Xylem Water Solutions AB (the Company) was previously named ITT Water & Wastewater AB. The name change took place in November 2011. This is document is (i) a document that relates to a product of the Company phased out prior to the name change; or (ii) an old version of documentation relating to a product that is still being produced by the Company but which document was published prior to the 1st of January 2012 . This document may therefore still be marked "ITT". Xylem Water Solutions AB is no longer an ITT company and the fact that "ITT" may appear on this document shall not be interpreted as a reference by the Company to "ITT" in the Company's current business activities. Any use or reference to "ITT" by you is strictly prohibited. In no event will we be liable for any incidental, indirect, consequential, punitive or special damages of any kind, or any other damages whatsoever, including, without limitation, those resulting from loss of profit, loss of contracts, loss of reputation, goodwill, data, information, income, anticipated savings or business relationships for any use by you of "ITT". This disclaimer notice shall be interpreted and governed by Swedish law, and any disputes in relation to it are subject to the jurisdiction of the courts in Sweden. If you do not agree to these terms and conditions you should not print this document and immediately stop accessing it.

xylem
Let's Solve Water

End of Disclaimer text.

xylem
Let's Solve Water

ITT

Water & Wastewater

Installation, Operation and Maintenance Manual

C3300/6x5, C/R3231, C3240, C3306, C3312, C3351, C3356, C3400, C3501, C3531, C3602, C3800

FLYGT

Engineered for life

Table of Contents

Introduction and Safety

Introduction

Purpose of this manual

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

- Installation
- Operation
- Maintenance

CAUTION:

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

NOTICE:

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

Inspect the delivery

Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.

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

Inspect the unit

1. Remove packing materials from the product.

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

   For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

Product warranty

Coverage

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

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

Limitations

The warranty does not cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting ITT

- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

Spare parts

ITT guarantees that spare parts will be available for 20 years after the manufacture of this product has been discontinued.

Safety

WARNING:

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

CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

Safety message levels

About safety messages

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

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

Definitions

Safety message level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury

Safety message level	Indication
 **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
 **Electrical Hazard:**	The possibility of electrical risks if instructions are not followed in a proper manner
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

User safety

General safety rules

These safety rules apply:

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

Safety equipment

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

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

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Electrical connections

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

Hazardous liquids

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

- Make sure that all personnel who work with biologically hazardous liquids are vaccinated against diseases to which they may be exposed.
- Observe strict personal cleanliness.

Wash the skin and eyes

Do the following if chemicals or hazardous fluids have come into contact with your eyes or your skin:

If you need to wash your...	Then...
Eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least one minute. 3. Seek medical attention, if required.

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 ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

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

Product and product handling requirements

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

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.
- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

Guidelines for compliance

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

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. Condition-monitoring devices include but are not limited to the following:

- Level indicators
- Temperature detectors

Environmental safety

The work area

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

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

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

Electrical installation

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

Transportation and Storage

Transportation guidelines

Precautions

WARNING:

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

Position and fastening

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

Horizontal position

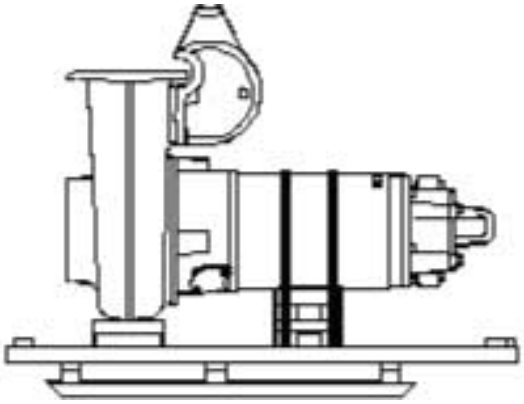


Figure 1: Horizontal position for transport

The impeller must be locked during transportation, if the pump is transported in the horizontal position.

Vertical position

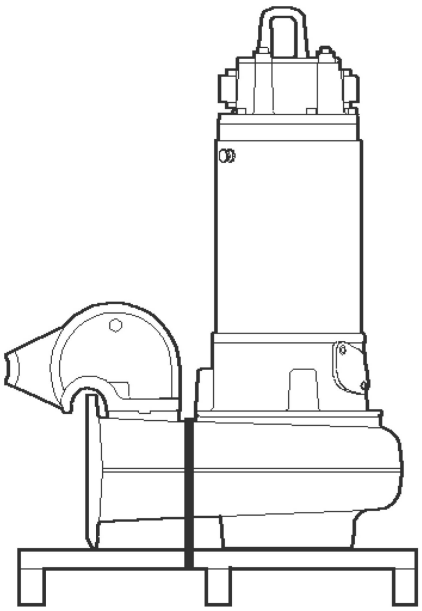


Figure 2: Vertical position for transport

The impeller/propeller must also be locked during transportation.

Lifting

WARNING:

- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Lift and handle the product carefully, using suitable lifting equipment.
- The product must be securely harnessed for lifting and handling. Use eyebolts or lifting lugs if available.
- Always lift the unit by its lifting handle. Never lift the unit by the motor cable or by the hose.
- Do not attach sling ropes to shaft ends.

Lifting equipment

Lifting equipment is always required when handling the pump. It must fulfill the following requirements:

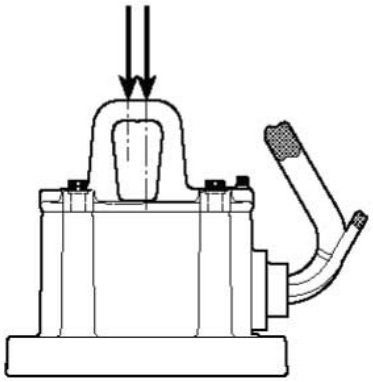
- The minimum height (contact ITT for information) between the lifting hook and the floor must be sufficient to lift the pump.
- The lifting equipment must be able to hoist the pump straight up and down, preferably without the need for resetting the lifting hook.
- The lifting equipment must be securely anchored and in good condition.
- The lifting equipment must support weight of the entire assembly and must only be used by authorized personnel.
- Two sets of lifting equipment must be used to lift the pump for repair work.
- The lifting equipment must be dimensioned to lift the pump with any remaining pumped media in it.
- The lifting equipment must not be oversized.

NOTICE:

Oversized lifting equipment could cause damage if the unit should stick when being lifted.

Lifting link placement for vertical lifting

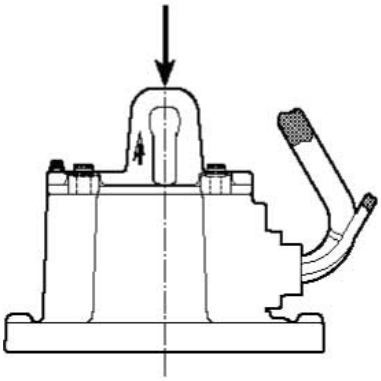
Use the following lifting link configurations to lift the pump in the vertical position.



The left arrow indicates placement of the lifting link when lifting the complete pump with 605–675 drive units. The right arrow indicates placement for lifting the drive unit only.

Figure 3: Drive units 605–675

Placement for lifting drive unit only, or complete pump C3231-C3356, with 705–775 drive units:



Placement for lifting complete pump C3400-C3602, with 705–775 drive units:

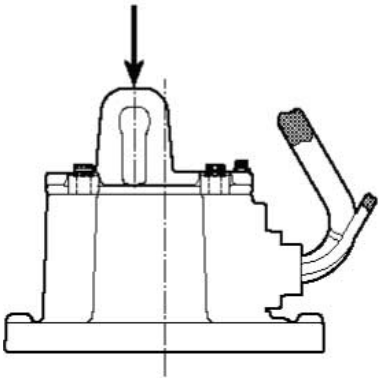


Figure 4: Drive units 705–775

When lifting only the drive unit for C3400–C3602 pumps, the lifting cover must be turned 180°.

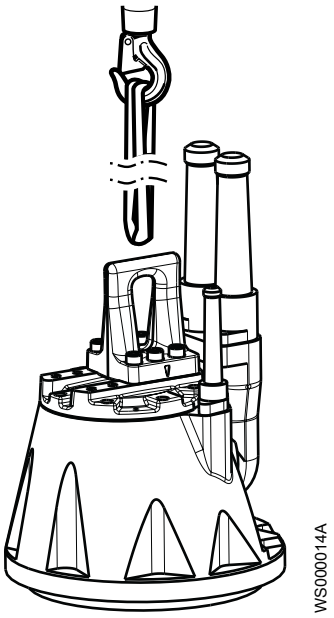
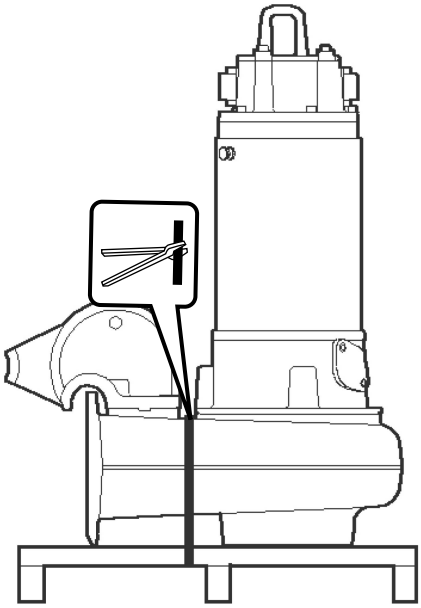


Figure 5: Drive units 805–995

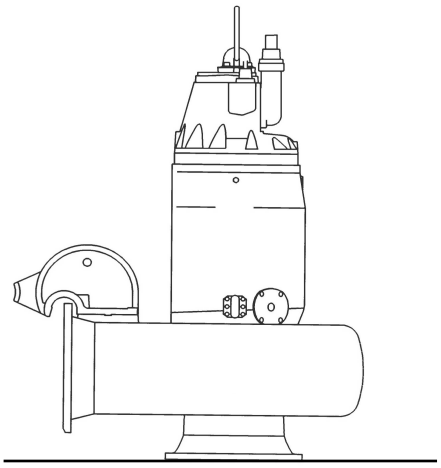
For 805–995 drive units, the lifting link must be positioned so that the complete pump hangs forward with an incline of 0–2° in relation to the vertical axis.

Lift pump from vertical position and remove transport pallet

1. Fasten a suitable lifting strap/sling to the lifting eye on the top of the drive unit.
   See *Lifting* (page 11).
2. Cut the transportation strap.



3. Lift up the pump using proper lifting equipment.
4. Place the pump upright on a rigid horizontal surface so that it cannot fall over.



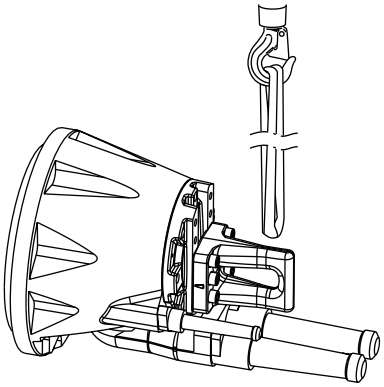
Lift pump from horizontal position and remove transport pallet

WARNING:

- An assembled pump must never be lifted by the holes in the hydraulic unit.
- Stay clear of suspended loads.

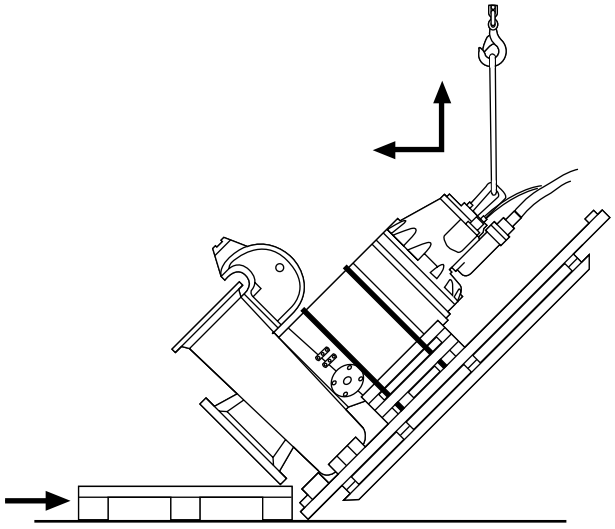
NOTICE:

- When handling the pump to and from horizontal position, the pump should always be lifted by the lifting link. Use a suitable lifting sling/strap.

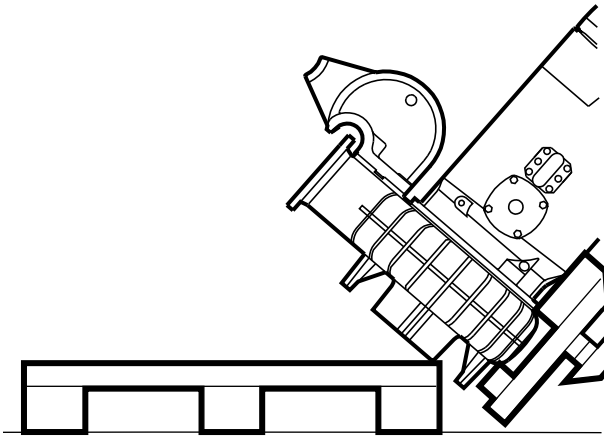


Lift with single-hook equipment

1. Fasten a suitable lifting sling/strap to the lifting eye on the top of the drive unit.
   See *Lifting* (page 11).
2. Raise the pump approximately halfway to its upright position.
   The pump is still be attached to the transport pallet.
3. Slide a pallet or similar object under the inlet section.
   This will minimize the jolt which may occur later in the lifting, when the pump is almost fully upright.



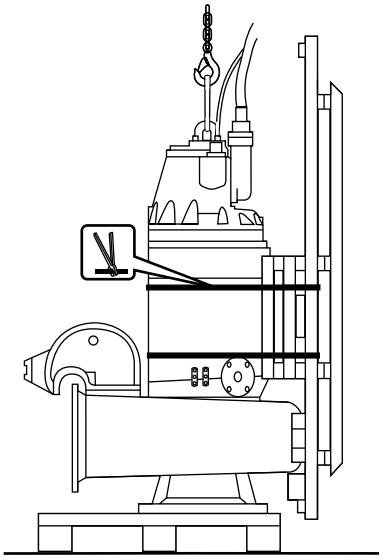
For C3231: Make sure that the support columns on C3231 are outside the pallet, as they may break if used as support when raising. See figure below.



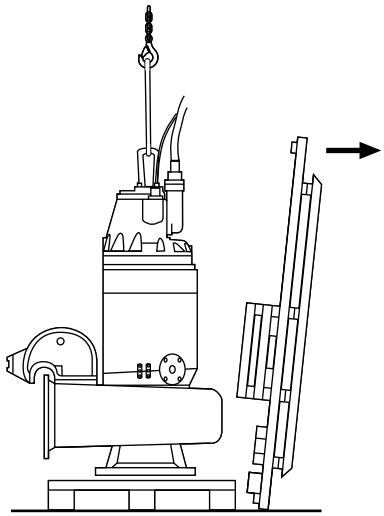
4. Continue raising the pump until it is in an upright position.
   The pump may jolt or sway near the end of the lifting operation.

WARNING:
Keep a safe distance while the unit is moving.

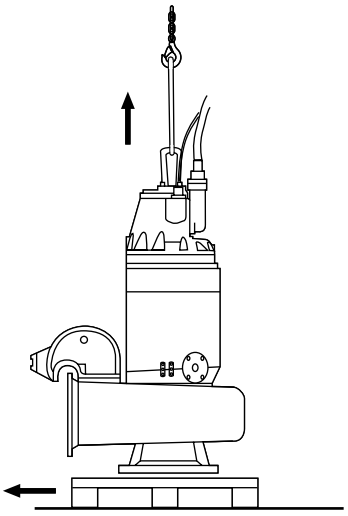
5. Remove the straps holding the pump to the transport pallet.



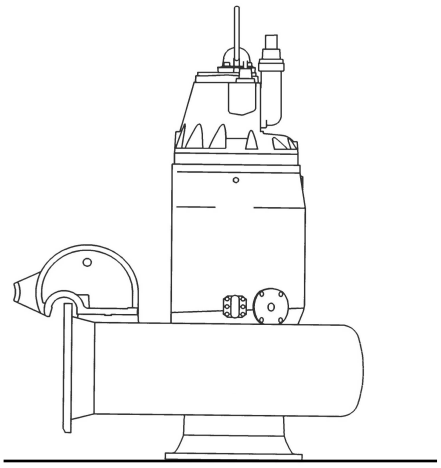
6. Remove the transport pallet.



7. Lift the pump and remove the support pallet.

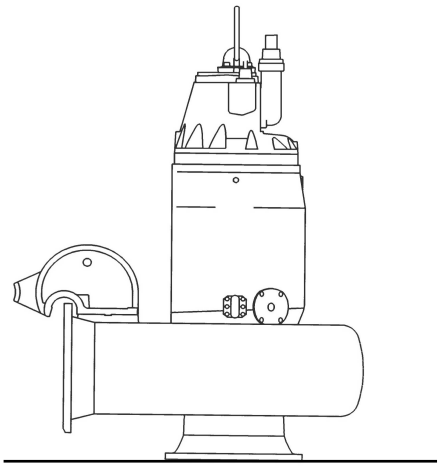


8. Place the pump upright on a rigid horizontal surface so that it cannot fall over.



Lift with double-hook equipment (recommended)

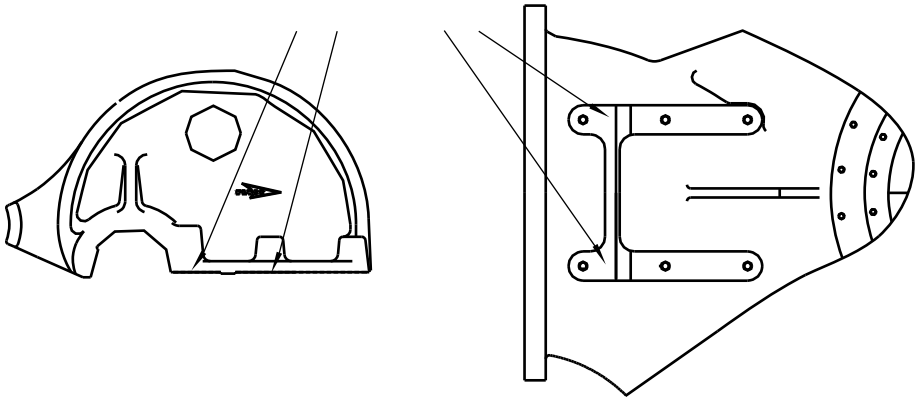
1. Fasten a suitable lifting sling/strap to the lifting eye on the top of the drive unit.
   See *Lifting* (page 11).
2. Fasten a sling around the hydraulic unit.
3. Remove the straps securing the pump to the transport pallet.
4. Lift up the pump.
5. Place the pump upright on a rigid horizontal surface so that it cannot fall over.



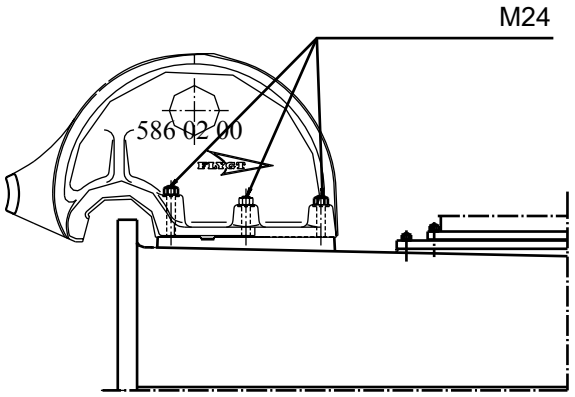
Install the guide claw (3800 only)

The guide claw is delivered detached from the pump.

1. Clean the contact surfaces shown with arrows in the figure below.



2. Tighten the M24 nuts.
   Tightening torque: 629 Nm (464 ft-lbs).



Storage guidelines

Storage location

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

NOTICE:

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

Freezing precautions

The pump is frost-proof while operating or immersed in liquid, but the impeller/propeller and the shaft seal may freeze if the pump is lifted out of the liquid into a surrounding temperature below freezing.

Follow these guidelines to avoid freezing damage:

When	Guideline
Before storage	• The pump must be allowed to run for a short time after raising it to discharge remaining pumped liquid. This does not apply to propeller pumps. • The discharge opening must be covered in a suitable way, or placed facing down so that any still remaining pumped liquid runs out. • If present, the cooling jacket must be drained manually by opening the air vent screws at the top of the cooling jacket.

When	Guideline
After storage	If the impeller/propeller is frozen, it must be thawed by immersing the pump in liquid before operating the pump.
	NOTICE: Never use a naked flame to thaw the unit.

Long-term storage

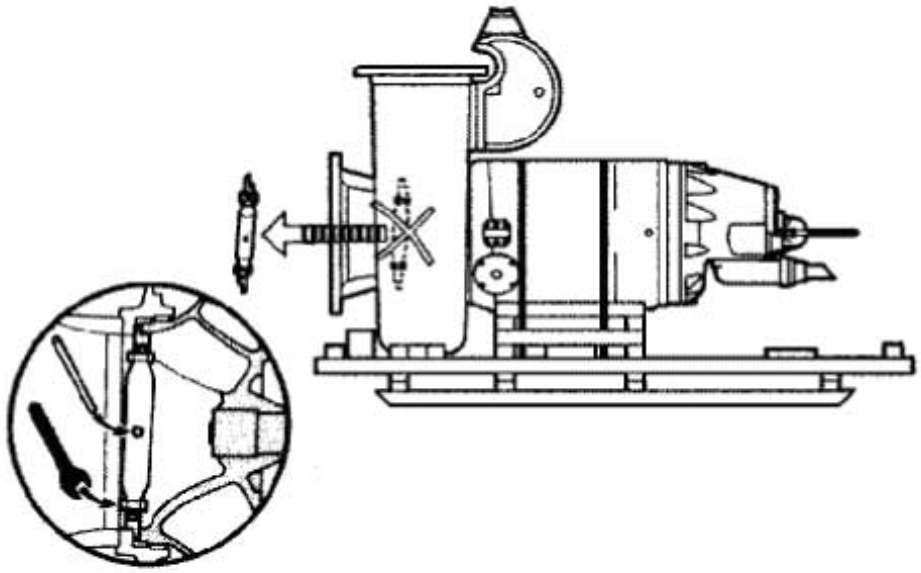
If the pump is stored more than 6 months, the following apply:

- Before operating the pump 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.

Reinstall the locking device

If the pump will be transported in the horizontal position, then the impeller/propeller must be locked during transport with the locking device.

1. Reinstall the locking device.



2. Clamp the locking device into position by turning and locking it by hand as tightly as possible.
3. Tighten a further 1/8 to 1/3 of a turn according to the torque specified in the cross-sectional drawing in the Part List.

Product Description

Pump Design

Intended Use

The product is intended for moving waste water, sludge, raw and clean water. Always follow the limits given in *Application limits* (page 110). If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.

WARNING:

In explosive or flammable environments, only use Ex- or MSHA-approved pumps.

NOTICE:

Do NOT use the pump in highly corrosive liquids.

Approvals

This section describes the EN and FM approvals that explosion-proof products have. For more information, please contact your ITT representative.

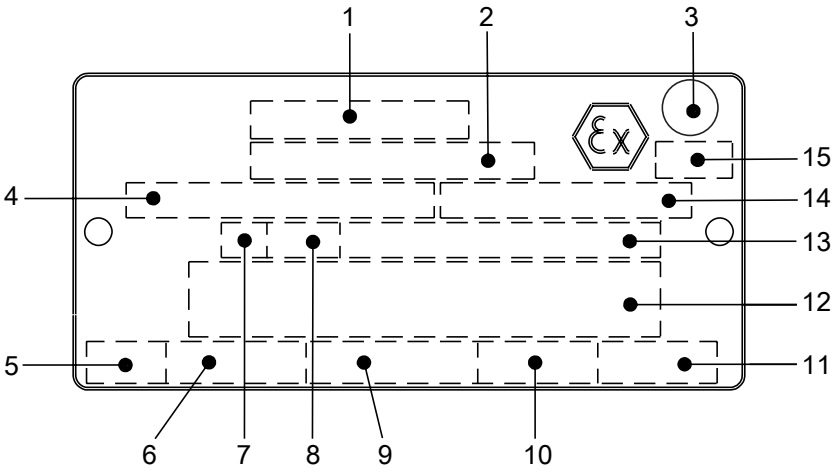
In addition to the data plate, explosion-proof products also have either an EN or a FM approval plate.

EN

European Norm (EN) approvals:

- ATEX Directive
- EN 50014, EN50018, EN 1127-1
- Ex II 2 G EEx dII T4/T3 (6x5)
- Ex II 2 G EEx dIIB T4/T3 (7x5)
- Ex II 2 G EEx dII T3 (8x5)
- Ex II 2 G EEx dII T4(25°C)/T3 (9x5)

(T4 on option.)



1. Approval
2. Approval authority + Approval Number
3. Approval for Class I
4. Approved drive unit
5. Stall time
6. Starting current; Rated current

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

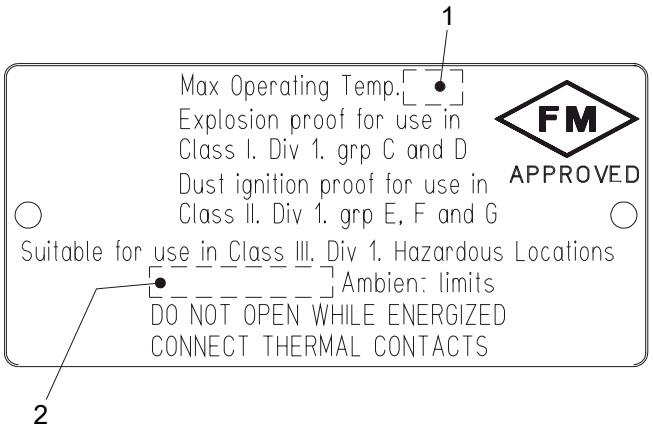
Figure 6: EN approval plate

EN approval for cable entry:

- Certificate number: INERIS 02ATEX 9008 U
- ⟨Ex⟩ II 2 G or IM2 EEx dIIC or EEx dI

FM

This illustration describes the approval plate for Factory Mutual (FM) and the information contained in its fields.



1. Temperature class
2. Maximal ambient temperature

Figure 7: FM approval plate

Spare parts

The following applies when servicing or repairing the pump:

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

Drive units

C3231

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3240

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3300

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15

C3306

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3312

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3351

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	905	915	6
	935	945	6
	965	975	6
1.2-6.6 kV	950	960	6
	985	995	6

C3356

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3400

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3501

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3531

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
	905	915	8
	935	945	8
	965	975	8
1.2-6.6 kV	862	872	15
	882	892	8
	950	960	8
	985	995	8

C3602

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
	905	915	8
	935	945	8
1.2-6.6 kV	862	872	15
	882	892	8
	950	960	8
	985	995	8

C3800

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	905	915	8
	935	945	8
	965	975	8
1.2-6.6 kV	950	960	8
	985	995	8

The monitoring equipment

The MAS 711 system

MAS 711 (Monitoring and Status) is a monitoring system for ITT Flygt pumps. It monitors and stores measurements from a number of sensors (temperature, leakage and vibration). These are used to:

- Protect the pump by raising an alarm when undesirable events occur.
- Track operational data.

Alarm levels can be set so that the operator is notified when an alarm event has occurred. Depending on the alarm/event configuration, the MAS 711 system may stop the pump.

The base unit stores all measurement data on its embedded server.

The system also includes a pump memory module, storing identity data of the pump.

The parameters tracked are chosen by the customer, and may include the following:

- Temperature (main and support bearings, stator winding)
- Vibration
- Leakage (in the stator housing, the junction box, and water in the oil chamber)
- Power monitoring

For more information, see the Installation and User Manual for MAS 711 monitoring systems.

Pump current

Pump current is an important parameter in itself, which the MAS 711 can also use to record running time, number of starts and other operating diagnostics.

Pump current is not measured using the 12/24 lead monitoring cable. To measure it, the control cabinet must be equipped with a current transformer. Alternatively the Flygt power analyzer PAN 312 is used, requiring three transformers. The measurement results are transmitted to MAS over a serial link (Modbus).

This information is fundamental for monitoring operation, maintenance planning and fault diagnosis.

Sensors, drive units up to 1.1 kV

The drive units in this voltage range are shown in *Drive units* (page 21).

Table 1: Sensors for pumps using drive units up to 1.1 kV

Parameter Monitored	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Vibration	VIS 10	24	Optional
Leakage in the junction box	Float Switch Leakage Sensor (FLS)	12	Standard
Stator winding temperature in one phase	Pt100 analogue temperature sensor in 1 stator winding	12	Standard
Stator winding temperature	Thermal switches (3), or	12	Standard
	PTC-thermistors (3)	24	Optional
Stator winding temperature in phases 2 and 3	Pt100 analogue temperature sensors in 2 additional stator windings	24	Optional
Main bearing temperature	Pt100 analogue temperature sensor	12	Standard
Leakage in the stator housing	Float Switch Leakage Sensor (FLS)	12	Standard
Water in oil (standard drive units only)	Capacitive Leakage Sensor (CLS)	24	Optional
Support bearing temperature	Pt100 analogue temperature sensor	24	Optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	12	Standard
Pump current	A current transformer in the control cabinet is required.		
Power monitoring	Separate electronic instrument using three current transformers.		Optional

For more information on the stator temperature monitoring, see *Stator temperature monitoring methods* (page 31).

Sensors, drive units 1.2 – 6.6 kV

The drive units in this voltage range are shown in *Drive units* (page 21).

Table 2: Sensors for pumps using 1.2 – 6.6 kV drive units

Description	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Vibration	VIS 10	24	Optional
Leakage in the junction box	Float Switch Leakage Sensor (FLS)	24	Standard
Stator winding temperature	PTC-thermistors (3+3)[1]	24	Standard
Stator winding temperature in phases 1, 2 and 3	Pt100 analogue temperature sensors in each stator winding (3+3)[2]	24	Standard
Main bearing temperature	Pt100 analogue temperature sensor	24	Standard
Leakage in the stator housing	Float Switch Leakage Sensor (FLS)	24	Standard
Water in oil (standard drive units only)	Capacitive Leakage Sensor (CLS)	24	Optional
Support bearing temperature	Pt100 analogue temperature sensor	24	Optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	24	Standard

[1] 6 total: 3 sensors are connected and 3 are built-in spares.
[2] 6 total: 3 sensors are connected and 3 are built-in spares.

Description	Sensor	Signal Cable, Number of Leads Required	Standard or Optional
Pump current	A current transformer in the control cabinet is required.		
Power monitoring	Separate electronic instrument using three current transformers.		Optional

For more information on the stator temperature monitoring, see *Stator temperature monitoring methods* (page 31).

Signal cables

The pump is delivered with the signal cable (also known as "auxiliary," "control" or "pilot" cable) mounted. The following SUBCAB signal cables are available:

- 12x1.5 mm^2 (unscreened, also known as unshielded). Conductors 1-12.
- 24x1.5 mm^2 (unscreened, also known as unshielded). Conductors 1-24.
- S12x1.5 mm^2 (screened, also known as shielded). Conductors 1-12.
- S24x1.5 mm^2 (screened, also known as shielded). Conductors 1-24.

The number of conductors required to connect the sensors to the monitoring system depends on the number and type of sensors being used. Medium-voltage (1.2–6.6 kV) drive units always have 24 signal cable leads.

Monitoring alternatives: MAS and CAS overviews

Monitoring system identification

The monitoring system appears on the drive unit's data plate in the "Additional Information" field. For more information about the drive unit data plate, see *The data plates* (page 43).

MAS system

MAS is the standard monitoring equipment.

Pumps with the standard MAS equipment with a 12-lead auxiliary cable are mounted with the following items:

- Thermal switches for stator temperature monitoring (3 in series) or PTC-thermistors
- Leakage sensor in the stator housing
- Leakage sensor in the junction box
- Analogue temperature sensor (Pt100) for main bearing temperature monitoring
- Analogue temperature sensor (Pt100) for stator winding temperature in one phase
- Pump memory

Pumps with the optional MAS equipment with a 24-lead auxiliary cable are mounted with the following possible options:

- Vibration sensor VIS10
- Analogue temperature sensor (Pt100) for stator winding temperature in phases 2 and 3
- Leakage sensor in the oil housing (CLS)
- Analogue temperature sensor (Pt100) for support bearing temperature monitoring

CAS system

Older pumps may be installed with the CAS system.

Pumps with the standard CAS equipment 12-lead auxiliary cable are mounted with the following items:

- Thermal switches for stator temperature monitoring (3 in series) or PTC-thermistors
- Leakage sensor in the stator housing
- Leakage sensor in the junction box
- Analogue temperature sensor (Pt100) for main bearing temperature monitoring

Pumps with the optional CAS equipment with a 12-lead auxiliary cable are mounted with the following possible options:

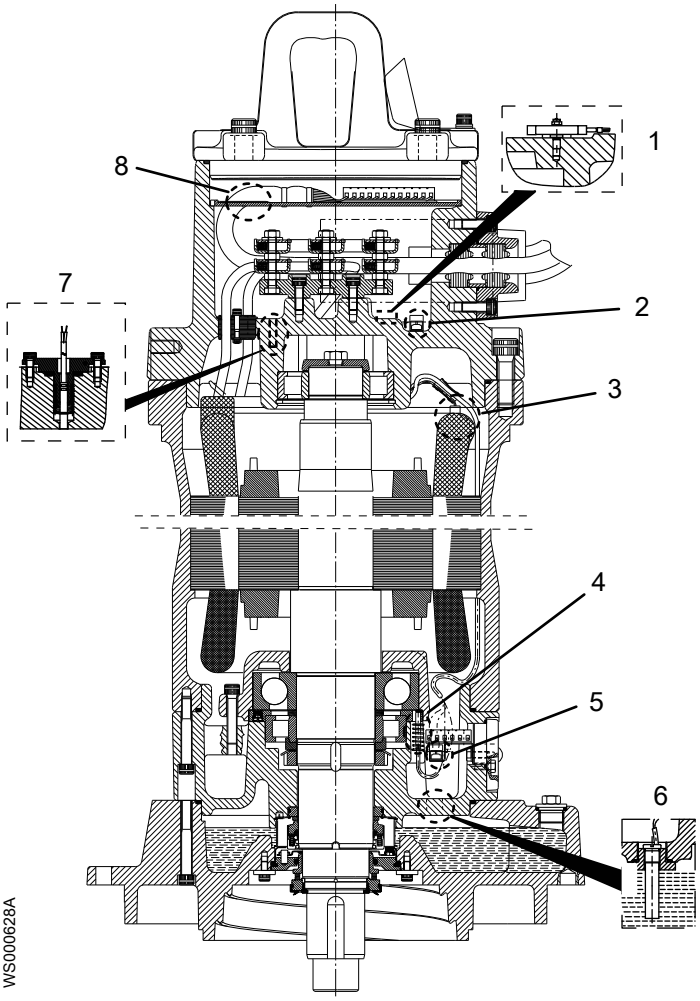
- Leakage sensor in the oil housing (CLS)
- Analogue temperature sensor (Pt100) for support bearing temperature monitoring. (Requires separate Pt100 relay.)

Pumps with the optional CAS equipment 24-lead auxiliary cable have the same options as for the 12-lead cable, and two additional analogue temperature sensors (Pt100) for stator winding temperature in 3 phases. (Requires addtional Pt100 relays.)

The CAS system has been replaced by the MAS system. CAS is no longer available as a spare part, but if necessary CAS may be replaced by the MAS 711 together with the MRM-01 relay. For more information see *CAS or MAS 711 + MRM-01 sensor connections* (page 55).

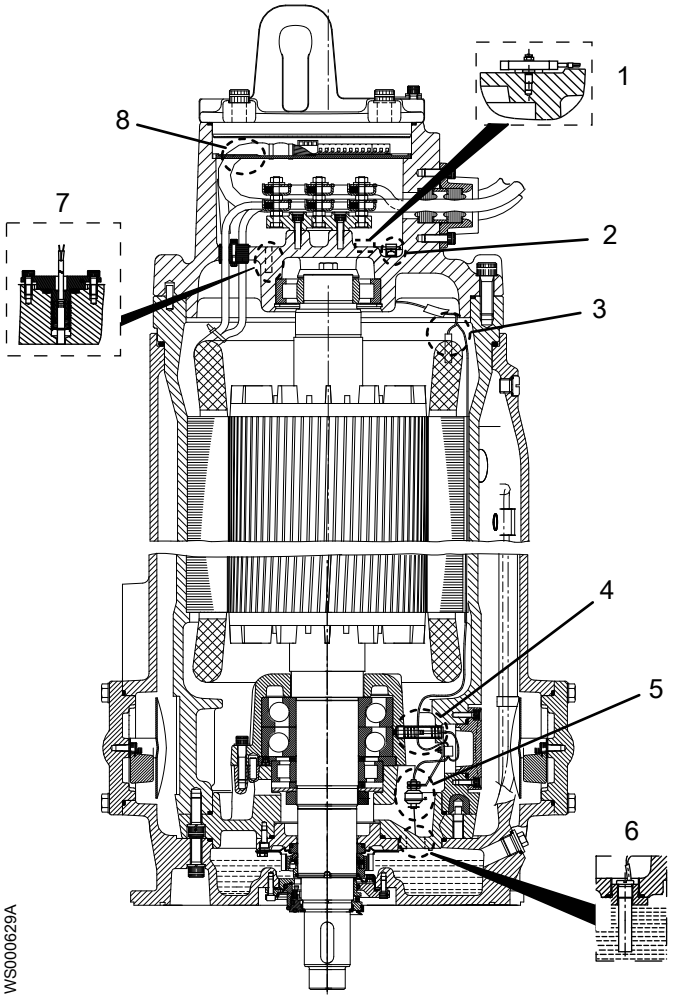
Sensors

6X5 drive units



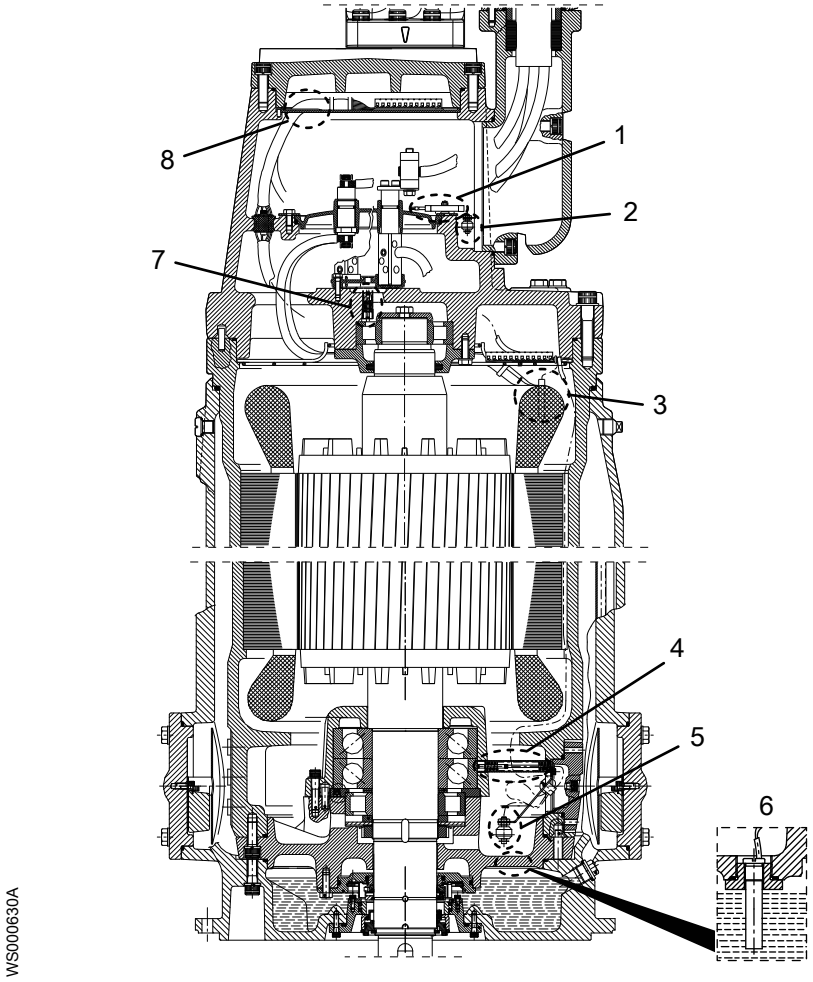
1. Vibration – VIS 10
2. Leakage in the junction box – FLS, Float Switch Leakage Sensor
3. Stator winding temperature
4. Main bearing temperature – Pt100 analogue temperature sensor
5. Leakage in the stator housing – FLS
6. Water in oil *(not available in explosion-proof drive units)* – CLS, Capacitive Leakage Sensor
7. Support bearing temperature – Pt100 analogue temperature sensor
8. Pump memory

7X5 drive units



1. Vibration – VIS 10
2. Leakage in the junction box – FLS, Float Switch Leakage Sensor
3. Stator winding temperature
4. Main bearing temperature – Pt100 analogue temperature sensor
5. Leakage in the stator housing – FLS
6. Water in oil *(standard drive units only)* – CLS, Capacitive Leakage Sensor
7. Support bearing temperature – Pt100 analogue temperature sensor
8. Pump memory

8X5 and 9X5 drive units



1. Vibration – VIS 10
2. Leakage in the junction box – FLS, Float Switch Leakage Sensor
3. Stator winding temperature
4. Main bearing temperature – Pt100 analogue temperature sensor
5. Leakage in the stator housing – FLS
6. Water in oil *(standard drive units only)* – CLS, Capacitive Leakage Sensor
7. Support bearing temperature – Pt100 analogue temperature sensor
8. Pump memory

Temperature sensors

Table 3: Thermal switch

Description	Measured value	Fault values
The thermal switch is a normally closed contact.	0-3 ohm, unless the wires are very long.	An infinite value (open circuit) indicates either high temperature or a fault (a wire is broken or there is a bad contact in a connector).

Table 4: PTC-thermistor

Description	Measured value	Fault values
The PTC-thermistor is a semiconductor device.	Resistance at normal temperature: • 50-100 ohm (150-300 ohm for three in series).	• Above the tripping point, T_{Ref}, the resistance increases dramatically to several Kohm. • An infinite value (open circuit) indicates a fault (a wire is broken or there is a bad contact in a connector). • A value close to zero indicates a short circuit in the wiring.

Table 5: Pt100 sensor

Description	Measured value	Fault values
The Pt100 sensor is a resistor changing value almost linearly with temperature.	Resistance: • 100 ohm at 0°C (32°F) • 107.79 ohm at room temperature (20°C, 68°F) • 138.5 ohm at 100°C (212°F) For resistance data between 0–160 0°C (32–212°F), see *Pt100 resistance* (page 32). Never connect the Pt100 sensor to a voltage higher than 2.5 V.	> 200 ohm (approx.) can indicate the following situations: • Broken sensor • Bad contact • Broken lead < 70 ohm (approx) indicates: • Short circuit.

For information on the various configurations of switches, thermistors and sensors used to monitor stator winding temperature, see *Stator temperature monitoring methods* (page 31).

FLS

Table 6: Float switch sensor (FLS)

Description	Measured value	Fault values
The float switches are leakage sensors located in the lower part of the stator housing and in the junction box.	Resistance. 2 sensor variants: FLS: • Normal: 1530 ohm • Alarm: 330 ohm FLS-10: • Normal: 1200 ohm • Alarm: 430 ohm	> 10% (approx.) deviation from rated ohm values indicates sensor fault, or fault in the wiring.

VIS10

Table 7: Vibration sensor (VIS10)

Description	Measured value	Fault values
The vibration sensor located in the junction box measures vibrations in one direction. The output is a 4-20 mA signal proportional to the vibration level.	Current, 4-20 mA	• >> 20 mA indicates a short circuit. • << 4 mA indicates a fault. • A zero value indicates a broken wire or bad contact in a connector.

CLS

Table 8: Water-in-oil sensor (CLS)

Description	Measured value	Fault values
Capacitive leakage sensor located in the oil housing. This sensor issues an alarm if the water content reaches a concentration of approximately 30% or more.	Standard drive unit only. CLS must be connected to 12 V DC with correct polarity (+/–).	See table below.

Table 9: CLS current measurements

Measuring result	Explanation
0 mA	Can indicate one of the following conditions: • The sensor has the wrong polarity. Check by changing plus and minus. • The cable/lead is broken.
4.0 to 8.0 mA	OK
27 to 33 mA	Alarm current
> 33 mA	Short circuit

Stator temperature monitoring methods

The purpose of stator-winding temperature monitoring is to make the motor shut off at high temperature. There are several monitoring methods, depending on the voltage of the motor, and types of thermal sensors chosen.

