xylem
Let's Solve Water

This is Generic IOM for all Pump model 2201 , Version 321 with MT impellers are highlighted in document

Installation, Operation, and Maintenance Manual

90001301_5.0

Flygt 2190, 2201

FLYGT
a xylem brand

Table of Contents

1 Introduction and Safety

1.1 Introduction

Purpose of the manual

The purpose of this manual is to provide the necessary information for working with the unit. Read this manual carefully before starting work.

Read and keep the manual

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

Intended use

WARNING:

Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment and the surroundings. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.

Other manuals

See also the safety requirements and information in the original manufacturer's manuals for any other equipment furnished separately for use in this system.

1.2 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 and its surroundings
- 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:	Notices are used when there is a risk of equipment damage or decreased performance, but not personal injury.

Special symbols

Some hazard categories have specific symbols, as shown in the following table.

Electrical hazard	Magnetic fields hazard
 Electrical Hazard:	 CAUTION:

1.3 User safety

All regulations, codes, and health and safety directives must be observed.

The site

- Observe lockout and tagout procedures before starting work on the product, such as transportation, installation, maintenance, or service.
- Pay attention to the risks presented by gas and vapors in the work area.
- Always be aware of the area surrounding the equipment, and any hazards posed by the site or nearby equipment.

Qualified personnel

This product must be installed, operated, and maintained by qualified personnel only.

Protective equipment and safety devices

- Use personal protective equipment as needed. Examples of personal protective equipment include, but are not limited to, hard hats, safety goggles, protective gloves and shoes, and breathing equipment.
- Make sure that all safety features on the product are functioning and in use at all times when the unit is being operated.

1.4 Ex-approved products

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

Personnel requirements

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

- All work on the product must be carried out by certified electricians and Xylem 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, IEC/EN 60079-17).

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

Product and product handling requirements

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

- Only use the product in accordance with the approved motor data.
- The equipment must never run dry during operation. The volute must be filled with liquid during operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- 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 Ex-approved Xylem representative.
- Only use original Xylem spare parts that are provided by an Ex-approved Xylem representative.
- The thermal contacts that are fitted to the stator windings must be connected correctly to a separate motor control circuit and in use. The thermal contacts shall be connected to a monitoring device, which disconnects the power supply immediately upon activation. This action prevents the rise of temperatures above the temperature value for the approval classification.
- The width of flameproof joints is more than the values specified in the tables of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- The gap of flameproof joints is less than the values specified in Table 2 of the EN/IEC 60079-1 standard. For information contact the manufacturer.
- It is NOT allowed to repair the flameproof joints.
- Ambient temperature: –20°C to 40°C

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 Ex-approved Xylem representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

Permitted liquid level for ATEX

ATEX-approved products must be fully submerged according to the ATEX approval. Level-sensing equipment must be installed if the product can be operated at less than the minimum submersion depth.

Monitoring equipment

For additional safety, use condition-monitoring devices. Examples of condition-monitoring devices include, but are not limited to, the following:

- Level indicators
- Temperature detectors in addition to the stator thermal detectors

Any thermal detectors or thermal protection devices delivered with the pump must be installed and in use at all times.

The site owner is responsible for selection, installation, and proper maintenance of functional monitoring equipment for motor protection.

1.5 MSHA requirements

According to the United States of America's Code of Federal Regulations, the following requirements must be fulfilled to maintain Mine Safety and Health Administration (MSHA) permissibility of this equipment:

Subject area	Requirements
General safety	• Frequent inspections must be made. • All electrical parts, portable cable, and wiring must be kept in a safe condition. • There must not be any openings into the casings of the electrical parts. • The machine frame must be effectively grounded (earthed). • Power wires must not be used for grounding (earthing) . • The operating voltage must match the voltage rating of the motor.

Subject area	Requirements
Service and repair	• Inspections, service, and repairs are only allowed when the portable cable is disconnected from the power supply. • Work must be performed by trained personnel (preferably the manufacturer or agent) to ensure that the pump is restored to its original state of safety in regards to all flame-arresting paths. • Replacement parts must be exactly equal to those provided by the manufacturer. • When cable entries are disturbed on pump or control, they must be reassembled in the approved manner.  **CAUTION: Explosion/Fire Hazard** Failure to restore the permissible equipment to its original state of safety will void the MSHA approval. The creation of a safety hazard will subject the owner / operator of a mine to citations and penalties under the law.
Fastenings	All bolts, nuts, screws, and threaded covers must be properly tightened and secured.
Cables	A flame-resistant portable cable must be used. It has to bear an MSHA-assigned identification number and be adequately protected by an automatic circuit-interrupting device. Special care must be taken in handling the cable to avoid mechanical damage and wear.
Operation	Poly-Life® equipped products must not be operated dry in hazardous areas.

1.6 Special hazards

1.6.1 Working in temporary installations

Certain industries, such as mining or construction, have a dynamic nature and require temporary installation of equipment. Due to the rugged nature of these applications, normal use of electrical equipment causes wear and tear that can result in insulation breaks, short-circuits, and exposed wires. To maximize safety when using the unit in rugged applications, the following conditions must be met:

- If electrical cables must be located such that they are at risk of being run over by heavy equipment, then provide mechanical protection to prevent physical damage to the cables.
- Visually inspect electrical equipment before use. Remove from service any equipment with exposed wires or visible damage.
- Use ground-fault circuit interrupters on all receptacles, or have an assured equipment grounding conductor program.

1.6.2 Biological hazards

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 may come into contact with biological hazards are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.

WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

1.6.3 Wash the skin and eyes

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.

1.7 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites

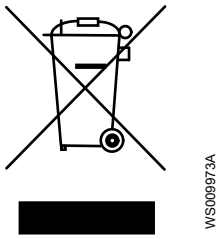
CAUTION: Radiation Hazard

Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

1.8 End of life product disposal

Handle and dispose of all waste in compliance with local laws and regulations.

Correct disposal of this product — WEEE Directive on waste electrical and electronic equipment



This marking on the product, accessories or literature indicates that the product should not be disposed of with other waste at the end of its working life.

To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Waste from electrical and electronic equipment can be returned to the producer or distributor.

1.9 Spare parts

CAUTION:

Only use the manufacturer’s original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the warranty.

1.10 Warranty

For information about warranty, see the sales contract.

2 Transportation and Storage

2.1 Examine the delivery

2.1.1 Examine the package

1. Examine the package for damaged or missing items upon delivery.
2. Record any damaged or missing items on the receipt and freight bill.
3. If anything is out of order, then file a claim with the shipping company.

   If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Examine the unit

1. Remove packing materials from the product.

   Dispose of all packing materials in accordance with local regulations.
2. To determine whether any parts have been damaged or are missing, examine the product.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.

   Use care around nails and straps.
4. If there is any issue, then contact a sales representative.

2.2 Transportation guidelines

2.2.1 Precautions

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Position and fastening

The unit can be transported either horizontally or vertically. Make sure that the unit is correctly fastened during transportation, and cannot roll or fall over.

2.2.2 Lifting

Always inspect the lifting equipment and tackle before starting any work.

WARNING: Crush Hazard

Always lift the unit by its designated lifting points.

Use suitable lifting equipment and ensure that the product is properly harnessed.

Wear personal protective equipment.

Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

2.3 Temperature ranges for transportation, handling and storage

Handling at freezing temperature

At temperatures below freezing, the product and all installation equipment, including the lifting gear, must be handled with extreme care.

Make sure that the product is warmed up to a temperature above the freezing point before starting up. Avoid rotating the impeller/propeller by hand at temperatures below the freezing point. The recommended method to warm the unit up is to submerge it in the liquid which will be pumped or mixed.

NOTICE:

Never use a naked flame to thaw the unit.

Unit in as-delivered condition

If the unit is still in the condition in which it left the factory - all packing materials are undisturbed - then the acceptable temperature range during transportation, handling and storage is: –50°C (–58ºF) to +60°C (+140ºF).

If the unit has been exposed to freezing temperatures, then allow it to reach the ambient temperature of the sump before operating.

Lifting the unit out of liquid

The unit is normally protected from freezing while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the unit is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

1. Empty all pumped liquid, if applicable.
2. Check all liquids used for lubrication or cooling, both oil and water-glycol mixtures, for the presence of unacceptable amounts of water. Change if needed.

Water-glycol mixtures: Units equipped with an internal closed-loop cooling system are filled with a mixture of water and 30% glycol. This mixture remains a flowing liquid at temperatures down to –13°C (9°F). Below –13°C (9°F), the viscosity increases such that the glycol mixture will lose its flow properties. However, the glycol-water mixture will not solidify completely and thus cannot harm the product.

2.4 Storage guidelines

Storage location

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

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

Long-term storage

If the unit is stored for more than six months, then the following apply:

- Before operating the unit after storage, it must be inspected. Special attention must be given to the seals and the cable entry.
- The impeller or propeller must be rotated every other month to prevent the seals from sticking together.

3 Product Description

3.1 Products included

Pump model	Standard	Ex-proof	MSHA	Drainage	Sludge	Material	Pareo™
2190.010	X			X		Aluminum	X
2190.320	X			X		Cast iron	X
2190.390	X			X		Stainless steel	X
2190.690		X		X		Cast iron	
2201.012	X			X		Aluminum	X
2201.020	X			X		Aluminum	X
2201.321	X			X		Cast iron	X
2201.390	X			X		Stainless steel	X
2201.590			X	X		Cast iron	
2201.692		X		X		Cast iron	

3.2 Pump design

The pump is submersible, and driven by an electric motor.

Intended use

The product is intended for moving waste water, sludge, raw and clean water. Always follow the limits given in *Technical Reference* on page 76. If there is a question regarding the intended use of the equipment, then contact a sales or authorized service representative before proceeding.

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

NOTICE:

Do NOT use the unit in highly corrosive liquids.

For information about pH, see *Technical Reference* on page 76.

Particle size

Pressure class	Number of holes	Hole dimensions Diameter, mm (in)
SH	549	12 (0.47)
HT	549	12 (0.47)
MT	636	15 (0.59)
LT	636	15 (0.59)

Pressure class

LT	Low head
MT	Medium head
HT	High head
SH	Super high head

Impeller type

B	Wear resistant

Poly-Life®

Version code 2190.010/2190.320, 2201.012/2201.020/2201.321: The pump is available with Poly-Life® polyurethane wear parts for extra resistance.

3.3 Monitoring equipment

The following applies to the monitoring equipment of the pump:

- The stator incorporates thermal contacts connected in series that activate the alarm at overtemperature.
- The thermal contacts open and close at the following temperatures:

Pump	Thermal contacts open	Thermal contacts close
2190.010/320/390/690	140°C (284°F)	105°C (221°F)
2201.012/020/321/390	125°C (257°F)	90°C (194°F)
2201.590, 50 Hz 2201.692	110°C (230°F)	75°C (169°F)
2201.590, 60 Hz	125°C (257°F)	90°C (194°F)

3.3.1 Pareo

Some of the pump versions are included in the Pareo system. For more information, see *Products included* on page 11.

The system is set up in one of two modes:

- Pareo mode
- Standard mode

For more information about Pareo, see the applicable documentation.

Pareo mode

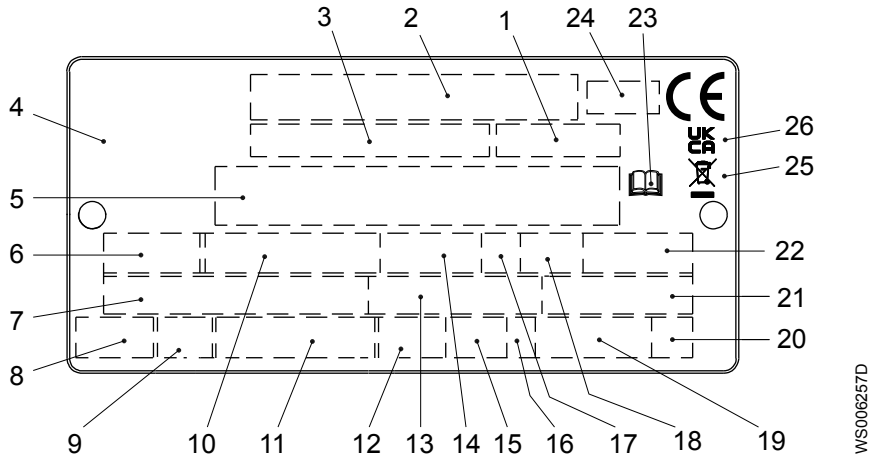
Extra parts are installed in the pump. A sticker is attached on the pump top to inform about the installation.

For more information, see *Replace the Pareo pump module* on page 69 and the mounting instructions.

Current transformer	• Gives measuring data to the pump module
Pump module	• Connects to the pump sensors • Communicates with the controller • Stores running data and data plate information

3.4 The data plate

The data plate is a metal label that is located on the main body of the products. The data plate lists key product specifications. Specially approved products also have an approval plate.



1. Curve code or Propeller code
2. Serial number
3. Product number
4. Country of origin
5. Additional information
6. Phase; type of current; frequency
7. Rated voltage
8. Thermal protection
9. Thermal class
10. Rated shaft power
11. International standard
12. Degree of protection
13. Rated current
14. Rated speed
15. Maximum submergence
16. Direction of rotation: L=left, R=right
17. Duty class
18. Duty factor
19. Product weight
20. Locked rotor code letter
21. Power factor
22. Maximum ambient temperature
23. Read installation manual
24. Notified body, only for EN-approved Ex products
25. WEEE-Directive symbol
26. UKCA marking

Figure 1: The data plate

3.5 Motor regulation

This product is submersible and therefore exempted from the motor efficiency requirement, in accordance with EU commission regulation 2019/1781 Article 2(2)(e).

3.6 Approvals

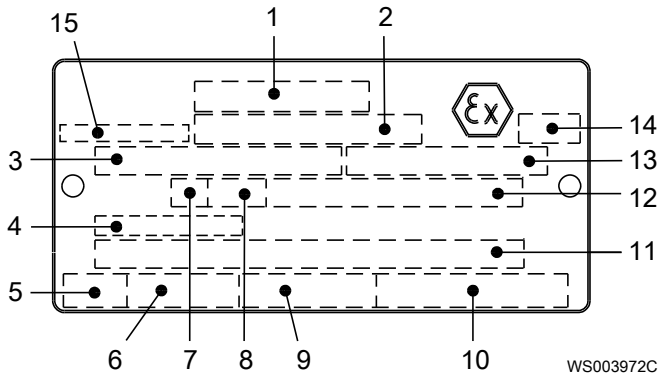
Product approvals for hazardous locations

Pump	Approval
2201.590	European Norm (EN) • ATEX Directive • EN 1127-1, EN 50014, EN 50018, EN 50019 • ⟨Ex⟩II 2G EEx de IIB T3
	MSHA: Mine Safety and Health Administration, USA. 30CFR Part 18, Approval number X/P-3400-1
2190.690 2201.692	European Norm (EN) • ATEX Directive • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • ⟨Ex⟩I M2 Ex db h I Mb

Pump	Approval
	IEC • IECEx scheme • IEC 60079-0:2017, IEC 60079-1:2014-06, ISO 80079-36:2016, ISO 80079-37:2016 • Ex db h I Mb
	UKEx • UK SI 2016 No. 1107 • EN IEC 60079-0:2018, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 • Ⓔx I M2 Ex db h I Mb

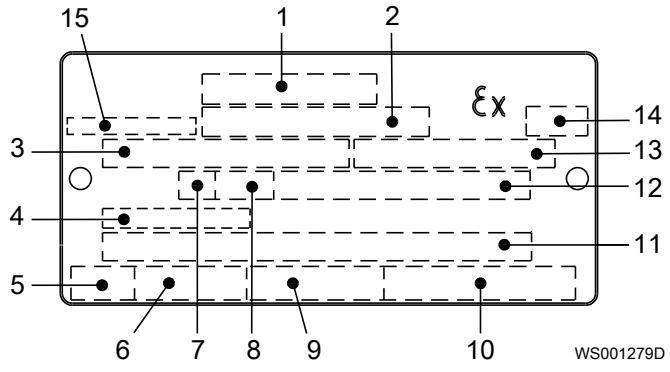
The Ex approval plate

EN approval plate



1. Approval
2. Approval authority and Approval number
3. Approved drive unit
4. Cable entry temperature
5. Stall time
6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

IEC approval plate



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7. Duty class
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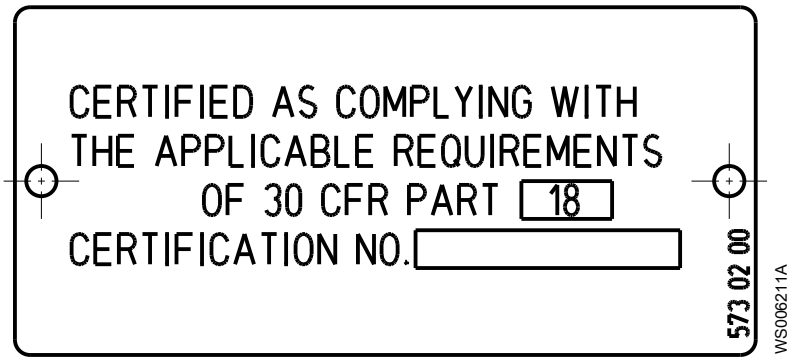
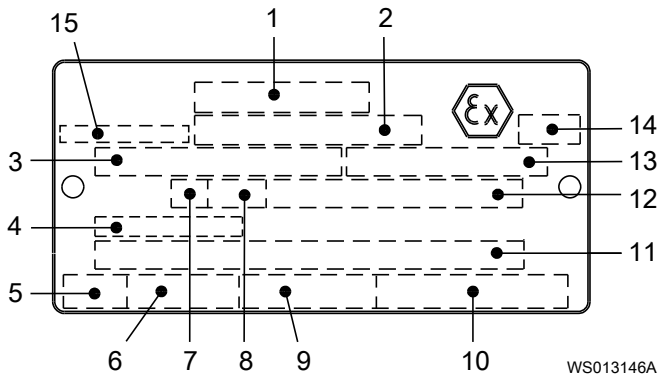
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. ATEX marking
15. Country of origin

The MSHA approval plate



United Kingdom: UKEx approval plate

This illustration describes the UKEx approval plate and the information that is contained in its fields.



1. Approval
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6. Starting current or Rated current
7. Duty class
8. Duty factor
9. Input power
10. Rated speed
11. Additional information
12. Maximum ambient temperature
13. Serial number
14. UKEx marking
15. Country of origin

3.7 Product denomination

Reading instruction

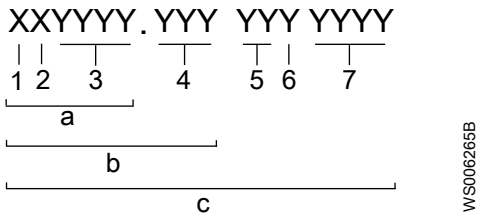
In this section, code characters are illustrated accordingly:

X = letter

Y = digit

The different types of codes are marked up with a, b and c. Code parameters are marked up with numbers.

Codes and parameters



Type of Callout	Number	Indication
Type of code	a	Sales denomination
	b	Product code
	c	Serial number
Parameter	1	Hydraulic end
	2	Type of installation
	3	Sales code

Type of Callout	Number	Indication
	4	Version
	5	Production year
	6	Production cycle
	7	Running number

4 Installation

4.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

4.1.1 Hazardous atmospheres

DANGER: Explosion/Fire Hazard

Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

Authority regulation

Vent the tank of a sewage station in accordance with local plumbing codes.

4.2 Requirements

Sedimentation prevention

In order to avoid sedimentation when the pumped liquid contains solid particles, the velocity of the liquid in the discharge line must exceed a certain value. Choose applicable minimum velocity from the table, and choose proper dimension of the discharge line accordingly.

Mixture	Minimum velocity, meter per second (feet per second)
Water + coarse gravel	4 (13)
Water + gravel	3.5 (11)
Water + sand, particle size <0.6 mm (0.024 in)	2.5 (8.2)
Water + sand, particle size <0.1 mm (0.004 in)	1.5 (4.9)

For more permanent installations with a heavily contaminated pumped liquid, a settling pump-sump is recommended.

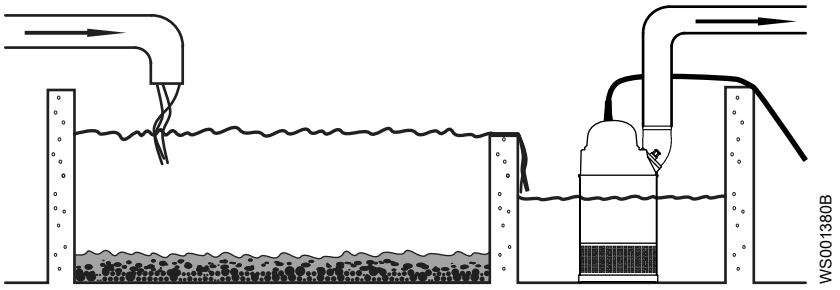
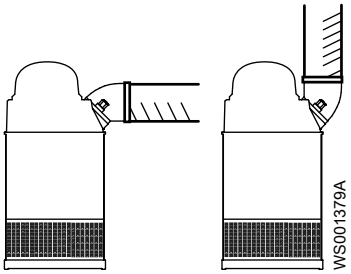
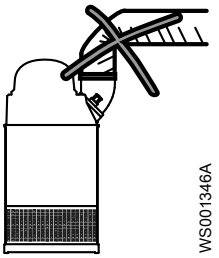


Figure 2: Settling pump-sump

Discharge line requirements

The discharge line can be run vertically or horizontally, but must be without sharp bends.

Proper horizontal and vertical installation	Improper installation with a sharp bend
	

Fasteners

- Only use fasteners of the correct size and material.
- Replace all corroded or damaged fasteners.
- Make sure that all the fasteners are correctly tightened and that there are no missing fasteners.

4.3 Install with S-installation

In the S-installation, the pump is transportable and intended to operate either completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe.

These requirements and instructions only apply when the installation is made according to the dimensional drawing.

1. Run the cable so that it has no sharp bends. Make sure that it is not pinched, and cannot be sucked into the pump inlet.
2. Connect the discharge line.
3. Lower the pump into the sump.
4. Place the pump on the base and make sure it cannot fall over or sink.

   Alternatively, the pump can be suspended with chains just above the sump bottom. Make sure that the pump cannot rotate at start-up or during operation.
5. Connect the motor cable and the starter and monitoring equipment according to the separate instructions.

   Make sure that the impeller rotation is correct. For more information, see *Check the impeller rotation* on page 31.

4.4 Make the electrical connections

4.4.1 General precautions

DANGER: Electrical Hazard

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.

WARNING: Electrical Hazard

Risk of electrical shock or burn. A certified electrician must supervise all electrical work. Comply with all local codes and regulations.

WARNING: Electrical Hazard

There is a risk of electrical shock or explosion if the electrical connections are not correctly carried out, or if there is fault or damage on the product. Visually inspect equipment for damaged cables, cracked casings or other signs of damage. Make sure that electrical connections have been correctly made.

WARNING: Crush Hazard

Risk of automatic restart.

CAUTION: Electrical Hazard

Prevent cables from becoming sharply bent or damaged.

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the cable ends dry at all times.

Requirements

These general requirements apply for the electrical installation:

- If the pump will be connected to the public mains, then the supply authority must be notified before installing the pump. When the pump is connected to the public power supply, it can cause flickering of incandescent lamps when started.
- The mains voltage and frequency must agree with the specifications on the data plate. If the pump can be connected to different voltages, then follow the specified voltage on the yellow sticker close to the cable entry.
- If the operation can be intermittent, such as S3 periodic duty, then the pump must be supplied with monitoring equipment supporting such operation.
- The thermal contacts or thermistors must be in use.

Motor and short-circuit protection

NOTICE:

A qualified electrician must select the size of motor protection breakers and fuses. The size must be chosen for the specific motor data such as rated current and starting current.

It is important that the short-circuit protection is not over-dimensioned. Over-dimensioned fuses or motor protection breakers decrease the protection for the motor.

- The fuse rating and the cables must be in accordance with the local rules and regulations.
- The fuses and circuit breakers must have the correct rating.
- The pump overload protection must be connected and set to the rated current.

The starting current in direct-on-line start can be up to six times higher than the rated current.

For more information, see the data plate and if applicable, the cable chart for the rated current.

Cables

These are the requirements to follow when you install cables:

- The cables must be in good condition, not have any sharp bends, and not be pinched.
- The cables must not be damaged and must not have indentations or be embossed (with markings, etc.) at the cable entry.
- The cable entry seal sleeve and washers must conform to the outside diameter of the cable.
- The minimum bending radius must not be below the accepted value.
- If using a cable which has been used before, a short piece must be peeled off when refitting it so that the cable entry seal sleeve does not close around the cable at the same point again. If the outer jacket of the cable is damaged, then replace the cable.

  Contact a sales or authorized service representative.
- The voltage drop in long cables must be taken into account. The drive unit's rated voltage is the voltage measured at the cable connection point in the pump.
- For SUBCAB® cables, the twisted pair copper foil must be trimmed.
- All unused conductors must be insulated.

4.4.2 Grounding (earthing)

Grounding (earthing) must be done in compliance with all local codes and regulations.

DANGER: Electrical Hazard

All electrical equipment must be grounded (earthed). Test the ground (earth) lead to verify that it is connected correctly and that the path to ground is continuous.

WARNING: Electrical Hazard

Risk of electrical shock. The ground (earth) lead must be sufficiently longer than the phase leads to make sure that the ground lead is the last to become disconnected if the cable is jerked loose.

WARNING: Electrical Hazard

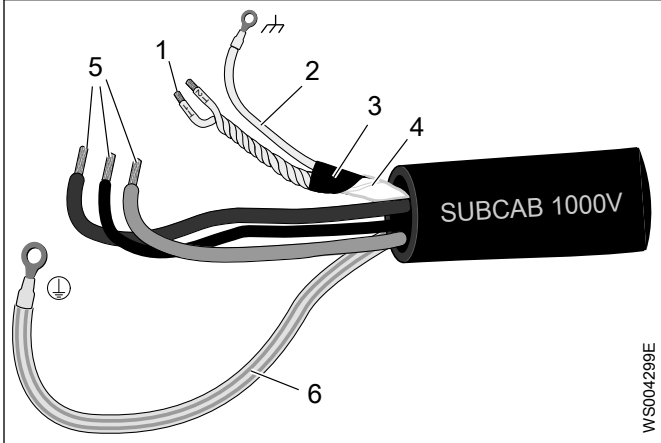
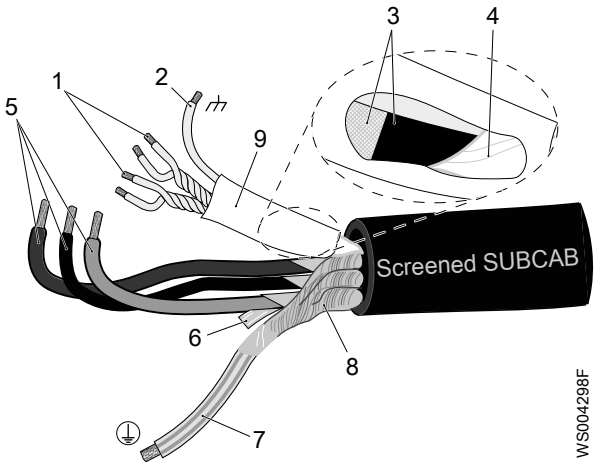
Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.

Ground (earth) conductor length

The ground (earth) conductor must be 100 mm (4.0 in) longer than the phase conductors in the junction box of the unit.

4.4.3 Prepare the SUBCAB™ cables

This section applies to SUBCAB™ cables with twisted-pair control conductors.

The prepared SUBCAB™ cable	The prepared screened SUBCAB™ cable, without cable lugs
	
1. T1+T2 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Ground (earth) conductor with yellow-green shrink tube	1. T1+T2 and T3+T4 twisted pairs in control element 2. Drain wire in control element (tinned copper strands) with shrink tube 3. Aluminum and textile layers 4. Insulation jacket or plastic jacket, for the control element 5. Power conductors 6. Plastic laminated aluminum foil, screen 7. Ground (earth) conductor with yellow-green shrink tube 8. Uncovered screen/braided wire 9. shrink tube

1. Peel off the outer jacket at the end of the cable.
2. Prepare the control element:
   a) Peel the insulation jacket or plastic jacket.
   b) Peel the aluminum and textile layers.

      The aluminum foil is a conductive screen. Do not peel more than necessary, and remove the peeled foil.

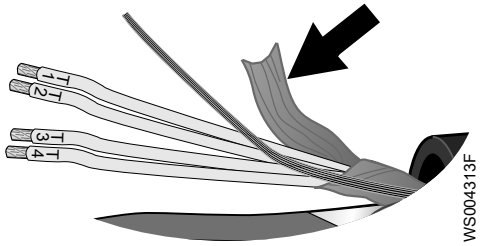


Figure 3: Aluminum foil on the control element.

   c) Put a white shrink tube over the drain wire.
   d) Twist T1+T2 and T3+T4.
   e) Put a shrink tube over the control element.

