1 500 | 1106	2 200 | 1623
80	2 050 | 461	2 500 | 562	2 250 | 506	3 950 | 888	1 150 | 848	1 300 | 959	1 600 | 1180	2 350 |1733
100	2 700 | 607	3 350 | 753	3 000 | 674	5 250 | 1180	1 250 | 922	1 450 | 1070	1 750 | 1291	2 600 | 1918
125	3 200 | 719	3 950 | 888	3 550 | 798	6 200 | 1394	1 500 | 1106	1 900 | 1401	2 100 | 1549	3 050 | 2250
150	4 050 | 910	5 000 | 1124	4 500 | 1012	7 850 | 1765	1 750 | 1291	2 050 | 1512	2 500 | 1844	3 650 | 2692

4.6.3 Suction-piping checklist

Performance curve reference

CAUTION:
Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

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

Suction-piping checks

Check	Explanation/comment	Checked
Check that the distance between the inlet flange of the pump and the closest elbow is at least five pipe diameters.	This minimizes the risk of cavitation in the suction inlet of the pump due to turbulence. See the Example sections for illustrations.	
Check that elbows in general do not have sharp bends.	See the Example sections for illustrations. —	
Check that the suction piping is one or two sizes larger than the suction inlet of the pump. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: • Sloping side down • Horizontal side at the top	See the example illustrations.	
Suggested suction strainers are used. Check that they are at least three times the area of the suction piping. Monitor the pressure drop across the suction strainer. An increased pressure drop across the strainer of 34.5 kPa | 5 psi indicates that the strainer should be removed and cleaned. After a period of time (24 hours minimum) system flushing should be complete and the suction strainer can be removed.	Suction strainers help to prevent debris from entering the pump. Mesh holes with a minimum diameter of 1.6 mm | 1/16 in. are recommended. Liquids with specific gravity less than 0.60 a pressure drop across the suction strainer may be due to ice buildup. Ice buildup can cause turbulence, low pressure areas and pumpage vaporization.	

Check	Explanation/comment	Checked
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance and prevent vapor locking especially with specific gravity of liquid less than 0.60.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	
Assure adequate insulation is applied for liquids with specific gravity less than 0.60.	To assure sufficient NPSHa.	

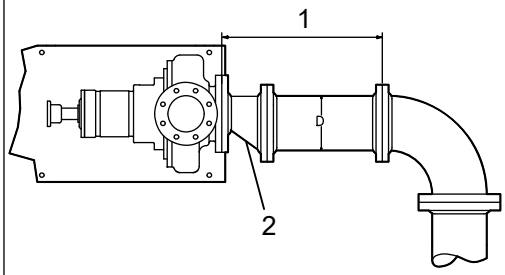
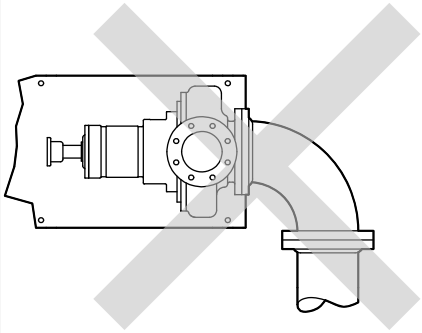
Liquid source below the pump

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

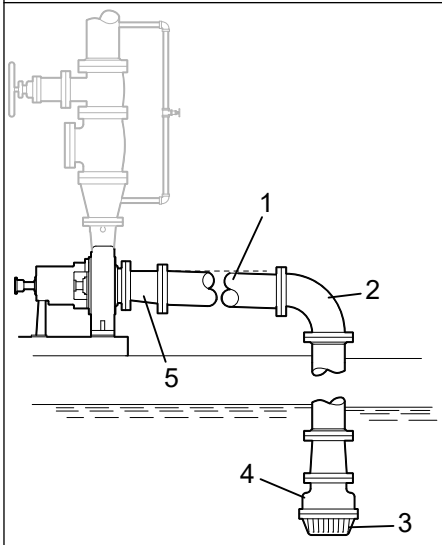
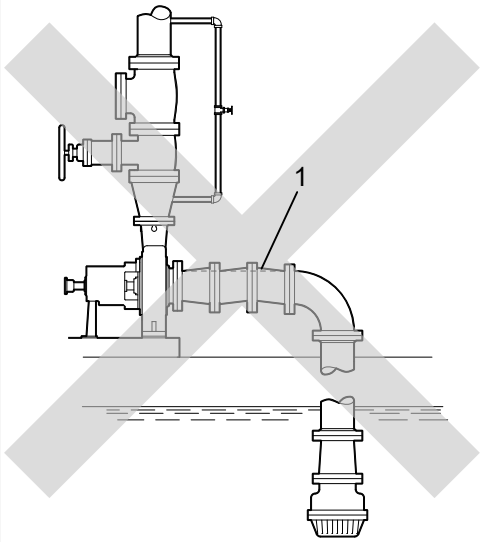
Liquid source above the pump

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

Example: Elbow close to the pump suction inlet

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

Example: Suction piping equipment

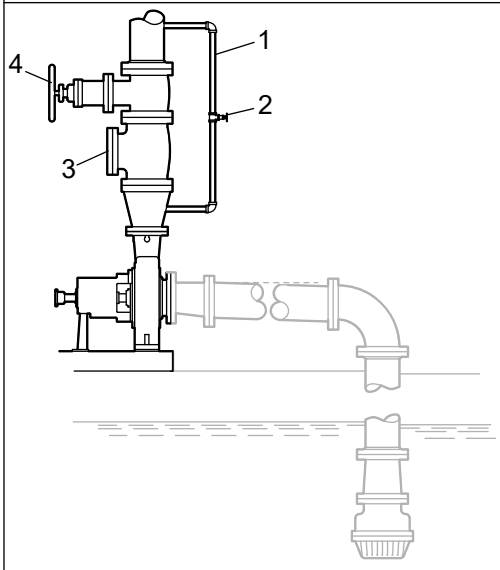
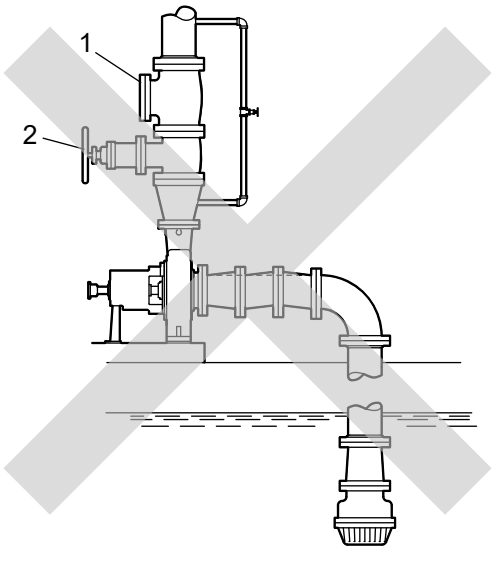
Correct	Incorrect
 1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top	 1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source

4.6.4 Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line. For specific gravity less than 0.60, minimize distance from pump discharge.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump • Reduce risk of pumpage vaporization and vapor locking at low flow rates for low specific gravity liquids. See Example: Discharge piping equipment for illustrations.	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve. The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow. See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

Example: Discharge piping equipment

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

4.6.5 Bypass-piping considerations

When to use a bypass line

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

When to install a minimum-flow orifice

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

When a minimum-flow orifice is unavailable

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

4.6.6 Auxiliary-piping checklist

Precautions

CAUTION:

- Risk of heat generation, seal failure, and possible physical injury. Sealing systems that are not self-purging or self-venting, such as plan 23, require manual venting prior to operation.
- Running a mechanical seal dry, even for a few seconds, can cause seal failure and physical injury. Never operate the pump without liquid supplied to the mechanical seal.

NOTICE:

- Auxiliary cooling and flush systems must be operating properly to prevent excess heat generation, sparks, and/or premature failure. Ensure auxiliary piping is installed as specified on the pump data sheet prior to startup.
- Make sure that the ignition temperature of the cooling liquid is at least 50 K higher than the surface temperature of the bearing frame, if the pump is used in potentially explosive environment.

When to install

Checklist

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

4.6.7 Final piping checklist

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

5 Commissioning, Startup, Operation, and Shutdown

5.1 Preparation for startup

WARNING:

- Risk of serious physical injury or death. Exceeding any of the pump operating limits (e.g. - pressure, temperature, power, etc.) could result in equipment failure, such as explosion, seizure, or breach of containment. Assure that the system operating conditions are within the capabilities of the pump.
- Risk of death or serious injury. Leaking fluid can cause fire and/or burns. Ensure all openings are sealed prior to filling the pump.
- Breach of containment can cause fire, burns, and other serious injury. Failure to follow these precautions before starting the unit may lead to dangerous operating conditions, equipment failure, and breach of containment.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of breach of containment and equipment damage. Ensure the pump operates only between minimum and maximum rated flows. Operation outside of these limits can cause high vibration, mechanical seal and/or shaft failure, and/or loss of prime.
- Risk of death, serious personal injury, and property damage. Heat and pressure build-up can cause explosion, rupture, and discharge of pumpage. Never operate the pump with suction and/or discharge valves closed.
- Running a pump without safety devices exposes operators to risk of serious personal injury or death. Never operate a unit unless appropriate safety devices (guards, etc.) are properly installed.
- Failure to disconnect and lock out driver power may result in serious physical injury or death. Always disconnect and lock out power to the driver before performing any installation or maintenance tasks.
    - Electrical connections must be made by certified electricians in compliance with all international, national, state, and local rules.
    - Refer to driver/coupling/gear manufacturer's installation and operation manuals (IOM) for specific instructions and recommendations.

