

ENGINEERING
TOMORROW



User Guide

Integrated Motor / Generator

EM-PME375



Revision history

Table of revisions

Date	Changed	Rev
July 2021	Updated user guide	0201

Contents

General information

Intended use of the user guide.....	5
Product naming convention	5
Conformity according to standards.....	6
Warranty.....	6
Terms and abbreviations.....	7
Responsibility of the manufacturer.....	7

Safety information

General safety statement.....	8
Safety message signal words.....	8
Safety symbols.....	8
Personal protective equipment.....	9
Security features.....	9
Electromagnetic compatibility (EMC).....	10

Product overview

Intended use of the electric machine.....	12
Used technology.....	12
System introduction.....	13
Connections and interfaces.....	14
Rating plate.....	15
Tightening torques.....	17

Design principles

System design.....	18
Cooling and temperature measurement	18
Inverter.....	18
Mounting structure.....	20
Supporting structure requirements.....	20
Shaft alignment and load.....	21
Customer connection interface design instruction.....	22

Transportation and storage

Transportation.....	29
Receiving and unpacking.....	29
Lifting.....	29
Storage.....	31
Extended storage.....	31

Installation

Required tools.....	33
Insulation resistance test.....	33
Mechanical installation.....	33
Allowed mounting positions.....	33
Mounting the electric machine.....	34
Installation procedure.....	36
Cooling connections.....	47
Electrical installation.....	48
Power connections.....	48
High voltage connection.....	48
Connection diagram.....	50
Low voltage connections.....	50
Grounding connections.....	52

Operation

Operation conditions.....	56
Condition monitoring during operation.....	56
Recommended coolants.....	56
Emergency operation.....	57

Maintenance

Contents

Regular maintenance..... 58
Cleaning..... 59
Cooling system maintenance..... 59

Dismounting

Troubleshooting

Aftersales

Service policy..... 62
Service parts..... 62

Disposal

Storage, installation and maintenance checklists

General information

This user guide is the installation, operation and maintenance user guide for the EM-PME375-T150 and EM-PME375-T200 electric machines.

Intended use of the user guide

This user guide contains instructions necessary to safely and properly handle, install, operate and maintain the electric machine. They should be brought to the attention of anyone who installs, operates or maintains the machine or associated equipment.

All of the safety warnings and instructions in this user guide must be followed to prevent injury to personnel or damage to property. Only qualified and authorized personnel, familiar with health and safety requirements and national legislation, shall be permitted to handle, install, operate and maintain the device.

This user guide must be kept for future reference during installation, operation and maintenance.

This user guide uses illustrations as examples only. Illustrations in this user guide may not necessarily reflect all system features.

Product naming convention

In this user guide, EM-PME family permanent magnet motors and generators are referred to as the electric machine.

Frame model indicates dimensions and electrical characteristics of the electric machine. The following naming convention is used to refer to the electric machine frame model:

- EM-PME375-T150-XXXX+XX
- EM-PME375-T200-XXXX+XX

The naming codes of the electric machine

Part of the name	Meaning
EM	Electric Machine
PMIXXX or PMEXXX	Permanent Magnet Internal and a number relative to the diameter of the electric machine, or Permanent Magnet External and a number relative to diameter of the electric machine
TXXXX	Average continuous torque of the motor range, relative to the length of the machine
XXXX	Rated rotation speed
+XX	Options, see option table below. Standard options are indicated by a star (*).

The power input of the electrical machine requires a three phase power system.

The electric machine can include some of the options available. The options of the electric machine are shown also in the rating plate, following the frame model code. Note! Only options that differ from the standard delivery are indicated. Following options are used, see Table below. For detailed information of the models, options and characteristics, see product data sheets.

General information

EM-PME375-T150 and EM-PME375-T200 options

Variant	Code	Description	Additional information
High voltage connector	*	High voltage plug-in connectors for 50 mm ² cables	One plug-in connector per phase for 50 mm ² cable
	+HVC1	High voltage plug-in connectors for 35 mm ² cables	One plug-in connector per phase for 35 mm ² cable
Rotation sensor	*	None	No resolver
	+RES1	Resolver	In-built non contacting resolver, 5-pole pair

Conformity according to standards

The electric machine as partly completed machinery is in conformity with the following other directive(s), harmonized standard(s) or other normative document(s), provided it/they are used in accordance with our instructions. As partly completed machinery the product itself does not have declaration of conformity but instead declaration of incorporation. This partly completed machinery must not be used before the final machinery into which it is to be incorporated has been declared in conformity with the Machinery Directive and other relevant directives.

Applicable Directives and standards

Standard	Explanation
Low Voltage Directive 2006/95/EC (until 19.4.2016) and Low Voltage Directive 2014/35/EU (from 20.4.2016 onwards)	Electrical equipment means any equipment designed for use with a voltage rating of between 50 and 1000 V for alternating current. This electric machine is subject to the Low Voltage Directive 2006/95/EC or 2014/35/EC.
Machinery Directive 2006/42/EC	This electric machine is partly subject to the Machinery Directive 2006/42/EC and it is considered as partly completed machinery, as a part of the final machinery.
IEC 60034-1:2010	Rotating electrical machines - Part 1: Rating and performance
IEC 60034-5:2000/A1:2006	Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification
IEC 60034-6:1991	Rotating electrical machines - Part 6: Methods of cooling
IEC 60034-7:1992/A1:2000	Rotating electrical machines - Part 7: Classification of types of construction, mounting arrangements and connection box position (IM Code)
IEC 60034-8:2007/A1:2014	Rotating electrical machines - Part 8: Terminal markings and direction of rotation
IEC 60034-14:2018	Amendment 1 - Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity.