      Make sure that the conductive aluminum foil and drain wire are covered.
3. Prepare the ground (earth) conductor of the SUBCAB™ cable:
   a) Peel the yellow-green insulation from the ground (earth) conductor.
   b) Check that the ground (earth) conductor is at least 10% longer than the phase conductors in the cabinet.
   c) If applicable, put a cable lug on the ground conductor.
4. Prepare the ground (earth) conductor of the screened SUBCAB™ cable:

a) Untwist the screens around the power conductors.
b) Twist all power conductor screens together to create a ground (earth) conductor.
c) Put a yellow-green shrink tube over the ground (earth) conductor.
   Leave a short piece uncovered.
d) Check that the connected ground (earth) conductor has sufficient slack. The conductor must stay connected even if the power conductors are pulled loose.

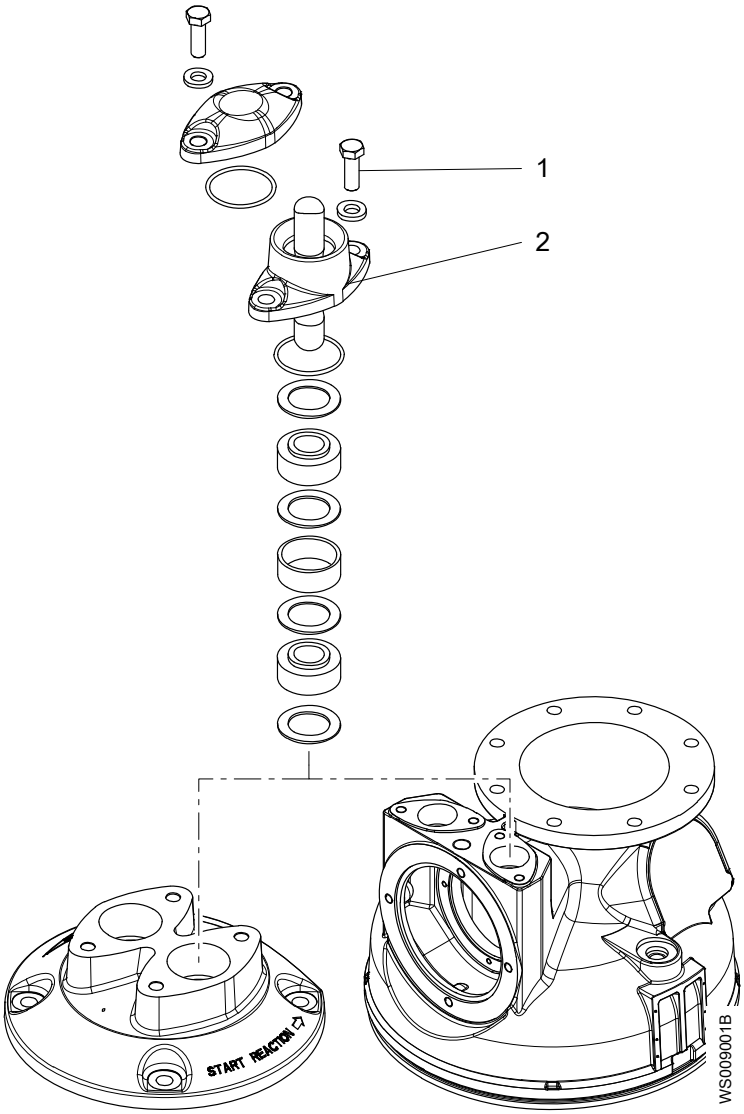
5. Prepare the power conductors:
   a) Remove the aluminum foil around each power conductor.
   b) Peel the insulation from each power conductor.
6. Prepare the ends of the ground (earth) conductor, the power conductors, and the drain wire:

Connection type	Action
Screw	Fit cable lugs to the ends.
Terminal block	Fit end sleeves or leave the ends as they are.

4.4.4 Connect the motor cable to the pump : Non-explosion proof versions

NOTICE:

Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable dry at all times.



Part	Description
1	Screws
2	Entrance flange

1. Check the data plate to see which connections are required for the power supply:
   - Y
   - D
   - Y serial
   - Y parallel
   - Y/D
2. Arrange the connections on the terminal board in accordance with the required power supply.

   Do not use links (jumper strips) with the Y/D start.

   Do not use links (jumper strips) with the 9 stator leads tandem-coupling.
3. Connect the motor conductors (U1, V1, W1) to the terminal board. Connect the ground (earth) lead.
4. Make sure that the pump is correctly connected to ground (earth).
5. Make sure that any thermal contacts incorporated in the pump are properly connected to the terminal board.

6. Install the cover.
7. Fasten the screws on the entrance flange so that the cable insertion assembly bottoms out.

After you have connected the motor cable to the pump, connect the motor cable and the control cable to the starter equipment.

DANGER: Explosion/Fire Hazard

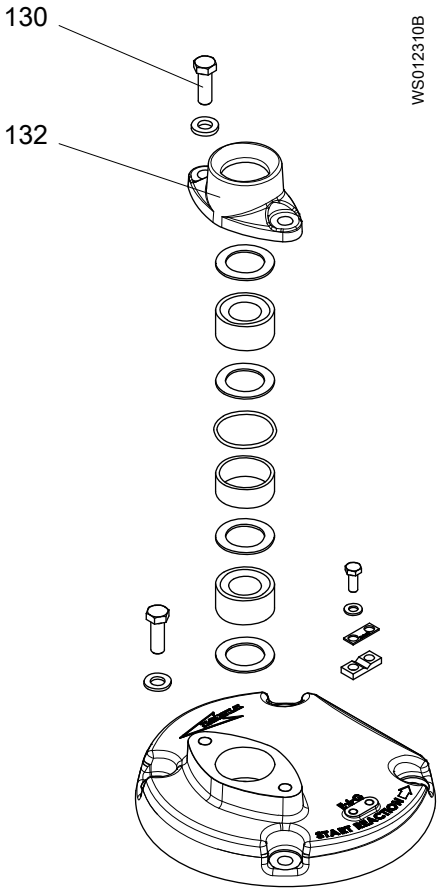
Special rules apply to installations in explosive or flammable atmospheres. Do not install the product or any auxiliary equipment in an explosive zone unless it is rated explosion-proof or intrinsically-safe. If the product is rated explosion-proof or intrinsically-safe, then see the specific explosion-proof information in the safety chapter before taking any further actions.

Three thermal contacts are incorporated in the stator. They are normally closed.

Thermal contacts must never be exposed to voltages higher than 250 V, breaking current maximum 6 A at a power factor 0.6. It is recommended that the thermal contacts are connected to 24 V over a separate fuse to protect any other automatic equipment.

4.4.5 Connect the motor cable to the pump: Ex-proof and MSHA versions

2190.690, 2201.692



Position number	Description
130	Hexagon head screw
132	Entrance flange

Figure 4: Cable entry

1. Check the data plate to see which connections are required for the power supply:

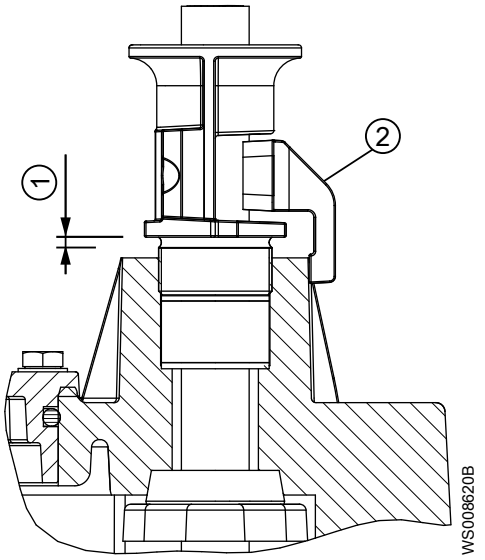
- Y
- D
- Y serial
- Y parallel
- Y/D

2. Arrange the connections on the terminal board in accordance with the required power supply.

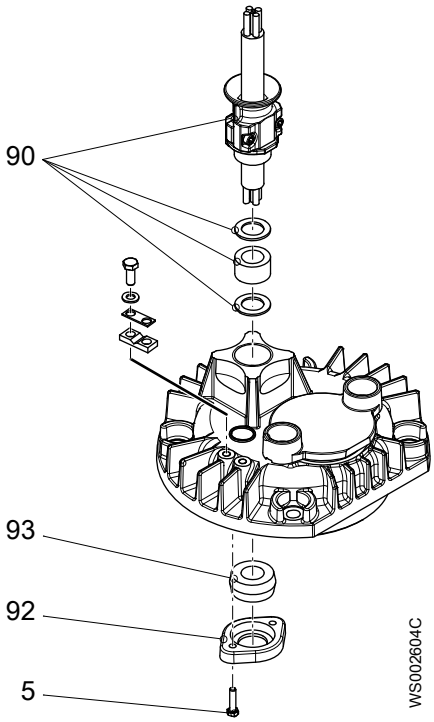
   Do not use links (jumper strips) with the Y/D start.

   Do not use links (jumper strips) with the 9 stator leads tandem-coupling.
3. Connect the motor conductors (U1, V1, W1) to the terminal board. Connect the ground (earth) lead.
4. Make sure that the pump is correctly connected to ground (earth).
5. Make sure that any thermal contacts incorporated in the pump are properly connected to the terminal board.
6. Install the cover.
7. Fasten the screws on the entrance flange so that the cable insertion assembly bottoms out.

2201.590



Position number	Description
1	Minimum clearance 3.2 mm (0.13 in)
2	Cable strain relief



Position number	Description
5	Hexagon head screw
90	Cable entry
92	Gland flange
93	Seal sleeve

Figure 5: Cable strain relief

1. Insert the motor cable.

   25–30 mm (0.9–1.2 in) of the jacket must be on the inside of the cover.
2. Check that the seal sleeves and washers conform to the outside diameter of the cable.
3. Tighten the cable entry so that the seal sleeve is compressed and seals between the motor cable and the cover.

Leave a clearance between the cover and the flange on the cable entry. See *Figure 5: Cable strain relief* on page 25.

The cable entry is threaded with Pg29/Pr37, Pg36/Pr47, and Pg42/Pr54.

4. Twist together the ground (earth) leads into a bundle and slip an insulating tube over the intertwined leads.

   The ground (earth) leads are located concentrically around each phase lead.

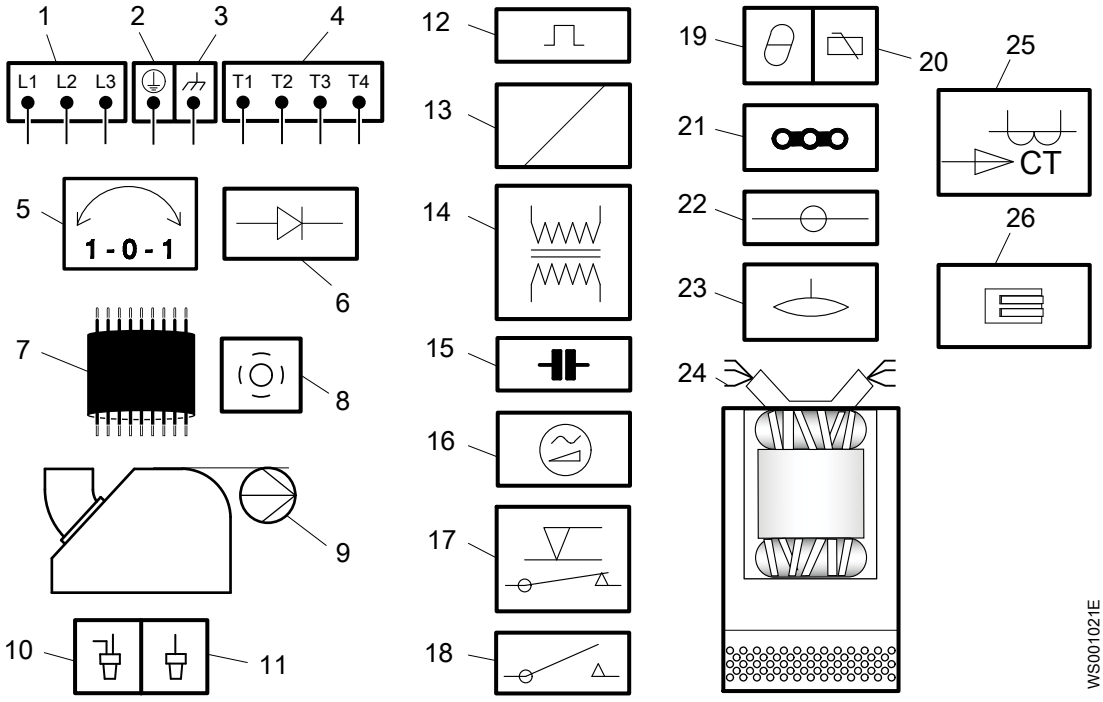
5. Fit the gland flange:
   a) Fit it with the largest diameter of the hole facing the inside of the cover.
   b) Tighten the screws, but leave 1 mm (0.04 in) of clearance between the cover and the gland flange.
6. Fit the O-ring on the cover.
7. Connect the leads.
8. Connect the control cable between the terminal board (H1 and H2) and the control circuit of the starter.
9. Fit and tighten the cover.

   Check, through the inspection hole, that no leads are pinched.

10. Fit the O-ring on the inspection cover.
11. Fit and tighten the inspection cover.
12. Fit and tighten the cable strain relief on the cable entry.
13. Connect the pump to ground (earth) with an external ground (earth) lead on the top of the cover.

4.4.6 Cable charts

Connection locations



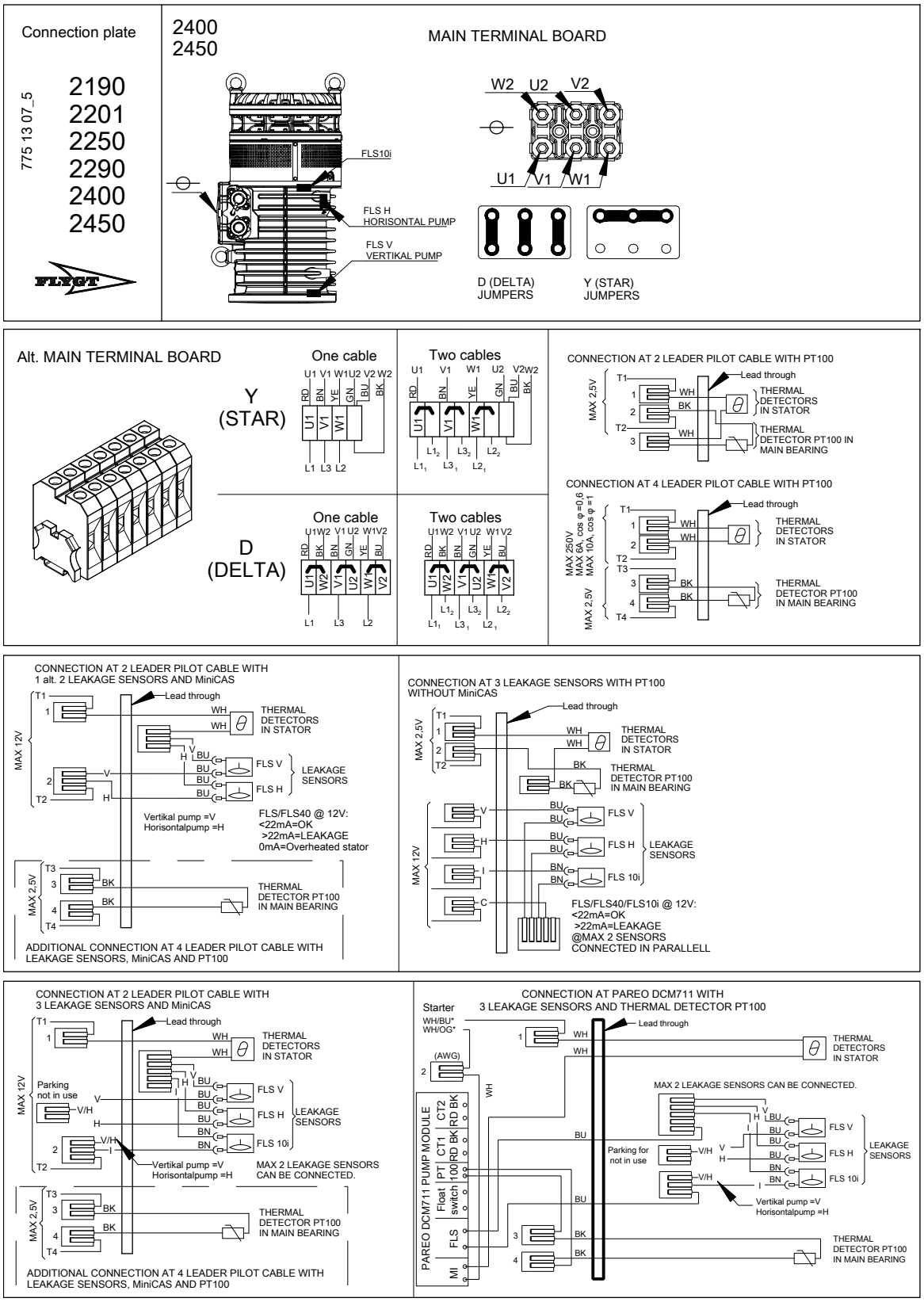
1	Starter equipment and main leads (L1, L2, L3)	14	Transformer
2	Ground (earth)	15	Capacitor
3	Functional ground	16	Softstarter
4	Control leads (T1, T2, T3, T4)	17	Level regulator
5	Phase shifter	18	Contactor, start relay or thermal relay

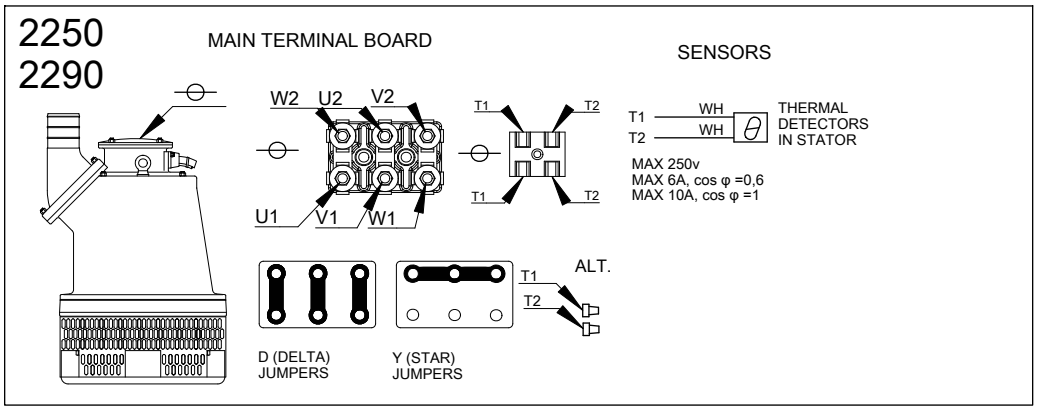
6	Diode	19	Thermal detector in stator
7	Motor cable	20	Thermal detector in main bearing
8	Screen	21	Jumper
9	Pump	22	Terminal board, terminal plate
10	Crimp connection	23	Leakage sensor
11	Crimp isolation	24	Stator leads (U1, U2, U5, U6, V1, V2, V5, V6, W1, W2, W5, W6, Z1, Z5, Z6)
12	Motor protector	25	Current transformer
13	Coil	26	Terminal block

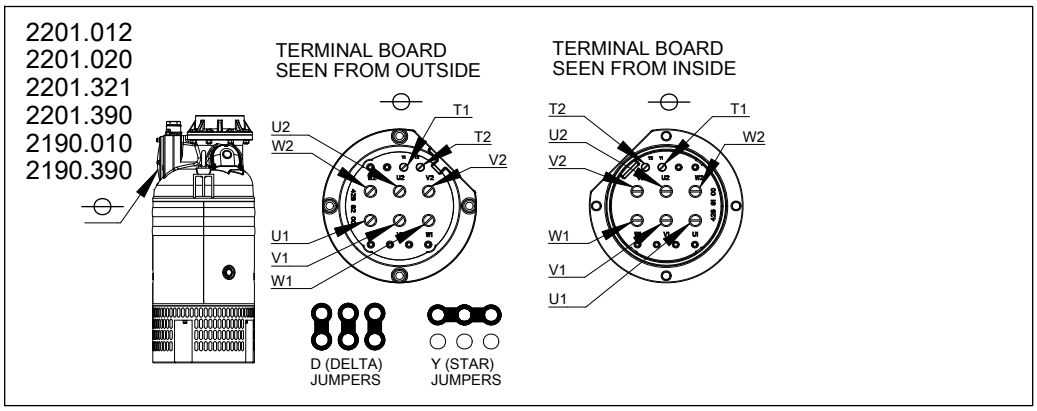
Color code standard

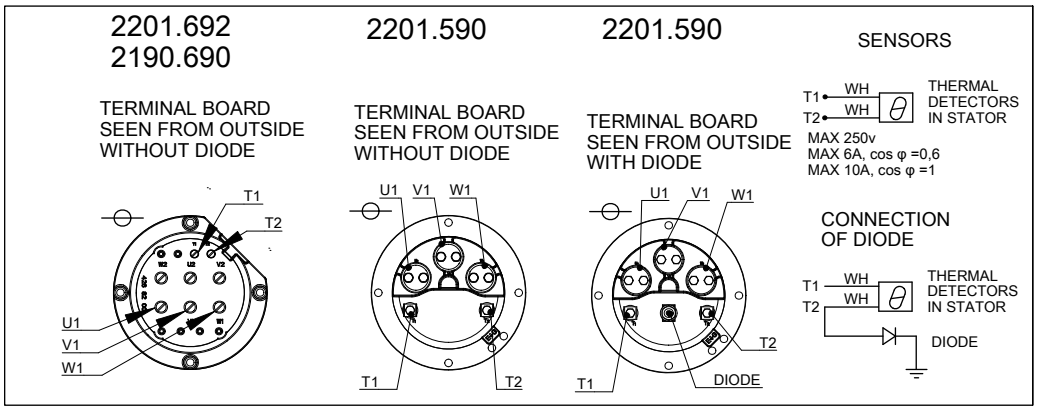
Code	Description
BN	Brown
BK	Black
WH	White
OG	Orange
GN	Green
GNYE	Green-Yellow
RD	Red
GY	Grey
BU	Blue
YE	Yellow

Drawing


Connection plate
775 13 07_5
2190
2201
2250
2290
2400
2450
2400
2450
MAIN TERMINAL BOARD
FLS10i
FLS H
HORISONTAL PUMP
FLS V
VERTIKAL PUMP
W2 U2 V2
U1 V1 W1
D (DELTA)
JUMPERS
Y (STAR)
JUMPERS
Alt. MAIN TERMINAL BOARD
Y
(STAR)
D
(DELTA)
One cable
Two cables
CONNECTION AT 2 LEADER PILOT CABLE WITH PT100
CONNECTION AT 4 LEADER PILOT CABLE WITH PT100
Lead through
THERMAL DETECTORS IN STATOR
THERMAL DETECTOR PT100 IN MAIN BEARING
MAX 2,5V
MAX 250V
MAX 6A, cos φ=0,6
MAX 10A, cos φ =1
CONNECTION AT 2 LEADER PILOT CABLE WITH
1 alt. 2 LEAKAGE SENSORS AND MiniCAS
CONNECTION AT 3 LEAKAGE SENSORS WITH PT100
WITHOUT MiniCAS
MAX 12V
FLS V
FLS H
FLS 10i
LEAKAGE SENSORS
Vertikal pump =V
Horisontalpump =H
FLS/FLS40 @ 12V:
<22mA=OK
>22mA=LEAKAGE
0mA=Overheated stator
FLS/FLS40/FLS10i @ 12V:
<22mA=OK
>22mA=LEAKAGE
@MAX 2 SENSORS
CONNECTED IN PARALLELL
ADDITIONAL CONNECTION AT 4 LEADER PILOT CABLE WITH
LEAKAGE SENSORS, MiniCAS AND PT100
CONNECTION AT 2 LEADER PILOT CABLE WITH
3 LEAKAGE SENSORS AND MiniCAS
CONNECTION AT PAREO DCM711 WITH
3 LEAKAGE SENSORS AND THERMAL DETECTOR PT100
Starter
Parking not in use
Parking for not in use
MAX 2 LEAKAGE SENSORS CAN BE CONNECTED.
PAREO DCM711 PUMP MODULE
Float switch
PT100
CT1
CT2
FLS
MI
WS011928B


2250
2290
MAIN TERMINAL BOARD
SENSORS
W2 U2 V2
U1 V1 W1
T1 T2
T1 T2
T1 WH
T2 WH
THERMAL
DETECTORS
IN STATOR
MAX 250v
MAX 6A, cos φ =0,6
MAX 10A, cos φ =1
ALT.
T1
T2
D (DELTA)
JUMPERS
Y (STAR)
JUMPERS


2201.012
2201.020
2201.321
2201.390
2190.010
2190.390
TERMINAL BOARD
SEEN FROM OUTSIDE
TERMINAL BOARD
SEEN FROM INSIDE
U2
W2
T1
T2
V2
U1
V1
W1
T2
T1
U2
V2
W2
W1
V1
U1
D (DELTA)
JUMPERS
Y (STAR)
JUMPERS


2201.692
2190.690
2201.590
2201.590
SENSORS
TERMINAL BOARD
SEEN FROM OUTSIDE
WITHOUT DIODE
TERMINAL BOARD
SEEN FROM OUTSIDE
WITHOUT DIODE
TERMINAL BOARD
SEEN FROM OUTSIDE
WITH DIODE
T1
T2
U1
V1
W1
T1 WH
T2 WH
THERMAL
DETECTORS
IN STATOR
MAX 250v
MAX 6A, cos φ =0,6
MAX 10A, cos φ =1
CONNECTION
OF DIODE
DIODE

WS011929B

775 13 07_5

2190
2201
2250
2290
2400
2450

WS011930B

SYMBOLS AND DENOMINATIONS

BN=Brown
BK=Black
WH=White
OG=Orange
GN=Green
GNYE=Green-Yellow
RD=Red
GY=Grey
BU=Blue
YE=Yellow

=Terminal board
=Screen
=Ground
=Functional ground
=Crimp connection
=Crimp isolation
=Terminal block
=Current transformer
CT

GC= Ground check
A = Cable dimension in cable specification
Use on cables not in use

← Y/D

	Screen as ground conductor Functional ground to GC 2x (S3xA+3xA/3+S(4x0,5)) Cable 2	Cable 1	Screen as ground conductor 2x (S3xA+3A/3+4x1,5) Cable 2	Cable 1	Functional ground to GC 7GA+S(2x0,5)	7GA+2x1,5	2 x 4GA & 2x1,5 Cable 2 Pilot	Cable 1	4GA & 4GA+2x1,5 Cable 2	Cable 1	2x (A AWG/3-2-1-GC) Cable 2	Cable 1
L1		BN		BN	BK 1	BK 1		BN		BN		RD
L3		GY		GY	BK 3	BK 3		GY		GY		WH
L2		BK		BK	BK 2	BK 2		BK		BK		BK
L1	BN		BN		BK 4	BK 4	BN		BN		RD	
L3	GY		GY		BK 6	BK 6	GY		GY		WH	
L2	BK		BK		BK 5	BK 5	BK		BK		BK	
	T1 WH	T1 WH	T1	T1 WH	T1 WH	T1 WH	T1 WH		T1 WH			OR
	T2 WH	T2 WH	T2	T2 WH	T2 WH	T2 WH	T2 WH		T2 WH			BU
	T3 WH	T3 WH	T3	T3 WH							OR	
	T4 WH	T4 WH	T4	T4 WH							BU	
					GNYE	GNYE	GNYE	GNYE	GNYE	GNYE	GNYE	GNYE
											YE	YE

(GC) (GC)

DOL →

MOTOR CABLE CONNECTION TO TERMINAL BOARD →

Screen as ground conductor Functional ground to GC S3xA+3xA/3+S(4x0,5)	Functional ground to GC 4GA+S(2x0,5)	Screen as ground conductor S3xA+3A/3+4x1,5	4GA	4GA+2x1,5	Cable 2 2x 4GA+2x1,5	Cable 1	A AWG/4 & 2x1,5	A AWG/3-2-1-GC	Terminal board
BN	BN	BN	BN	BN	BN	BN	RD	RD	U1
GY	GY	GY	GY	GY	GY	GY	WH	WH	V1
BK	BK	BK	BK	BK	BK	BK	BK	BK	W1
									W2
									U2
									V2
T1 WH	T1 WH	T1 WH		T1 WH	T1 WH	T1 WH	T1 WH	OR	ALT. T1
T2 WH	T2 WH	T2 WH		T2 WH	T2 WH	T2 WH	T2 WH	BU	ALT. T2
T3 WH		T3 WH							ALT. T3
T4 WH		T4 WH							ALT. T4
	GNYE		GNYE	GNYE	GNYE	GNYE	GNYE	GNYE	
								YE	GC