By using an analogue sensor, two adjustable alarm limits can be used, one for warning ("B"-alarm) and one for pump stop ("A"-alarm). The configurations which may be used for monitoring the stator-winding temperature depend upon the voltage range of the drive unit. See *Drive units* (page 21) for the voltage range for each drive unit.

Up to 1.1 kV drive units

Table 10: Stator temperature monitoring configuration, up to 1.1 kV

Standard / Optional	Monitoring Configuration Description
Standard	This method uses the following configuration: • Three thermal switches, connected in series, are incorporated in the coil ends of the stator winding. The switches are normally closed, and open at 140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.
	Or:
	This method uses the following configuration: • Three thermistors, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F). • One Pt100 sensor is incorporated in one of the windings.
Optional	This method uses the following configuration: • Three thermal switches, connected in series, are incorporated in the coil ends of the stator winding. The switches are normally closed, and open at 140°C (285°F). • Three Pt100 sensors, one for each phase, are incorporated in the windings.
	Or:
	This method uses the following configuration: • Three thermistors, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=140°C (285°F). • Three Pt100 sensors, one for each phase, are incorporated in the windings.

1.2–6.6 kV drive units

Table 11: Stator temperature monitoring configuration, 1.2–6.6 kV

Standard / Optional	Monitoring Configuration Description
Standard	This configuration uses the following: • Three thermistors, connected in series, are incorporated in the coil ends of the stator windings. T_{Ref}=155°C (310°F) for medium-voltage drive units. • Three Pt100 sensors, one for each phase, are incorporated in the windings. There are three additional thermistors, and 3 additional Pt100 sensors, already in place in the stator windings as reserves. See below for sensor markings.

Stators used in the 1.2–6.6 kV drive units are equipped with 3 Pt100 sensors marked 19:20, 21:22, and 23:24. These are connected at the plinth on the terminal plate. The stator is also equipped with a duplicate set of 3 Pt100 sensors, marked 19s:20s, 21s:22s, and 23s:24s. This duplicate set is not connected to the terminal plate as long as the first set of 3 Pt100 sensors are functioning; it is kept in reserve as a back-up set. The ends of the reserve sensor leads are isolated, and leads bundled among the other cables, until the back-up Pt100 sensors are needed.

Pt100 resistance

This table shows the relationship between temperature (°C) and resistance (ohms).

T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms		T, °C	R, ohms
0	100.00		33	112.83		66	125.54		99	138.12		132	150.57
1	100.39		34	113.22		67	125.92		100	138.50		133	150.95
2	100.78		35	113.61		68	126.31		101	138.88		134	151.33
3	101.17		36	113.99		69	126.69		102	139.26		135	151.70
4	101.56		37	114.38		70	127.07		103	139.64		136	152.08
5	101.95		38	114.77		71	127.45		104	140.02		137	152.45
6	102.34		39	115.15		72	127.84		105	140.39		138	152.83
7	102.73		40	115.54		73	128.22		106	140.77		139	153.20
8	103.12		41	115.93		74	128.60		107	141.15		140	153.58
9	103.51		42	116.31		75	128.98		108	141.53		141	153.95
10	103.90		43	116.70		76	129.37		109	141.91		142	154.32
11	104.29		44	117.08		77	129.75		110	142.29		143	154.70
12	104.68		45	117.47		78	130.13		111	142.66		144	155.07
13	105.07		46	117.85		79	130.51		112	143.04		145	155.45
14	105.46		47	118.24		80	130.89		113	143.42		146	155.82
15	105.85		48	118.62		81	131.27		114	143.80		147	156.19
16	106.24		49	119.01		82	131.66		115	144.17		148	156.57
17	106.63		50	119.40		83	132.04		116	144.55		149	156.94
18	107.02		51	119.78		84	132.42		117	144.93		150	157.31
19	107.40		52	120.16		85	132.80		118	145.31		151	157.69
20	107.79		53	120.55		86	133.18		119	145.68		152	158.06
21	108.18		54	120.93		87	133.56		120	146.06		153	158.43
22	108.57		55	121.32		88	133.94		121	146.44		154	158.81
23	108.96		56	121.70		89	134.32		122	146.81		155	159.18
24	109.35		57	122.09		90	134.70		123	147.19		156	159.55
25	109.73		58	122.47		91	135.08		124	147.57		157	159.93
26	110.12		59	122.86		92	135.46		125	147.94		158	160.30
27	110.51		60	123.24		93	135.84		126	148.32		159	160.67
28	110.90		61	123.62		94	136.22		127	148.70		160	161.04
29	111.28		62	124.01		95	136.60		128	149.07			
30	111.67		63	124.39		96	136.98		129	149.45			
31	111.94		64	124.77		97	137.36		130	149.82			
32	112.45		65	125.16		98	137.74		131	150.20			

Pump memory

The pump memory is located inside the pump's junction box. The memory is loaded with data from the factory, which is then uploaded to the MAS system at first startup.

The data that is uploaded contains the following features:

- Data plate information
- Sensor types and manufacturer's recommended alarm settings
- Operational data and data to support service:
  - Histograms of temperatures, vibrations, and cycle length
  - Start and stop registration
  - Service log with a maximum of 200 lines of text
  - Conditions to prompt for service based on e.g. running time, number of starts and stops or specific dates

For more information, see the Installation and User Manual for the MAS 711 monitoring systems.

The cooling system

The cooling system removes the heat generated by the motor. Most of the heat is transferred to the surrounding media (i.e. out of the motor) through the stator housing. The table below gives an overview of the various cooling systems.

Cooling system type	Description
Direct cooling (no cooling jacket)	The pump is fully submerged and directly cooled by the surrounding water.
Integrated cooling (cooling jacket)	A portion of the pumped liquid is circulated from the pump housing through the cooling jacket. This allows the pump to work continuously at output regardless of whether the pump above of below the surface of the liquid.
External cooling (cooling jacket)	The cooling jacket is sealed off from the pump housing and connected to a separate (external) cooling system.

For more information regarding the versions please contact your ITT representative.

NOTICE:

Always operate the pump with the drive unit completely submerged in the pumped liquid, if the pump is delivered without the integral drive unit cooling jacket. When emptying the sump, the lowest liquid level must not be lower than the top of the pump housing. Contact your local ITT representative for more information.

Direct cooling

In direct cooling, the pump is submerged in the liquid being pumped.

For direct cooling to be used, the pump must be completely submerged during normal operation.

On certain occasions, for example when emptying a sump, partial submersion is allowed. The allowable time for this is limited by several factors, such as ambient temperature, size of the sump, inflow, outflow and so on. For more information please contact your ITT representative.

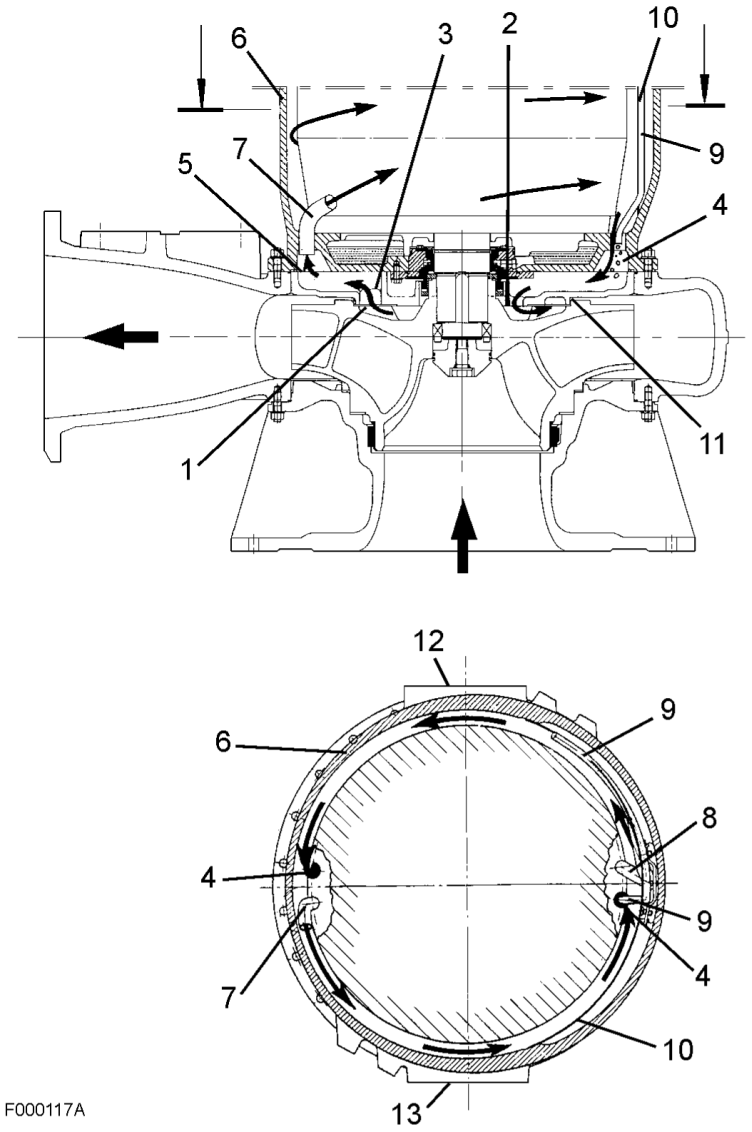
Integrated cooling

With integrated cooling, a portion of the pumped liquid is circulated from the pump housing through the cooling jacket. The pumped media removes the heat from the motor, and then returns to the pump housing, where it re-joins the main stream of liquid being pumped.

This cooling system is designed to tolerate a range of water qualities, up to and including municipal sewage. Larger particles and other contaminants in the pumped liquid are kept out of the cooling jacket by a narrow gap between the guide ring and the impeller.

System

The figure below shows the various parts of the integrated cooling system.



1. Back-vane on impeller
2. Coolant outlet, to pump housing
3. Coolant inlet, from pump housing
4. Air evacuation
5. Coolant entry
6. Cooling jacket
7. Coolant supply pipe, lower
8. Coolant supply pipe, upper
9. Air evacuation pipe
10. Metal shield
11. Anti-contamination gap
12. Inspection cover
13. Inspection cover

A separate circulation pump is not needed for integrated cooling. Circulation through the cooling jacket is provided by back-vanes on the impeller.

Ports and fittings

With integrated cooling, the cooling jacket is equipped with the following ports:

Port	Quantity	Description
Inlet pipes	2	Diametrically opposed one at bottom and one approximately 2/3 up. Not external ports – **no inlet connection required during pump installation.**

Port	Quantity	Description
Outlet ports	2	Diametrically opposed at bottom of jacket. Not external ports – **no outlet connection required during pump installation.**
Air vent	1	Automatic. Situated at top of jacket.
Drain	1	Situated at lower part of jacket. ISO G 3/4 threaded connection.

For information regarding the fittings required to drain the cooling jacket, see *Fittings needed to drain cooling jacket* (page 38).

Filling and draining

With integrated cooling, the cooling jacket fills automatically at pump start-up.

For instructions on draining the cooling jacket, see *Empty the coolant (integrated cooling)* (page 85).

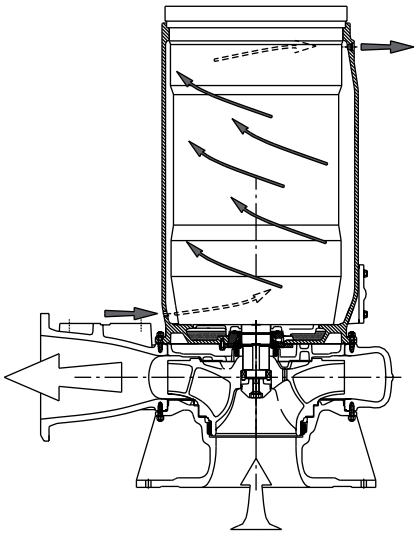
Z-installation orientation

Z-installations using integrated cooling require a specific orientation. The drive unit must be oriented such that the air evacuation system and the stator housing leakage sensor function properly. The cooling jacket inspection cover marked “SENSORS” must be oriented downwards.

External Cooling

With external cooling, the drive unit is equipped with a cooling jacket. Water circulates through the jacket, cooling the motor. The cooling water circuit may be open or closed. In both cases, it is completely isolated from the pumped media.

The figure below shows the principle of the external cooling system.



Applications where external cooling might be used include the following:

- If the temperature of the pumped media exceeds 40°.
- When extreme amounts of concentrated sewage where grease or fats are present, is combined with operating close to the limits of the cooling system.
- When the pumped media contains abrasive or corrosive components.
- In variable speed applications, where the lowest speed falls below the speed limit for the integrated cooling system during longer periods of operation.

With external cooling, the cooling jacket is equipped with the following ports:

Port	Quantity	Description
Inlet port	1	Located at bottom of jacket. Threaded ISO G 3/4.
Outlet port	1	Located at top of jacket. Threaded ISO G 3/4. Also used to drain jacket.
Air vent	1	Located at top of jacket.

For information regarding the fittings required to drain the cooling jacket, see *Fittings needed to drain cooling jacket* (page 38).

For instructions on draining the cooling jacket, see *Empty the coolant (external cooling)* (page 86).

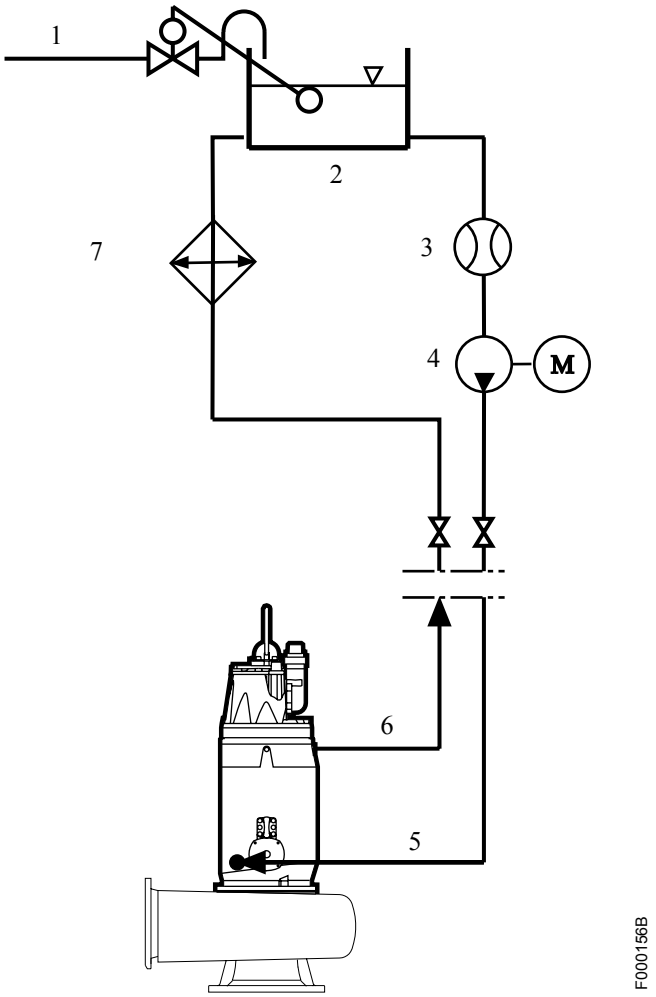
Supply water flow

For information about dimensioning the water supply for external cooling, please contact your ITT representative.

External cooling, closed loop

NOTICE: It is extremely important that the cooling water flow is maintained at or above the desired minimum level while the pump is running.

For a closed loop system, the cooling water supply should be arranged as shown in the figure below.



1. Cooling water supply
2. Expansion tank
3. Flow meter
4. Circulation pump
5. Coolant in
6. Coolant out
7. Heat exchanger

Item	Notes
Cooling water supply	Incoming supply should be equipped with a vacuum valve. It should also be separated from the cooling circuit with a non-return (check) valve.
Expansion tank	Equipped with a level regulator. The tank is used to fill up the system at start-up, and then acts as an expansion tank.

Item	Notes
Circulation pump	The pump must be able to deliver **at least** the minimum required flow (including pressure drop in supply and return line) at all times.
Flow meter or flow switch	Used to monitor that the required flow of coolant is maintained during pump operation. The flow meter should have an electric output that can be wired into the pump power supply circuit in such a way, that the pump is stopped if the flow of coolant is interrupted.
Coolant in	Supply line (coolant in) and return line (coolant out) should both be fitted with valves so that the pump can be isolated from the cooling circuit during service.
	The supply line should also be fitted with a three-way connection and valving so that the cooling jacket can be drained before service work. See *Fittings needed to drain cooling jacket* (page 38).

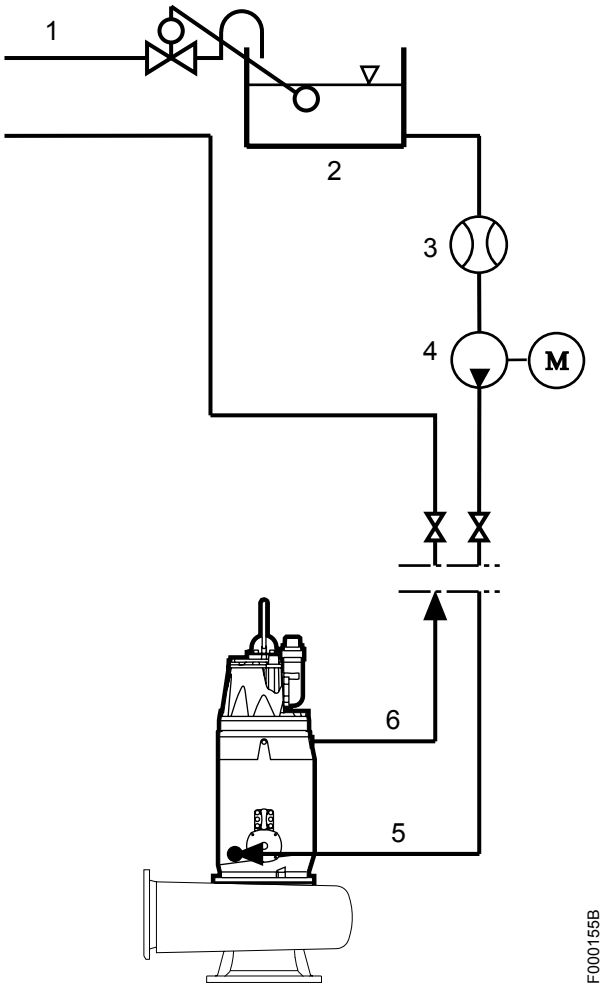
For P- and S-installations, two 1-inch inner diameter reinforced water hoses are needed. To avoid movement in the sump, they should be fixed with cable ties to the cables.

For T- and Z-installation, pipes should be used instead of hoses to minimize the risk of accidental leakage. Flexible connections (for example, reinforced hose) from the pipe to the pump are advised, to avoid transmitting vibrations from the pump to the pipes.

External cooling, open loop

NOTICE: It is extremely important that the cooling water flow is maintained at or above the desired minimum level while the pump is running.

For an open loop system, the cooling water supply should be arranged as shown in the figure below.



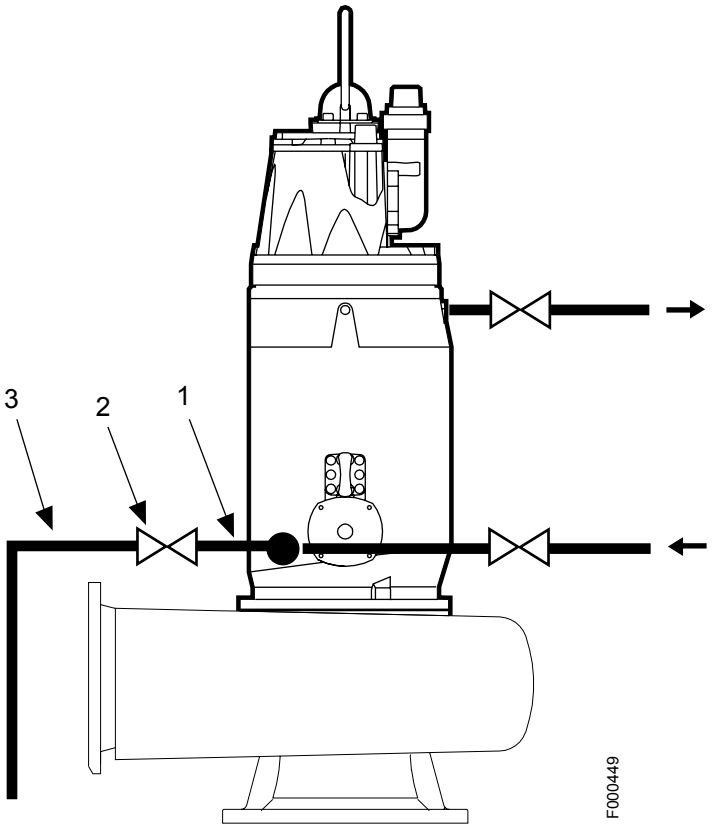
1. Cooling water supply
2. Supply tank
3. Flow meter
4. Circulation pump
5. Coolant in
6. Coolant out

Item	Notes
Cooling water supply	Incoming supply should be equipped with a vacuum valve. It should also be separated from the cooling circuit with a non-return (check) valve.
Supply tank	Local regulations may require that the supply line (especially in sewage applications) is totally separated from the cooling circuit.
Circulation pump	The pump must be able to deliver **at least** the minimum required flow (including pressure drop in supply and return line).
Flow meter or flow switch	Used to monitor that the required flow of coolant is maintained during pump operation. The flow meter should have an electric output that can be wired into the pump power supply circuit in such a way, that the pump is stopped if the flow of coolant is interrupted.

Fittings needed to drain cooling jacket

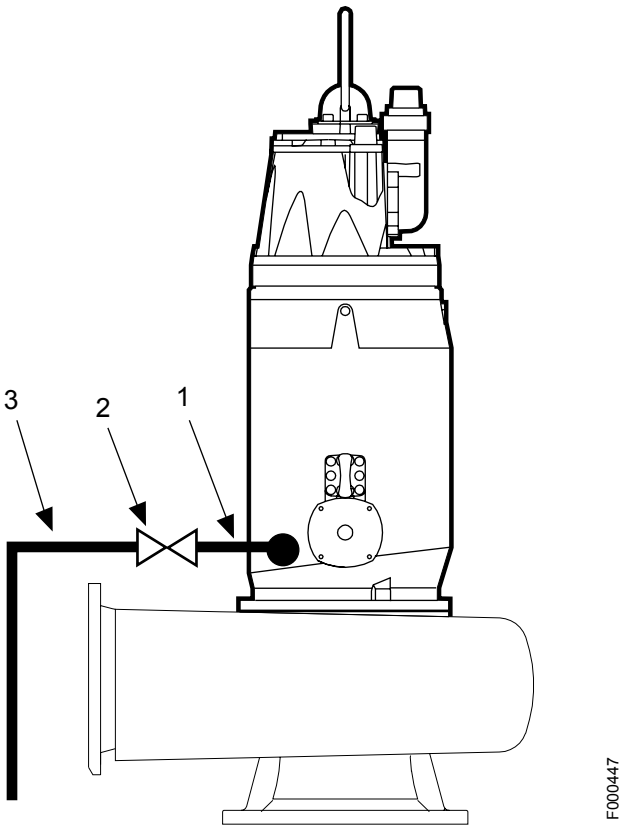
This section describes the fittings needed to drain the cooling jacket. It is applicable to both integrated cooling and external cooling systems.

The cooling jacket on T and Z installations with integrated cooling, and P, S and T installations with external cooling, should be fitted with a nipple, a stop-cock, and a pipe or hose leading to a suitable sump. If external cooling is used, then a tee will be needed.



1. Tee, nipple (if needed)
2. Shutoff valve
3. Pipe to drain coolant

Figure 8: P, S, and T installations with external cooling



1. Nipple
2. Shutoff valve
3. Pipe to drain coolant

Figure 9: T and Z installations with integrated cooling

Seal Flushing

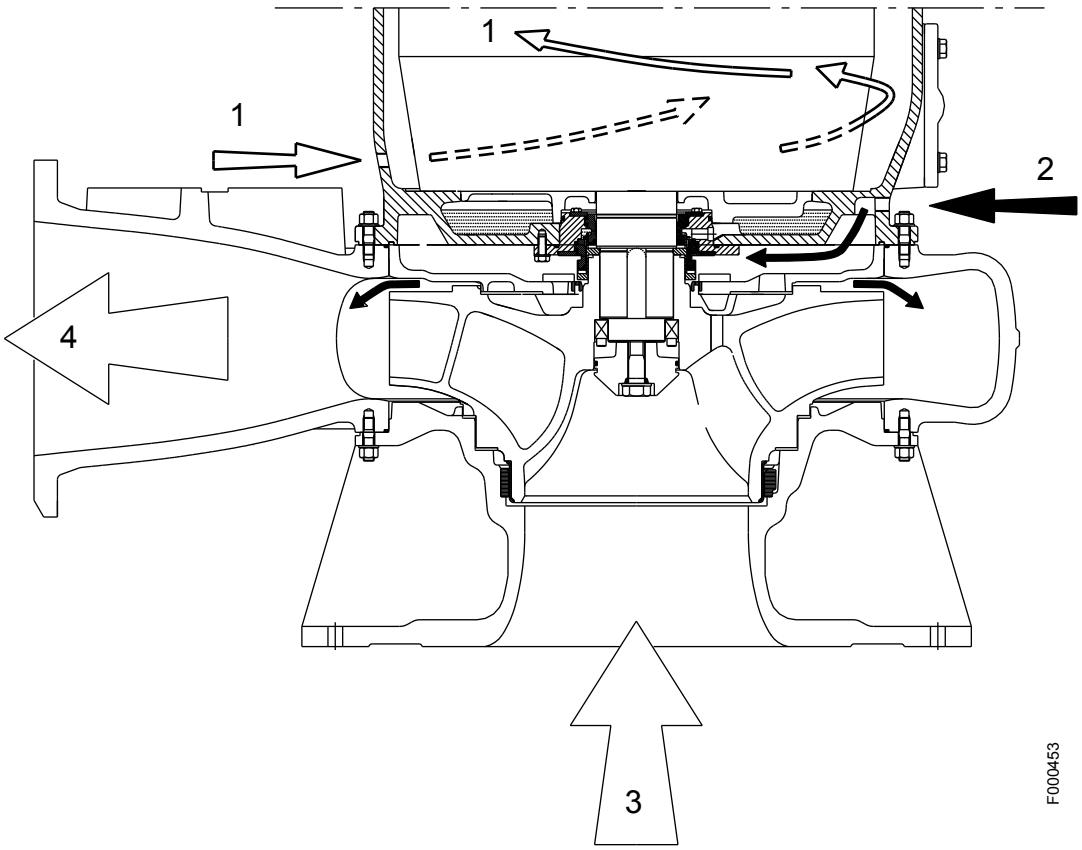
NOTICE:

Seal flushing requires external cooling.

Seal flushing is sometimes used when pumping demanding fluids which could cause fouling of the outer mechanical seal. The seal is continuously flushed with a supply of clean water. This keeps the mechanical shaft seal in clean water and isolated from the aggressive or abrasive fluid being pumped.

After circulating around the seal, the flush water continues out into the pump housing, where it combines with the fluid being pumped.

The figure below shows the flows of seal flush water, coolant and fluid being pumped.



1. Coolant
2. Seal flushing, inlet
3. Pumped fluid, inlet
4. Pumped fluid and seal flush water, outlet

Applications for seal flushing

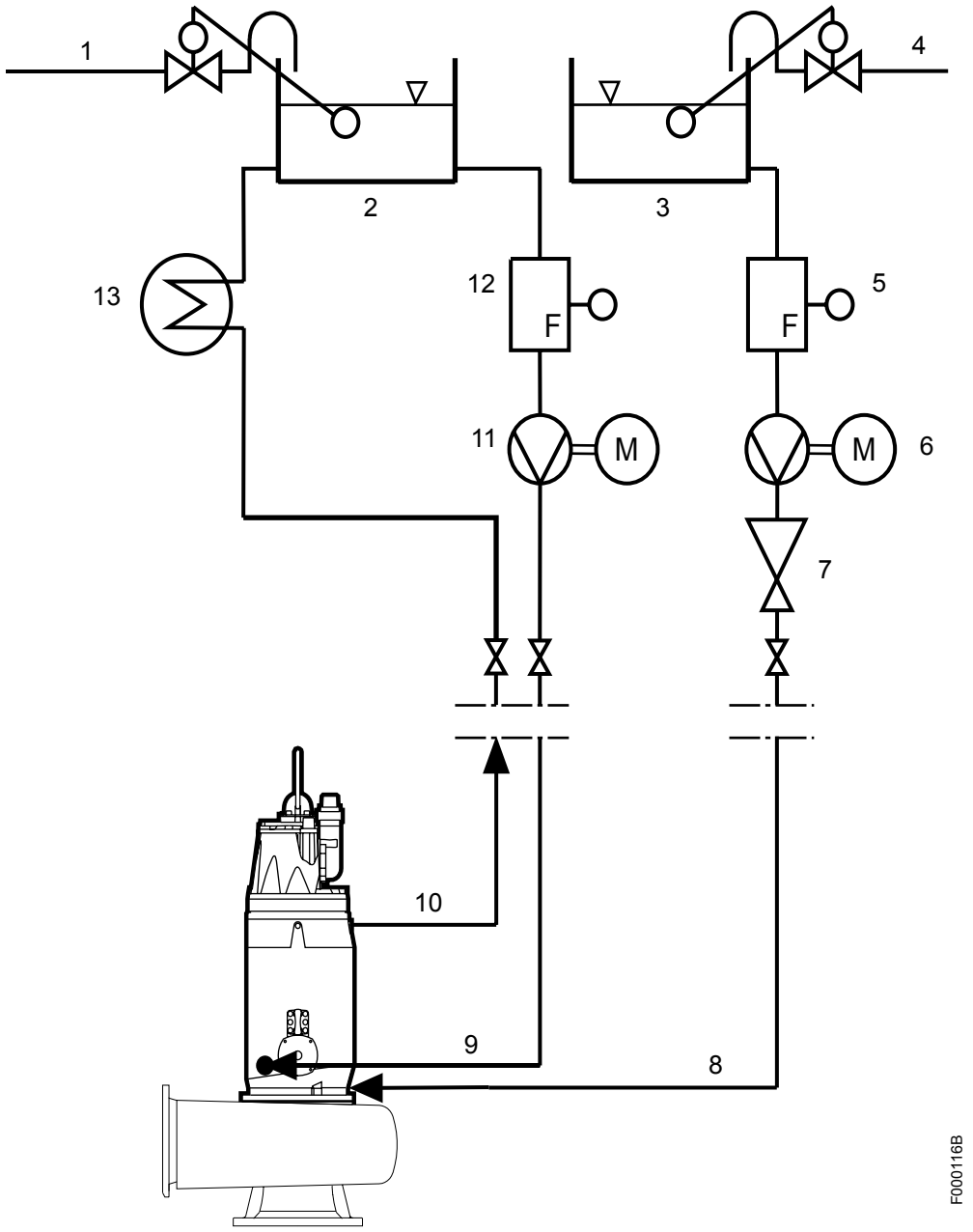
Examples of demanding applications where seal flushing might be used include the following:

- Corrosive liquids
- Water containing excessive amounts of sand, fine sediment or other abrasive material
- Water containing calcium deposits
- Water containing excessive amounts of fibers or other materials with a tendency to clog together.

For more information regarding seal flushing applications please contact your ITT representative.

Circuit diagram for seal flushing

The supply of incoming flushing water should be arranged as described in the circuit diagram below. As all slushing water is lost into the hydraulic end, this is always an open circuit solution.



1. Cooling water supply
2. Expansion tank
3. Supply tank
4. Seal flushing water supply
5. Flow meter
6. Booster pump
7. Constant flow valve
8. Seal flushing inlet to pump
9. Coolant inlet to motor
10. Coolant outlet
11. Circulation pump
12. Flow meter
13. Heat exchanger

It is recommended that a constant flow valve is installed in the supply line. This should be chosen to give a flow of at least 15 liters/min (4 US gal/min). If the valve is exposed to a sufficient pressure difference between its input and output connection, then the output flow will remain constant even if the pressure at the output connection varies. This feature is important if the pump operates at different duty points.

Connections for seal flushing

P- and S-installations	T- and Z-installations
A 3/4" I.D. reinforced water hose is needed for the seal flushing. The supply line for the seal flushing water should be equipped with a stop-cock for service work. In order to avoid movement of the hose in the sump, it should be fixed to the cables with cable ties.	Pipes instead of hoses should be used to minimize rish of accidental leakage. However, flexible cables to the pump (for example, a piece of reinforced hose) are advised, to avoid transmitting vibrations from the pump to the pipes.

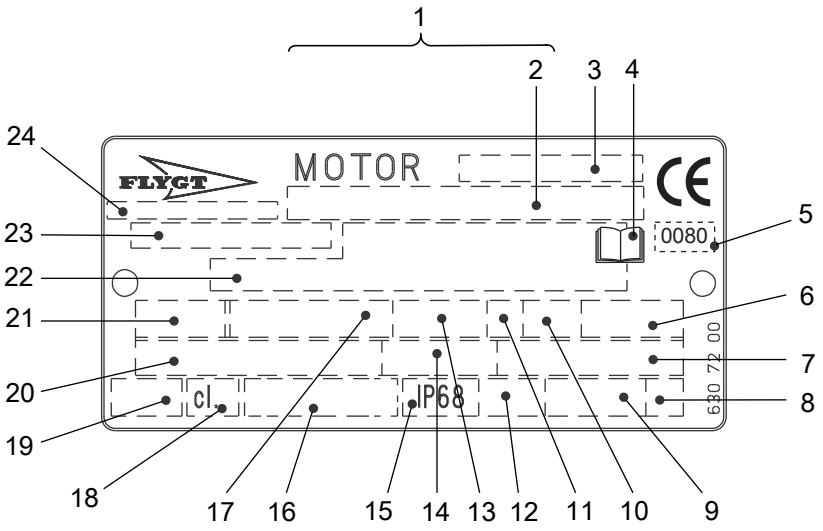
The table below describes the inlet port and the outlet control.

Item		Description
Flush water inlet	Location	At the lower part of the cooling jacket.
	Connection	Threaded ISO G 3/4.
Outlet control		Flushing water outlet is controlled by a lip seal, which acts as a check valve between the guide ring and the impeller hub to protect the mechanical seal.

The data plates

The data plates include key product specifications.

Drive unit

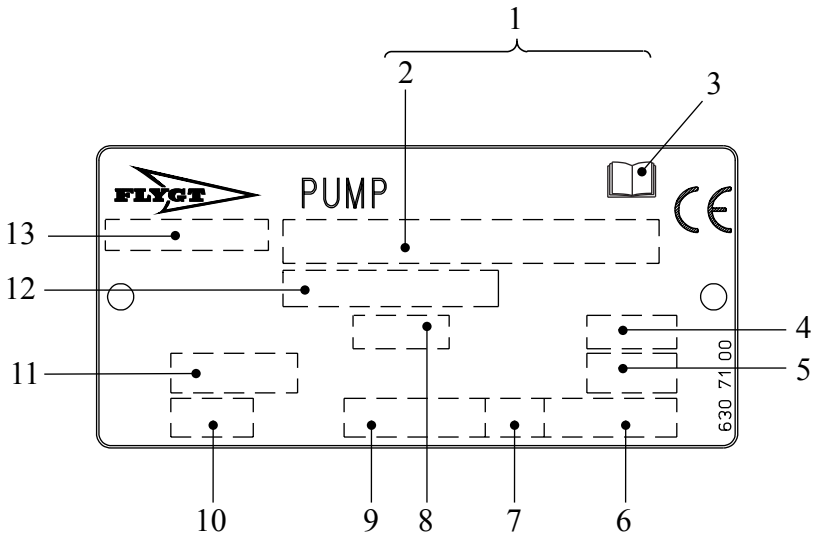


1. Serial number
2. Product code + Number
3. Motor denomination
4. Read installation manual
5. Notified body / only for EN-approved Ex-products
6. Maximum ambient temperature
7. Power factor
8. Locked rotor code letter
9. Product weight
10. Duty factor
11. Duty class
12. Maximal submergence
13. Rated speed
14. Rated current
15. Degree of protection
16. International standard
17. Rated shaft power
18. Thermal class
19. Thermal protection
20. Rated voltage
21. Phase; Type of current; Frequency
22. Additional information

23. Product number
24. Country of origin

Figure 10: The drive unit plate

Hydraulic unit



1. Serial number
2. Product code + Number
3. Read installation manual
4. Impeller diameter
5. Propeller blade angle
6. Product weight
7. Direction of rotation: L=left, R=right
8. Impeller code
9. Rated speed
10. Pressure class
11. Column diameter/Inlet and outlet diameter
12. Product number
13. Country of origin

Figure 11: The hydraulic unit plate

Installation

Install the pump

WARNING:

- Before installing the pump, check that the cable and cable entry have not been damaged during transportation.
- Note that special rules apply to installation in explosive atmospheres.
- Make sure that the pump cannot roll or fall over and injure people or damage property.
- Do not install CSA-approved products in locations that are classified as hazardous in the national electric code, ANSI/NFPA 70-2005.

NOTICE:

- Do not run the pump dry.
- Never force piping to make a connection with a pump.

Consult the nearest ITT representative regarding the following:

- Sizing of the pump, piping station, and access frame
- Choice of auxiliary equipment
- Other aspects of installation

These requirements apply:

- Use the pump dimensional drawing in order to ensure proper installation.
- Provide a suitable barrier around the work area, for example, a guard rail.
- Check the explosion risk before you weld or use electric hand tools.
- Remove all debris from the inlet piping system before you install the pump.
- Remove all debris from the pump sump before you install the pump.

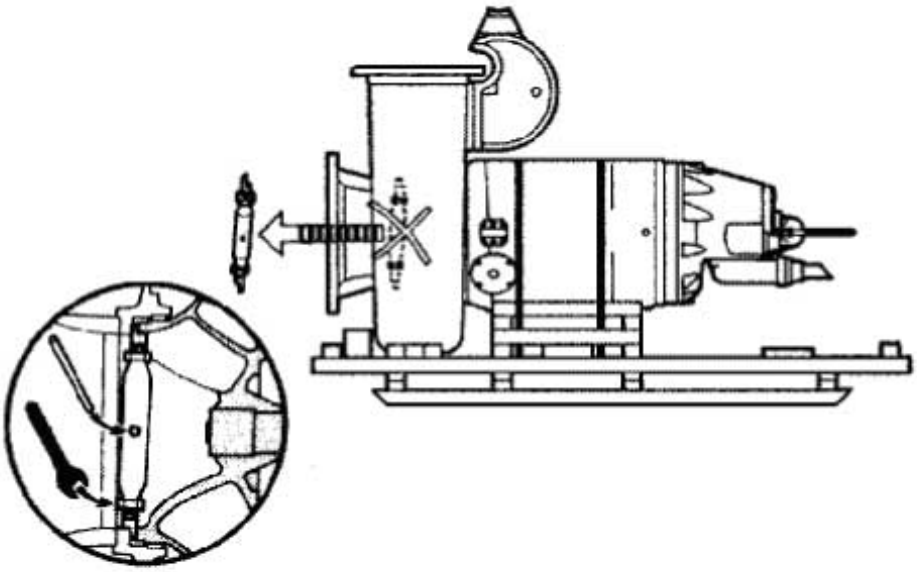
Fasteners

WARNING:

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

The locking device

Pumps delivered in the horizontal position have a locking device for the impeller/propeller. Before you install the pump, you must remove this locking device.



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.

The following 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
- Level regulators or other control equipment for start, stop, and alarm
- Cable holder for holding the cable and regulating the height of the level regulators
- 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 casing flange and a bracket for attaching the guide equipment)
- Bushings for vibration damping between the guide bars and the discharge connection

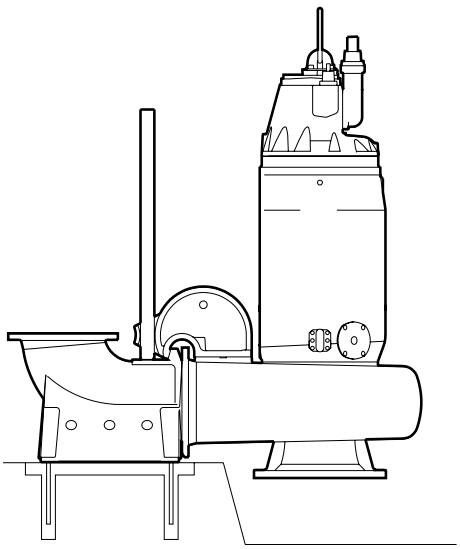


Figure 12: P-installation

1. Provide a barrier around the pump pit; for example, a guardrail.

Make sure the sump is dry.

2. Place the discharge connection in the correct position.
3. Mount the anchor bolts.
4. Level the discharge connection, using a leveller and if necessary, shims.
5. Place the discharge connection in position, and tighten the nuts.
6. Connect the discharge pipe to the discharge connection.
7. Install the guide bars:
   a) Secure the guide bars in the bracket.
   b) Check that the guide bars are placed vertical by using a level or a plumb line.
8. Lower the pump along the guide bars.

   On reaching the bottom position, the pump will automatically connect to the discharge connection.
9. Check that the pump is seated correctly at the discharge connection.
10. Secure the cables:
    a) Make sure that the cables cannot be sucked into the inlet of the pump. Support straps are required for deep installations.
    b) Run the cables up to the electrical panel or junction box and connect them according to the separate instructions.
11. Clean all debris from the sump, before filling the sump.

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. For more detailed information about the different installation types, see the Parts List document.

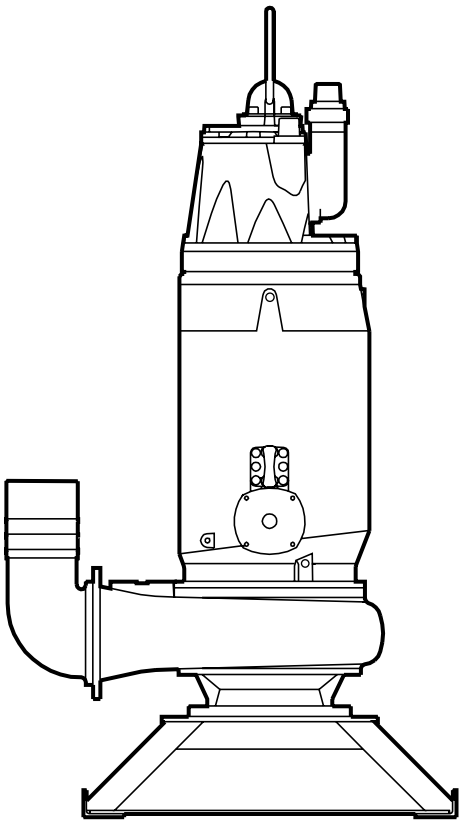


Figure 13: S-installation

1. Connect the discharge line.
2. Lower the pump into the sump.

3. Run the cables up to the electrical panel or junction box, and connect them according to the instructions in *Connect the cables* (page 50).
4. Place the pump on the base and make sure it cannot fall over or sink.

   Alternatively, the pump can be suspended by its lifting eye just above the sump bottom.
5. Secure the cables.

   Make sure that the cables cannot be sucked into the inlet of the pump. Support straps are required for deep installations.
6. Secure the discharge hose or pipe in a safe manner.

Install with T/Z-installation

- In the T-installation the pump is installed in a stationary vertical position in a dry well next to the wet sump.
- In the Z-installation, the pump is installed in a horizontal position on a support stand, and a bell-mouth is connected to the inlet pipe.

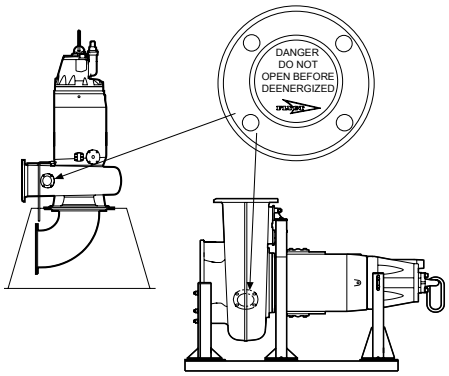


Figure 14: T-installation (left) and Z-installation

Z-installations using integrated cooling require a specific orientation. The drive unit must be oriented such that the air evacuation system and the stator housing leakage sensor function properly. The cooling jacket inspection cover marked "SENSORS" must be oriented downwards.