Warranty

Danfoss offers warranty against defects in workmanship and materials for its products for a period of twelve (12) months from commissioning or eighteen months (18) from delivery (Incoterms-EXW), whichever occurs first.

In order for the warranty to be valid, the customer must follow the requirements of this and all related documents, especially those set out in the product installation and maintenance, as well as the applicable standards and regulations in force in each country.

Defects arising from the improper or negligent use, operation, and/or installation of the equipment, non-execution of regular preventive maintenance, as well as defects resulting from external factors or equipment and components not supplied/recommended by Danfoss, will not be covered by the warranty.

General information

The warranty will not apply if the customer at its own discretion makes repairs and/or modifications to the equipment without prior written consent from Danfoss.

Terms and abbreviations

The symbols, terms and abbreviations in the Tables below are possibly used in this manual.

Symbols

Symbol	Variable	Unit
U	Rated voltage (phase-to-phase AC)	V _{rms}
I	Rated current (AC)	A _{rms}
P	Rated Power (S1)	kW
T	Rated torque (S1) at rated speed	Nm
T_{\max}	Maximum torque	Nm
n	Rated speed	rpm
$Max\ n$	Maximum speed	rpm
f	Rated supply frequency at nominal speed	Hz
PF	Power factor ($\cos\phi$)	
Q_c	Rated coolant liquid flow	l/min
T_c	Rated coolant liquid input temperature	°C
T_{amb}	Rated ambient temperature	°C
RES_COS	Cosine signal received from the resolver	deg
RES_SIN	Sinusoidal signal received from the machine resolver	deg
GND	Ground in electrical connections	
Ω (Ohm)	Resistance	Ω

Term / abbreviation

Term/ Abbreviation	Explanation
Resolver	Rotation meter in electric machines, used for measuring degrees of rotation
AC	Alternating current
DC	Direct current
PMSM	Permanent Magnet Synchronous Machine
SRPM	Synchronous Reluctance assisted Permanent Magnet
S1	Duty type according to the IEC60034; Continuous running duty
S9	Duty type according to the IEC60034; Duty with non-periodic load and speed variations

Responsibility of the manufacturer

Danfoss is responsible for the safety, reliability and performance of the electric machine only if:

- Handling, mounting, installation, operation and maintenance are done by qualified and authorized personnel.
- The installation of the system complies with the requirements of the appropriate regulations.
- The electric machine is used in accordance with the instructions in this user guide.
- The electric machine is installed, maintained and serviced in accordance with the instructions in this user guide.

Safety information

General safety statement

- The electric machine is intended for use as a component for industrial and commercial installations. The end product containing the electric machine must conform with all related regulations.
- The use of the electric machine is prohibited in hazardous areas unless it is expressly designed for such use.
- The electric machine is intended for installation, use and maintenance by qualified personnel, familiar with health and safety requirements and national legislation. Ignoring these instructions may invalidate all applicable warranties.
- These instructions must be followed to make sure of safe and correct installation, operation and maintenance of the electric machine. They should be brought to the attention of anyone who installs, operates or maintains the electric machine or associated equipment.
- High voltage and rotating parts can cause serious or fatal injuries. For electric machine covered by this user guide, it is important to observe safety precautions to protect personnel from possible injury.

Safety message signal words

Safety message signal words indicate the severity of a potential hazard.

DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.





WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. CAUTION may also alert against unsafe practices.

NOTICE Indicates a potentially hazardous situation which, if not avoided, could result in property damage.

Safety symbols

The following safety and information related symbols appear in this user guide and on the electric machine.

	Danger This symbol is identified by a yellow background, red octagonal band and a black STOP text. It indicates a hazardous situation that causes severe injury or death. Action indicated by this symbol may not be executed.
	General warning This symbol is identified by a yellow background, black triangular band, and a black exclamation point symbol. It indicates a general potentially hazardous situation.
	Electric shock warning The symbol is identified by a yellow background, black triangular band, and a black arrowhead symbol. It indicates dangerous electrical voltage that could cause an electric shock to a person.
	Burn warning The symbol is identified by a yellow background, black triangular band, and a black wavy lines symbol. It indicates a hot device that could cause burns to a person. The symbol also indicates that the device should be placed and installed so that contact with its potentially hot surface is not possible.

Safety information

	Magnet warning The symbol is identified by a yellow background, black triangular band, and a black magnet symbol. It indicates strong magnetic field that could cause harm to a person or property.
	Rotating shaft warning The symbol is identified by a yellow background, black triangular band, and a black rotating shaft symbol. It indicates strong rotating shaft that could cause harm to a person or property.
	General Information.
	Read the instructions in the user guide.

Personal protective equipment

Personal protective equipment shall be used when necessary during handling, installation and maintenance of the electric machine to avoid injury.