NOTICE:

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

NOTICE:

You must follow these precautions before you start the pump:

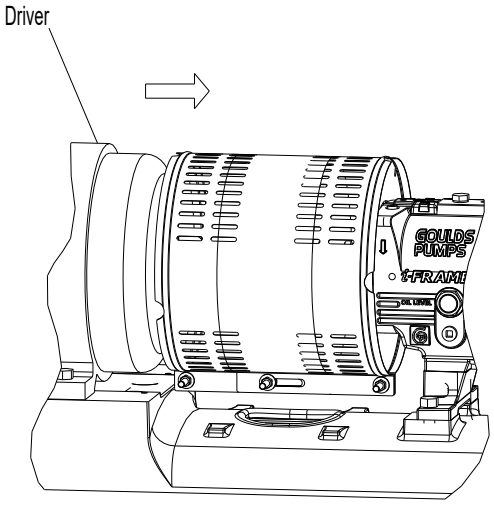
- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- If temperatures of the pumped fluid will exceed 93°C | 200°F, then warm up the pump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

temperature is within 38°C | 100°F of the fluid temperature. Accomplish this by flowing fluid from pump inlet to discharge drain (optionally, the casing vent can be included in warm-up circuit but not required). Soak for (2) hours at process fluid temperature.

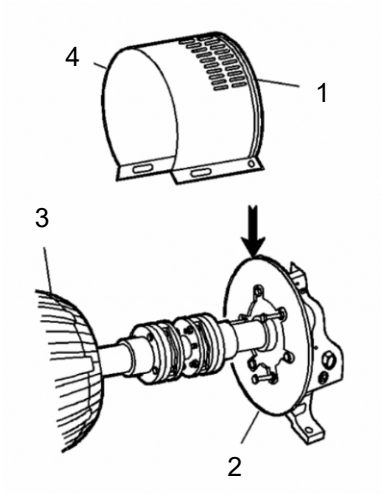
At initial startup, do not adjust the variable-speed drivers or check for speed governor or over-speed trip settings while the variable-speed driver is coupled to the pump. If the settings have not been verified, then uncouple the unit and refer to instructions supplied by the driver manufacturer.

5.2 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 half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.
5. 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.
6. Remove the pump half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.



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

5.3 Check the rotation - Frame Mounted

WARNING:

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

1. Lock out power to the driver.
2. Make sure that the coupling hubs are fastened securely to the shafts.
3. Make sure that the coupling spacer is removed.
   The pump ships with the coupling spacer removed.
4. Unlock power to the driver.
5. Make sure that everyone is clear, and then jog the driver long enough to determine that the direction of rotation corresponds to the arrow on the bearing housing, or close-coupled frame.
6. Lock out power to the driver.

5.4 Couple the pump and driver

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

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

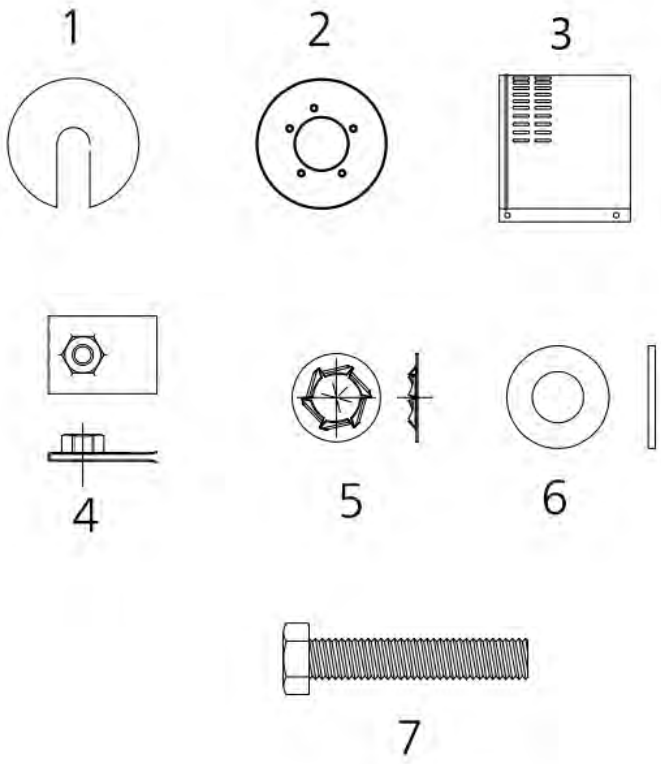
Couplings must have proper certification to be used in an Ex classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling. Refer to driver/coupling/gear manufacturers IOM for specific instructions and recommendations.

5.5 Install the coupling guard

WARNING:

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

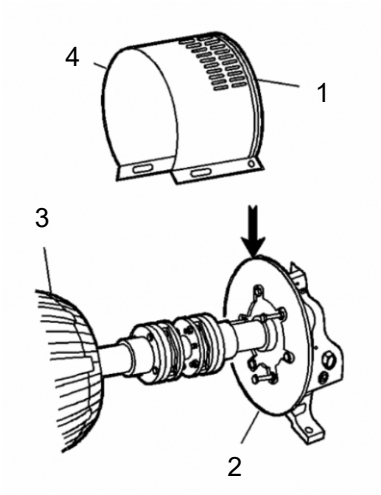
WARNING:
The coupling guard used in an Ex classified environment must be properly certified and constructed from a spark resistant material.



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

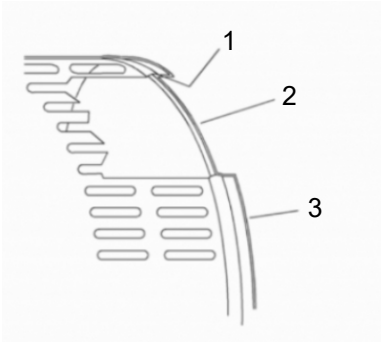
Figure 22: Required parts

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



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

Figure 23: Align pump end guard half with annular groove



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

Figure 24: Annular groove in coupling guard

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

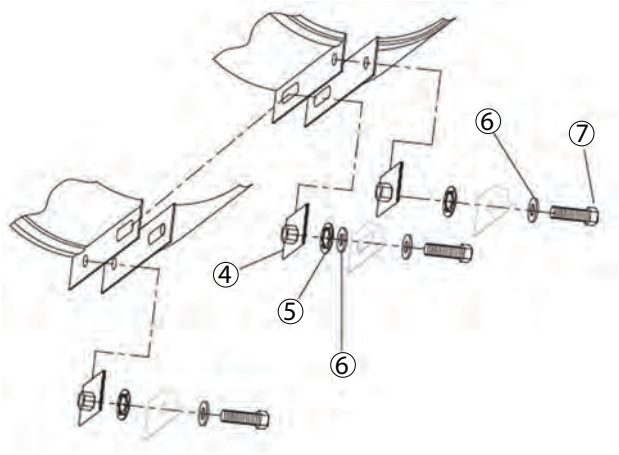


Figure 25: Captured hardware component assembly

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

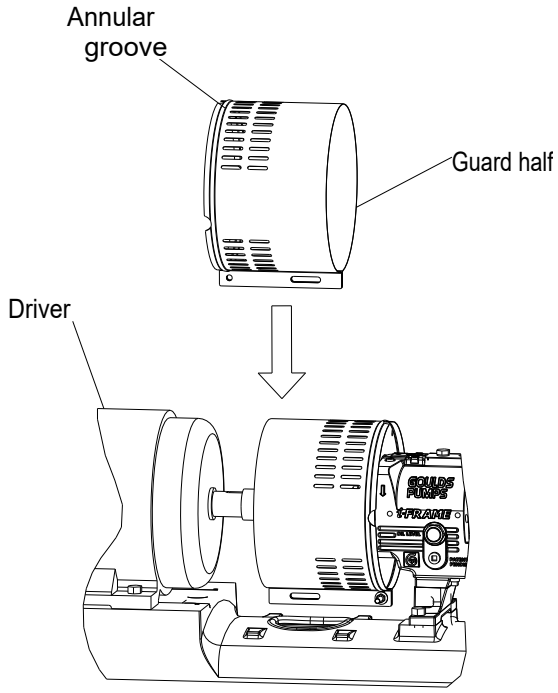


Figure 26: Placement of driver half of coupling guard

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

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

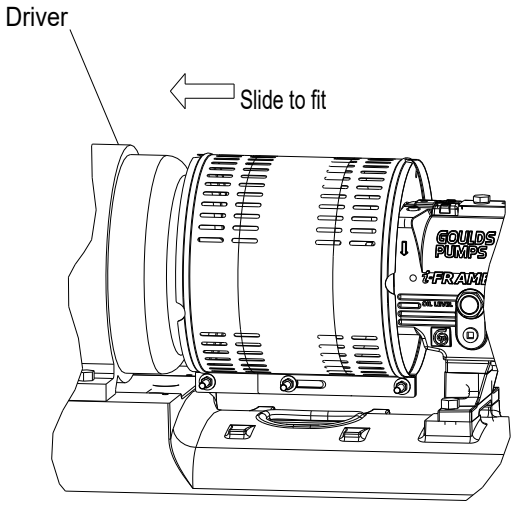


Figure 27: Slide driver-half of coupling guard towards motor

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

5.6 Bearing lubrication (Grease lubricated pumps)

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.