The following items are required:

- Support stand for anchoring the pump to a base
- Plate or base stand with anchor bolts for anchoring the pump to a concrete base
- Inlet elbow for connecting the suction line and discharge line
- Shut-off valves to permit the pump to be removed for service
- Air vent on the discharge side between the pump and the check valve

WARNING:

Never remove the inspection cover during service or internal cleaning of the pump housing until the pump has been de-energized and drained.

1. For Z-installations: Check that the drive unit is oriented such that the cooling jacket inspection cover marked "SENSORS" is facing downwards.
2. Fasten the pump:
   a) Use the anchor bolts to bolt the base stand to the concrete base.
   b) Bolt the pump to the base stand and the suction connection.
3. Make sure that the pump is vertical (T-installation) or horizontal (Z-installation).
4. Connect the suction line and discharge line.
5. Run the cables up to the electrical panel or junction box, and connect them according to the separate instructions. For information about electrical connections, see *Connect the cables* (page 50).
6. Make sure that the weight of the pump does not put strain on the piping.

Make the electrical connections

General precautions

Electrical Hazard:

- A certified electrician must supervise all electrical work. Comply with all local codes and regulations.
- Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and cannot be energized. This applies to the control circuit as well.
- Leakage into the electrical parts can cause damaged equipment or a blown fuse. Keep the end of the motor cable above the liquid level.
- Make sure that all unused conductors are insulated.
- 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.

CAUTION:

If the pump is equipped with automatic level control and/or internal contactor, there is a risk of sudden restart.

Requirements

These general requirements apply for electrical installation:

- The supply authority must be notified before installing the pump if it will be connected to the public mains. When the pump is connected to the public power supply, it may 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, the connected voltage is specified by a yellow sticker close to the cable entry.
- The fuses and circuit breakers must have the proper rating, and the pump overload protection (motor protection breaker) must be connected and set to the rated current according to the data plate and if applicable the cable chart. The starting current in direct-on-line starting can be up to six times higher than the rated current.
- The fuse rating and the cables must be in accordance with the local rules and regulations.
- If intermittent operation is prescribed, the pump must be provided with monitoring equipment supporting such operation.
- The thermal contacts must be connected to a protection circuit in accordance with the product approvals.
- The thermal contacts/thermistors must be in use.
- For FM-approved pumps, FLS must be connected and in use in order to meet approval requirements.
- The environment must be appropriate for medium-voltage (1.2–10 kV) cables and electrical work.

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 sheathing 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. For more information, see *Cable charts* (page 58).
- The correct entrance flange must be used with the existing cable according to the table in *Cable charts* (page 58).
- 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 sheath of the cable is damaged, then replace the cable. Contact an ITT service shop.
- 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 requirements if a Variable Frequency Drive (VFD) is used. For more information, contact your ITT representative (VFD-supplier).

Earthing (Grounding)

Electrical Hazard:

- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.
- If the motor cable is jerked loose by mistake, the earth (ground) conductor should be the last conductor to come loose from its terminal. Make sure that the earth (ground) conductor is longer than the phase conductors. This applies to both ends of the motor cable.
- Risk of electrical shock or burn. You must connect an additional earth- (ground-) fault protection device to the earthed (grounded) connectors if persons are likely to come into physical contact with the pump or pumped liquids.

Connect the cables

1. Connect the monitoring equipment.
2. Connect the cable to the terminal board:
   - If you have the MAS system, connect the cable to its terminal board according to the illustration and table in *MAS sensor connections* (page 53).

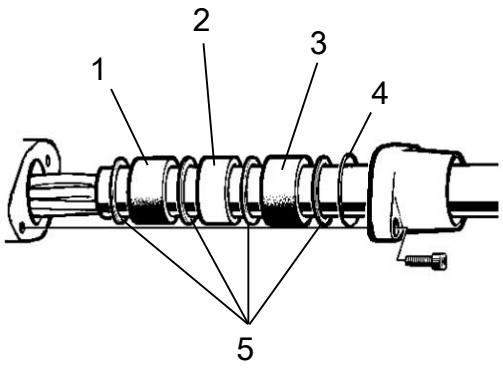
     NOTICE:

     As the cable ends are sealed to eliminate moisture entrainment during transport and storage, no wire markings for the sensors at the outlet end of the cable are made at the factory. Markings must therefore be carried out during installation of the pump.

     At the first installation, the MAS base unit and the pump memory should be synchronized. To synchronize the units do the following:

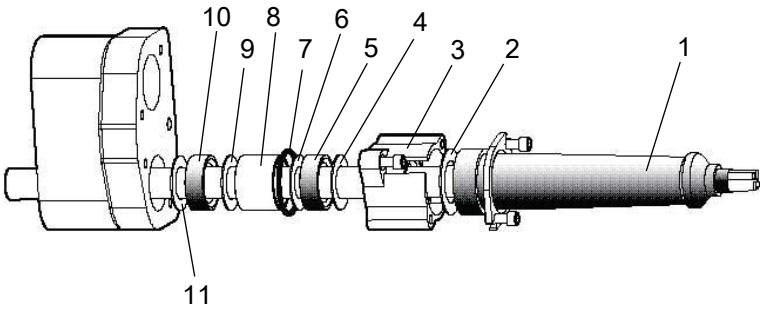
     1. Check that the communication between the pump and the MAS base unit is activated.
     2. Upload the factory settings of sensors and associated parameters by choosing the command "copy all from pump memory to MAS". For more information about the MAS installation, see the Installation and User Manual for the MAS-711 monitoring equipment.
3. Connect the power cable:
   a) Check the data plate to determine which connection, Y or D, is valid for the voltage supply.
   b) Arrange the connection on the terminal board in accordance with Y or D.
   c) Connect the power cable leads to the terminal board connection U1, U2, V1, V2, W1, W2, and earth (ground) according to the cable chart.

   See *Cable charts* (page 58).
4. Install the entrance flange:
   a) Mount the entrance-flange parts according to the illustration for the correct drive unit.



1. Seal sleeve
2. Spacer ring
3. Seal sleeve
4. O-ring
5. Washer

Figure 15: Drive units 605-775



1. Protective sleeve
2. Washer
3. Connection flange
4. Washer
5. Seal sleeve
6. Washer
7. O-ring
8. Spacer ring
9. Washer
10. Seal sleeve
11. Washer

Figure 16: Drive unit 805-995

b) Mount the protective rubber sleeve onto the cable where it leaves the junction box (connection housing).

The rubber sleeve must have the correct size to give the correct compression around the cable.

c) Fasten the connection flange to the entrance flange.

Make sure that the seal sleeve is not misaligned with the rubber sleeve and that the entrance flange supports the cable so that it cannot be excessively bent.

5. Connect the starter equipment:

a) Connect the power cable to the starter equipment according to the diagram in *Power cable phase sequence* (page 51).

b) Connect the auxiliary cable to the starter equipment.

Power cable phase sequence

In the following figure, the triangle marked “L1,” “L2” and “L3” shows the phase sequence.

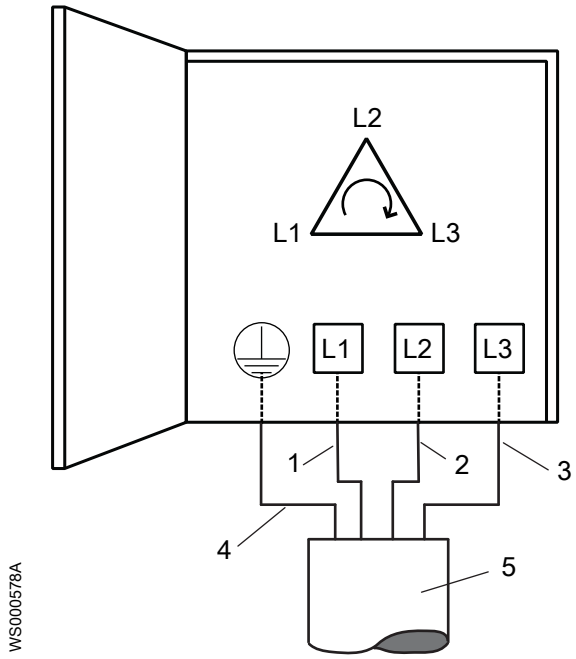


Figure 17: Correct phase sequence

Item	Description	Color of cable lead		
		SUBCAB	SUBCAB AWG	NTSCGEWTOEUS (marking on lead)
1	L1 cable lead	Brown	Red	Black (L1)
2	L2 cable lead	Black	Black	Black (L2)
3	L3 cable lead	Grey	White	Black (L3)
4	Earth PE or ground cable lead	Green/Yellow	Green/Yellow	Green/Yellow
Not shown	Ground check GC cable lead	—	Yellow	—
5	Power cable to pump			

MAS sensor connections

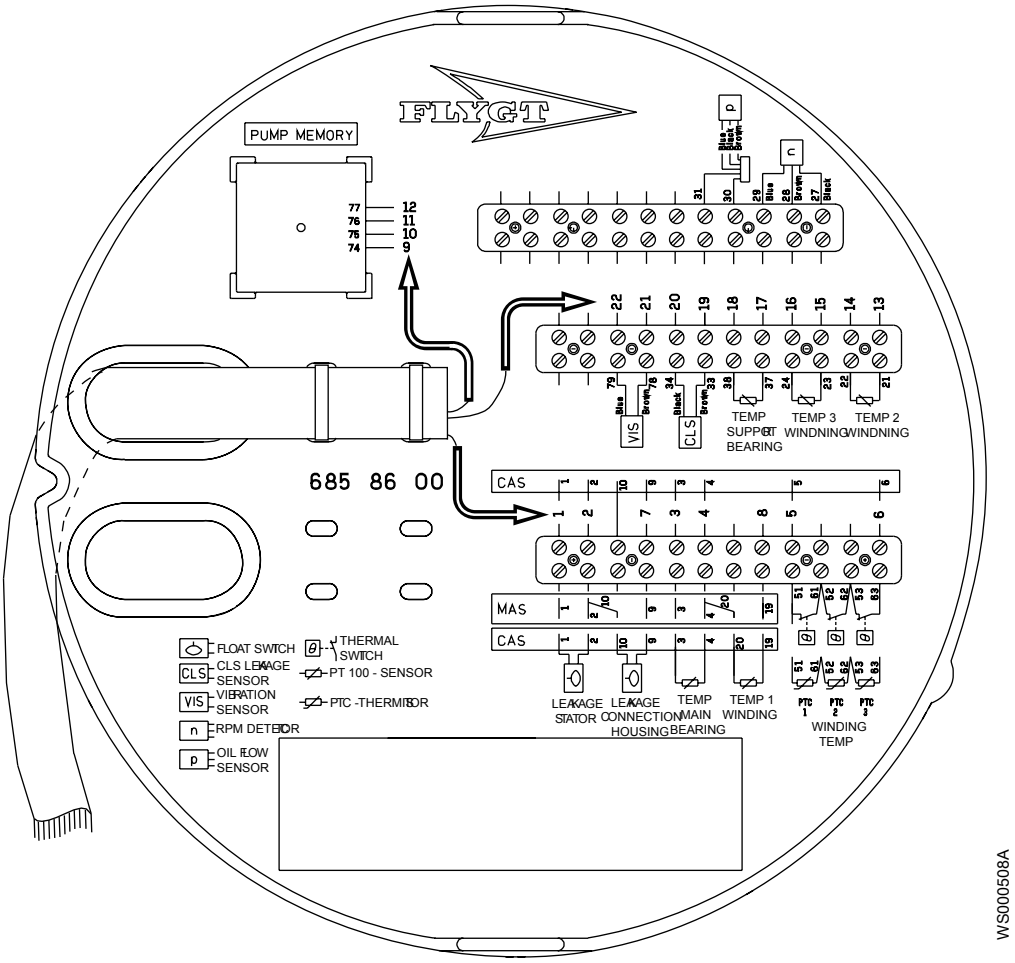


Figure 18: Connections at the pump. Arrows indicate SUBCAB cable lead numbers.

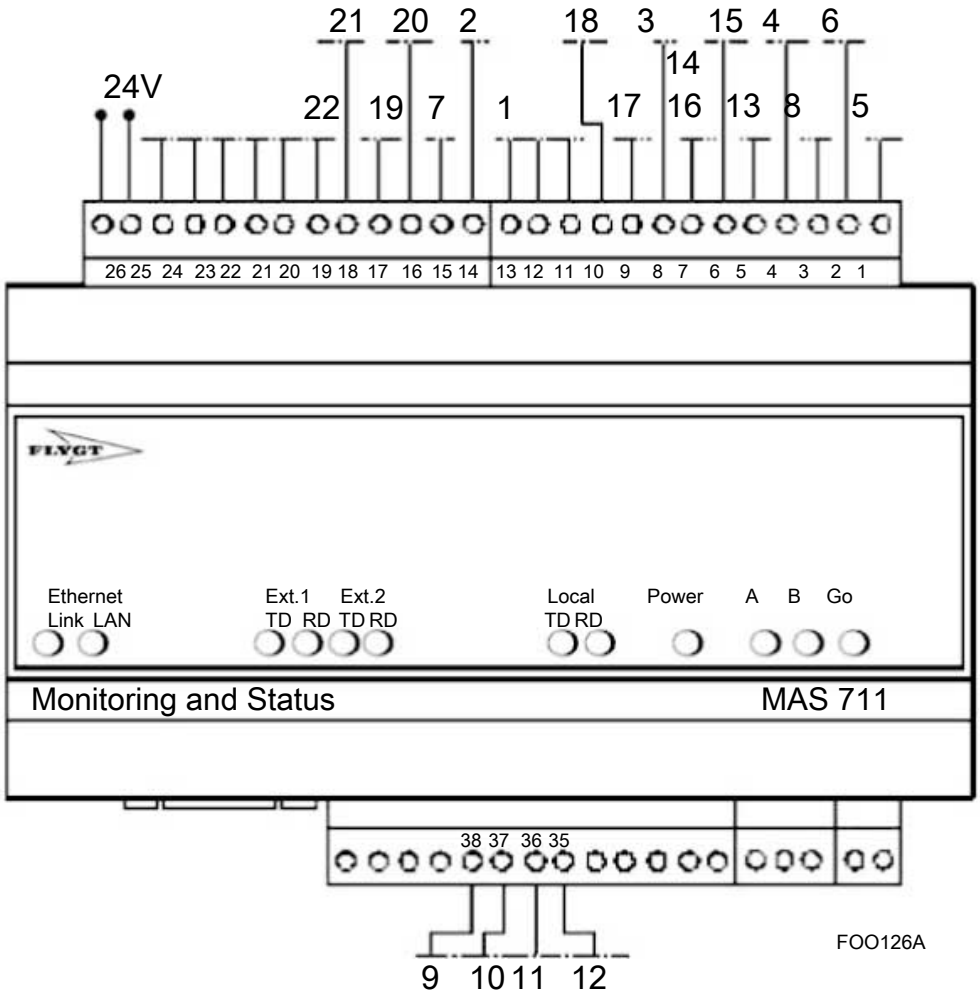


Figure 19: Connections at the MAS 711 base unit

This table shows how the conductors are connected to the different sensors.

Sensor		Terminal block	Conductor number for 12-lead cable	Conductor for 24-lead cable
Float switch in the stator housing[3]		1	1	1
		2	2	2
Float switch in the junction box		9	7	7
		2	—	—
Pt100 in the main bearing[4]		3	3	3
		4	4	4
Pt100 in the support bearing		37	—	17
		38	—	18
Thermal switches or thermistors in the stator		5	5	5
		6	6	6
CLS sensor in the oil housing	+	33	—	19
	–	34	—	20
Pt100 in the stator winding 1		19	8	8
		4	—	—

[3] The leakage sensors in the stator housing and the junction box use the same terminal (terminal 2) on the terminal block.

[4] The Pt100 sensor in the main bearing and the support bearing use the same terminal (terminal 4) on the terminal block

Sensor		Terminal block	Conductor number for 12-lead cable	Conductor for 24-lead cable
Pt100 in the stator winding 2		21	—	13
		22	—	14
Pt100 in the stator winding 3		23	—	15
		24	—	16
Pump memory RS-485 B		74	9	9
Pump memory RS-485 A		75	10	10
Pump memory supply, earth (ground)		76	11	11
Pump memory supply, 12 V DC+		77	12	12
Vibration sensor VIS10	+	78	—	21
	–	79	—	22

CAS or MAS 711 + MRM-01 sensor connections

The CAS monitoring system has been replaced by the MAS 711. This section provides information for connecting CAS to 6X5, 7X5, 8X5 and 9X5 drive units in the following situations:

- A replacement pump is being installed at an older pump station, where the CAS system is still functioning.
- A replacement monitoring system is needed at an older pump station, where the pump is still working but the CAS system must be replaced.

The CAS monitoring system is no longer available as a spare part. If a replacement for CAS is needed at an older pump station, then the MAS 711 plus the MRM-01 relay may be used.

Connection plate in pump housing

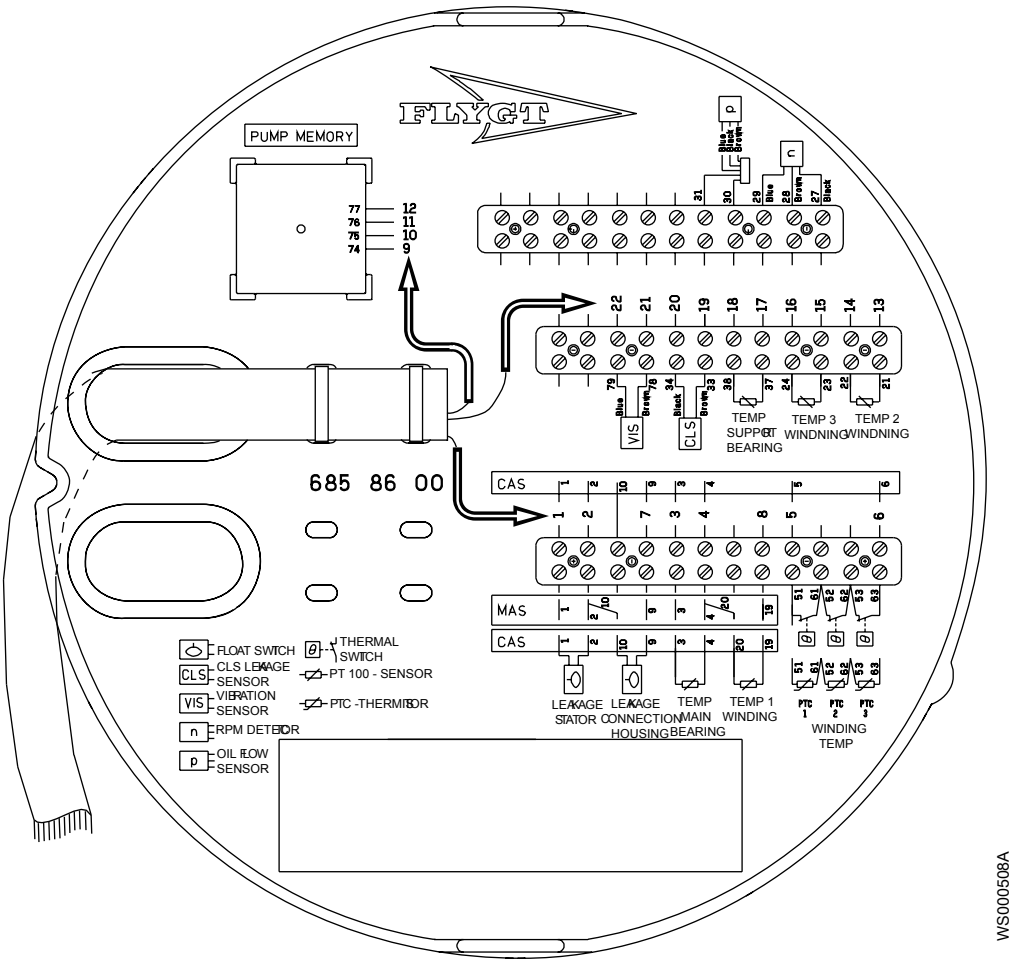


Figure 20: Connections at the pump. Arrows indicate SUBCAB® cable lead numbers.

MAS 711 + MRM-01

This section provides connection diagrams for replacing the CAS monitoring system with the MAS 711 together with the MRM-01 relay.

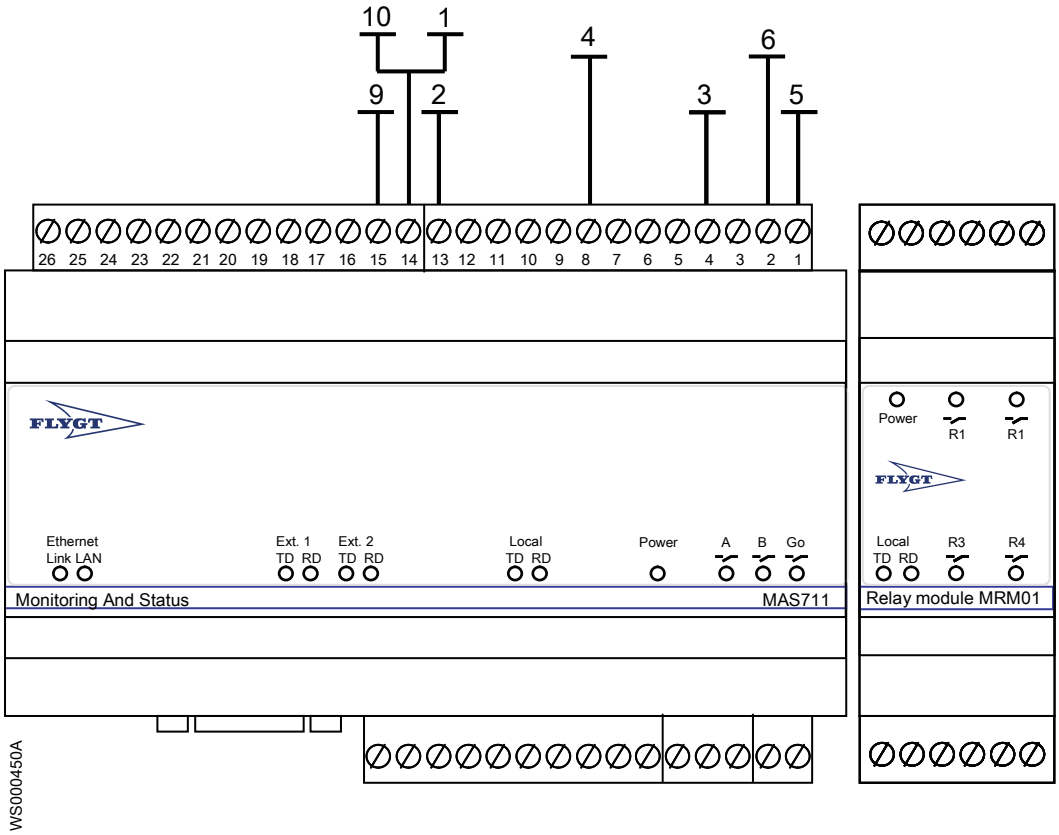


Figure 21: Connections at the MAS 711 + MRM-01 base units

Description	Part number
Unit, MAS 711 and MRM-01	40 50 15 45
MAS 711	40 50 11 41
MRM-01	40 50 15 36

CAS-connected pumps

The CAS system is no longer available as a spare part.

This section provides connection diagrams for replacement pumps at stations equipped with a functioning CAS monitoring system.

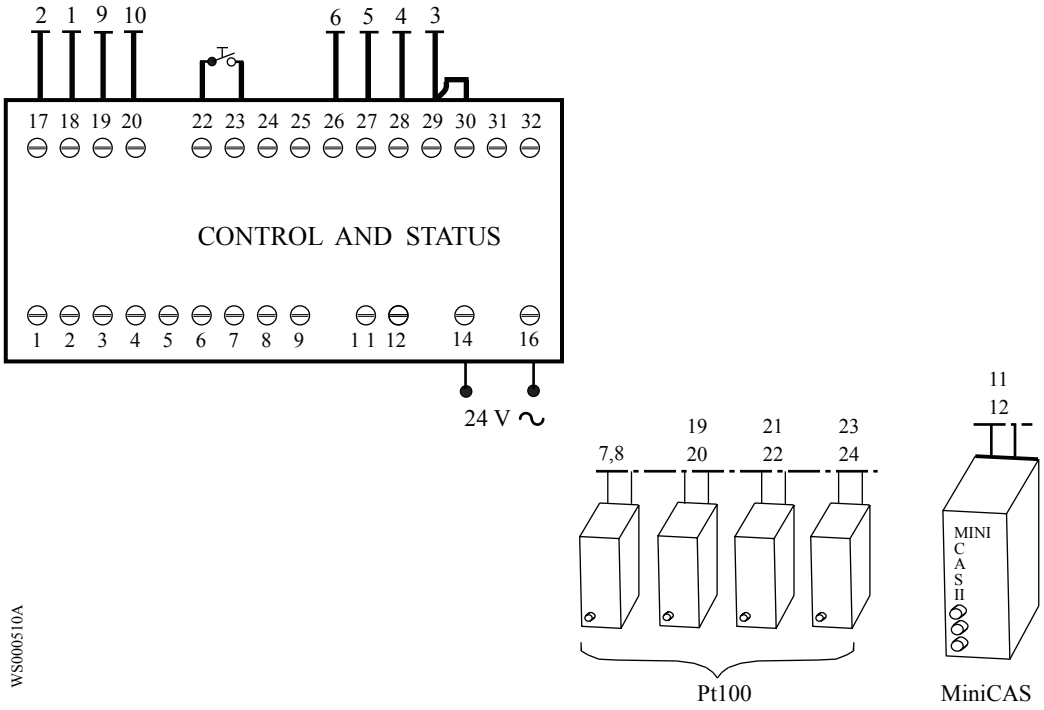


Figure 22: Connections at the CAS base unit

For more information about the CAS system, see *CAS system* (page 26).

Connection table

This table shows how the conductors are connected to the different sensors.

Sensor		Terminal block	Conductor number for 12-lead cable	Conductor for 24-lead cable
Float switch in the stator housing		1	1	1
		2	2	2
Pt100 in the main bearing		3	3	3
		4	4	4
Thermal switches or thermistors in the stator		5	5	5
		6	6	6
Pt100 in the support bearing		37	7	7
		38	8	8
Float switch in the junction box		9	9	9
		10	10	10
CLS sensor in the oil housing	+	33	11	11
	–	34	12	12
Pt100 in the stator winding 1		19	—	19
		20	—	20
Pt100 in the stator winding 2		21	—	21
		22	—	22
Pt100 in the stator winding 3		23	—	23
		24	—	24

Cable charts

Electrical Hazard: The end of the cable must not be submerged. Leads have to be above flood level, as water may penetrate through the cable into the junction box.

Colors and markings on power cables

Table 12: Colors or markings on the main leads

Mains	Color of cable lead		
	SUBCAB	SUBCAB AWG	NTSCGEWTOEUS (marking)
L1 cable lead	Brown	Red	Black (L1)
L2 cable lead	Black	Black	Black (L2)
L3 cable lead	Grey	White	Black (L3)
Earth PE or ground cable lead	Green/Yellow	Green/Yellow	Green/Yellow
Ground check GC cable lead	—	Yellow	—

Table 13: Color of stator leads. (Cables up to 1.1 kV. Not valid for 1.2–10 kV cables.)

Stator leads	Color
U1	Red
V1	Brown
W1	Yellow
U2	Green
V2	Blue
W2	Black

Drive units up to 1.1 kV

D-connection, 3-pole terminal, 1 or 2 cables

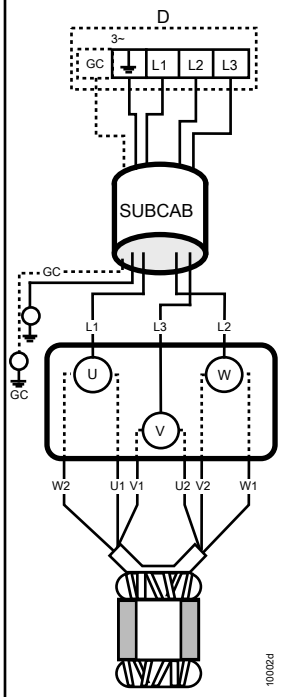


Figure 23: Schematic diagram

This cable chart shows the connection for drives units in the 6X5 series.

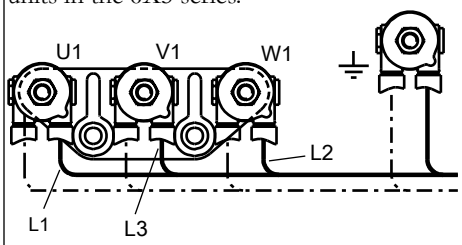


Figure 24: Drive units 605/615, 665/675

This cable chart shows the connection for drive units in the 8X5 and 9X5 series; also drive units 7X5 with large junction box (see *Connection houses (junction boxes) in 7X5 drive units* (page 66)).

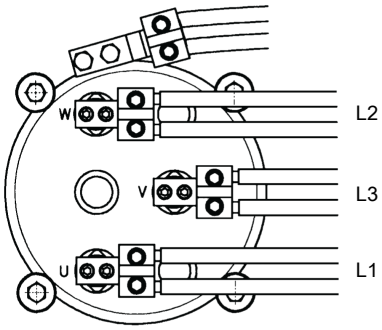


Figure 25: Drive units 805/815, 835/845, 865/875, 885/895; 905/915, 935/945, 965/975; 7X5 with large junction box

D-connection, 6-pole terminal, 1 cable; 6x5 and 7x5 series

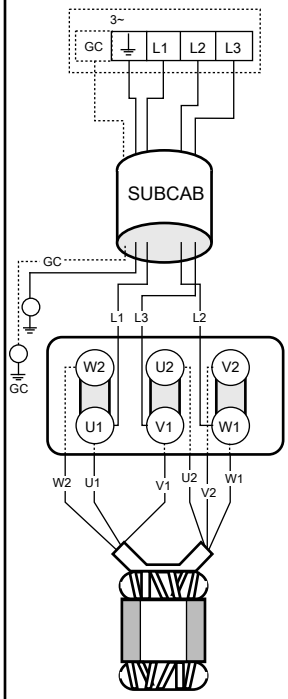


Figure 26: Schematic diagram

Connection for 6X5 and 7X5 drives units.

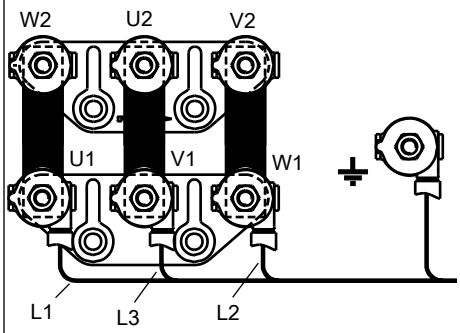


Figure 27: Drive units 605/615, 665/675; 705/715, 735/745, 765/775

D-connection, 6-pole terminal; 2 cables

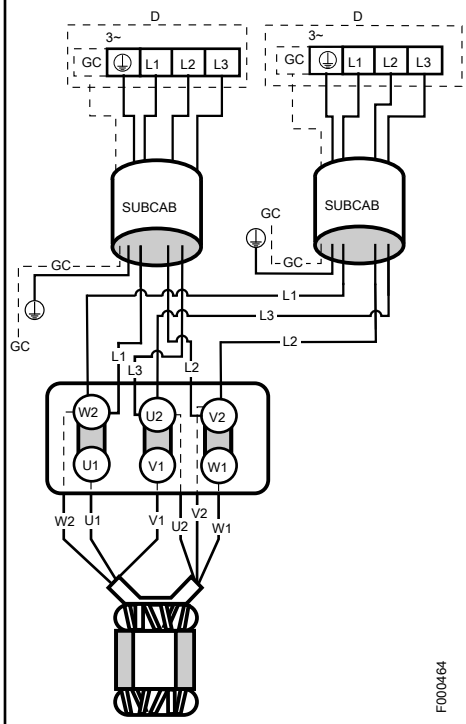


Figure 28: Schematic diagram

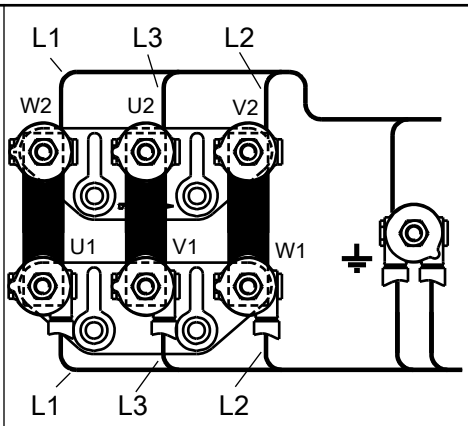


Figure 29: 2 cables, drive units 605/615, 665/675; 705/715, 735/745, 765/775

Connection for 8X5 and 9X5 drive units; also drive units 7X5 with large junction box (see *Connection houses (junction boxes) in 7X5 drive units* (page 66)).

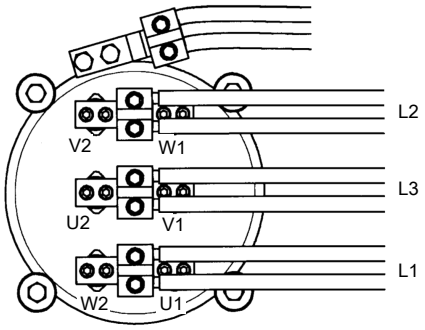


Figure 30: 2 cables, drive units 805/815, 835/845, 865/875, 885/895; 905/915, 935/945, 965/975; 7X5 with large junction box

D-connection, 6-pole terminal; 3 cables

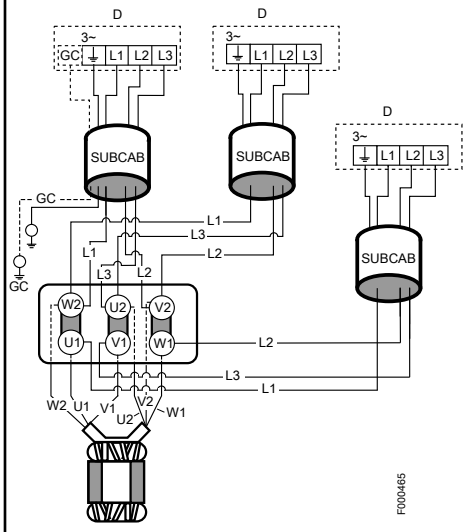


Figure 31: Schematic diagram

Connection for 8X5 and 9X5 drive units; also drive units 7X5 with large junction box (see *Connection houses (junction boxes) in 7X5 drive units* (page 66)).

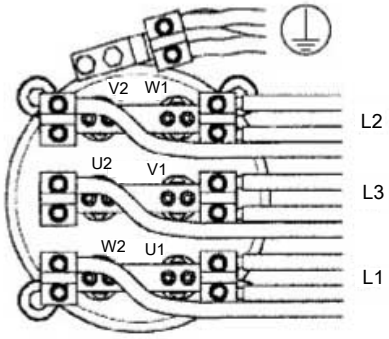


Figure 32: 3 cables, drive units 805/815, 835/845, 865/875, 885/895; 905/915, 935/945, 965/975; 7X5 with large junction box

Y-connection, 1 or 2 cables

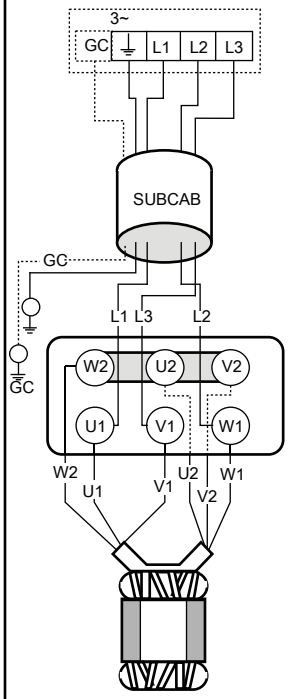


Figure 33: Schematic diagram

This cable chart shows the connection for drive units in the 6X5 and 7X5 series.

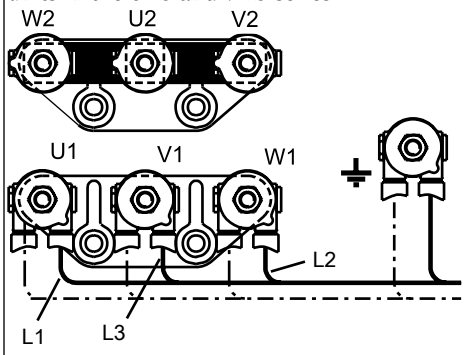


Figure 34: Drive units 605/615, 665/675; 705/715, 735/745, 765/775

This cable chart shows the connection for drive units in the 8X5 and 9X5 series; also drive units 7X5 with large junction box (see *Connection houses (junction boxes) in 7X5 drive units* (page 66)).

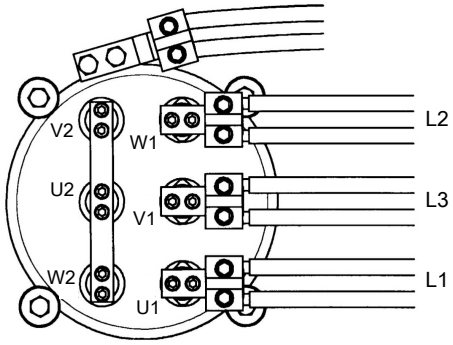


Figure 35: Drive units 805/815, 835/845, 865/875, 885/895; 905/915, 935/945, 965/975; 7X5 with large junction box

Y/D-connection, 2 cables

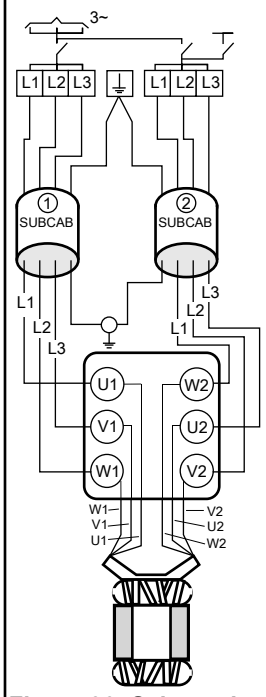


Figure 36: Schematic diagram

This cable chart shows the connection for drives units in the 6X5 and 7X5 series.

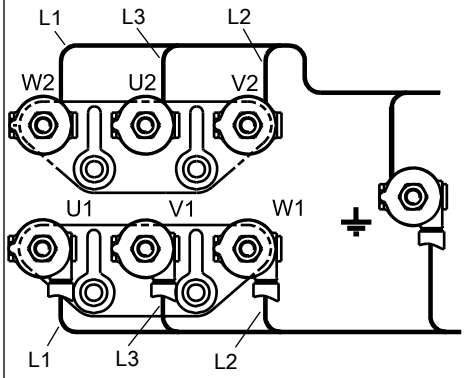


Figure 37: Drive units 605/615, 665/675; 705/715, 735/745, 765/775

This cable chart shows the connection for drive units in the 8X5 and 9X5 series; also drive units 7X5 with large junction box (see *Connection houses (junction boxes) in 7X5 drive units* (page 66)).

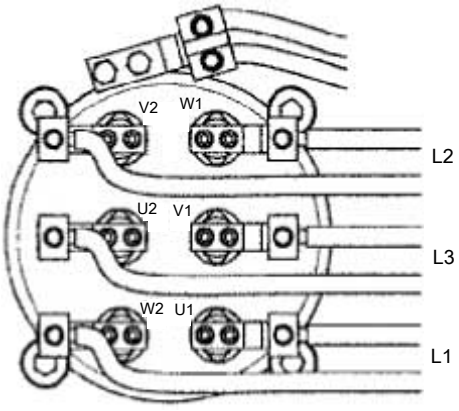


Figure 38: Drive units 805/815, 835/845, 865/875, 885/895; 905/915, 935/945, 965/975; 7X5 with large junction box

Drive units 1.2–6.6 kV

The connection diagrams for medium-voltage (1.2–6.6 kV) drive units are shown in the table below.

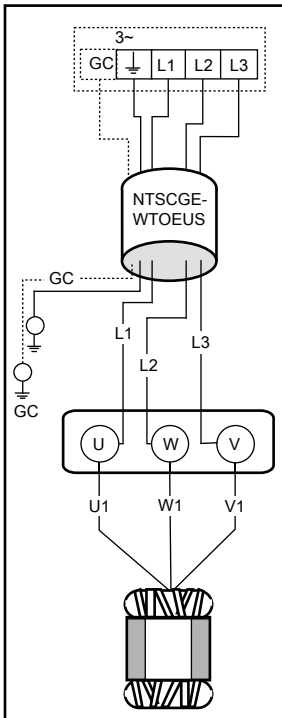


Figure 39: Schematic diagram

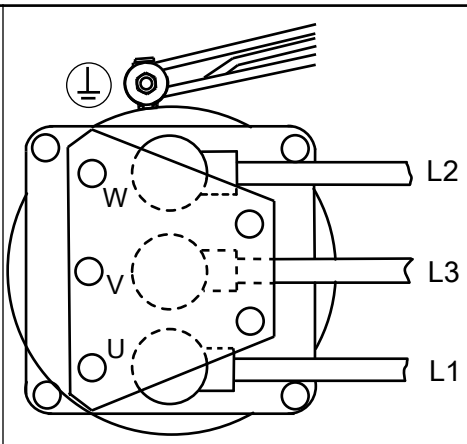


Figure 40: Connection diagram

Cable bending radius, weight and diameter

This table shows the minimum bending radius, weight and outer diameter for SUBCAB® control cables.

Table 14: SUBCAB® control cables

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
12x1.5 mm^2	190	0.53	Ø 18.2–21.2
24x1.5 mm^2	250	0.90	Ø 24.9–28.9
S12x1.5 mm^2	300	0.78	Ø 29.9–31.0
S24x1.5 mm^2	350	1.59	Ø 33.0–37.0

This table shows the minimum bending radius, weight and outer diameter for SUBCAB® power cables.

Table 15: SUBCAB® power cables

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
4 G 16 mm^2	260	1.25	Ø 26.0–28.0
4 G 25 mm^2	320	1.9	Ø 32.5–34.5
4 G 35 mm^2	360	2.5	Ø 36.5–38.5
4 G 50 mm^2	410	3.4	Ø 41.0–45.0
4 G 70 mm^2	450	4.5	Ø 45.0–49.0
4 G 95 mm^2	500	5.8	Ø 54.0–58.0
4 G 120 mm^2	600	7.3	Ø 56.0–60.0

This table shows the minimum bending radius, weight and outer diameter for SUBCAB AWG power cables.

Table 16: SUBCAB AWG power cables

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
4AWG/3-2-1-GC	320	2.0	Ø 32.8–34.8
1AWG/3-2-1-GC	400	3.5	Ø 40.7–42.7

This table shows the minimum bending radius, weight and outer diameter for Screened SUBCAB® cables (for VFD operation).

Table 17: Screened SUBCAB cables

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
S3x16+3x16/3+4x1.5	320	1.5	Ø 29.0–32.0
S3x25+3x16/3+4x1.5	330	1.6	Ø 30.0–33.0
S3x35+3x16/3+4x1.5	350	2.1	Ø 32.0–35.0
S3x50+3x25/3+4x1.5	420	3	Ø 38.0–42.0
S3x70+3x35/3+4x1.5	460	4	Ø 42.0–46.0
S3x95+3x50/3+4x1.5	530	5	Ø 49.0–53.0
S3x120+3x70/3+4x1.5	560	6	Ø 52.0–56.0
S3x185+3x95/3+4x1.5	670	9.5	Ø 65.0–69.0

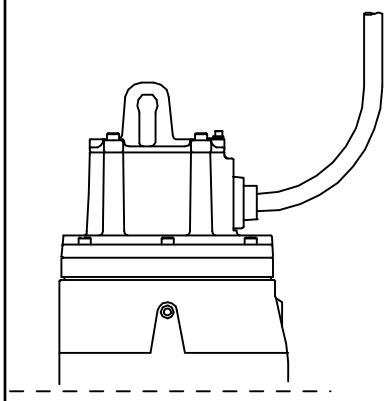
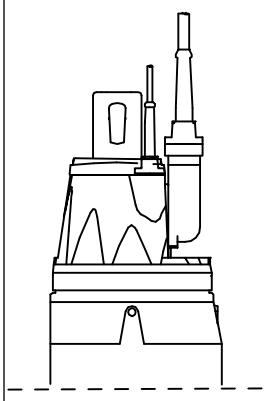
This table shows the minimum bending radius, weight and outer diameter for HSP NTSCGEWTOEUS 1.2–10 kV cables.