	Use eye protective equipment like safety goggles or mask when you work with the electric machine. Permanent damage to the eye could be caused if bearing grease, melted nitrile rubber (radial lip seal), glycol or other fluids splash.
	Use hearing protective equipment when you work on the electric machine. Hearing injuries can be caused by too loud noise (noise in excess of 85 dBA).
	Use head protective equipment like helmet when you lift the electric machine! Head injuries can be caused by object impact.
	Use cut resistant gloves when you handle and maintain the electric machine. There is a risk of cut injuries.
	Use protective footwear when you lift or move the electric machine! Foot injuries could be caused if lifting system or lifting brackets fail.



Security features

The electric machines have at least three PT100 temperature sensors in the windings. The amount of the sensors depend on the options chosen. The temperature signal(s) can be read out from the measurement

Safety information

connector of the electric machine. You can connect the temperature signal to the temperature surveillance pin in the inverter (EC-C) and make sure that the inverter has the temperature protection feature of the electric machine activated.

Electromagnetic compatibility (EMC)



	When interfacing other equipment, connect only equipment that are specified as part of the system and that are compatible.
	Magnetic and electromagnetic fields generated near the current-carrying conductors and permanent magnets in electric machines represent a health danger to persons with heart pacemakers, metal implants and hearing aids. Persons with a heart pacemaker, metal implants or hearing aids must consult a doctor before they enter the following areas: <ul style="list-style-type: none">• Areas in which electric equipment and parts are operated• Areas in which electric equipment with permanent magnets are stored, mounted, operated or repaired If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

EMC stands for Electromagnetic compatibility. It is the ability of electric equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality. This is a legal requirement for all equipment taken into service within the European Economic Area (EEA).

Our products are designed with high standards of EMC in mind. Connect the power lines and groundings along the instructions in this user guide to achieve the required level of EMI protection.

It is the responsibility of the installer to make sure that the equipment or system into which the product is incorporated complies with the EMC legislation of the country of use. Within the European Union, equipment into which this product is incorporated must comply with the EMC Directive 2014/30/EU.

Product overview

	The electric machine is not a complete machine as such, but it must be integrated to another system. This requires more work and planning than normal electric machine does.
	For harsh conditions, like salty air in marine applications, it is recommended to check the surface treatment possibilities with the factory.

The electric machines have been developed especially for heavy duty, marine and transportation applications. They are more reliable, smaller, lighter and more efficient than conventional products on the market.

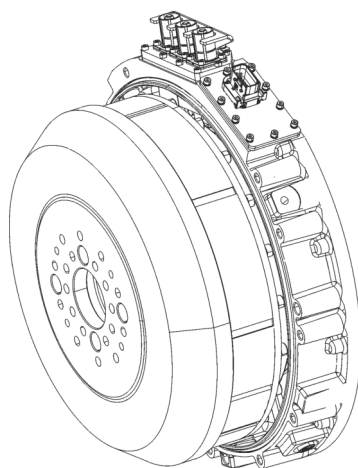
Typical applications of the electric machines are:

- Motor (electric propulsion) and generator for hybrid marine vessels or mobile work machine and bus parallel hybrid applications.
- Traction motor and generator for electrical or hybrid electrical mobile work machines or buses.

The electric machines feature Synchronous Reluctance assisted Permanent Magnet (SRPM) motor technology, having several advanced features:

- Extremely compact and robust structure.
- High efficiency throughout the operation range.
- Liquid cooling with water/glycol mixture.
- Low coolant flow required.
- High allowed coolant temperature.
- Possibility for IP65 enclosure class to maximize reliability.
- Multiple mounting possibilities.
- Extended speed and torque capabilities compared to standard PM machines.
- Machine structure designed to be able to produce high starting torques (instant torque to non-moving wheel).
- Optimized speed range to meet most common gear ratios used in heavy mobile machinery.

The electric machine



The integrated electric machines have several frame models (sizes) to be the optimal solutions for several applications. These are T150 and T200 frames. The electric machines also have options for temperature sensors.

Product overview

Intended use of the electric machine

This electric machine is intended to be used as a motor or generator and as a part of a machinery, for example in:

- Power train of a marine vessel, transportation vehicle or a heavy duty work machine.
- Power generation equipment.

In a power generation equipment the electric machines are intended to be powered by a prime mover, for example, an internal combustion engine and controlled by the above mentioned electric power inverter.

The electric machine is solely intended for professional use, and may be operated only by trained professionals. The maintenance of the electric machine may be done only by trained professionals.

Forbidden use of the electric machine

It is forbidden to use, handle and maintain the machine in following ways (including but not limited to):

- Using the electric machine for other purposes than defined in this user guide.
- Disregarding the obligation to comply with the user guide, safety signs and rating plate of the electric machine.
- Using the electric machine, making adjustments and maintenance without first reading this user guide.
- Exceeding the designed limits during the electric machine operation.
- Using non-original service parts of wrong material causing corrosion problems and mechanical failures in time.
- Operating and performing maintenance for the electric machine without appropriate personal protective equipment.
- Using electric machine parts like frame, shaft end or terminal box for climbing or for support for other structures.
- Causing any kind of impact forces to the electric machine (for example hitting or hammering or dropping objects).
- Operating the electric machine with electric connections other than defined in the user guide and/or other documents.
- Operating the electric machine with insufficiently tightened connections or cable glands.
- Operating the electric machine with power cables routed against the instructions.
- Operating the electric machine without properly dimensioned and operating cooling system.
- Operating the electric machine without following the bearing lubrication instructions.
- Touching the connection terminal of the electric machine or doing maintenance or adjustment operations on the electric machine with the electricity connected.
- Touching the connection terminal if the rotor can be turned by an external prime mover.
- Lifting the electric machine from wrong lifting points and without correct lifting equipment.
- Lifting additional load with the machine.
- Storing the electric machine outdoors in wet or dusty conditions.
- Storing the electric machine without correct support to prevent rolling or falling of the machines.
- Using the electric machine in potentially explosive environment.
- Allowing dirt or liquid to enter into the electric machine or connection box.
- Using cables that cannot withstand the maximum currents of the electric machine.