(GC) (GC)

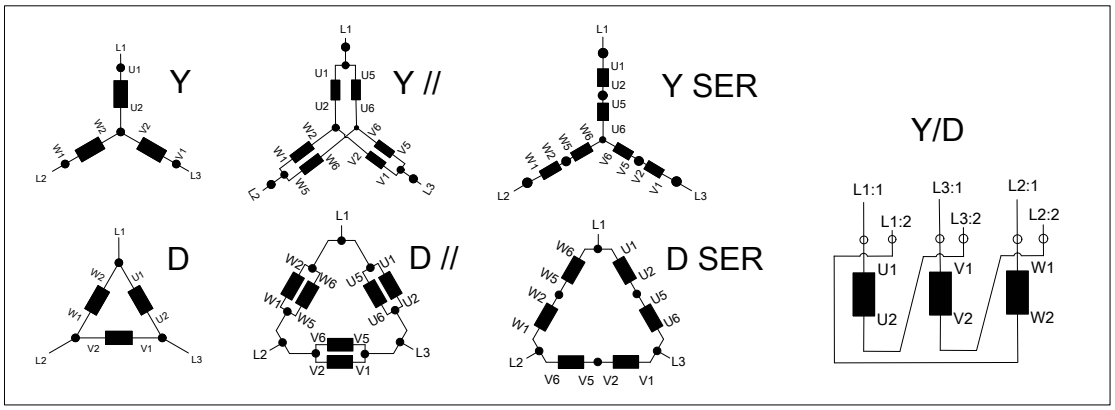
← STATOR LEADS AND THERMAL CONTACTS CONNECTION TO TERMINAL BOARD

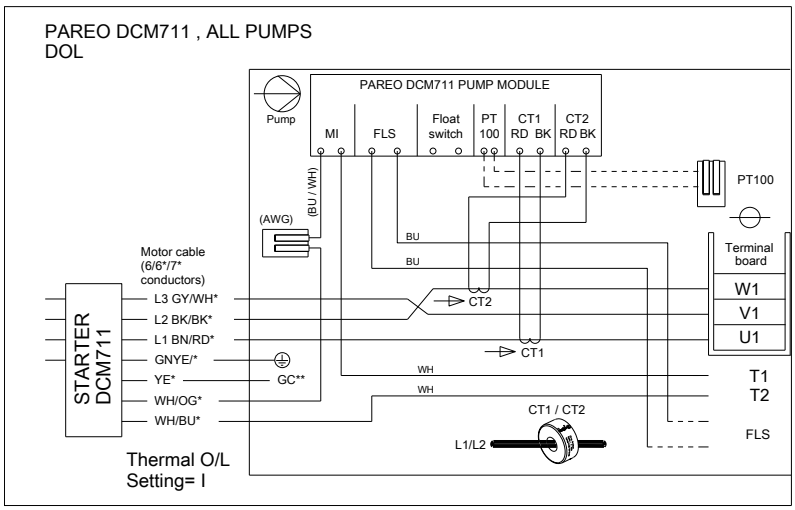
Terminal board	3 leads Y	6 leads D	6 leads Y	6 leads Y/D	9 leads Y serial	9 leads Y //	9 leads D serial	9 leads D//	12 leads Y //	12 leads D serial	12 leads D //
U1	U	U1	U1	U1	U1	U1 U5	U1	U1 U5 W2	U1 U5	U1 W6	U1 U5
V1	V	V1	V1	V1	V1	V1 V5	V1	V1 V5 U2	V1 V5	V1 U6	V1 V5
W1	W	W1	W1	W1	W1	W1 W5	W1	W1 W5 V2	W1 W5	W1 V6	W1 W5
W2	-	W2	W2	W2	U2 U5	U2	W2 W5	-	U6 V6 W6	W2 W5	W2 W6
U2	-	U2	U2	U2	V2 V5	V2	U2 U5	-	- - -	U2 U5	U2 U6
V2	-	V2	V2	V2	W2 W5	W2	V2 V5	-	U2 V2 W2	V2 V5	V2 V6
ALT. T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
ALT. T2	T2	T2	T2	T2	T2	T2	T2	T2	T2	T2	T2
ALT. T3	T3	T3	T3	T3	T3	T3	T3	T3	T3	T3	T3
ALT. T4	T4	T4	T4	T4	T4	T4	T4	T4	T4	T4	T4

GC

STATOR LEAD COLOURS

U1,U5	RD
U2,U6	GN
V1,V5	BN
V2,V6	BU
W1,W5	YE
W2,W6	BK
T1,T2	WH/YE
T3, T4	BK





WS011931B

* SUBCAB AWG/CSA cable

GC** Ground (earth) check

4.5 Check the impeller rotation

CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.

Check the direction of rotation each time the cable has been re-connected and after phase or total supply failure.

1. Start the motor.
2. Stop the motor.
3. Check that the impeller rotates in the correct direction.

   The correct direction of impeller rotation is clockwise when you look at the pump from above. When started, the pump will react in the opposite direction to the impeller rotation.

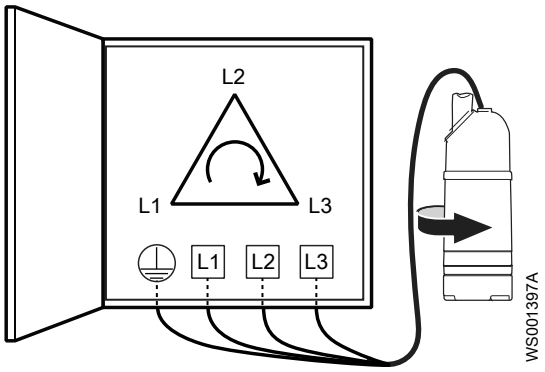


Figure 6: Start reaction

4. If the impeller rotates in the wrong direction, then do the following:
   – If the motor has a 3-phase connection, then transpose two phase conductors and repeat this procedure from step 1.

   For 3-phase pumps with external starters or without built-in motor protection, the phases must be shifted on the output terminal of the starter.

5 Operation

5.1 Precautions

Before taking the unit into operation, check the following:

- All recommended safety devices are installed.
- The cable and cable entry have not been damaged.
- All debris and waste material has been removed.

NOTICE:

Never operate the pump with the discharge line blocked, or the discharge valve closed.

WARNING: Crush Hazard

Risk of automatic restart.

Distance to wet areas

WARNING: Electrical Hazard

Risk of electrical shock or burn. You must connect an additional ground- (earth-) fault protection device to the grounded (earthed) connectors if persons are likely to come into contact with liquids that are also in contact with the pump or pumped liquid.

CAUTION: Electrical Hazard

Risk of electrical shock or burn. The equipment manufacturer has not evaluated this unit for use in swimming pools. If used in connection with swimming pools then special safety regulations apply.

Noise level

NOTICE:

The sound power level of the product is lower than 70 dB(A). However, in some installations the resulting sound pressure level may exceed 70 dB(A) at certain operating points on the performance curve. Make sure that you understand the noise level requirements in the environment where the product is installed. Failure to do so may result in hearing loss or violation of local laws.

Do not allow the pump to snore or run dry

The equipment must never run dry during operation. The volute must be filled with liquid during operation.

Dry running during service and inspection is only permitted for brief periods of time.

5.2 Start the pump

CAUTION: Crush Hazard

The starting jerk can be powerful. Make sure nobody is close to the unit when it is started.

CAUTION: Thermal Hazard

The surfaces or parts of the unit may become hot during operation. Allow surfaces to cool before starting work, or wear heat-protective clothing.

NOTICE:

Make sure that the rotation of the impeller is correct. For more information, see Check the impeller rotation.

1. Inspect the pump. Check that there is no physical damage to the pump or cables.
2. Check the oil level in the oil housing.
3. Remove the fuses or open the circuit breaker, and check that the impeller can rotate freely.

WARNING: Crush Hazard

Never put your hand into the pump housing.

4. Check that the monitoring equipment (if any) works.
5. Check that the impeller rotation is correct.
6. Start the pump.

5.3 Clean the pump

The pump must be cleaned if it has been running in very dirty water. If clay, cement or other similar dirt is left in the pump it may clog the impeller and seal, preventing the pump from working.

Let the pump run for a while in clean water, or flush it through the discharge connection.

6 Maintenance

6.1 Precautions

Before starting work, make sure that the safety instructions have been read and understood.

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

WARNING: Biological Hazard

Infection risk. Rinse the unit thoroughly with clean water before working on it.

CAUTION: Crush Hazard

Make sure that the unit cannot roll or fall over and injure people or damage property.

Make sure that you follow these requirements:

- Check the explosion risk before you weld or use electrical hand tools.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product and its components have been thoroughly cleaned.
- Before starting work, make sure that the work area is well-ventilated.
- Do not open any vent or drain valves 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.

Ground continuity verification

A ground (earth) continuity test must always be performed after service.

6.2 Maintenance guidelines

During the maintenance and before reassembly, always remember to perform these tasks:

- Clean all parts thoroughly, particularly O-ring grooves.
- Change all O-rings, gaskets, and seal washers.
- Lubricate all springs, screws, O-rings with grease.

During the reassembly, always make sure that existing index markings are in line.

The reassembled drive unit must always be insulation-tested and the reassembled pump must always be test-run before normal operation.

6.3 Torque values

All screws and nuts must be lubricated to achieve correct tightening torque. Screws that are screwed into stainless steel must have the threads coated with applicable lubricants to prevent seizing.

If there is a question regarding the tightening torques, then contact a sales or authorized service representative.

Screws and nuts

Table 1: Stainless steel, A2 and A4, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
50	1.0 (0.74)	2.0 (1.5)	3.0 (2.2)	8.0 (5.9)	15 (11)	27 (20)	65 (48)	127 (93.7)	220 (162)	434 (320)
70, 80	2.7 (2)	5.4 (4)	9.0 (6.6)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
100	4.1 (3)	8.1 (6)	14 (10)	34 (25)	66 (49)	115 (84.8)	248 (183)	481 (355)	—	—

Table 2: Steel, torque Nm (lbf·ft)

Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
8.8	2.9 (2.1)	5.7 (4.2)	9.8 (7.2)	24 (18)	47 (35)	81 (60)	194 (143)	385 (285)	665 (490)	1310 (966.2)
10.9	4.0 (2.9)	8.1 (6)	14 (10)	33 (24)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
12.9	4.9 (3.6)	9.7 (7.2)	17 (13)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825.1)	2210 (1630)

Table 3: Brass, torque Nm (lbf·ft)

M5	M8	M10
2.7 (2.0)	11 (8.1)	22 (16.2)

Hexagon screws with countersunk heads

For hexagon socket head screws with countersunk head, maximum torque for all property classes must be 80% of the values for property class 8.8.

Round nuts with set screws

Table 4: Set screw, torque Nm (lbf·ft)

The torque values are only valid for the set screw, and not for the round nut.

M8	M10
18 (13)	35 (26)

6.4 Service

Regular inspection and service of the pump ensures more reliable operation.

Type of service	Purpose	Inspection interval
Inspection	To prevent operational interruptions and machine breakdown. Measures to secure performance and pump efficiency are defined and decided for each individual application. It can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	Twice a year
Overhaul	To secure a long operating lifetime for the product. It includes replacement of key components and the measures taken during an inspection.	Every year, under normal operating conditions

NOTICE:

Shorter intervals may be required when the operating conditions are extreme, for example with very abrasive or corrosive applications or when the liquid temperatures exceed 40°C (104°F).

6.4.1 Inspection

Regular inspection and service of the pump ensures more reliable operation.

Service item	Action
Visible parts on the pump and installation	1. Check that all screws, bolts, and nuts are properly tightened. 2. Check the condition of the cooling jacket, strainer, cover, lifting handles, eye bolts, ropes, chains, and wires. 3. Check for worn or damaged parts. 4. Adjust and/or replace if necessary.
Pipes, valves, and other peripheral equipment	1. Check for worn or damaged parts. 2. Adjust and/or replace if necessary.
Impeller	1. Check for worn or damaged parts. 2. Adjust and/or replace if necessary. Wear on the impeller or surrounding parts necessitates fine adjustments of the impeller or replacement of worn parts.
Oil	Check the oil: 1. Take an oil sample. 2. If the oil contains particles, then replace the mechanical seal. Contact an authorized service shop. Make sure that the volume is filled to the correct level. A smaller amount of water is not harmful for the mechanical seal.
Cable entry	1. Check that the following requirements are met: – The cable clamps must be properly tightened. – The seal sleeve and the washers must conform to the outside diameter of the cables. 2. Cut off a piece of the cable so that the seal sleeve closes around a new position on the cable. 3. Replace the seal sleeve, if necessary.

Service item	Action
Inspection volume[1]	1. Remove the inspection screw. 2. Drain all liquid, if any. 3. If there is oil in the inspection volume, then empty the oil and check again after one week. If there is oil in the inspection volume again, then replace the mechanical seal. Contact an authorized service shop. 4. If there is water in the inspection volume, then check that the inspection screw O-ring is not damaged. 5. Check that the inspection screw is properly tightened.
Cable	1. If the outer jacket is damaged, then replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched.
Cooling system	If the flow through the system has been partly restricted, then rinse and clean.
Level sensors or other sensor equipment	1. Check the functionality. 2. Repair or replace any damaged equipment. 3. Clean and adjust the equipment.
Starter equipment	1. Check the condition and functionality. 2. Contact an electrician, if necessary.
Insulation resistance in the stator	1. Check the insulation between: – Phase–phase on the stator – Phase–ground (earth) The insulation should be > 1 megaohm. Use a 1000-VDC megger to test the insulation. 2. If the resulting value is < 1 megaohm, then contact an authorized service shop.

6.4.2 Overhaul

The basic repair kit includes O-rings, seals, and bearings.

For an overhaul, do the following in addition to the tasks listed under Inspection.

Service item	Action
Support and main bearing	Replace the bearings with new bearings.
Mechanical seal	Replace with new seal units.

6.5 Change the oil

A paraffin oil with viscosity close to ISO VG32 is recommended. The pump is delivered from the factory with this type of oil. Examples of suitable oil types are the following:

- Statoil MedicWay 32™
- BP Enerpar M 004™
- Shell Ondina 927™
- Shell Ondina X430™

In applications where poisonous properties are of less concern, a mineral oil with viscosity up to ISO VG32 can be used.

Empty the oil

1. Lay the pump on its side.

   Lock the pump with supports to prevent it from rolling over.
2. Remove the oil plug.
3. Remove the oil screw.

[1] Regardless of individual applications, the inspection volume should not be inspected less frequently than the intervals for normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).

There are two oil screws. Either screw can be used for drainage, but it is easier to drain the oil if both oil screws are removed.

CAUTION: Compressed Gas Hazard

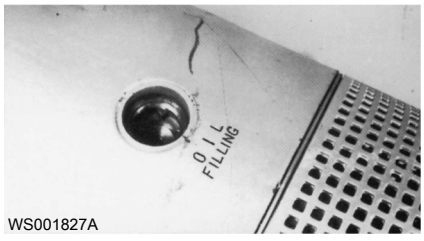
Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

4. Fit the oil drainage tube (optional).
   The tube is included with the pump at delivery.
5. Turn the pump so that the oil hole faces downwards and let the oil run out into a container.

Fill with oil

1. Replace the oil screw O-ring.
2. Put one of the oil screws back and tighten it.
3. Put the corresponding oil plug back.
4. Turn the pump so that the oil hole faces up and fill by using new oil.

Pump	Oil Quantity, L (qt)
– 2190.010 – 2190.320 – 2190.390 – 2190.690 – 2201.012 – 2201.020 – 2201.321 – 2201.390 – 2201.590 – 2201.692	5 (5.3)



5. Put the oil screw back and tighten it.
   Tightening torque: 10–20 Nm (7.4–15 lbf·ft)
6. Put the oil plug back.

6.6 Replace the impeller

Before you replace the impeller, drain the oil in the oil housing. See applicable steps in *Change the oil* on page 38.

6.6.1 Remove the impeller, alternative 1, shaft with shaft key

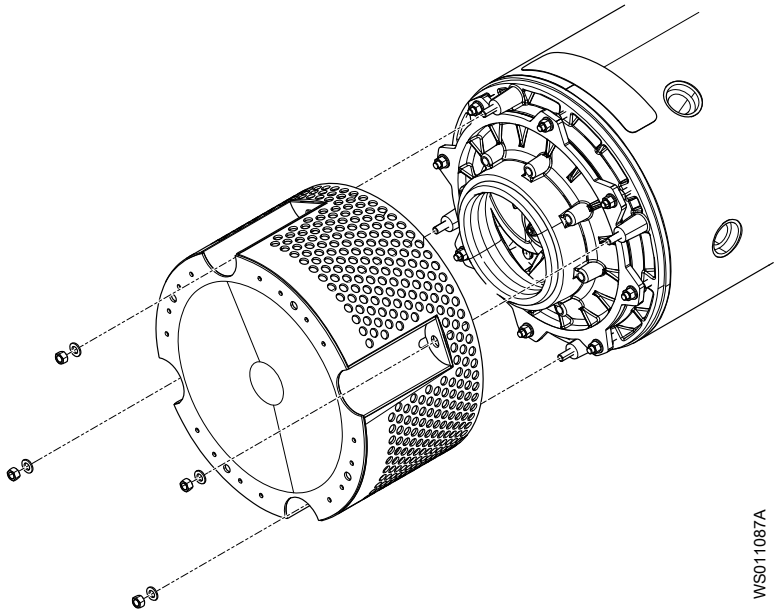
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

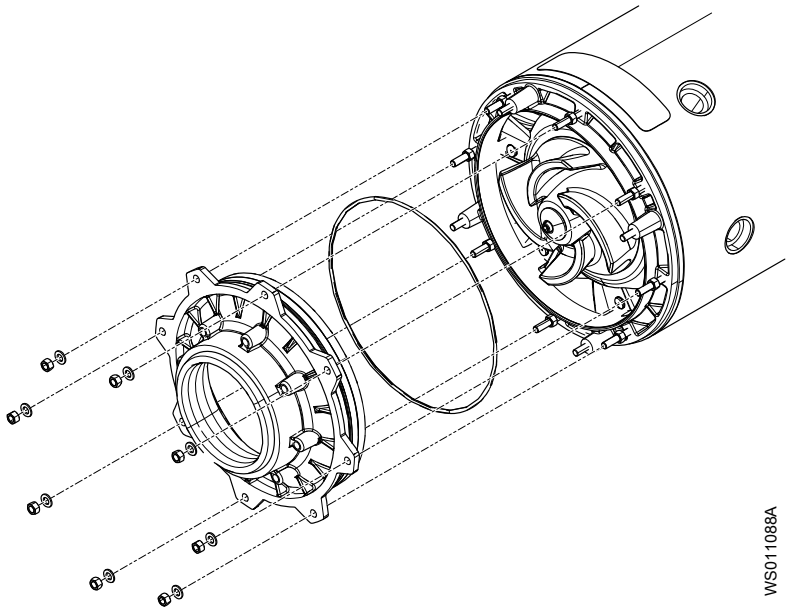
Table 5: Applicability

Product code	Pressure class	Open or closed impeller
2201.020	LT	Open
2201.590	MT, HT	Open

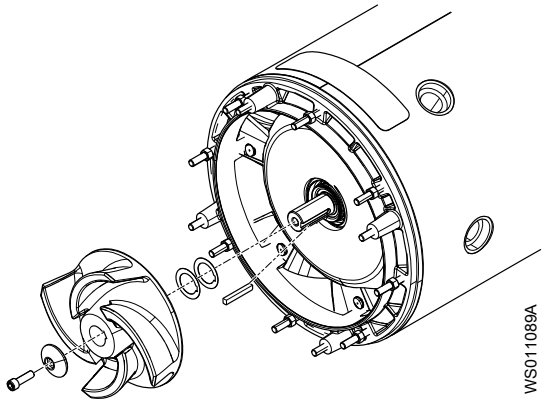
1. Lay the pump on its side or turn it upside down.
2. Remove the strainer.



3. Remove the suction cover.



4. Remove the impeller:
   a) Remove the impeller nut.
      For 2201.020, the fastener is a screw.
   b) Remove the washer.
   c) Pull off the impeller.
      Use an impeller puller or pry off carefully with two strong screwdrivers or bars.



6.6.2 Remove the impeller, alternative 2, conical sleeve, HT closed impeller

CAUTION: Cutting Hazard

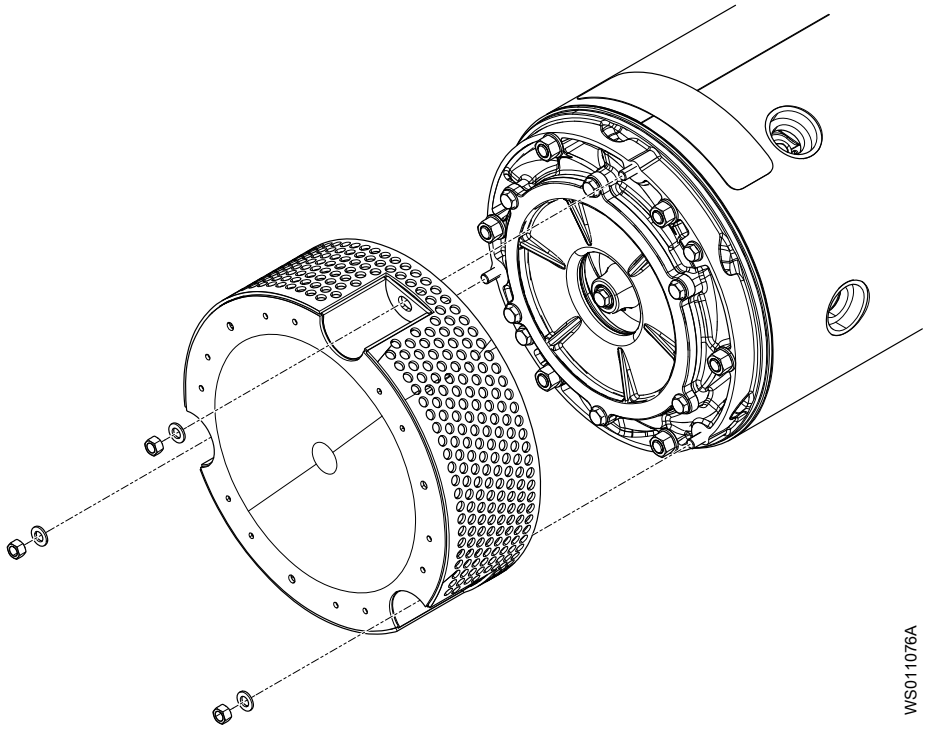
Worn parts can have sharp edges. Wear protective clothing.

Table 6: Applicability

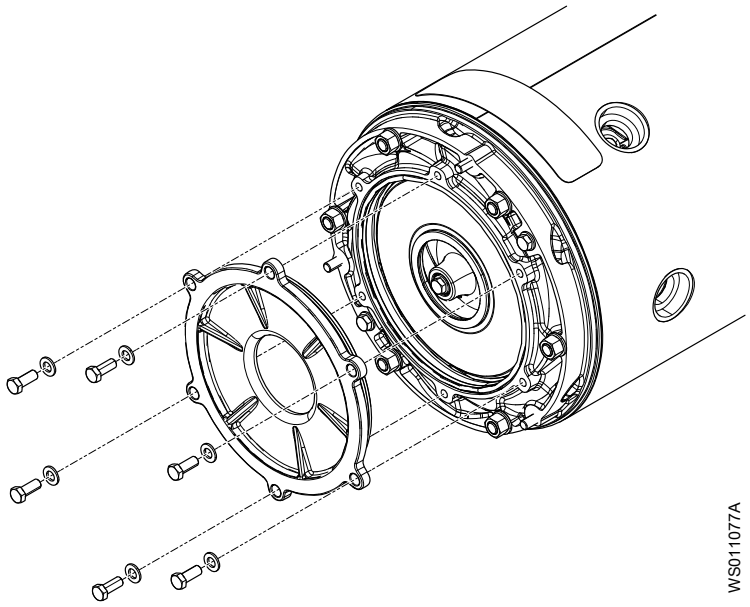
Product code	Pressure class	Open or closed impeller
2190.010	HT	Closed
2190.320	HT	Closed
2190.390	HT	Closed
2190.690	HT	Closed
2201.012	HT	Closed
2201.321	HT	Closed
2201.390	HT	Closed

Product code	Pressure class	Open or closed impeller
2201.692	HT	Closed

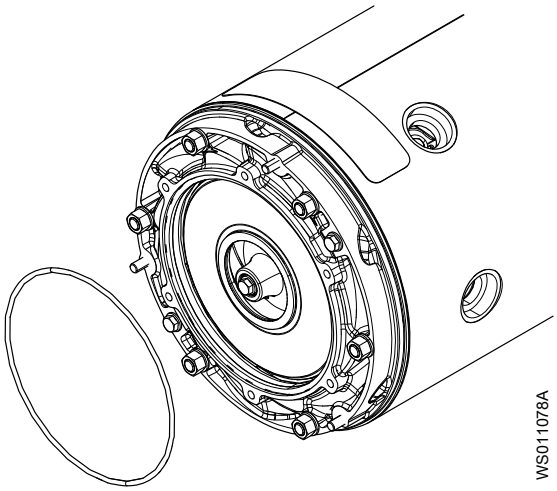
1. Remove the strainer.



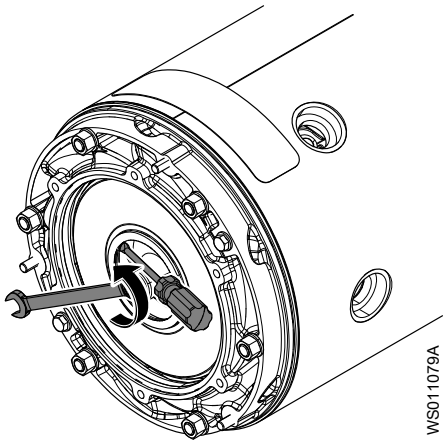
2. Remove the suction cover.



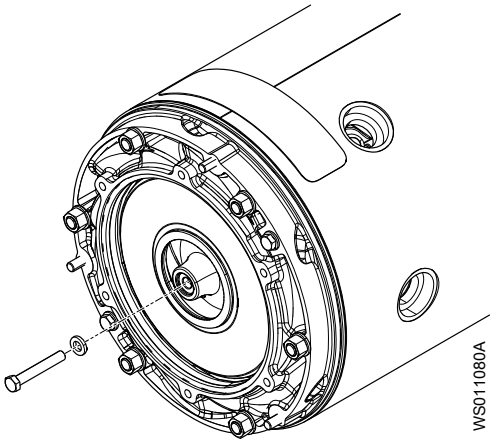
3. Remove the O-ring.



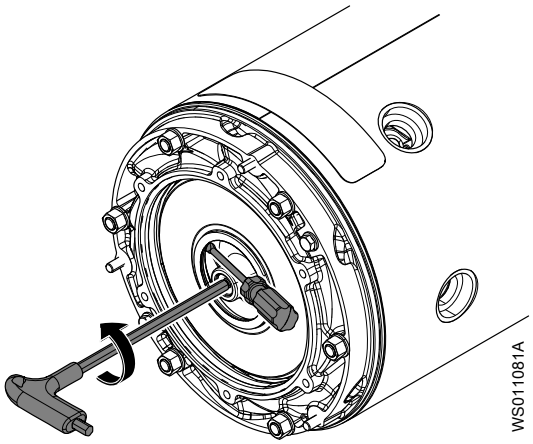
4. Loosen the impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.



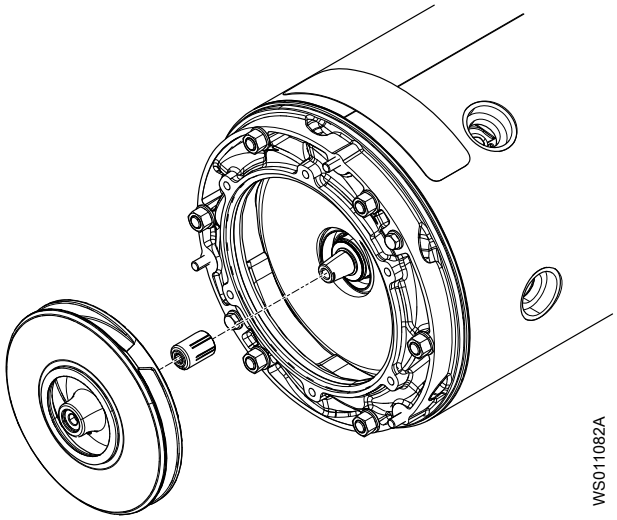
   b) Remove the impeller screw and the washer.



