



Flygt 3102

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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
 <p data-bbox="583 260 797 289">Electrical Hazard:</p>	 <p data-bbox="1127 260 1260 289">CAUTION:</p>

1.3 User safety

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

The site

- Observe lockout/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 60°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).

Minimum permitted liquid level

See the dimensional drawings of the product for the minimum permitted liquid level according to the approval for explosion proof products. If the information is missing on the dimensional drawing, the product must be fully submerged. 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 Special hazards

1.5.1 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.

1.5.2 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.6 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



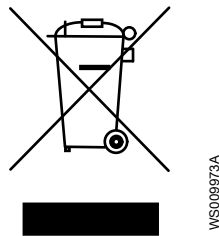
CAUTION: Radiation Hazard

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.

1.7 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.

1.8 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.

1.9 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

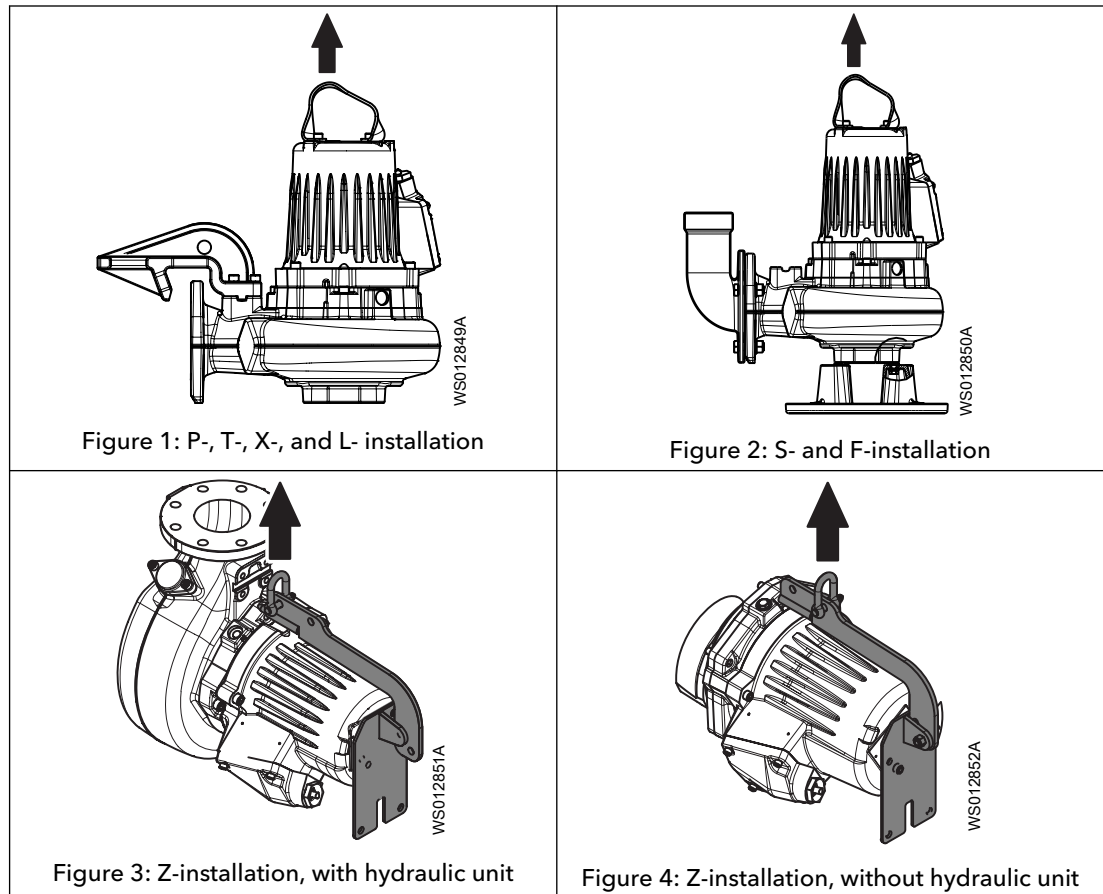
- Always lift the unit by its designated lifting points.
- Use suitable lifting equipment and ensure that the product is properly harnessed.
- Wear personal protective equipment.
- Stay clear of cables and suspended loads.

NOTICE:

Never lift the unit by its cables or hose.

Lifting points

The following images show the lifting points for the different installation types. For more information about the installation types, see [Installation](#) on page 18.



Lifting equipment

Lifting equipment is always required to handle the unit. The lifting equipment must fulfill the following requirements:

- The minimum height between the lifting hook and the floor must be sufficient to lift the unit. Contact a Xylem representative for more information.
- The lifting equipment must be able to hoist the unit straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be correctly anchored and in good condition.
- The lifting equipment must support the weight of the entire assembly. Only authorized personnel may use the lifting equipment.
- The lifting equipment must be dimensioned to lift the unit with any remaining pumped media in it.
- The lifting equipment must not be oversized.



CAUTION: Crush Hazard

Over-dimensioned lifting equipment can lead to injury. A site-specific risk analysis must be done.

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 (-58°F) to $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$).

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 more than six months, then the following apply:

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

Packaging material stacking limit

If the packaging material has an indicated stacking limit, then it is valid for 23°C (73°F) and 50% relative humidity. Depending on the material, other temperature and humidity ranges can reduce the stacking limit.

3 Product Description

Products included

Pump	Non-explosion proof drive unit	Explosion proof drive unit	High Efficiency motor (LSPM)	D-hydraulic	F-hydraulic	M-hydraulic (Grinder)	Adaptive N™ hydraulic
3102.060	X						X ¹
3102.070		X					X ¹
3102.090		X		X	X		
3102.160	X						X ³
3102.170	X					X	
3102.181	X			X	X		
3102.190		X					X ³
3102.760	X						X ²
3102.770		X					X ²
3102.890		X				X	
3102.900	X		X				X ³
3102.910		X	X				X ³
3102.920	X		X				X ¹
3102.930		X	X				X ¹
3102.960	X		X				X ²
3102.970		X	X				X ²
¹ Hard-Iron™ ² Stainless steel ³ Cast iron, gray							

Pump-specific information

For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

3.1 Pump design

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

Intended use

The product is intended for moving wastewater, sludge, raw and clean water. Always follow the limits that are given in [Technical Reference](#) on page 71. If there is a question regarding the intended use of the equipment, please contact a local sales and 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.

Spare parts

- Modifications to the unit or installation should only be carried out after consulting with Xylem.
- Original spare parts and accessories that are authorized by Xylem are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation. For more information contact your Xylem representative.

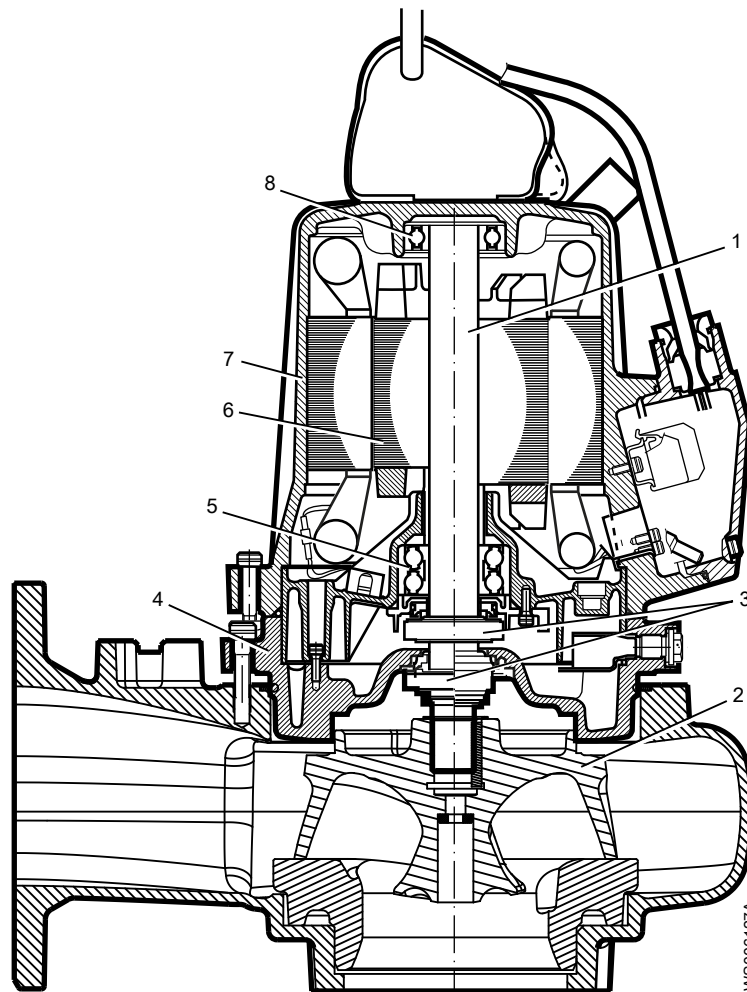
Pressure class

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

Exterior™ product concept

Exterior™ is a product concept including N-technology, Premium efficiency motor, and the intelligent control SmartRun™.

Parts



Position	Denomination	Description
1	Shaft	The shaft is made of stainless steel with an integrated rotor.
2	Impeller	There are multiple types of impellers. For information about the pumps impellers, see Parts List.
3	Mechanical seals	One inner and one outer seal in a combination of materials: <ul style="list-style-type: none"> • Aluminium oxide Al_2O_3 • Silicon carbide RSiC • Corrosion-resistant cemented carbide WCCR For information about the pumps mechanical seals, see Parts List.
4	Oil housing	The oil housing includes a coolant that lubricates and cools the seals; the housing acts as a buffer between the pumped fluid and the drive unit.
5	Main bearing	The bearing consisting of a two-row angular contact ball bearing.
6	Motor	For information about the motor, see Technical Reference on page 71.
7	Stator housing	The pump is cooled by the ambient liquid/air.
8	Support bearing	The bearing consisting of a single-row ball bearing.

3.2 Sensors and monitoring equipment

The following applies to the monitoring equipment of the pump:

- The stator incorporates three thermal contacts connected in series that activate the alarm and stops the pump at overtemperature
- The thermal contacts open at 125°C (257°F).

- Ex-approved pumps must have thermal contacts connected to the control panel.
- The sensors must be connected to either the MiniCAS II monitoring equipment or an equivalent equipment.
- The monitoring equipment must be of a design that makes automatic restart impossible.
- Information in the junction box shows if the pump is equipped with optional sensors.

Optional sensors

FLS FLS is a miniature float switch for detection of liquid in the stator housing. Due to its design it is best suited for pumps in a vertical position. The FLS sensor is installed in the bottom of the stator housing.

CLS CLS is a sensor for detection of water in the oil housing. The sensor initiates an alarm when the oil contains approximately 35% water. The sensor is installed in the bearing housing/bearing holder with its sensing part in the oil housing. The CLS sensor is not applicable to Ex-approved pumps.

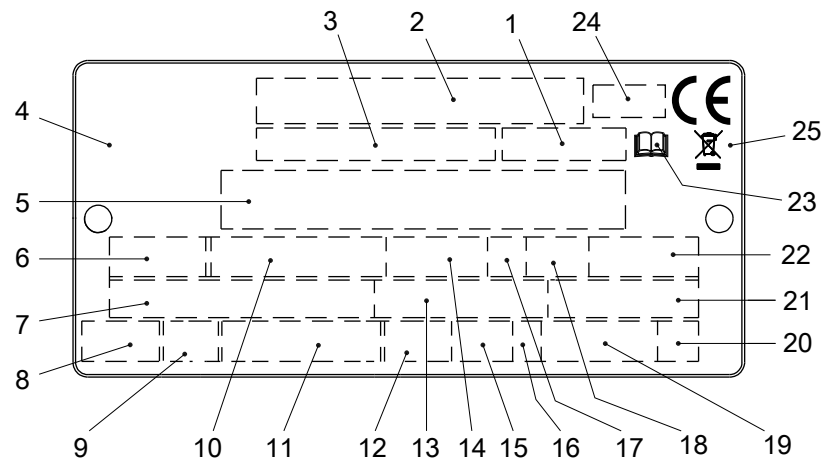
NOTICE:

The CLS sensor body is made of glass. Handle the sensor with care.

One CLS and one FLS sensor can be used in the same pump, if they are connected in parallel.