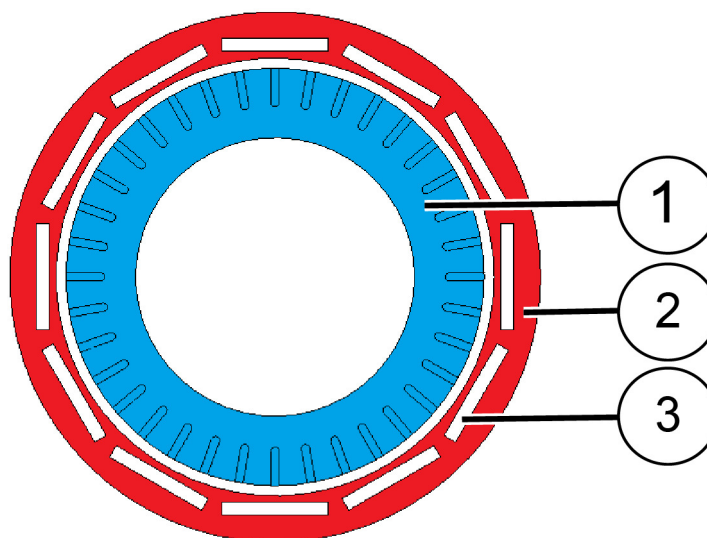
Used technology

This electric machine is a Synchronous Reluctance assisted Permanent Magnet (SRPM) machine. This technology has several benefits compared to standard permanent magnet (PM) technology and traditional induction machine (IM) technology. The SRPM technology combines the benefits of PM and Synchronous Reluctance technology, having increased torque capability over wide speed range and ability to produce torque to higher speeds. The machine efficiency at lower speeds is also good.

Product overview

The supply current to the stator windings create rotating magnetic field, which in turn rotates the rotor containing permanent magnets. In the synchronous permanent magnet machine, the rotation of the rotor (shaft) is synchronized with the frequency of the power supply current. The reluctance technology maximizes the pull-out torque of the machine.

The permanent magnets of the rotor are of salient-pole design, having embedded permanent magnets in the rotor structure. This structure makes the machine mechanically more stable and capable of higher speed operations. See Figure below illustrating the magnet topology of the electric machine. The Figure shows the principle only, and is not an exact illustration of the structure.



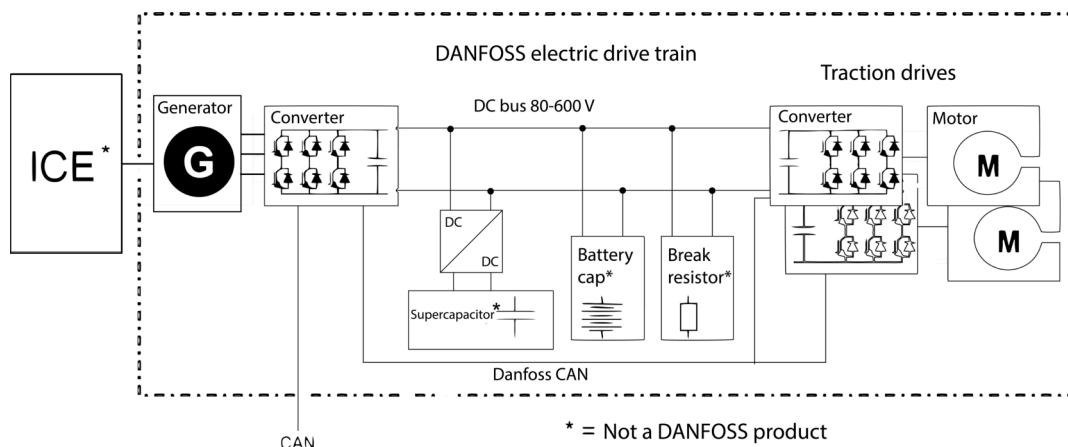
Machine topology

1	Electric machine stator and stator windings
2	Electric machine rotor
3	Permanent magnets in the rotor

System introduction

Danfoss provides electric drive trains for applications in heavy mobile work machines, marine vessels and buses. The drive trains include all essential components from converting from traditional to hybrid electric (HEV) or electric vehicle (EV) solutions. Danfoss technology saves fuel and lowers emission and noise levels.