Table 18: HSP NTSCGEWTOEUS 1.2–10 kV

Cable	Minimum bending radius in mm	Weight in kg/m	Outer diameter, minimum-maximum in mm
3x25+3x25/3	385	3.32	Ø 46.4–49.4
3x35+3x25/3	410	3.81	Ø 49.0–52.0
3x50+3x25/3	450	4.78	Ø 54.0–58.0

Connection houses (junction boxes) in 7X5 drive units

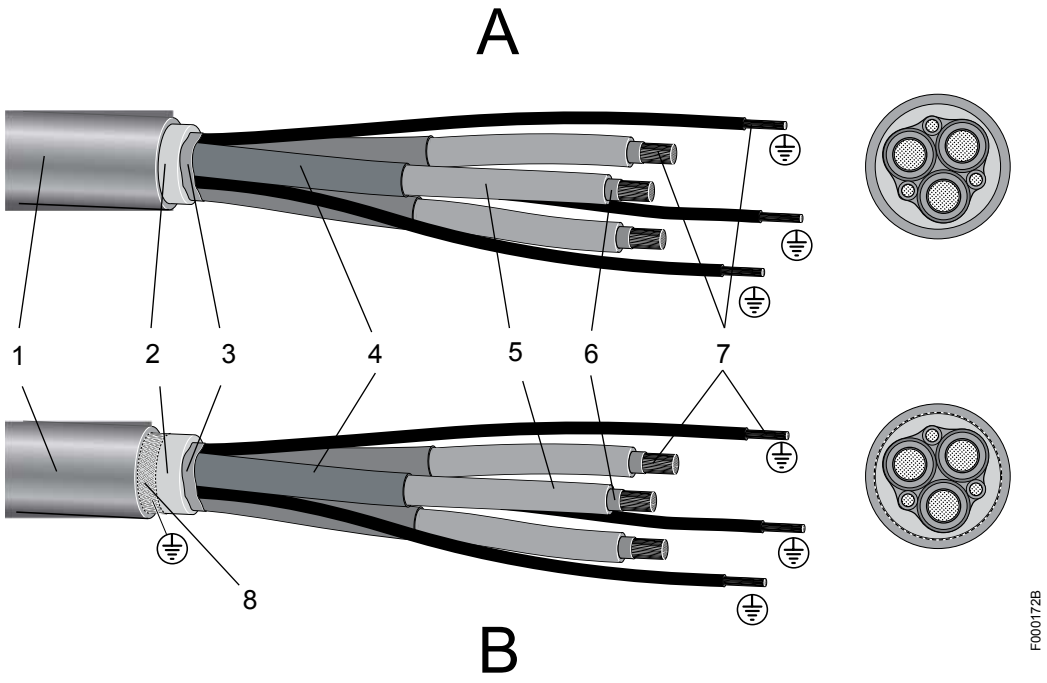
This table shows the large and small connection houses (junction boxes) for 7X5 drive units.

Small connection housing	Large connection housing
	

Prepare the medium-voltage cable

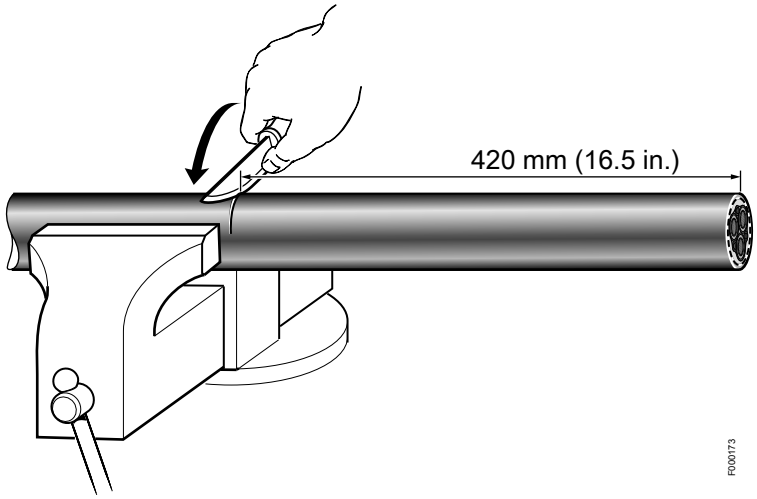
This instruction is for preparing medium voltage (1.2-10 kV) power cables prior to connecting them at the pump.

The upper illustration (A) shows a cable without screen. The lower illustration (B) shows a screened cable.

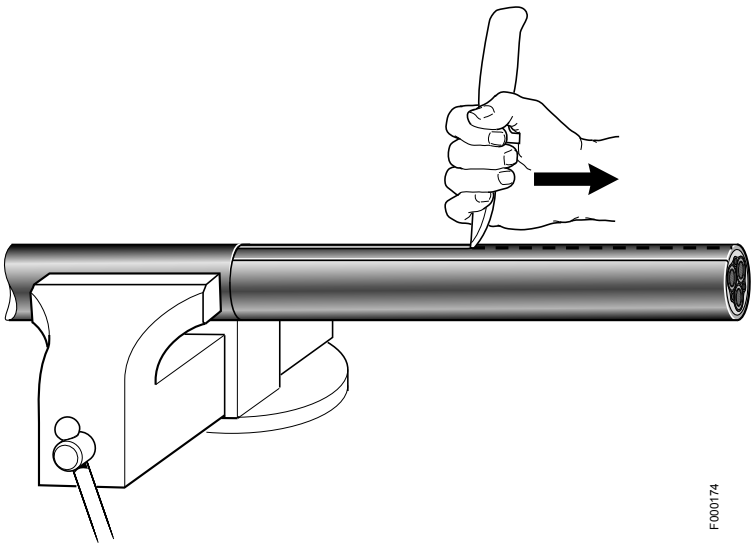


1. Outer cable sheath
2. Inner sheath
3. Conductive foil
4. Conductive layer
5. Conductor insulation
6. Conductive foil
7. Copper conductor
8. Shield wires

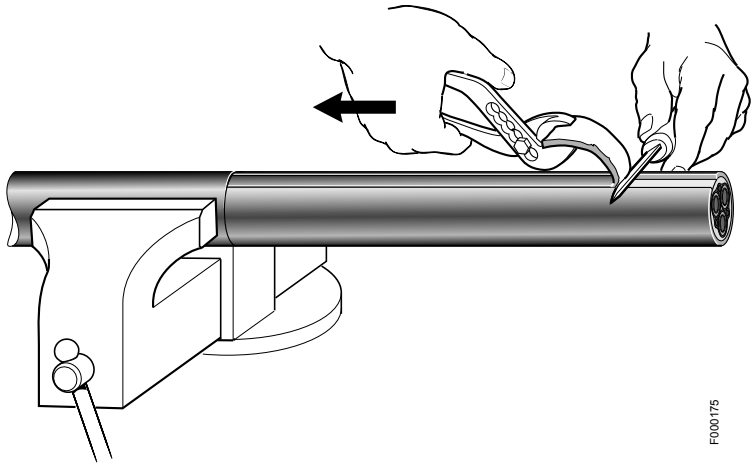
1. Peel off 420 mm of the cable casing at the connection ends of the cable.
   a) Make the vertical cut.



   b) Make the horizontal cut.

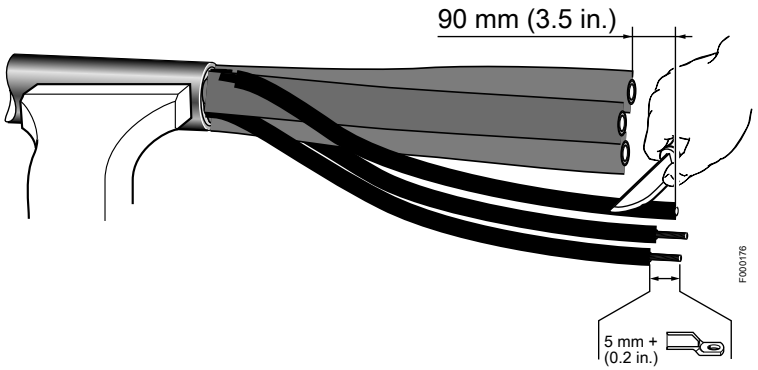


c) Remove the cable casing.

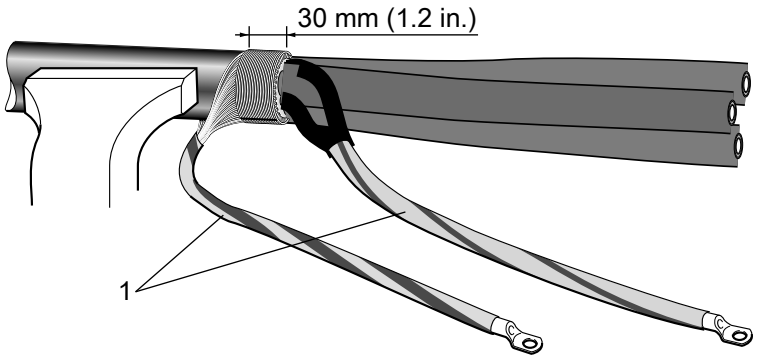


2. Peel off the casing from the leads.

Cable without screen:

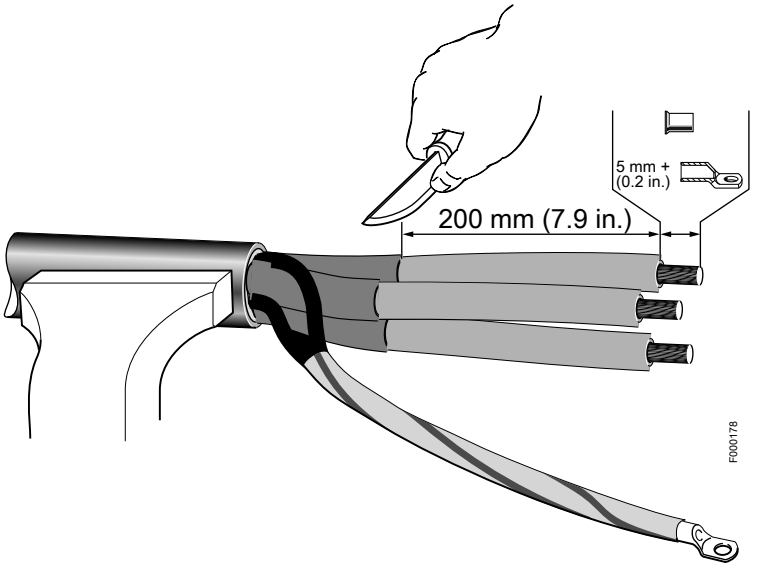


Screened cable:

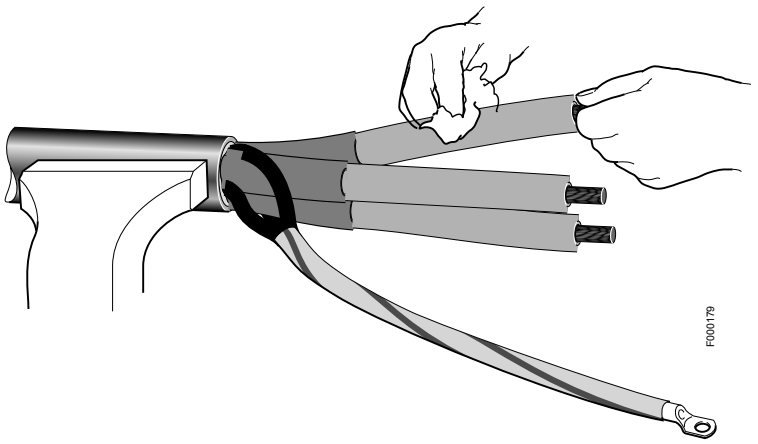


1. Yellow/green insulating hose

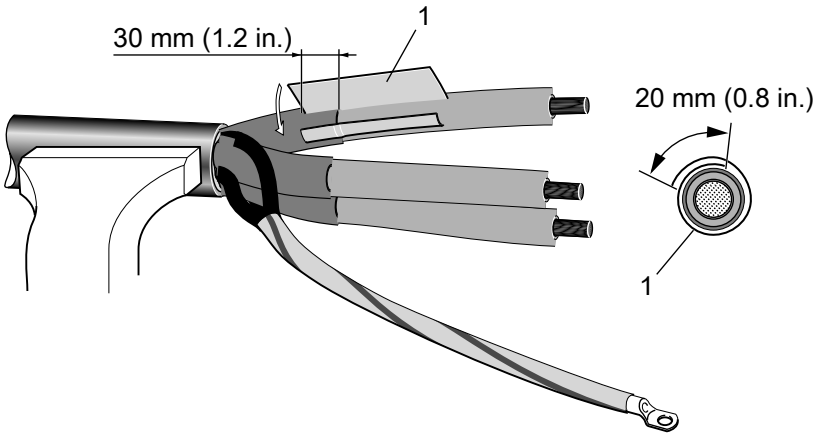
3. Peel off the conductive layer.



4. Clean the power leads with chemically pure petrol.

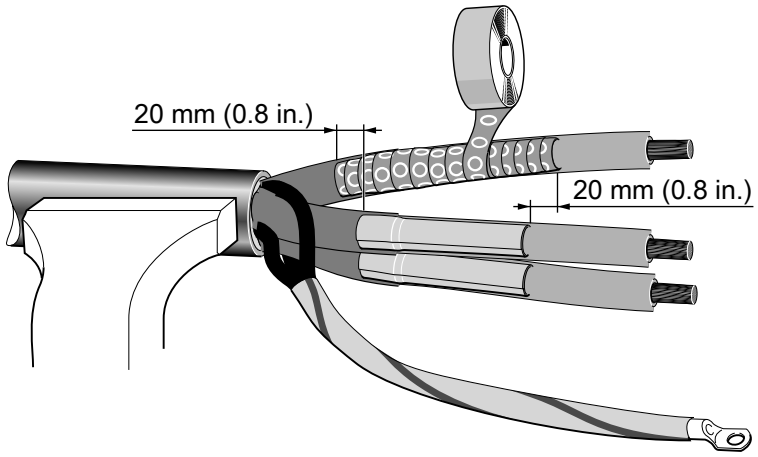


5. Attach the FSD (stress-grading pad) to the leads.

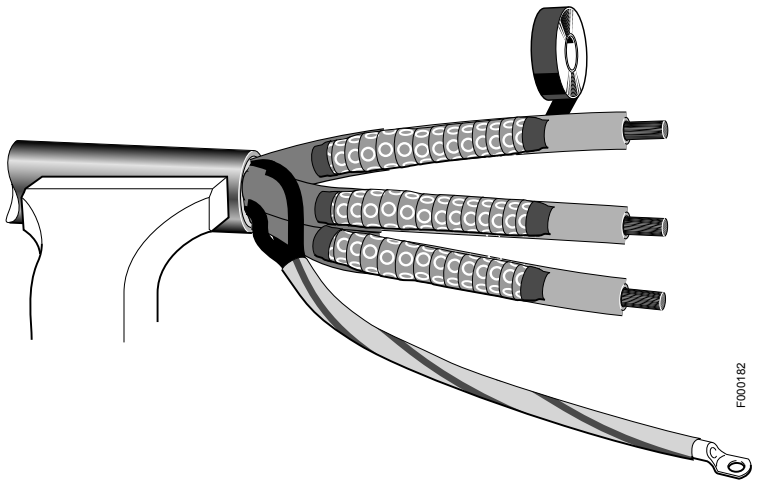


1. FSD, stress-grading pad

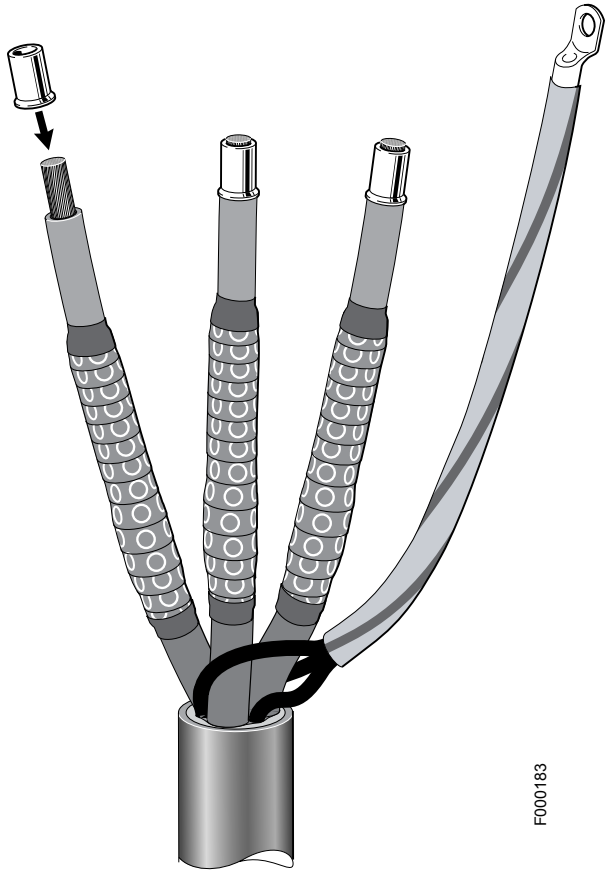
6. Apply four turns of IV (insulating self-bonding) tape with half overlap. Stretch the tape until the markings are circular.



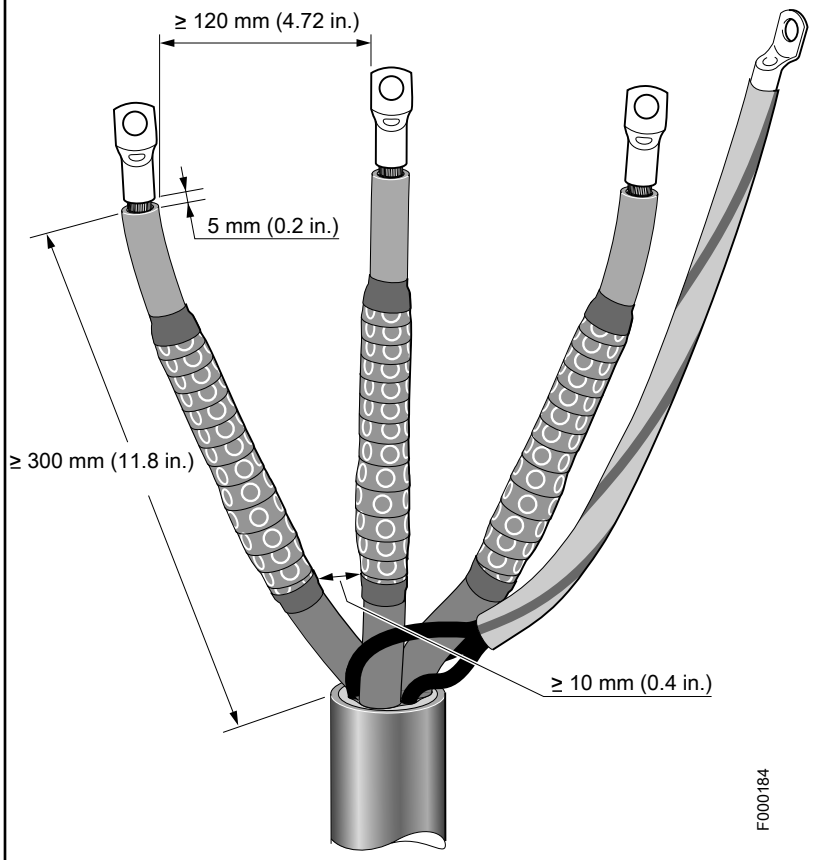
7. Fasten the IV tape ends with electrical tape.



8. Fasten the connection shoes and connection eyes to the leads.



Example of cable end at electrical panel:



Dimensions shown are the recommended distances.

Connect the coolant

This instruction is for connecting the cooling system to the pump.

Connect the integrated cooling system

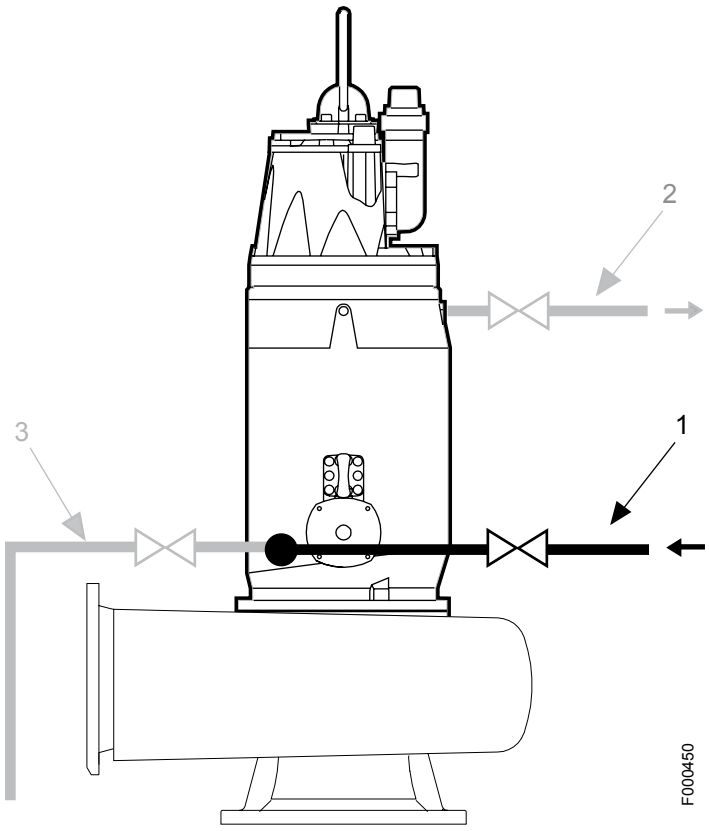
This instruction is for connecting a drainage pipe to the bottom of the cooling jacket for pumps using integrated cooling. The pumped fluid is used as coolant in these systems. Coolant supply (inlet) and return (outlet) lines do not have to be connected when integrated cooling is used.

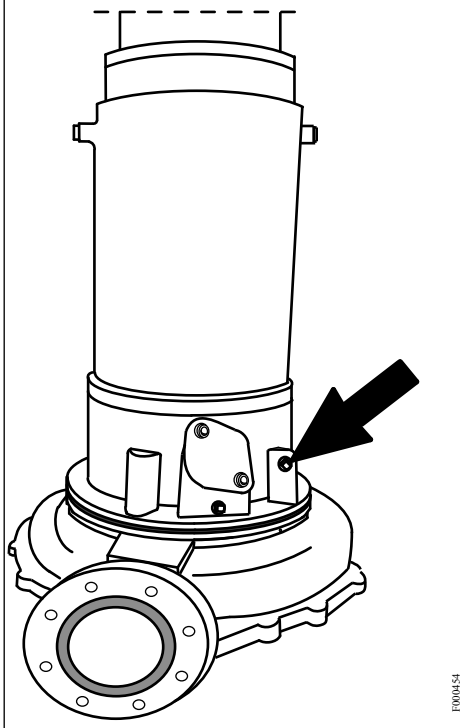
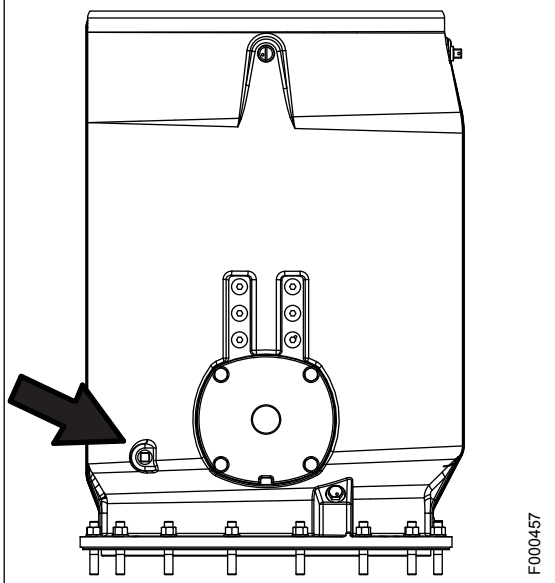
Connect the fittings to drain the coolant as shown in *Fittings needed to drain cooling jacket* (page 38).

Connect the external cooling system

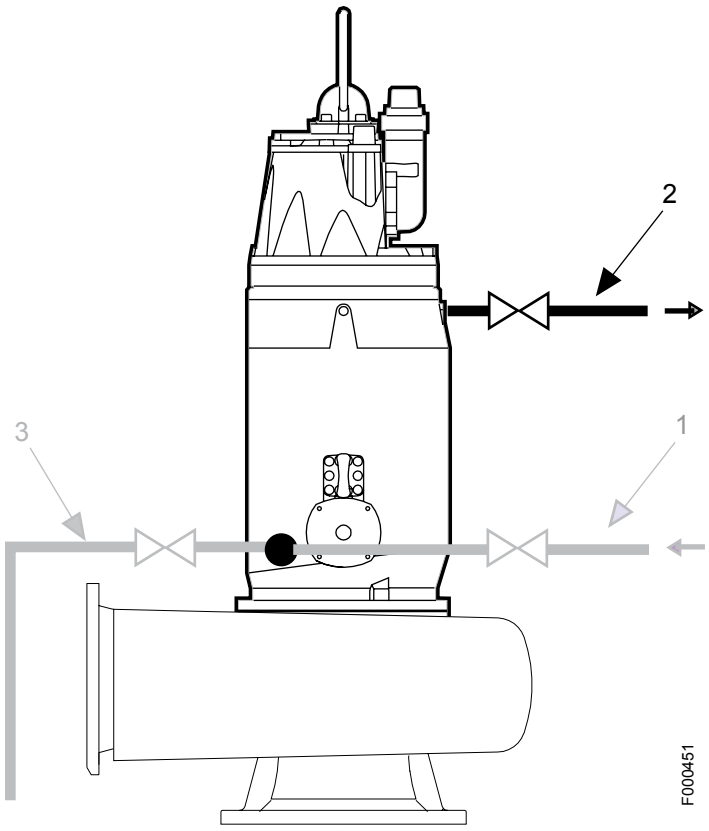
This instruction is for connecting external cooling systems to the pump.

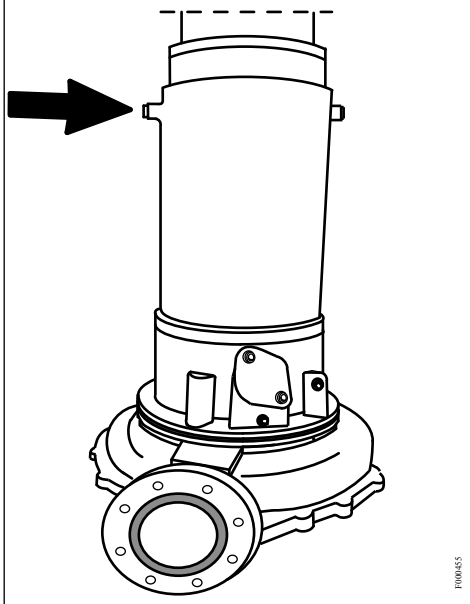
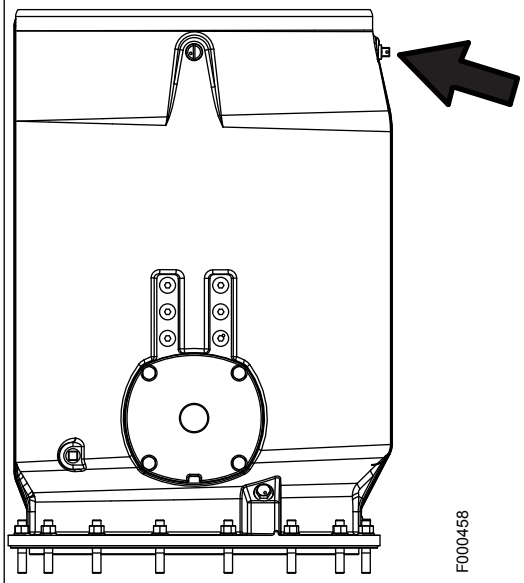
1. Connect the coolant supply line to the pump inlet.


2
3
1
F000450

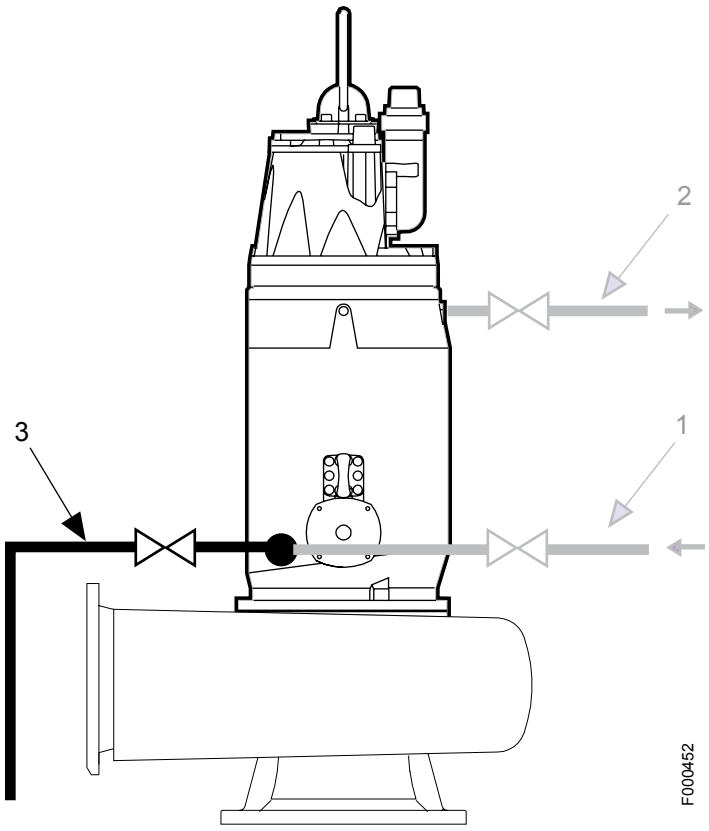
Drive units	Connection port
• 605, 615 • 665, 675	
• 705, 715 • 735, 745 • 765, 775 • 805, 815 • 835, 845 • 862, 872 • 865, 875 • 882, 892 • 885, 895 • 905, 915 • 935, 945 • 950, 960 • 965, 975 • 985, 995	

2. Connect the coolant return line to the outlet on the pump.


2
3
1
F000451

Drive units	Connection port
• 605, 615 • 665, 675	
• 705, 715 • 735, 745 • 765, 775 • 805, 815 • 835, 845 • 862, 872 • 865, 875 • 882, 892 • 885, 895 • 905, 915 • 935, 945 • 950, 960 • 965, 975 • 985, 995	

3. Connect the fittings to drain the coolant, see *Fittings needed to drain cooling jacket* (page 38).



Connect the seal flushing

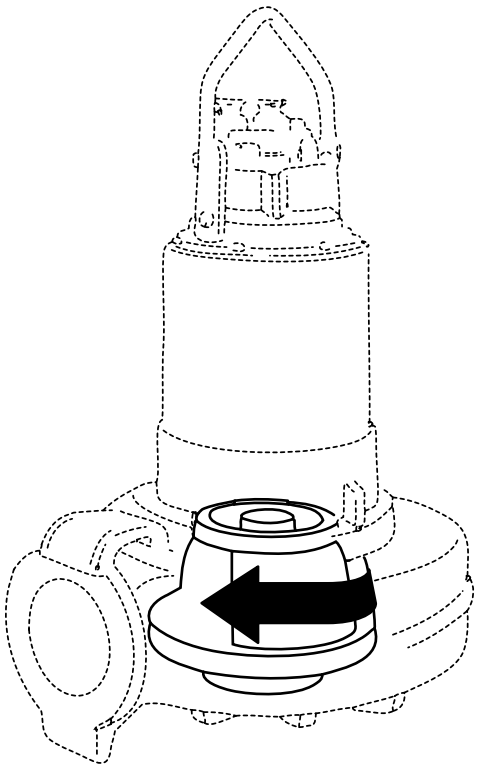
This instruction is for connecting the seal flushing water to the pump, in applications where seal flushing is used.

1. Check that the supply of incoming seal flushing water has been arranged as shown in *Circuit diagram for seal flushing* (page 41).
2. Connect the seal flushing supply water to the pump.
   See *Connections for seal flushing* (page 43).

Check the impeller rotation

WARNING:
The starting jerk can be powerful.

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



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

4. If the impeller/propeller rotates in the wrong direction, check that the phase leads are correctly connected. See *Power cable phase sequence* (page 51).

   After re-connecting phase leads, do this procedure again.

Operation

Precautions

- Never operate the pump without safety devices installed.
- Never operate the pump with the discharge valve closed.
- Make sure that all safety guards are in place and secure.
- Make sure you have a clear path of retreat.
- Never work alone.
- Beware of the risk of a sudden start if the product is used with an automatic level control and/or internal contactor.

Noise level

In certain installations and at certain operating points on the pump performance curve, the noise level can be greater than 70 dB.

Pumps with power output greater than 30 kW, as shown in the diagram below, may have a noise level between 70 dB and maximum 85 dB at the best efficiency point.

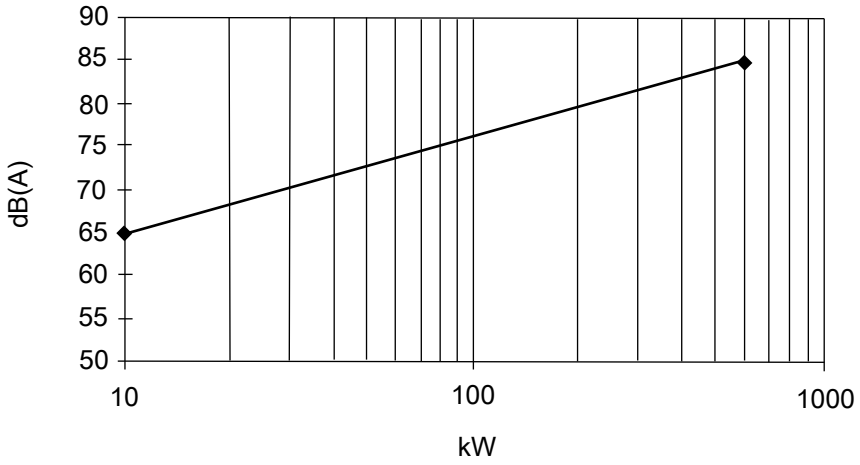


Figure 41: Sound pressure

Start the pump

WARNING:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- Make sure nobody is close to the pump when it is started. The pump will jerk in the opposite direction of the impeller rotation.

1. Check that:
   a) The monitoring equipment works.
   b) The starter equipment is installed according to the manufacturer's instructions.
   c) All the alarms are functioning.
   d) The oil is at the correct level in the oil housing.
2. Remove the fuses or open the circuit breaker, and check that the impeller can be rotated freely.
   Make sure the locking device has been removed. See *The locking device* (page 45).
   Make sure that the propeller rotates in the correct direction. See *Check the impeller rotation* (page 77).
3. Conduct insulation test phase to ground. To pass, value must exceed 5 Megohms.
4. Start the pump.

Check that:

- the machine is working without noise or vibration.
- all electrical values are correct.
- all accessories are working properly.

Note any abnormalities.

Modifications for freezing conditions

If the pump is installed in such a way that it can be exposed to temperatures at or below the freezing point (that is, the pump is not totally submerged), then special modifications must be made to the pump and the installation.

For more information please contact your ITT representative.

Maintenance

Precautions

WARNING:

- Always follow safety guidelines when working on the pump. See *Introduction and Safety* (page 5).
- If you need to work on the pump, make sure that it is isolated from the power supply and cannot be energized.

WARNING:

- Check that local safety regulations are followed.
- Check the guard rails, covers, and other protections.
- Rinse the pump thoroughly with clean water before working on the pump.
- Rinse the components in water after dismantling.
- Make sure that the pump cannot roll or fall over and injure people or damage property.
- In some installations, the pump and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.
- Make sure nobody is close to the pump when it is started. The pump will jerk in the opposite direction of the impeller rotation.

The following requirements apply:

- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.
- Never work alone.
- Check the explosion risk before starting work.
- Allow all system and pump components to cool before you handle them.
- 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.
- Depressurize and empty the coolant system for T and Z installations, and all installations with external cooling.
- Make sure electrical power is disconnected, locked and tagged.

Service

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

Every time the site is visited, visually inspect the accessories and sump for corrosion, wear or damage.

Table 19: Service intervals

Type of service	Purpose	Interval
Inspection	To prevent operational interruptions and machine breakdown. Measures to secure performance and pump efficiency are defined and decided for each individual application. It can include such things as impeller trimming, wear part control and replacement, control of zinc-anodes and control of the stator.	12,000 hours or 3 years, whichever comes first. Applies to normal applications and operating conditions at media (liquid) temperatures < 40°C (104°F).

Type of service	Purpose	Interval
Major overhaul	To secure a long operating lifetime for the product. It includes replacement of key components and the measures taken during an inspection.	24,000 hours or 6 years, whichever comes first. 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).

Inspection

CAUTION:

The inside may be pressurized. Be careful when opening the inspection covers.

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

Do the following to service the pump:

Part to service	Action
Pump casing	Check the entire pump and the cables for external mechanical damage.
Cable	1. If the outer jacket is damaged, replace the cable. 2. Check that the cables do not have any sharp bends and are not pinched. 3. Check that the leads and cable entry screws are correctly connected and tightened to the correct torque.
Lifting handle	Check the lifting handle for corrosion or other damage.
Junction box	1. General: Check that it is clean and dry. If it is wet: a. Check the cable entry. b. Replace the O-rings. (New O-rings should be fitted to all O-ring seal joints opened during inspection.) 2. Terminal board: Check that the connections are properly tightened.
Junction box insulation, drive units up to 1.1 kV	Check the condition and function. See *Check the junction box insulation, up to 1.1 kV drives* (page 84).
Junction box insulation, drive units 1.2 - 6.6 kV	Check the condition and function. See *Check the junction box insulation, 1.2-6.6 kV drives* (page 84).
Stator housing	1. Check that it is clean and dry: • If there is oil in the stator housing, drain and clean. After one week of operation, check again. If there is still oil in the stator housing, change the seals. • If there is water in the stator housing and there was water in the oil, change the seals immediately. • If there is water in the stator housing, but there was no water in the oil, check all other connections. 2. Replace the O-rings.

Part to service	Action
Oil housing	1. Check the oil quality: • If there is water in the oil, drain the oil and replace with new oil. After one week of operation, check the oil quality again. • If the oil is free from water, fill oil to the correct level, if necessary. 2. Replace the filling plug O-rings.
Hydraulic parts	1. Check the general condition of the impeller/propeller and the wear ring. 2. Replace if necessary. 3. If applicable, check the O-ring.
Zinc anodes	Check and change if necessary.
Screw joints	Check all externally accessible screw joints, and tighten if necessary to correct torque. See *Torque values* (page 101).
Electrical cabinets	Check that they are clean and dry.
Connection to power	Check that the connections are properly tightened.
Level regulators	Check the condition and function. See *Check the leakage sensors* (page 85).
Temperature sensors	Check the condition and function. See *Check the temperature sensors* (page 84).

After any service involving the power connections, you must always check the rotation before operating the pump. See *Check the impeller rotation* (page 77).

Major overhaul

1. Perform a complete inspection service. See *Inspection* (page 82).
2. Do these additional steps:

Part to service	Action
Isolation check, drive units up to 1.1 kV	Check that the resistance between earth and phase lead is more than 5 MΩ.
Isolation check, 1.2 – 6.6 kV drive units	1. Check that the resistance between earth and phase lead is above the minimum for the motor voltage. Recommended test voltage: 500 V DC (max. 1000 V DC). The resistance value is related to motor voltage and should have minimum value of 5 MΩ/kV at a temperature of 25°C (77°F). For example, for a 6 kV motor the resistance between earth and phase lead should be more than 30 MΩ.
Cable	Check that the rubber sheathing (jacket) is undamaged. Change if necessary.
Oil housing	Change the oil.
General dismantling and cleaning	1. Dismantle the pump completely. 2. Clean all the parts. 3. Re-assemble after replacing bearings, O-rings and seals.
Bearings	Replace the bearings with new bearings.
O-rings and other rubber sealing parts	Replace O-rings and other rubber sealing parts.
Seals	Replace with new seals.
Sensors	Check the following: 1. Stator temperature sensors. 2. Bearing temperature sensors. 3. FLS and CLS sensors. See *Check the temperature sensors* (page 84) and *Check the leakage sensors* (page 85).

Part to service	Action
Impeller/propeller	Check the general status of the impeller/propeller and wear ring. Change if necessary.
Zinc anodes	Check their condition. Replace if necessary.
Screw joints	Check all externally accessible screw joints and tighten if necessary to correct torque. See torque table and Parts List.
Lifting handle	Check its condition. Replace if necessary.
Painting	Touch up any painting if necessary.
Rotational direction	Check impeller/propeller rotation direction. See *Check the impeller rotation* (page 77).
Voltage and amperage	Check the running values.
Electrical cabinets/ panels	Check that they are clean and dry.
Connection to power	Check the cable connections. Tighten if necessary.
Overload and other protections	Check settings
Level regulators	Check condition and function.

After any service involving the power connections, you must check the rotation before operating the pump. See *Check the impeller rotation* (page 77).

Check the junction box insulation, up to 1.1 kV drives

1. Check that the resistance between the earth (ground) and phase lead is more than 5 megohms.

   Use a 1000 V DC megger.

   The resistance should preferably be more than 50 MΩ.
2. Keep a record of the results.

Check the junction box insulation, 1.2-6.6 kV drives

1. Check that the resistance value is a minimum of 5 megohms/kV at a temperature of 25°C (77°F).

   Use a 1000 V DC megger. Recommended test voltage: 500 V DC, max. 1000 V DC.

   The resistance should preferably be more than 300 megohms.

   The resistance value is related to the motor voltage. For example, with a 6 kV motor, the resistance between earth (ground) and phase lead should be more than 30 megohms.
2. Keep a record of the results.

Check the temperature sensors

If the pump is connected to the MAS monitoring system, then it is recommended that the sensors be checked in the MAS unit. Otherwise, use a multimeter.

The different types of temperature sensors are:

- Thermal switches
- PTC-thermistors
- Pt100

NOTICE: Do not use a megger or other device applying a higher voltage than 2.5 V.

1. Disconnect the sensor wires.

2. Measure the resistance to check the status of the sensor and wiring according to the values in *Sensors* (page 27).
3. Measure between each sensor lead to earth (ground) to establish that the resistance is infinite (or at least several Megaohm).

Check the leakage sensors

If the pump is connected to the MAS monitoring system, then it is recommended that the sensors be checked in the MAS unit. Otherwise, use a multimeter.

1. Check the float switch (FLS) in the stator housing, according to the values in *Sensors* (page 27).

   Measure ohms by using a multimeter to establish either of the conditions below (or both if the sensor is accessible).
2. Check the float switch (FLS) in the junction box (connection housing).
3. Check the water-in-oil sensor (CLS) in the oil housing:
   a) Connect the CLS to a 12 V DC supply.

      The sensor must have the correct polarity in order to be checked. However, it will not be damaged if plus and minus are switched.
   b) Use a multimeter as an ammeter, and connect it in series with the sensor.
   c) If the sensor is accessible, check: the alarm function by gripping the sensor in your hand.

      Skin and blood tissue contain a high content of water.

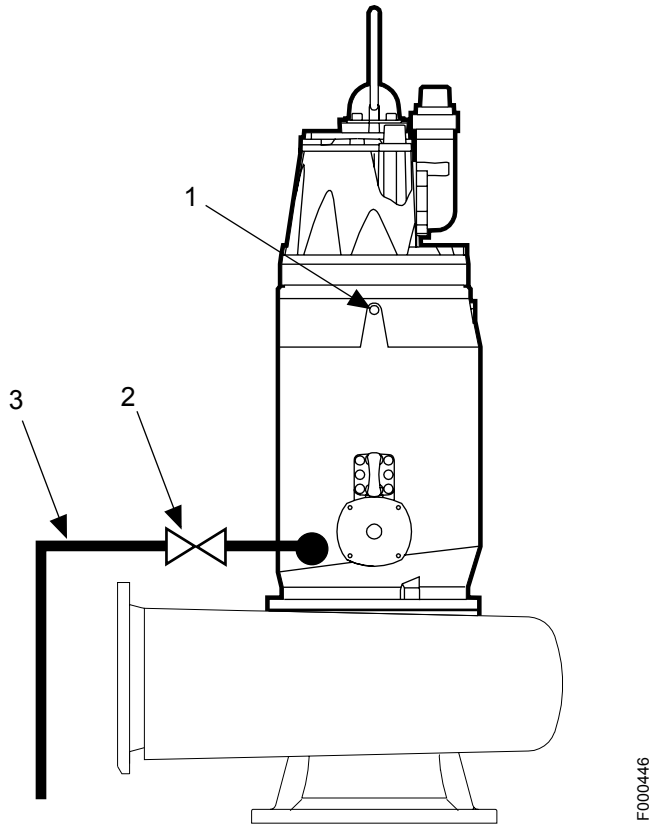
   For interpretation of the CLS measurement results, see *Sensors* (page 27).