3.3 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


WS006257C

24. Notified body, only for EN-approved Ex products
 25. WEEE-Directive symbol

Figure 5: The data plate

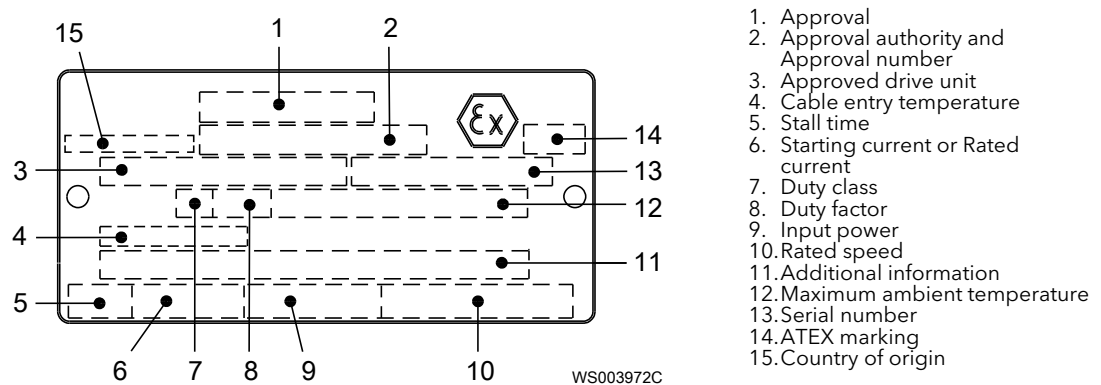
3.4 Approvals

Product approvals for hazardous locations

Pump	Approval
<ul style="list-style-type: none"> • 3102.070 • 3102.090 • 3102.190 • 3102.770 • 3102.890 • 3102.910 • 3102.930 • 3102.970 	<p>European Norm (EN)</p> <ul style="list-style-type: none"> • ATEX Directive • EN 60079-0:2012/A11:2013, EN 60079-1:2014, EN ISO 80079-36:2016, EN ISO 80079-37:2016 •  II 2 G Ex db h IIB T4 Gb <p>IEC</p> <ul style="list-style-type: none"> • IECEx scheme • IEC 60079-0:2011, IEC 60079-1:2014; IEC 80079-36:2016; IEC 80079-37:2016 • Ex db h IIB T4 Gb <p>FM (FM Approvals)</p> <ul style="list-style-type: none"> • Explosion proof for use in Class I, Div. 1, Group C and D • Dust ignition proof for use in Class II, Div. 1, Group E, F and G • Suitable for use in Class III, Div. 1, Hazardous Locations <p>CSA Ex</p> <ul style="list-style-type: none"> • Explosion proof for use in Class I, Div. 1, Group C and D

EN approval plate

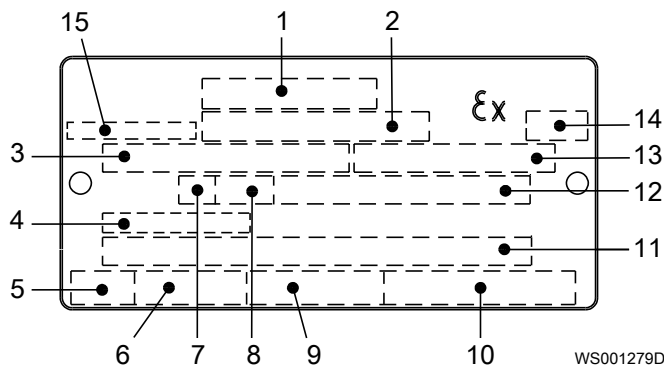
This illustration describes the EN approval plate and the information that is contained in its fields.



IEC approval plate

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

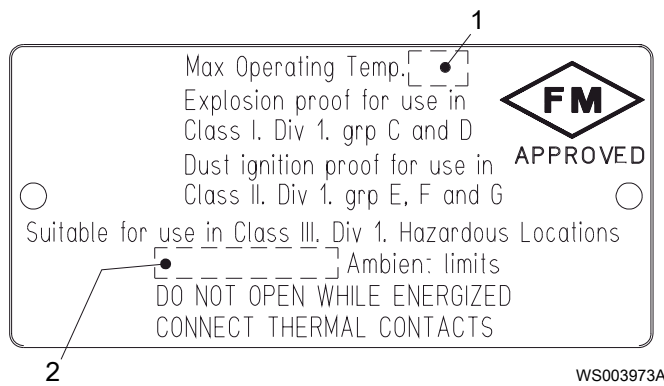
International Norm; not for EU member countries.



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

FM approval plate

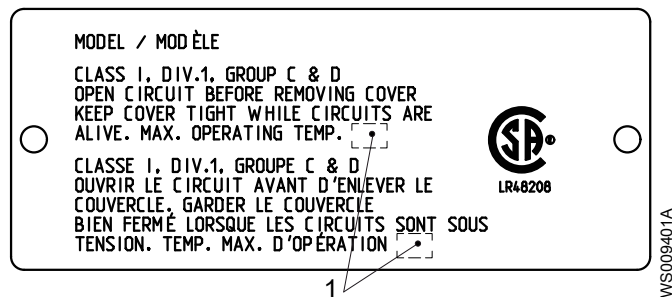
This illustration describes the FM approval plate and the information that is contained in its fields.



1. Temperature class
2. Maximum ambient temperature

CSA approval plate

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



1. Temperature class

3.5 Product denomination

Reading instruction

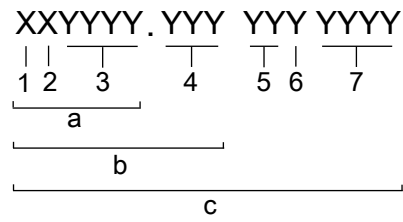
In this section, code characters are illustrated accordingly:

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



WS006265B

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
	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.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.



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.

General requirements

These requirements apply:

- Use the pump dimensional drawing in order to ensure proper installation.

Before installing the pump, do the following:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that equipment is in place so that the unit cannot roll or fall over during the installation process.
- Check the explosion risk before you weld or use electric hand tools.
- Check that the cable and cable entry have not been damaged during transport.
- Always remove all debris and waste material from the sump, inlet piping, and discharge connection, before you install the pump.
- If the unit has a permanent magnet motor, then ensure that you have read and understood all safety instructions regarding permanent magnet motors.

NOTICE:

Do not run the pump dry.

NOTICE:

Never force piping to make a connection with a pump.

Authority regulation

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

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.

4.2 Install with P-installation

In the P-installation, the pump is installed on a stationary discharge connection, and operates either completely or partially submerged in the pumped liquid. These requirements and instructions only apply when the installation is made according to the dimensional drawing.

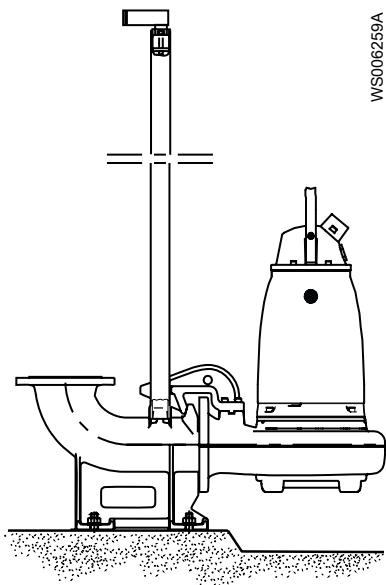


Figure 6: P-installation

These items are required:

- Guide bars
- Guide bar bracket for attaching the guide equipment to the access frame or to the upper part of the sump
- Cable holder for holding the cable
- Access frame (with covers) to which the upper guide bar bracket and cable holder can be attached
- Discharge connection for connecting the pump to the discharge line
The discharge connection has a flange which fits the pump housing flange and a bracket for attaching the guide equipment.
- Fasteners for the discharge connection
- Anchor bolts

1. Install the access frame:
 - a) Place the access frame in position and align it horizontally.
 - b) Grout the frame in place.
2. Grout the anchor bolts in place.

Be careful when you align and position the discharge connection in relation to the access frame.

3. Place the discharge connection in position, and tighten the nuts.
4. Install the guide bars:
 - a) Secure the guide bars in the bracket.
 - b) Check that the guide bars are placed vertically. Use a level or a plumb line.
5. Connect the discharge pipe to the discharge connection.
6. Lower the pump along the guide bars.

When it reaches the bottom position, the pump automatically connects to the discharge connection.

7. Secure the motor cable:
 - a) Fasten the permanent lifting device to the pump and to the access frame. For example, you can use a stainless-steel lifting chain with shackles.
 - b) Fasten the cable to the cable holder.

Make sure that the cable cannot be sucked into the pump inlet or that it is neither sharply bent, or pinched. Support straps are required for deep installations.
 - c) 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 39.

Clean all debris from the sump before starting the pump.

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 and stands on a base stand.

These requirements and instructions only apply when the installation is made according to the dimensional drawing. For information about the different installation types, see Parts List.

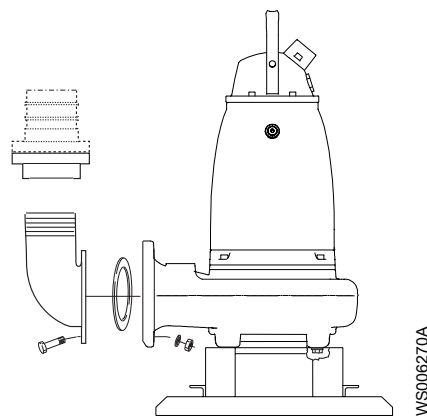


Figure 7: S-installation

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.

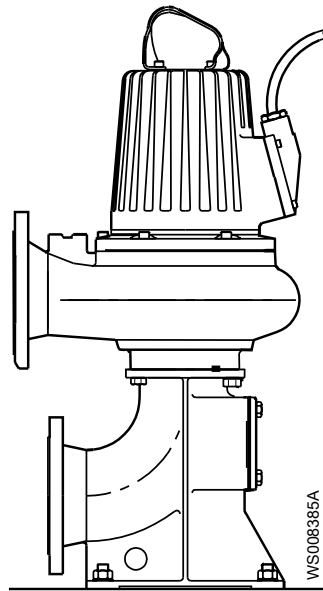
Make sure that the impeller rotation is correct. For more information, see [Check the impeller rotation](#) on page 39.

4.4 Install with T-installation

This installation is not applicable for these versions:

- .170
- .890

In the T-installation, the pump is installed in a vertical position in a dry well next to the wet sump. These requirements and instructions only apply when the installation is made according to the dimensional drawing.



These items are required:

- Anchor bolts for anchoring the pump to a base.
- Shut-off valves that allow you to remove the pump from service

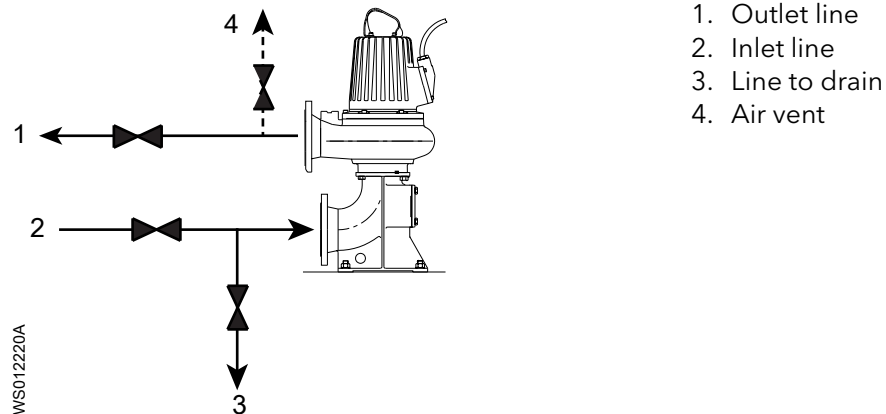


Figure 8: Shutoff and air vent valves (generic pump shown)

NOTICE:

The risk of freezing is particularly high in T- or Z-installations.

1. Fasten the pump:
 - a) Bolt the stationary suction connection to the concrete base.
 - b) Bolt the pump to the suction connection.
2. Make sure that the pump is vertical for the T-installation.
3. Connect the suction line and discharge line.
4. 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 39.
5. Make sure that the weight of the pump does not put strain on the piping.

4.5 Install with Z-installation

This installation is not applicable for these versions:

- .170
- .890

In the Z-installation, the pump is installed in a horizontal position on a support stand in a dry well next to the wet sump. The following requirements and instructions are for Z-installations that comply to the dimensional drawing.

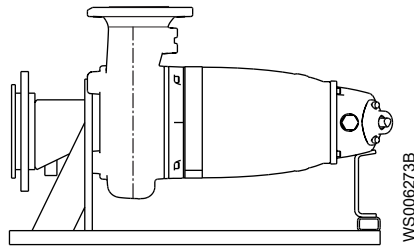


Figure 9: Z-installation

These items are required:

- Anchor bolts for anchoring the pump to a base.
- Shut-off valves that allow you to remove the pump from service

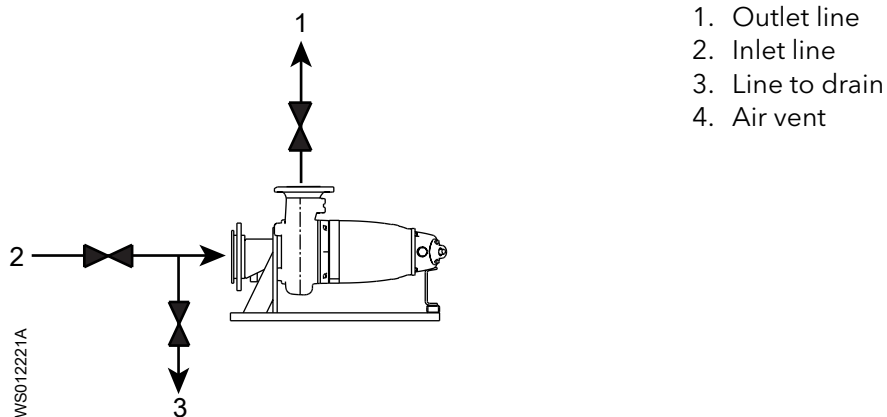


Figure 10: Shutoff and air vent valves (generic pump shown)

NOTICE:

The risk of freezing is particularly high in T- or Z-installations.

1. Fasten the pump:
 - a) Bolt the stationary suction connection to the concrete base.
 - b) Bolt the pump to the suction connection.
2. Make sure that the pump is vertical for the T-installation or horizontal for the Z-installation.
3. Connect the suction line and discharge line.
4. 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 39.
5. Make sure that the weight of the pump does not put strain on the piping.

4.6 Install with F-installation

In the F-installation, the pump is free standing and installed primarily in a small sump on a firm surface. The pump is intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe and with supporting legs and/or a strainer. These requirements and instructions are for F-installations that comply to the dimensional drawing.