5. Remove the impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.
   b) Turn the adjustment screw counterclockwise until the impeller loosens from the shaft.
      Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



c) Pull off the impeller.



6.6.3 Remove the impeller, alternative 3, conical sleeve, SH closed impeller

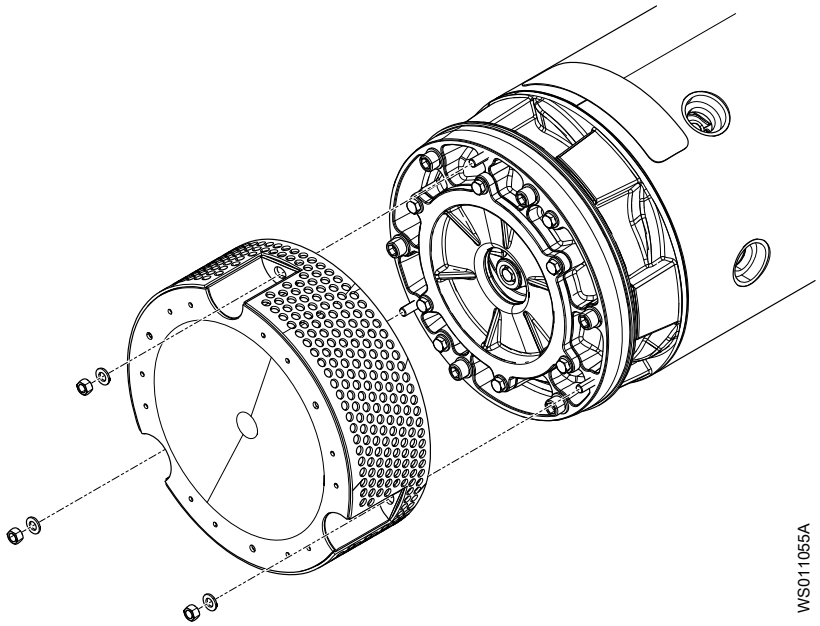
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

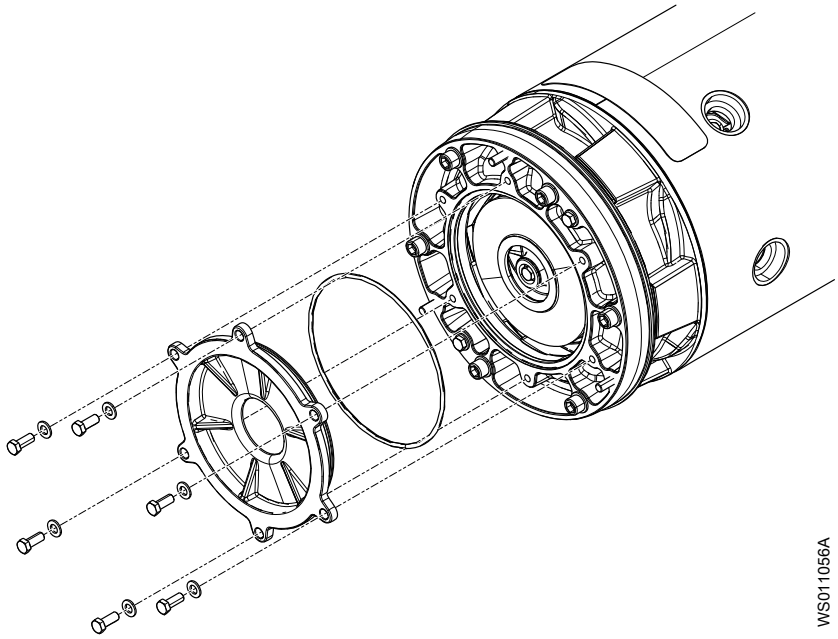
Table 7: Applicability

Product code	Pressure class	Open or closed impeller
2201.012	SH	Closed
2201.321	SH	Closed
2201.390	SH	Closed
2201.590	SH	Closed
2201.692	SH	Closed

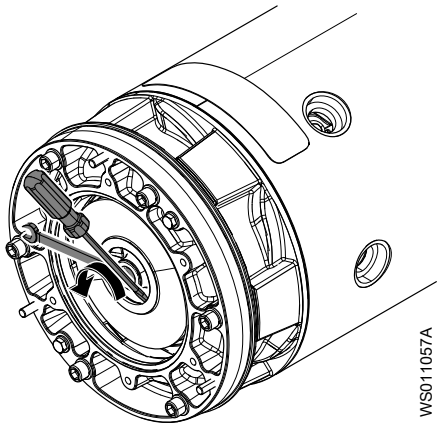
1. Remove the strainer.



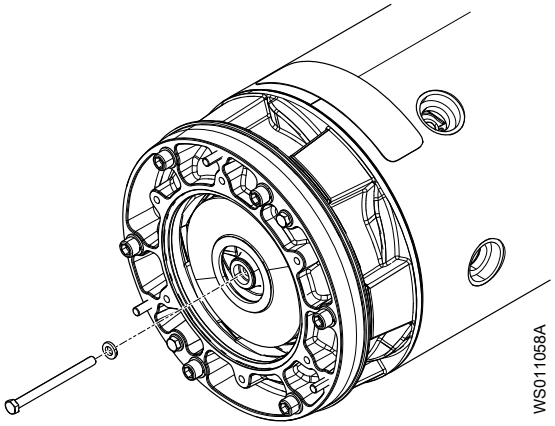
2. Remove the suction cover.



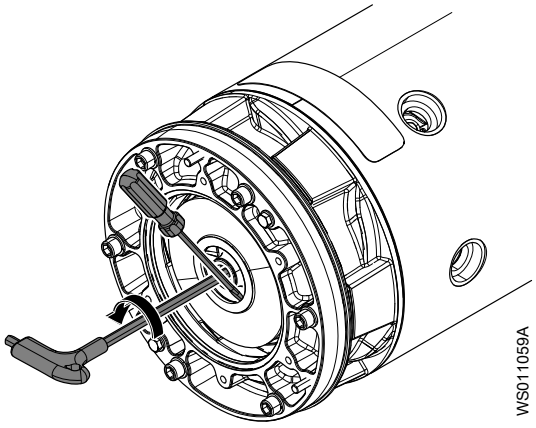
3. Loosen the lower impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.



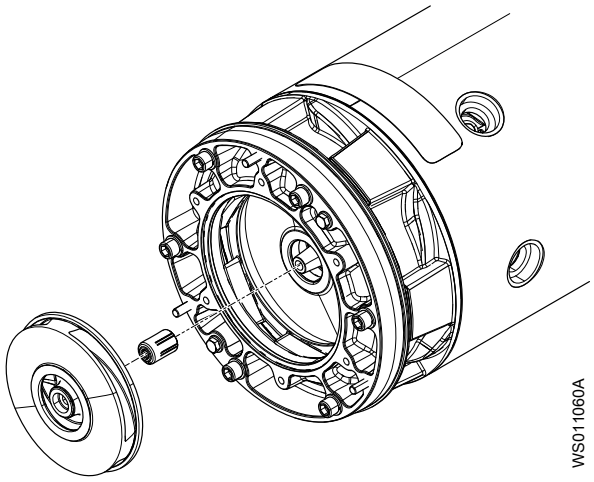
b) Remove the impeller screw and the washer.



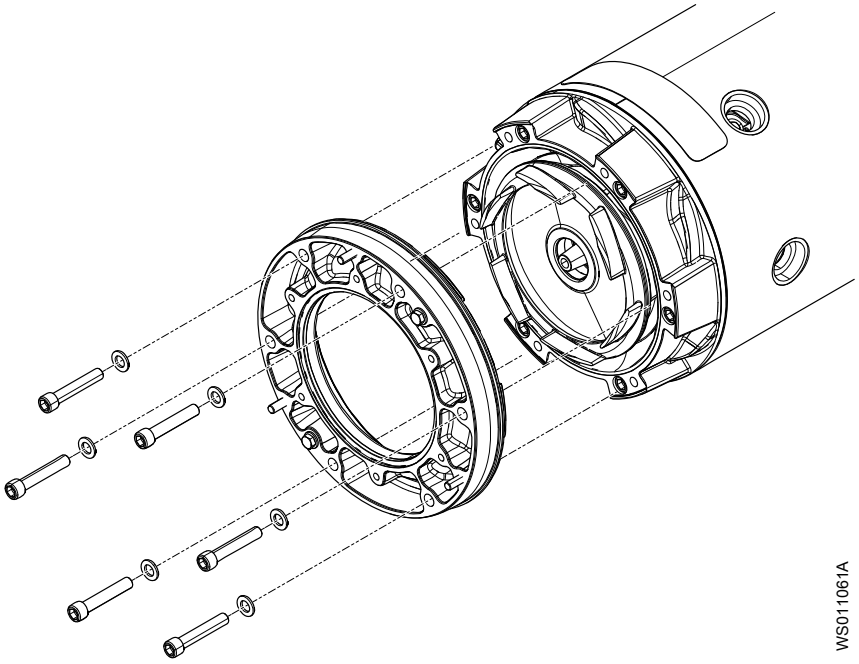
4. Remove the lower impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.
   b) Turn the adjustment screw counterclockwise until the impeller loosens from the shaft.
      Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



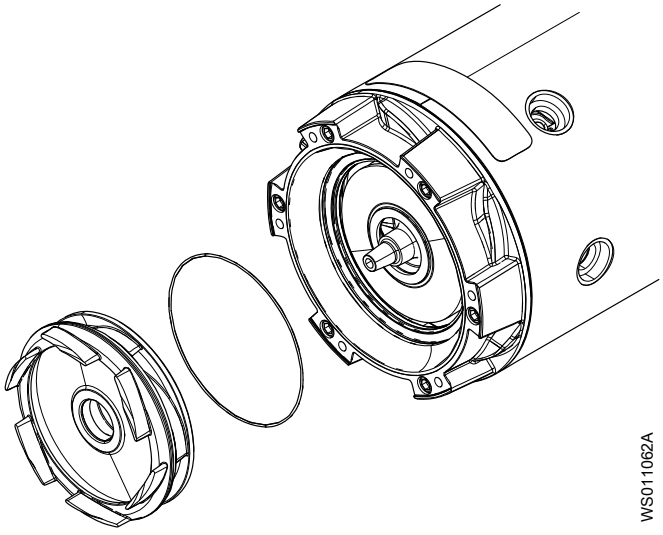
   c) Pull off the impeller.



5. Remove the lower diffuser.



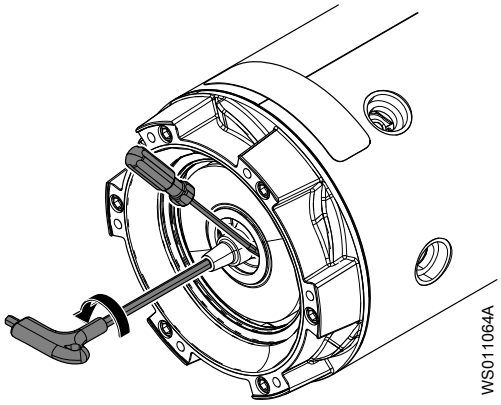
6. Remove the inner diffuser.



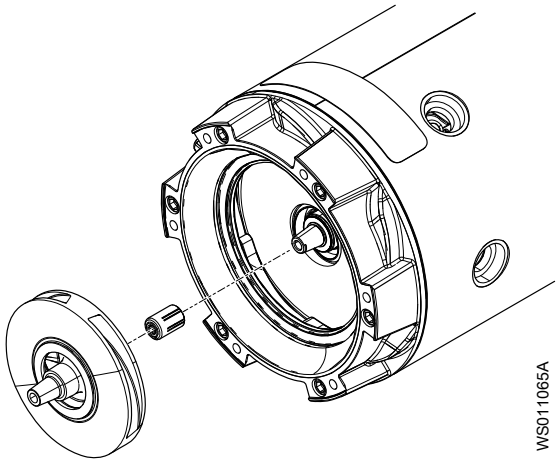
7. Remove the upper impeller:
   a) Lock the impeller to prevent rotation.

Use pliers, a screwdriver, or similar.

b) Turn the adjustment screw counterclockwise until the impeller loosens from the shaft.
Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



c) Pull off the impeller.



6.6.4 Remove the impeller, alternative 4, conical sleeve, HT/MT open impeller

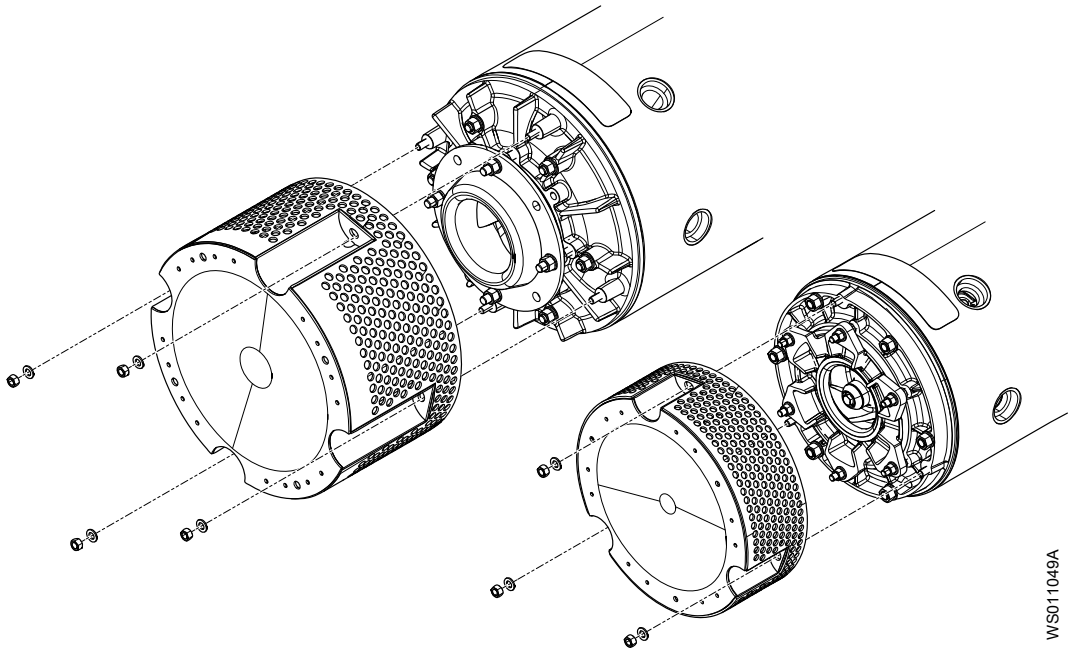
CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

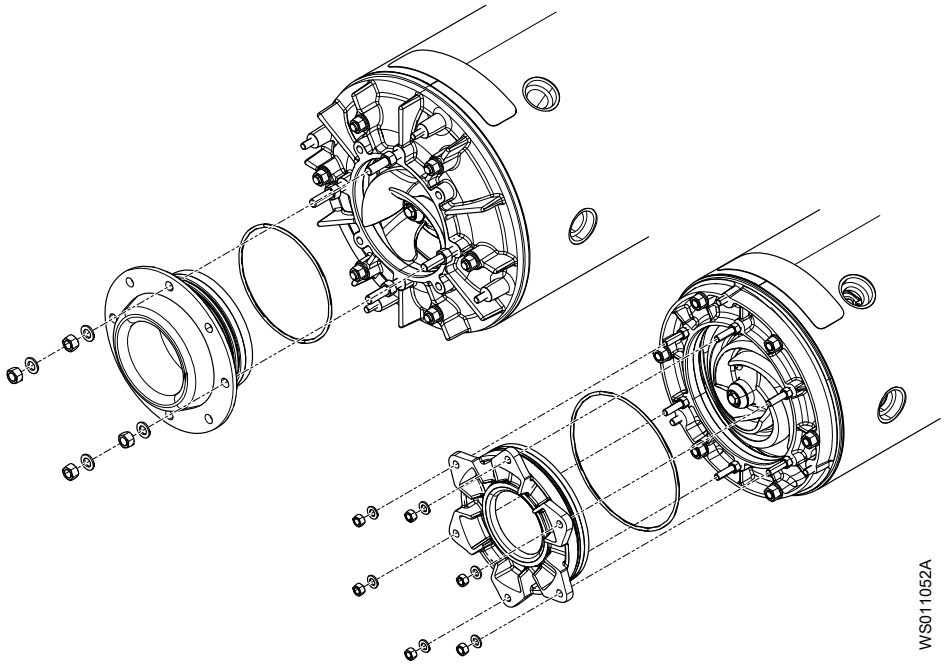
Table 8: Applicability

Product code	Pressure class	Open or closed impeller
2190.010	HT	Open
2190.320	HT	Open
2190.390	HT	Open
2190.690	HT	Open
2201.012	MT, HT	Open
2201.321	MT, HT	Open
2201.390	MT, HT	Open
2201.692	MT, HT	Open

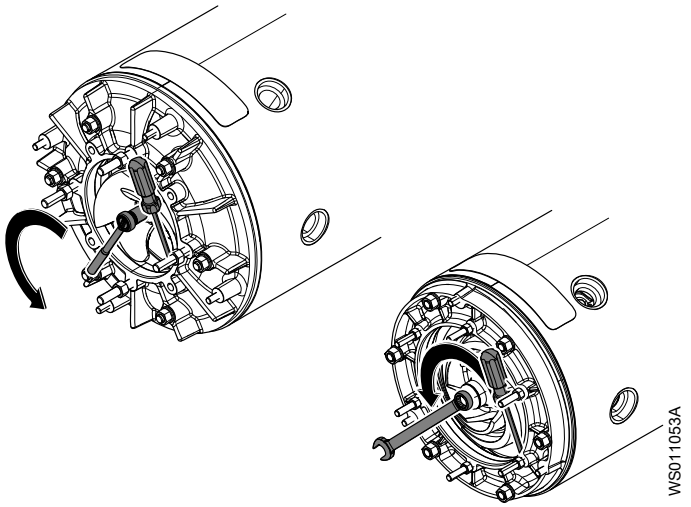
1. Remove the strainer.



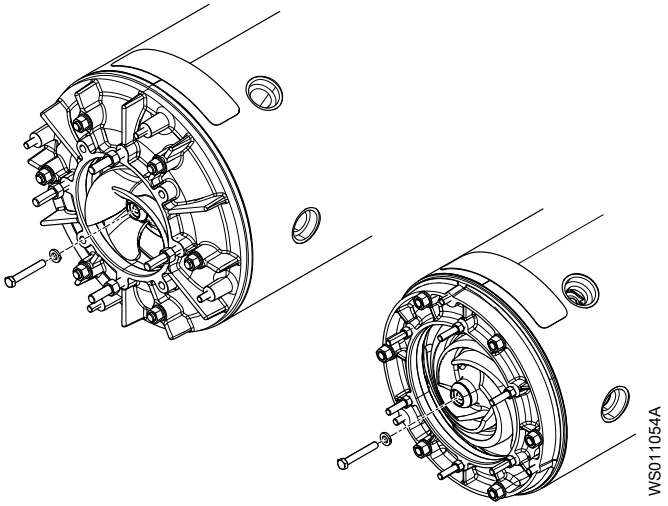
2. Remove the suction cover.



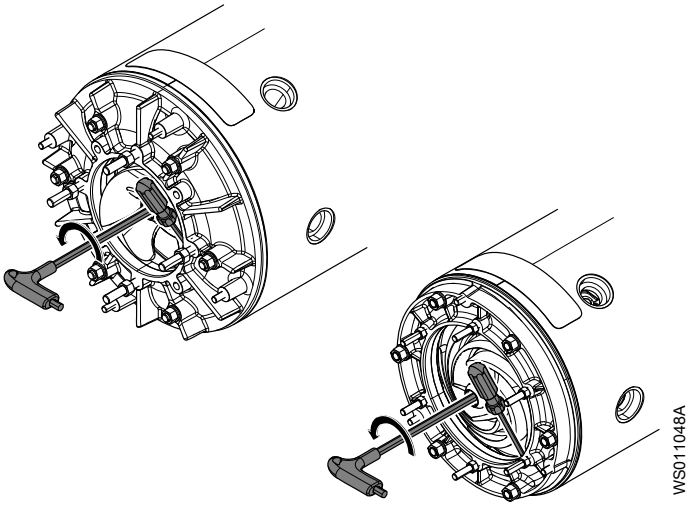
3. Loosen the impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.



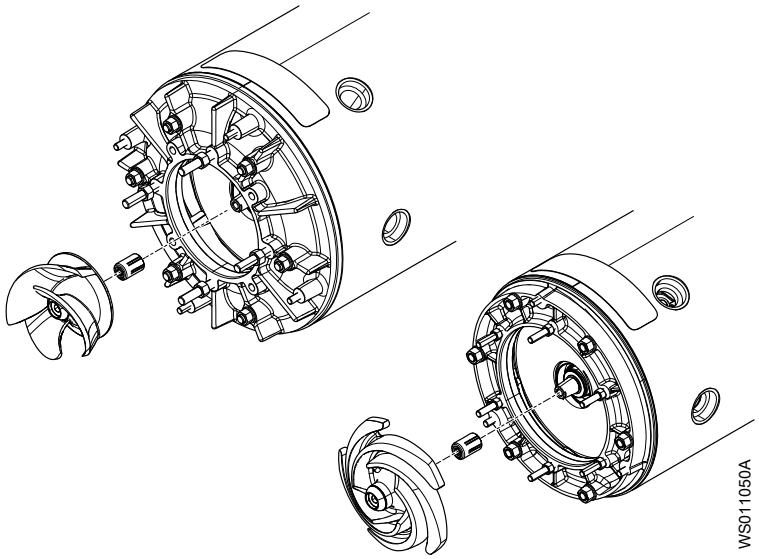
b) Remove the impeller screw and the washer.



4. Remove the impeller:
   a) Lock the impeller to prevent rotation.
      Use pliers, a screwdriver, or similar.
   b) Turn the adjustment screw counterclockwise until the impeller loosens from the shaft.
      Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



   c) Pull off the impeller.



6.6.5 Install the impeller, alternative 1, shaft with shaft key

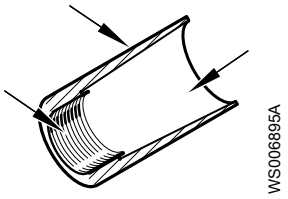
Table 9: Applicability

Product code	Pressure class	Open or closed impeller
2201.020	LT	Open
2201.590	MT, HT	Open

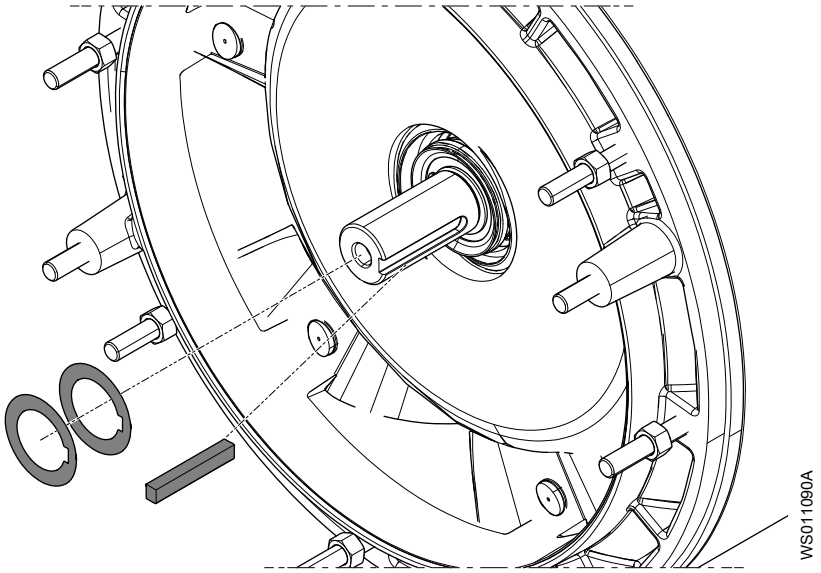
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.
      The end of the shaft must be clean and free from burrs.
   b) Grease the end of the shaft and the impeller hub.
      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

      NOTICE:
      Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

      NOTICE:
      For stainless steel impellers, use molybdenum disulphide (MoS_2). Do not apply MoS_2 on sealings.

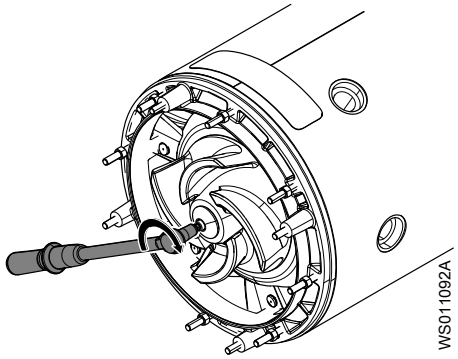


   c) Insert the key in the keyway of the shaft.
   d) Fit an applicable number of adjusting washers on the shaft.



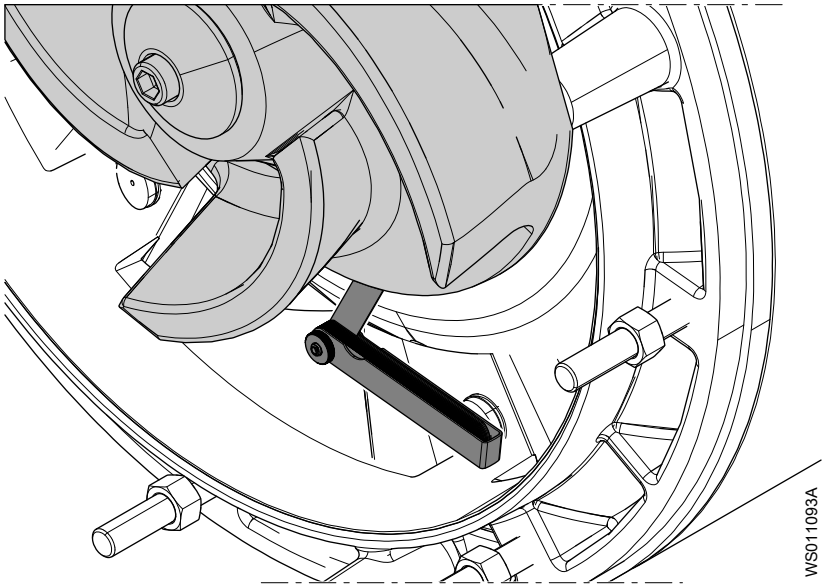
2. Fit the washer and the nut. For 2201.020, the fastener is a screw.
3. Tighten the impeller nut. For 2201.020, the fastener is a screw.

Product code	Tightening torque, Nm (lbf·ft)
2201.020	76 (57) Tighten a further 1/8 turn, 45° after tightening to the correct torque.
2201.590	200 (150)

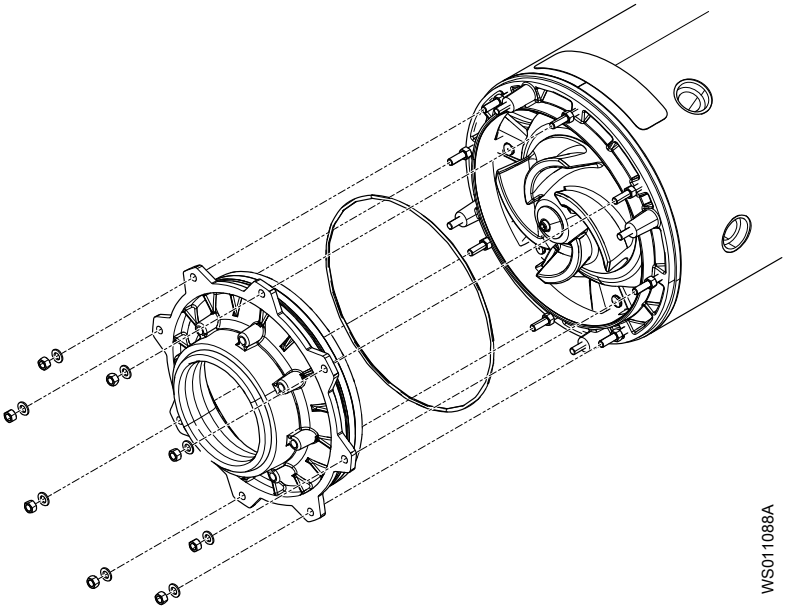


4. Use the washer to secure the nut.
5. Check that the impeller can rotate freely.
6. Use the adjusting washers to adjust the impeller clearance.