Empty the coolant (integrated cooling)

WARNING:

The cooling jacket must be drained before service.

1. Remove the vent plug marked “1” in the figure below.
2. Depressurize the cooling system by opening the stop-cock marked “2” in the figure below (if applicable).
3. Remove the coolant filling plug and empty the coolant through the drainage pipe, marked “3” in the figure below.
4. After you empty the cooling jacket on P and S installations, run the pump run dry for no more than 30 seconds to expel all water from the impeller area.



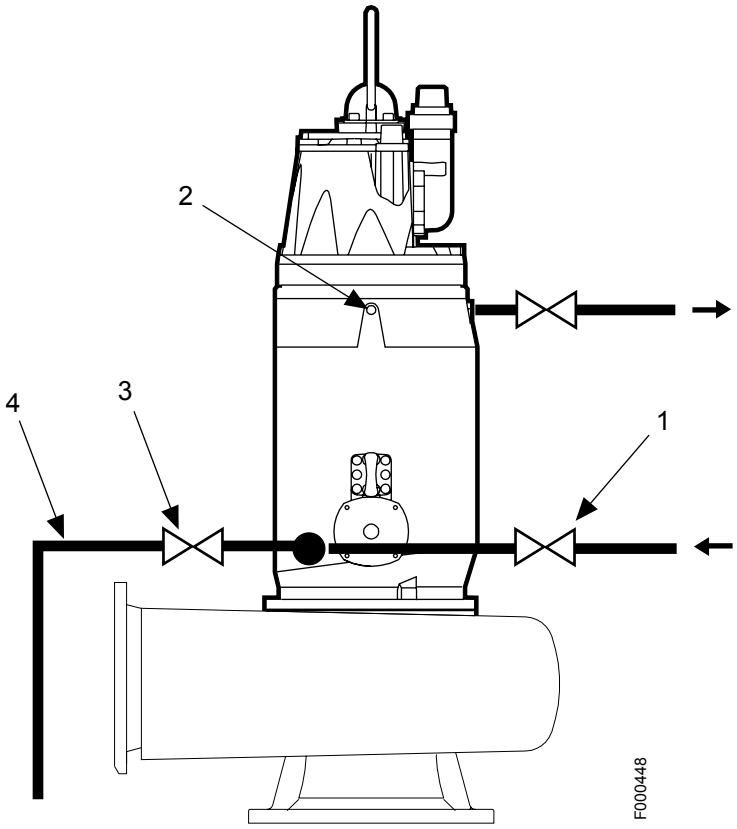
1. Vent plug
2. Stop-cock
3. Drainage pipe

Figure 42: T and Z installations with integrated cooling

Empty the coolant (external cooling)

WARNING: Failure to drain the cooling jacket before service may cause injury.

1. Turn off the supply of coolant to the pump, see "1" in the figure below.
2. Remove the vent plug marked "2" in the figure below.
3. Depressurize the cooling system by opening the stop-cock marked "3" in the figure below (if applicable).
4. Remove the coolant filling plug and empty the coolant through the drainage pipe, marked "4" in the figure below.
5. After you empty the cooling jacket on P and S installations, run the pump dry for no more than 30 seconds to expel all water from the impeller area.



1. Coolant inlet
2. Vent plug
3. Stop-cock
4. Drainage pipe

Figure 43: P, S, and T installations with external cooling

Oil change

The pump is delivered with a tasteless, odorless, medical white oil of paraffin type that fulfills FDA 172.878.

The replacement oil must have a viscosity class of ISO VG 15–35. Examples of suitable oil types are the following:

- Mobile Whiterex
- Shell Ondina

The amount of oil required is given below.

Table 20: Pumps with cooling jacket

Drive unit	Volume of oil
6X5	4.5 liters (4.7 US quarts)
7X5	5.5 liters (5.8 quarts)
8X5	11 liters (11.6 US quarts)
9X5	9 liters (9.5 US quarts)

Table 21: Pumps without cooling jacket

Drive unit	Hydraulic unit	Volume of oil
6X5, 7X5	C3300, C3231, C3306, C3356	5.2 liters (5.5 quarts)
7X5, 8X5	C3240, C3312, C3400	11.5 liters (12.1 quarts)
8X5	C3501, C3531, C3602	8.4 liters (8.9 quarts)
9X5	C3351, C3531, C3602, C3800	9 liters (9.5 quarts)

Empty the oil

1. Unscrew the oil plugs.

WARNING:
The oil housing may be pressurized. Hold a rag over the oil plug to prevent oil from spraying out.

2. Pump out the oil.
   Use oil drainage pump 83 95 42. Make sure that the plastic tube goes all the way to the bottom of the oil housing.

Fill with oil

1. Fill the housing with new oil.
   Make sure that the oil reaches the oil holes when standing vertically.
2. Insert and tighten plugs with the new O-rings and plugs.
   Tightening torque: 80 Nm (60 ft-lbs)

3. Check the paint; if damaged, repaint.

Horizontal lifting

Two sets of lifting equipment must be used to lift the pump for repair work.

The drive unit must never be placed on the shaft unit or the impeller/propeller. Damage to the impeller/propeller, seals or bearings can result from placing the drive unit on the impeller/propeller or shaft.

Use the following method to lift the pump in the horizontal position.

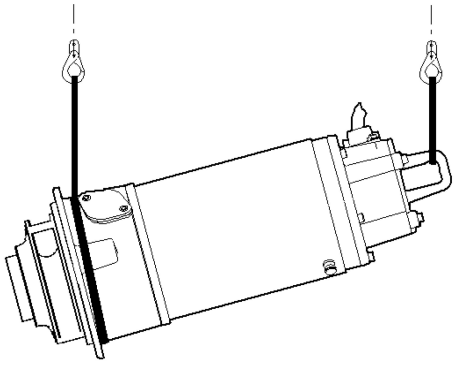


Figure 44: Drive units 605–775

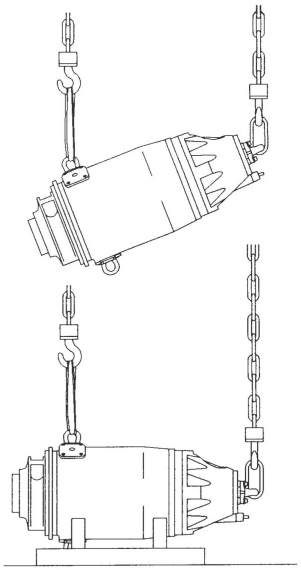


Figure 45: Drive units 805–995

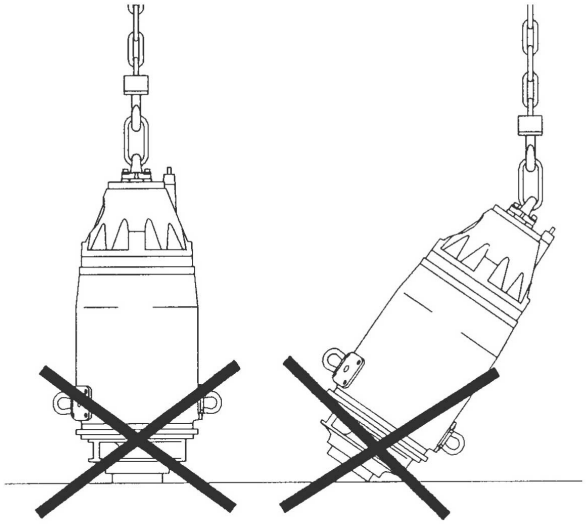


Figure 46: Incorrect lifting method

Replace the wear parts

When the clearance between the impeller skirt and the pump housing wear ring exceeds 2 mm (0.08 in.) one or more of the following replacements must be made.

Replace the pump housing wear ring

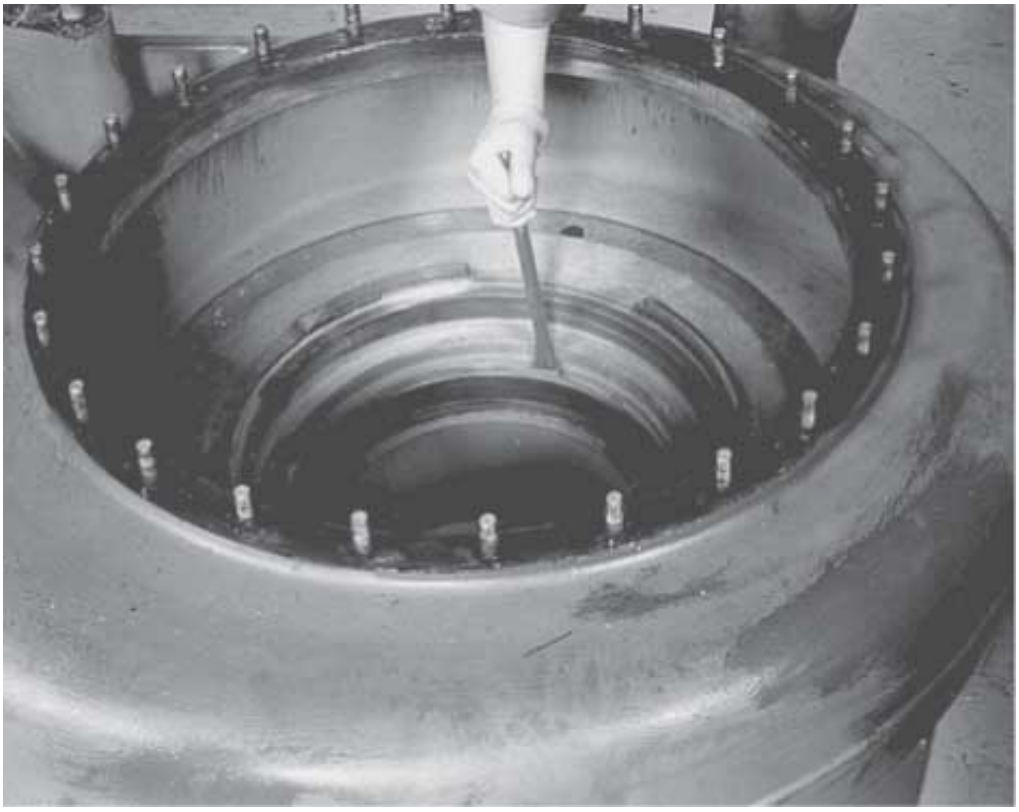
If the wear ring is made of brass this procedure will be easier if the suction cover is first heated, and/or the wear ring is cooled down.

1. Disconnect and lift off the drive unit with pump housing from the suction cover.
2. Lay the drive unit in a horizontal position.

WARNING:

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

3. Remove the wear ring by using a crow bar.



4. Drive in the new wear ring.
   To prevent deformation, use a maul and a wooden block.

Replace the impeller wear ring

1. Disconnect and lift off the drive unit from the pump housing.
2. Lay the drive unit in a horizontal position.

WARNING:
Make sure that the pump cannot roll or fall over and injure people or damage property.

3. Knock off the wear ring from the impeller.
   If necessary, use a grinder to make grooves in the wear ring.
4. Heat the new wear ring and press it onto the impeller.

Replace the impeller

Before you replace the impeller, you must drain the oil in the oil housing. See applicable steps in *Empty the oil* (page 88).

When replacing the impeller, the mechanical face seal should be replaced to ensure maximum sealing properties. Use an ITT new or factory reconditioned mechanical face seal unit. This work requires special tools and should be carried out by a service technician authorized by ITT.

Remove the impeller

WARNING:

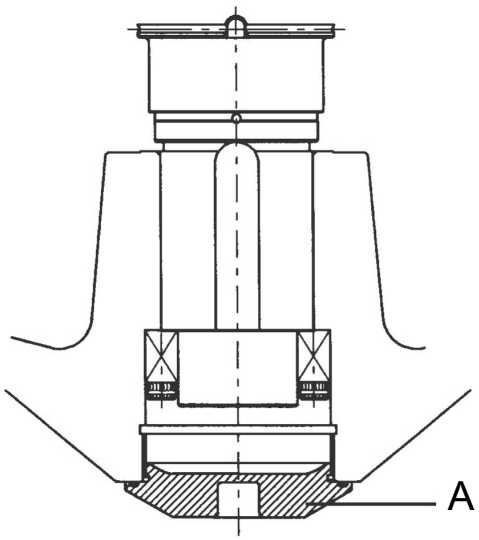
A worn impeller and/or pump housing can have very sharp edges. Wear protective gloves.

1. For all pumps except C3300/6x5 HT, complete these steps:
   a) Disconnect and lift off the drive unit from the pump housing.
   b) Lay the drive unit in a horizontal position.
      Make sure it cannot roll.

WARNING:

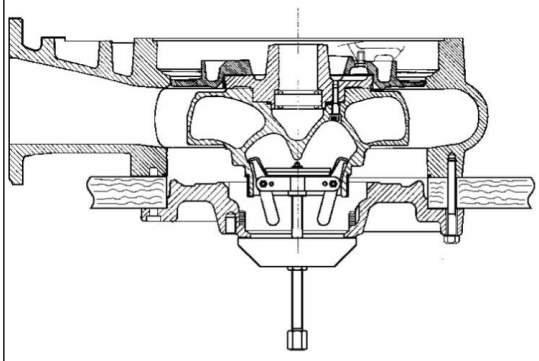
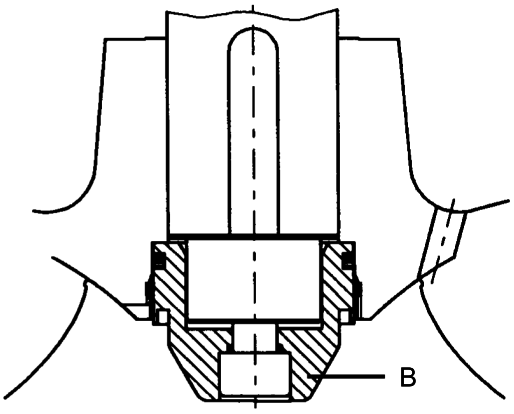
Make sure that the pump cannot roll or fall over and injure people or damage property.

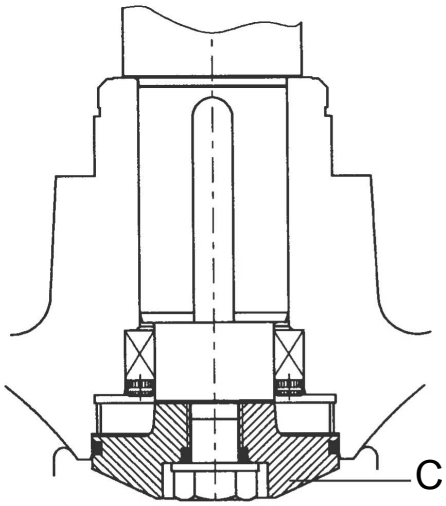
2. Depending on which pump model you have, do one of the following:

Pump	Action
C3300/6x5 LT and MT	Remove the centre screw in the impeller-sealing washer. The locking assembly is now accessible for removal.
C3231, C3306, or C3356	Remove the impeller-sealing washer (A) using the Allen key hole in the washer. (The washer is threaded into the impeller hub.) Use a 19 mm Allen key.  The locking assembly is now accessible for removal.

<table>
<tr><th>Pump</th><th>Action</th></tr>
<tr><td>C3300/6x5 HT</td><td>Make sure that the pump housing is still connected to the drive unit. The impeller for this version is fitted to a hub with two screws.
1. Lay the pump on its side.

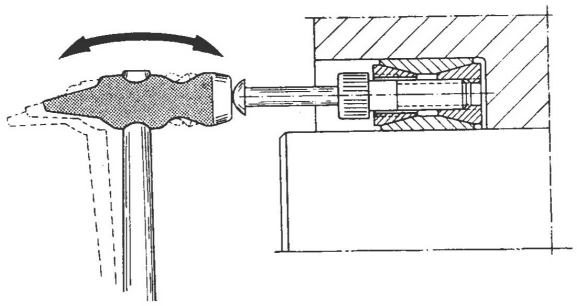
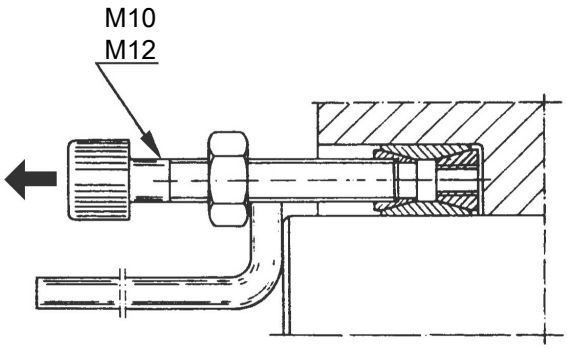
WARNING:
Make sure that the pump cannot roll or fall over and injure people or damage property.

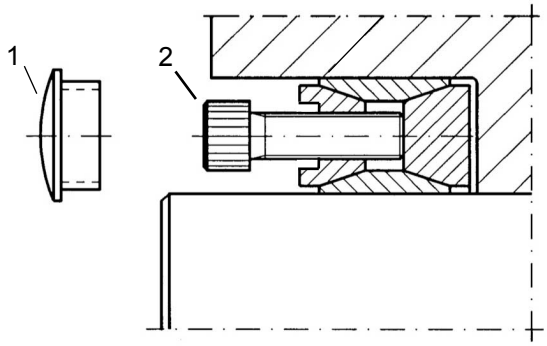
2. Remove the screws for the suction cover and replace three of the screws with the longer screw 813963 (M16 x 160).
3. Push out the suction cover and place a distance block between the pump housing and the suction cover.
Minimum distance = 30 mm (1.18 in).
4. Remove the two screws for the impeller.
5. Apply the puller unit 4917400 according to the illustration and pull off the impeller.
Remove the suction cover and the impeller.
6. Disconnect and lift off the drive unit from the pump housing.
 
The locking assembly is now accessible for removal.</td></tr>
<tr><td>R3231</td><td>Remove the sealing washer unit (B). Use a 17 mm Allen key for removal. Since this version has no locking assembly, you can now remove the impeller.
  </td></tr>
</table>

Pump	Action
C3240, C3312, C3351, C3400, C3501, C3531, C3602 or C3800	Remove the impeller screw. Insert the puller screw 576 84 00 in the thread of the impeller-sealing washer (C) to remove the washer.   **Figure 47: C3240, C3312, C3351, C3400, C3501, C3531, C3602 or C3800** The locking assembly is now accessible for removal.

Remove the locking assembly

1. Remove the locking assembly:

Locking assembly:	Action:
• 84 59 12 • 84 59 13 • 84 59 14 • 84 59 17	1. Loosen the screws on the locking assembly evenly and in sequence. See *Sequence for tightening or loosening locking assembly bolts* (page 99). If the locking assembly is still locked, do as follows: a. Loosen the inner ring by tapping it lightly, as shown in the illustration.  b. If tapping did not loosen the ring, replace the three "light-colored" screws with three M10 draw-bolts (for 84 59 12 and 84 59 13) or M12 draw-bolts (for 84 59 14 and 84 59 17).  2. Remove the locking assembly.

Locking assembly:	Action:
• 84 60 11	1. Remove the four plastic plugs (labelled “1” in figure below) covering the threaded holes for the special separation screws.  2. Loosen the inner ring by means of four locking assembly screws (M14) as separation screws (labelled “2” in figure above). See illustration below.  3. Remove the locking assembly.

2. Pull off the impeller:
   a) Fit the tools required for impeller removal according to the tool list for the appropriate pump. See *Tools* (page 102).
   b) Pull off the impeller.

      Use the hydraulic unit with the partially threaded screw in the Basic kits for removal (or screw unit 602 31 00 for C3800).

Install the impeller

When installing a stainless steel impeller onto a stainless steel shaft, the shaft end should be greased with National Chemsearch THREAD-EZE. Make sure that no grease is on the contact surfaces of the locking assembly.

1. Make sure that the end of the shaft is clean and free of burrs.

   Polish off any flaws with fine emery cloth.
2. Grease the end of the shaft and the impeller hub.
3. Depending on which pump model you have, do the following:

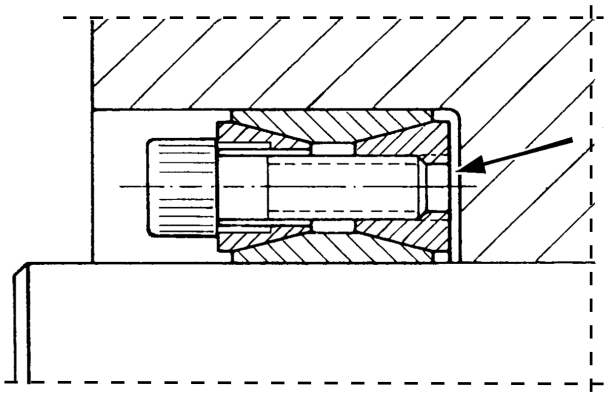
If you have pump...	Then...
• C3300/6X5	1. Place the impeller and impeller hub on the shaft and press it onto the shaft with the impeller screw. For C3300/6x5 HT, press the hub onto the shaft. 2. Go on to *Install the locking assembly* (page 97).
• Other C-pump	1. Place the impeller on the shaft and fit the hydraulic tool with the M16 screw. 2. Use the appropriate washer to press the impeller in place. 3. Remove the hydraulic tool. 4. Go on to *Install the locking assembly* (page 97).

Install the locking assembly

1. Fit the locking assembly in place:

   a) Apply a thin layer of grease at the surface indicated by the arrow in the illustration below.

   Do not use oil containing molybdenum disulphide (MoS_2).



b) Fit the locking assembly (well-oiled) in the impeller hub without tightening any screws.

2. For C3300/6X5, tighten the screws manually in three stages.

   Tighten using the sequence that is shown in *Sequence for tightening or loosening locking assembly bolts* (page 99), until the locking assembly keeps the impeller/impeller hub in place.

3. For all pump models except C3300/6X5, fit the impeller:

   a) Place the washer over the locking assembly.

      See *Tools* (page 102) for the washer for the respective pump.

      For the correct position, use an Allen key through one of the slots in the washer and into one of the "light-colored" screws in the locking assembly.

   b) Fit the impeller screw, or the screw unit (with hydraulic tool if applicable), through the center hole in the washer and into the shaft end.

      See *Tools* (page 102) for the screw/screw unit for the respective pump.

   c) Tighten the centre screw so that the washer keeps the locking assembly and the impeller in place.

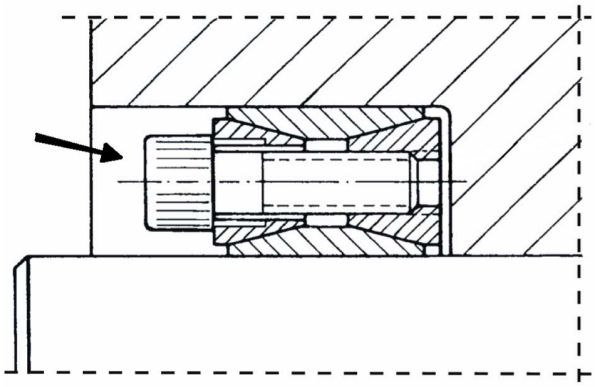
   d) When the impeller is firmly seated, slightly tighten the three "light-colored" screws in the locking assembly through the slots in the washer.

      This keeps the impeller in place against the shaft shoulder.

e) Remove the center screw and the washer.

4. Tighten the locking assembly screws evenly in three stages, following the sequence and tightening torques given in *Sequence for tightening or loosening locking assembly bolts* (page 99).
5. Fill the space with grease, allowing space for the sealing washer.

   The space to be filled with grease is indicated by the arrow in the illustration below.



6. Fit the impeller sealing washer and tighten the impeller screw.
7. For C3300/6x5 HT: place the impeller onto the impeller hub and tighten the two screws that hold the impeller. Tighten to the correct torque.

After installing the impeller you must do the following:

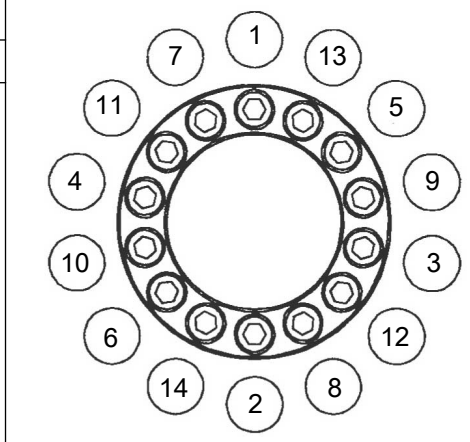
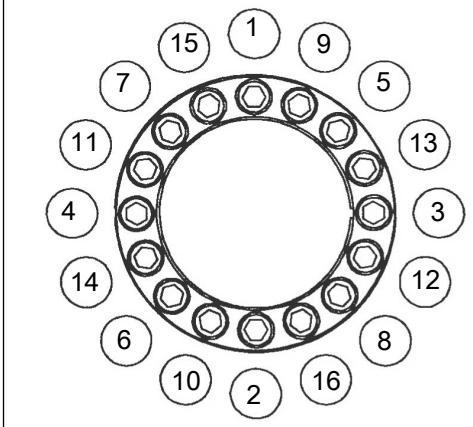
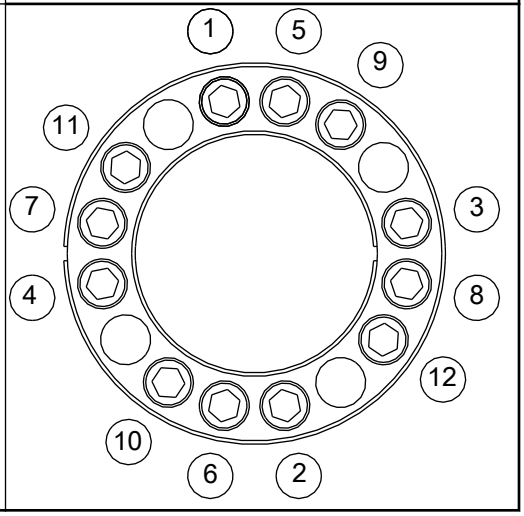
1. Check that the impeller can be rotated by hand.
2. Check the zinc anodes (if applicable) to make sure they are large enough and intact. Replace after approximately 75% consumption.
3. Fit the drive unit to the pump housing. Make sure that the pump housing has the correct orientation. Remember the O-ring between the pump housing and the drive unit.

More extensive repairs require special tools and should be carried out by a service technician authorized by ITT.

Sequence for tightening or loosening locking assembly bolts

Bolt sequence

The following illustrations show the sequence used for tightening or loosening the impeller locking assembly bolts.

Locking assembly	Shaft end diameter, mm	Sequence for tightening or loosening bolts
84 59 12	70	
84 59 13	75	
84 59 14	90	
84 59 17 C3351, C3531, C3602 with drive units 905–960	110	
84 60 11 C3351, C3531, C3602 with drive units 965–995; and C3800	110	

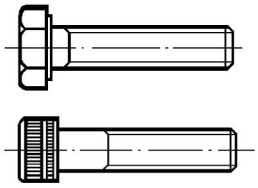
Tightening torques

The table below gives the torque which should be used in each stage of the bolt-tightening process.

Locking assembly	Shaft end diameter, mm	Torque for tightening bolts
84 59 12	70	• Stage 1: 12 Nm (8.8 ft-lbs) • Stage 2: 24 Nm (18 ft-lbs) • Stage 3: 35 Nm (26 ft-lbs)
84 59 13	75	
84 59 14	90	• Stage 1: 24 Nm (18 ft-lbs) • Stage 2: 48 Nm (35 ft-lbs) • Stage 3: 70 Nm (52 ft-lbs)
84 59 17 (C3351, C3531, C3602 with drive units 905–960)	110	• Stage 1: 24 Nm (18 ft-lbs) • Stage 2: 48 Nm (35 ft-lbs) • Stage 3: 70 Nm (52 ft-lbs)
84 60 11 (C3351, C3531, C3602 with drive units 965–995; and C3800)	110	• Stage 1: 70 Nm (52 ft-lbs) • Stage 2: 154 Nm (113 ft-lbs) • Stage 3: 230 Nm (170 ft-lbs)

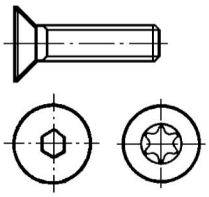
Torque values

Screws and nuts



	Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
Stainless steel, A2 and A4, torque Nm (ft-lbs)	70 +80[5]	2.7 (2)	5.4 (4)	9.3 (6.9)	22 (16)	44 (32)	76 (56)	187 (138)	364 (268)	629 (464)	1240 (915)
Carbon steel and alloyed steel, torque Nm (ft-lbs)	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)
	10.9	4.0 (2.9)	8.1 (6)	14 (10.3)	33 (24.3)	65 (48)	114 (84)	277 (204)	541 (399)	935 (689)	1840 (1357)
	12.9	4.9 (3.6)	9.7 (7.2)	17 (12.5)	40 (30)	79 (58)	136 (100)	333 (245)	649 (480)	1120 (825)	2210 (1630)

Screws with countersunk heads



[5] Property class 70 is torque tightened as class 80.

	Property class	M4	M5	M6	M8	M10	M12	M16	M20	M24
Stainless steel, A2 and A4, torque Nm (ft-lbs)	70 +80[5]	1.2 (0.9)	2.7 (2)	5.4 (4)	9.3 (6.9)	22 (16)	44 (32)	76 (56)	120 (88)	187 (138)
Carbon steel and alloyed steel, torque Nm (ft-lbs)	8.8	2.3 (1.7)	4.6 (3.4)	7.8 (5.8)	19 (14)	38 (28)	65 (48)	158 (116)	308 (228)	532 (392)
	10.9	3.2 (2.4)	6.5 (4.8)	11(8)	26 (19)	52 (38)	91 (67)	222 (164)	433 (320)	748 (552)
	12.9	3.9 (2.9)	7.8 (5.8)	14 (10.3)	32 (23.6)	63 (46)	109 (80)	266 (196)	519 (383)	896 (661)

Tools

Service guide

The service guide is a search engine for pump part numbers and spare parts. The service guide is available at www.itt.com. For a valid password, contact flygtpumpar@flygt.com.

Tools

Beside ordinary tools, the following tools are required in order to preform the necessary maintenance of the pump.

Part no	Denomination	Range of use
83 95 42	Oil drainage pumps	Drainage pumps for emptying oil housing
84 13 68	Hydraulic unit	

Table 22: R3231

Part no	Denomination	Range of use
436 19 00	Basic kit II	
436 74 00	Impeller tool	

Table 23: C3300/6X5 LT

Part no	Denomination	Range of use
84 20 49	Puller	
479 23 00	Extension	
479 25 00	Washer	

Table 24: C3300/6X5 MT

Part no	Denomination	Range of use
400 54 03	Dismount./lifting tool (for imp. x41, x42)	
400 54 05	Dismount./lifting tool (for imp. x32)	

Table 25: C3300/6X5 HT

Part no	Denomination	Range of use
81 39 63	Screw (3 pcs)	
491 74 00	Puller unit	

Table 26: C3231, C3306, C3356

Part no	Denomination	Range of use
432 43 00	Washer (included in basic kit II)	
436 19 00	Basic kit II	
436 74 00	Impeller tool	
582 65 00	Stand unit	
588 92 00	Washer unit	Mounting the locking assembly

Table 27: C3240, C3312, C3400, C3501

Part no	Denomination	Range of use
332 91 00	Stop spring removing tool	
399 41 00	Mounting tool set (for shaft with Ø 75 and 90 mm)	Mounting the seal
576 83 01	Washer (for shaft with Ø 75 mm, 7X5 units)	Mounting the locking assembly
576 83 02	Washer (for shaft with Ø 90 mm, 8X5 units)	Mounting the locking assembly
576 84 00	Puller screw	
584 81 00	Washer	
587 72 00	Impeller tool (for shaft with Ø 75 and 90 mm)	
587 94 00	Basic kit V	

Table 28: C3351

Part no	Denomination	Range of use
576 83 04	Washer (for shaft Ø110 mm, 905 - 960 drive units)	Mounting the locking assembly
576 84 00	Puller screw	
584 81 00	Washer	
587 73 00	Impeller tool (for shaft Ø110 mm; 905 - 960 drive units)	
587 94 00	Basic kit V	
660 48 00	Impeller tool (for shaft Ø110 mm, 965 - 995 drive units)	Removing the impeller
660 49 00	Impeller tool (for shaft Ø110 mm, 965 - 995 drive units)	Mounting the locking assembly and the impeller

Table 29: C3531, C3602

Part no	Denomination	Range of use
332 91 00	Stop spring removing tool	
399 41 00	Mounting tool unit (for shaft Ø75 and Ø90 mm)	Mounting the seal
576 83 01	Washer (for shaft Ø75, 7X5 drive units)	Mounting the locking assembly
576 83 02	Washer (for shaft Ø90 mm, (for 8X5, 905, 915 drive units)	Mounting the locking assembly
576 83 03	Washer (for shaft Ø110 mm, for 905 - 960 drive units)	Mounting the locking assembly
576 84 00	Puller screw	
584 81 00	Washer	
587 72 00	Impeller tool (for shaft Ø75 mm, 7X5 drive units and for shaft Ø90 mm, 8X5, and 905, 915 drive units)	
587 73 00	Impeller tool (for shaft Ø110, 905 - 960 drive units)	
587 94 00	Basic kit V	
660 48 00	Impeller tool (for shaft Ø110, 965 - 995 drive units)	Removing the impeller
660 49 00	Impeller tool (for shaft Ø110 , 965 - 995 drive units)	Mounting the locking assembly and the impeller

Table 30: C3800

Part no	Denomination	Range of use
576 84 00	Puller screw	
589 23 00	Screw unit (mounting)	The locking assembly and the impeller

Part no	Denomination	Range of use
602 18 00	Impeller tool	
602 31 00	Screw unit (removal)	
660 49 00	Impeller tool (mounting)	The locking assembly and the impeller

Technical Reference

Product overview

Submersible pump for pumping water and wastewater containing solids or long-fibred material.

Installations

Pump	Installation			
	P	S	T	Z
C3231	X	X	X	X
C3240	X	X	X	X
C3300	X	X	X	X
C3306	X	X	X	X
C3312	X	X	X	X
C3351	X		X	X
C3356	X		X	X
C3400	X		X	X
C3501	X		X	X
C3531	X		X	X
C3602	X		X	X
C3800	X		X	X

Accessories

Mechanical accessories which are available include the following:

- Cable handling systems
- Lifting equipment

Electrical accessories which are available include the following:

- Pump controller
- Control panels
- Starters
- MAS and other monitoring relays

See your ITT representative for further information.

Options

The following options are available:

- Zinc anodes for corrosion protection
- Special coating system (with epoxy base coat) for demanding environments
- Power monitoring
- Monitoring options for temperature, vibration and water in the oil housing

Materials

Impeller

Table 31: C3240, C3300

Material	Flygt material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561:1997 No. JL 1040	ASTM-A 48 – No 35 B

Table 32: C3231, C3306, C3312, C3356, C3400, C3501

Material	Flygt material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561:1997 No. JL 1040	ASTM-A 48 – No 35 B
Stainless steel (duplex)	M0344.2324.12	EN 10283:2010 No. 1.4474	ASTM (CD-4MCuN)

Table 33: C3351, C3531

Material	Flygt material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561:1997 No. JL 1040	ASTM-A 48 – No 35 B
Cast iron (spheroidal graphite)	M0316.0727.02	EN 1563:1997 No. JS 1050 (GJS–500–7)	ASTM-A 536 – No. 80-55-06
Stainless steel (duplex)	M0344.2324.12	EN 10283:2010 No. 1.4474	ASTM (CD-4MCuN)

Table 34: C3602, C3800

Material	Flygt material number	Standard	
		Europe	USA
Cast iron (spheroidal graphite)	M0316.0727.02	EN 1563:1997 No. JS 1050 (GJS–500–7)	ASTM-A 536 – No. 80-55-06
Stainless steel (duplex)	M0344.2324.12	EN 10283:2010 No. 1.4474	ASTM (CD-4MCuN)

Pump housing

Table 35: C3231, C3240, C3300, C3306, C3312, C3351, C3356, C3400, C3800

Available materials	Flygt material number	Standard	
		Europe	USA
Cast iron	M0314.0125.00	EN 1561:1997 No. JL 1040	ASTM-A 48 – No 35 B

Table 36: C3501, C3531

Available materials	Flygt material number	Standard	
		Europe	USA
Cast iron (spheroidal graphite)	M0316.0727.02	EN 1563:1997 No. JS 1050 (GJS–500–7)	ASTM-A 536 – No. 80-55-06

Table 37: C3602

Installation	Available materials	Flygt material number	Standard	
			Europe	USA
CT	Cast iron (spheroidal graphite)	M0316.0727.02	EN 1563:1997 No. JS 1050 (GJS–500–7)	ASTM-A 536 – No. 80-55-06
Other	Cast iron	M0314.0125.00	EN 1561:1997 No. JL 1040	ASTM-A 48 – No 35 B

Mechanical face seals

Seal	Material, rotating ring	Material, stationary ring
Inner	Wolfram Carbide Corrosion Resistant (WCCR)	WCCR
Outer	WCCR	WCCR

Drive unit shaft

Available materials	Flygt material number	Standard	
		Europe	USA
Stainless steel (martensitic)	M0344.2321.03	EN 10088-3:1995 No. 1.4057	ASTM/AISI 431
Stainless steel (austenitic-ferritic)	M0344.2324.02	EN 10088-3:1995 No. 1.4460	ASTM/AISI 329

O-rings

Available materials	Flygt material number	Standard	
		Europe	USA
Nitrile rubber 70º IRH	M0516.2637.04	—	—

Coating system

The following table describes the two variants of paint systems available for the pump, Standard and Special. The choice of coating system depends upon the service environment, see the Flygt standard M0700.00.0001 (Coating Selection Guidelines).

Coating system	Basecoat	Topcoat	Total dry film thickness	Flygt standard
Standard	Acrylic (waterborne) or alkyd (solventborne)	Oxirane ester, 2–pack	200 µm	M0700.00.0004
Special (option)	Epoxy	Oxirane ester, 2–pack	500 µm	M0700.00.0005

Mounting-related data

Depth of immersion

The maximum depth of immersion is 20 m (65 ft.).

Weight

See the dimensional drawing for pump weights.

Cables

Table 38: C3231, C3300, C3306, C3356

SUBCAB®	Maximum voltage 600–1000 V, intended for drive units up to 1.1 kV. To be dimensioned by ITT Water & Wastewater.

Table 39: C3240, C3312, C3351, C3400, C3501, C3531, C3602, C3800

SUBCAB®	Maximum voltage 600–1000 V, intended for drive units up to 1.1 kV. To be dimensioned by ITT Water & Wastewater.
NTSCGEWTOEUS	For use with medium voltage (1.2–6.6 kV) drive units. To be dimensioned by ITT Water & Wastewater.

Engineering data

Performance curves, motor data and dimensional drawings are available from your ITT representative.

Impeller throughlet

Pump	Throughlet	
	mm	in.
C3231	88 / 102	3.46 / 4.02
C3240	78	3.07
C3300	See the dimensional drawing.	
C3306	104	4.09
C3312	102	4.02
C3351	110	4.33
C3356	102	4.02
C3400	110	4.33
C3501	110	4.33
C3531	105	4.13
C3602	126	4.96
C3800	144	5.67

Drive units

C3231

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3240

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3300

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15

C3306

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3312

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3351

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	905	915	6
	935	945	6
	965	975	6
1.2-6.6 kV	950	960	6
	985	995	6

C3356

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	605	615	15
	665	675	15
	705	715	15
	735	745	15
	765	775	15

C3400

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3501

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
1.2-6.6 kV	862	872	15
	882	892	8

C3531

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	705	715	15
	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
	905	915	8
	935	945	8
	965	975	8
1.2-6.6 kV	862	872	15
	882	892	8
	950	960	8
	985	995	8

C3602

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	735	745	15
	765	775	15
	805	815	15
	835	845	15
	865	875	15
	885	895	8
	905	915	8
	935	945	8
1.2-6.6 kV	862	872	15
	882	892	8
	950	960	8
	985	995	8

C3800

Voltage range	Standard drive units	Explosion-proof drive units	Maximum number of starts per hour
Up to 1.1 kV	905	915	8
	935	945	8
	965	975	8
1.2-6.6 kV	950	960	8
	985	995	8

Operational data

Application limits

Table 40: Process data

Parameter	Value
Liquid temperature	Max. +40°C (+105°F)
Depth of immersion	Max. 20 m (65 ft.)
pH of pumped liquid	pH 6–11
Liquid density	Max. 1100 kg/m^3 (9.17 lb per gal.)

Motor Data

Motor characteristics

Insulation class	H (+180°C, +356°F)
Voltage variation	Max. +/- 10%
Voltage imbalance between phases	Max. 2%

Frequency

Pump	50 Hz	60 Hz
C3231	X	X
C3240	X	X
C3300	X	X
C3306	X	X
C3312	X	X
C3351	X	X
C3356	X	X
C3400	X	X
C3501	X	X
C3531	X	X
C3602	X	X
C3800	X	X

Monitoring with MAS

The pump is designed for use with the Flygt MAS monitoring system. The parameters tracked are chosen by the customer and can include the following:

- Temperature (main and support bearings, stator windings)
- Vibration
- Leakage (in stator housing, junction box, and water into oil chamber)
- Power monitoring

Table 41: Parameters monitored

Description	Sensor	Standard or optional
Pump memory	Printed circuit board for pump memory includes a temperature sensor.	Standard
Leakage in the junction box	Float Switch Leakage Sensor (FLS)	Standard
Main bearing temperature	Pt100 analogue temperature sensor	Standard
Leakage in the stator housing	Float Switch Leakage Sensor (FLS)	Standard
Stator winding temperature	See table below.	Standard
Support bearing temperature	Pt100 analogue temperature sensor	Optional
Water in oil	Capacitive Leakage Sensor (CLS)	Optional
Vibration	VIS 10	Optional
Power monitoring	Separate electronic instrument using three current transformers.	Optional
Pump current	A current transformer in the control cabinet is required.	

Table 42: Stator winding temperature, monitoring configurations

Drive units	Sensors in coil ends of stator windings	Additional sensors, incorporated in the stator windings:	
		Always (standard)	Additional option
Up to 1.1 kV	One of the following choices: • 3 thermal switches (standard), or • 3 PTC-thermistors (optional)	Pt100 analogue temperature sensor in 1 stator winding (standard)	Pt100 analogue temperature sensors in 2 additional stator windings (optional)

Drive units	Sensors in coil ends of stator windings	Additional sensors, incorporated in the stator windings:	
		Always (standard)	Additional option
1.2–6.6 kV	PTC-thermistors (3+3) 3 sensors are connected in series, and 3 are built-in reserves.	Pt100 analogue temperature sensors in all 3 stator windings (3+3) Each winding has 1 sensor connected, and 1 built-in reserve.	