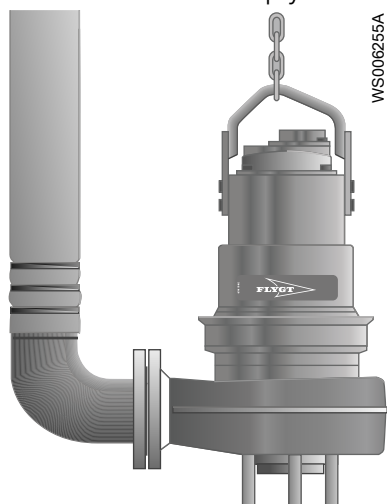


Figure 11: F-installation

These items are required:

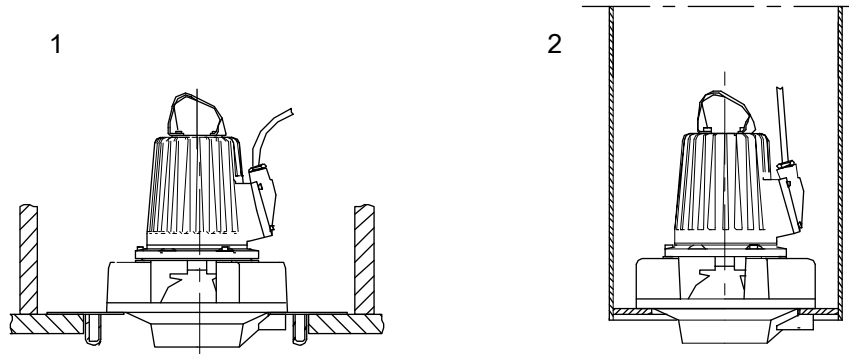
- Nipple pipe/Flange/Coupling
 - Pipe or hose
1. Run the cable so that it has no sharp bends, is not pinched, and cannot be sucked into the pump inlet.
 2. Fit the nipple pipe/flange/coupling.
 3. Lower the pump into the sump.
 4. Place the pump on the sump bottom and make sure it cannot fall over.
 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 39.

4.7 Install with L-installation

In the L-installation, the pump is installed in a vertical, semipermanent, wet well column pipe arrangement. The well is divided into a suction part and a discharge part. The pump end is equipped with guide vanes.

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



1. Concrete installation
2. Column installation

Figure 12: L-installation alternatives

These items are required:

- Plate 416 13 0x or column pipe 416 12 xx for L-installation
- Anchor bolts for L-installation
- Cable holder

1. Select one of the following steps:

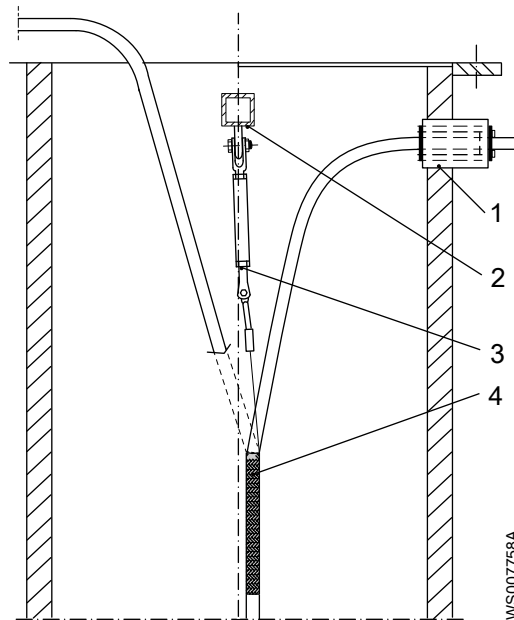
Type of installation	Action
Concrete installation	<ol style="list-style-type: none"> 1. Place the plate for L-installation in position and align it horizontally. 2. Grout the anchor bolts in place. 3. Protect the bolts with corrosion-protective compound.
Column installation	<ol style="list-style-type: none"> 1. Cast the column pipe in concrete or install the pre-fabricated column. 2. Place the column in position and align it horizontally. 3. Grout the anchor bolts in place at the top flange of the column pipe. 4. Protect the bolts with corrosion-protective compound.

2. Run a cable between the pump and the starter and monitoring equipment.
Make sure that the cable is not sharply bent or pinched.
3. 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 39.
4. Install the pump.
 - a) Fasten the lifting device to the pump.
Use a stainless steel lifting chain with shackles.
 - b) Lower the pump into the correct position according to the dimensional drawing.
Make sure that the pump cannot rotate at start-up or during operation.
5. Secure the motor cable:
 - a) Install the cable support grip and the turnbuckle.
Use a support that is positioned over the center of the column.

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Make sure that the cable is kept taut in the center of the column pipe and that it is not sharply bent or pinched.

- b) If the discharge column is pressurized, then install a cable entry seal unit in the side of the column.



1. Cable entry seal unit
2. Support
3. Turnbuckle
4. Cable support grip

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

Clean all debris from the column pipe before starting the pump.

4.8 Install with X-installation

In the X-installation, the pump has no pre-determined mechanical connection. The flange is drilled.

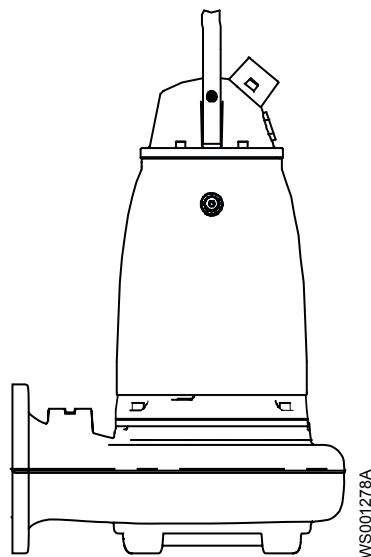


Figure 13: X-installation

NOTICE:

A pump prepared for X-installation is only approved to be used in P- or S-installation. Never use it in T- or Z-installation

For installation instructions, see appropriate mechanical accessories.

4.9 Make the electrical connections

4.9.1 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: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.



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.
- If stated on the data plate, then the motor is convertible between different voltages.
- The thermal contacts or thermistors must be in use.
- For FM-approved pumps, a leakage sensor must be connected and in use to meet approval requirements.

Motor and short-circuit protection

A qualified electrician must select the size of motor protection breakers and fuses, so that it is sufficient 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 and 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. See the data plate and if applicable the cable chart for the rated current. The starting current in direct-on-line start can be up to six times higher than 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.
- The screened cable must be used according to the European CE and EMC requirements if a Variable Frequency Drive (VFD) is used. For more information, contact a sales or authorized service representative (VFD-supplier).
- Make sure that the cable is long enough for maintenance work.
- For SUBCAB[®] cables, the twisted pair copper foil must be trimmed.
- All unused conductors must be insulated.

4.9.2 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

If the power cable is jerked loose, then the ground (earth) conductor must be the last conductor to come loose from its terminal. Make sure that the ground (earth) conductor is longer than the phase conductors at both ends of the cable.

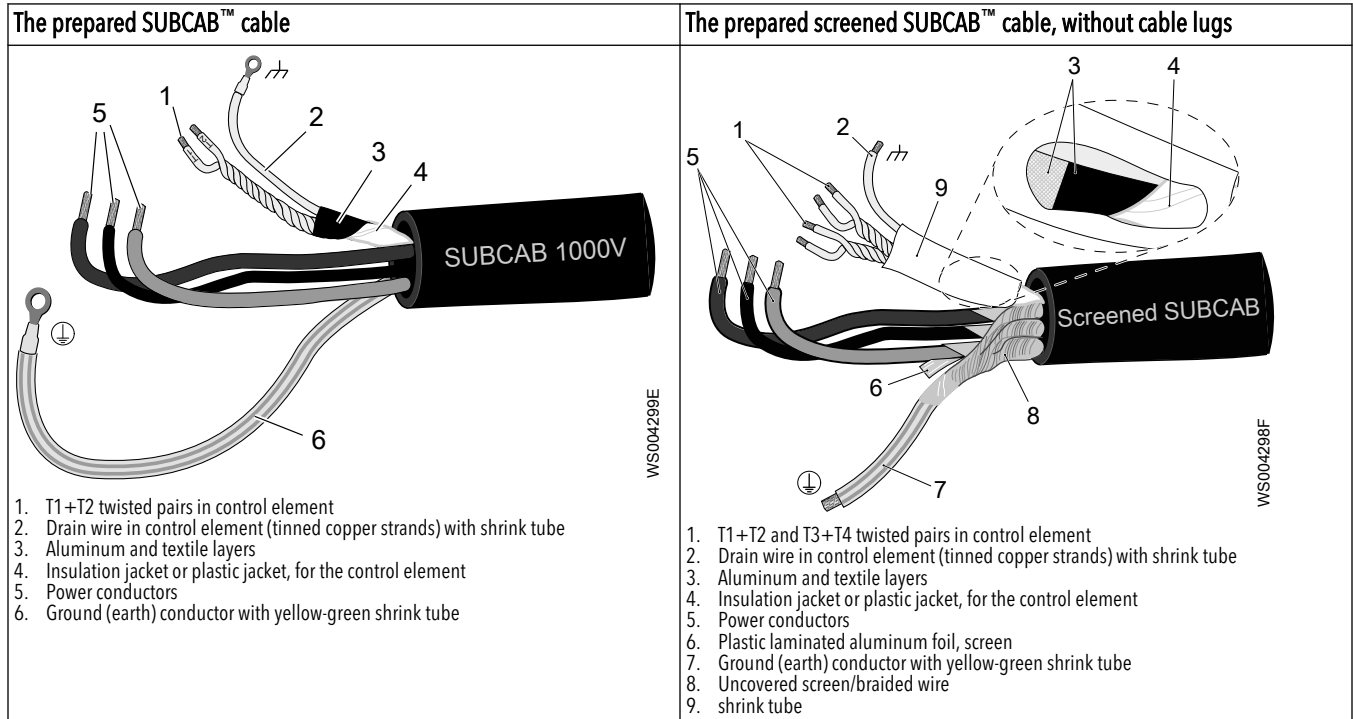


WARNING: Electrical Hazard

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.

4.9.3 Prepare the SUBCAB™ cables

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



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.

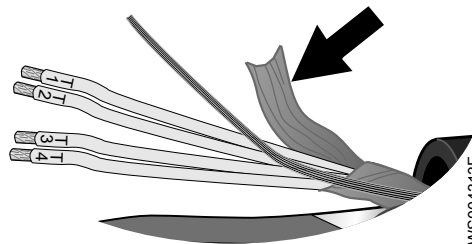


Figure 14: Aluminum foil on the control element.

- c) Put a white shrink tube over the drain wire.

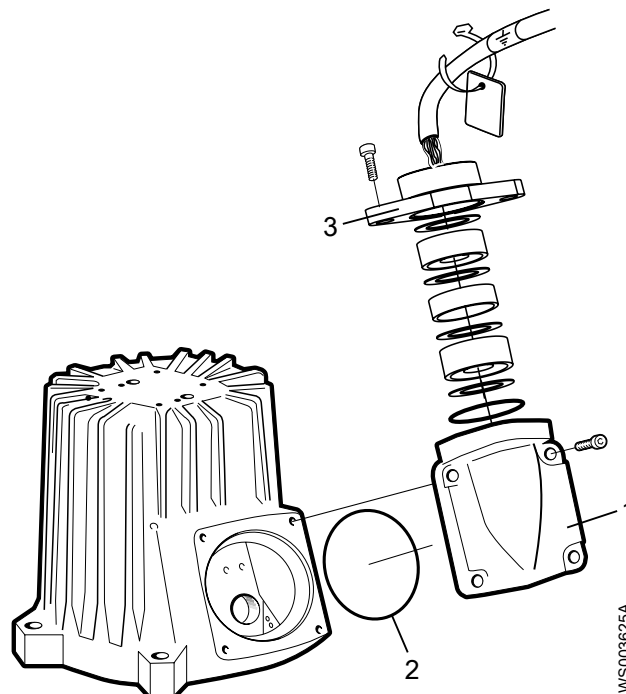
- d) Twist T1+T2 and T3+T4.
- e) Put a shrink tube over the control element.
Make sure that the conductive aluminum foil and drain wire are covered.
3. Prepare the ground (earth) conductor of the SUBCAB™ cable:
 - a) Peel the yellow-green insulation from the ground (earth) conductor.
 - b) Check that 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.

4.9.4 Connect the motor cable to the pump

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.



1. Entrance cover
2. O-ring
3. Entrance flange
1. Remove the entrance cover and the O-ring from the stator housing.
This provide access to the terminal board/closed end splices.
2. Check the data plate to see which connections are required for the power supply.
3. Arrange the connections on the terminal board/closed end splices in accordance with the required power supply.
4. Connect the mains leads (L1, L2, L3, and ground (earth)) according to applicable cable chart.
The ground (earth) lead must be 50 mm (2.0 in.) longer than the phase leads in the junction box of the unit.
5. Make sure that the pump is correctly connected to ground (earth).
6. Make sure that any thermal contacts incorporated in the pump are properly connected to the terminal block/closed end splices.
7. Install the entrance cover and the O-ring on the stator housing.
8. Fasten the screws on the entrance flange so that the cable insertion assembly bottoms out.

4.9.5 Connect the motor cable to the starter and monitoring 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.

NOTICE:

Thermal contacts are incorporated in the pump.

NOTICE:

Thermal contacts must never be exposed to voltages higher than 250 V, breaking current maximum 5 A.

The single phase pumps must be equipped with a starter which has start and run capacitors.

A specially Flygt designed starter is required for the operation of single phase pumps. The connection of the motor cable to the starter is shown in the wiring diagram.