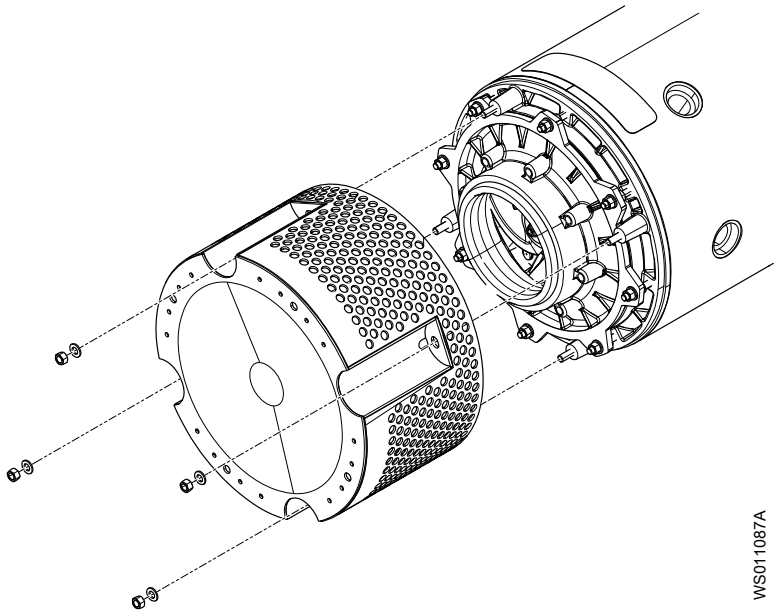
   The impeller clearance should be 0.2–0.3 mm (0.008–0.012 in) when the impeller is tightened.



7. Install and adjust the suction cover.
   See *Adjust the suction cover: open impeller* on page 67.



8. Install the strainer.



6.6.6 Install the impeller, alternative 2, conical sleeve, HT closed impeller

Table 10: Applicability

Product code	Pressure class	Open or closed impeller
2190.010	HT	Closed
2190.320	HT	Closed
2190.390	HT	Closed
2190.690	HT	Closed
2201.012	HT	Closed
2201.321	HT	Closed
2201.390	HT	Closed
2201.692	HT	Closed

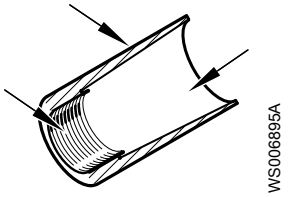
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.

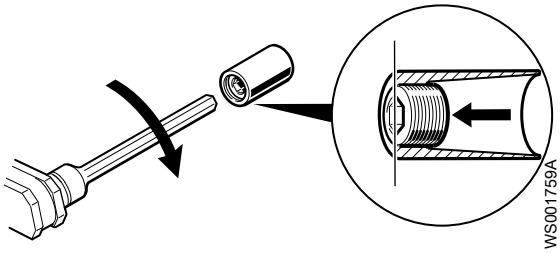
      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

      NOTICE:

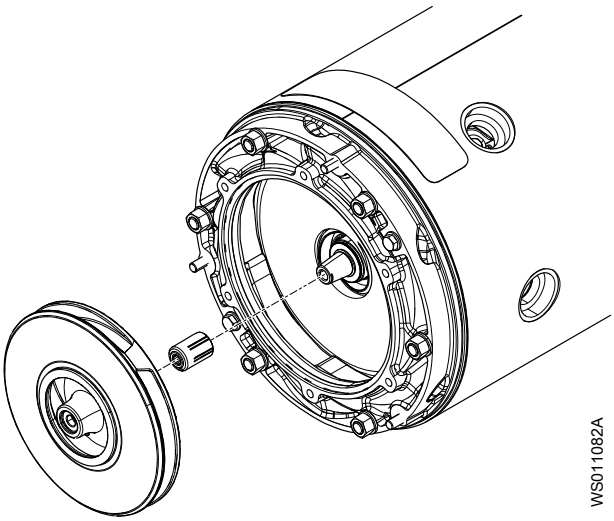
      Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



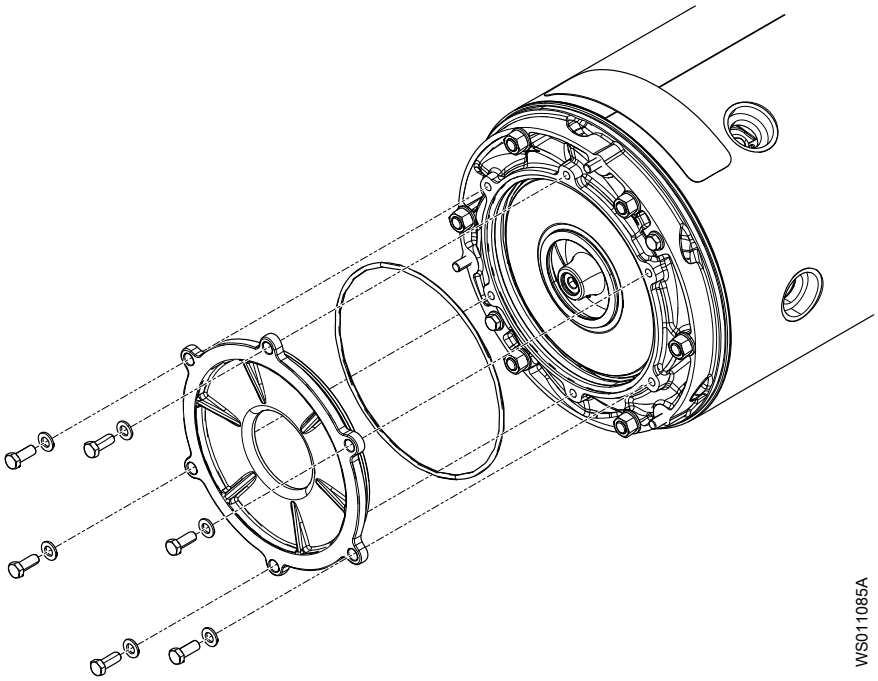
2. Align the edge of the adjustment screw with the edge of the conical sleeve so that they are flush.



3. Lubricate the threads of the impeller screw and the washer.
   The correct lubrication of the screw and washer is lubricating grease for assembly of bolts, and so forth. Example: Kluber ALTEMP Q NB 50.
4. Check that the impeller screw is clean and easy to screw into the shaft end.
   This is to prevent the shaft from rotating with the impeller screw.
5. Assemble the conical sleeve in the impeller.
   Make sure that the conical sleeve bottoms in the impeller.



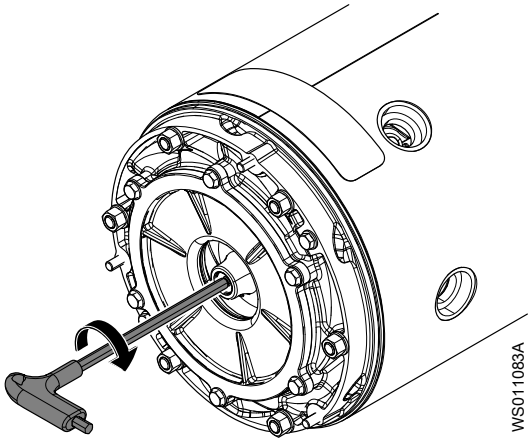
6. Assemble the impeller with the conical sleeve onto the shaft.
   Make sure that the conical sleeve bottoms in the impeller.
7. Install the suction cover and its O-ring and tighten.
   Tightening torque: 76 Nm (57 lbf·ft)



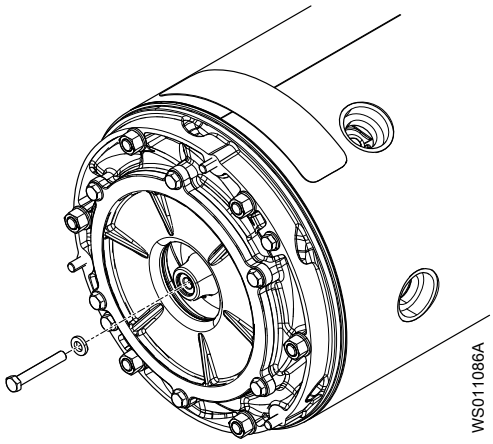
8. Turn the adjustment screw clockwise until the impeller makes contact with the suction cover. Tighten a further 1/8 turn, 45°.

   This will ensure the correct clearance between the impeller and the suction cover in the next step.

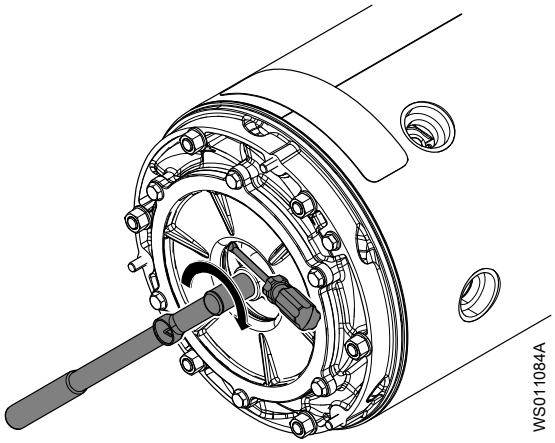
   Use a 12 mm hexagon bit adapter (Allen socket).



9. Attach the impeller:
   a) Put the washer on the impeller screw.

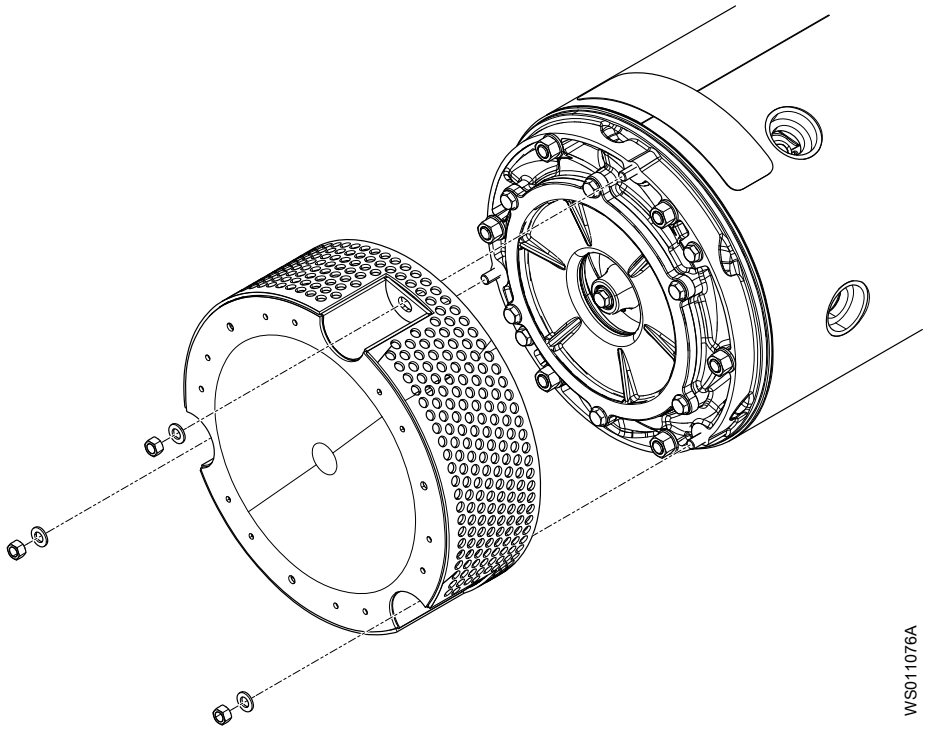


b) Lock the impeller to prevent rotation.
   Use pliers, a screwdriver, or similar.
c) Tighten the impeller screw.
   Tightening torque: 76 Nm (57 lbf·ft)



d) Tighten a further 1/8 turn, 45°.
   The screw becomes loaded to its yield point and the load capacity of the joint becomes higher.
e) Check that the impeller can rotate freely.

10. Install the strainer and the nuts.
    Tightening torque: 76 Nm (57 lbf·ft)



6.6.7 Install the impeller, alternative 3, conical sleeve, SH closed impeller

Table 11: Applicability

Product code	Pressure class	Open or closed impeller
2201.012	SH	Closed
2201.321	SH	Closed
2201.390	SH	Closed
2201.590	SH	Closed
2201.692	SH	Closed

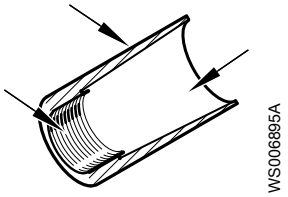
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.

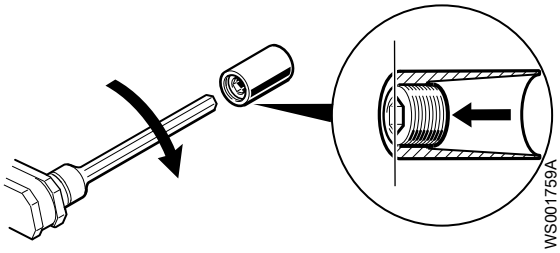
      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

      NOTICE:

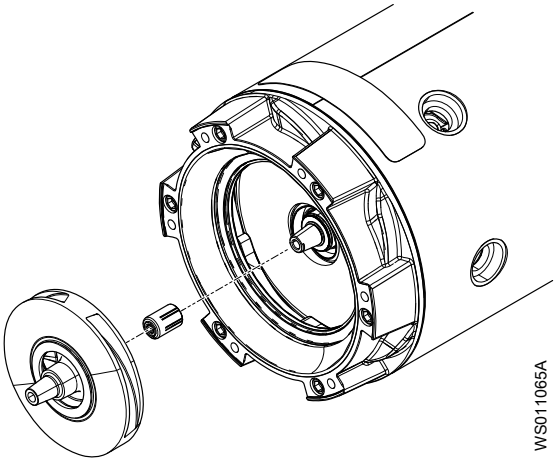
      Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



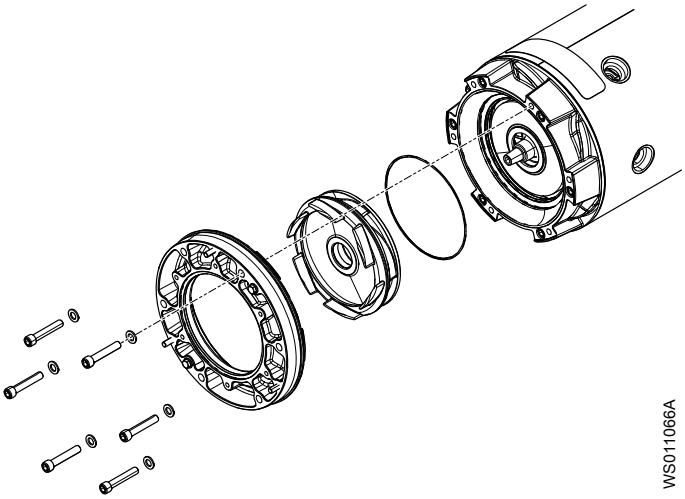
2. Align the edge of the upper adjustment screw with the edge of the upper conical sleeve so that they are flush.



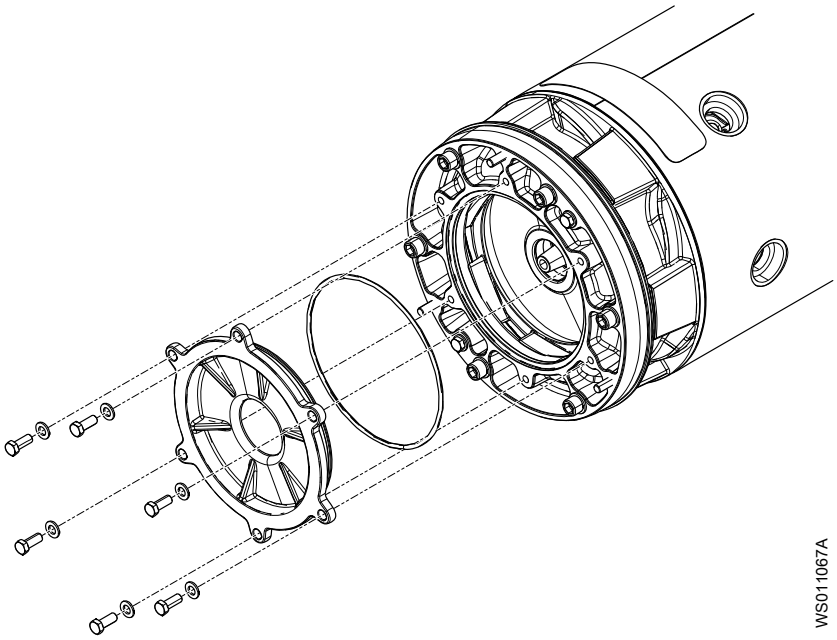
3. Lubricate the threads of the impeller screw and the washer.
   The correct lubrication of the screw and washer is lubricating grease for assembly of bolts, and so forth. Example: Kluber ALTEMP Q NB 50.
4. Check that the impeller screw is clean and easy to screw into the shaft end.
   This is to prevent the shaft from rotating with the impeller screw.
5. Assemble the upper conical sleeve and the upper impeller onto the shaft.



6. Install the diffuser parts and tighten.



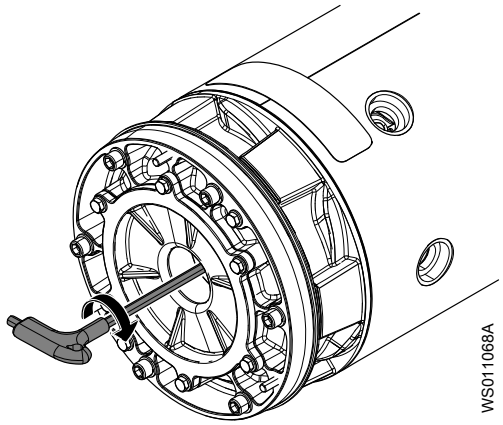
7. Install the suction cover and its O-ring and tighten.
   Tightening torque: 76 Nm (57 lbf·ft)



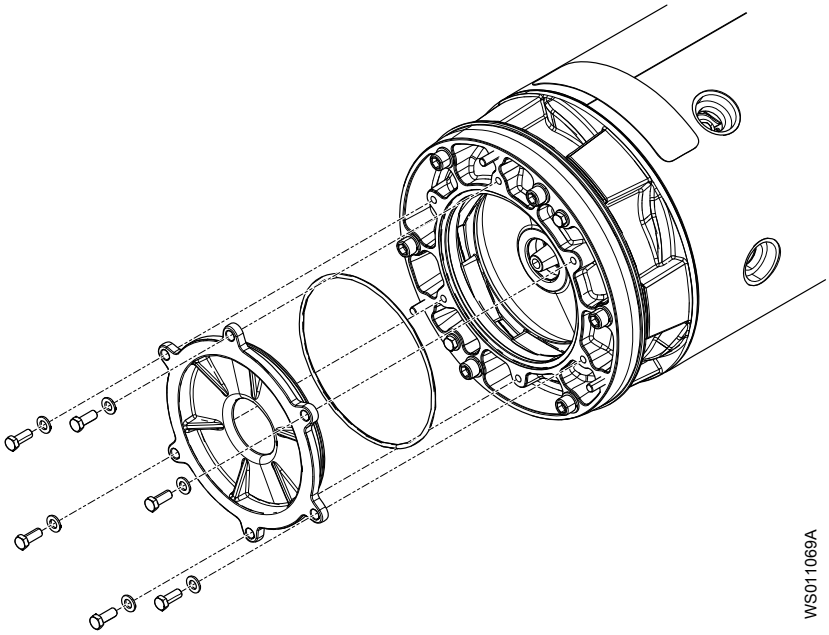
8. Turn the upper adjustment screw clockwise until the upper impeller makes contact with the suction cover.

   This will verify the correct clearance between the impeller and the suction cover in the next step.

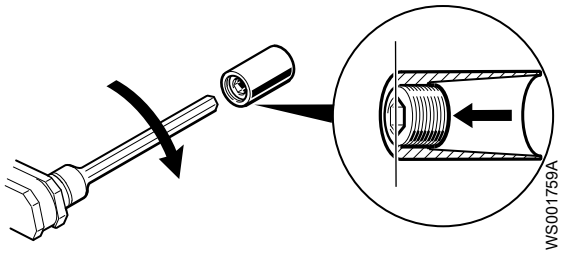
   Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



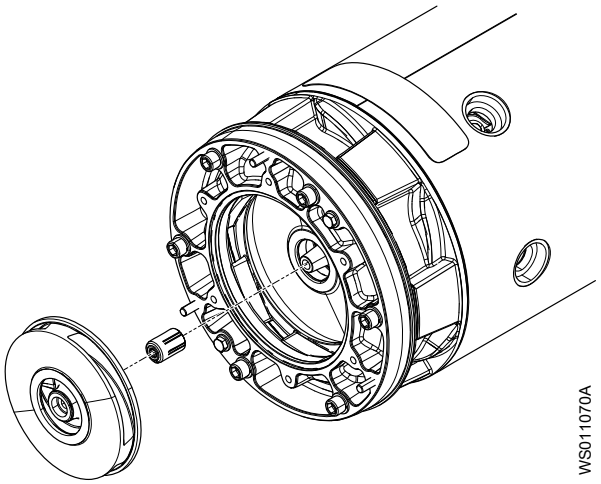
9. Remove the suction cover.



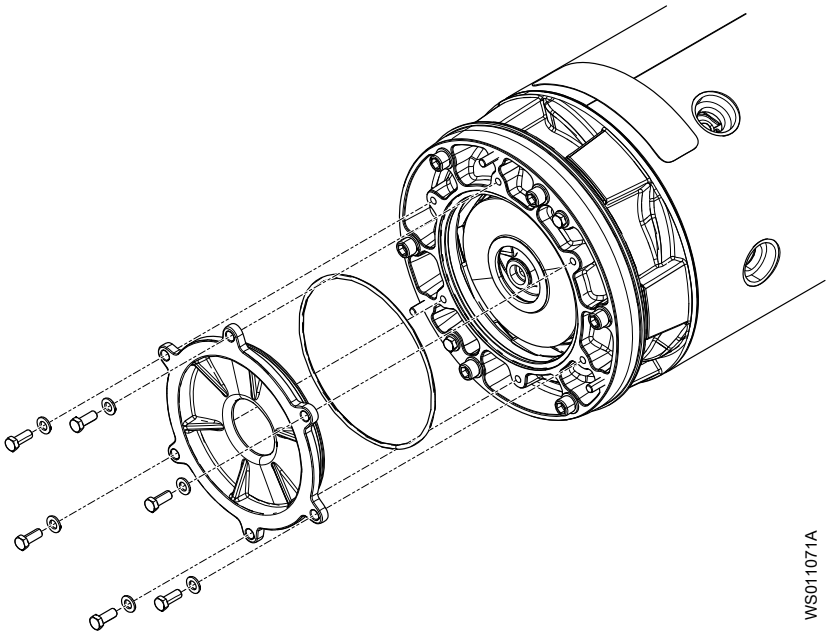
10. Align the edge of the lower adjustment screw with the edge of the lower conical sleeve so that they are flush.



11. Assemble the lower conical sleeve and the lower impeller onto the shaft end of the upper impeller.



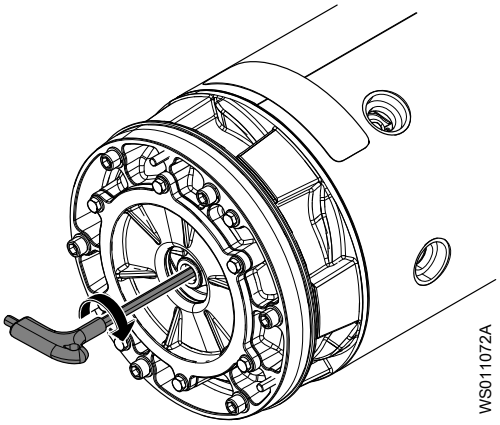
12. Install the suction cover and its O-ring and tighten.
    Tightening torque: 76 Nm (57 lbf·ft)



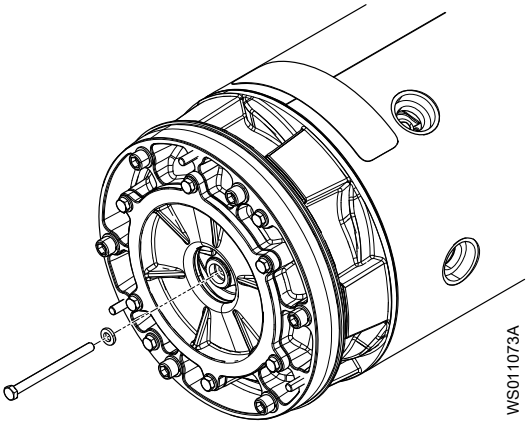
13. Turn the lower adjustment screw clockwise until the lower impeller makes contact with the suction cover. Tighten a further 1/6 turn, 60°.

    This will verify the correct clearance between the lower impeller and the suction cover in the next step.

    Use a 12 mm hexagon bit adapter (Allen socket) with a 100 mm (4 in) extension.



14. Attach the impeller:
    a) Put the washer on the impeller screw.

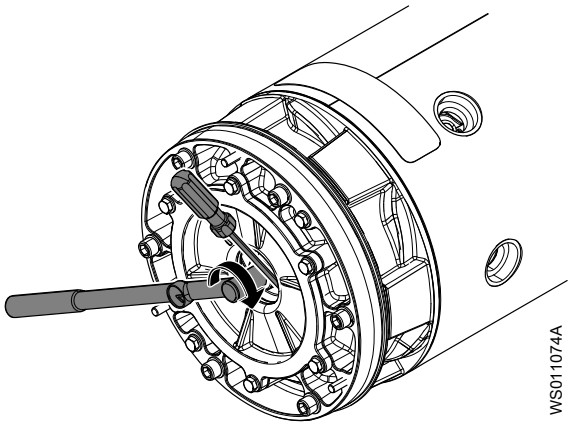


    b) Lock the impeller to prevent rotation.

       Use pliers, a screwdriver, or similar.

c) Tighten the impeller screw.

Tightening torque: 76 Nm (57 lbf·ft)



d) Tighten a further 1/8 turn, 45°.

The screw becomes loaded to its yield point and the load capacity of the joint becomes higher.

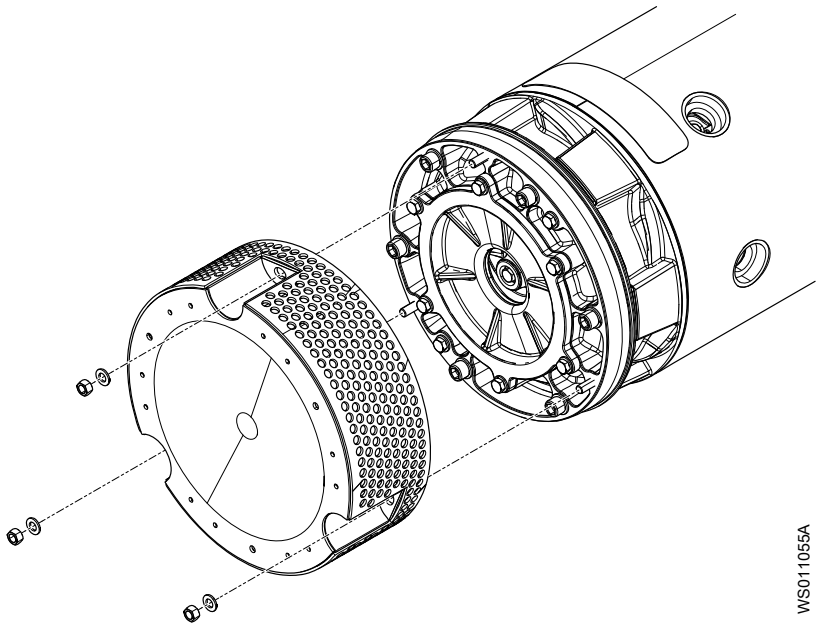
e) Check that the upper and lower impeller can rotate easily.

15. Check that the impeller can rotate freely.

If not, then the adjustment screw and the conical sleeve have not been aligned, and the shaft may have been displaced relative to the main bearing.

16. Install the strainer and the nuts.

Tightening torque: 76 Nm (57 lbf·ft)



6.6.8 Install the impeller, alternative 4, conical sleeve, HT/MT open impeller

Table 12: Applicability

Product code	Pressure class	Open or closed impeller
2190.010	HT	Open
2190.320	HT	Open
2190.390	HT	Open
2190.690	HT	Open
2201.012	MT, HT	Open

Product code	Pressure class	Open or closed impeller
2201.321	MT, HT	Open
2201.390	MT, HT	Open
2201.692	MT, HT	Open

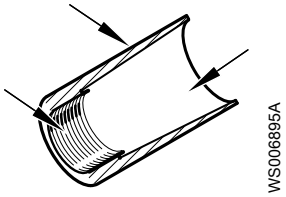
1. Prepare the shaft:
   a) Polish off any flaws by using a fine emery cloth.

      The end of the shaft must be clean and free from burrs.
   b) Coat the inner conic, the outer cylindrical surfaces, and the thread of the conical sleeve with a thin layer of grease.