5.6.1 Lubricating oil requirements (Oil lubricated pumps)

Oil quality requirements

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

Lubricating oil type	• CLP46 • DIN 51517 • HD 20W/20 SAE
Kinematic viscosity at 40°C | 104°F	46 ±4 mm^2/sec | 0.0713 ±0.006 $in.^2$/sec
Flash point (Cleveland)	175°C | 347°F
Setting point (Pourpoint)	-15°C | 5°F
Application temperature (Contact your ITT representative to determine a suitable type of lubrication if ambient temperatures are below -10°C | 14°F.	Higher than permitted bearing temperature

Oil quantity requirements

Bearing frame size	Oil quantity in liters | quarts
24	0.5 | 0.53
32	1.1 | 1.16
42	1.5 | 1.58
48	2.1 | 2.21

5.6.2 Lubricate the bearings with oil (Oil lubricated pumps)

WARNING:

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

NOTICE:
The pump is not filled with oil when delivered. Fill with oil before operating the pump.

- Determine which procedure to use in order to fill the bearing frame with oil:

If...	Then...
The pump has an oil level sight glass (standard design)	Use the "Fill the bearing frame with oil" procedure.
The pump has a constant level oiler (optional)	Use the "Fill the bearing frame with an optional oiler" procedure.

5.6.2.1 Fill the bearing frame with oil

NOTICE:
Maintain an exact oil level. If the oil level is too high, the bearing temperature can increase. If the oil level is too low, the bearing will not be properly lubricated and could cause operational problems.

1. Remove the oil filling plug.
2. Pour oil into the opening.
3. Fill until the oil level rises to the center of the oil level sight glass.

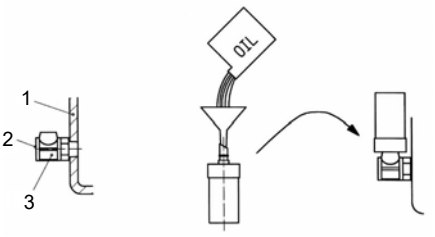
Figure 28: Oil level sight glass

5.6.2.2 Fill the bearing frame with an optional oiler

NOTICE:
Maintain an exact oil level. If the oil level is too high, the bearing temperature can increase. If the oil level is too low, the bearing will not be properly lubricated and could cause operational problems.

The constant level oiler is supplied loose.

1. Unscrew the reservoir from the main body (right-threaded) and set aside.
2. Seal the main body to the bearing frame at the connection for the constant level oiler, using PTFE sealing tape.
3. Tighten until the threaded boss is in a vertical position.
4. Remove the oil filling plug near the upper side of the bearing frame.
5. Fill with oil by pouring into the connection opening until the oil level almost reaches the middle of the oil level sight glass in the main body.
6. Fill the reservoir using a funnel.



1. Bearing frame
2. Oil level sight glass
3. Main body

Figure 29: Filling bearing frame oiler

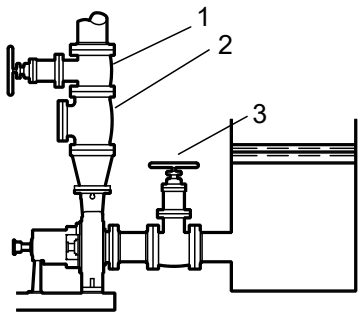
7. Place the O-ring on the reservoir spout.
8. Place your thumb over the reservoir spout.
9. Invert the spout and insert it into the internal threaded boss on the main body.
10. Tighten the reservoir.
    The oil then flows from the reservoir into the bearing chamber.
11. Repeat steps 6 through 10 until the reservoir remains two-thirds full.

Refill with oil whenever the oil level in the reservoir drops below one-third full.

5.7 Pump priming

5.7.1 Prime the pump with the suction supply above the pump

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



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

Figure 30: Suction supply above pump

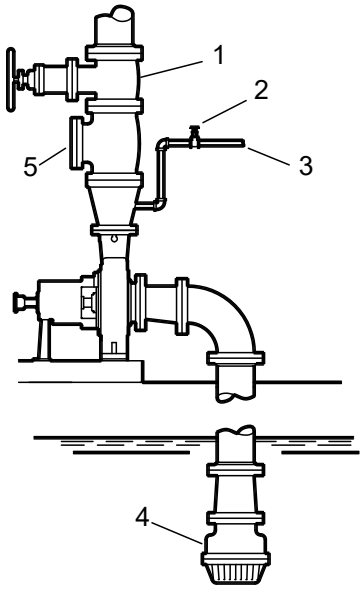
5.7.2 Prime the pump with the suction supply below the pump

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

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

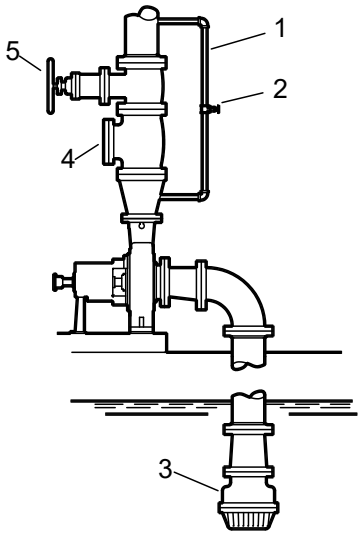
1. Close the discharge isolation valve.
2. Open the air vent valves in the casing.

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.



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

Figure 31: Pump priming with suction supply below pump with foot valve and an outside supply



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

Figure 32: Pump priming with suction supply below pump with foot valve using bypass around check valve

5.7.3 Other methods of priming the pump

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

- Prime by ejector
- Prime by automatic priming pump

5.8 Start the pump

WARNING:

- Risk of equipment damage, seal failure and breach of containment. Ensure all flush and cooling systems are operating correctly prior to starting pump.
- Make sure that the ignition temperature of the cooling liquid is at least 50 K higher than the surface temperature of the bearing frame, if the pump is used in potentially explosive environment.

NOTICE:

- Risk of equipment damage due to dry operation. Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver immediately, reprime, and attempt to restart the pump.
- On frame mounted units, ensure that the oil level is correct prior to starting pump. Close coupled pumps do not have oil lubricated bearings.
- Continuous operation against a closed discharge valve will cause the pump to overheat. Overheating the magnetic drive assembly will weaken or ruin the magnets.

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

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

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

1. Fully close or partially open the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.
5. If the pump fails to reach the correct pressure, perform these steps:
   a) Stop the driver.
   b) Prime the pump again.
   c) Restart the driver.
6. Monitor the pump while it is operating:
   a) Check the pump for bearing temperature, excessive vibration, and noise.
   b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

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

CAUTION:

When the motor is running but the pump is not conveying, this means that the magnetic drive has stopped. Then proceed as follows:

a) Close disharge valve down to the position *minimum flow rate*.
b) Start motor again.

5.9 Inadmissible modes of operations and their consequences (examples)

CAUTION:
Inadmissible modes of operation, even for a short time, can result in serious damage to the unit.

In connection with explosion protection, potential sources of ignition (overheating, electrostatic and induced charges, mechanical and electric sparks) may result from these inadmissible modes of operation; their occurrence can only be prevented by adhering to the intended use.

Pump is started up without medium:

- The plain bearings in the pump may be destroyed.
- Other pump components may be destroyed due to overheating.

Suction line not opened or not opened fully:

- Pump suffers cavitation – material damage.
- Pump does not achieve the necessary head or flow rate.
- Pump may be destroyed due to overheating.

Discharge valve closed too much:

- Pump may be destroyed due to overheating.
- Axial thrust too great.

Discharge valve opened too much:

- Pump can cavitate. Particularly severe with an empty discharge line.
- Risk of pressure surge.
- Possible damage to the plain bearings.
- Magnetic drive may stop.
- Motor may be overloaded.

Suction valve and discharge valve closed:

Destruction due to rapid overheating and sharp rise in pressure.

Control of the pump with the suction valve:

Cavitation – the flow is only to be regulated on the discharge side.

Operation with magnetic drive stopped:

If no heat is dissipated, damage to the inner and drive magnet assemblies may occur.

5.10 Pump operation precautions

General considerations

WARNING:

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

NOTICE:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

- Risk of equipment damage from unexpected heat generation. Do not overload the driver. Ensure that the pump operating conditions are suitable for the driver. The driver can overload in these circumstances:
  - The specific gravity or viscosity of the fluid is greater than expected
  - The pumped fluid exceeds the rated flow rate.

Operation at reduced capacity

WARNING:

- Risk of breach of containment and equipment damage. Excessive vibration levels can cause damage to bearings, stuffing box, seal chamber, and/or mechanical seal. Observe pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down and resolve.
- Risk of explosion and serious physical injury. Do not operate pump with blocked system piping or with suction or discharge valves closed. This can result in rapid heating and vaporization of pumpage.
- Risk of equipment damage and serious physical injury. Heat build-up can cause rotating parts to score or seize. Observe pump for excessive heat build-up. If normal levels are exceeded, shut down and resolve.

NOTICE:

- Cavitation can cause damage to the internal surfaces of the pump. Ensure net positive suction head available ($NPSH_A$) always exceeds NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.
- Do not run pump below minimum pressure at the suction side. Provide monitoring device with automatic switch-off function in case of low pressure.

Operation under freezing conditions

NOTICE:

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

Temperature ratings

CAUTION:

Do not operate the pump above the rated temperature range of the magnets. This will weaken or ruin the magnets.