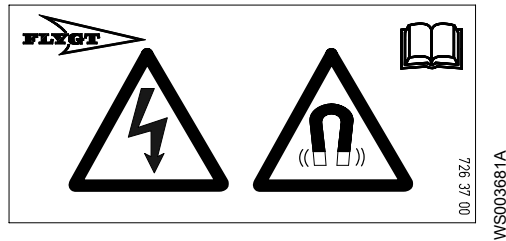
1. If thermal contacts are included in the pump installation, then connect the T1 and T2 control conductors to the MiniCAS II monitoring equipment.

If the temperature of the pumped liquid is above 40°C (104°F), then do not connect the T1 and T2 leads to thermal contacts.

NOTICE:

The thermal contacts are incorporated in the stator. Connect them to 24 V over separate fuses to protect other automatic equipment.

2. Connect the mains leads (L1, L2, L3, and ground (earth)) to the starter equipment.
For information about the phase sequence and the color codes of the leads, see Cable charts.
3. Applicable for permanent magnet motor; ensure that the warning label is attached to the cable end. In case the label is missing, attach the spare label to the cable end.
The label is delivered with the pump.



4. Check the functionality of the monitoring equipment:
 - a) Check that the signals and the tripping function work correctly.
 - b) Check that the relays, lamps, fuses, and connections are intact.
 Replace any defective equipment.

4.9.6 Cable charts

Description

This topic contains general connection information. It also provides cable charts that show connection alternatives for use with different cables and power supply.

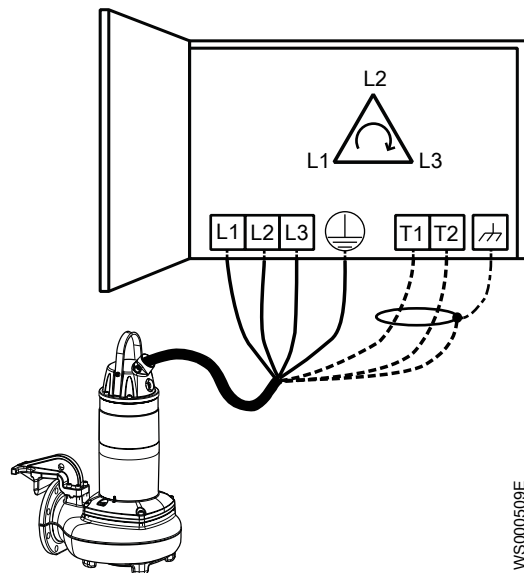
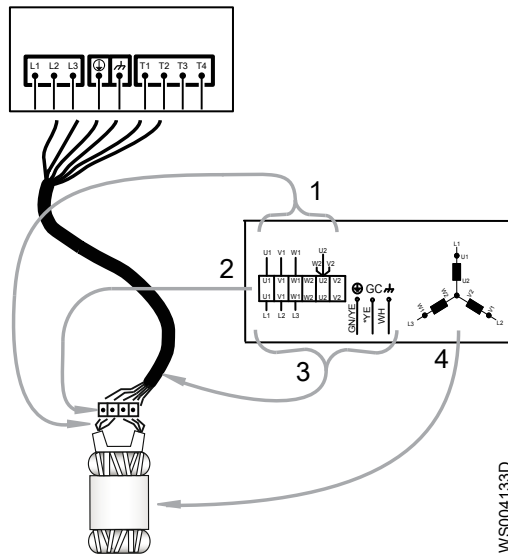


Figure 15: Phase sequence

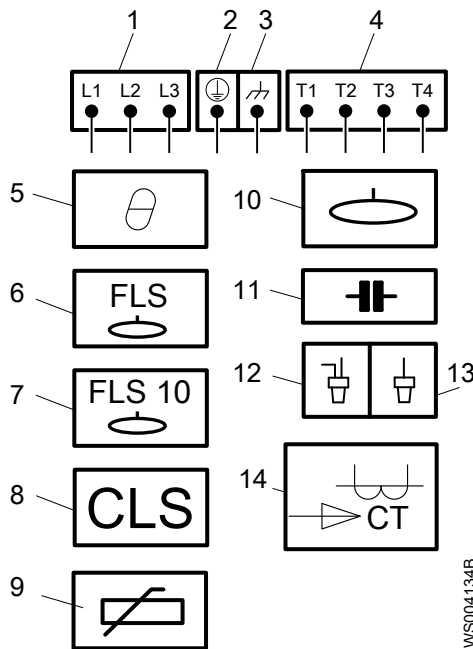
Connection locations

The figures in this section illustrate how to interpret the connection strip symbols.



1. Stator leads
2. Terminal board
3. Power cable leads
4. Stator (internal connection illustrated)

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1. Starter equipment and mains leads (L1, L2, L3)
2. Ground (earth)
3. Functional ground
4. Control leads (T1, T2, T3, T4)
5. Thermal contact
6. FLS
7. FLS 10
8. CLS
9. Thermistor
10. Level sensor
11. Capacitor
12. Crimp connection
13. Crimp isolation
14. Current transformer

WS004134B

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

4.9.6.1 Colors and markings of leads

Motor connection		Mains		SUBCAB 7GX Screenflex 7GX	SUBCAB 4GX Screenflex 4GX	SUBCAB AWG	SUBCAB Screened
Colours and marking of main leads		1~	3~				
COLOUR STANDARD BN=Brown BK=Black WH=White OG=Orange GN=Green GN/YE=Green-Yellow RD=Red GY=Grey BU=Blue YE=Yellow *SUBCAB AWG ** Ground Conductor is stranded around cores GC=Ground Check	STATOR LEADS U1,U5 RD U2,U6 GN V1,V5 BN V2,V6 BU W1,W5 YE W2,W6 BK T1,T2 WH/YE	1	L1	BK 1	BN	RD	BN
		2	L2	BK 2	BK	BK	BK
		3	L3	BK 3	GY	WH	GY
			L1	BK 4	-	-	-
			L2	BK 5	-	-	-
			L3	BK 6	-	-	-
				GN/YE	GN/YE	GN/YE	**Screen/PE from cores
				Screen (WH)	Screen (WH)	-	Screen (WH)
			GC	-	-	YE	-
		772 17 00 (REV 7)					

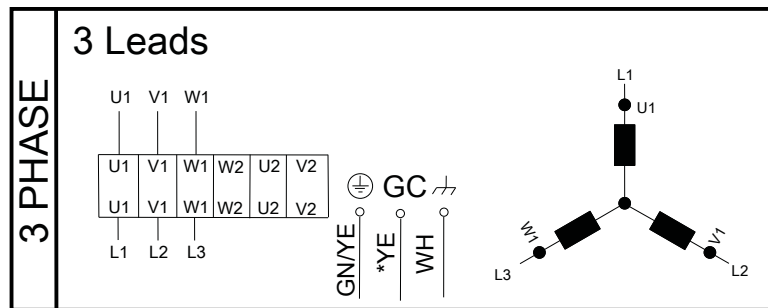
Figure 16: 3-phase and 1-phase without built-in starter

For markings on sensor leads, see [Sensors connection](#) on page 37.

4.9.6.2 Connections included

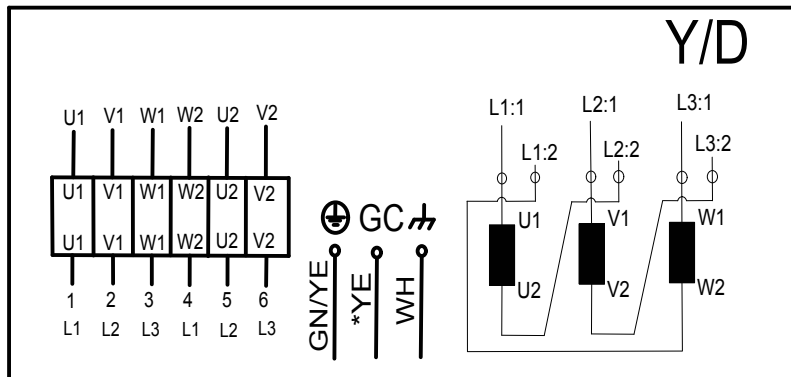
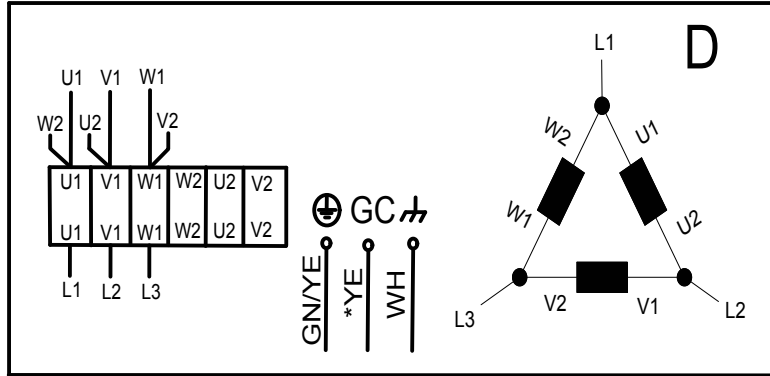
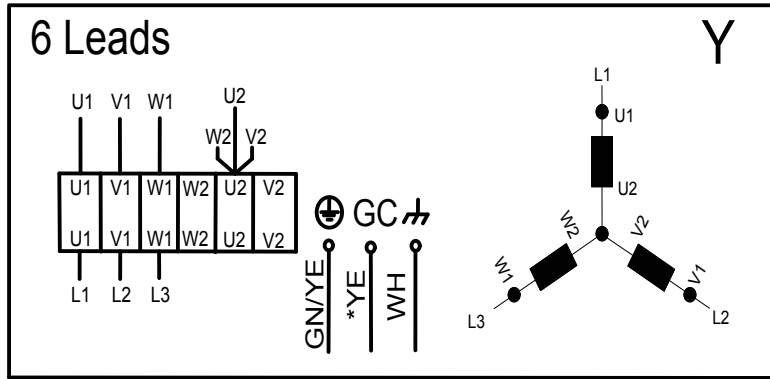
- [3-phase connection](#) on page 33
- [1-phase connection](#) on page 36
- [Sensors connection](#) on page 37
- [Screened cable connection](#) on page 37

4.9.6.3 3-phase connection



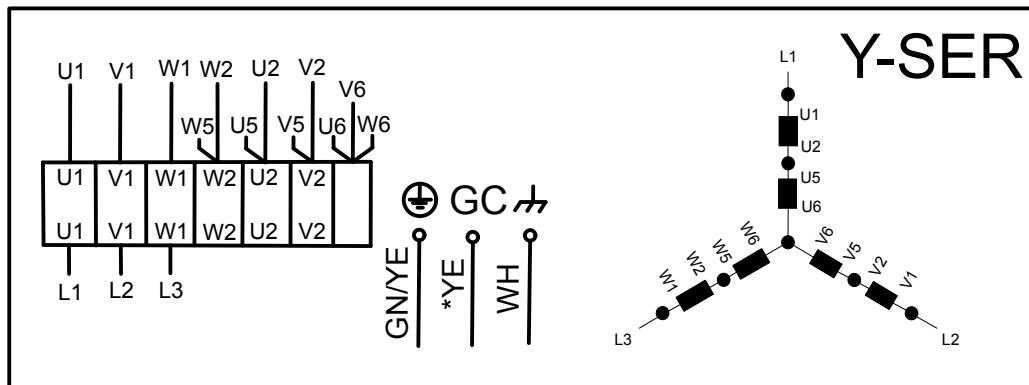
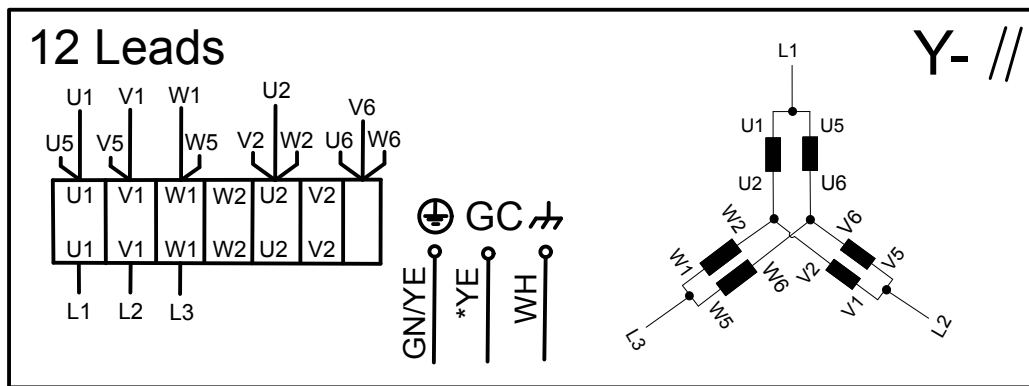
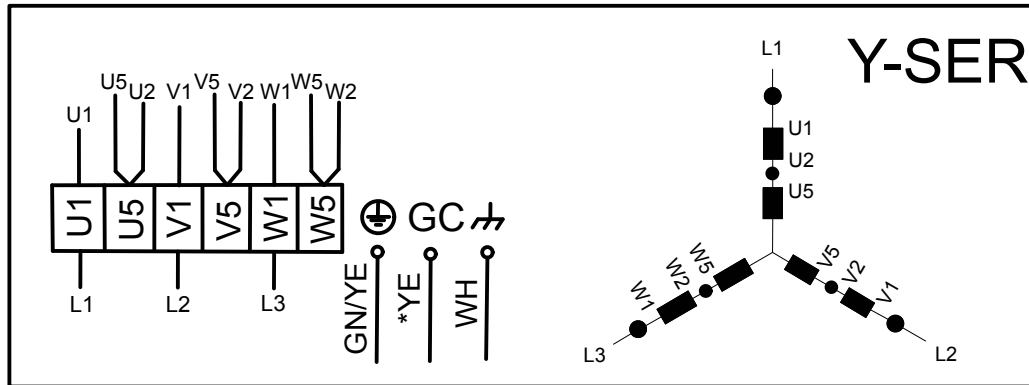
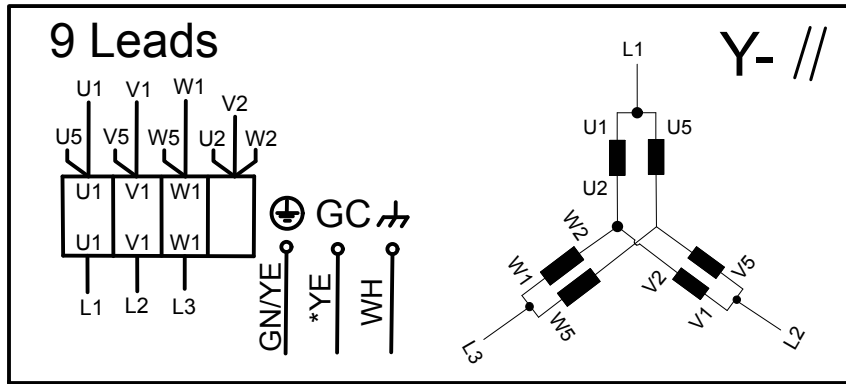
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WS004127A