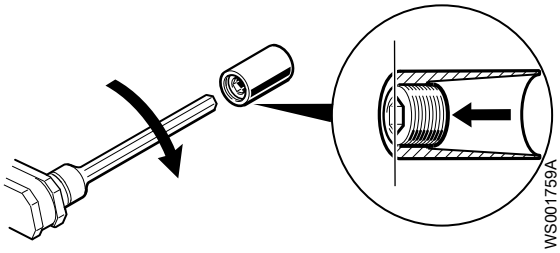
      The correct lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

      NOTICE:

      Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.



2. Align the edge of the adjustment screw with the edge of the conical sleeve so that they are flush.

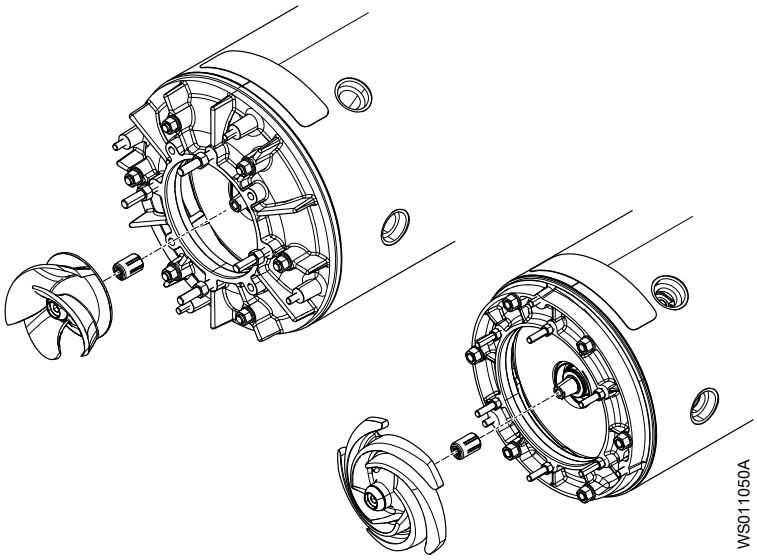


3. Lubricate the threads of the impeller screw and the washer.

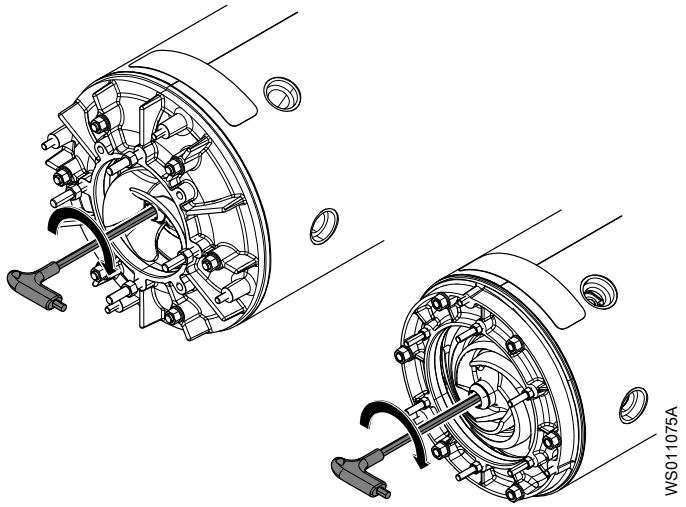
   The correct lubrication of the screw and washer is lubricating grease for assembly of bolts, and so forth. Example: Kluber ALTEMP Q NB 50.
4. Check that the impeller screw is clean and easy to screw into the shaft end.

   This is to prevent the shaft from rotating with the impeller screw.
5. Assemble the conical sleeve in the impeller.

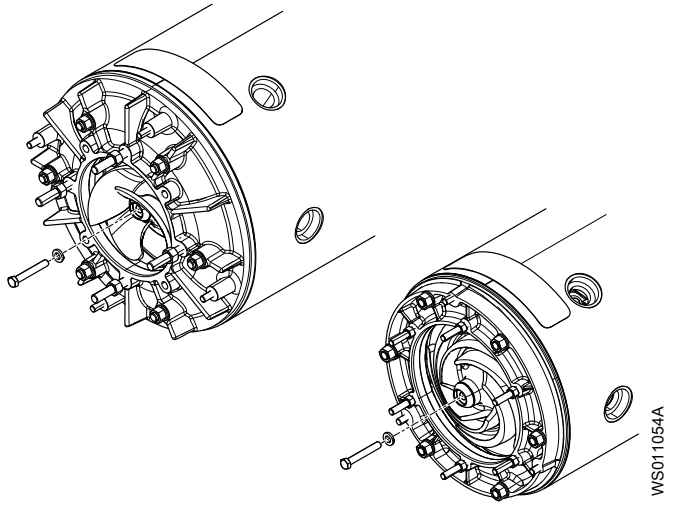
   Make sure that the conical sleeve bottoms in the impeller.



6. Assemble the impeller with the conical sleeve onto the shaft.
7. Press the impeller against the seal housing cover. Turn the adjustment screw clockwise until the clearance between the impeller and the seal housing cover is 0.5–0.7 mm (0.02–0.03 in).



8. Attach the impeller:
   a) Put the washer on the impeller screw.

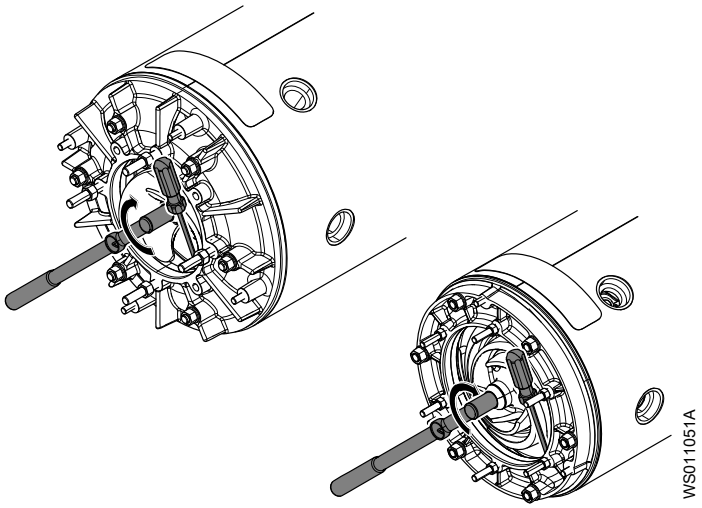


   b) Lock the impeller to prevent rotation.

Use pliers, a screwdriver, or similar.

c) Tighten the impeller screw.

Tightening torque: 76 Nm (57 lbf·ft)

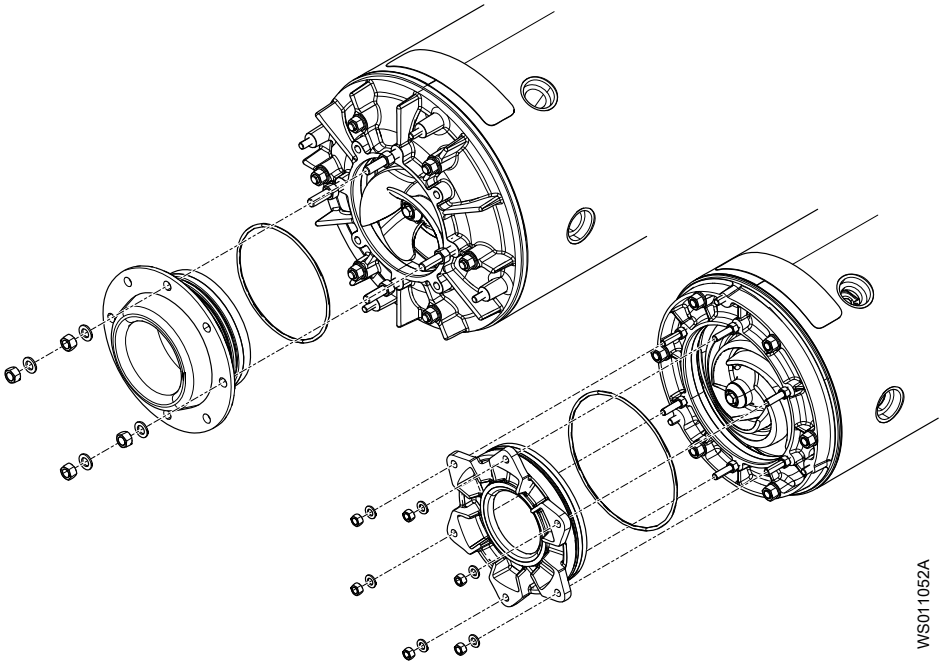


d) Tighten a further 1/8 turn, 45°.

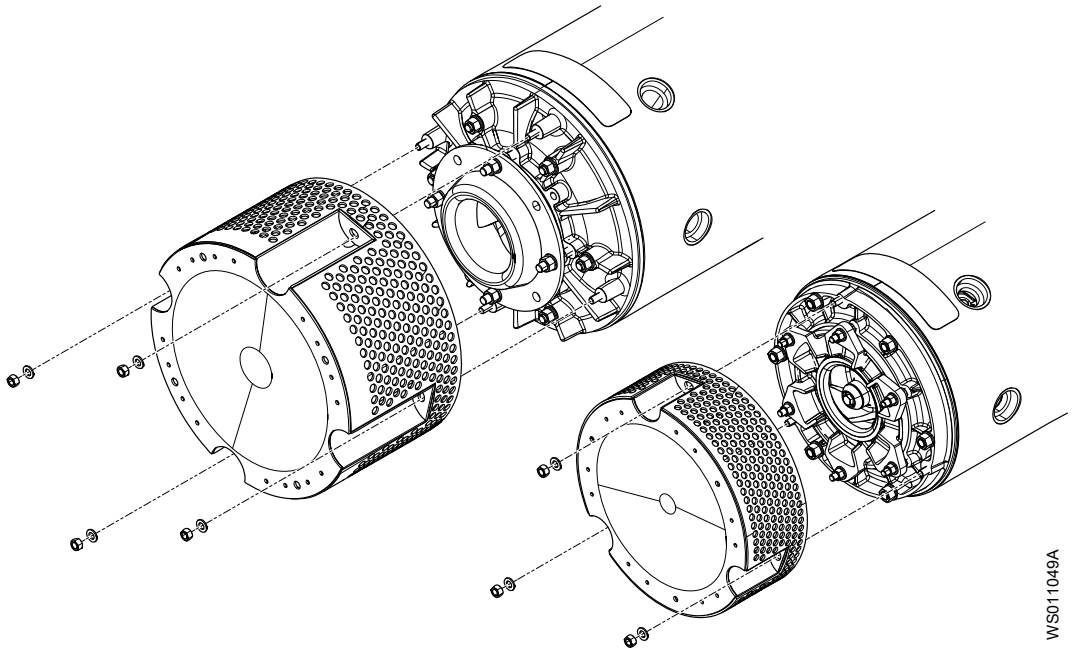
The screw becomes loaded to its yield point and the load capacity of the joint becomes higher.

9. Install and adjust the suction cover.

See *Adjust the suction cover: open impeller* on page 67.



10. Install the strainer.

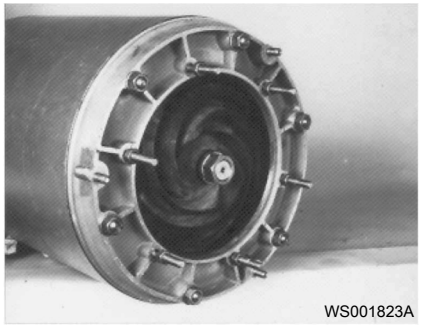


6.6.9 Adjust the suction cover: open impeller

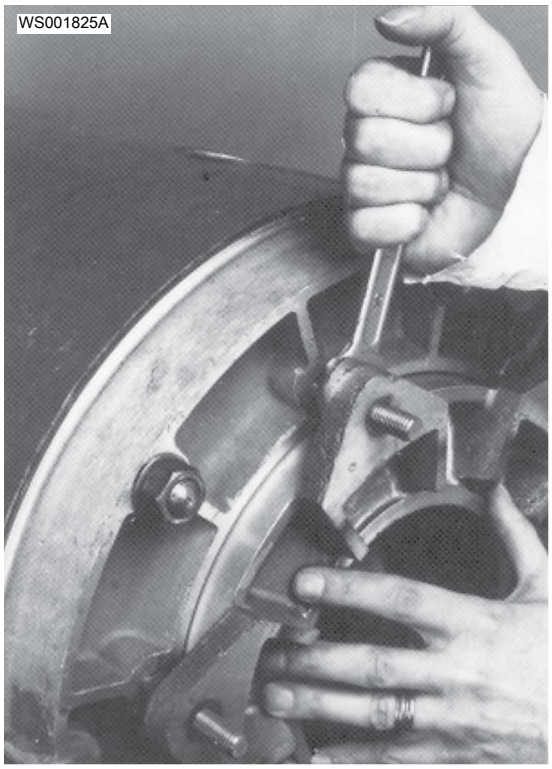
Table 13: Applicability

Product code	Pressure class	Open or closed impeller
2190.010	HT	Open
2190.320	HT	Open
2190.390	HT	Open
2190.690	HT	Open
2201.012	MT, HT	Open
2201.020	LT	Open
2201.321	MT, HT	Open
2201.390	MT, HT	Open
2201.590	MT, HT	Open
2201.692	MT, HT	Open

1. Turn the adjusting nuts to the bottom of the studs.



2. Fit the O-ring.
3. Press the suction cover against the impeller.
4. Tighten the adjusting nuts so that they lie flush against the suction cover.



5. Back off all adjusting nuts another half turn (counterclockwise).
6. Put washers and nuts on the studs. Tighten the nuts evenly all around.
7. Check that the impeller can rotate freely.

   The impeller clearance should be 0.2–0.3 mm (0.008–0.012 in) when the impeller is tightened.
8. Version code 590: Lock the nuts with tab washers.
9. Install the strainer.

6.6.10 Replace the diffuser

1. Remove the diffuser:
   a) Remove the impeller, see previous instructions.
   b) Remove the screws and washers.

   c) Remove the diffuser.

2. Install the diffuser:
   a) Install the diffuser.
   b) Install the diffuser by using the screws and washers.
      Tightening torque: 160–200 Nm (120–150 lbf·ft)

6.7 Replace the Pareo™ pump module

For further information on the kit content, see the mounting instructions that are included in the kits.

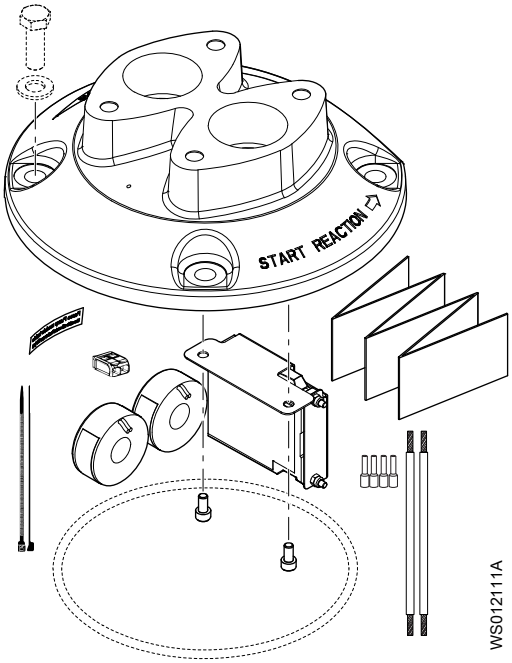


Figure 7: 2190.010, 2201.012 HT/SH

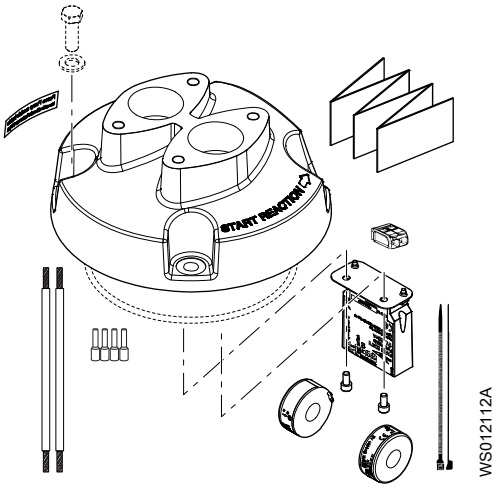


Figure 8: 2190.320, 2190.390, 2201.321 HT/SH/MT-H, 2201.390

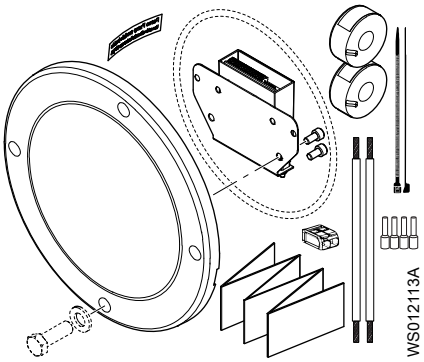


Figure 9: 2201.012 MT, 2201.020

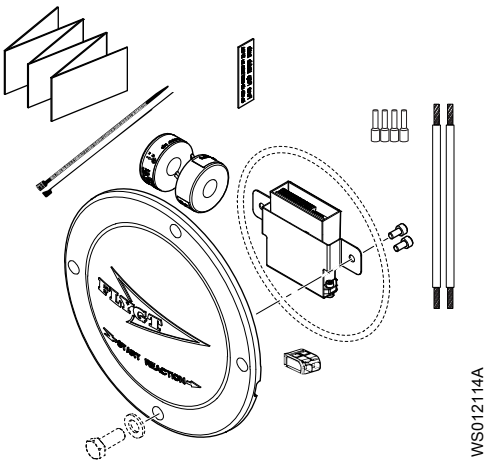


Figure 10: 2201.321 MT-V

6.7.1 Remove the Pareo™ pump module

1. Remove the fasteners for the cover.
2. Loosen the cover and the gasket.
3. Disconnect the motor cable.
   The leads L1 and L2 pass through the current transformers CT1 and CT2.
4. Unstrap and remove CT1 and CT2 from L1 and L2.
5. Remove the fasteners.

6. Loosen the pump module.
7. Disconnect the pump module.
8. Remove the pump module.

6.7.2 Install the Pareo™ pump module (reinstallation)

For more information, see the connection plate.

1. Pull L1 through CT1 and L2 through CT2.
   Be aware of the directional arrows on the current transformers CT1 and CT2.
2. Strap L1 to CT1 and L2 to CT2.
   Use the cable ties.
3. Connect the motor cable.
4. Connect the pump module.
   Connect any additional sensors.
5. Install the pump module.
6. Install and tighten the fasteners.
7. Install the gasket and the cover.
8. Install and tighten the fasteners.

6.7.3 Install the Pareo™ pump module (retrofit)

For more information, see the connection plate.

1. Remove the fasteners for the cover.
2. Loosen the cover and the gasket.
3. Disconnect the motor cable.
4. Replace the cover:

Condition	Action
Pump with a contactor unit	1. Remove and discard the cover, the gasket, and the motor cable. 2. Assemble the motor cable from the Pareo™ controller DCM 711 and the new cover. 3. Tighten the cable gland. 4. Disconnect and remove the contactor unit.
Pump without a contactor unit	1. Remove and discard the cover and the gasket. 2. Assemble the motor cable and the new cover. 3. Tighten the cable gland.

5. Disconnect any additional sensors.
6. Pull L1 through CT1 and L2 through CT2.
   Be aware of the directional arrows on the current transformers CT1 and CT2.
7. Strap L1 to CT1 and L2 to CT2.
   Use the cable ties.
8. Connect the motor cable.
9. Connect the pump module.
   Connect any additional sensors.
10. Install the pump module.
11. Install and tighten the fasteners.
12. Install a new gasket and the new cover.
13. Install and tighten the fasteners.
14. Attach the sticker on the pump top.

7 Troubleshooting

7.1 General precautions

Before starting work, make sure that the safety instructions have been read and understood.

DANGER: Inhalation Hazard

Before entering the work area, make sure that the atmosphere contains sufficient oxygen and no toxic gases.

7.2 Electrical troubleshooting

DANGER: Electrical Hazard

Troubleshooting a live control panel exposes personnel to hazardous voltages. Electrical troubleshooting must be done by a qualified electrician.

Follow these guidelines when troubleshooting:

- Disconnect and lock out the power supply except when conducting checks that require voltage.
- Make sure that no one is near the unit when the power supply is reconnected.
- When troubleshooting electrical equipment, use the following:
  - Universal instrument multimeter
  - Test lamp (continuity tester)
  - Wiring diagram

7.3 The pump does not start

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
An alarm signal has been triggered on the control panel.	Check that: • The impeller rotates freely. • The sensor indicators do not indicate an alarm. • The overload protection is not tripped.

Cause	Remedy
The pump does not start automatically, but can be started manually.	Check that: • The start level regulator is functioning. Clean or replace if necessary. • All connections are intact. • The relay and contactor coils are intact. • The control switch (Man/Auto) makes contact in both positions. Check the control circuit and functions.
The installation is not receiving voltage.	Check that: • The main power switch is on. • There is control voltage to the start equipment. • The fuses are intact. • There is voltage in all phases of the supply line. • All fuses have power and that they are securely fastened to the fuse holders. • The overload protection is not tripped. • The motor cable is not damaged.
The impeller is stuck.	Clean: • The impeller • The sump in order to prevent the impeller from clogging again.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.4 The pump does not stop when a level sensor is used

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: • There are no leaks from the piping and/or discharge connection. • The impeller is not clogged. • The non-return valve(s) are functioning properly. • The pump has adequate capacity. For information: Contact a sales or authorized service representative.
There is a malfunction in the level-sensing equipment.	• Clean the level regulators. • Check the functioning of the level regulators. • Check the contactor and the control circuit. • Replace all defective items.
The stop level is set too low.	Raise the stop level.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.5 The pump starts-stops-starts in rapid sequence

Cause	Remedy
The pump starts due to back-flow which fills the sump to the start level again.	Check that: • The distance between the start and stop levels is sufficient. • The non-return valve(s) work(s) properly. • The length of the discharge pipe between the pump and the first non-return valve is sufficiently short.
The self-holding function of the contactor malfunctions.	Check: • The contactor connections. • The voltage in the control circuit in relation to the rated voltages on the coil. • The functioning of the stop-level regulator. • Whether the voltage drop in the line at the starting surge causes the contactor's self-holding malfunction.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.6 The pump runs but the motor protection trips

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The motor protection is set too low.	Set the motor protection according to the data plate and if applicable the cable chart.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the wet well. • Check that the impeller is correctly trimmed.
The drive unit cannot receive full voltage on all three phases.	• Check the fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents change, or they are too high.	Contact a sales or authorized service representative.
The insulation between the phases and ground in the stator is defective.	1. Use an insulation tester. Use a 1000 VDC insulation and continuity tester to check that the insulation between the phases, and between any phase and ground, is > 5 megohms. 2. If the insulation is less, then do the following: Contact a sales or authorized service representative.

Cause	Remedy
The density of the pumped fluid is too high.	Make sure that the maximum density is 1100 kg/m³ (9.2 lb/US gal) • Change the impeller, or • Change to a more applicable pump • Contact a sales or authorized service representative.
The ambient temperature is more than the maximum ambient temperature.	The pump must not be used for such an application.
There is a malfunction in the overload protection.	Replace the overload protection.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

7.7 The pump delivers too little or no water

DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

NOTICE:

Do NOT override the motor protection repeatedly if it has tripped. Doing so may result in equipment damage.

Cause	Remedy
The impeller rotates in the wrong direction.	• If it is a 3-phase pump, then transpose two phase leads. • If it is a 1-phase pump, then do the following: Contact a sales or authorized service representative.
One or more of the valves are set in the wrong positions.	• Reset the valves that are set in the wrong position. • Replace the valves, if necessary. • Check that all valves are correctly installed according to media flow. • Check that all valves open correctly.
The impeller is difficult to rotate by hand.	• Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The pipes are obstructed.	To ensure a free flow, clean out the pipes.
The pipes and joints leak.	Find the leaks and seal them.
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.
The liquid level is too low.	• Check that the level sensor is set correctly. • Depending on the installation type, add a means for priming the pump, such as a foot valve.

If the problem persists, then contact a sales or authorized service representative.

Always state the serial number of the product, see *Product Description* on page 11.

8 Technical Reference

8.1 Application limits

Data	Description
Media (liquid) temperature	Maximum 40°C (104°F)
pH of the pumped media (liquid)	Aluminum: 5–8. Version code: 2190.010, 2201.012, 2201.020 Cast iron: 6–11. Version code: 2190.320, 2190.690, 2201.321, 2201.590, 2201.692 Stainless steel: 2–10. Version code: 2190.390, 2201.390
Media (liquid) density	1100 kg/m³ (9.2 lb for each US gal) maximum
Depth of immersion	Maximum 20 m (65 ft)
Maximum permissible working pressure	11.8 bar (171 psi)
Other	For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump. For other applications, contact a sales or authorized service representative for information.

8.2 Motor data

Feature	Description
Motor type	Squirrel-cage induction
Frequency	50 Hz or 60 Hz
Supply	3-phase
Starting method	Direct on-line Star-delta
Maximum starts for each hour	30 evenly spaced starts for each hour
Code compliance	IEC 60034-1
Voltage variation without overheating	±10%, if it does not run continuously at full load
Voltage imbalance tolerance	2%
Stator insulation class	H (180°C [356°F])

Motor encapsulation

Motor encapsulation is in accordance with IP68.