Magnetic types	Rated temperature
Neodymium iron (NdFe)	180°C | 356°F
Samarium Cobalt (SmCo)	280°C | 536°F

5.11 Shut down the pump

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

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

5.12 Make the final alignment of the pump and driver

WARNING:

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

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

1. Run the unit under actual operating conditions for enough time to bring the pump, driver, and associated system to operating temperature.
2. Shut down the pump and the driver.
3. Remove the coupling guard.
   See Remove the coupling guard in the Maintenance chapter.
4. Check the alignment while the unit is still hot.
   Refer to 4.4 Pump-to-driver alignment on page 32 in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

6 Maintenance

6.1 Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

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

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

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

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

- Lubricate the bearings.
- Inspect the seal.
- Perform a vibration analysis.
- Monitor the discharge pressure.
- Monitor the temperature.

Routine inspections

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

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

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.*
- Inspect the temperature.*

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Change the oil every three months (2000 operating hours) at minimum.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

- Check the pump capacity.

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

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

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

6.2 Bearing maintenance

Lubrication schedule

NOTICE:
Change the bearings after 90% of the nominal bearing life time, if the pump is used in potentially explosive environment.

Type of bearing	First lubrication	Lubrication intervals
Oil lubricated	Change the oil after 200 hours for new bearings.	After the first 200 hours, change the oil every 4000 operating hours or every six months.

6.2.1 Changing the radial ball bearings

When changing the radial ball bearings, you merely need to remove the bearing pedestal from the plant.

For removal and dismantling of the bearing pedestal, see 6.3.7 Remove bearing pedestal on page 66 and Dismantling bearing pedestal.

6.3 Disassembly

6.3.1 Disassembly precautions

WARNING:

- Chemical hazard. You must individually decontaminate each component according to all federal, state, local, and company environmental regulations.
- A build up of gases within the pump, sealing system, or process-piping system can result in an explosive environment within the pump. Make sure that the process piping system, pump, and sealing system are properly vented prior to operation.
- Burn Hazard. Coupling may be hot. Use proper protection when handling.
- Burn Hazard. use proper protection when handling bearings.
- Avoid injury. Worn pump components can have sharp edges. Wear appropriate gloves while handling these parts.
- Risk of serious personal injury from exposure to hazardous or toxic liquids. A small amount of liquid will be present in certain areas like the seal chamber upon disassembly.
- Process fluid leaks can result in an explosive atmosphere. Follow all pump and seal assembly procedures.
- Risk of serious personal injury. Applying heat to impellers, propellers, or their retaining devices can cause trapped liquid to rapidly expand and result in a violent explosion. This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Never apply heat to aid in their removal unless explicitly stated in this manual.

- Risk of serious physical injury or death from rapid depressurization. Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, opening vent or drain valves, or disconnecting piping.
- Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.
- Precautions must be taken to prevent physical injury. The pump may handle hazardous and/or toxic fluids. Proper personal protective equipment should be worn. Pumpage must be handled and disposed of in conformance with applicable environmental regulations.

CAUTION:

- You must keep the shop area clean and free of any substances that can contaminate the magnets, such as ferrous metals.
- The magnets in this unit are extremely powerful. Beware of serious injury to fingers and hands. Keep magnetic drive components and magnetic tools apart by a minimum of 1 m | 3 ft.

NOTICE:
Use a bench with a non-magnetic work surface such as wood or brass when you work on the pump.

6.3.2 Magnetic fields

WARNING:
People with an artificial pacemaker Keep torso at a minimum distance of 500 mm.

CAUTION:

- Strong magnetic fields.
- Risk during dismantling and in the vicinity of magnetic drives as single parts.
- Remove loose parts and other magnetisable metals from the work bench. They could otherwise be attracted: Risk of accident.
- Place any tools needed at a safe distance.
- Keep electronic equipment and measuring instruments at a distance. In cases of doubt ask the equipment manufacturer.
- Hold magnetic drives as single parts firmly or secure. Otherwise, they could be attracted, for example, by a vice: Risk of accident.
- Mechanical watches and electric data carriers as well as digital watches or pocket calculators: 150 mm distance.
- Data carriers such as credit cards, cheque cards, ID cards with magnetic strips or magnetic tapes: 150 mm distance.

6.3.3 Protective clothes

CAUTION:
Even if the pump has been properly evacuated and rinsed, residue of the medium may still remain in the pump.
Example: Between sealing surfaces or in the bearing seats.

Protective clothing in accordance with the regulations is to be worn.

Protective clothing is also to be worn even if only the bearing pedestal is to be removed. It may be that medium has penetrated into the lantern chamber through the can.

6.3.4 Required tools

WARNING:
This pump contains extremely strong magnets. You must use non-magnetic tools and work surfaces.

Tools

- Assorted metric open-end or socket sizes 13 mm, 17 mm, 18 mm, 19 mm, and 24 mm
- Hex wrenches, sizes 2.5 mm, 3 mm, 5 mm, and 6 mm with a 12.07 cm | 4.75 in. minimum reach
- Hex wrench, size 8 mm with 15 cm | 6 in. minimum reach
- Torque wrench
- Strap wrench
- 3/8 in. eyebolt

6.3.5 Drain the pump

CAUTION:

- Risk of physical injury. Allow all system and pump components to cool before handling.
- If the pumped fluid is non-conductive, drain and flush the pump with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.

6.3.6 Dismantling

There are three possibilities for dismantling:

1. Dismantling the entire pump from the plant.
2. Dismantling the entire slide-in unit, i.e. the housing remains in the plant.
3. Removing only the drive section, i.e. the pump does not need to be drained (back-pull-out design). Refer to Coupling.

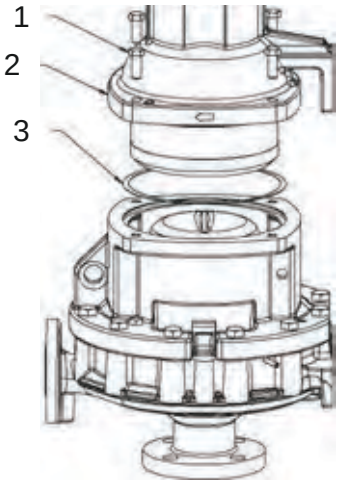
Dismantling of the entire pump is described.

- Secure pump on a workbench or worktop with the suction nozzle facing downwards.
- Screw ring bolt M8 into the drive shaft.

6.3.7 Remove bearing pedestal

CAUTION:
Magnetic forces.
Axial forces are produced when the bearing pedestal is pulled out of the lantern. These forces diminish again abruptly after it has been removed.

The operating torque of the magnetic coupling installed is specified on the type plate.



1. Hex screw (901)
2. Bearing pedestal (330)
3. Flat gasket (400)

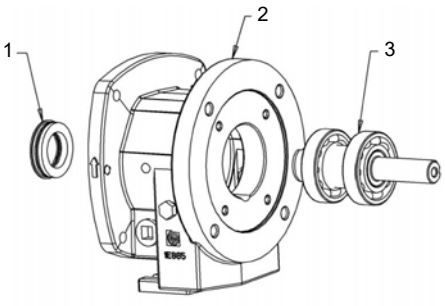
1. Undo bearing pedestal (330) screwing 901/4, 554/2.
2. Detach the bearing pedestal from the lantern (344) centering, if necessary using 2 levers.
   If required you have the possibility to use the two threaded holes in the beating frame for jacking screws.

Group 1	M12
Group 2	M14

3. Raise the bearing pedestal unit off the lantern with a crane or pull it by hand out of the lantern.
4. Remove flat gasket 400.

6.3.8 Dismantling bearing pedestal

1. Undo hex. socket screw (914/1) in counterclockwise direction.
2. Pull off drive magnet assembly (858).
3. Undo screws 914/2 and rear bearing cover 361.
4. Remove cover gasket 403.
5. Remove wavy spring washer 953/1 and pull out drive shaft 213 with both ball bearings 321.



1. Rotary shaft seal (421) (oil lubrication only)
2. Bearing pedestal (330)
3. Drive with shaft bearings

6. Both radial ball bearings lie against the shaft collar so remove singly on a press.
7. Undo srews 901/5 and remove support bracket 183.

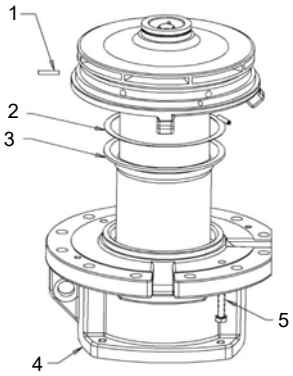
6.3.9 Remove the lantern, can and plain bearing pedestal

1. Undo housing screwing (901/1), (554/1).

NOTICE:
Do not undo the two screws (901/3) (if installed). They hold the lantern (344), can (159) and plain bearing pedestal (339) together.

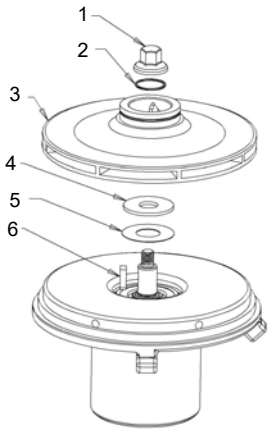
2. Pull the entire slide-in unit out of the housing (100).
3. If the housing does not move (e.g. owing to corrosion at the centering), remove the two plastic plugs from the lantern (344).
4. Screw in jacking screws M8 and use them to press off the lantern.