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4.9.6.4 1-phase connection

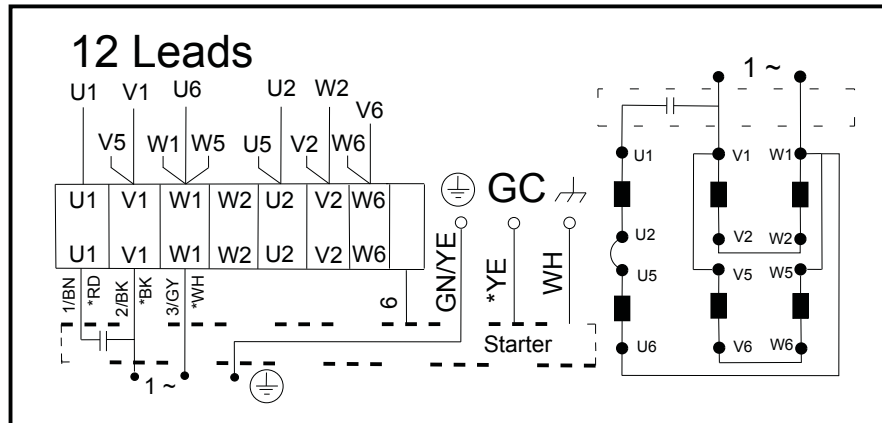
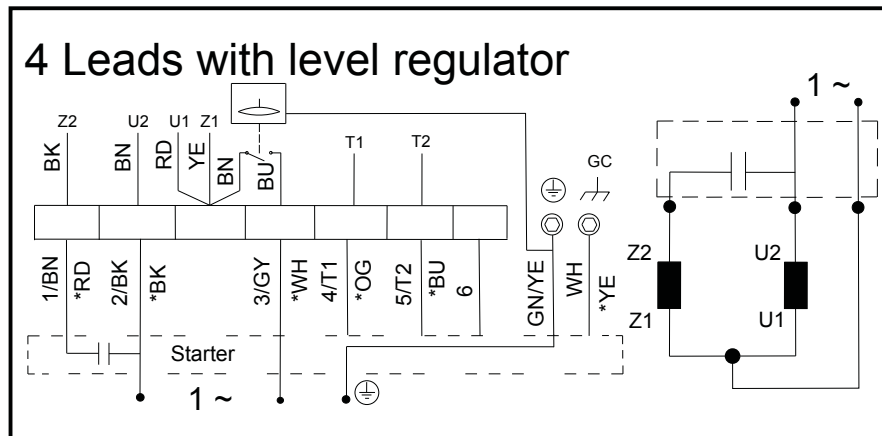
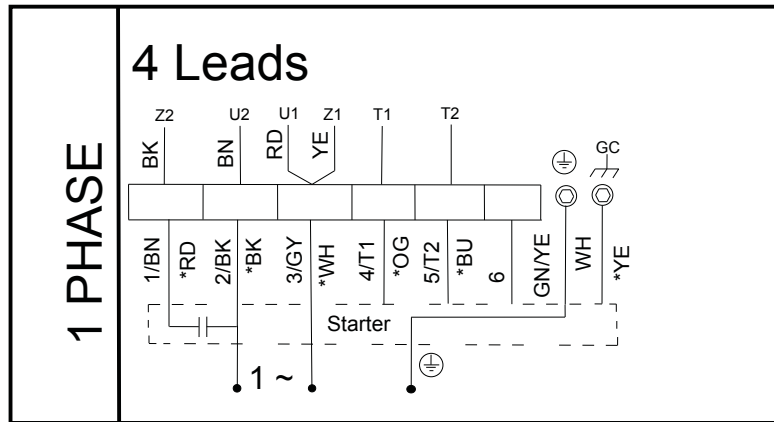
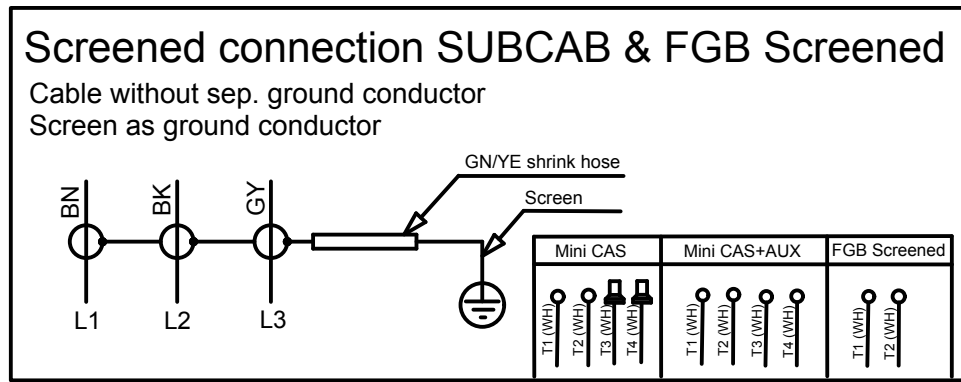


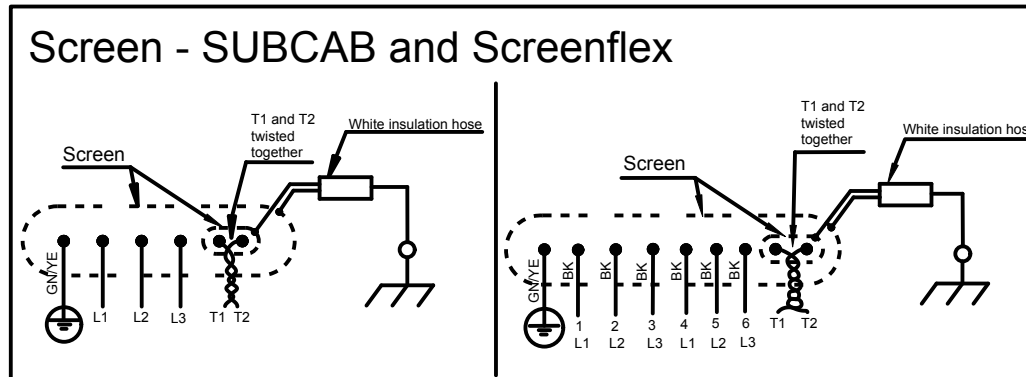
Figure 17: Without built-in starter

For more information, see [Colors and markings of leads](#) on page 33.

4.9.6.5 Screened cable connection



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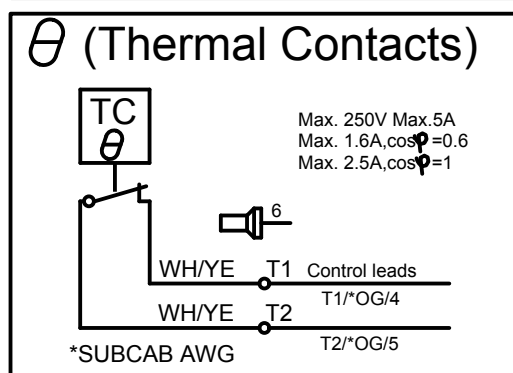
Sensors connection

Not all charts are applicable for every product.

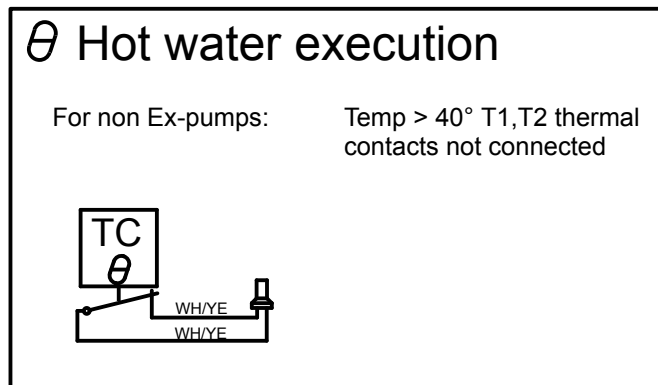
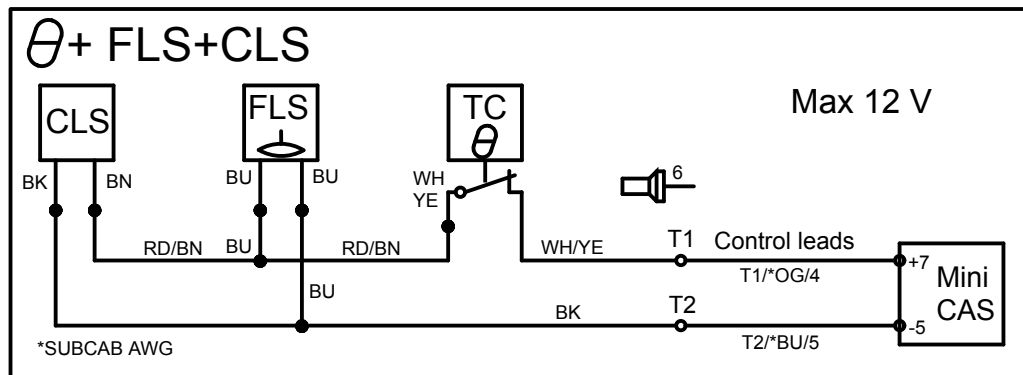
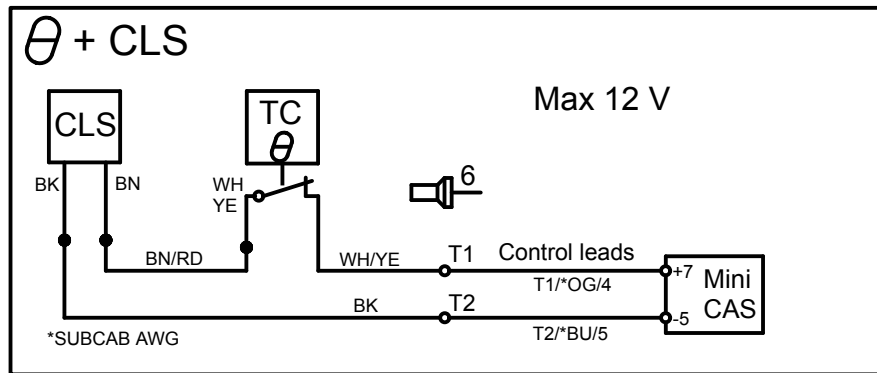
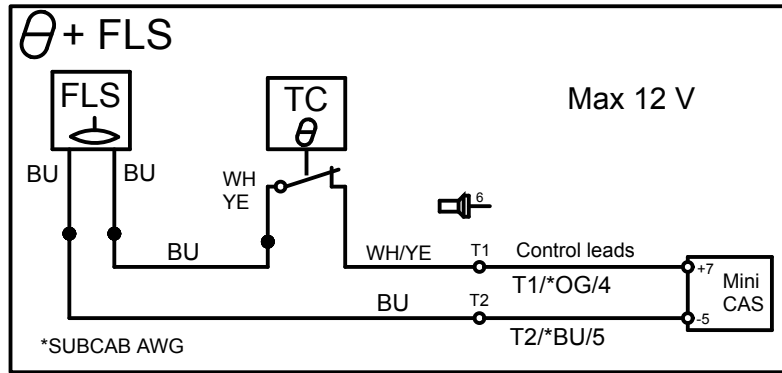
These sensor connections are applicable for 3-phase and 1-phase without built-in starter:

SENSORS	Control	SUBCAB 7GX & 4GX Screenflex	SUBCAB AWG	SUBCAB screened
	T1	WH T1	OG	WH T1
	T2	WH T2	BU	WH T2
	T3	-	-	WH T3
	T4	-	-	WH T4

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This sensor connection is applicable for 1-phase with built-in starter:

Sensor connection characteristics

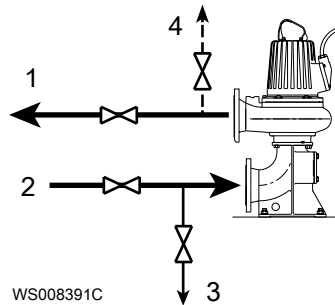
The values have a 10 % tolerance.