8.3 Specific motor data: Version code 2190.010, 2201.012/020

2190.010, 3–phase, 50 Hz

Motor type:

- 2,910 rpm
- 25 kW (34 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	79	460
230	D	76	485

Voltage, V	Connection	Rated current, A	Starting current, A
380	Y	46	265
380	D	46	258
400	Y	44	280
400	D	43	269
415	D	42	286
440	D	41	305
500	D	35	227
525	D	33	198
550	D	32	209
660	Y	26	150
690	Y	25	158
1000	Y	18	128

2201.012, 3-phase, 50 Hz

Motor type:

- 2,940 rpm
- 37 kW (50 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	117	700
230	D	112	740
380	Y	67	405
380	D	67	405
400	Y	65	430
400	D	65	430
415	D	62	350
440	D	59	375
500	D	51	271
525	D	49	296
550	D	47	310
660	Y	39	231
690	Y	37	246
1000	Y	26	184

2201.020, 3-phase, 50 Hz

Motor type:

- 1,465 rpm
- 30 kW (40 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	108	895
230	D	110	945
380	Y	62	515
380	D	61	485
400	Y	64	550
400	D	61	520
415	D	54	415

Voltage, V	Connection	Rated current, A	Starting current, A
440	D	54	450
500	D	45	335
525	D	44	355
550	D	45	375
660	Y	35	281
690	Y	35	297

2190.010, 3–phase, 60 Hz

Motor type:

- 3,510 rpm
- 29 kW (39 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D//	91	555
230	D//	87	585
380	Y//	53	320
400	Y//	50	340
440	DSER	46	277
440	D	46	260
460	DSER	43	292
460	D	44	274
480	D	42	287
575	D	35	227
600	D	33	238

2201.012, 3-phase, 60 Hz

Motor type:

- 3,540 rpm
- 43 kW (58 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
200	D	152	725
208	D	144	760
220	D	136	810
220	D//	134	710
230	D	133	895
230	D//	127	750
380	Y	78	465
380	Y//	77	410
400	Y	76	520
400	Y//	73	435
440	DSER	67	355
440	D	68	405
460	DSER	64	375
460	D	65	480
480	D	65	470
575	D	52	249

Voltage, V	Connection	Rated current, A	Starting current, A
600	D	50	284

2201.020, 3-phase, 60 Hz

Motor type:

- 1,760 rpm
- 37 kW (50 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
200	D	138	885
208	D	130	940
220	D//	123	865
230	D//	119	915
400	D	72	605
380	D	73	565
460	DSER	59	455
400	Y//	68	530
440	DSER	61	430
380	Y//	71	495
440	D	65	495
460	D	64	480
480	D	63	520
575	D	48	305
600	D	46	360

8.4 Specific motor data: Version code 2190.320/690, 2201.321/590/692

2190.320, 3-phase, 50 Hz

Motor type:

- 2,935 rpm
- 23 kW (31 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	72	460
230	D	69	485
380	Y	42	265
380	D	42	258
400	Y	40	280
400	D	40	269
415	D	39	286
440	D	38	305
500	D	32	227
525	D	31	240
550	D	31	254
660	Y	24	150
690	Y	23	158

Voltage, V	Connection	Rated current, A	Starting current, A
1000	Y	16	128

2190.690, 3-phase, 50 Hz

Motor type:

- 2,935 rpm
- 23 kW (31 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	72	460
230	D	69	485
380	Y	42	265
380	D	42	258
400	Y	40	280
400	D	40	269
415	D	39	286
440	D	38	305
500	D	32	227
525	D	31	240
550	D	31	254
660	Y	24	150
690	Y	23	158
1000	Y	16	128

2201.321, 3-phase, 50 Hz

- 2,940 rpm
- 37 kW (50 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	117	700
230	D	112	740
380	Y	67	405
380	D	67	405
400	Y	65	430
400	D	65	430
415	D	62	350
440	D	59	375
500	D	51	271
525	D	49	296
550	D	47	310
660	Y	39	231
690	Y	37	246
1000	Y	26	184

2201.590/692, 3-phase, 50 Hz

Motor type:

- 2,940 rpm
- 37 kW (50 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
380	D	67	405
400	D	65	430
415	D	62	350
440	D	59	375
500	D	51	271
550	D	47	310
1,000	D	26	184
1,100	D	24	150

2190.320, 3-phase, 60 Hz

Motor type:

- 3,525 rpm
- 29 kW (39 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	91	630
230	D	88	665
380	Y	53	360
380	Y//	53	320
400	Y	51	375
400	Y//	50	340
440	DSER	45	377
440	D	46	296
460	DSER	43	292
460	D	43	274
480	D	42	287
575	D	35	227
600	D	33	238

2190.690, 3-phase, 60 Hz

Motor type:

- 3,525 rpm
- 29 kW (39 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	91	630
230	D	88	665
380	Y	53	360
380	Y//	53	320
400	Y	51	375
400	Y//	50	340
440	DSER	45	377
440	D	46	296
460	DSER	43	292
460	D	43	274
480	D	42	287
575	D	35	227

Voltage, V	Connection	Rated current, A	Starting current, A
600	D	33	238

2201.321, 3-phase, 60 Hz

- 3,540 rpm
- 43 kW (58 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
200	D	152	725
208	D	144	760
220	D	136	810
220	D//	134	710
230	D	133	895
230	D//	127	750
380	Y	78	465
380	Y//	77	410
400	Y	76	520
400	Y//	73	435
440	DSER	67	355
440	D	68	405
460	DSER	64	375
460	D	65	480
480	D	65	470
575	D	52	249
600	D	50	284

2201.590/692, 3-phase, 60 Hz

Motor type:

- 3,540 rpm
- 43 kW (58 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
440	D	68	405
460	D	65	480
550	Y//	54	283
575	D	52	249
1100	YSER	27	141

8.5 Specific motor data: Version code 2190.390, 2201.390

2190.390, 3–phase, 50 Hz

Motor type:

- 2,935 rpm
- 22 kW (30 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	69	460
230	D	66	485
380	Y	40	265

Voltage, V	Connection	Rated current, A	Starting current, A
380	D	40	258
400	Y	38	280
400	D	38	269
415	D	37	286
440	D	36	305
500	D	31	227
525	D	30	240
550	D	30	254
660	Y	23	150
690	Y	22	158
1000	Y	16	128

2201.390, 3-phase, 50 Hz

- 2,950 rpm
- 36 kW (50 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	113	700
230	D	109	740
380	Y	66	405
380	D	66	405
400	Y	63	430
400	D	63	430
415	D	60	350
440	D	57	375
500	D	50	271
525	D	48	296
550	D	46	310
660	Y	38	231
690	Y	36	246
1000	Y	26	184

2190.390, 3–phase, 60 Hz

Motor type:

- 3,535 rpm
- 26 kW (35 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	81	830
230	D	79	665
380	Y	48	360
380	Y//	47	320
400	Y	45	375
400	Y//	45	340
440	DSER	40	377
440	D	41	296
460	DSER	40	277

Voltage, V	Connection	Rated current, A	Starting current, A
460	D	39	274
480	D	37	287
575	D	31	227
600	D	30	238

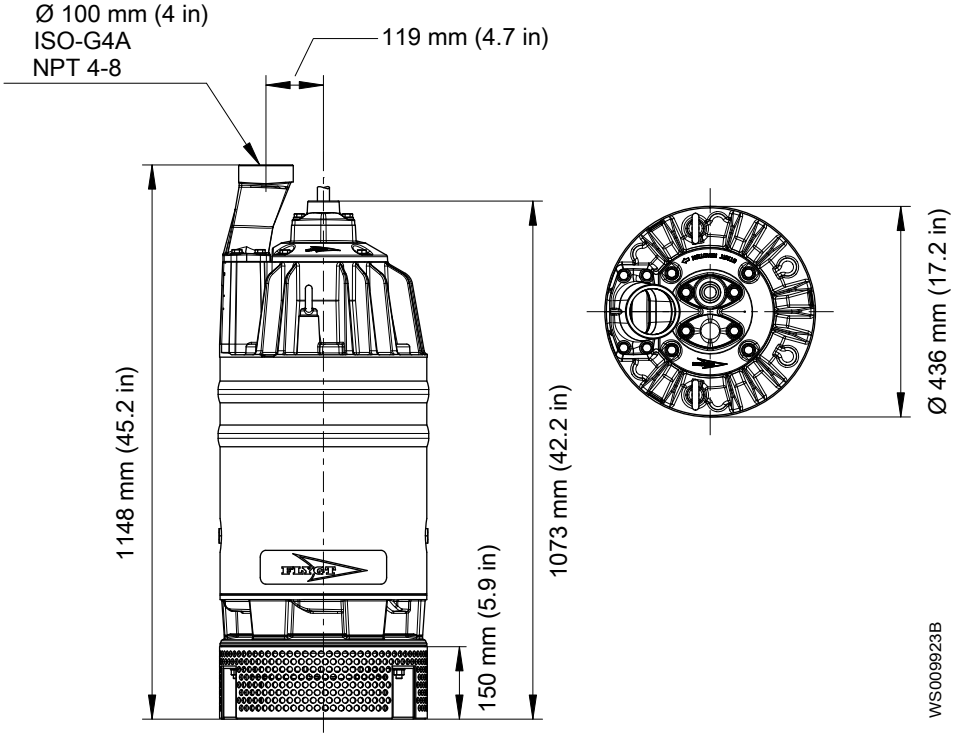
2201.390, 3-phase, 60 Hz

- 3,555 rpm
- 42 kW (56 hp)

Voltage, V	Connection	Rated current, A	Starting current, A
220	D	131	810
230	D	129	895
380	Y	76	465
380	Y//	75	410
400	Y	74	520
400	Y//	71	435
440	DSER	65	355
440	D	66	405
460	DSER	62	375
460	D	63	480
480	D	63	470
575	D	51	249
600	D	48	284

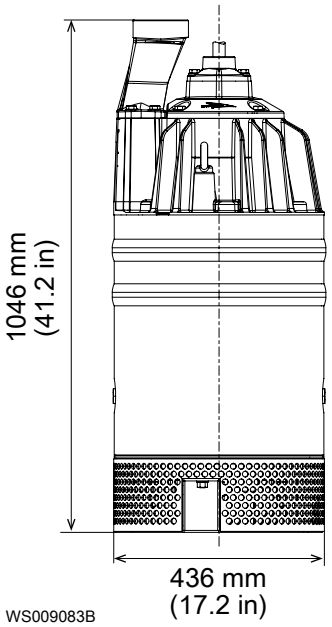
8.6 Dimensions and weights

8.6.1 2201.012 SH



Version	Weight without motor cable, kg (lbs)
2201.012 SH	270 (595)

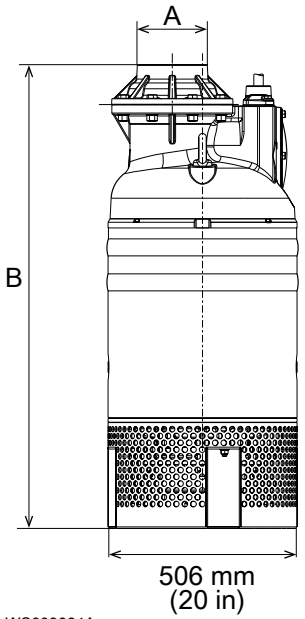
8.6.2 2190.010 HT, 2201.012 HT



WS009083B

Version	Weight without motor cable, kg (lbs)
2201.012 HT	240 (530)
2190.010 HT	210 (463)

8.6.3 2201.012 MT, 2201.020 LT



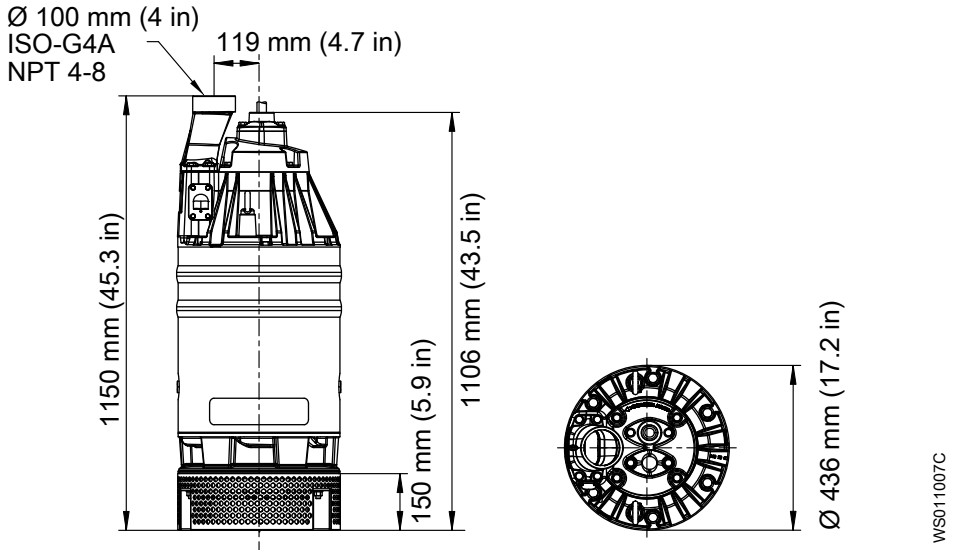
WS009084A

A	B
6 in (152 mm) (hose)	1332 mm (52.4 in)
8 in (203 mm) (hose)	1302 mm (51.3 in)
ISO-G6, NPT 6	1227 mm (48.3 in)

A	B
ISO-G8, NPT 8	1217 mm (47.9 in)

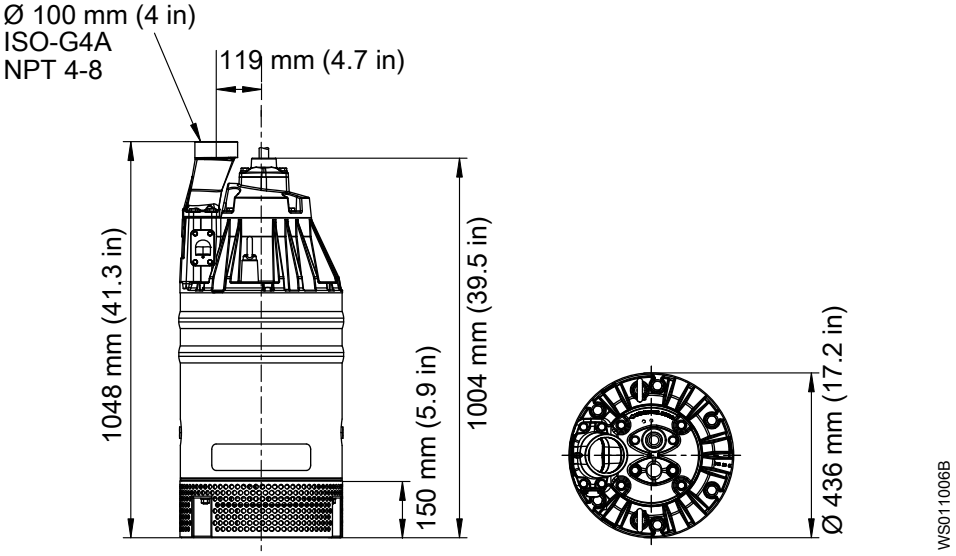
Version	Weight without motor cable, kg (lbs)
2201.012 MT	280 (618)
2201.020 LT	285 (628)

8.6.4 2201.321 SH, 2201.390 SH



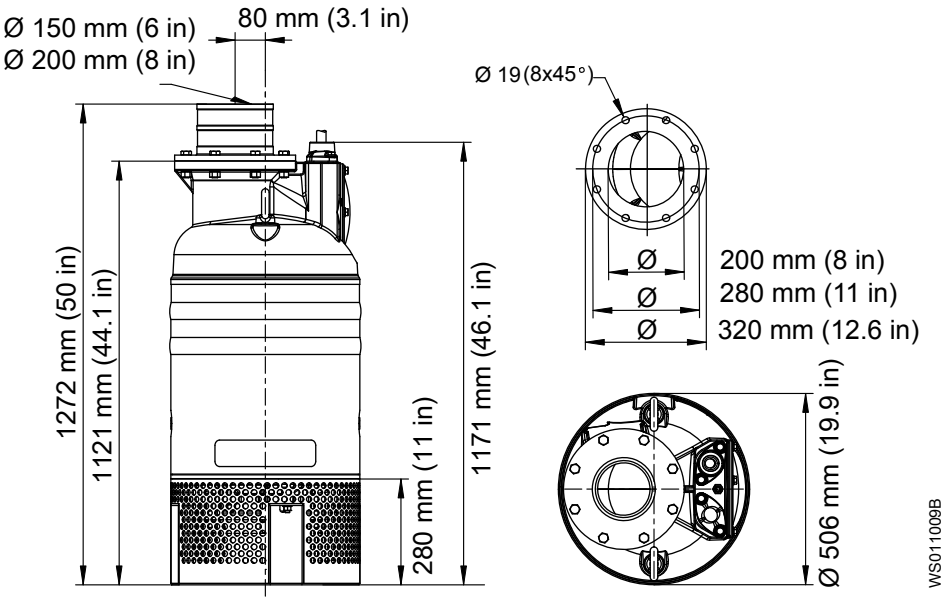
Version	Weight without motor cable, kg (lbs)
2201.321 SH	395 (871)
2201.390 SH	430 (948)

8.6.5 2201.321 HT, 2201.390 HT, 2190.320 HT, 2190.390 HT

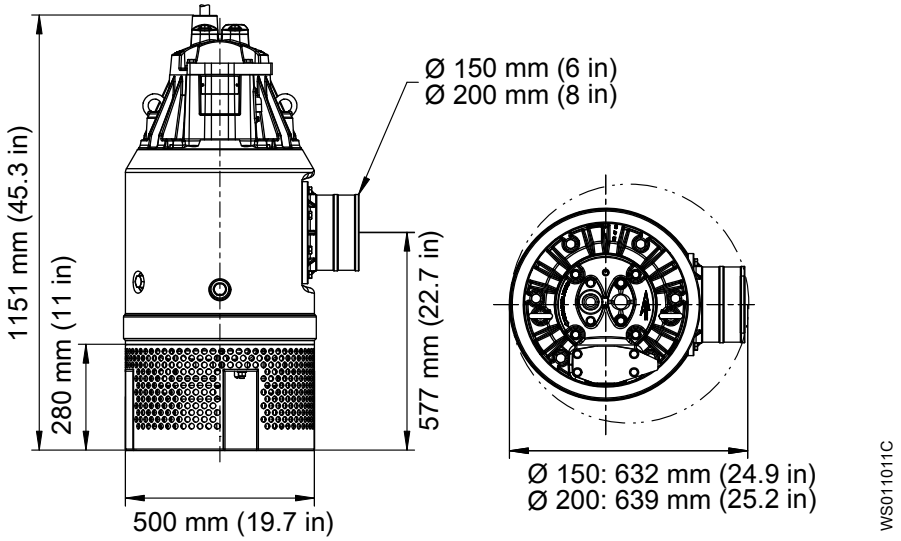


Version	Weight without motor cable, kg (lbs)
2201.321 HT	350 (772)
2201.390 HT	385 (849)
2190.320 HT	335 (739)
2190.390 HT	370 (816)

8.6.6 2201.321 MT, 2201.390 MT

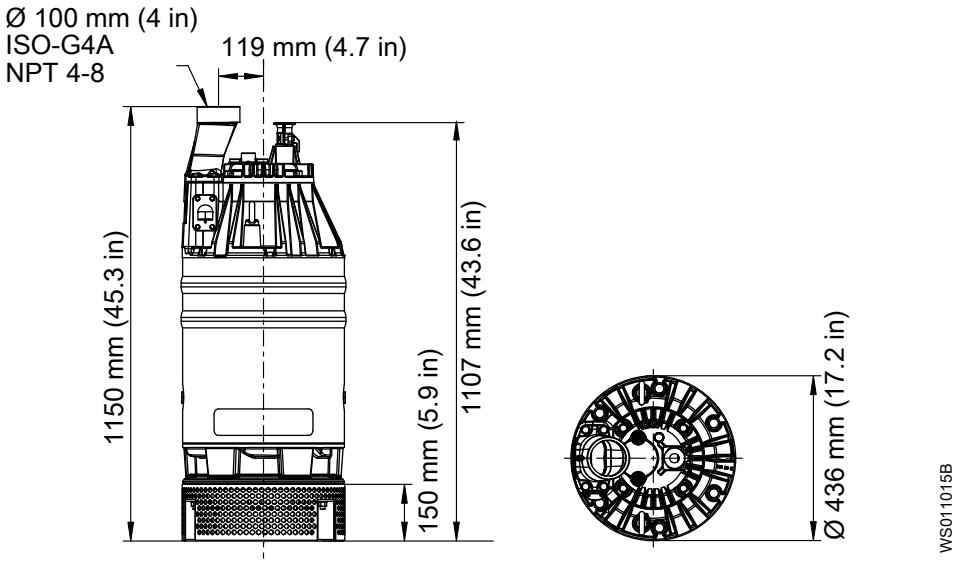


Version	Weight without motor cable, kg (lbs)
2201.321 MT, vertical outlet	460 (1014)



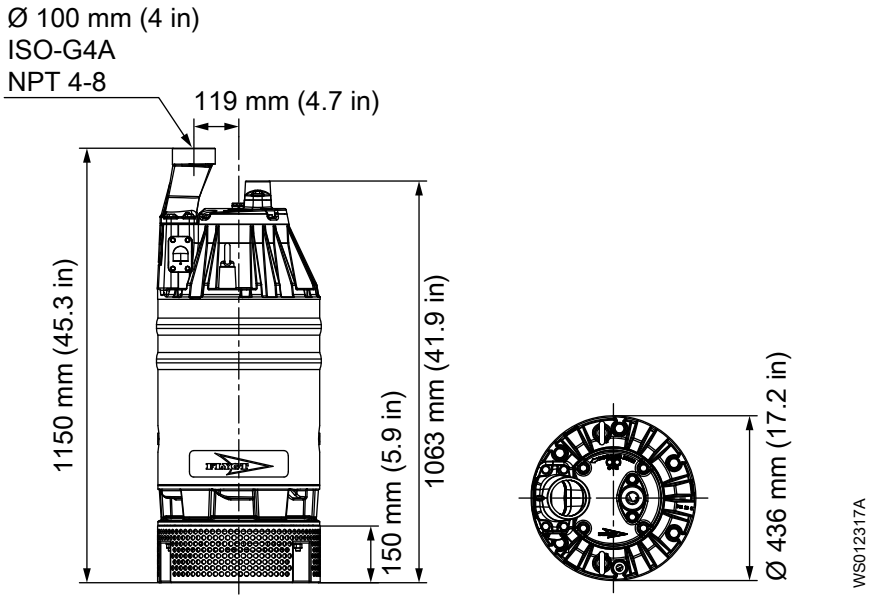
Version	Weight without motor cable, kg (lbs)
2201.321 MT, horizontal outlet	445 (981)
2201.390 MT, horizontal outlet	490 (1080)

8.6.7 2201.590 SH



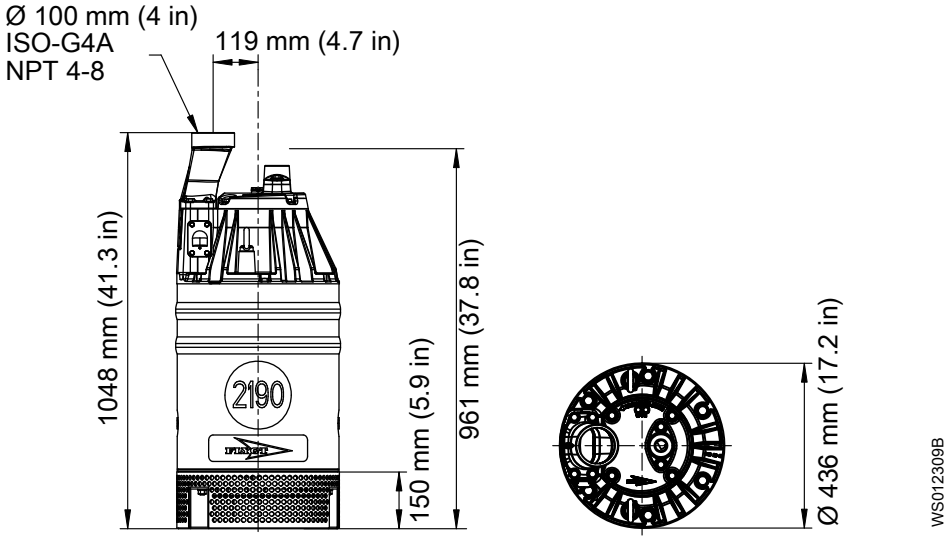
Version	Weight without motor cable, kg (lbs)
2201.590 SH	395 (871)

8.6.8 2201.692 SH



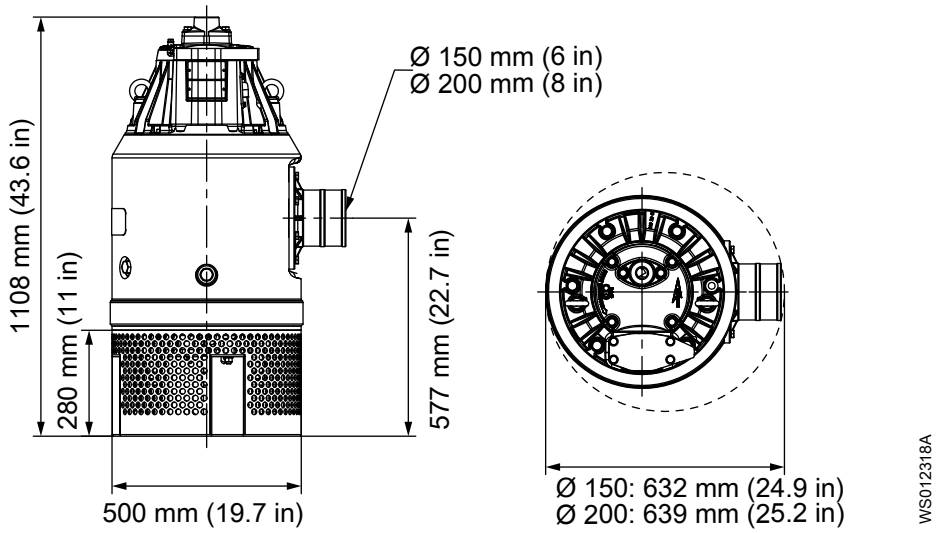
Version	Weight without motor cable, kg (lbs)
2201.692 SH	395 (871)

8.6.9 2201.692 HT, 2190.690 HT



Version	Weight without motor cable, kg (lbs)
2201.692 HT	350 (772)
2190.690 HT	335 (739)

8.6.10 2201.692 MT



Version	Weight without motor cable, kg (lbs)
2201.692 MT, horizontal outlet	445 (981)

8.6.11 2201.590 MT/HT

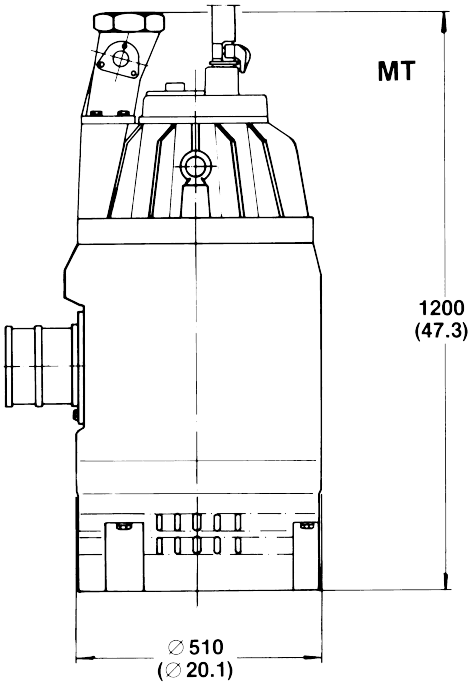


Figure 11: MT

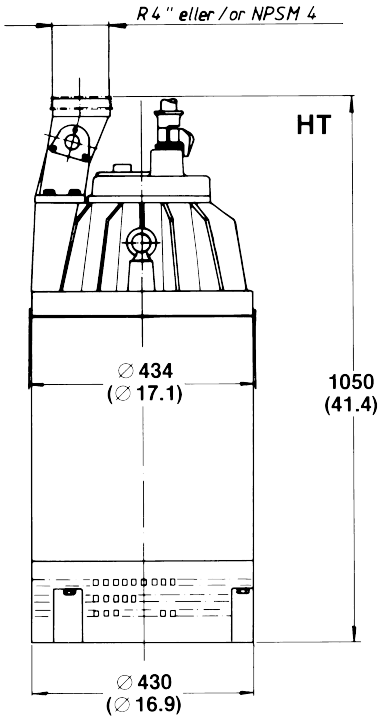


Figure 12: HT

Version	Weight without motor cable, kg (lbs)
MT	445 (980)
HT	350 (770)

8.7 Performance curves

Test standard

Pumps are tested in accordance with ISO 9906:2012, HI 11.6:2012.