6.3.10 Dismantle the lantern, can and plain bearing pedestal



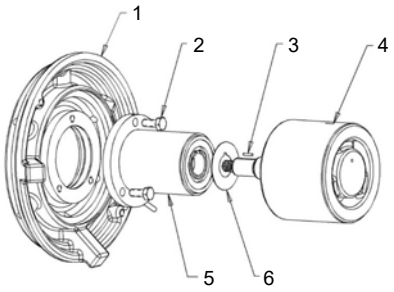
1. Setscrew (904)
2. Can gasket (406)
3. Can (159)
4. Lantern (344)
5. Hex screw (901)

1. Place the unit lantern (344) / plain bearing pedestal (339) / impeller (230) on the workbench with the impeller facing upwards.
2. Remove the two hex. screws (901/3) or the 3 setscrews (904/1) (depending on size).
3. Remove lantern (344) and can (159).
4. Place remaining unit on the inner magnet assembly.
5. Place strap wrench around the impeller and undo the impeller nut (231) counterclockwise.
6. Pull off impeller (230).
7. Remove key (940/1), distance washer (551/1) and intermediate ring (509/2).



1. Impeller nut (231)
2. Impeller nut O-ring (412) (optional)
3. Impeller (230)
4. Distance washer (551)
5. Intermediate ring (509)
6. Impeller key (940)

8. Pull the plain bearing cartridge (310) with plain bearing pedestal (339) out of the inner magnet assembly 859.



1. Plain bearing pedestal (339)
2. Hex screw (901/2)
3. Key (940)
4. Inner magnet assembly (859)
5. Plain bearing cartridge (310)
6. Intermediate ring (509)

9. Remove 2nd intermediate ring (509/1) from the inner magnet assembly (859).
10. If the inner magnet assembly or inner magnet assembly shaft has to be replaced (split inner magnet assembly): Push the inner magnet assembly shaft (220) and key (940/3) out of the inner magnet assembly (859). Make sure that the thread for the impeller nut is not damaged.
11. Undo screws (901/2) and remove plain bearing cartridge (310) from the plain bearing pedestal (339).

6.3.11 Dismantling the plain bearing

The plain bearing cartridge (310) is one unit which - if necessary - is replaced completely.

6.4 Pre-assembly inspections

Guidelines

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

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

NOTICE:

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

6.4.1 Replacement guidelines

Casing check and replacement

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

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

Casing areas to inspect

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

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

Gaskets, O-rings, and seats replacement

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

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

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

Containment shell

- Make sure that the wall thickness of the containment shell (159) is a minimum of 0.991 mm | 0.039 in.
- Make sure that the containment shell is free from pitting or cracks.
- Replace the containment shell if there are any grooves in excess of 0.127 mm | 0.005 in.

6.4.2 Magnet inspections

WARNING:
The magnets contained in this unit are extremely powerful. Keep magnetic drive components and magnetic tools apart from each other by a minimum of 2 m | 6 ft. Serious injury to fingers and hands will result if you do not follow this precaution.

Driven magnet assembly inspections

Perform these checks on the driven magnet assembly (859):

- Check that the assembly is free from bulges.
- Check that the assembly is free from pits and scratches that exceed 0.127 mm | 0.005 in. deep.
- Check that the assembly is free from erosion or corrosion that exceeds 0.127 mm | 0.005 in. deep.
- Check the pump-out vanes for cracks and corrosion.
- Check that the circulation holes are open.

Drive magnet assembly

The magnets are extremely brittle. It is normal to have chips that amount to 10% of the magnet surface per MMPA Standard No. 0100-90.

Perform these checks on the drive magnet assembly (858):

- Check that the magnets are free of major cracks and extent over 50% of the surface and are free of imperfections that create loose particles.
- Replace the magnets if the magnets and drive magnet carrier were exposed to any pumped fluid.
- Check the drive magnet carrier for cracks and replace if any cracks are found.
- Check the drive magnet carrier hub OD is free from grooves and scratches that are greater than 0.127 mm | 0.005 in.
- Check the magnets for proper bonding to the metal carrier.

6.4.3 Bearing-frame inspection

Checklist

Check the bearing frame (330) for these conditions:

- Visually inspect the bearing frame 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.
- Inspect the inboard bearing bores. If any bores are outside the measurements in the Bearing fits and tolerances table, replace the bearing frame.

  The maximum acceptable bore is 7.203 cm | 2.836 in. for S-group pumps and 9.002 cm | 3.544 in. for M-group pumps.
- Inspect the labyrinth seal O-rings for cuts and cracks.
- Inspect the ball bearings for containment and damage.
- Make sure the gasket surfaces are clean.
- Visually inspect the bearing end cover for cracks and pits.

6.4.4 Bearings inspection

Condition of bearings

Do not reuse bearings. The condition of the bearings provides useful information on operating conditions in the bearing frame.

Checklist

Perform these checks when you inspect the bearings:

- Inspect the ball bearings for contamination and damage.
- Note any lubricant condition and residue.
- Inspect the ball bearings to see if they are loose, rough, or noisy when you rotate them.
- Inspect the silicon carbide bearings for cracks, chips, or excessive wear. If any of these conditions exist, replace the bearing cartridge.
- Investigate any bearing damage to determine the cause. If the cause is not normal wear, correct the issue before you return the pump to service.

6.5 Reassembly

A complete assembly operation is described in the following.

Sub-sections can be deduced from this.

- Good mechanical engineering practice is to be observed for assembly work.
- Use original spare parts. See also Conversion work and production of spare parts by the customer. Do not use defective parts.
- Treat close-tolerance areas (not stainless steel components) with a corrosion inhibitor. Grease screw threads prior to assembly. (ICM)
-
- Check whether all parts fit and only then perform assembly.
- Important dimensions are to be checked before assembly, e.g. by fitting parts together as a test.
- These important dimensions are centerings, bearing seats or bearing clearances.
- During assembly, gaskets (400), (401) and (406) are to be replaced, intermediate rings (509) must be replaced.
- Prior to assembly, remove any metallic particles adhering to parts fitted with magnets.

6.5.1 Assemble bearing pedestal

1. Press both radial ball bearings 321 onto the drive shaft 213.
2. Insert key 940/2 into the drive shaft.
3. Install the pre-assembled drive shaft into the bearing pedestal from the motor side.
4. Insert wavy spring washer 953/1 into the bearing pedestal.
5. Mount rear bearing cover 361 with the hex. socket screw 914/2.
6. Mount support bracket 183 with hex. screws 901/5 and toothed lock washers 554/3.
   The attachment slots of the support surface face towards the housing.

6.5.2 Assemble the drive magnet

1. Clamp the pre-assembled bearing pedestal on the shaft end in the vice so that the carrier groove ,is facing upwards.
2. Mount drive magnet assembly 858 onto the drive shaft so that the driver cams engage.
3. Screw in hex. socket screw 914/1 with tooth lock washer 936/1. Secure thread, with a drop e.g of Loctite 234.
   A hex. socket screw key with a minimum length of 120 mm is required for tightening.

6.5.3 Assemble the plain bearing pedestal with impeller, inner magnet assembly and plain bearings

1. Insert the plain bearing cartridge (310) into the centering of the plain bearing pedestal (339).
2. Move the plain bearing cartridge into a position which permits all 3 hex. screws (901/2) to be inserted.
3. Tighten screws with an open-jaw wrench. For tightening torques, see Intended use.
4. Insert key (940/3) into keyway on driven shaft.

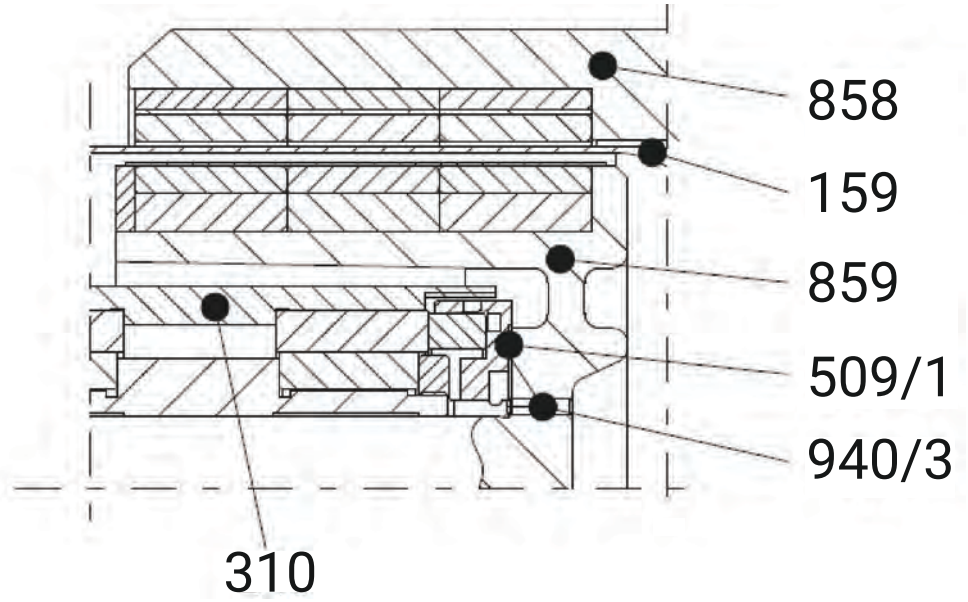


Figure 33: Single-part inner magnet assembly

5. If necessary, cut out a small corner on the inside diameter of the intermediate ring (509/1) so that a recess is produced.
6. Then mount the intermediate ring (509/1) onto the shaft of the inner magnet assembly (859).
7. Apply Anti Seize assembly paste to the shaft and impeller holder.
8. Place inner magnet assembly on the workbench and mount the pre-assembled unit plain bearing pedestal / plain bearing cartridge from above onto the inner magnet assembly. Make sure that the parallel pin (562/1) engages in the carrier groove of the plain bearing cartridge. To facilitate alignment, the plain bearing pedestal can be turned to and fro slightly.
9. Mount 2nd intermediate ring (509/2) onto the drive shaft.
10. Mount distance washer (551/1).
11. Insert key (940/1).
12. Mount impeller (230).
13. Insert PTFE O-ring (912/1) into the groove of the impeller nut (231).
14. Tighten impeller nut. Secure it with a drop of e. g. Loctite (234). Counter check the inner magnet assembly with a strap wrench. For tightening torques, see Tightening torques.
15. It must be possible to easily turn the plain bearing pedestal (339) by hand. When raising the plain bearing pedestal, a slight axial play of the plain bearing of up to 1 mm must be felt.
16. The axial play of the plain bearing is automatically set during assembly.