C3231 Motor rating and performance, 50 Hz

Low voltage

Table 43: C3231, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
430	1480	605 / 615	400	70	127	800	0.86
		665 / 675	400	88	153	1025	0.86
		665 / 675	400	105	190	1380	0.85
		705 / 715	400	125	234	1525	0.83
		735 / 745	400	170	300	2020	0.87
455	1480	605 / 615	400	70	127	800	0.86
		665 / 675	400	85	153	1025	0.86
		665 / 675	400	105	190	1380	0.85
		705 / 715	400	125	234	1525	0.83
		735 / 745	400	170	300	2020	0.87
655	985	605 / 615	400	58	118	660	0.78

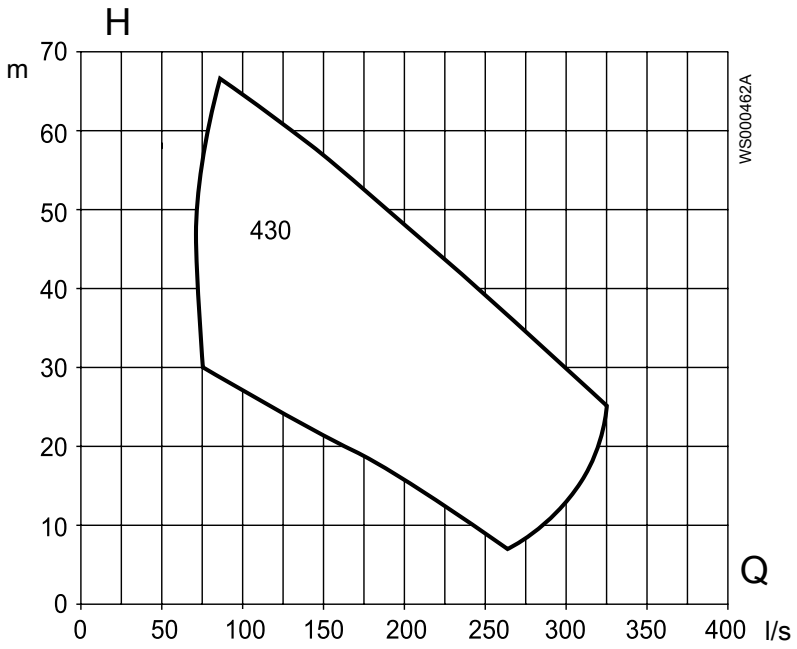


Figure 48: C3231, 50 Hz, low voltage (1 of 2)

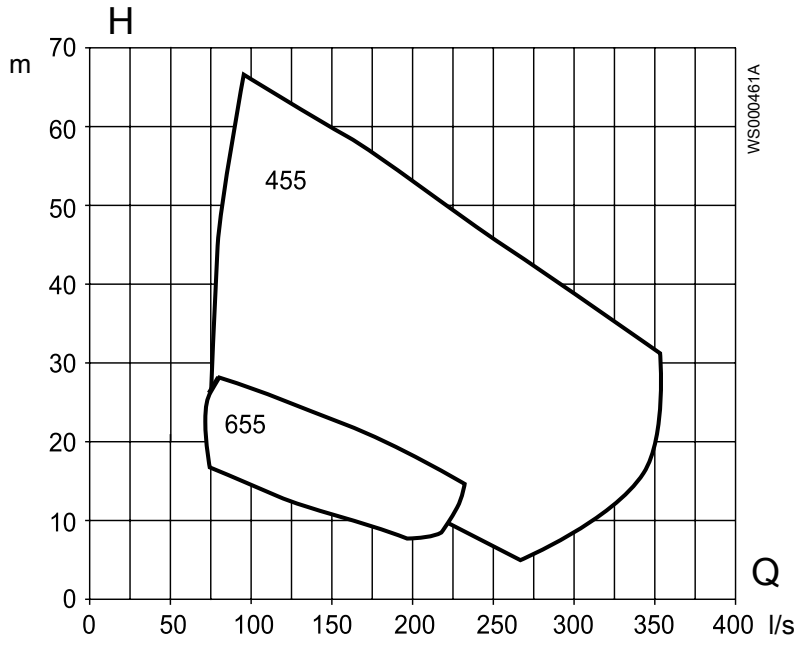


Figure 49: C3231, 50 Hz, low voltage (2 of 2)

C3240 Motor rating and performance, 50 Hz

Low voltage

Table 44: C3240, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
450	1490	805 / 815	400	215	375	2920	0.88
		835 / 845	400	290	515	4505	0.86
		865 / 875	400	375	650	5420	0.88

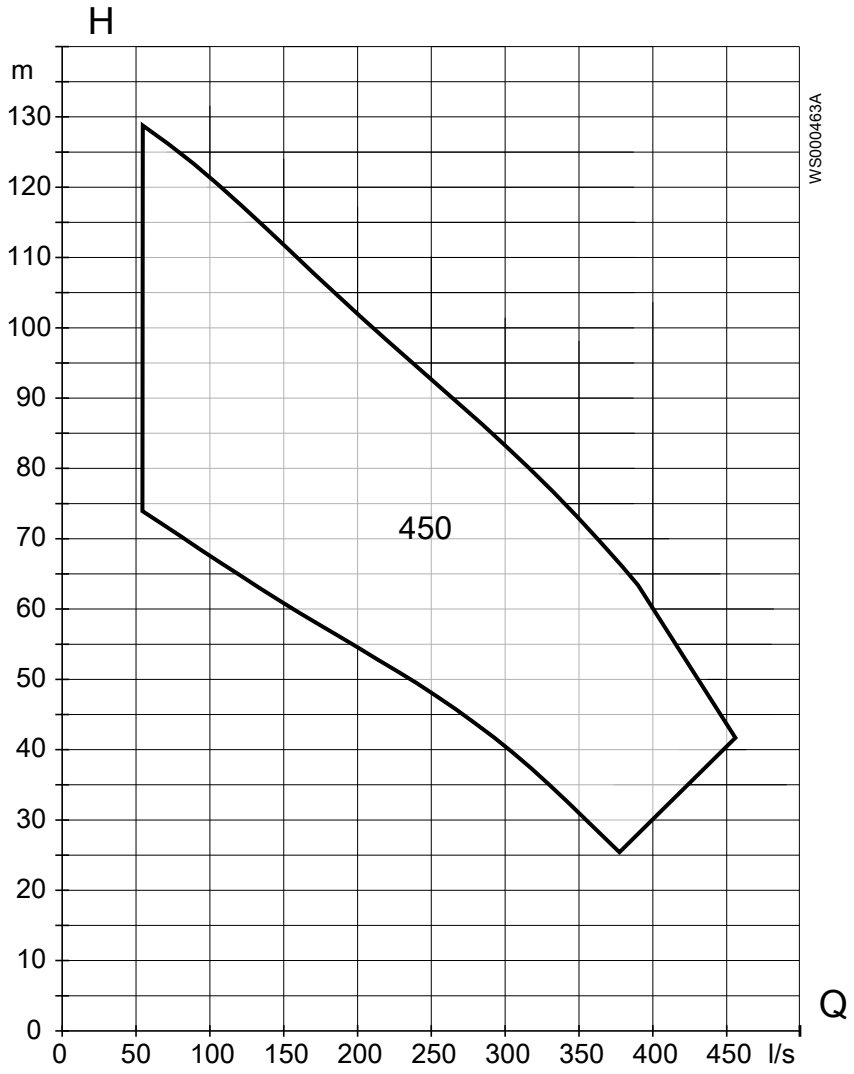


Figure 50: C3240, 50 Hz, low voltage

Medium voltage

Table 45: C3240, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
450	1490	862 / 872	6000	205	24	188	0.85
			3300	215	47	360	0.84
		882 / 892	3300	290	63	475	0.84
			3300	345	74	505	0.85
			6000	275	33	260	0.84
			6000	325	39	284	0.84

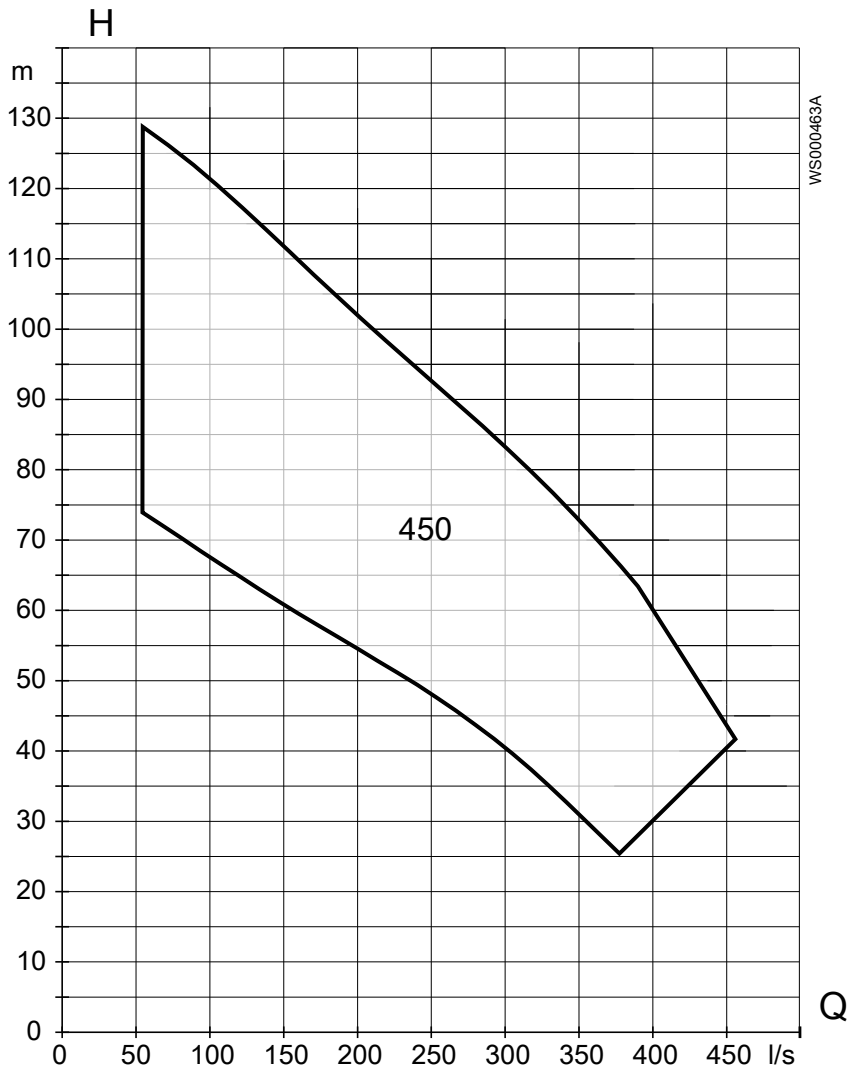


Figure 51: C3240, 50 Hz, medium voltage

C3300 Motor rating and performance, 50 Hz

Low voltage

Table 46: C3300, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
601	985	605 / 615	400	58	118	660	0.78
		665 / 675	400	75	150	835	0.79
		665 / 675	400	90	185	1160	0.76
460	1480	605 / 615	400	70	127	800	0.86

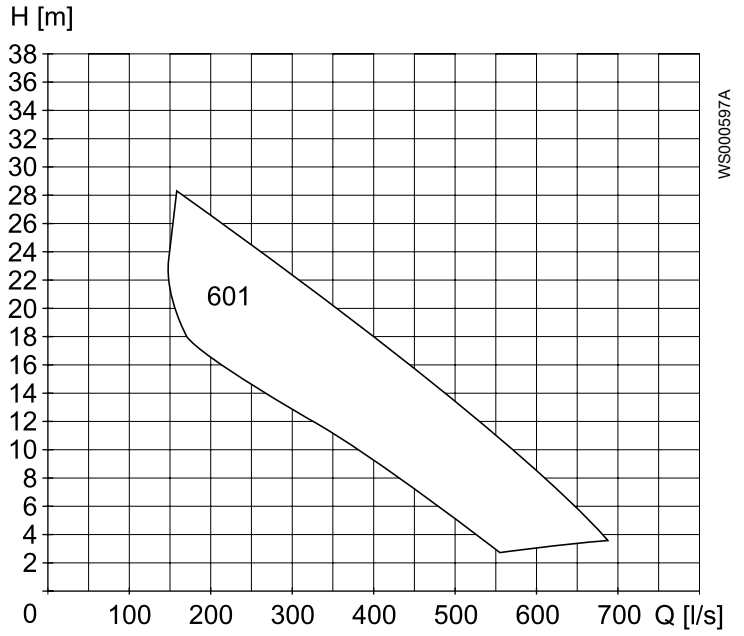


Figure 52: C3300, 50 Hz, low voltage (1 of 2)

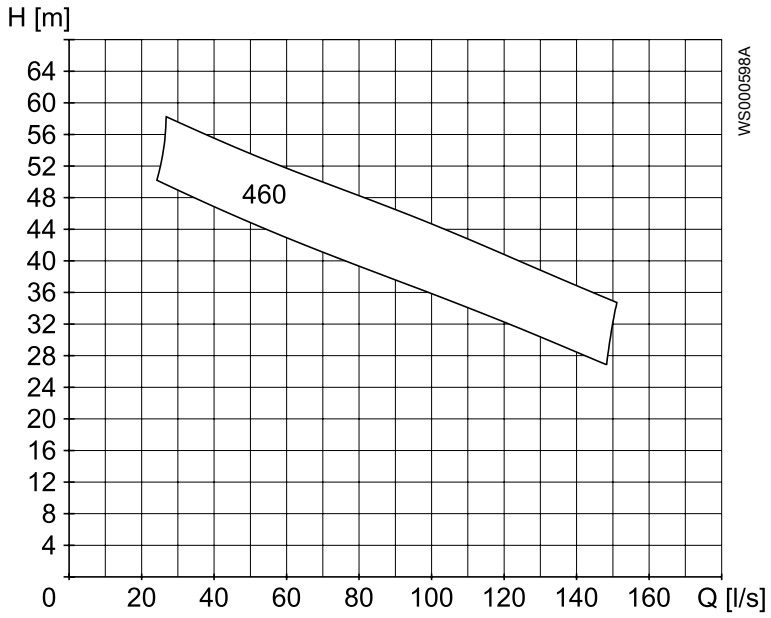


Figure 53: C3300, 50 Hz, low voltage (2 of 2)

C3306 Motor rating and performance, 50 Hz

Low voltage

Table 47: C3306, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
410	1480	735 / 745	400	170	300	2020	0.87
		765 / 775	400	215	395	2945	0.83
610	1480	605 / 615	400	58	118	660	0.78
		665 / 675	400	75	150	835	0.79
		665 / 675	400	90	185	1160	0.76
		705 / 715	400	100	202	1150	0.78
		735 / 745	400	140	268	1545	0.81

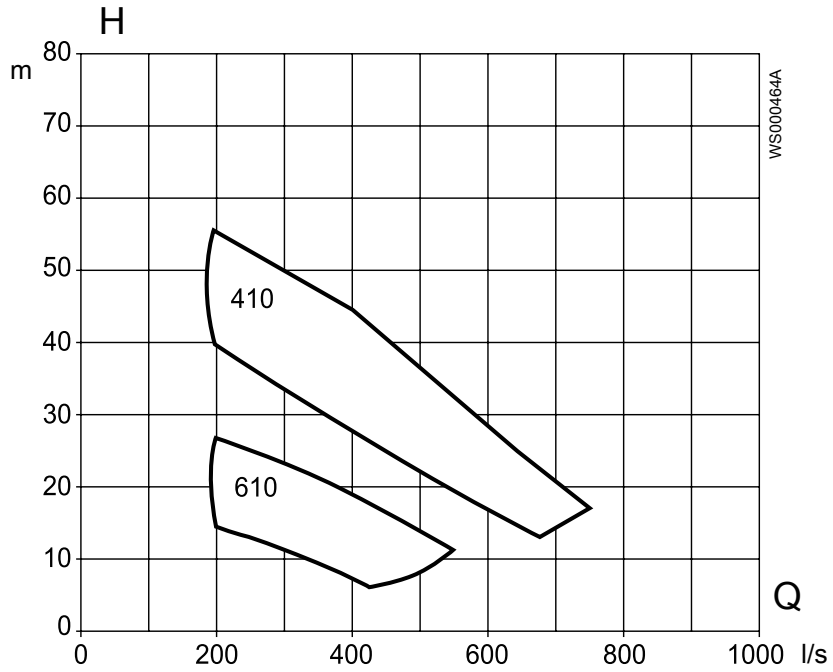


Figure 54: C3306, 50 Hz, low voltage

C3312 Motor rating and performance, 50 Hz

Low voltage

Table 48: C3312, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
630	735	705 / 715	400	55	107	505	0.82
			400	90	182	775	0.79
830	985	705 / 715	400	100	202	1150	0.78
		735 / 745	400	140	268	1545	0.81
		765 / 775	400	180	360	2215	0.77
		835 / 845	400	250	465	2645	0.82

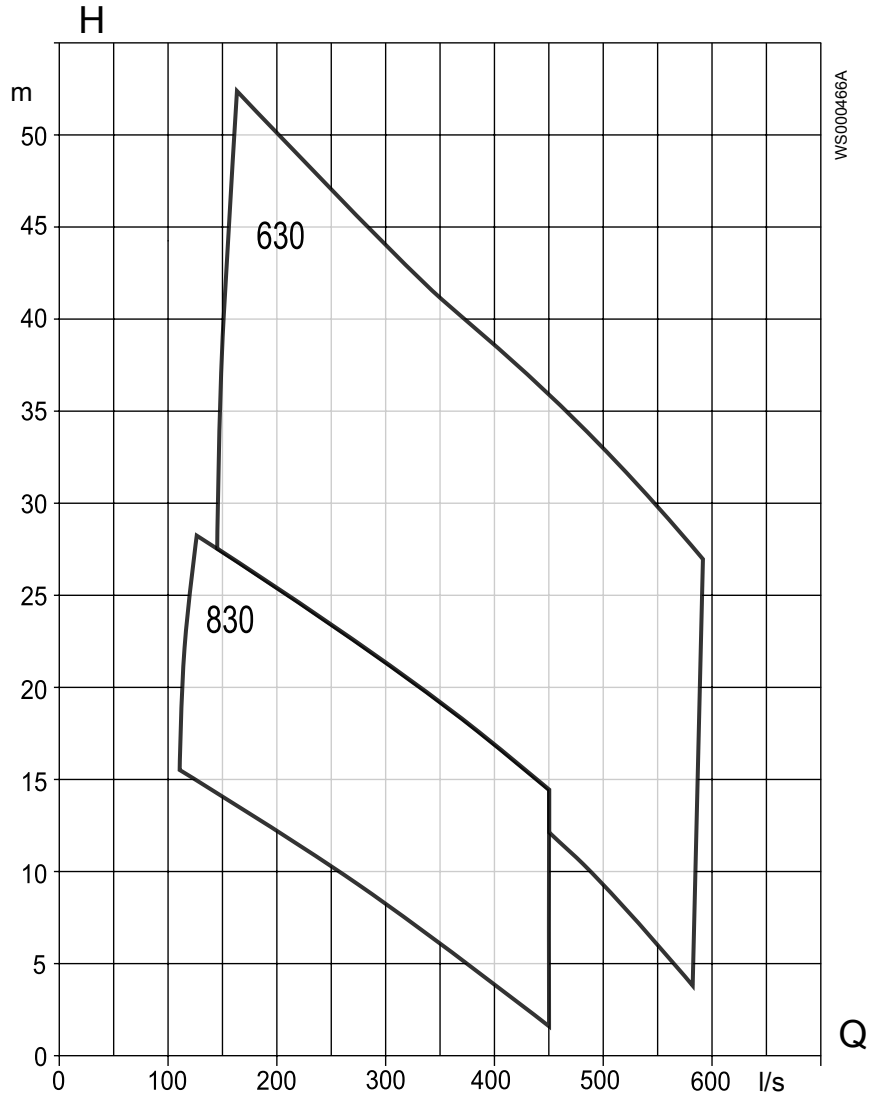


Figure 55: C3312, 50 Hz, low voltage

Medium voltage

Table 49: C3312, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
630	990	862 / 872	3300	190	41	262	0.85
			6000	180	22	140	0.85
		882 / 892	3300	250	54	390	0.85
			6000	240	29	218	0.84

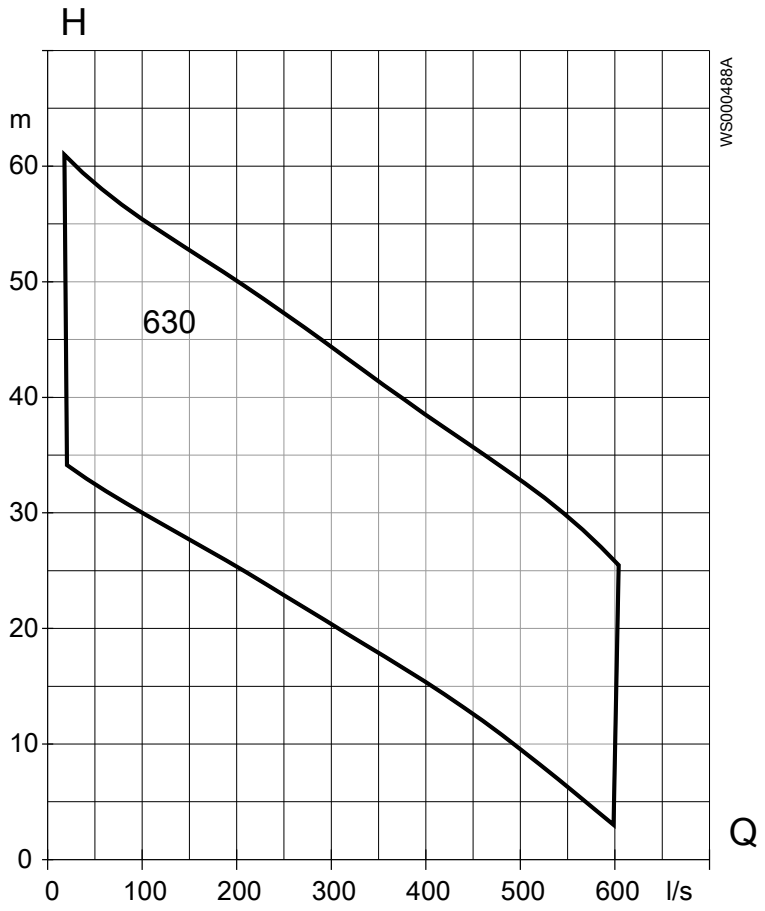


Figure 56: C3312, 50 Hz, medium voltage

C3351 Motor rating and performance, 50 Hz

Low voltage

Table 50: C3351, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
650	990	905 / 915	400	290	525	3115	0.84
			400	375	685	4180	0.83
		935 / 945	400	460	840	5190	0.82
			400	560	990	5580	0.85

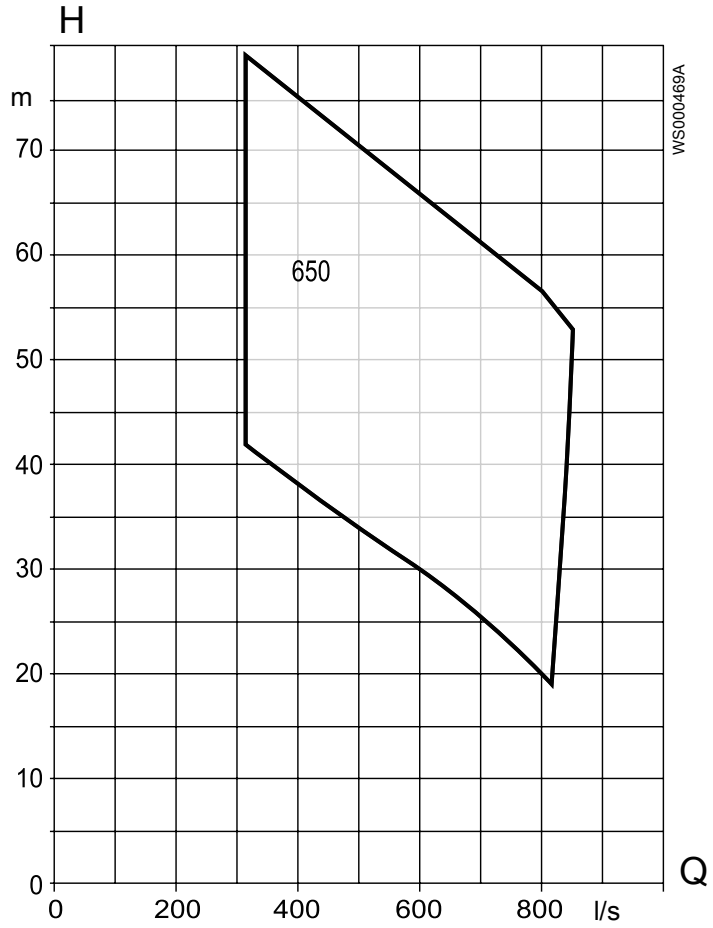


Figure 57: C3351, 50 Hz, low voltage

Medium voltage

Table 51: C3351, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
650	995	950 / 960	6000	250	30	178	0.84
				315	38	228	0.85
			3300	265	58	330	0.84
				340	76	455	0.82
		985 / 995	6000	380	46	288	0.84
				445	54	340	0.84
				520	61	370	0.86
			3300	400	86	490	0.86
				470	104	655	0.83
				500	108	695	0.85
850	745	950 / 960	6000	215	28	151	0.83
				270	33	190	0.82
			3300	225	51	291	0.82
				290	65	360	0.82

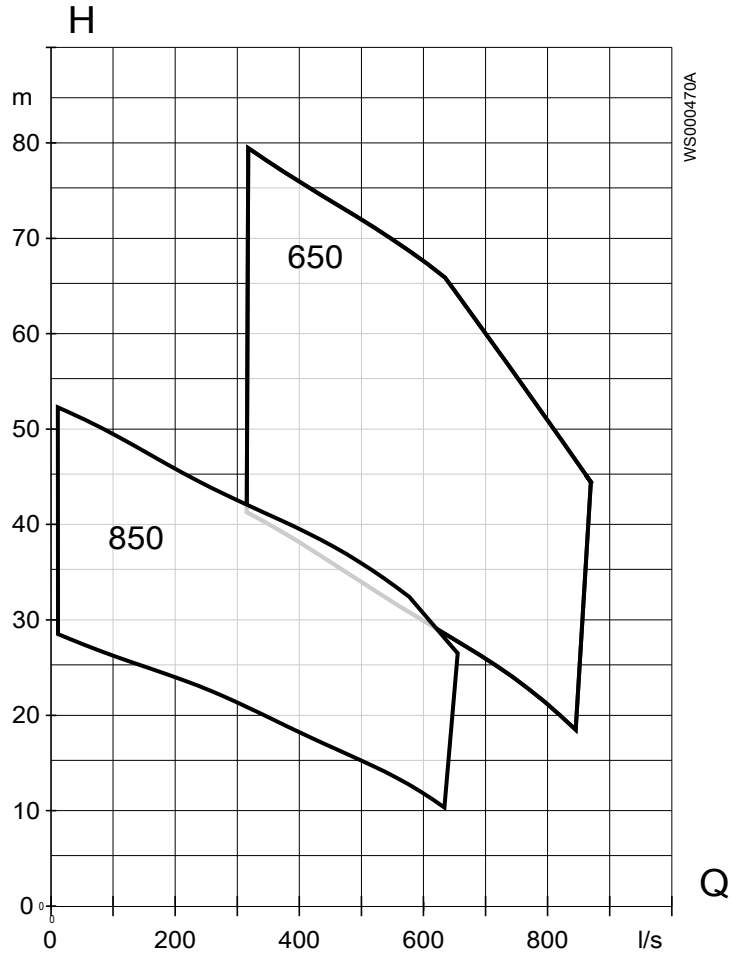


Figure 58: C3351, 50 Hz, medium voltage

C3356 Motor rating and performance, 50 Hz

Low voltage

Table 52: C3356, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
610	985	605 / 615	400	58	118	660	0.78
		665 / 675	400	75	150	835	0.79
		665 / 675	400	90	185	1160	0.76
		705 / 715	400	100	202	1150	0.78
		735 / 745	400	140	268	1545	0.81
		765 / 775	400	209	345	2230	0.80
810	730	605 / 615	400	45	95	425	0.77
		665 / 675	400	55	115	525	0.77

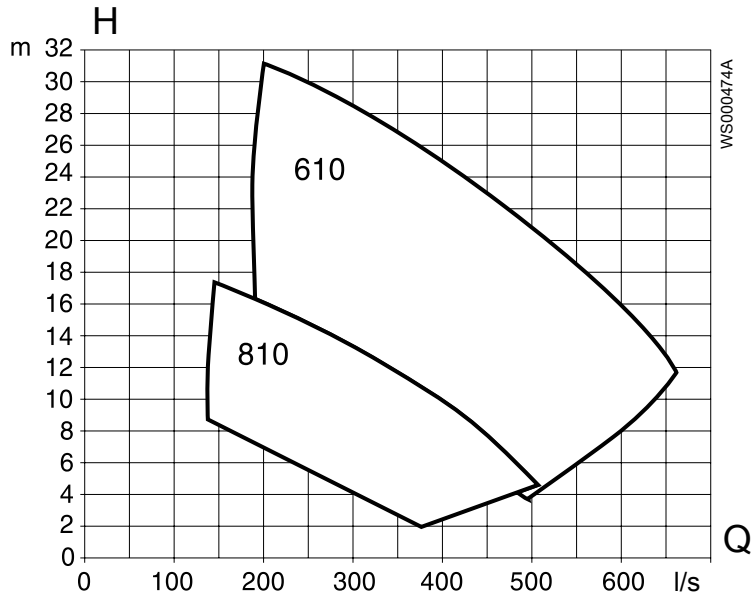


Figure 59: C3356, 50 Hz, low voltage

C3400 motor rating and performance, 50 Hz

Low voltage

Table 53: C3400, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1230	490	705 / 715	400	30	81	289	0.60
		705 / 715	400	40	110	390	0.59
1030	590	705 / 715	400	40	88	385	0.73
		705 / 715	400	60	135	550	0.71
		735 / 745	400	90	227	940	0.64
830	730	705 / 715	400	90	182	775	0.79
		735 / 745	400	125	245	1065	0.81
		765 / 775	400	150	292	1330	0.81
		805 / 815	400	160	305	1360	0.81
630	990	805 / 815	400	180	330	1765	0.83
		835 / 845	400	250	465	2645	0.82
		865 / 875	400	310	575	3370	0.82

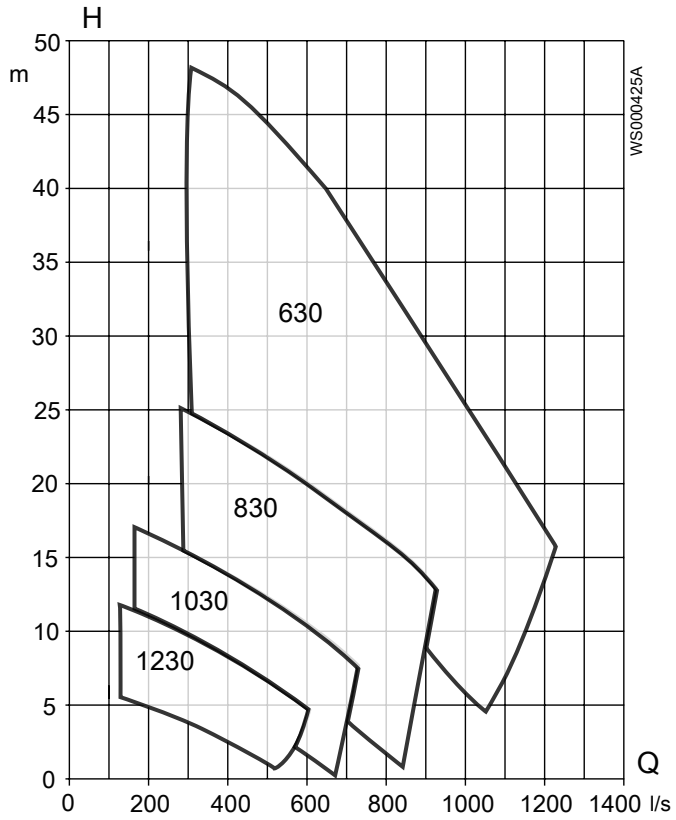


Figure 60: C3400, 50 Hz, low voltage

Medium voltage

Table 54: C3400, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
630	995	862 / 872	6000	180	22	140	0.85
			3300	190	41	262	0.85
		882 / 892	6000	240	29	218	0.84
			3300	250	54	390	0.85
			6000	305	37	292	0.83
			3300	340	72	510	0.86
830	740	862 / 872	6000	150	19	109	0.81
			3300	180	22	140	0.85

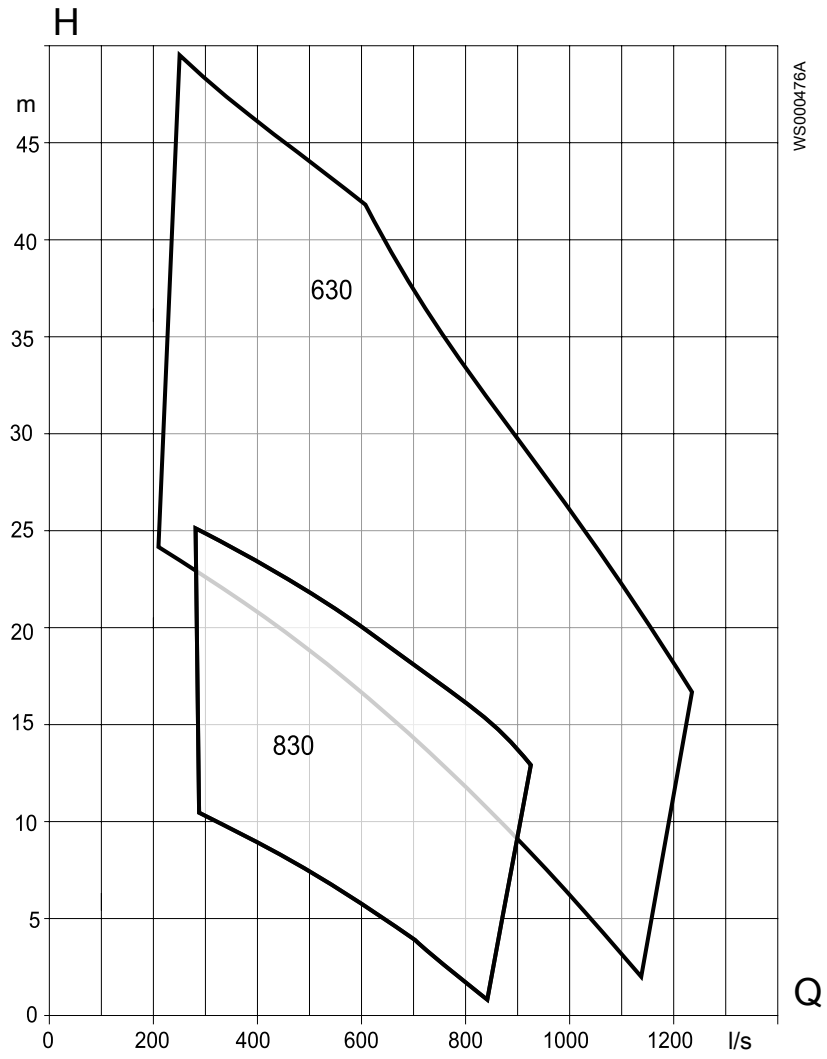


Figure 61: C3400, 50 Hz, medium voltage

C3501 Motor rating and performance, 50 Hz

Low voltage

Table 55: C3501, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1430	415	705 / 715	400	40	115	370	0.57
		735 / 745	400	60	164	505	0.59
1230	490	705 / 715	400	40	110	390	0.59
		735 / 745	400	60	158	550	0.61
		765 / 775	400	80	207	710	0.62
		805 / 815	400	100	256	1025	0.61
1030	590	735 / 745	400	90	227	940	0.64
		765 / 775	400	110	250	1110	0.70
		805 / 815	400	125	269	1245	0.73
		835 / 845	400	170	380	1920	0.70
830	730	765 / 775	400	150	292	1330	0.81
		835 / 845	400	215	435	2385	0.76
		865 / 875	400	275	535	2730	0.79

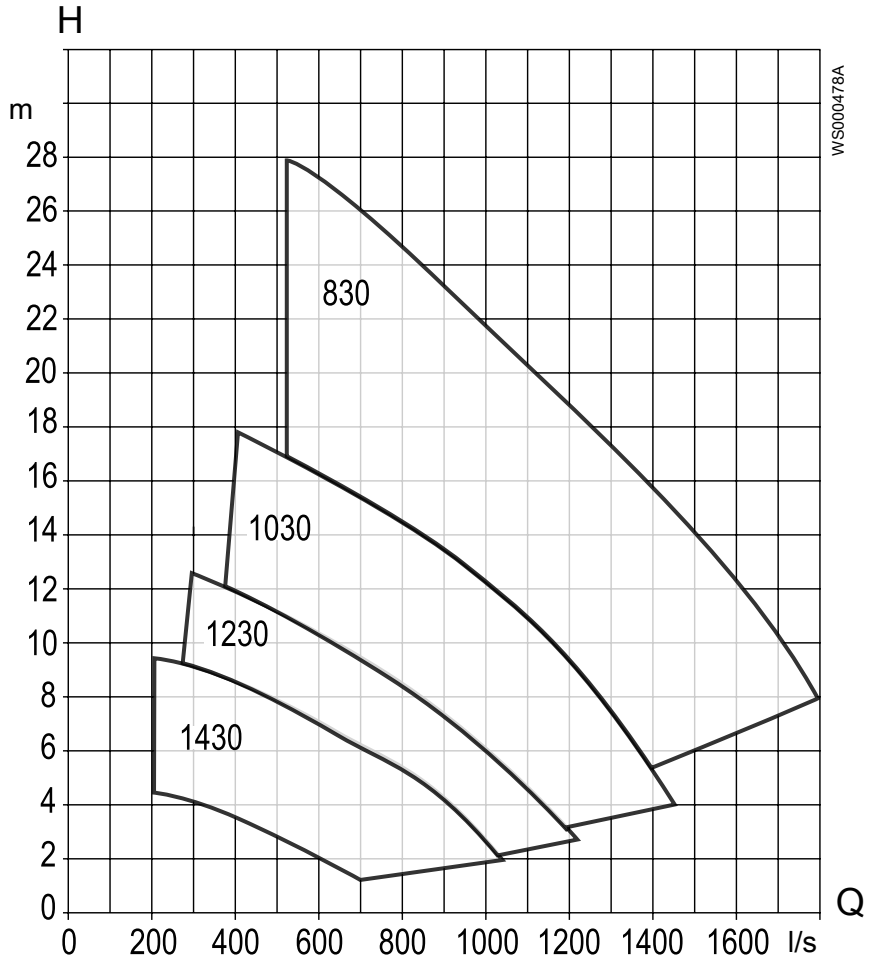


Figure 62: C3501, 50 Hz, low voltage

Medium voltage

Table 56: C3501, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1230	490	862 / 872	6000	110	19	82	0.62
			3300	120	36	148	0.64
1030	590	862 / 872	6000	130	19	87	0.71
			3300	140	37	162	0.72
		882 / 892	6000	165	23	103	0.74
			3300	175	44	184	0.75
830	740	862 / 872	6000	150	19	109	0.81
			3300	165	38	214	0.81
		882 / 892	6000	185	23	140	0.81
			3300	215	52	320	0.78
			6000	235	30	179	0.79
			3300	250	57	320	0.81

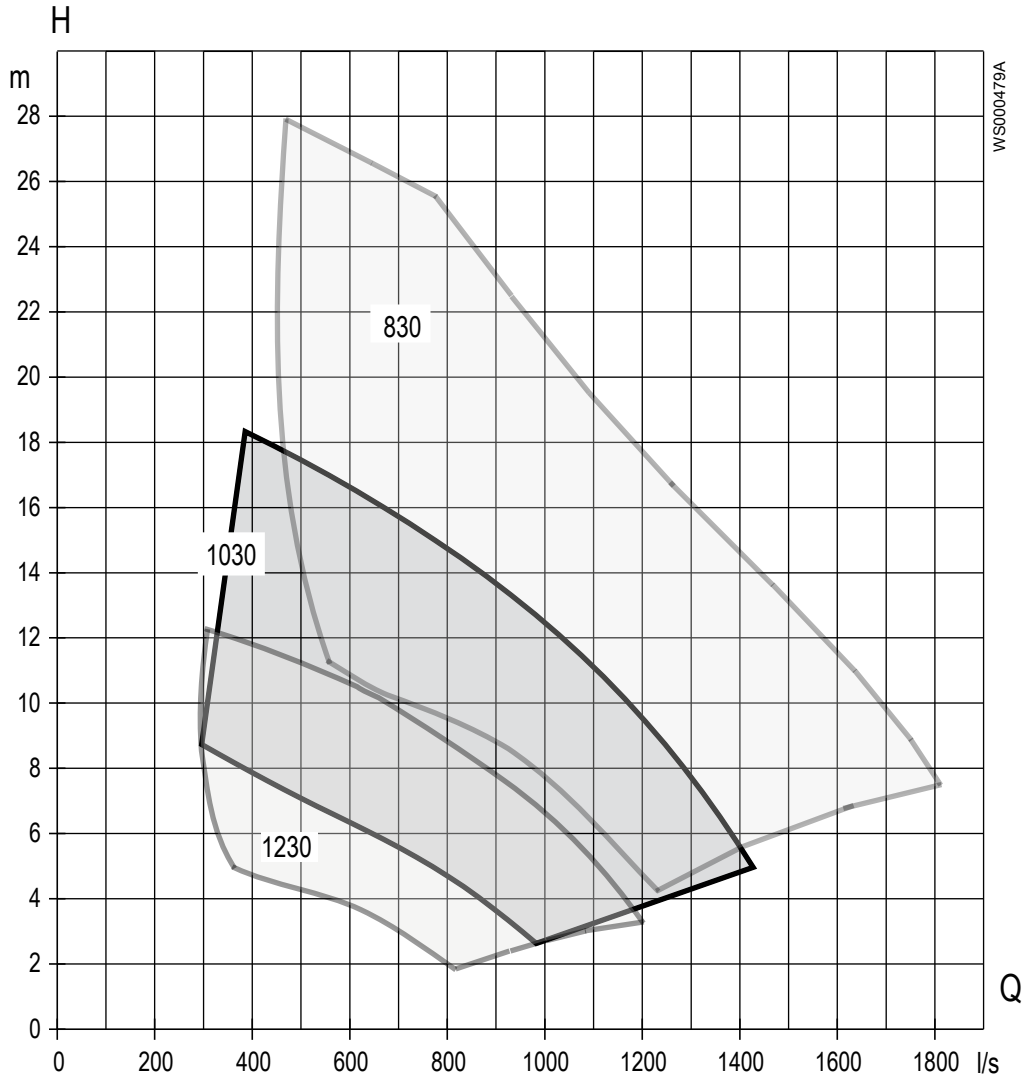


Figure 63: C3501, 50 Hz, medium voltage

C3531 Motor rating and performance, 50 Hz

Low voltage

Table 57: C3531, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1440	415	705 / 715	400	40	115	345	0.60
		735 / 745	400	60	167	475	0.62
		765 / 775	400	70	195	575	0.61
1240	490	705 / 715	400	40	110	390	0.59
		735 / 745	400	60	158	550	0.61
		765 / 775	400	80	207	710	0.62
		805 / 815	400	100	256	1025	0.61
		835 / 845	400	140	360	1455	0.61
1040	585	705 / 715	400	60	138	520	0.74
		735 / 745	400	90	222	880	0.68
		765 / 775	400	110	230	920	0.73
		805 / 815	400	125	275	1170	0.75
		835 / 845	400	170	380	1800	0.73
		865 / 875	400	215	460	1915	0.76
840	735	735 / 745	400	125	245	1065	0.81
		805 / 815	400	160	305	1360	0.81
		835 / 845	400	215	460	2385	0.77
		865 / 875	400	275	535	2730	0.79
		905 / 915	400	340	610	3295	0.84
		935 / 945	400	400	730	4510	0.82
640	990	835 / 845	400	250	475	2495	0.84
		865 / 875	400	310	575	3370	0.82
		905 / 915	400	375	700	3935	0.85
		935 / 945	400	460	855	4880	0.85
		935 / 945	400	560	1025	5250	0.87
		965 / 975	400	680	960	5920	0.85

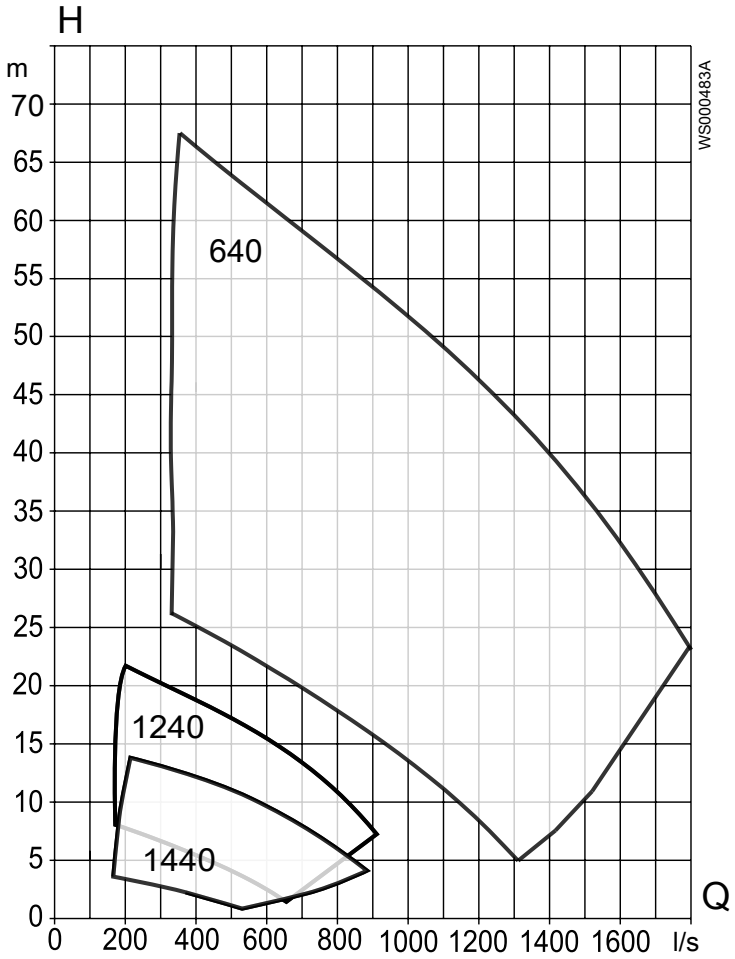


Figure 64: C3531, 50 Hz, low voltage (1 of 2)