Sensors	Value (mA)	Definition
FLS and thermal contact	0	Overtemperature
	7.8	OK
	36	Leakage

Sensors	Value (mA)	Definition
CLS and thermal contact	0	Overtemperature
	5.5	OK
	29	Leakage (5 seconds delay)
CLS, FLS and thermal contact	0	Overtemperature
	13.3	OK
	36-42	Leakage (0/5 seconds delay)

4.10 T-installation: Bleed air before starting pump

1. Open the valve on the air vent line and bleed out the air. See the following figure.



1. Outlet line
2. Inlet line
3. Line to drain
4. Air vent

Figure 18: T-installation

2. Close the valve on the air vent line before the pump is started.

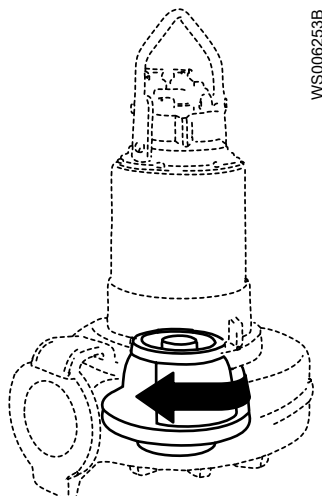
4.11 Check the impeller rotation



CAUTION: Crush Hazard

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

1. Start the motor.
2. Stop the motor after a few seconds.
3. Check that the impeller rotates according to this illustration.



The correct direction of impeller rotation is clockwise when you look at the pump from above.

4. If the impeller rotates in the wrong direction, then do one of these steps:
 - If the motor has a 1-phase connection, then contact a sales or authorized service representative.
 - If the motor has a 3-phase connection, then transpose two phase leads and do this procedure again.

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.

5.2 Estimate zinc anode replacement intervals

The mass and surface area of the zinc anodes are designed to protect the pump surface for 1 year in sea water with an average temperature of 20°C (68°F). Shorter inspection intervals and anode replacement can be required, depending upon the water temperature and the chemical composition as well as the presence of other metals in the vicinity of the pump.

The rate of zinc consumption, and the appropriate inspection intervals, can be estimated by measuring how much zinc is consumed during the first two months following installation.

Anodes are replaced when the anode mass is reduced to a selected fraction of its initial mass. The recommended interval for the selection fraction is 0.25-0.50 (25-50%).

1. Remove, weigh, and reinstall one or more of the exterior zinc anodes before starting up the pump.
2. After two months, remove and weigh the same zinc anode or anodes again.

3. Divide the lapsed time in days (between steps 1 and 2) by the anode weight loss in grams to get the calculated anode consumption rate (days/gram).
If multiple anodes were weighed, then use the anode which has lost the most weight for this calculation.
4. Calculate future replacement intervals so that they occur when the selected fraction of zinc is remaining.

5.3 Start the pump



CAUTION: Crush Hazard

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

NOTICE:

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

1. Check the oil level in the oil housing.
2. 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.

3. Conduct insulation test phase to ground. To pass, the value must exceed 5 megaohms.
4. Check that the monitoring equipment works.
5. Start the pump.

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.

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.

6.2 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 suitable 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 (ft-lbs)

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 (ft-lbs)

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 (ft-lbs)

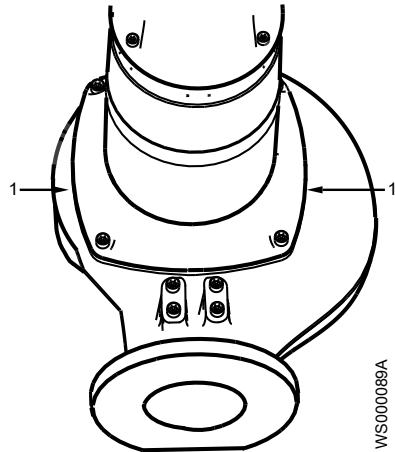
M5	M8	M10
2.7 (2.0)	11 (8.1)	22 (16.2)

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 above.

6.3 Change the oil

This image shows the plugs that are used to change the oil.



WS000089A

1. Oil plug

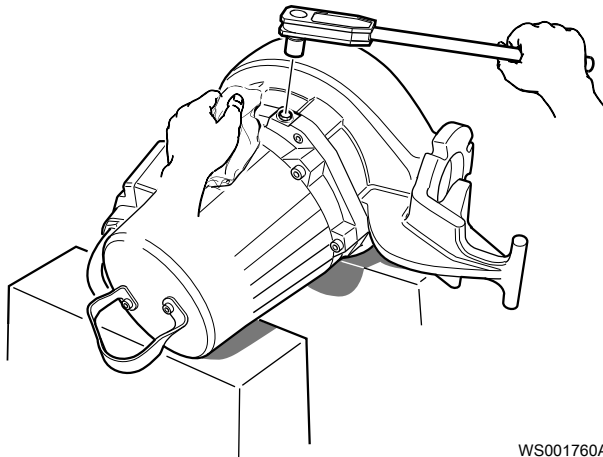
Empty the oil



CAUTION: Compressed Gas Hazard

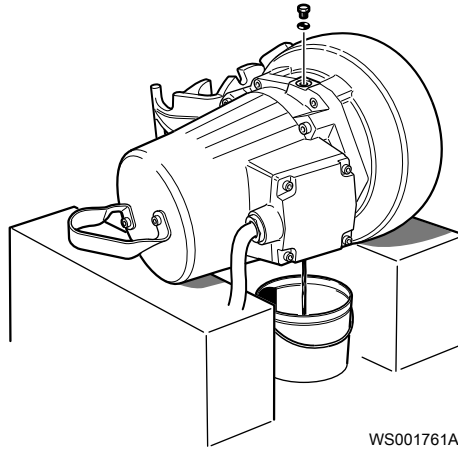
Air inside the chamber may cause parts or liquid to be propelled with force. Be careful when opening. Allow the chamber to de-pressurize before removal of the plug.

1. Place the pump in a horizontal position and unscrew the oil plug.
If the pump has a hole with the markings "oil out" it is important that this hole is used for drainage.



WS001760A

2. Place a container under the pump and turn the pump.
3. Unscrew the other oil plug.
If this hole has the markings "oil in", raise the pump upright for a short period of time during drainage in order to drain all the oil.



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Fill with oil

The oil should be a medical white oil of paraffin type that fulfills FDA 172.878 (a) and viscosity close to VG32. Examples of suitable oil types are the following:

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

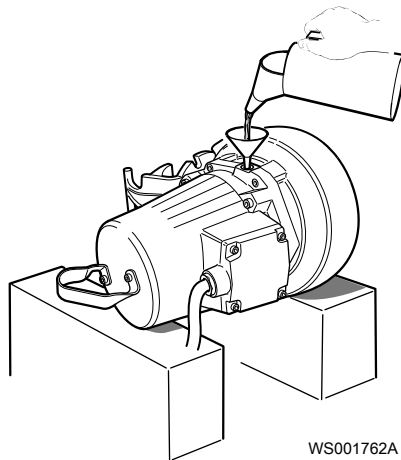
1. Replace the O-rings of the oil plugs.
2. Refit an oil plug in the hole that faces downwards or is marked "oil out", and tighten.

Tightening torque: 10-40 Nm (7.5-29.5 ft-lb)

3. Fill with oil through the hole on the opposite side or the hole marked "oil in".

If the hole is marked "oil in", slightly tilt the pump and lower it again in order to fill the pump with the correct quantity.

Quantity: approximately 1.0 L (1.1 qt).



WS001762A

4. Refit the oil plug and tighten.

Tightening torque: 10-40 Nm (7.5-29.5 ft-lb).

6.4 Service the pump

Type of maintenance	Purpose	Inspection interval
Initial inspection	A Xylem-authorized personnel checks the pump condition. From the results, the personnel recommends the intervals for the periodical inspection and overhaul for the installation.	Within the first year of operation.

Type of maintenance	Purpose	Inspection interval
Periodical inspection	The inspection prevents operational interruptions and machine breakdowns. The measures to increase performance and pump efficiency are decided for each application. They can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	Up to every year Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).
Overhaul	The overhaul lengthens the operating lifetime of the product. It includes the replacement of key components and the measures that are taken during an inspection.	Up to every three years Applies to normal applications and operating conditions at media (liquid) temperatures <40°C (104°F).

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

Service item	Action
Cable	<ol style="list-style-type: none"> 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.
Connection to power	Check that the connections are properly secured.
Electrical cabinets	Check that they are clean and dry.
Impeller	<ol style="list-style-type: none"> 1. Check the impeller clearance. 2. Adjust the impeller, if necessary.
Stator housing	<ol style="list-style-type: none"> 1. Drain all liquid, if any. 2. Check the resistance of the leakage sensor. Normal value approximately 1500 ohms, alarm approximately 430 ohms.
Insulation	<p>Use a megger maximum 1000 V.</p> <ol style="list-style-type: none"> 1. Check that the resistance between the ground (earth) and phase lead is more than 5 megohms. 2. Conduct a phase-to-phase resistance check.
Junction box	Check that it is clean and dry.
Lifting device	Check that the local safety regulations are followed.
Lifting handle	<ol style="list-style-type: none"> 1. Check the screws. 2. Check the condition of the lifting handle and the chain. 3. If necessary, replace.
O-rings	<ol style="list-style-type: none"> 1. Replace the oil plug O-rings. 2. Replace the O-rings at the entrance or junction cover. 3. Grease the new O-rings.
Overload protection and other protections	Check the correct settings.
Personnel safety devices	Check the guard rails, covers, and other protections.
Rotation direction	Check the impeller rotation.
Oil housing	Fill with new oil, if necessary.
Terminal block/closed end splice	Check that the connections are properly secured.
Thermal contacts	Normally closed circuit; interval 0-1 ohm.

Service item	Action
Voltage and amperage	Check the running values.

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.

6.4.3 Service in case of alarm

For information about indication values for sensors, see [Sensors connection](#) on page 37.

Alarm source	Action
CLS	Check for water in the oil housing. If the oil contains too much water, then do the following: <ol style="list-style-type: none"> 1. Drain the oil and water. 2. Replace with new oil.
FLS	<ol style="list-style-type: none"> 1. Check for liquid in the stator housing. 2. Drain all liquid, if any. 3. Check the mechanical seal unit, the O-rings, and the cable entry, if liquid was found.
Thermal contact	Check the start and stop levels.
The overload protection	Check that the impeller can rotate freely.

6.5 Replace the impeller

Required tools:

- 8 mm hexagon bit adapter with an extension of at least 125 mm (4.92 in)
- Impeller puller

If applicable, contact your local sales and service representative for correct type and size.

- Rod (wood or copper) for locking the impeller in place, if applicable
- Two crowbars, if applicable



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

NOTICE:

When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

If you fail with the impeller installation, then you must redo the installation procedure from the beginning.

6.5.1 Replace the impeller: D

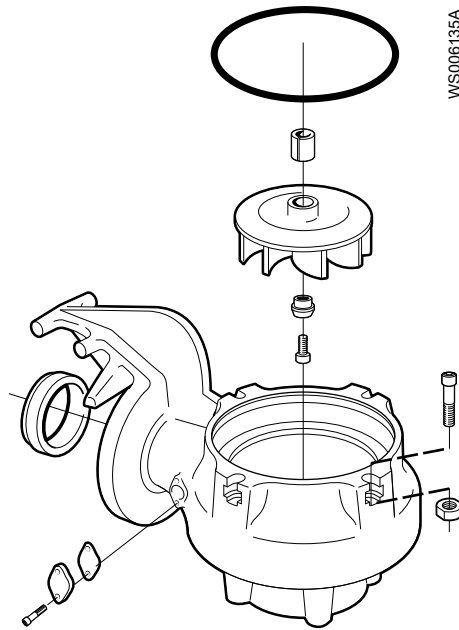


Figure 19: D-impeller

6.5.1.1 Remove the impeller: D



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the pump housing or the suction cover.



2. Remove the impeller screw.
If applicable, use the rod.



Figure 20: D-impeller

3. Remove the washer.
4. Remove the impeller.
Use the impeller puller or the crowbars.



Figure 21: D-impeller

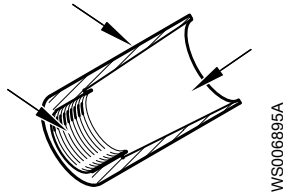
5. Remove the conical sleeve.

6.5.1.2 Install the impeller: D

1. Prepare the shaft:
 - a) Polish off any flaws with 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 proper 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. Mount the impeller:
 - a) Fit the conical sleeve onto the shaft.



- b) Lubricate the impeller screw threads and contact surface.
Ensure that all parts are clean.
 - c) Fit the washer on the lubricated impeller screw.
 - d) Press the impeller onto the shaft with the impeller screw.

NOTICE:

The impeller may get jammed against the oil housing bottom. Pull out the impeller a couple of millimeters, when mounting a C impeller with the pressure class LT.

3. Tighten the impeller screw.

If applicable, use the rod.

Tightening torque: 65 Nm (48 ft-lbs)

Tighten a further 1/8 turn, 45° after tightening to the correct torque.



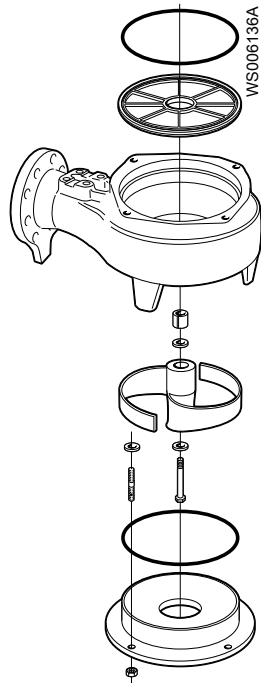
Check that the impeller can rotate freely.

4. Mount the pump housing:

- a) T-, Z-installation only: Fit a new lubricated O-ring to the pump housing.
 - b) Fit the pump housing.
 - c) Fit and tighten the lubricated screws.
- Tightening torque: 57 Nm (42 ft-lb).



6.5.2 Replace the F-impeller



6.5.2.1 Remove the F-impeller



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

- 1. Remove the suction cover.
If necessary, then pry off the suction cover.
- 2. Remove the impeller screw, the ring, and the washers.
If applicable, use the rod.