Overview of the Danfoss drive train system



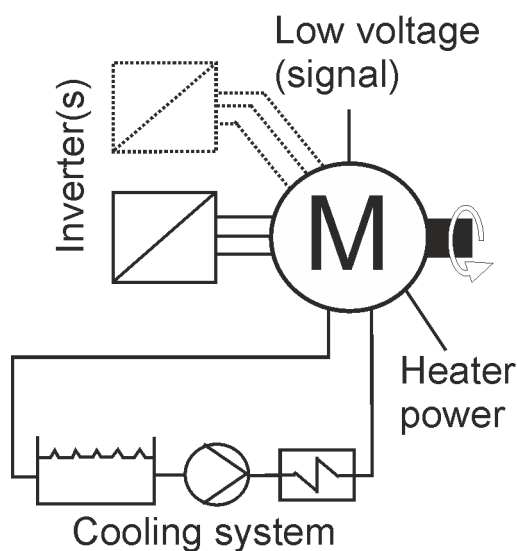
Product overview

The electric machines are liquid cooled with water/glycol mixture. For more information, see Chapter [Cooling connections](#).

A low voltage measurement signal connector is attached to the electric machines. Different temperature and resolver signals can be read, depending on the machine options chosen. For more information about the connection, see Chapter [Low voltage connections](#).

The electric machines (some models) can be equipped with one or two anti-condensations heater(s), depending on the machine type and the option chosen. The heater is used to prevent any water condensing inside the machine enclosure.

Overview of electric machine system



Connections and interfaces

The electric machines are connected mechanically and electrically as a part of a machinery or as a part of a power generation equipment.

Mechanical interfaces:

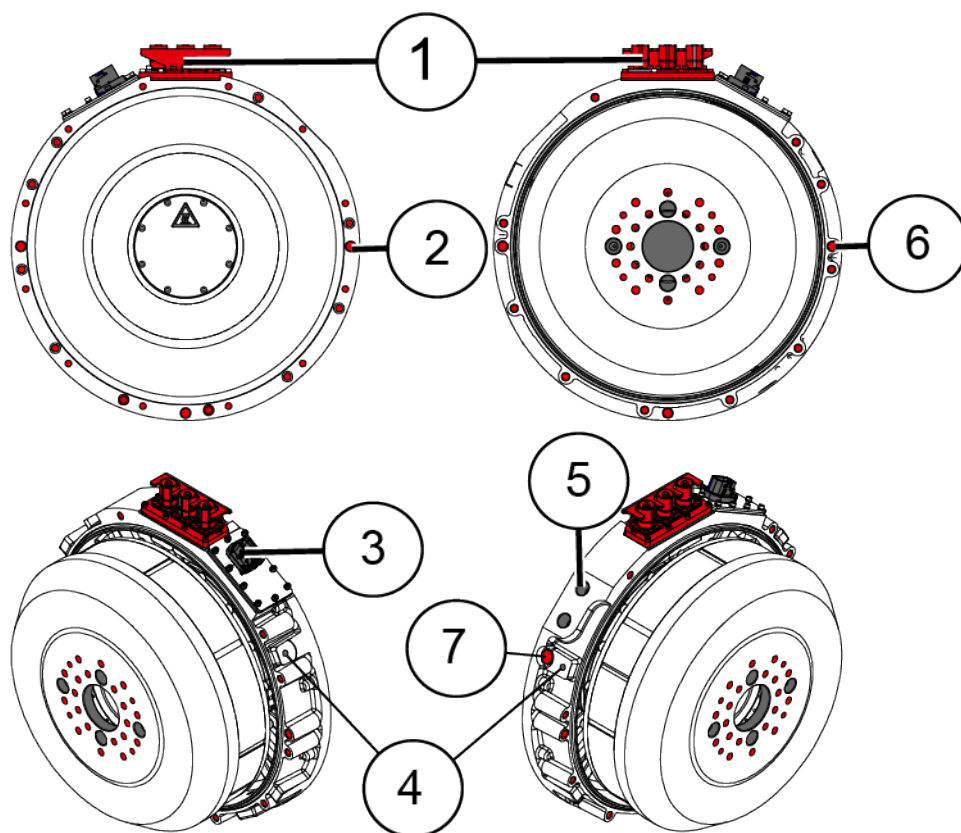
- Lifting points.
- Flange mounting (D-end and N-end).
- Cooling system connections (bores).
- Air ventilation plug.

Electrical interfaces:

- Power connections.
- Measurement connections.
- Low voltage (measurement signal) grounding connection.
- Power grounding connection.

Product overview

Connections and interfaces



1	Power connections
2	N-end flange mounting
3	Low voltage connector (measurement connector), including low voltage grounding connector
4	Lifting points
5	Cooling system connections (bores)
6	D-end flange mounting
7	Air ventilation plug

Rating plate

Each electric machine has a rating plate which can be found on the machine frame. The rating plate contains machine rating and identification. The rating values in the Figure below are not correct for this machine. See the rating plate on the machine and data sheets for the correct values.

Product overview

Rating plate

① **EM-PMX-XXXX-XXXX**

② **EM-PMX-XXXX-XXXX + XXXX + XXX + XXX**

MADE IN FINLAND

Serial No. XXXXX - XXXXXXXXX

U: XXX V	Qc: XX l/mi	IP rating: IPXX
I: XX A	Pole pairs: X	Cooling: XXX
P: XXkW	Tc: XX°C	Rotation: XXX
n: XXXX rpm	Mounting: XX	Max n: XXXX rpm
T: XXX Nm	Mass XXX kg	Insul. class: XXX °C
PF: XXX	Duty: XX	Temp. class XXX °C
f: XXX Hz	Tamb: XX °C	Bear./ D-end XXX
		Bear./ N-end: XXX
		Max. Pressure: X bar