8.7.1 2190.010

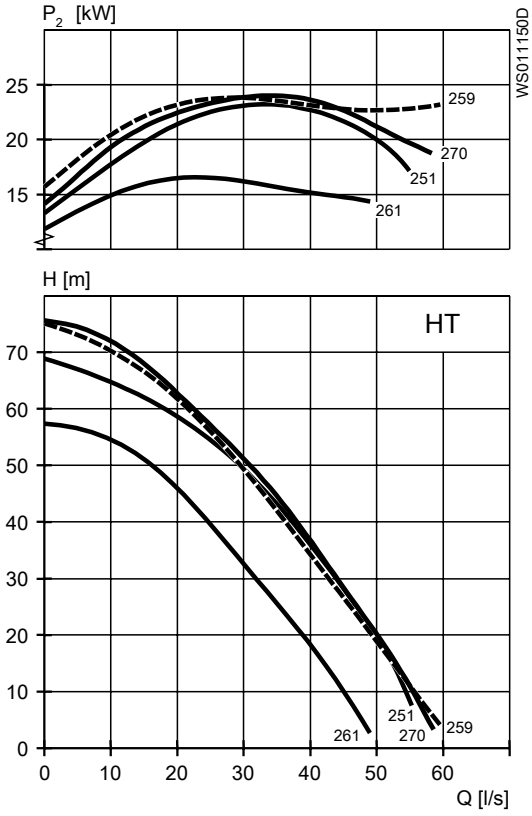


Figure 13: 50 Hz

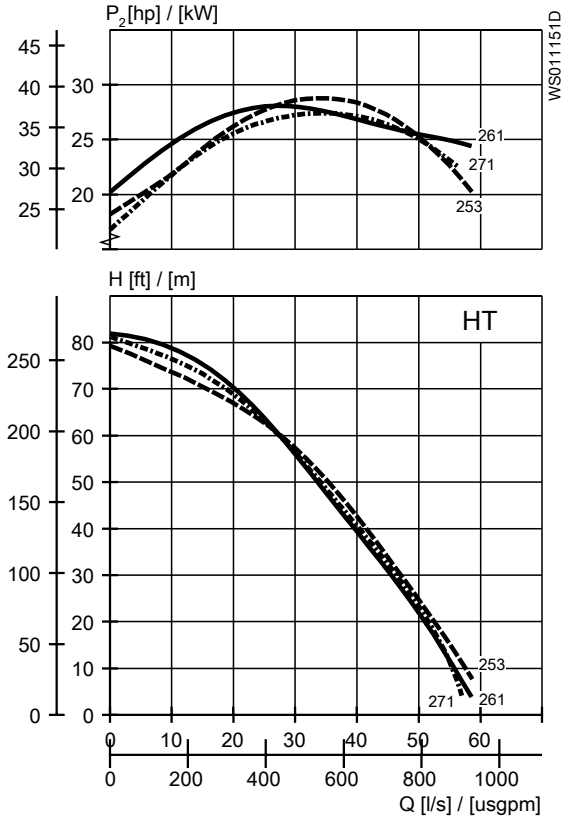


Figure 14: 60 Hz

8.7.2 2190.320

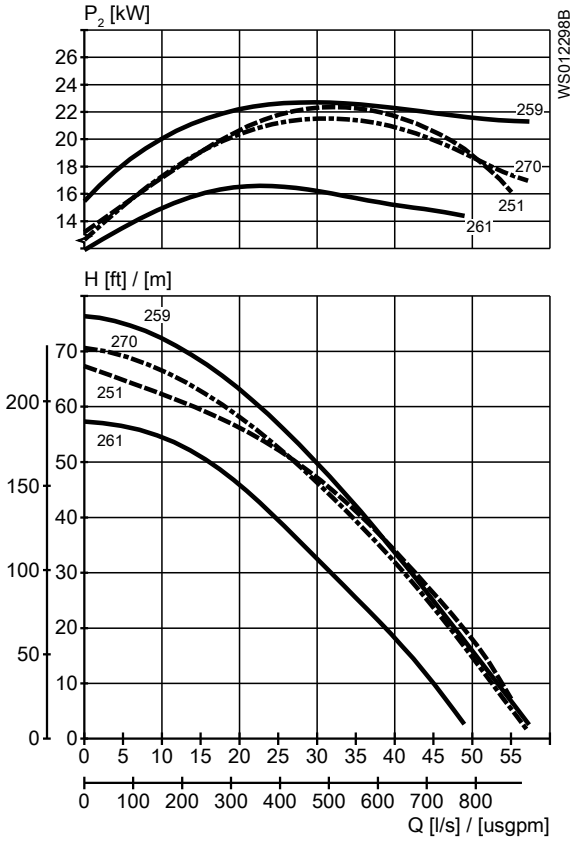


Figure 15: 50 Hz

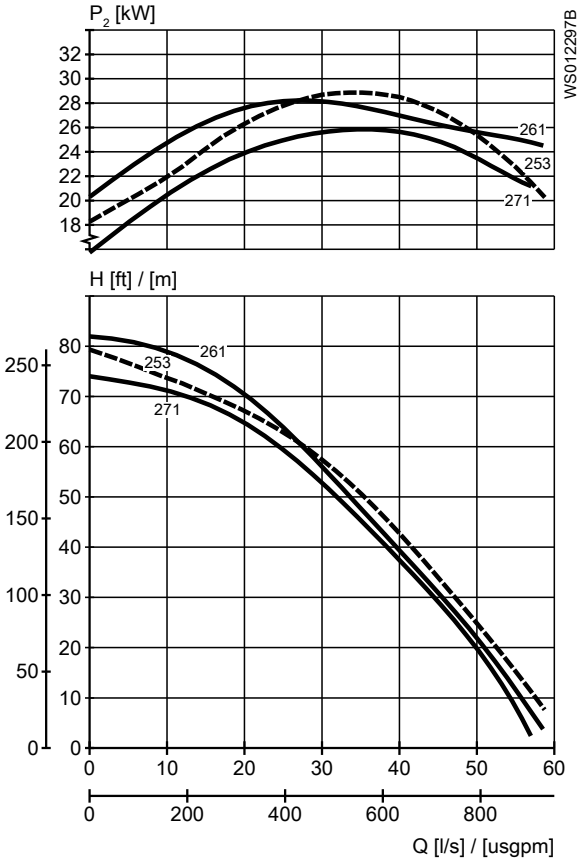


Figure 16: 60 Hz

8.7.3 2190.390

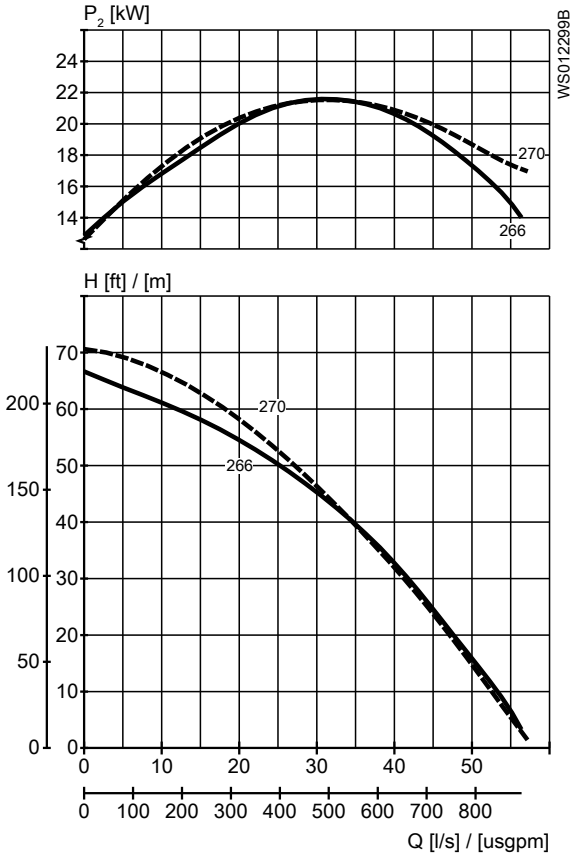


Figure 17: 50 Hz

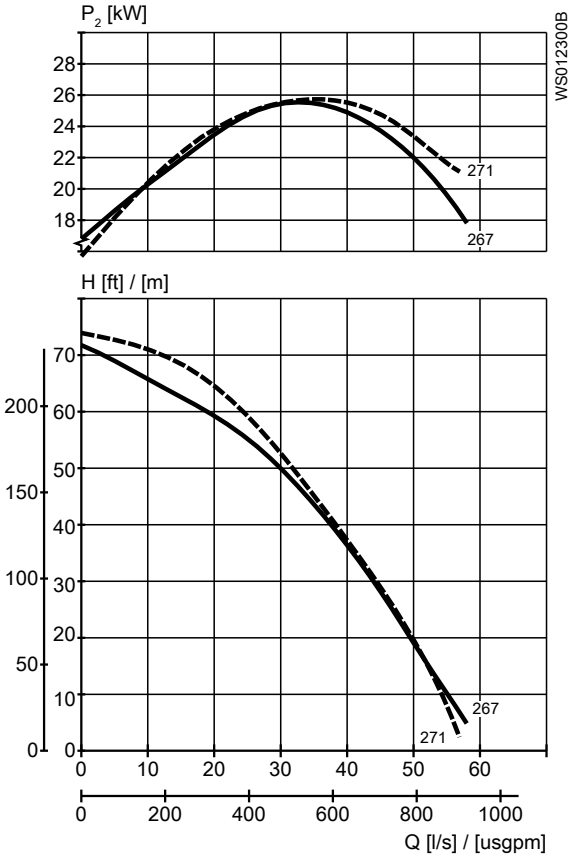


Figure 18: 60 Hz

8.7.4 2190.690

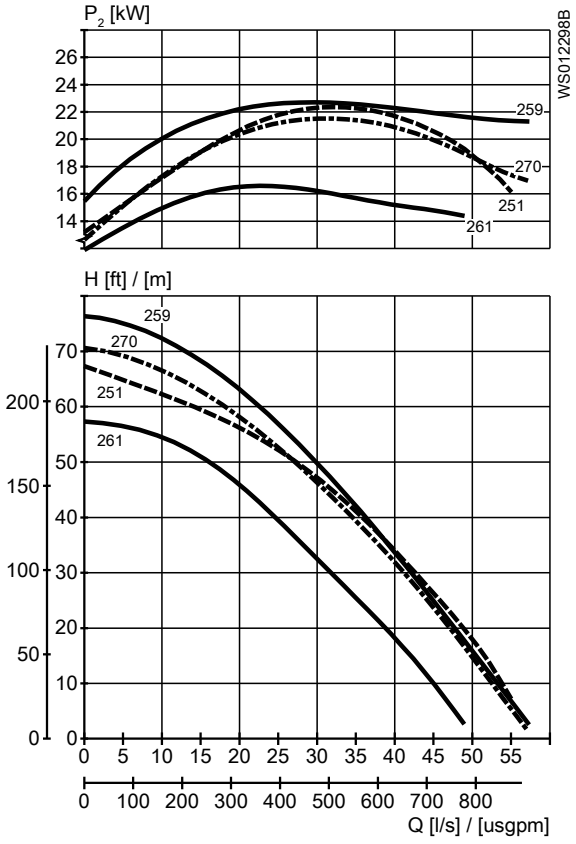


Figure 19: 50 Hz

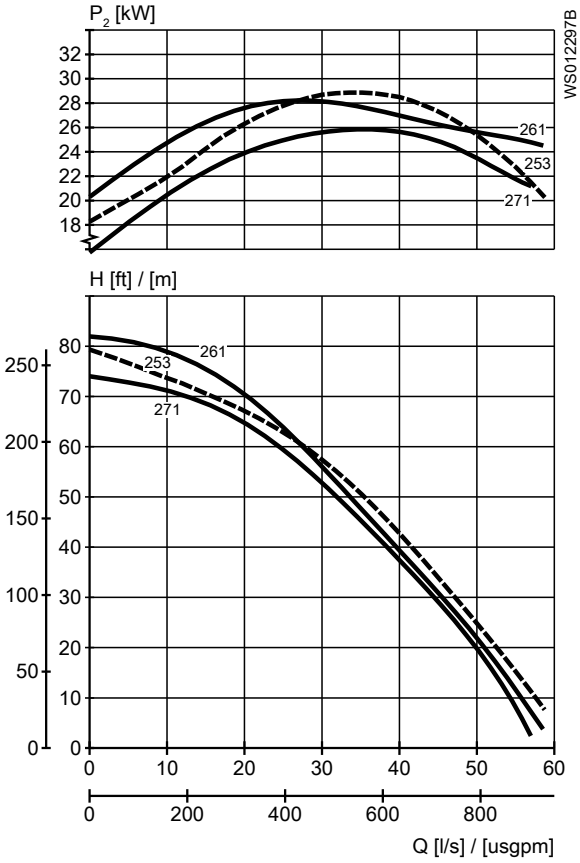


Figure 20: 60 Hz

8.7.5 2201.012

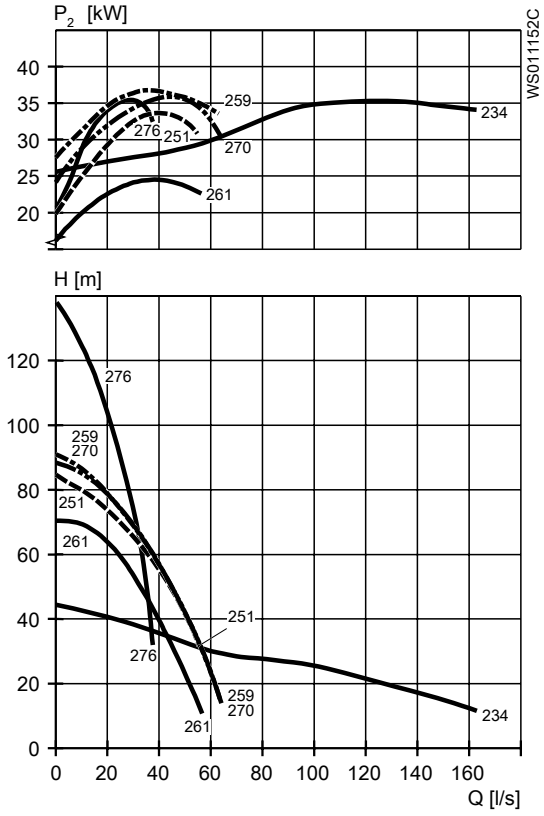


Figure 21: 50 Hz

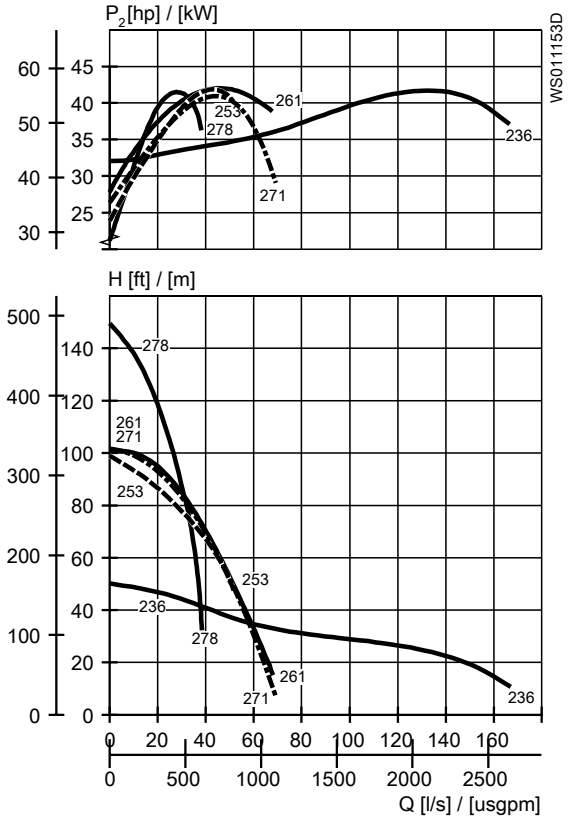


Figure 22: 60 Hz

8.7.6 2201.020

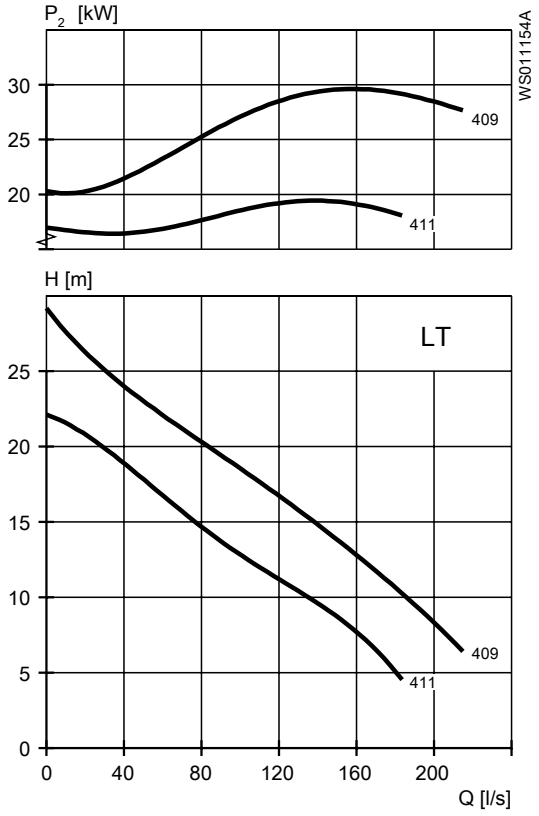


Figure 23: 50 Hz

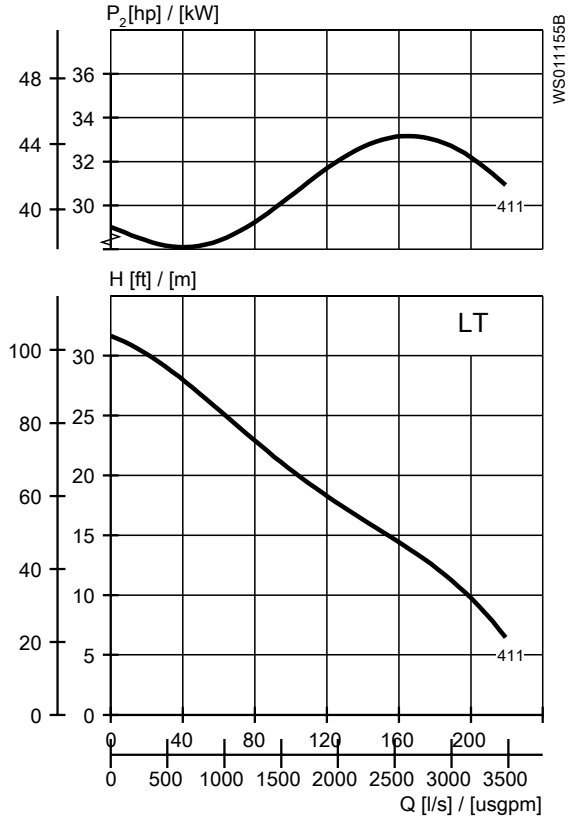
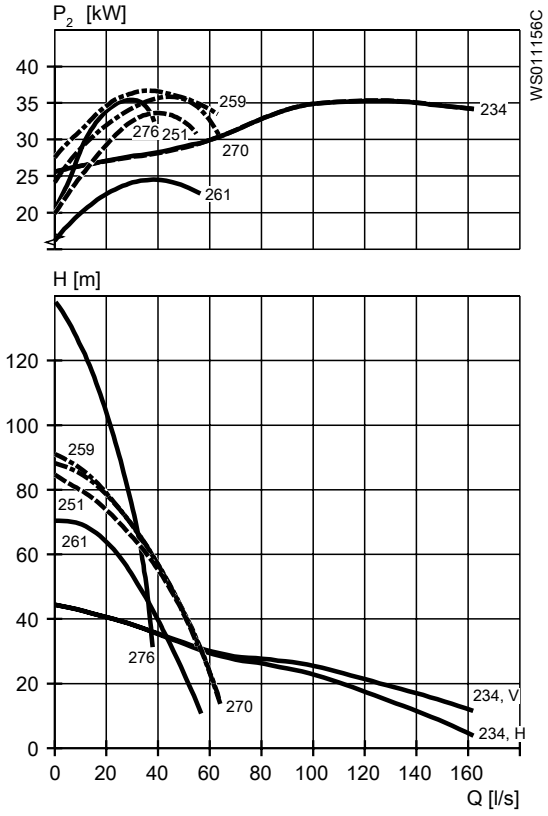


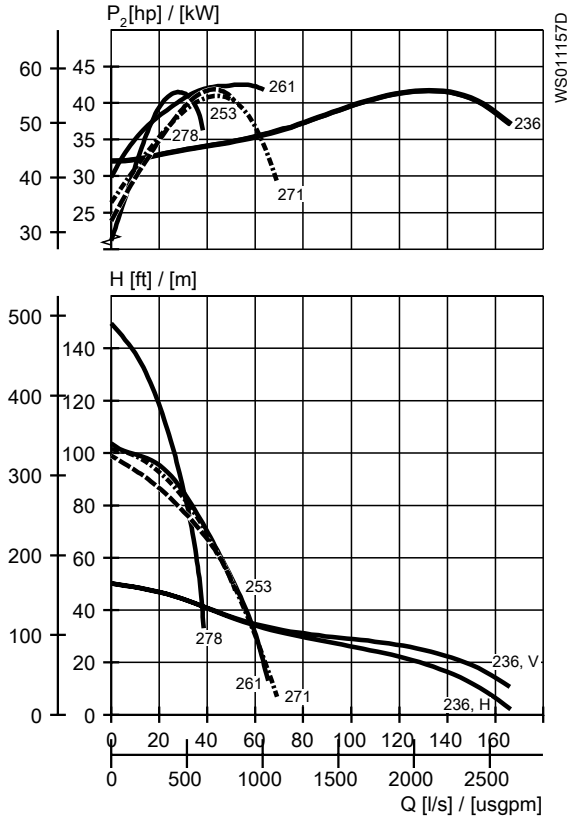
Figure 24: 60 Hz

8.7.7 2201.321



- V = Vertical
- H = Horizontal

Figure 25: 50 Hz



- V = Vertical
- H = Horizontal

Figure 26: 60 Hz

8.7.8 2201.390

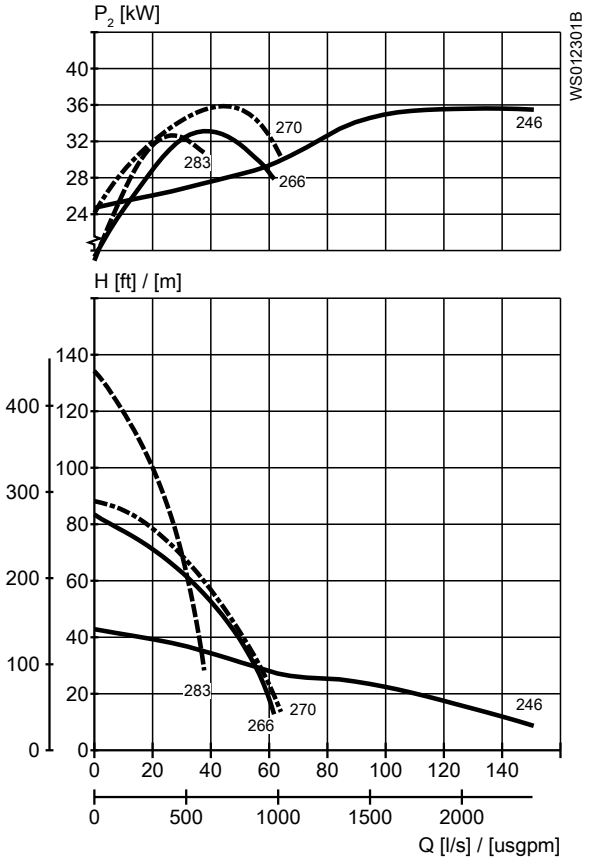


Figure 27: 50 Hz

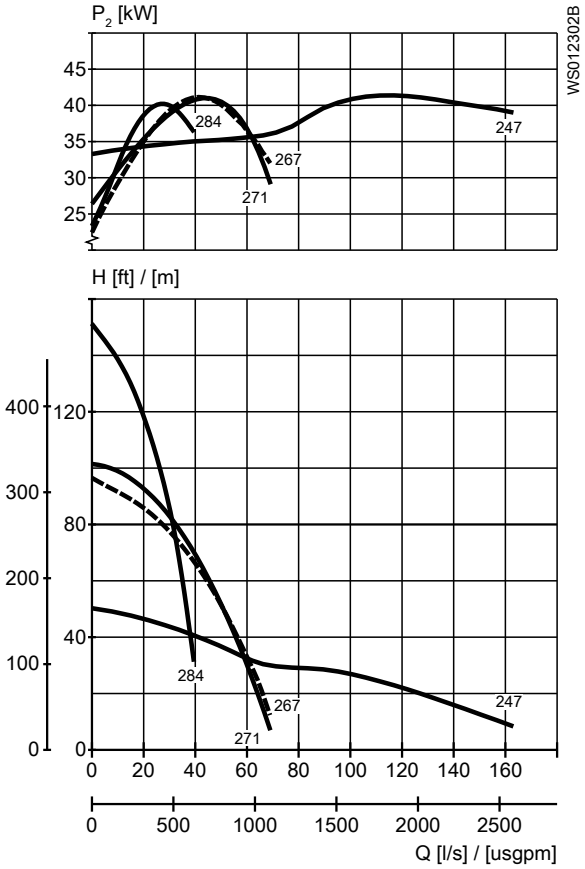


Figure 28: 60 Hz

8.7.9 2201.590

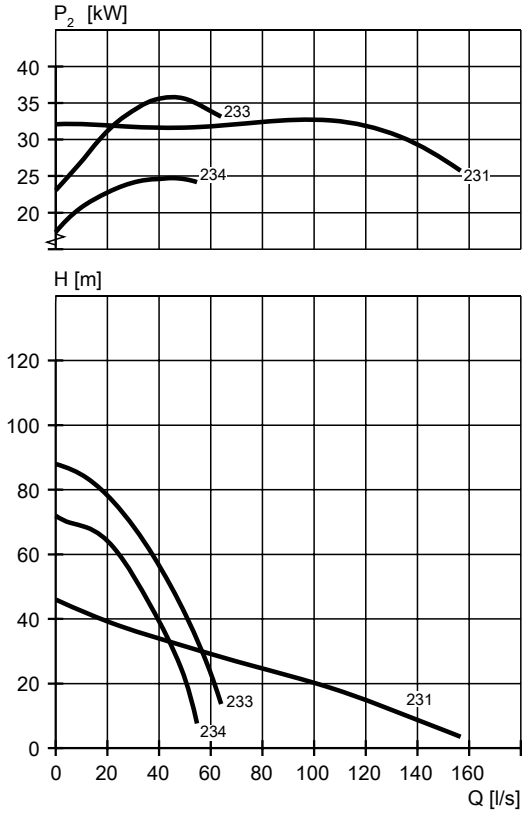


Figure 29: 50 Hz

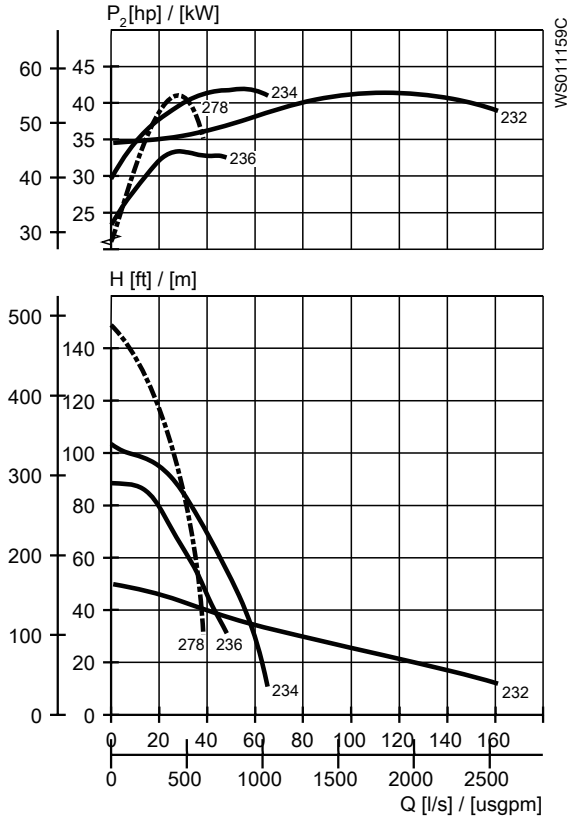


Figure 30: 60 Hz

8.7.10 2201.692

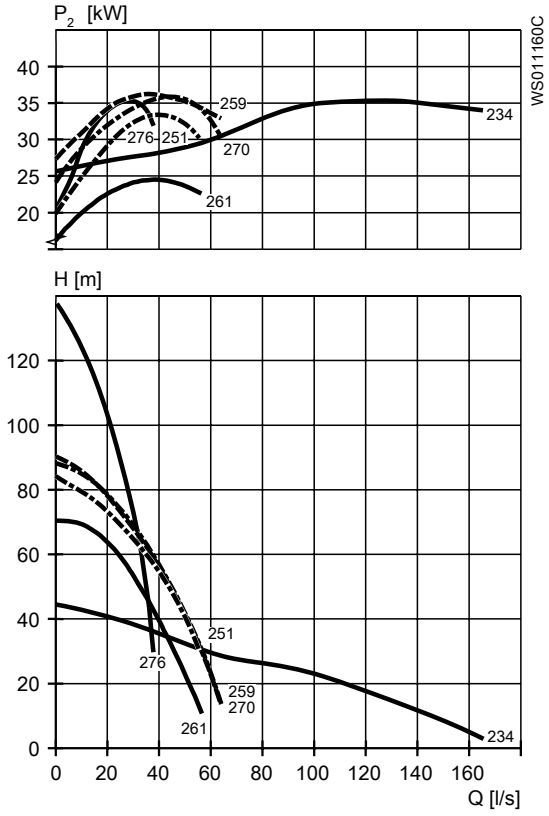


Figure 31: 50 Hz

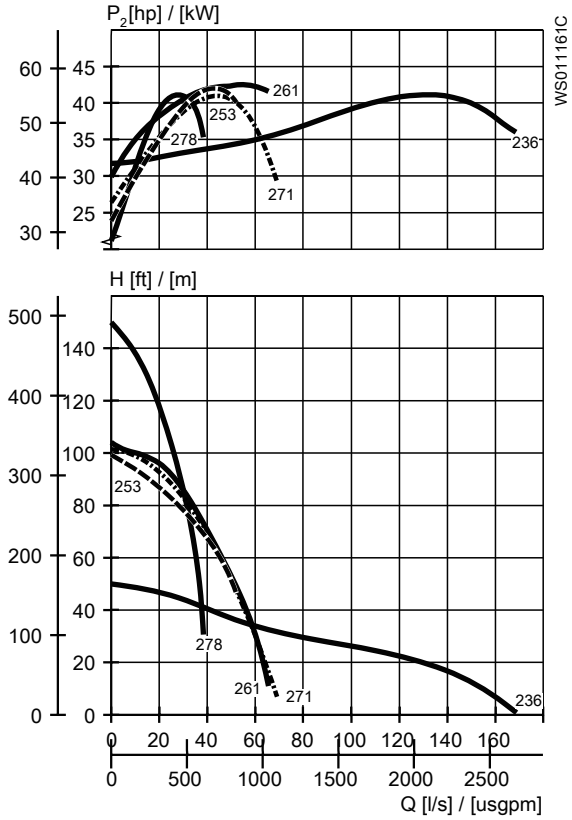


Figure 32: 60 Hz

Xylem |’zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We’re a global team unified in a common purpose: creating advanced technology solutions to the world’s water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

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xylem
Let’s Solve Water

Xylem Water Solutions Global Services AB 556782-9253
361 80 Emmaboda
Sweden
Tel: +46-471-24 70 00
Fax: +46-471-24 74 01
http://tpi.xyleminc.com
www.xylemwatersolutions.com/contacts/

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The original instruction is in English. All non-English instructions are translations of the original instruction.

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