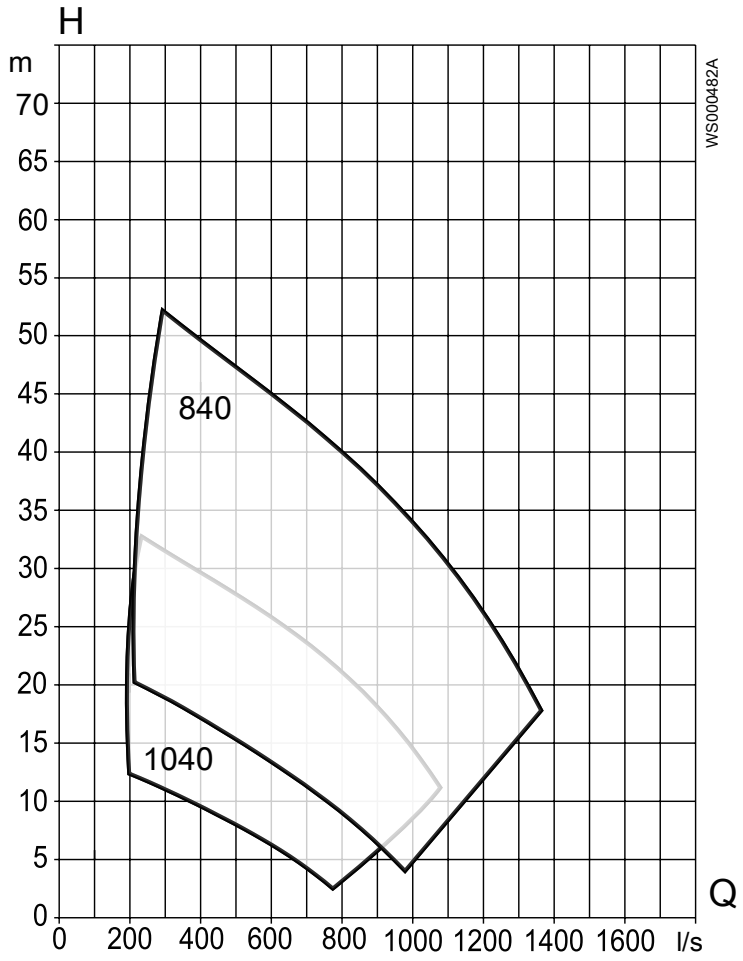


Figure 65: C3531, 50 Hz, low voltage (2 of 2)

Medium voltage

Table 58: C3531, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1240	495	862 / 872	6000	110	19	82	0.62
			3300	120	36	148	0.64
		882 / 892	6000	130	21	94	0.67
			3300	140	40	142	0.68
1040	595	862 / 872	6000	130	21	94	0.67
			3300	140	40	172	0.68
		882 / 892	6000	165	23	103	0.74
			3300	175	44	184	0.75
			6000	205	28	148	0.74
			3300	225	56	276	0.75

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
840	745	862 / 872	6000	150	19	109	0.81
			3300	165	38	214	0.81
		882 / 892	6000	185	23	140	0.81
			3300	215	435	320	0.76
			6000	235	30	179	0.79
			3300	250	57	320	0.81
		950 / 960	6000	215	27	151	0.83
			3300	225	51	291	0.82
			6000	270	33	190	0.82
			3300	290	65	360	0.82
		985 / 995	6000	330	42	253	0.81
			3300	350	79	460	0.82
			6000	380	47	285	0.82
			3300	400	89	495	0.83
640	990	882 / 892	6000	240	29	218	0.84
			3300	250	54	390	0.85
			6000	305	37	292	0.83
			3300	340	72	510	0.86
		950 / 960	6000	250	30	178	0.84
			3300	265	58	330	0.84
			6000	315	38	228	0.85
			3300	340	76	455	0.82
		985 / 995	6000	380	46	288	0.84
			3300	400	86	490	0.86
			6000	445	54	340	0.84
			3300	470	104	655	0.83
			3300	520	112	695	0.85
			6000	520	61	370	0.86

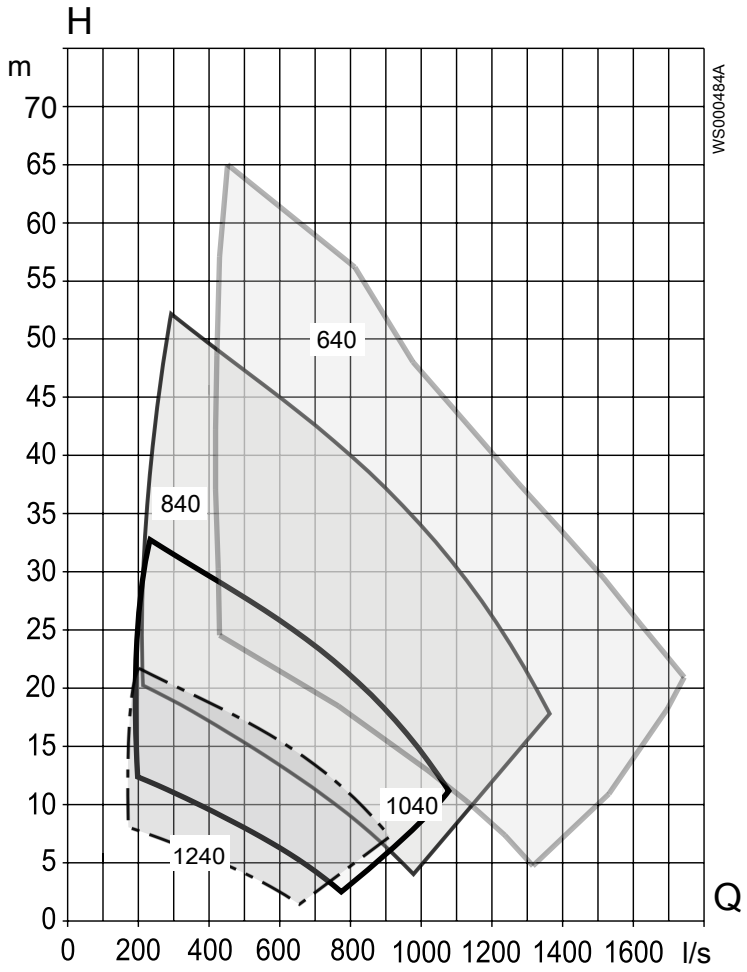


Figure 66: C3531, 50 Hz, medium voltage

C3602 Motor rating and performance, 50 Hz

Low voltage

Table 59: C3602, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1440	415	735 / 745	400	60	164	505	0.59
		765 / 775	400	70	193	610	0.59
		805 / 815	400	80	215	830	0.59
1240	490	735 / 745	400	60	158	550	0.61
		765 / 775	400	80	207	710	0.62
		805 / 815	400	100	256	1025	0.61
		835 / 845	400	140	360	1455	0.61
1040	590	765 / 775	400	110	250	1110	0.70
		805 / 815	400	125	269	1245	0.73
		835 / 845	400	170	380	1920	0.70
		865 / 875	400	215	450	2045	0.74
		905 / 915	400	250	475	2465	0.80
840	740	835 / 845	400	215	435	2385	0.76
		865 / 875	400	275	535	2730	0.79
		905 / 915	400	340	610	3295	0.84
		935 / 945	400	400	730	4510	0.82
			400	460	835	5180	0.83

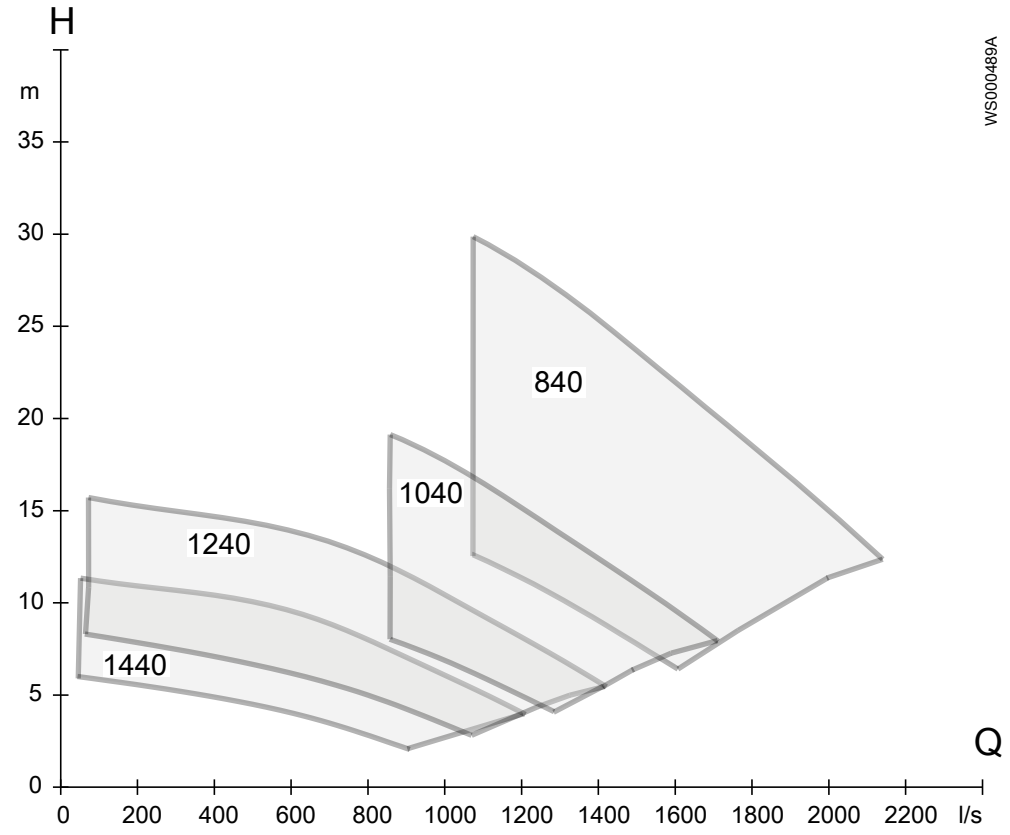


Figure 67: C3602, 50 Hz, low voltage

Medium voltage

Table 60: C3602, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1440	420	862 / 872	6000	80	14	48	0.62
			3300	85	29	100	0.57
1240	495	862 / 872	6000	110	19	82	0.62
			3300	120	36	148	0.64
		882 / 892	6000	130	21	94	0.67
			3300	140	40	172	0.68
1040	595	862 / 872	6000	130	19	87	0.71
			3300	140	37	162	0.72
		882 / 892	6000	165	23	103	0.74
			3300	175	44	184	0.75
			6000	205	28	148	0.74
			3300	225	56	276	0.75
840	745	882 / 892	6000	185	23	140	0.81
			3300	215	52	320	0.78
			6000	235	30	179	0.79
			3300	250	57	320	0.81
		950 / 960	6000	215	27	151	0.83
			3300	225	51	291	0.82
			6000	270	33	190	0.82
			3300	290	65	360	0.82
		985 / 995	6000	330	42	253	0.81
			3300	350	79	460	0.82
			6000	380	47	285	0.82
			3300	400	89	495	0.83
			6000	440	55	335	0.81
			3300	460	102	570	0.83

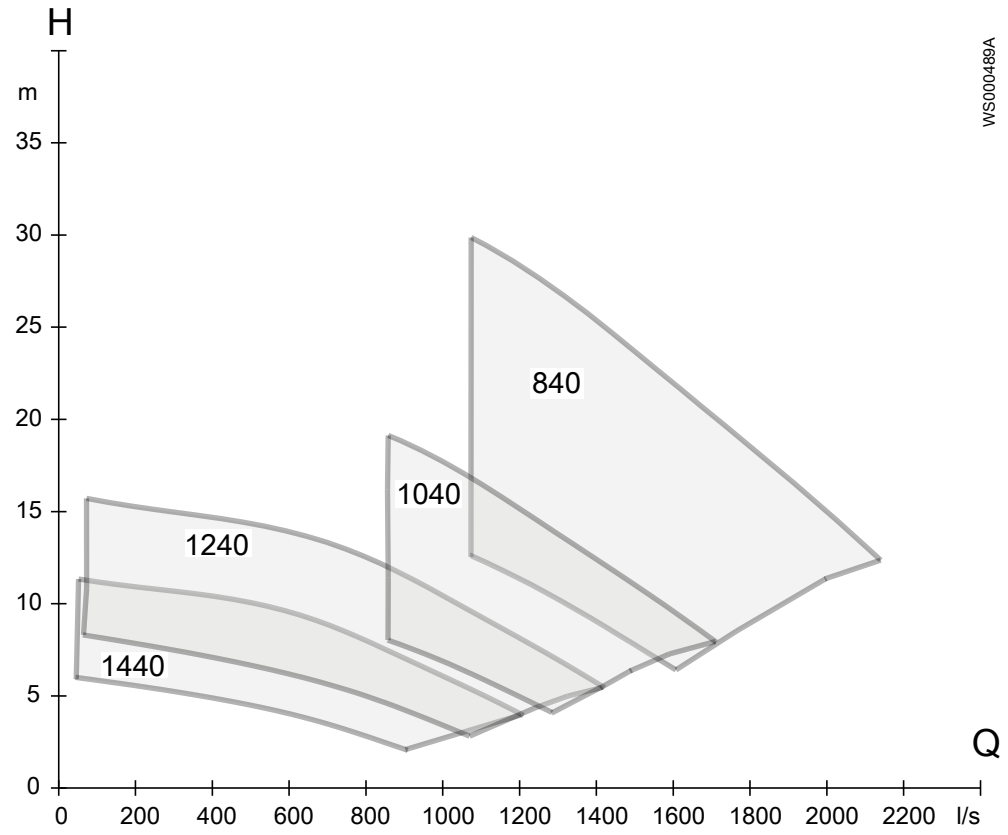


Figure 68: C3602, 50 Hz, medium voltage

C3800 Motor rating and performance, 50 Hz

Low voltage

Table 61: C3800, 50 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1240	495	905 / 915	400	225	455	1690	0.77
			400	275	575	2490	0.73
		935 / 945	400	325	665	2780	0.75
1040	595	905 / 915	400	325	615	3075	0.80
		935 / 945	400	375	735	4080	0.77
			400	450	815	3470	0.84
		965 / 975	400	550	1045	5555	0.79
840	740	935 / 945	400	400	730	4510	0.82
			400	460	835	5180	0.83
		965 / 975	400	560	985	5875	0.85

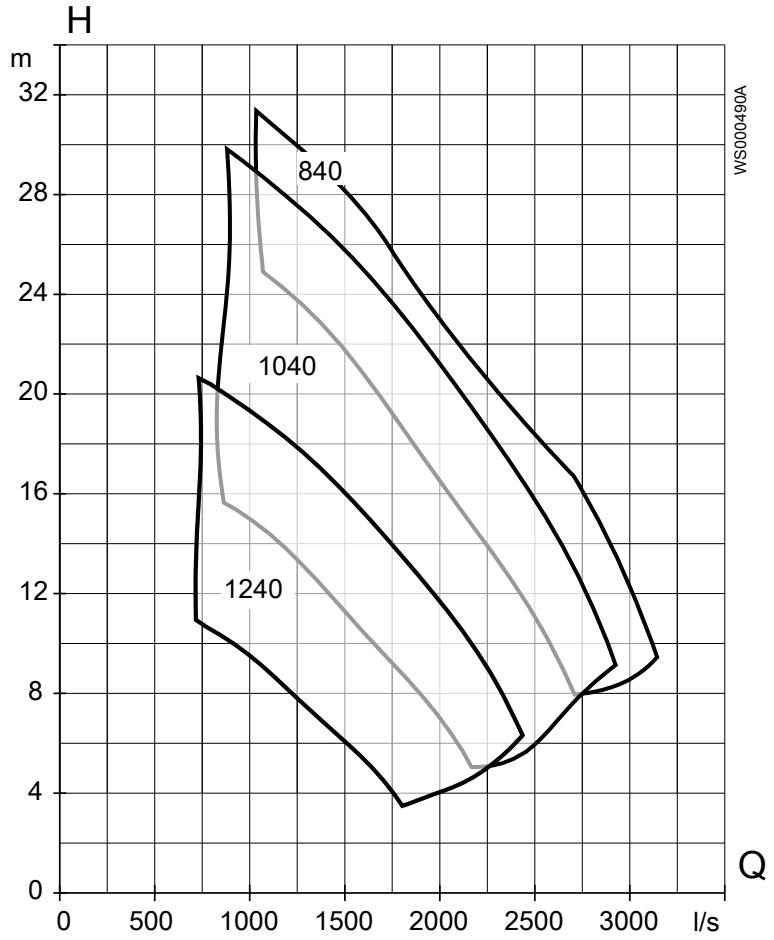


Figure 69: C3800, 50 Hz, low voltage

Medium voltage

Table 62: C3800, 50 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
1240	495	950 / 960	3300	170	45	195	0.71
			3300	210	54	231	0.73
		985 / 995	3300	250	64	275	0.73
			3300	285	73	320	0.73
1040	595	985 / 995	3300	285	65	335	0.82
			3300	320	73	405	0.81
			3300	400	90	500	0.82
840	740	985 / 995	3300	400	89	495	0.83
			3300	460	102	570	0.83

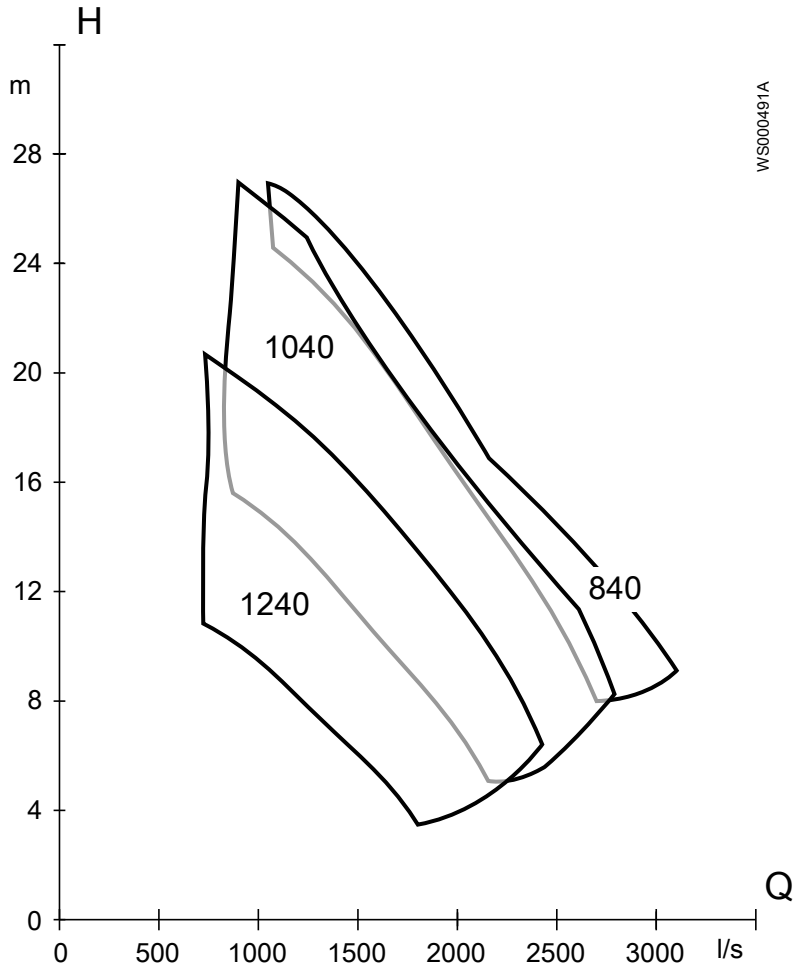


Figure 70: C3800, 50 Hz, medium voltage

C3231 Motor rating and performance, 60 Hz

Low voltage

Table 63: C3231, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
430	1780	665 / 675	460	119	183	1395	0.87
		705 / 715	460	138	220	1525	0.85
		735 / 745	460	186	284	2030	0.88
	1785	765 / 775	460	250	385	2955	0.86
455	1780	705 / 715	460	138	220	1525	0.85
		735 / 745	460	186	284	2030	0.88
	1785	765 / 775	460	250	385	2955	0.86
630	1185	605 / 615	460	67	115	685	0.81
			460	82	139	685	0.81
655	1185	605 / 615	460	67	115	685	0.81
			460	82	139	685	0.81

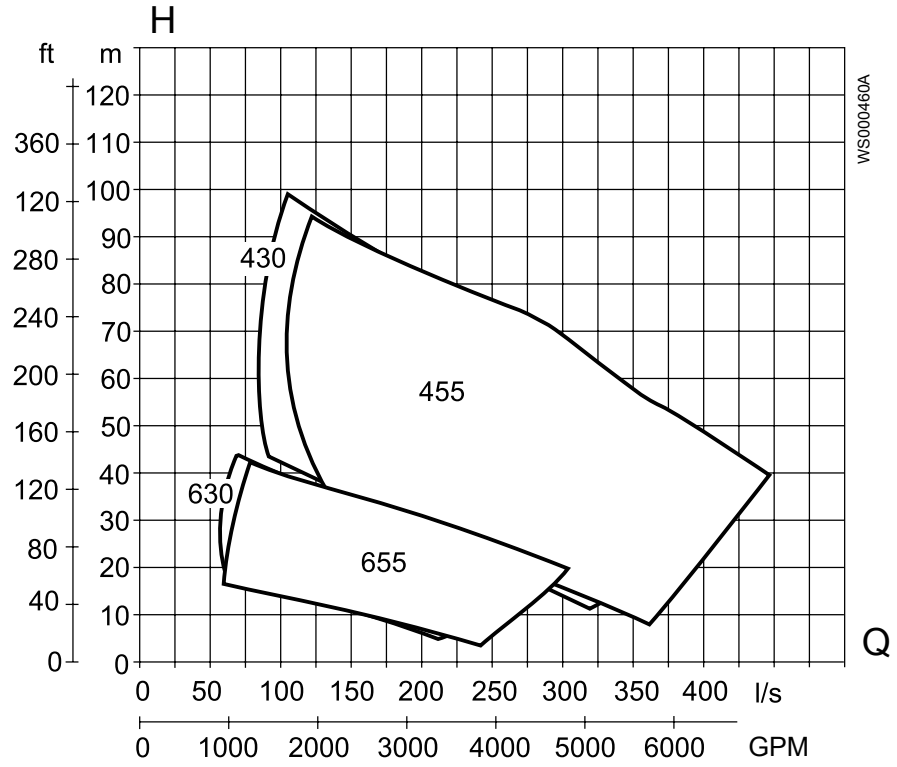


Figure 71: C3231, 60 Hz, low voltage

C3240 Motor rating and performance, 60 Hz

Low voltage

Table 64: C3240, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
450	1800	805 / 815	460	335	375	2925	0.89
			600	335	288	2295	0.89
		835 / 845	460	455	510	4515	0.88
			600	455	410	3950	0.84
		865 / 875	460	580	635	5380	0.90
			600	580	505	4755	0.86

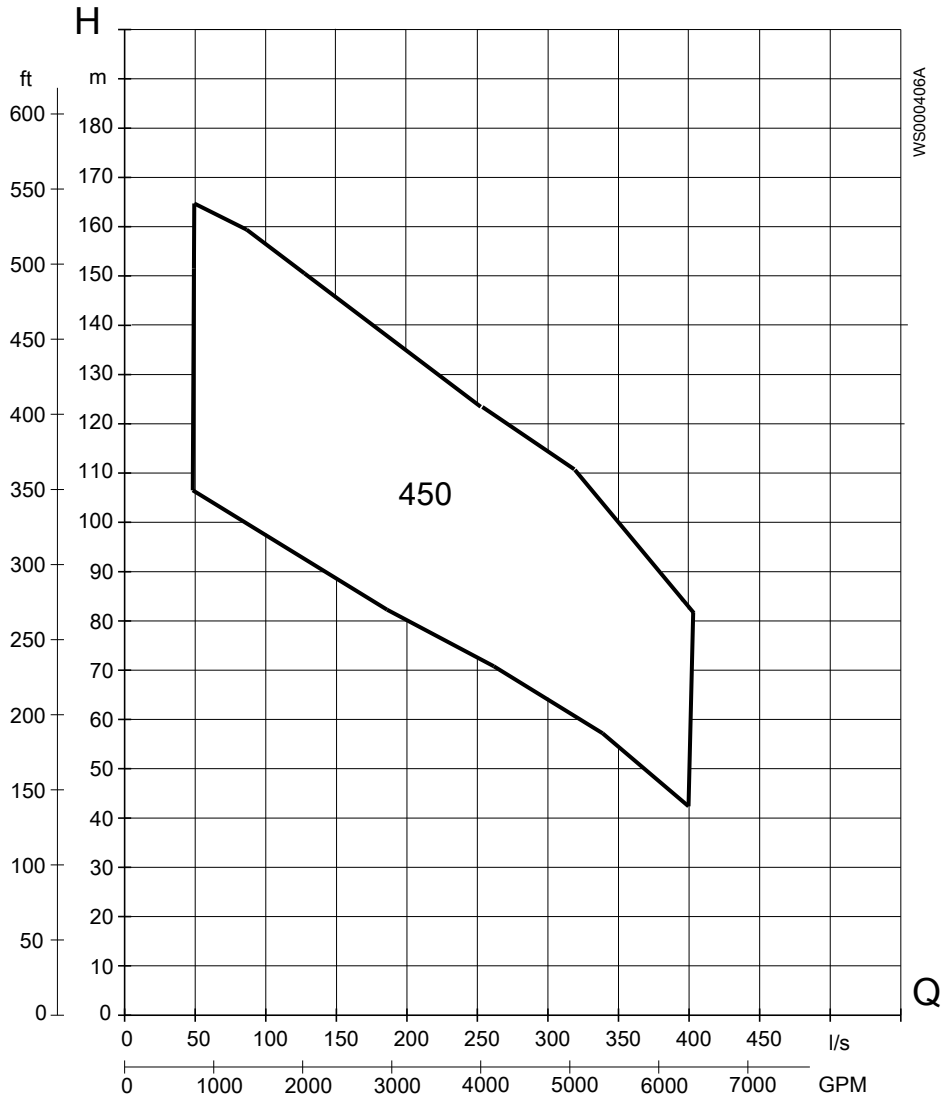


Figure 72: C3240, 60 Hz, low voltage

Medium voltage

Table 65: C3240, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
450	1800	862 / 872	4160	340	43	345	0.85
		882 / 892	4160	450	56	445	0.87
			4160	540	68	505	0.85

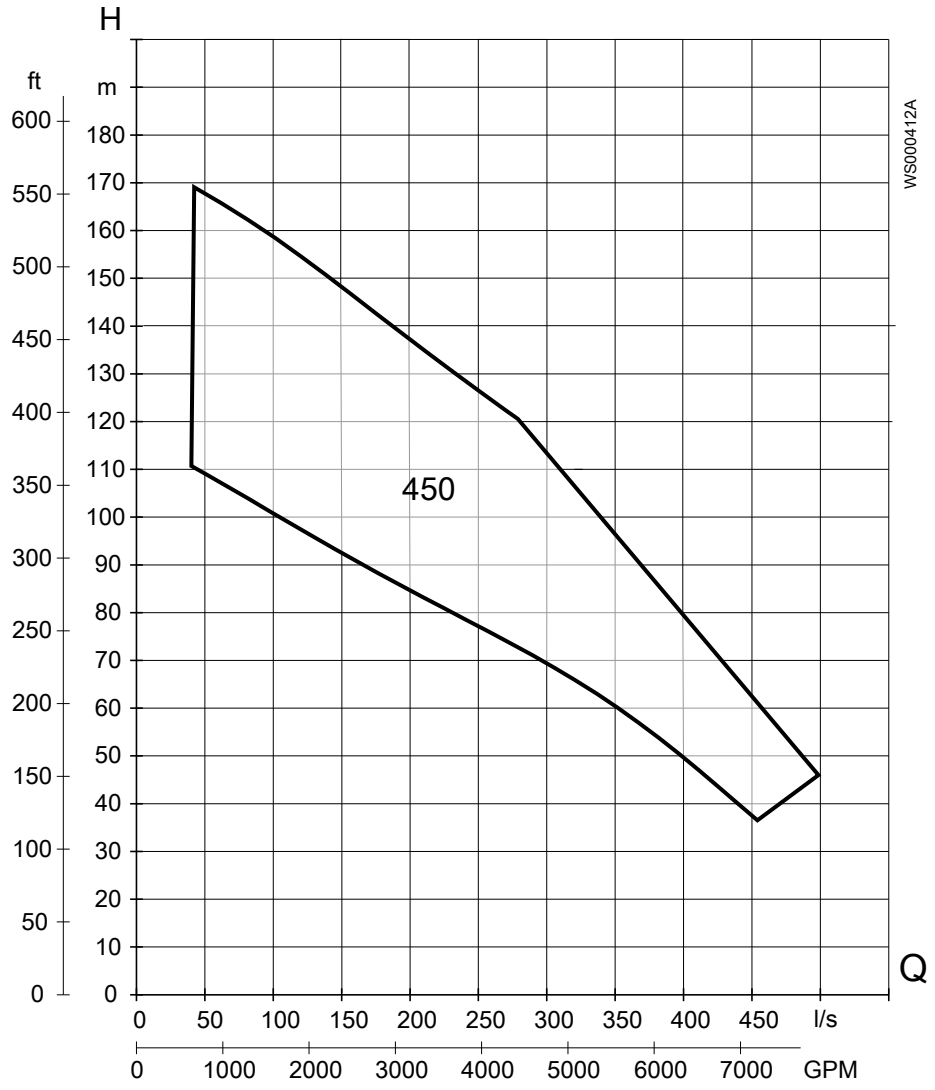


Figure 73: C3240, 60 Hz, medium voltage

C3300 Motor rating and performance, 60 Hz

Low voltage

Table 66: C3300, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
801	880	605 / 615	460	52	92	440	0.79
		665 / 675	460	63	111	550	0.79
601	1185	665 / 675	460	82	139	865	0.81
		665 / 675	460	104	179	1195	0.79
640	1185	605 / 615	460	67	115	685	0.81
		665 / 675	460	82	139	865	0.81
460	1780	605 / 615	460	75	117	810	0.87
		665 / 675	460	97	149	1035	0.87
		665 / 675	460	119	183	1395	0.87

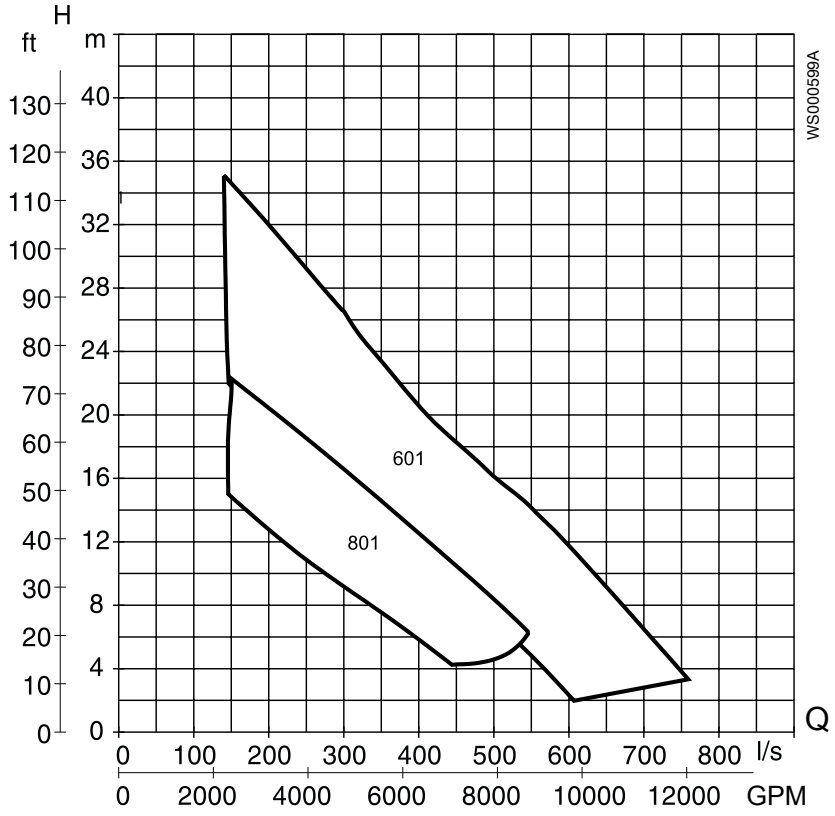


Figure 74: C3300, 60 Hz, low voltage (1 of 3)

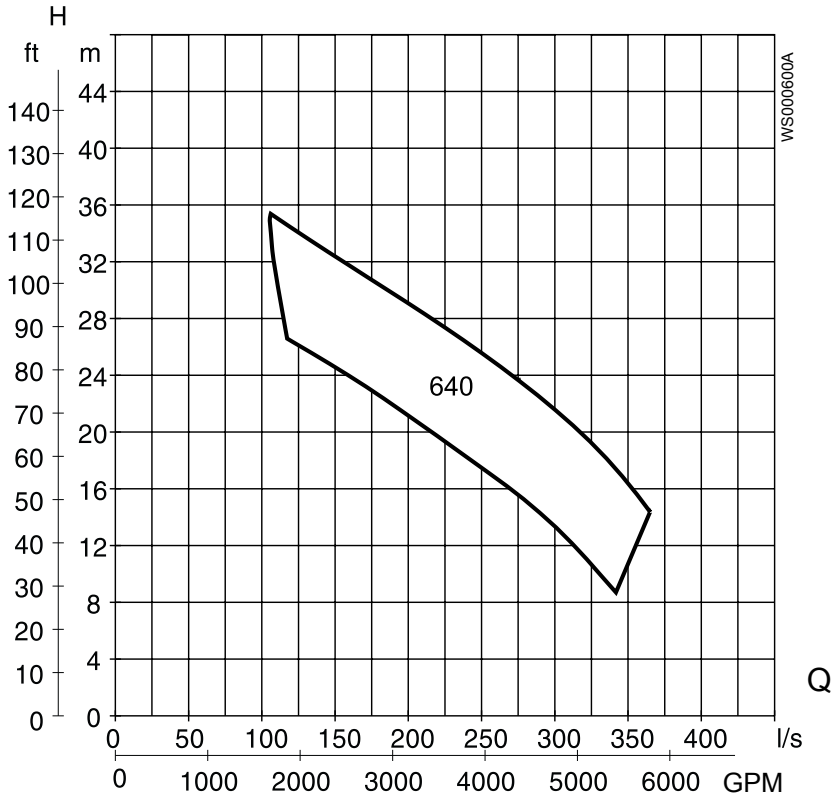


Figure 75: C3300, 60 Hz, low voltage (2 of 3)

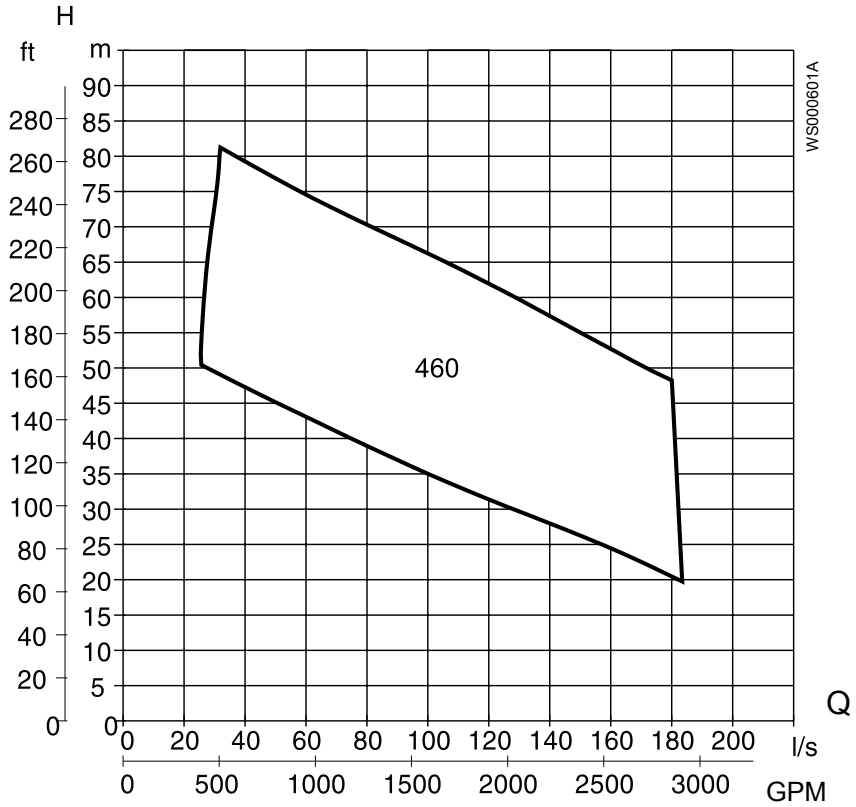


Figure 76: C3300, 60 Hz, low voltage (3 of 3)

C3306 Motor rating and performance, 60 Hz

Low voltage

Table 67: C3306, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
610	1185	665 / 675	460	82	139	865	0.81
		665 / 675	460	104	179	1195	0.79
		705 / 715	460	112	190	1155	0.80
		735 / 745	460	160	260	1555	0.83
631	1185	665 / 675	460	82	139	865	0.81
		665 / 675	460	104	179	1195	0.79
		705 / 715	460	112	190	1155	0.80
		735 / 745	460	160	260	1555	0.83
810	880	605 / 615	460	52	92	440	0.79
		665 / 675	460	63	111	550	0.79
		665 / 675	460	75	128	665	0.80
831	880	605 / 615	460	52	92	440	0.79
		665 / 675	460	63	111	550	0.79
		665 / 675	460	75	128	665	0.80

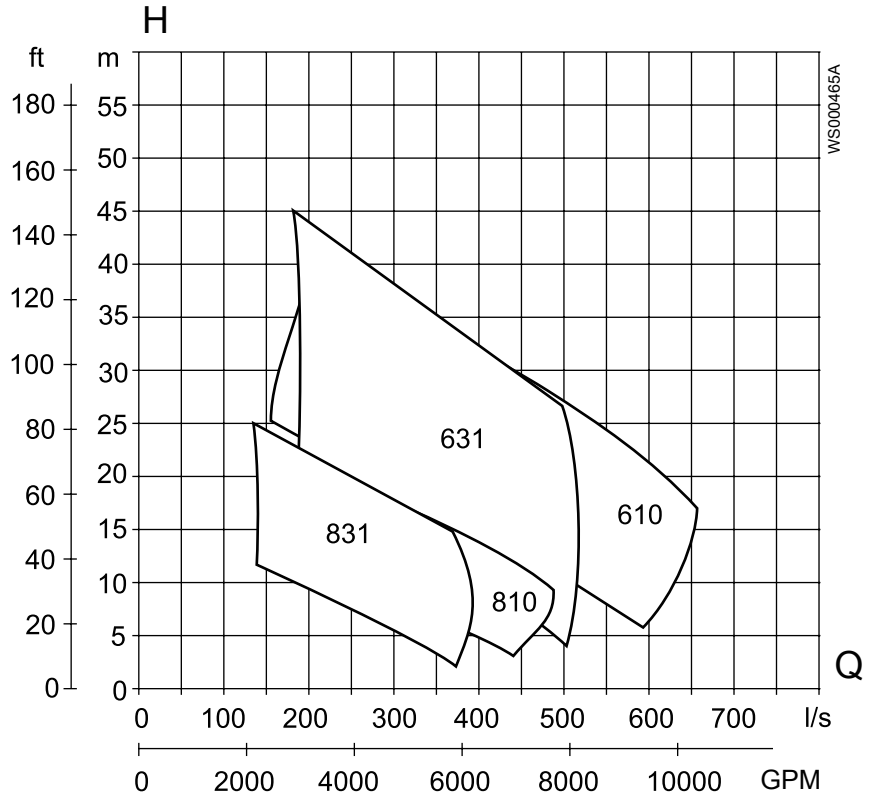


Figure 77: C3306, 60 Hz, low voltage

C3312 Motor rating and performance, 60 Hz

Low voltage

Table 68: C3312, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
830	885	705 / 715	460	90	112	515	0.83
			600	90	87	445	0.82
			460	135	173	790	0.81
			600	135	135	625	0.8
		735 / 745	460	185	231	1090	0.82
			600	185	178	840	0.82
		765 / 775	460	230	285	1355	0.82
			600	230	218	1025	0.82
630	1185	735 / 745	460	215	260	1555	0.83
			600	215	206	1305	0.80
		765 / 775	460	280	345	2230	0.80
			600	280	263	1640	0.81
		835 / 845	460	385	455	2670	0.84
			600	385	345	1975	0.84
		865 / 875	460	470	555	3405	0.84
			600	470	435	2835	0.84

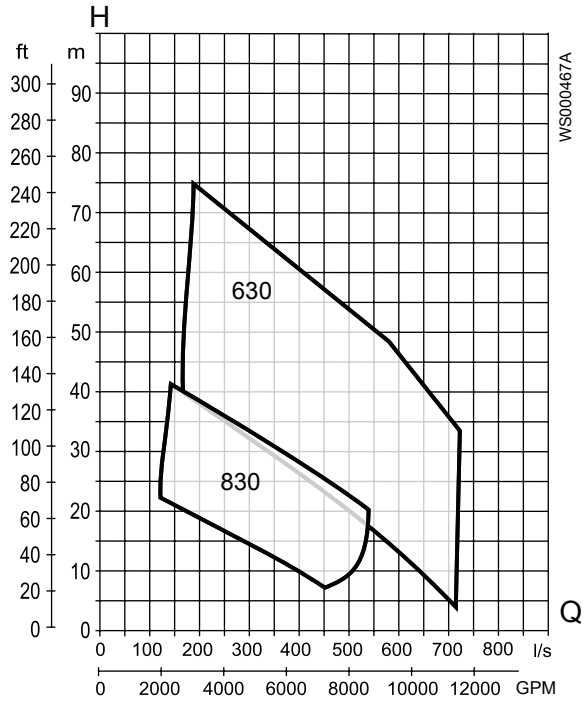


Figure 78: C3312, 60 Hz, low voltage

Medium voltage

Table 69: C3312, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
630	1195	862 / 872	4160	310	39	269	0.87
		882 / 892	4160	405	52	395	0.85
			4160	525	66	490	0.86

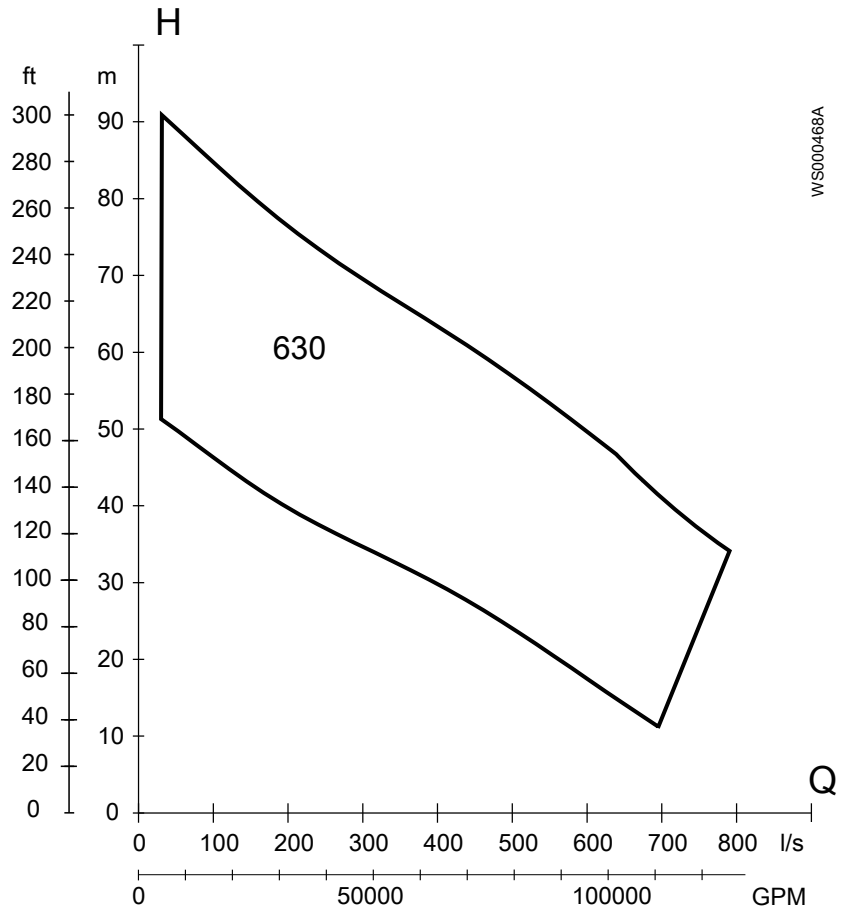


Figure 79: C3312, 60 Hz, medium voltage

C3351 Motor rating and performance, 60 Hz

Low voltage

Table 70: C3351, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
650	995	905 / 915	4160	580	675	4170	0.84
		935 / 945	4160	720	830	5175	0.84
			4160	860	970	5570	0.86
		965 / 975	4160	1040	1145	5985	0.88
850	895	905 / 915	4160	430	495	2755	0.85
		935 / 945	4160	525	605	3340	0.85
			4160	620	720	4570	0.84