Manuf.: 20XX

Danfoss A/S, 6430 Nordborg, Denmark

Rating plate fields




Field	Explanation	Unit
1	Electric machine product family: EM-PMI or EM-PME	
2	Electric machine type code and options	
Serial No.	Serial number	
U	Rated voltage	V _{rms}
I	Rated current (AC)	I _{rms}
n	Rated speed	rpm
PF	Power factor	
f	Rated supply frequency at nominal speed	Hz
Q _c	Rated coolant liquid flow	l/min
Pole pairs	Number of magnetic pole pairs of the machine	
T _c	Rated coolant liquid input temperature	°C
Mounting	Allowed mounting position according to IEC60034-7	
Mass	Mass of the electric machine	kg
Duty	Defined rotating electric machine duty cycles by IEC60034-1 standard	
T _{amb}	Rated ambient temperature	°C
IP rating	Enclosure class according to IEC60034-5	
Cooling	Cooling method according to IEC60034-6	
Rotation	Direction of rotor rotation with default phase order. Observed facing the D-end.	
Max n	Maximum rotation speed	rpm
Insul. class	Temperature rating (class) of insulation of the electric machine according to IEC60034-1	
Temp. class	Temperature rating (class) of individual insulation materials of the insulation according to IEC60034-1	

Product overview

Rating plate fields (continued)

Bear. / D-end	Bearing type (types) in the D-end of the electric machine	
Bear. / N-end	Bearing type in the N-end of the electric machine	
Max. pressure	Cooling liquid max pressure	
CE	Depending on the details of the delivery, the rating plate might not have CE-marking	

Tightening torques

	Tightening torque tolerance is +/- 5% of the specified tightening torque.
	Use threadlocking adhesive for RST bolts.
	Do not install dry screws or other fastening equipment. Add suitable lubrication, for example Wuerth HSP 1400, to prevent excess friction.

Tightening torques to use unless otherwise noted





	8.8	10.9	12.9
Thread	Nm	Nm	Nm
M5	7	10	11
M6	11	17	19
M8	27	40	47
M10	54	79	93
M12	93	137	160
M14	148	218	255
M16	230	338	395

Design principles

This Chapter describes design principles that must be taken into account when designing the system using the electric machine.

System design

Cooling and temperature measurement

	Do not operate the electric machine without correctly dimensioned and operating cooling system.
	Mount the electric machine in correct position, see Chapter Allowed mounting position.
	When you connect the cooling system make sure that the cooling medium flows freely in and out from the electric machine with the cooling medium flow equal or higher than rated.
	The cooling medium temperature at the inlet of the electric machine must be lower or equal to the rated temperature.

See more detailed information about coolant connection bore specifications, required coolant liquid flow and other specifications in the product data sheet. Rated values can be found from the electric machine rating plate.

The electric machine has at least one PT100 temperature sensor in the windings. The amount of the sensors depend on the options chosen. The temperature signal(s) can be read out from the measurement connector of the machine.

You can connect one temperature signal to the temperature surveillance pin in the inverter (EC-C1200) and make sure that the inverter has the machine temperature protection feature activated.

The maximum allowed winding temperature of the electric machine is shown in the rating plate and in the data sheet.

The PT100 temperature sensor characteristics are: resistance 100 Ω at 0 $^{\circ}\text{C}$ temperature, and the resistance increases 0.385 Ω per each 1 $^{\circ}\text{C}$ increase of temperature.

Inverter

The electric machine is intended to be powered and controlled with an inverter capable of supplying three-phase alternating current and that is capable of controlling the electric machine. The electric machine is not suitable for direct online use.

If the electric machine is driven with an inverter from a supplier other than Danfoss Editron, the electric machine performance may differ from rated values. The optimum performance of the electric machine is obtained with Danfoss Editron inverters. These inverters are:

Design principles

- Compact and light.
- Liquid cooled.
- Tolerant to high mechanical vibration (10 G) and shock (50 G).
- Efficient, efficiency > 98 %.
- Reliable, no moving components.



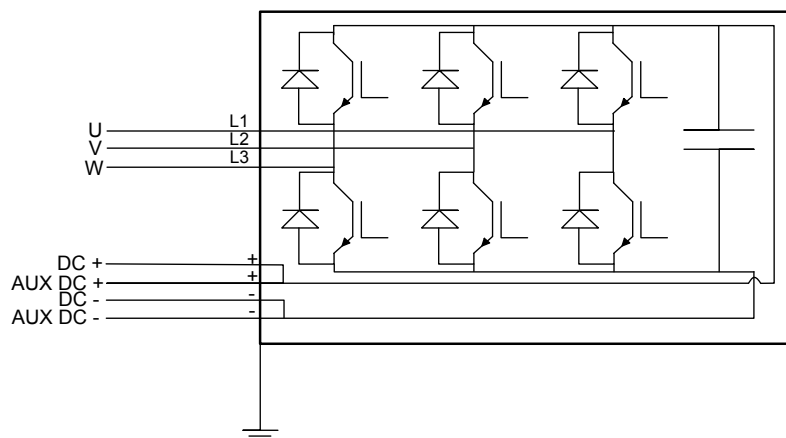
Do not exceed the maximum rotation speed of the electric machine.

EC-C1200



Design principles

Schematic of the inverter powerstage



The main machine power driving parameters are shown in the machine rating plate. For more information, contact Danfoss representative.