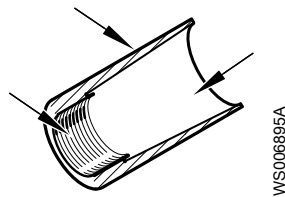
3. Remove the impeller.
Use the impeller puller or the crowbars.
Use the impeller screw to push the impeller.
4. Remove the conical sleeve.

6.5.2.2 Install the F-impeller

1. Prepare the shaft:
 - a) Polish off any flaws with 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 proper 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. Mount the impeller:
 - a) Fit the conical sleeve onto the shaft.
 - b) Fit one plain washer with a thickness of 2 mm (0.08 in), eight adjustment washers with a thickness of 0.5 mm (0.02 in), and eight adjustment washers with a thickness of 0.2 mm (0.008 in) onto the impeller.



- c) Lubricate the impeller screw threads and contact surface.
Ensure that all parts are clean.
 - d) Press the impeller onto the shaft with the impeller screw.
3. Fasten the impeller:
- a) Prevent the impeller from rotating by inserting the rod through the pump housing outlet.
 - b) Tighten the impeller screw.
If applicable, use the rod.
Tightening torque: 65 Nm (48 ft-lb).
Tighten a further 1/8 turn, 45° after tightening to the correct torque.



- Check that the impeller can rotate freely.
4. Adjust the impeller:
- a) Measure the distance between the edge of the impeller and the pump housing cover.
The correct distance should be 0.5-1.5 mm (0.02-0.06 in). Add or remove the appropriate number of adjusting washers in order to achieve correct distance.



WS002107A

- b) Tighten the impeller screw.
 If applicable, use the rod.
 Tightening torque: 65 Nm (48 ft-lb).
 Check that the impeller can rotate freely.
5. Fit a new lubricated O-ring to the into the groove in the pump housing.



WS002080A

6. Mount the suction cover:
- a) Fit the studs on the pump housing.
 Use Loctite 603 locking liquid in order to secure the studs.
- b) Fit two adjustment washers with a thickness of 2 mm (0.08 in) and 8-10 adjustment washers with a thickness of 0.25 mm (0.01 in), onto each stud.



WS002014A

- c) Fit the suction cover to the studs.

- d) Fit the lock nuts onto the studs.
- e) Tighten the nuts.
Tightening torque: 17 Nm (13 ft-lb)



- 7. Adjust the suction cover:
 - a) Measure the distance between the impeller and the suction cover.
The correct distance should be 0.5-1 mm (0.02-0.04 in). Add or remove the appropriate number of adjusting washers in order to achieve the correct distance.



- b) Tighten the nuts.
Tightening torque: 17 Nm (13 ft-lb).



- 8. Raise the pump to a vertical position.
Check that the impeller can rotate freely.

6.5.3 Replace the M-impeller

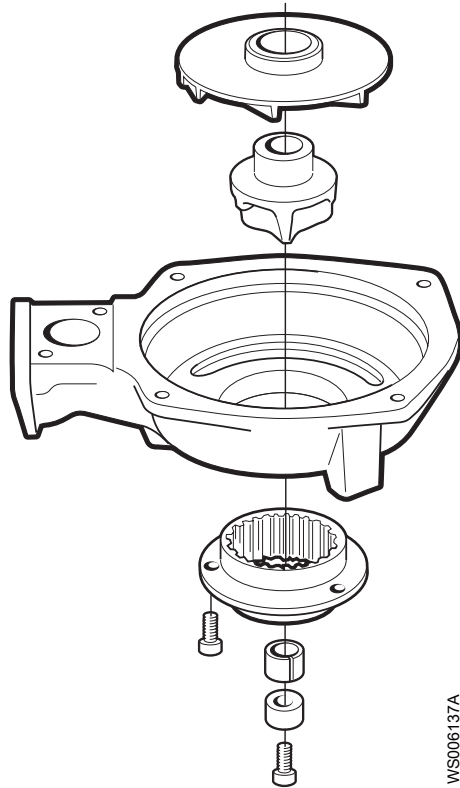


Figure 22: M-impeller

6.5.3.1 Remove the M-impeller



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

1. Remove the pump housing.
2. Remove the impeller screw and outer sleeve.
If applicable, use the rod.

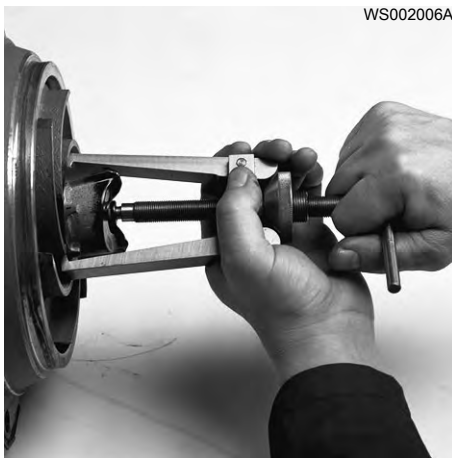


3. Refit the impeller screw.



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4. Fit the impeller puller and pull off the impeller and cutting wheel. Place a protector between the screw head and the impeller puller.



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5. Remove the conical sleeve.



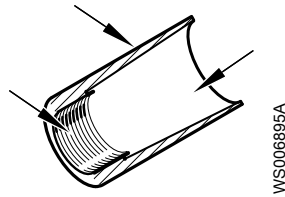
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6.5.3.2 Install the M-impeller

1. Prepare the shaft:
 - a) Polish off any flaws with 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 proper 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. Mount the impeller:
 - a) Fit the conical sleeve onto the shaft.



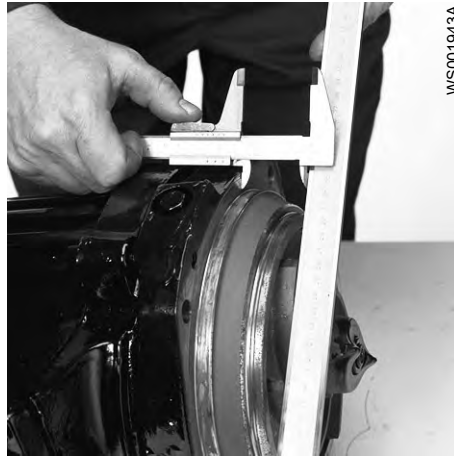
- b) Fit the cutting wheel into the impeller.
 - c) Fit the outer sleeve onto the lubricated impeller screw.
 - d) Fit the impeller with the cutting wheel onto the shaft with the impeller screw.

Do not tighten the impeller screw.

3. Adjust the impeller:
 - a) Use a straightedge and a vernier to measure the distance between the vanes of the impeller and the shoulder for the pump housing on the oil housing bottom.

Pressure class	Phase	Hz	Distance
LT	1	60	43.5±0.3 mm (1.71±0.01 in.)
LT	3	50, 60	46.0±0.3 mm (1.81±0.01 in.)
HT	1,3	50, 60	43.5±0.3 mm (1.71±0.01 in.)

- b) Slide the impeller on to the shaft until you reach the correct distance.



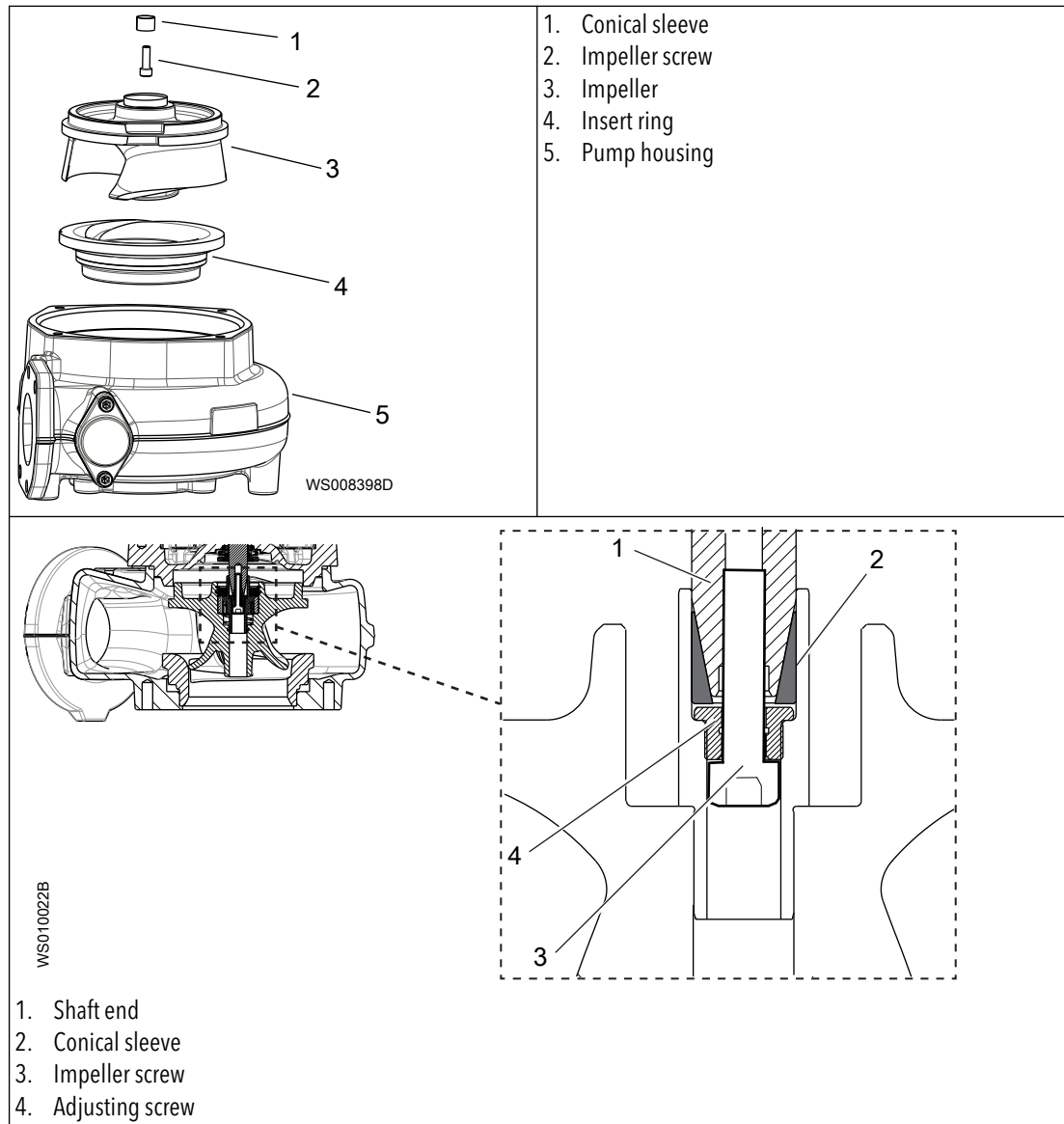
4. Tighten the impeller screw.
If applicable, use the rod.
Tightening torque: 65 Nm (48 ft-lbs)
Tighten a further 1/8 turn, 45° after tightening to the correct torque.



- Check that the impeller can rotate freely.
5. Mount the pump housing:
 - a) Fit a new lubricated O-ring into the pump housing.
 - b) Fit the pump housing.
 - c) Fit and tighten the lubricated screws.
Tightening torque: 57 Nm (42 ft-lb).



6.5.4 Replacing the Adaptive N™ impeller



CAUTION: Cutting Hazard

Worn parts can have sharp edges. Wear protective clothing.

NOTICE:

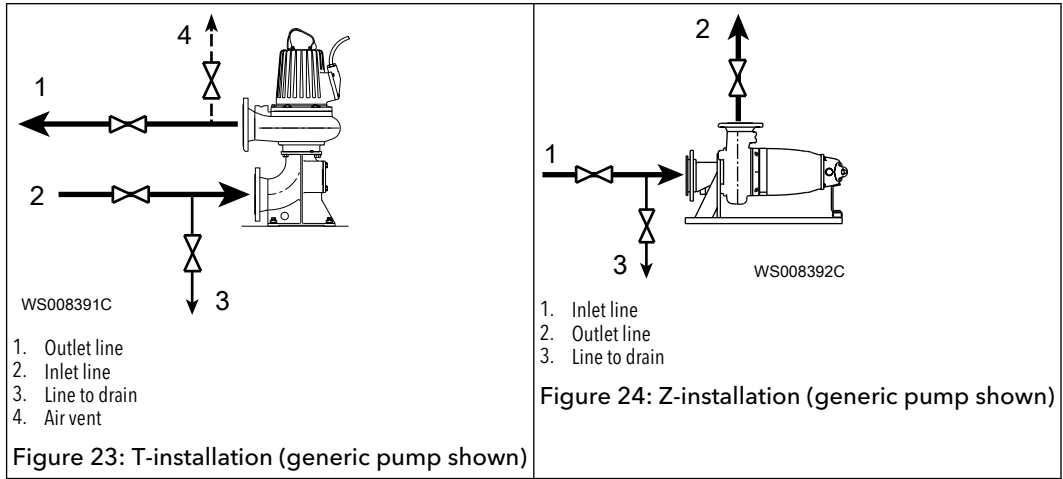
When laying the pump on its side, do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

6.5.4.1 Prepare the pump for removal: T-, Z-installations

The pump must be removed from the installation to change the impeller.

1. Close the valves on the inlet and outlet lines.

See the following figures.