6.5.4 Assemble the can and lantern

1. Place the can gasket (406) in the centering on the plain bearing pedestal (339).
2. Mount can (159) and lantern (344).
3. Screw the two connection screws (901/3) or the 3 setscrews (904/1) (depending on size) of the lantern (344) into the plain bearing pedestal (339) and tighten.

6.5.5 Final assembly

1. Secure the housing (100) with the suction nozzle facing downwards on a workbench or worktop.
2. Insert the housing gasket (401) into the housing centering.

3. Insert the unit pre-assembled as described in 6.5.3 Assemble the plain bearing pedestal with impeller, inner magnet assembly and plain bearings on page 73 and 6.5.4 Assemble the can and lantern on page 73 into the housing so that the crane hook of the lantern faces the centre of the discharge nozzle.
4. Screw in the housing screw (901/1) with washer (554/1) and tighten.
5. Insert flat gasket (400/1) into the centering of the lantern (344).
6. Place the bearing pedestal/drive magnet assembly unit pre-assembled in 6.5.1 Assemble bearing pedestal on page 72 and 6.5.2 Assemble the drive magnet on page 72.
7. Screw a commercially available ring bolt M8 into the end of the drive shaft.
8.  Place the bearing pedestal unit on the lantern 344 using a crane.
9. Screw in hex. screws (901/4) with washers (554/2) and tighten.
10. Insert plastic plugs into the tapped bores for the jacking screws on the lantern (344).
11. Turn the inner magnet assembly shaft by hand to check its function. Check by looking into the suction nozzle whether the impeller turns.

6.5.6 Fill bearing pedestal with oil (Oil lubricated pumps)

Oil quantities:

For group: 1 approx. 750 ml

For group 2: approx. 1000 ml

With an expected bearing temperature of about 70°C we recommend a mineral oil with the following characteristics:

Viscosity index: approx. 85

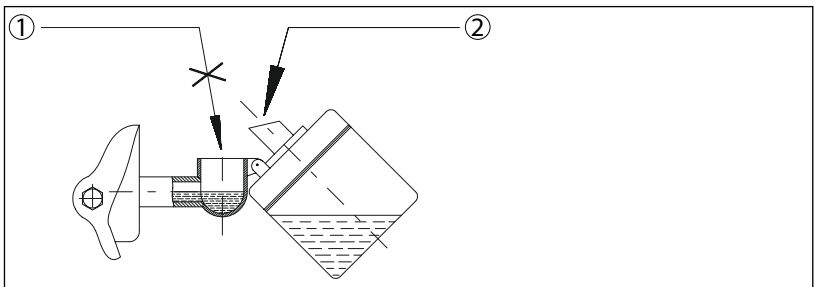
Kinematic viscosity at 40°C: appr. 40 mm^2/s

Procedure for filling with oil:

Pour in oil up to the middle of the oil sight glass 642/1 at the fill/vent plug 672/1.

If a constant level oiler (option) has been installed:

1. Tilt constant level oiler.
2. Fill the oiler with oil.



1. Never fill up with oil at this point
2. Always fill up with oil at this point

3. Swing the constant level oiler into the vertical position.
4. If the oil level still falls too much, pour more oil into the oiler.

6.5.7 Tests

The pumps are tested with water at the manufacturer's.

The operating data measured are documented in a test certificate.

The following conveying data can be checked using the pump performance curves:

- Flow rate
- Head
- Power requirement

- NPSHR

6.5.8 Assembly references

6.5.8.1 Sound pressure levels

Sound pressure levels L_{pA} in dB(A) (ICM)

Sound pressure level L_{PA} measured in 1 m distance from pump surface acc. to DIN 45635, part 1 and 24. Room and foundation influences are not considered. The tolerance for these values is ±3 dB(A).

Addition with 60 Hz-operation:

Pump alone: -

Pump with motor: +4 dB(A)

Pump size	Bearing Pedestal	Group	Sound pressure level [dB A] at speed [min^{-1}]			
			3500	2900	1750	1450
40−25−160 (*)	24	1	63	59,2	50,3	47
50−32−160			64,2	60,4	51,5	48,2
65−40−160			65,6	61,8	52,5	49,6
80−50−160			68,3	64,5	55,6	52,3
40−25−200 (*)			64,9	61,1	52,2	48,9
50−32−200			66,4	62,6	53,7	50,4
65−40−200			68,2	64,4	55,5	52,3
80−50−200			70,8	67	58,1	54,8
100−65−160	32	2.1	70,2	66,4	57,5	54,1
125−80−160			72,8	69	60,1	56,8
100−65−200			73,2	69,4	60,5	57,2
125−80−200			75,2	71,4	62,5	59,2
125−100−200			77,4	73,6	64,7	61,4
40−25−250 (*)	32	2.2	69	65,2	56,3	53
50−32−250			71	67,2	58,3	55
65−40−250			71,3	67,5	58,6	55,3
80−50−250			74,5	70,7	61,8	58,5
100−65−250			77	73,2	64,3	61
125−80−250			78,3	74,5	65,6	62,3
50−32−315 (*)			74,5	70,7	61,8	58,5
65−40−315			76	72,2	63,3	60
80−50−315			77,3	73,5	64,6	61,3
(*) Supplementary sizes, not contained in ISO28858 / EN22858						

6.5.8.2 Bolt torque values

Screw torque values

This table provides the recommended screw torque values.

Location	Bolt size	Torque for lubricated threads in Nm | lb-ft	Torque for dry threads in Nm | lb-ft
Casing screws	M12	35 | 26	50 | 37
	M16	105 | 77	150 | 111
	M20	210 | 155	305 | 225
All other screws	M10	40 | 30	50 | 37

Location	Bolt size	Torque for lubricated threads in Nm | lb-ft	Torque for dry threads in Nm | lb-ft
	M12	60 | 44	90 | 66
	M16	150 | 111	220 | 162

Nut torque values

This table provides the recommended nut torque values.

Location	Frame size	Torque for lubricated threads in Nm | lb-ft	Torque for dry threads in Nm | lb-ft
Impeller nut	24	35 | 26	45 | 33
	32	105 | 77	130 | 96
	42	210 | 155	260 | 192
	48	380 | 280	475 | 350

6.5.8.3 Bearing types

Use this table in order to determine the correct bearings for the pump. You can find the size of the bearing frame in the data sheet or the order confirmation.

Bearing frame size	Radial bearing	Thrust bearing
24	6307 - C3	3307A - C3
32	6309 - C3	3309A - C3
42	6311 - C3	3311A - C3
48	6313 - C3	3313A - C3

6.5.8.4 Spare parts

Spare parts order

Provide this information when you order spare parts. You can find the required information in the data sheet and the relevant sectional drawing:

- Pump model and size
- Serial number (order number)
- Part name
- Sectional drawing, item number

7 Troubleshooting

7.1 Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	Reprime the pump and check that the pump and suction line are full of liquid.
	The suction line is clogged.	Check the suction line pressure. If it is low, locate and remove any obstructions.
	The impeller is clogged.	Disassemble the impeller and remove the blockage.
	The magnet is de-coupling.	Shut down the pump and check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
The pump is not producing rated flow or head.	There is an air leak in the suction line.	Check for leaks and repair the lines.
	The impeller is partly clogged.	Back flush the pump to clean the impeller.
	The impeller rings are worn.	Replace the defective ring as required.
	There is insufficient suction head.	Make sure that the suction line shutoff valve is fully open and the line is unobstructed. Check the suction pressure.
	The impeller is either worn or broken.	Inspect and replace the impeller if necessary.
	The rotation is wrong.	Correct the wiring.
Pump starts and then stops pumping.	The pump is not primed correctly.	Reprime the pump.
	There is an air leak in the suction line.	Check for leaks and correct.
	The magnet is de-coupling.	Shut down the pump. Check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
	There are either air or vapor pockets in the suction line.	Rearrange the piping to eliminate air pockets.
The bearings run hot.	The bearings are not lubricated properly.	Check the suitability and level of the lubricant.
	The lubricant is cooling.	Check the cooling system.
	The pump is not aligned properly.	Check the pump alignment.
Pump is noisy or vibrates.	The pump or driver is not aligned properly.	Align the shafts.
	There is a partially-clogged impeller causing the imbalance.	Disassemble the impeller and remove the blockage.
	There is a broken or bent impeller or shaft.	Replace as required.
	The base is not rigid enough.	Tighten the pump and motor hold-down bolts or adjust the stilts. Then check the grout.
	The suction or discharge piping is not anchored or properly supported.	Anchor the piping per the Hydraulic Institute Standards recommendations (Edition 14, centrifugal pump section).
	The pump is cavitating.	Increase the NPSH available.
The motor requires excessive power.	The head is lower than the rating and the pump has too much liquid.	Install a throttle valve.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.