You can connect one of the temperature signals (from the low voltage connector) to the temperature surveillance pin in the inverter and make sure that the inverter has the machine temperature protection feature activated.

Mounting structure

Supporting structure requirements



Do not install the electric machine near or in direct contact with easily flammable materials. The surface of the electric machine can be hot.

The mating housing arrangement of the electric machine must be secure and sufficiently rigid to prevent vibrations and mechanical failures. Necessary actions should be taken to avoid corrosion on the mating housing arrangement.

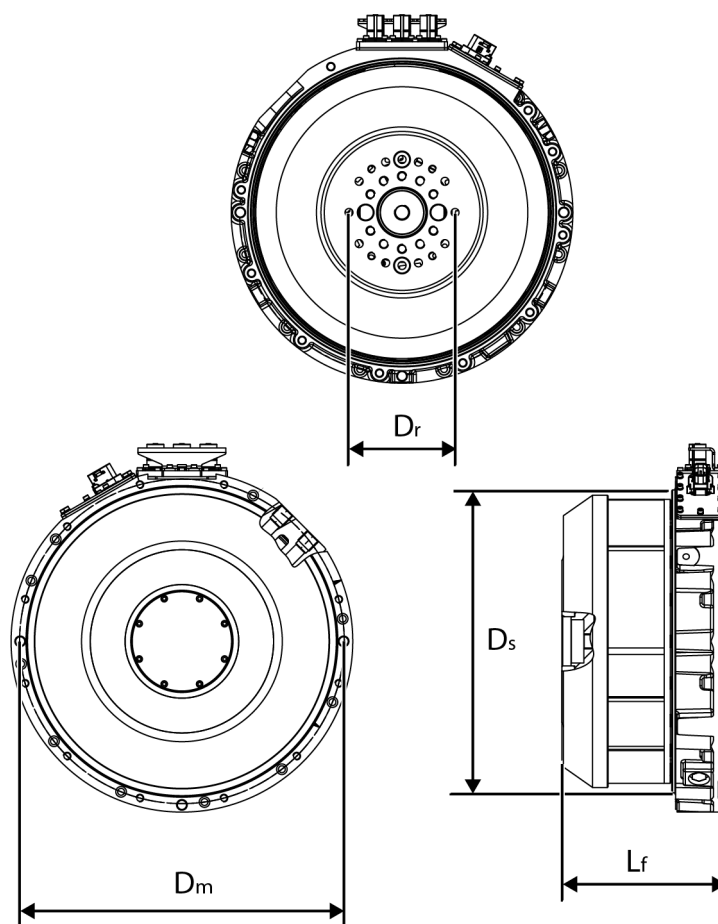
The supporting structure for the electric machine must be such that the electric machine can be mounted using its allowed mounting positions, see Chapter [Allowed mounting positions](#).

The mounting space must be adequate for the electric machine mounting and possible auxiliary components. See the length and the diameter data of the electric machine from the product drawing. Main dimensions of the electric machine are shown in the Figure below (the illustration may differ from the actual electric machine).

The electric machine has a SAE 3 flywheel housing in N-end. The D-end has a circle of bolt holes for fastening. See specific installation instructions.

Design principles

Main dimensions of the electric machine



Symbol	Explanation
L_F	Length of the electric machine frame.
D_M	Diameter of the flange mounting bore circle.
D_S	Diameter of the mounting shoulder.
D_R	Diameter of the rotor connection interface.

For all dimensions of the electric machine, see the product drawings.

Shaft alignment and load

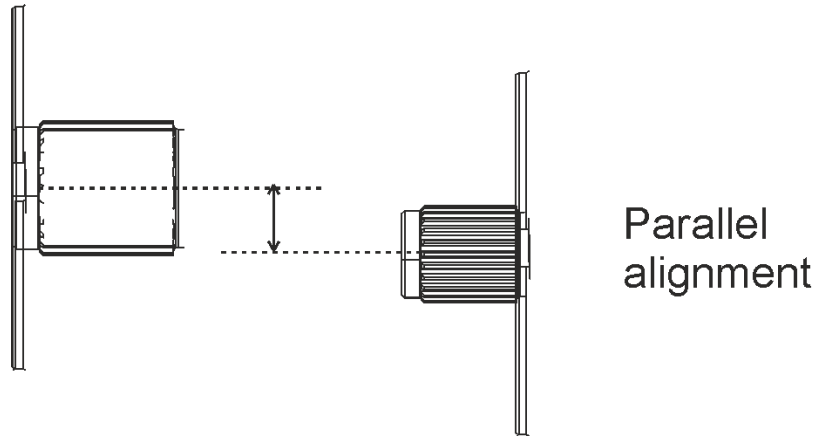
	<p>Improper alignment (misalignment) may result in bearing overloads, premature bearing failures, vibrations and shaft failures. Flexible coupling does not compensate for excessive misalignment.</p>
--	---

Alignment between the shaft and mating structure must be accurate.