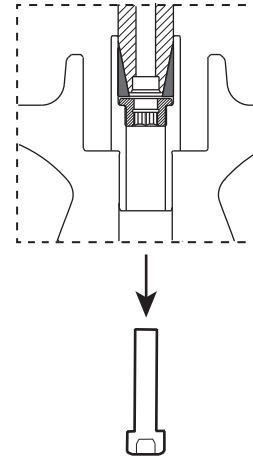
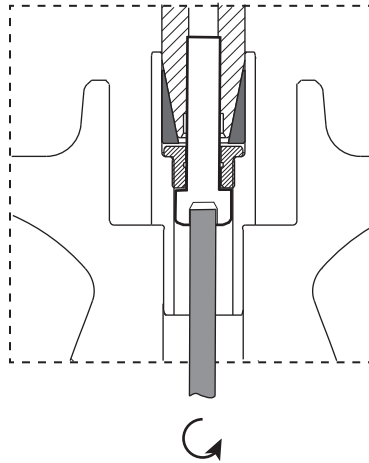


2. Drain the pump by opening the valve on the drain line.
3. Remove the pump from the installation.

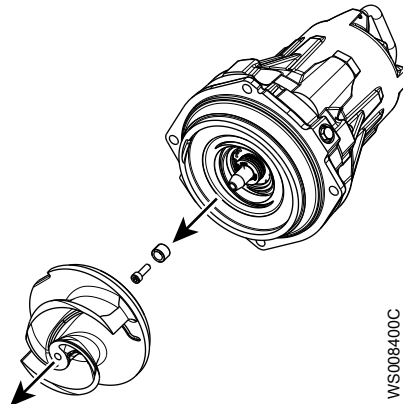
6.5.4.2 Remove the Adaptive N™ impeller: P, S, T, Z installations

To see which pumps are Adaptive N™, see [Product Description](#) on page 11.

1. Remove the pump housing.
2. Remove the impeller.
 - a) Loosen the impeller screw.



- b) Remove the impeller.
Use the impeller puller or the crowbars.
- c) Remove the impeller screw and the conical sleeve.



WS010024B

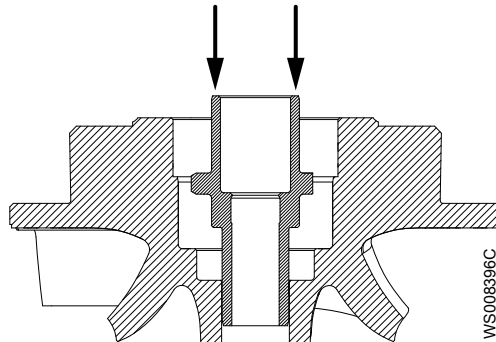
WS008400C

6.5.4.3 Install the Adaptive N™ impeller: P, S, T, Z installations

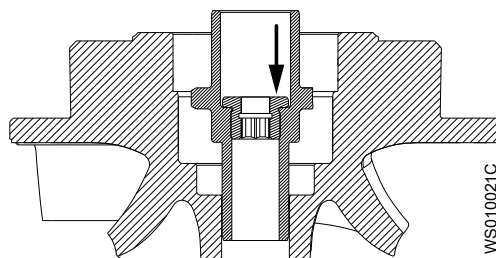
To see which pumps are Adaptive N™, see [Product Description](#) on page 11.

1. Before mounting the impeller, check that the sleeve moves freely up and down by pushing on it.

When the sleeve is released, it should be fully pushed out again. If the sleeve does not move freely, or does not come fully out, then replace the impeller unit.



2. Check that the adjusting screw is correctly positioned in the new impeller.

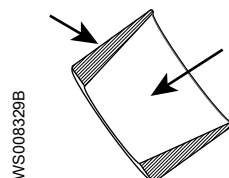


3. Prepare the shaft:

- a) Polish off any flaws with a fine emery cloth.

The end of the shaft must be clean and free from burrs.

- b) Coat the inner conic and the outer cylindrical surfaces of the sleeve with a thin layer of grease.

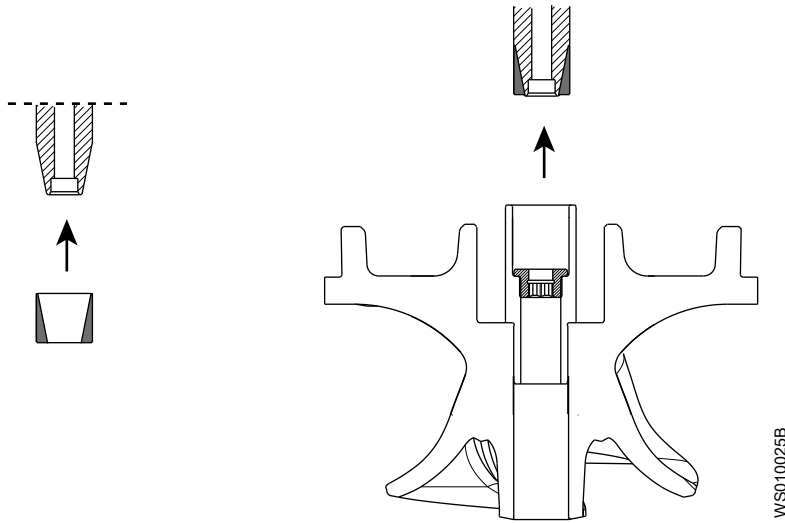


The proper lubrication is grease for bearings, for example Exxon Mobil Unirex N3, Mobil Mobilith SHC 220 or equivalent.

NOTICE:

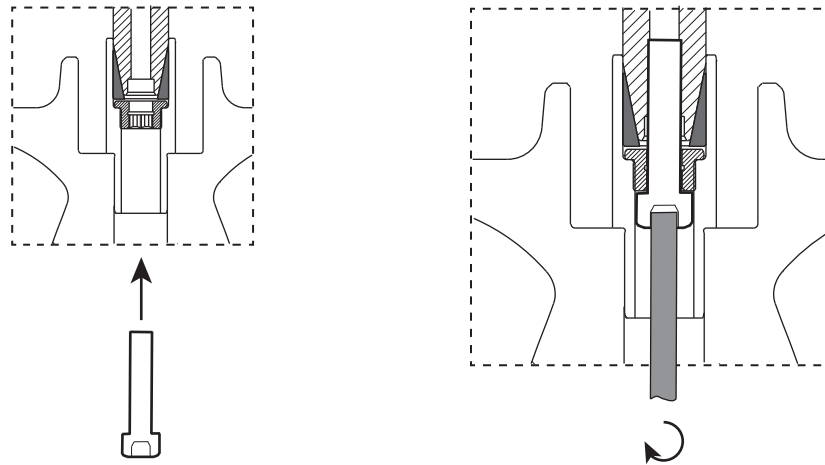
Surplus grease can cause the impeller to become loose. Remove surplus grease from conical and/or cylindrical surfaces of shafts and/or sleeves.

4. Mount the impeller sleeve and impeller.



WS010025B

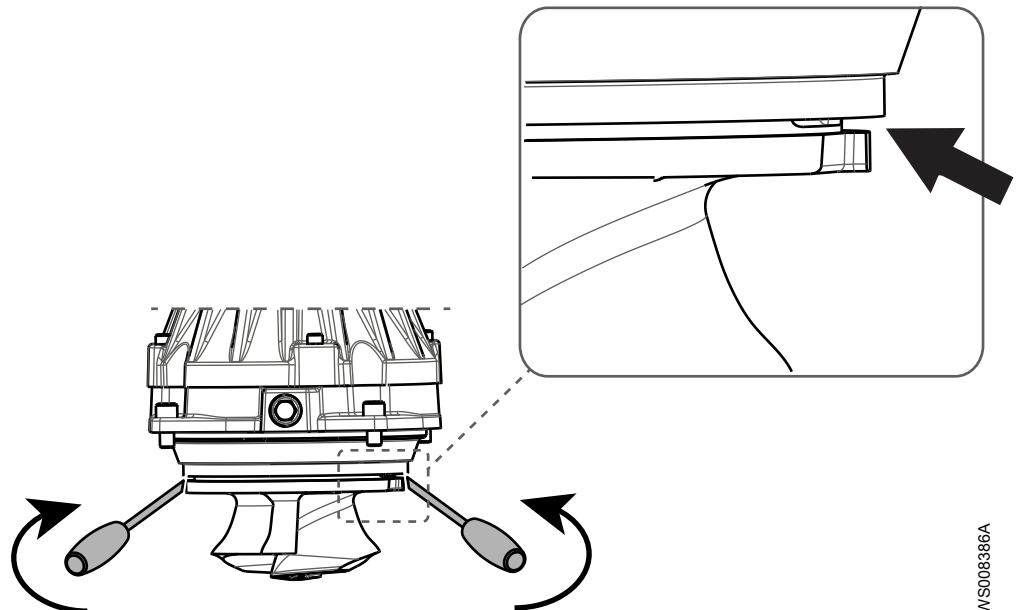
5. Secure the impeller in place with the screw.



WS010023B

6. Check that the impeller is in its lowest position:

a) Insert two screwdrivers as shown in the following figure, and push the impeller downwards.



WS008386A

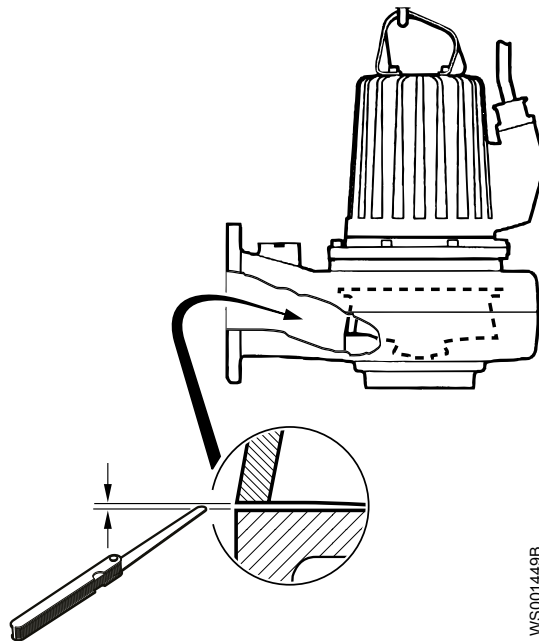
7. Mount the pump housing:

- a) Fit the pump housing.
 - b) Fit and tighten the lubricated screws.
Tightening torque: 57 Nm (42 ft-lb).
8. Loosen the impeller screw and turn the adjustment screw clockwise until the impeller makes contact with the insert ring.
 9. Tighten the impeller screw.
Tightening torque: 65 Nm (48 ft-lb).
Tighten a further 1/8 turn, 45°, after tightening to the correct torque.
 10. Check that the impeller can rotate freely.

**WARNING: Crush Hazard**

Beware of the pinch point hazard between the rotating impeller and the guide pin.

11. Check with an extended feeler gauge that the impeller clearance is 0.1–0.6 mm (0.004–0.024 in).



WS001449B

12. Re-install the pump.

T-installations: See the instructions in [T-installation: Bleed air before starting pump](#) on page 39.

7 Troubleshooting

7.1 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

7.2 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.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

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: <ul style="list-style-type: none"> • The impeller rotates freely. • The sensor indicators do not indicate an alarm. • The overload protection is not tripped.
The pump does not start automatically, but can be started manually.	Check that: <ul style="list-style-type: none"> • 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.

Cause	Remedy
The installation is not receiving voltage.	Check that: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.

7.3 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.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

Cause	Remedy
The pump is unable to empty the sump to the stop level.	Check that: <ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.

7.4 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.

7.5 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.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

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.	<ul style="list-style-type: none"> • Clean the impeller. • Clean out the sump. • Check that the impeller is properly trimmed.
The drive unit is not receiving full voltage on all three phases.	<ul style="list-style-type: none"> • Check the fuses. Replace fuses that have tripped. • If the fuses are intact, then notify a certified electrician.
The phase currents vary, or they are too high.	Contact a sales or authorized service representative.

Cause	Remedy
The insulation between the phases and ground in the stator is defective.	<ol style="list-style-type: none"> 1. Use an insulation tester. With a 1000 V DC megger, check that the insulation between the phases and between any phase and ground is > 5 megaohms. 2. If the insulation is less, then do the following: Contact a sales or authorized service representative.
The density of the pumped fluid is too high.	<p>Make sure that the maximum density is 1100 kg/m³ (9.2 lb/US gal)</p> <ul style="list-style-type: none"> • Change the impeller, or • Change to a more suitable pump • Contact a sales or authorized service representative.
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.

7.6 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.



WARNING: Electrical Hazard

The permanent-magnet motor generates voltage when the shaft rotates, even if power sources are disconnected. Never perform any electrical work if the shaft could rotate.

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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.

Cause	Remedy
There are signs of wear on the impeller, pump, and casing.	Replace the worn parts.
The liquid level is too low.	<ul style="list-style-type: none">• 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
Liquid temperature	40°C (104°F) maximum The pump can be operated at full load only if at least half the stator housing is submerged. 3102.060, 3102.160, 3102.181, 3102.760: <ul style="list-style-type: none"> • Warm-liquid version: 70°C (158°F) maximum
pH of the pumped media (liquid)	5.5–14
Liquid density	1100 kg/m ³ (9.2 lb per US gal) maximum
Depth of immersion	Maximum 20 m (65 ft)
Other	For the specific weight, current, voltage, power ratings, and speed of the pump, see the data plate of the pump.

8.2 Motor data

Feature	Description
Motor type	3102.060/.070/.090/.160/.170/.181/.190/.760/.770/.890: <ul style="list-style-type: none"> • Squirrel-cage induction motor 3102.900/.910/.920/.930/.960/.970: <ul style="list-style-type: none"> • Line-started, permanent-magnet synchronous motor
Frequency	50 Hz or 60 Hz
Supply	1-phase or 3-phase
Starting method	<ul style="list-style-type: none"> • Direct on-line • Star-delta • Soft starter Not recommended for LSPM motors <ul style="list-style-type: none"> • Variable Frequency Drive (VFD)
Maximum starts per hour	30 evenly-spaced starts per 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.

Xylem |'zīləm|

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

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