Symptom	Cause	Remedy
	The head is higher than the rating, which is at capacity.	Check the impeller diameter.
	The rotating parts are binding or are severely worn.	Check the internal wearing parts for proper clearances.
	The motor rotation is incorrect.	Correct the wiring.
The condition monitoring device shuts down the pump.	The sleeve and thrust bearings are damaged.	Replace as required.
	There is a plugged recirculation circuit.	Disassemble and remove the blockage. Then determine and correct the cause of the blockage.
	There is recirculation liquid vaporization.	Correct all of these as necessary: • Check the actual liquid temperature versus the design temperature. • Check the actual NPSH available versus the design. • Check the minimum flow requirement for the pump size.
	The containment shell is damaged.	Replace as required.
	The magnets are de-coupling.	Check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.
	The pump is running dry.	• Check the control device for proper operation. • Check the suction line for blockage. • Reprime the pump.
	There is excessive motor power.	The system head is lower than the rating and pumps too much liquid. Check the rotating parts for binding and wear. The liquid is heavier than expected.

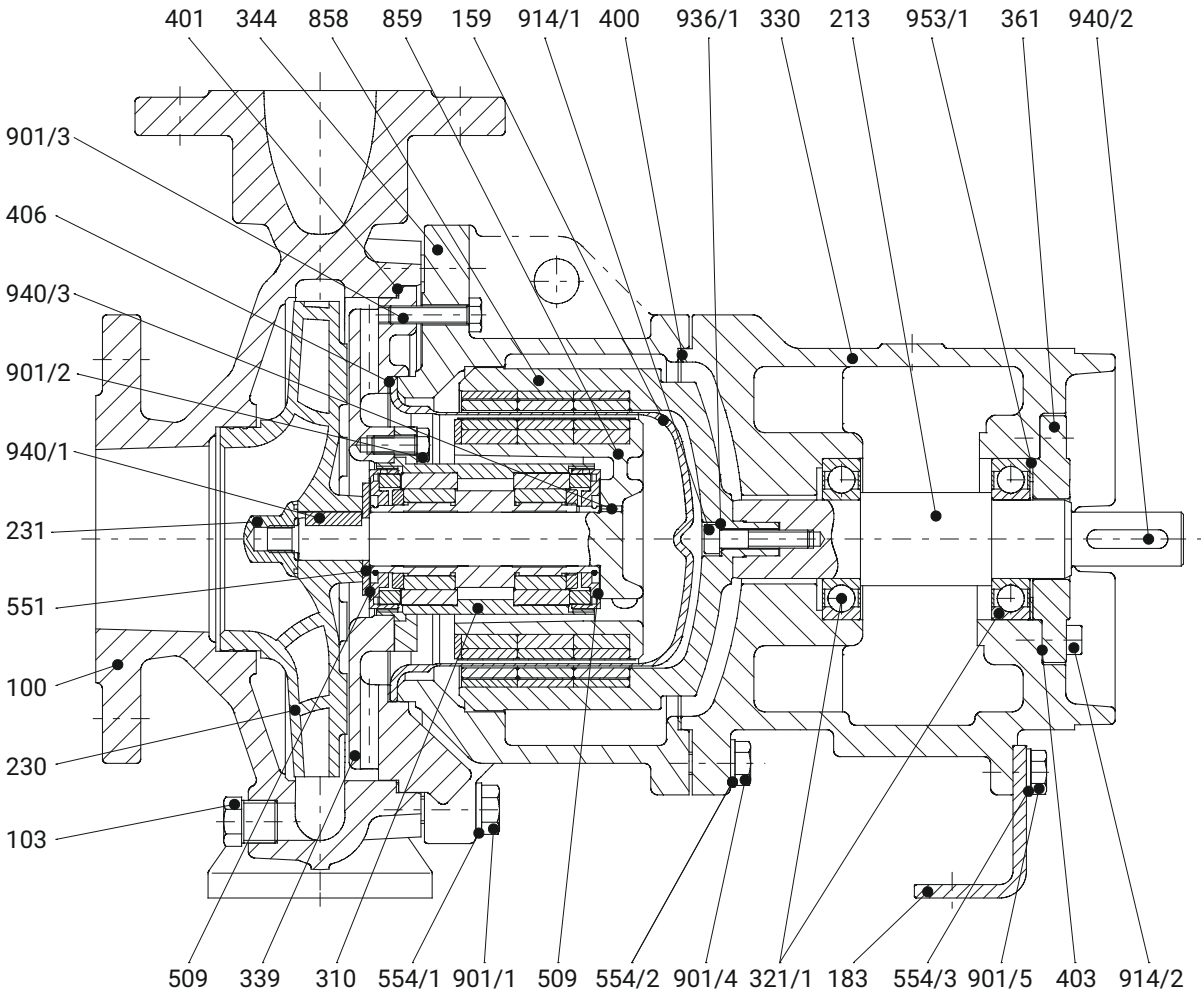
7.2 Alignment troubleshooting

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

8 Parts Lists and Cross-Sectionals

8.1 Parts List and Cross-Sectional Drawings

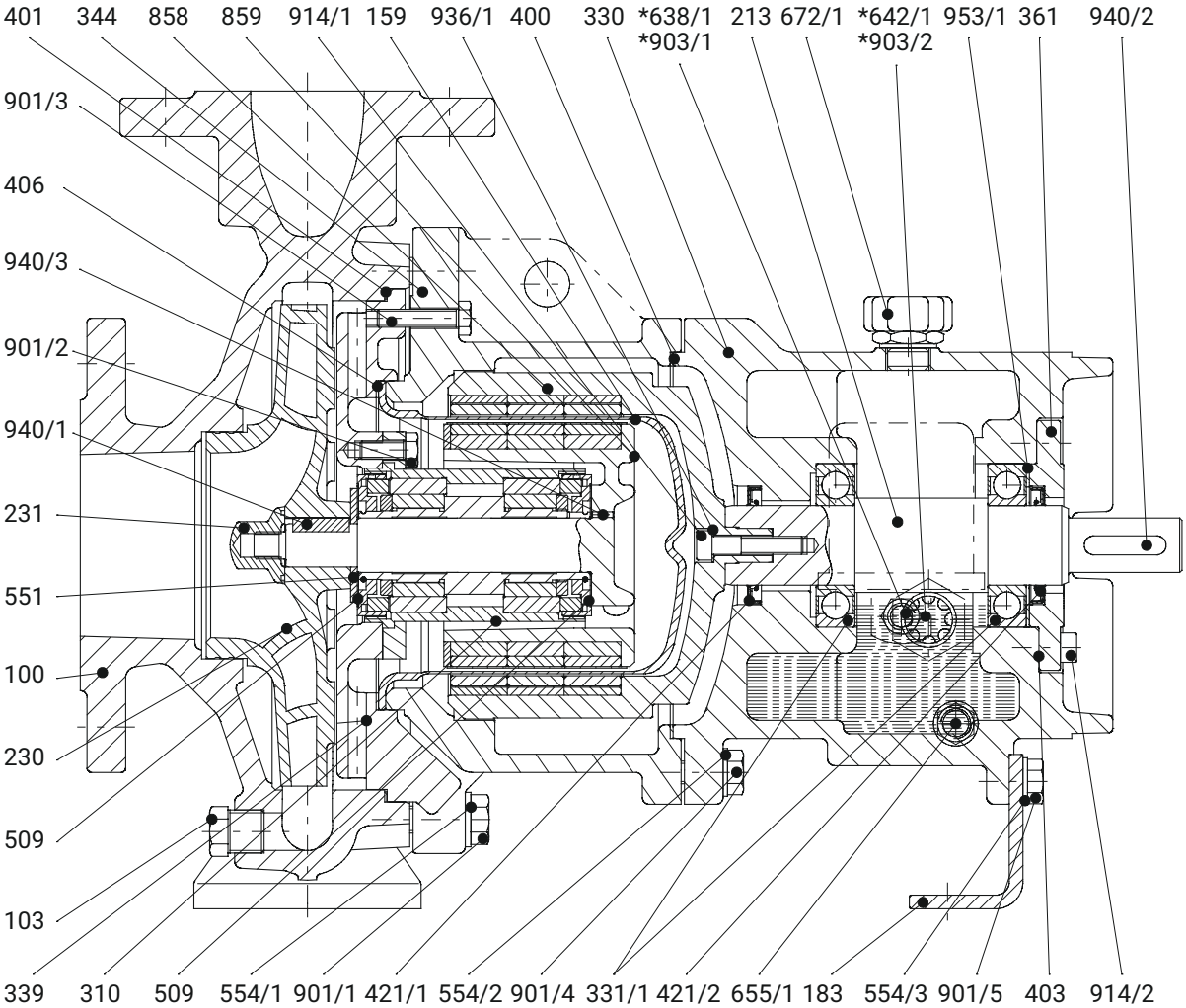
ICM/ICMP with grease for life



Item Number	Description
100	Housing
103	Case drain plug
159	Can
183	Support bracket
213	Drive shaft
230	Impeller
231	Impeller nut
310	Plain bearing cartridge
321/x	Radial ball bearing
330	Bearing pedestal
339	Plain bearing pedestal
344	Lantern
361	Rear bearing cover
400/1	Flat gasket
401	Housing gasket
403	Cover gasket