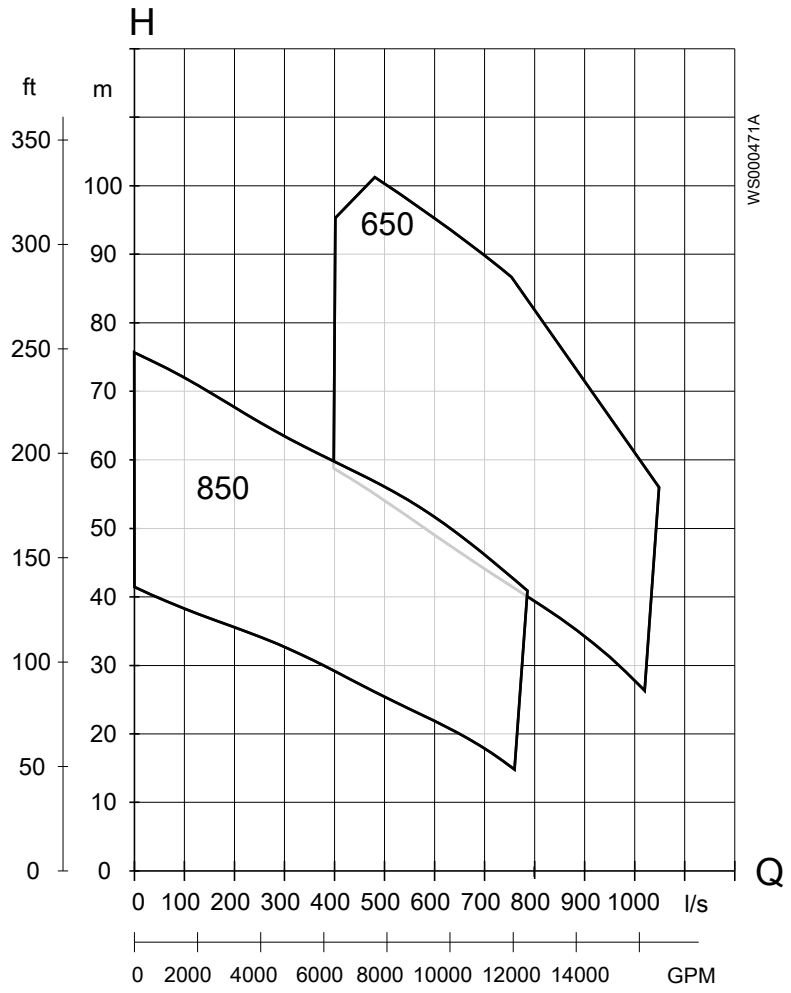


Figure 80: C3351, 60 Hz, low voltage

Medium voltage

Table 71: C3351, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
650	1195	985 / 995	4160	630	83	545	0.82
			4160	730	94	625	0.84
			4160	800	101	660	0.86
850	895	950 / 960	4160	350	47	284	0.82
			4160	450	60	365	0.82
		985 / 995	4160	540	72	455	0.81

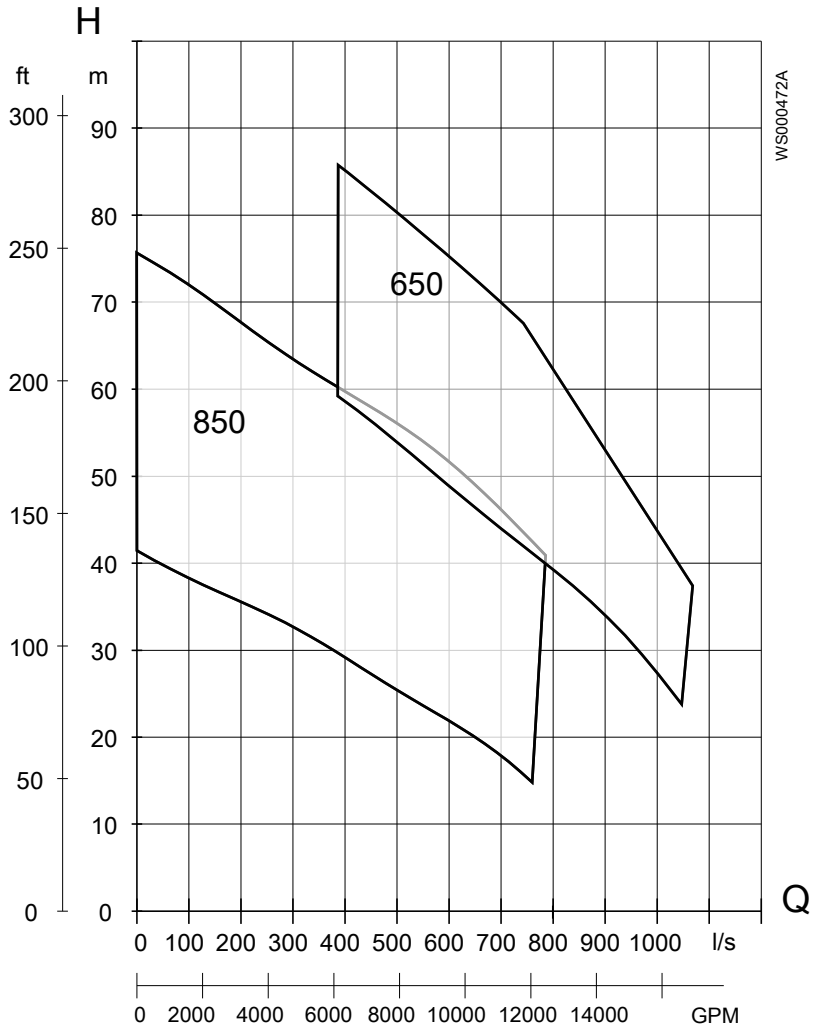


Figure 81: C3351, 60 Hz, medium voltage

C3356 Motor rating and performance, 60 Hz

Low voltage

Table 72: C3356, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, kW	Rated current, A	Starting current, A	Power factor cos φ
610	1185	665 / 675	460	82	139	865	0.81
		665 / 675	460	104	179	1195	0.79
		705 / 715	460	112	190	1155	0.80
		735 / 745	460	160	260	1555	0.83
		765 / 775	460	209	345	2230	0.80
810	730	605 / 615	460	52	92	440	0.79
		665 / 675	460	63	111	550	0.79
		665 / 675	460	75	128	660	0.80
		705 / 715	460	101	173	790	0.81

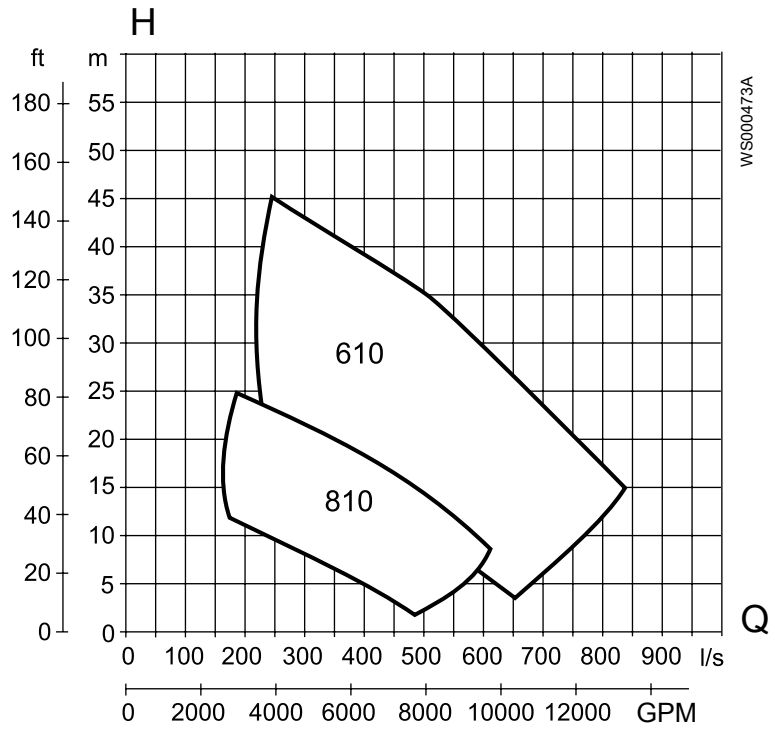


Figure 82: C3356, 60 Hz, low voltage

C3400 motor rating and performance, 60 Hz

Low voltage

Table 73: C3400, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1430	505	705 / 715	460	60	110	375	0.57
			600	60	85	297	0.57
1230	590	705 / 715	460	60	103	395	0.61
			600	60	76	282	0.63
		735 / 745	460	90	148	565	0.63
			600	90	116	445	0.62
		765 / 775	460	120	195	725	0.63
			600	120	154	590	0.61
1030	710	735 / 745	460	90	129	565	0.72
			600	90	103	485	0.69
		765 / 775	460	135	211	960	0.66
			600	135	167	775	0.64
		835 / 845	460	170	231	890	0.75
			600	170	184	825	0.72
		865 / 875	460	185	253	1275	0.74
			600	185	210	1180	0.68
830	885	735 / 745	460	185	231	1085	0.82
			600	185	178	840	0.82
		765 / 775	460	230	285	1355	0.82
			600	230	218	1025	0.82
		835 / 845	460	335	430	2425	0.78
			600	335	340	2045	0.75
		865 / 875	460	415	515	2785	0.80
			600	415	395	2150	0.80
630	1190	735 / 745	460	385	455	2670	0.84
			600	385	345	1975	0.84
		765 / 775	460	470	555	3405	0.84
			600	470	435	2835	0.82

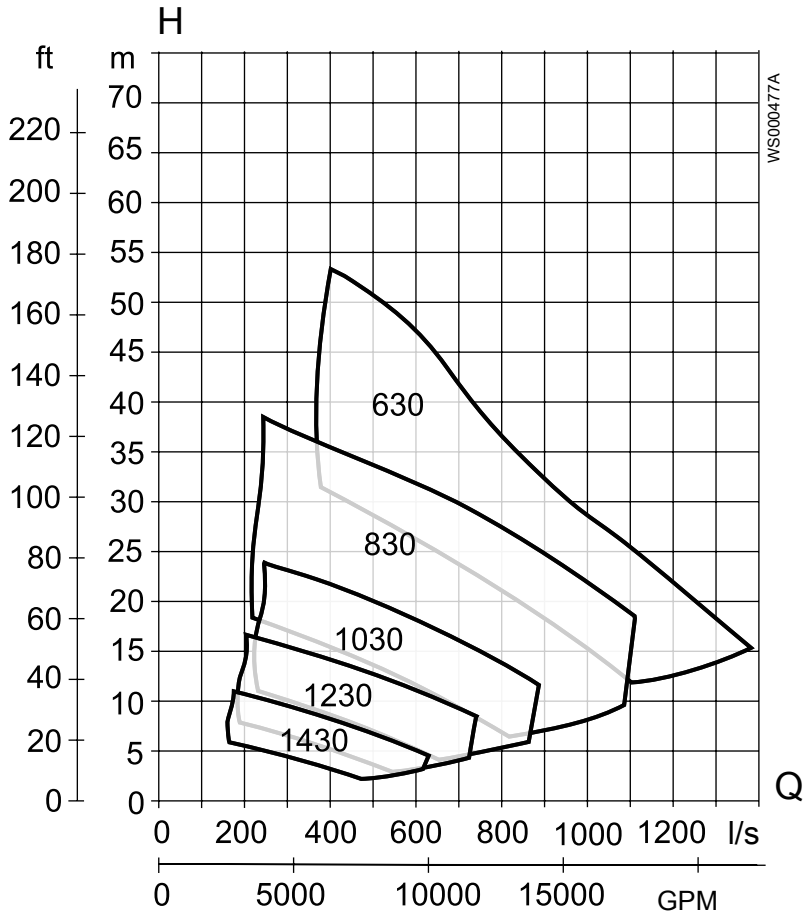


Figure 83: C3400, 60 Hz, low voltage

Medium voltage

Table 74: C3400, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1030	710	862 / 872	4160	220	33	147	0.75
830	895	862 / 872	4160	250	34	213	0.81
		882 / 892	4160	330	46	305	0.79
			4160	400	55	330	0.80
630	1195	882 / 892	4160	405	52	395	0.85
			4160	525	66	490	0.86

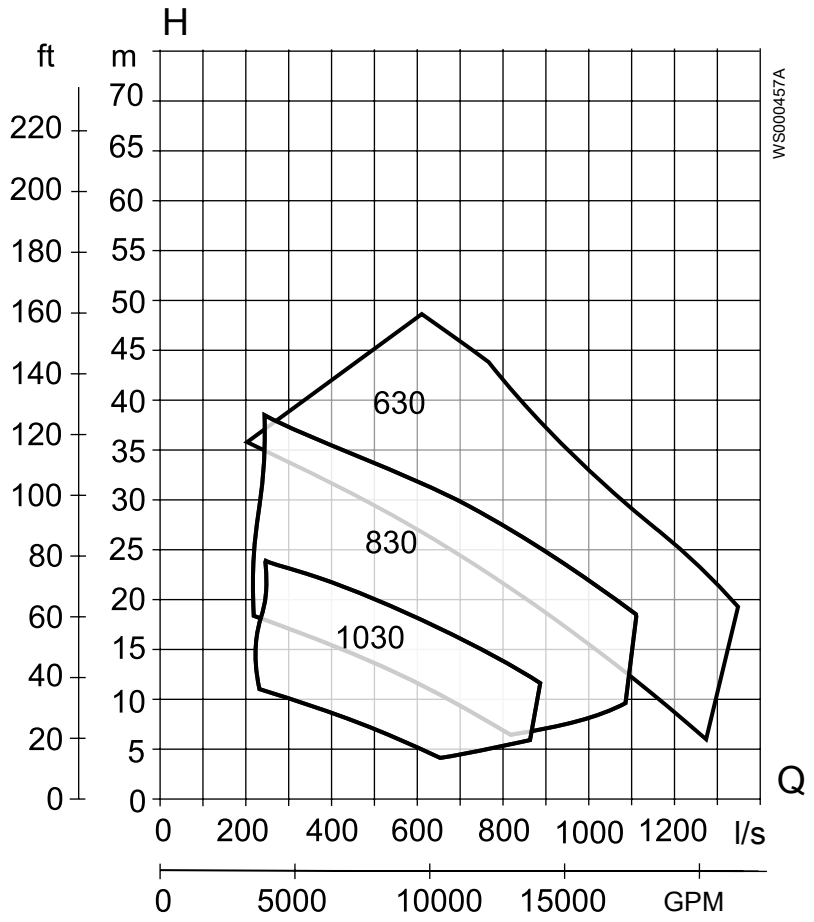


Figure 84: C3400, 60 Hz, medium voltage

C3501 Motor rating and performance, 60 Hz

Low voltage

Table 75: C3501, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1430	505	705 / 715	460	60	110	375	0.57
			600	60	85	297	0.57
		735 / 745	460	90	157	515	0.60
			600	90	123	420	0.58
		765 / 775	460	110	190	625	0.60
			600	110	153	540	0.57
		805 / 815	460	130	214	855	0.62
			600	130	173	730	0.59
1230	590	735 / 745	460	90	148	565	0.63
			600	90	116	445	0.62
		765 / 775	460	120	195	725	0.63
			600	120	154	590	0.61
		805 / 815	460	150	243	1055	0.62
			600	150	191	860	0.61
		835 / 845	460	215	345	1500	0.62
			600	215	279	1270	0.59
1030	710	765 / 775	460	170	231	890	0.75
			600	170	184	825	0.72
		805 / 815	460	185	253	1275	0.74
			600	185	210	1180	0.68
		835 / 845	460	250	355	1965	0.71
			600	250	276	1555	0.69
		865 / 875	460	325	430	2095	0.75
			600	325	325	1530	0.76

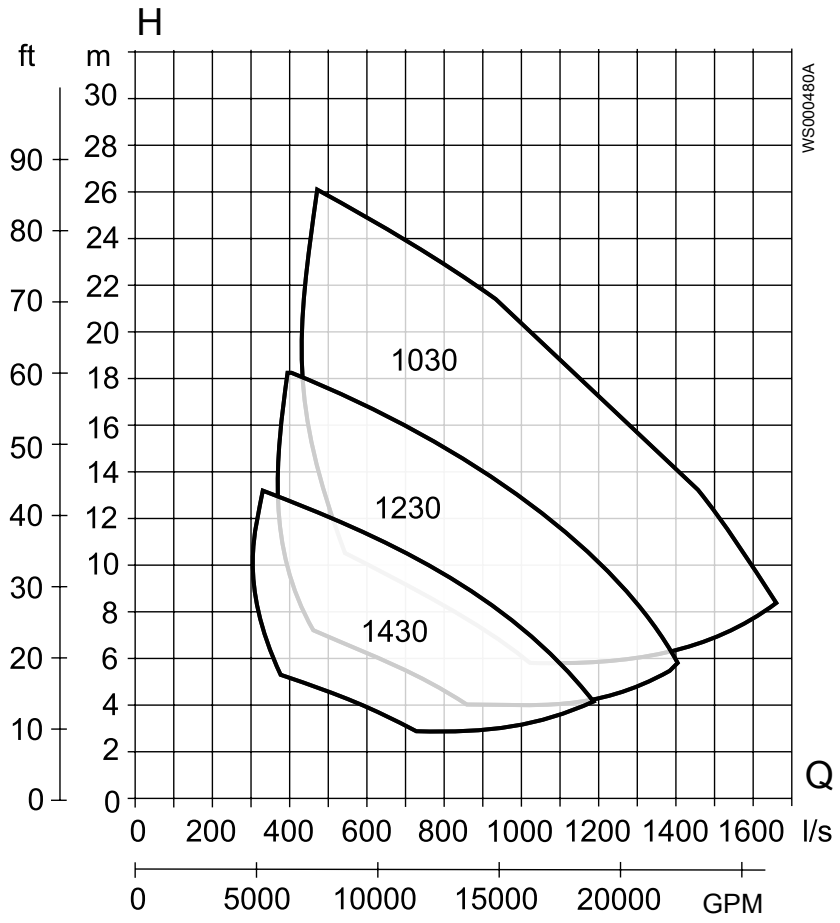


Figure 85: C3501, 60 Hz, low voltage

Medium voltage

Table 76: C3501, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1430	505	862 / 872	4160	135	26	95	0.60
1230	590	862 / 872	4160	190	34	153	0.63
		882 / 892	4160	225	37	175	0.68
1030	710	862 / 872	4160	220	33	147	0.75
		882 / 892	4160	270	40	184	0.75
		882 / 892	4160	350	50	264	0.77

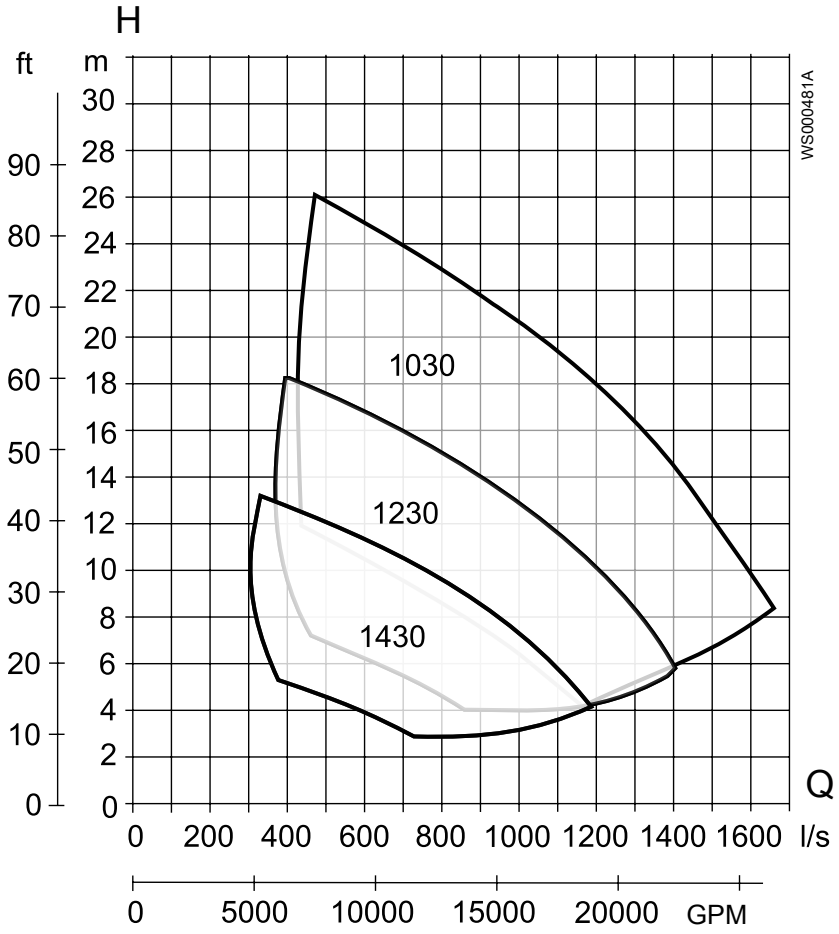


Figure 86: C3501, 60 Hz, medium voltage

C3531 Motor rating and performance, 60 Hz

Low voltage

Table 77: C3531, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	505	705 / 715	460	60	110	375	0.57
			600	60	85	297	0.57
		735 / 745	460	90	157	515	0.60
			600	90	123	420	0.58
		765 / 775	460	110	190	625	0.60
			600	110	153	540	0.57
		805 / 815	460	130	214	855	0.62
			600	130	173	730	0.59
		835 / 845	460	170	269	1035	0.65
			600	170	226	960	0.60
1240	590	735 / 745	460	90	148	565	0.63
			600	90	116	445	0.62
		765 / 775	460	120	195	725	0.63
			600	120	154	590	0.61
		805 / 815	460	150	243	1055	0.62
			600	150	191	860	0.61
		835 / 845	460	215	345	1505	0.62
			600	215	279	1270	0.59
		865 / 875	460	280	435	1800	0.65
			600	280	355	1580	0.61
1040	705	735 / 745	460	135	211	960	0.66
			600	135	167	775	0.64
		765 / 775	460	170	231	890	0.75
			600	170	184	825	0.72
		805 / 815	460	185	253	1275	0.74
			600	185	210	1180	0.68
		835 / 845	460	250	355	1965	0.71
			600	250	276	1555	0.69
		865 / 875	460	325	430	2100	0.75
			600	325	325	1530	0.76
		905 / 915	460	385	465	2485	0.81
			600	385	350	1815	0.82
			460	500	600	3095	0.82
			600	500	480	2780	0.78

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
840	890	835 / 845	460	335	430	2425	0.78
			600	335	340	2045	0.75
		865 / 875	460	415	515	2785	0.80
			600	415	395	2150	0.80
		905 / 915	460	430	495	2755	0.85
			600	430	380	2010	0.85
			460	525	605	3340	0.85
			600	525	465	2580	0.85
		935 / 945	460	620	720	4570	0.84
			600	620	545	3115	0.85
			460	720	835	5250	0.84
			600	720	640	4155	0.84
		965 / 975	460	870	980	5975	0.86
			600	870	750	4530	0.87

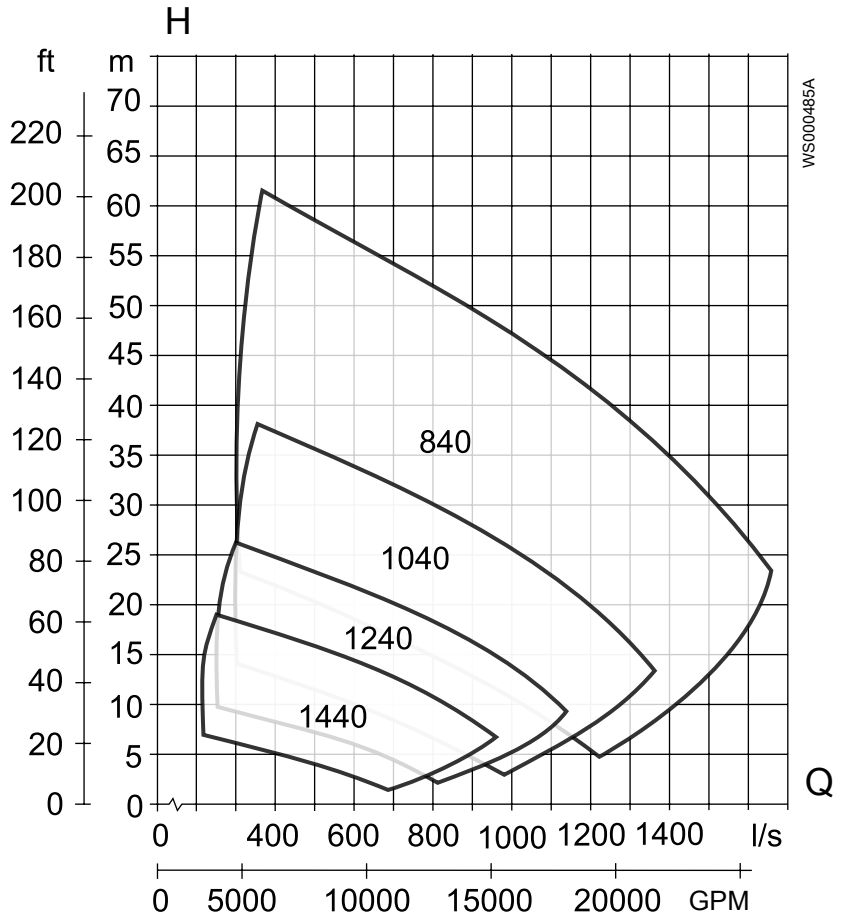


Figure 87: C3531, 60 Hz, low voltage

Medium voltage

Table 78: C3531, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	505	862 / 872	4160	135	26	95	0.60
		882 / 892	4160	180	34	118	0.61
1240	590	862 / 872	4160	190	34	153	0.63
		882 / 892	4160	225	37	175	0.68
			4160	300	48	208	0.70
1040	705	862 / 872	4160	220	33	147	0.75
		882 / 892	4160	270	40	184	0.75
			4160	350	50	264	0.77
		950 / 960	4160	310	42	217	0.82
			4160	390	52	280	0.82
		985 / 995	4160	440	59	340	0.81
			4160	540	72	405	0.82
840	890	882 / 892	4160	330	46	305	0.79
			4160	400	55	330	0.80
		950 / 960	4160	350	47	284	0.82
			4160	450	60	365	0.82
		985 / 995	4160	540	72	455	0.81
			4160	670	87	495	0.84
			4160	740	96	575	0.84

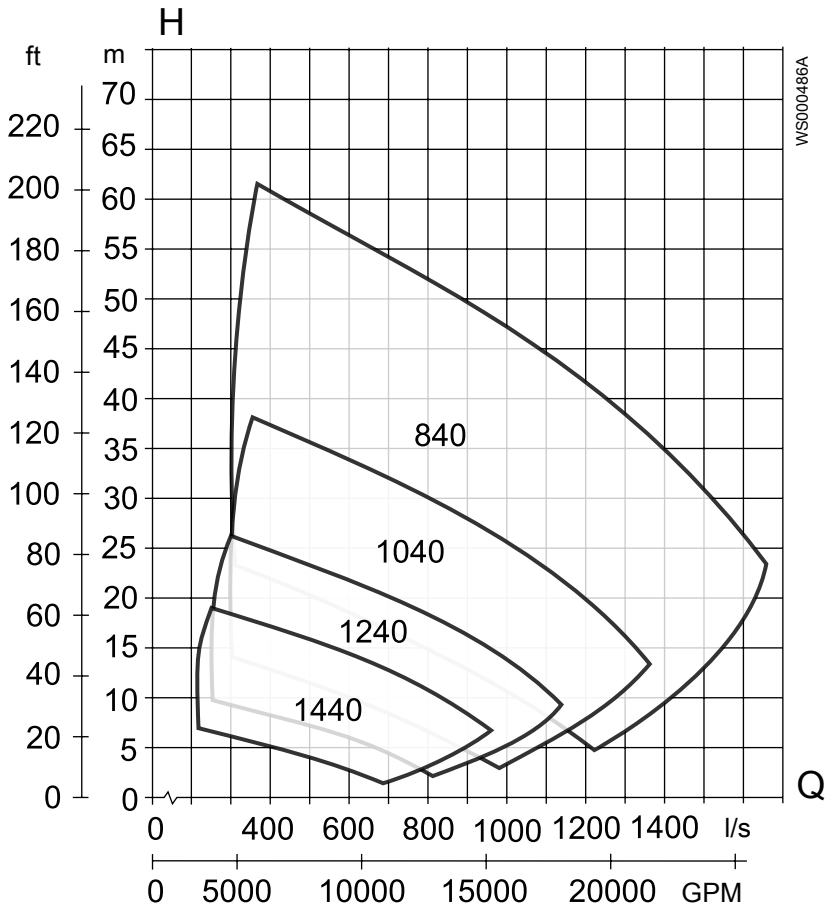


Figure 88: C3531, 60 Hz, medium voltage

C3602 Motor rating and performance, 60 Hz

Low voltage

Table 79: C3602, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	505	735 / 745	460	90	157	515	0.60
			600	90	123	420	0.58
		765 / 775	460	110	190	625	0.60
			600	110	153	540	0.57
		805 / 815	460	130	214	855	0.62
			600	130	173	730	0.59
		835 / 845	460	170	269	1035	0.65
			600	170	226	960	0.60
		865 / 875	460	215	335	1290	0.66
			600	215	269	1090	0.63
1240	590	805 / 815	460	150	243	1055	0.62
			600	150	191	860	0.61
		835 / 845	460	215	345	1500	0.62
			600	215	279	1270	0.59
		865 / 875	460	280	435	1800	0.65
			600	280	355	1580	0.61
1040	705	835 / 845	460	250	355	1965	0.71
			600	250	276	1555	0.69
		865 / 875	460	325	430	2095	0.75
			600	325	325	1530	0.76
		905 / 915	460	385	465	2485	0.81
			600	385	350	1815	0.82
			460	500	600	3095	0.82
			600	500	480	2780	0.78

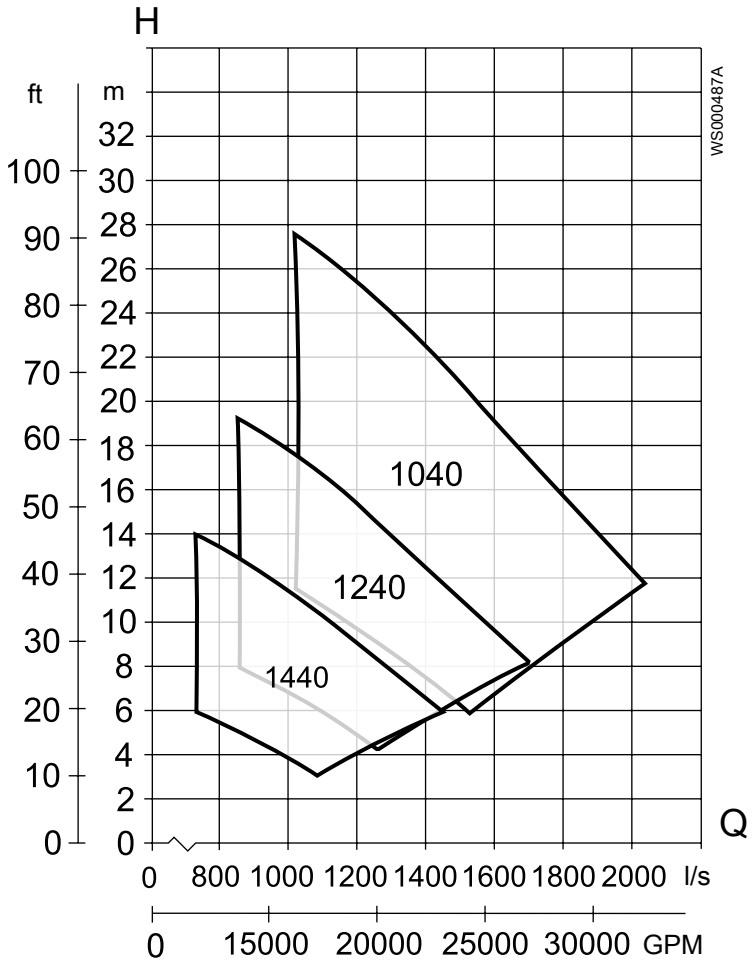


Figure 89: C3602, 60 Hz, low voltage

Medium voltage

Table 80: C3602, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	505	862 / 872	4160	135	26	95	0.60
		882 / 892	4160	180	34	118	0.61
1240	590	862 / 872	4160	190	34	153	0.63
		882 / 892	4160	225	37	175	0.68
			4160	300	48	208	0.70
1040	705	882 / 892	4160	270	40	184	0.75
			4160	350	50	264	0.77
		950 / 960	4160	310	42	217	0.82
			4160	390	52	280	0.82
		985 / 995	4160	440	59	340	0.81
			4160	540	72	405	0.82

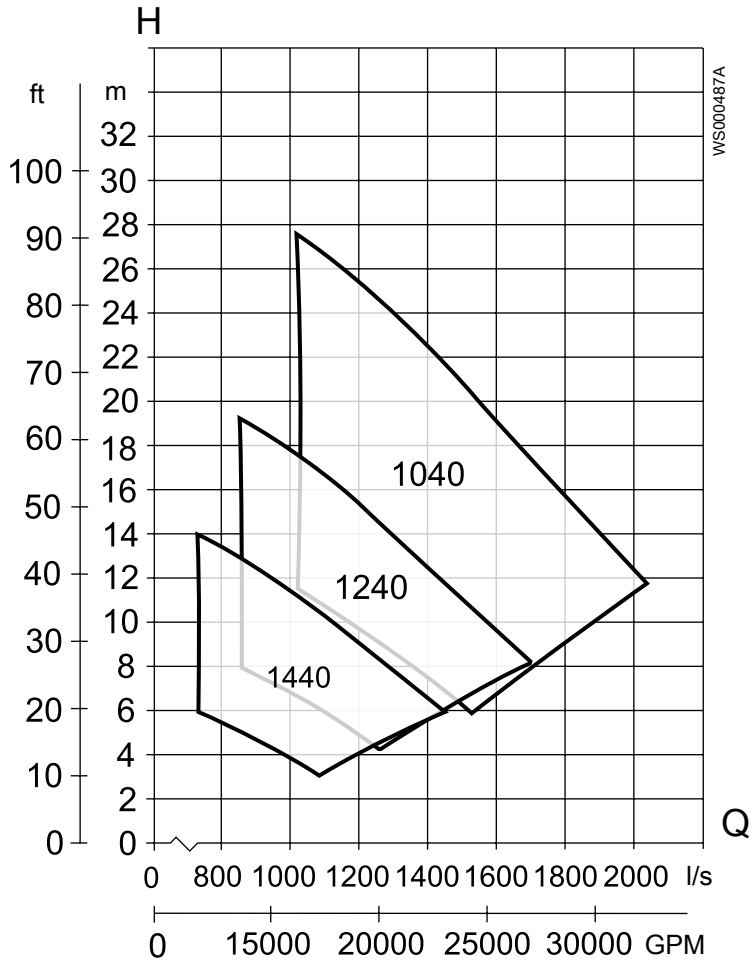


Figure 90: C3602, 60 Hz, medium voltage

C3800 Motor rating and performance, 60 Hz

Low voltage

Table 81: C3800, 60 Hz, low voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	500	905 / 915	460	240	515	1840	0.74
			600	240	254	1005	0.72
			460	310	420	1605	0.73
			600	310	325	1265	0.73
		935 / 945	460	385	515	1840	0.74
			600	385	430	1850	0.68
			460	460	630	2410	0.72
			600	460	510	2160	0.69
1240	595	905 / 915	460	350	450	1710	0.78
			600	350	345	1355	0.77
			460	430	570	2520	0.75
			600	430	435	1905	0.75
		935 / 945	460	500	650	2815	0.76
			600	500	500	2230	0.75
			460	600	780	3375	0.76
			600	600	615	2850	0.74
		965 / 975	460	730	955	4070	0.75
			600	730	800	3785	0.69
1040	710	935 / 945	460	580	710	4215	0.80
			600	580	510	2355	0.85
			460	700	805	3490	0.85
			600	700	625	3035	0.84
		965 / 975	460	845	1010	5615	0.82
			600	845	755	3900	0.84

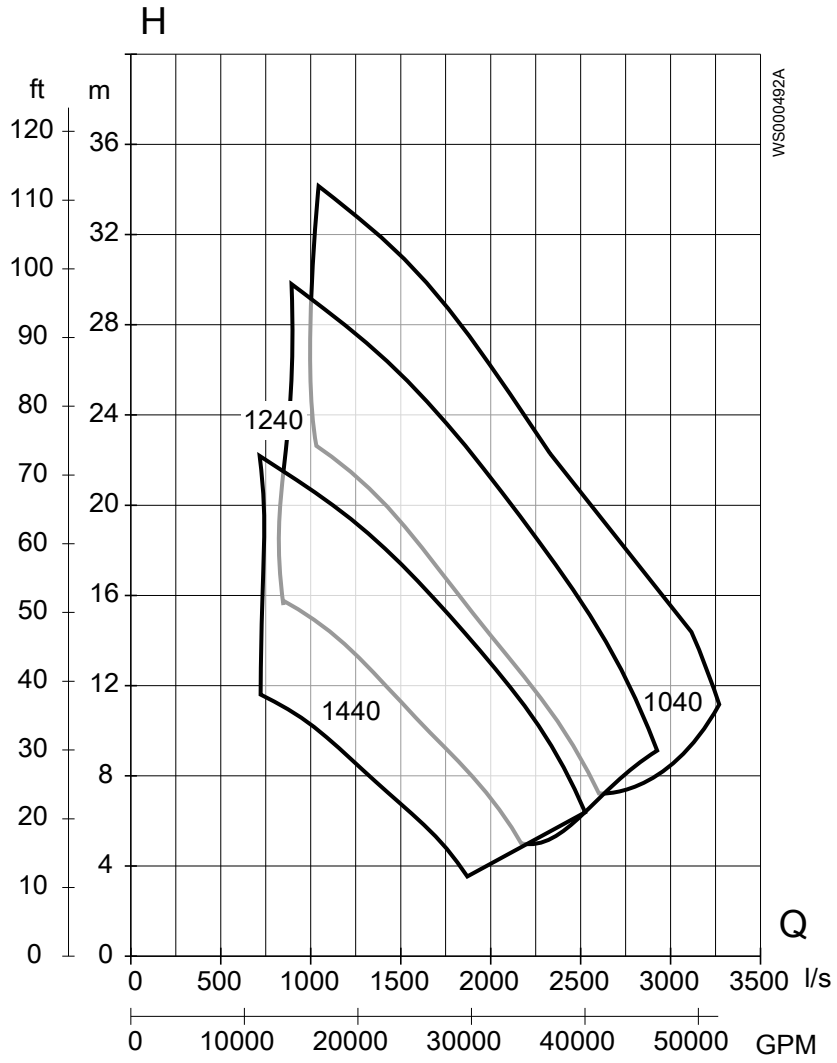


Figure 91: C3800, 60 Hz, low voltage

Medium voltage

Table 82: C3800, 60 Hz, medium voltage

Curve / impeller no.	Rotations per minute	Drive unit	Voltage, V	Rated power, HP	Rated current, A	Starting current, A	Power factor cos φ
1440	500	950 / 960	4160	215	35	129	0.69
			4160	280	45	167	0.69
		985 / 995	4160	335	52	185	0.71
			4160	400	63	233	0.70
			4160	460	72	270	0.71
1240	595	985 / 995	4160	400	61	284	0.72
			4160	470	71	330	0.73
			4160	560	82	375	0.75
1040	710	985 / 995	4160	440	59	340	0.81
			4160	540	72	405	0.82
			4160	670	88	485	0.83

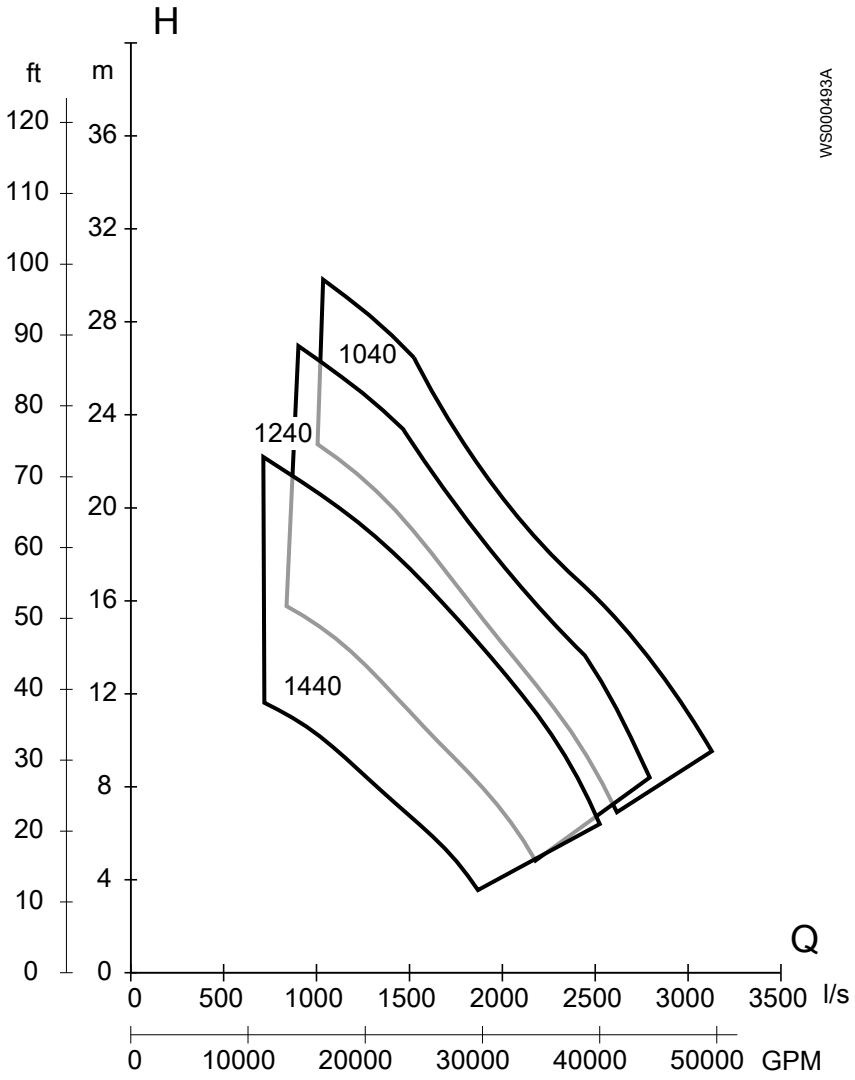


Figure 92: C3800, 60 Hz, medium voltage

ITT

What can ITT Water & Wastewater do for you?

Integrated solutions for fluid handling are offered by ITT Water & Wastewater as a world leader in transport and treatment of wastewater. We provide a complete range of water, wastewater and drainage pumps, equipment for monitoring and control, units for primary and secondary biological treatment, products for filtration and disinfection, and related services. ITT Water & Wastewater, headquartered in Sweden, operates in some 140 countries across the world, with own plants in Europe, China and North and South America. The company is wholly owned by the ITT Corporation of White Plains, New York, supplier of advanced technology products and services.

FLYGT SANITAIRE® WEDECO LEOPOLD

Visit our Web site for the latest version of this document and more information
http://webservices.ittwww.com/tpi/

ITT Water & Wastewater AB
Gesällvägen 33
174 87 Sundbyberg
Sweden
Tel. +46-8-475 60 00
Fax +46-8-475 69 00