Item Number	Description
406	Can gasket
412/1	O-ring
509/x	Intermediate ring
551/1	Distance washer
554/x	Washer
858	Drive magnet assembly
859	Inner magnet assembly
901/x	Hex screw
904/2	Setscrew
914/x	Hex socket screw
936/x	Tooth lock washer
940/x	Key
953/1	Wavy spring washer

ICM with oil bath lubrication



Item Number	Description
100	Housing
103	Case drain plug
159	Can
183	Support bracket
213	Drive shaft

Item Number	Description
220	Inner magnet assembly shaft
230	Impeller
231	Impeller nut
310	Plain bearing cartridge
321/x	Radial ball bearing
330	Bearing pedestal
339	Plain bearing pedestal
344	Lantern
361	Rear bearing cover
400/1	Flat gasket
401	Housing gasket
403	Cover gasket
406	Can gasket
412/1	O-ring
509/x	Intermediate ring
551/1	Distance washer
554/x	Washer
638/1	Constant level oiler
642/1	Oil sight glass
655/1	Oil drain plug
672/1	Fill/vent plug
858	Drive magnet assembly
859	Inner magnet assembly
901/x	Hex screw
903/x	Screw plug
904/2	Setscrew
914/x	Hex socket screw
936/x	Tooth lock washer
940/x	Key
953/1	Wavy spring washer

8.2 Spare and repair parts

Recommended spare parts

Item	Quantity	Part
231	1	Impeller nut
310	1	Plain bearing cartridge
321	2	Radial ball bearing
400	1	Flat gasket
403	1	Cover gasket
406	1	Can gasket
509	1	Intermediate ring
858	1	Drive magnet assembly
859	1	Inner magnet assembly
940	1	Key

9 Decommissioning

9.1 Putting pump out of operation

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

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

Emptying

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

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

Empty the pump and operator side pipelines completely in the safe area.

Clean

The following prerequisites for cleaning must be fulfilled:

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

9.2 Disposal

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

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

NOTICE:
If necessary, enclose a declaration of no objection (refer 10.1 Declaration of no objection on page 83 with each disassembled component.

3. Recycle disassembled components in accordance with local regulations. A typical procedure is:
    - Scrap metals
    - Give plastic elements to recycling
    - Dispose of remaining components

10 Certificates

10.1 Declaration of no objection

Please copy, fill it out and send it with the pump.

Statutory regulations oblige all commercial companies to protect their employees, the public and the environment from the hazardous effects of dangerous substances.

For this reason, repair and inspection of the components may only be undertaken once the following declaration has been correctly and fully filled out and signed by an authorised, qualified specialist.

If safety measures must be employed despite complete emptying and cleaning on the part of the operator, then this required information must be passed on. This declaration of no objection comprises part of the repair or inspection order.

We hereby declare that the enclosed component

Type: _____

Serial number: _____

- is free of hazardous materials. Special safety measures for further handling of the device are not necessary.
- The device has been fully emptied and thoroughly cleaned inside and out prior to dispatch.

The following media was previously conveyed by the pump: _____

The medium was hazardous:	❒ YES	❒ NO
The pump was emptied by the operating firm:	❒ YES	❒ NO
The pump was thoroughly cleaned inside and out by the operating firm:	❒ YES	❒ NO
The pump came into contact with hazardous substances:	❒ YES	❒ NO

If yes: Hazardous material number according to Ordinance on Hazardous Substances (GefStoffV): _____

or CAS registration number (Chemical Abstract Service): _____

Company/Institute: _____

Street: _____

Postcode, city: _____

Telephone: _____

Name: _____

Item: _____

Date: _____

Signature, Company stamp: _____

10.2 Declarations of conformity and incorporation

EC-Declaration of Conformity

We herewith declare,

ITT Bornemann GmbH
Postfach 11 62, 31676 Obernkirchen, Germany
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the machinery (centrifugal pump):

Order - No.:
Denomination:
Quantity:
Serial - No.:
Year of manufacture:

Is in conformity with the following EC-Directives, provided that the site conditions for the commissioning are met as specified in the engineering documents, in particular in the operation manual:

Machinery - Directive (2006/42/EC)

☐ **EMC - Directive (2014/30/EU)**

Separate declarations of conformity are attached if marked below.

☐ **ATEX - Directive (2014/34/EU)**

☐ **PED- Directive (2014/68/EU)**

Harmonized standards used:

- **EN 349:1993+A1:2008**
- **EN 14120:2015**
- **EN 13732-1:2008**
- **EN 12162:2001+A1:2009**
- **EN ISO 12100:2010**
- **EN 809:1998+A1:2009+AC:2010**

Obernkirchen, date**:**

Managing Director

Technical Manager

UKCA-Declaration of Conformity

We herewith declare,

ITT Bornemann GmbH
Postfach 11 62, 31676 Obernkirchen, Germany
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the machinery (centrifugal pump):

Order - No.: …
Denomination: …
Quantity: …
Serial - No.: …
Year of manufacture: …

Is in conformity with the following EC-Directives, provided that the site conditions for the commissioning are met as specified in the engineering documents, in particular in the operation manual:

Supply of Machinery (Safety) Regulations 2008 No 1597

☐ **ECR - Directive (2016 No. 1091)**

Separate declarations of conformity are attached if marked below.

☐ **UKEX - Directive (2016 No. 1107)**

☐ **PESR- Directive (2016 No 1105)**

Designated standards used:

- **EN 349:1993+A1:2008**
- **EN 14120:2015**
- **EN 13732-1:2008**
- **EN 12162:2001+A1:2009**
- **EN ISO 12100:2010**
- **EN 809:1998+A1:2009+AC:2010**

Obernkirchen, date**:**

Managing Director

Technical Manager

EC-Declaration of Incorporation

According to directive on machinery 2006/42 EC appendix II B

We herewith declare,

ITT Bornemann GmbH
Postfach 11 62, 31676 Obernkirchen, Germany
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the incomplete machinery(centrifugal pump):
Order - No.:
Denomination:
Quantity:
Serial - No.:
Year of manufacture:

Conforms to the following basic requirements of the directive on machinery (2006/42/EC): appendix I, Article 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.3, 1.3.4, 1.3.7 and 1.7.3.

Harmonized standards used:

• **EN 13732-1:2008**	• **EN 12162:2001+A1 :2009** • **EN ISO 12100:2010** • **EN 809:1998+A1:2009+AC:2010**

The commissioning is prohibited until it has been established, that the machinery, into which the above mentioned machinery is to be installed, complies with the Directive machinery (2006/42/EC).

We also declare that the relevant technical documentation for this incomplete machine was prepared according to appendix VII, Part B and commit ourselves to provide them in copy on demand to the market surveillance authorities.

Obernkirchen, date**:**

Managing Director

Technical Manager

UKCA-Declaration of Incorporation

According to **Supply of Machinery (Safety) Regulations 2008 No 1597**

We herewith declare,

ITT Bornemann GmbH
Postfach 11 62, 31676 Obernkirchen, Germany
Fon +49 (0) 5724 390-0, Fax +49 (0) 5724 390-290,

that the incomplete machinery(centrifugal pump):
Order - No.:
Denomination:
Quantity:
Serial - No.:
Year of manufacture:

Conforms to the following basic requirements of the directive on Machinery (Safety) Regulations 2008 No 1597: Annex I, Article 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.3, 1.3.4, 1.3.7 and 1.7.3.

Designated standards used:

• **EN 13732-1:2008**	• **EN 12162:2001+A1 :2009** • **EN ISO 12100:2010** • **EN 809:1998+A1:2009+AC:2010**

The commissioning is prohibited until it has been established, that the machinery, into which the above mentioned machinery is to be installed, complies with the machinery directive (2008 No 1597).

We also declare that the relevant technical documentation for this incomplete machine was prepared according to appendix VII, Part B and commit ourselves to provide them in copy on demand to the market surveillance authorities.

Obernkirchen, date**:**

Managing Director

Technical Manager

11 Other Relevant Documentation or Manuals

11.1 For additional documentation

For any other relevant documentation or manuals, contact your ITT representative.

12 Local ITT Contacts

12.1 Regional offices

Region	Address	Telephone	Fax
North America (Headquarters)	ITT - Goulds Pumps 240 Fall Street Seneca Falls, NY 13148 USA	+1 315-568-2811	+1 315-568-2418
Houston office	12510 Sugar Ridge Boulevard Stafford, TX 77477 USA	+1 281-504-6300	+1 281-504-6399
Los Angeles	ITT - Goulds Pumps 880 W. Crowther Ave Placentia, CA 92870 USA	+1 562-908-4125	+1 562-695-8523
Asia Pacific	ITT Fluid Technology Asia Pte Ltd 1 Jalan Kilang Timor #04-06 Singapore 159303	+65 627-63693	+65 627-63685
Asia Pacific	ITT Goulds Pumps Ltd 35, Oksansandan-ro Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do 28101, Rep. of KOREA	+82 234444202	
Europe	ITT Bornemann GmbH Industriestrasse 2, 31683 Obern-kirchen, Germany	+49 5724 390 2340	+49 5724 390 290
Latin America	ITT - Goulds Pumps Camino La Colina # 1448 Condominio Industrial El Rosal Huechuraba Santiago 8580000 Chile	+562 544-7000	+562 544-7001
Middle East and Africa	ITT - Goulds Pumps Achileos Kyrou 4 Neo Psychiko 115 25 Athens Greece	+30 210-677-0770	+30 210-677-5642

Visit our website for the latest version of this document and more information:
http://www.gouldspumps.com

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