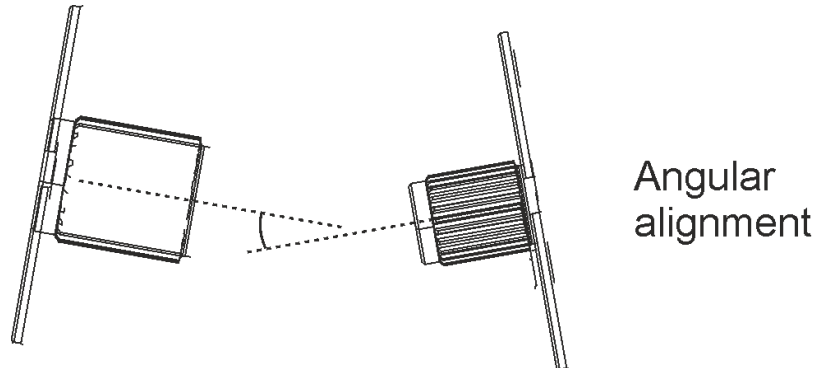
The misalignment can be parallel or angular misalignment, or combination of those. With parallel misalignment, the center lines of both shafts are parallel but they are offset. With angular misalignment, the shafts are at an angle to each other. Figures below illustrate the parallel and angular misalignment.

Design principles

Parallel alignment of the shaft and mating structure



Angular alignment of the shaft and mating structure



Customer connection interface design instruction

This Chapter describes the necessary design loads and tolerances for designing connection interface for Danfoss integrated electric machines (EM-PME375-T150 and EM-PME375-T200).

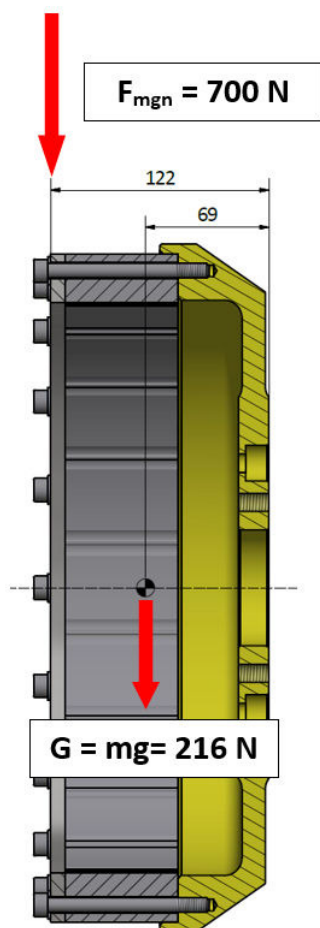
Design loads for EM-PME375-T150 and EM-PME375-T200 rotor

F_{mgn} = Magnetic force between rotor and frame

G = Gravitational force of rotor

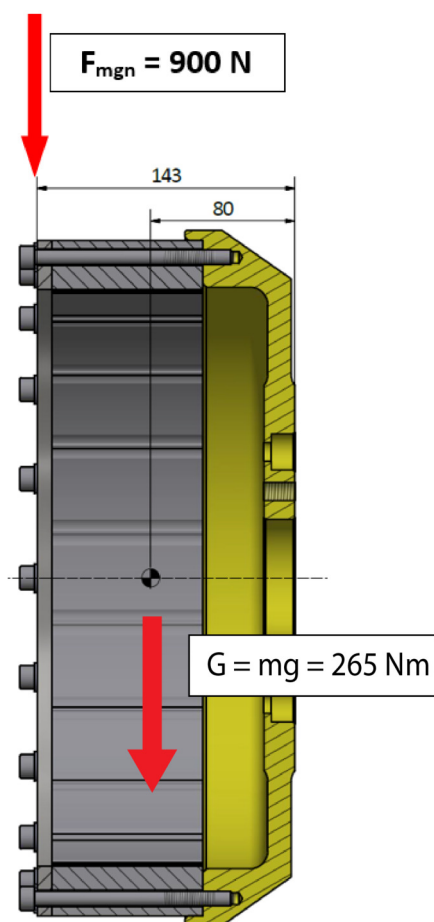
Design principles

Design loads for EM-PME375-T150 rotor



Design principles

Design loads for EM-PME375-T200 rotor



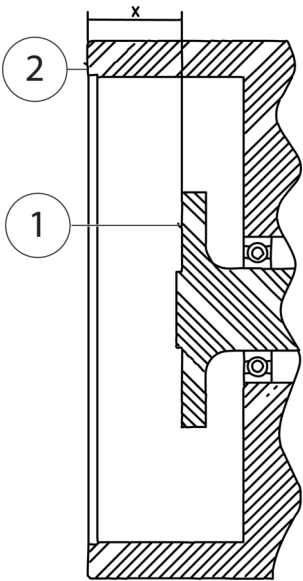
Allowed axial tolerances of connection interfaces:

Electric machine type EM-PME375-T150: Dimension X = $129,6\text{mm} \pm 0,5\text{mm}$

Electric machine type EM-PME375-T200: Dimension X = $150,0\text{mm} \pm 0,5\text{mm}$

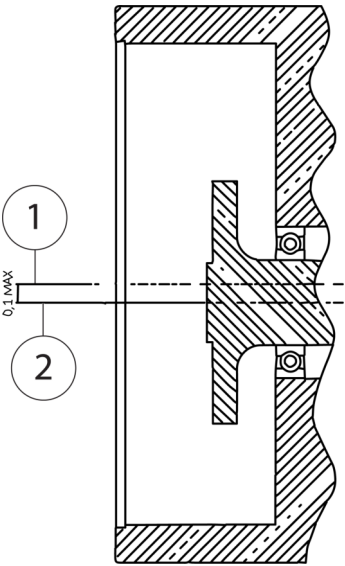
Design principles

Allowed axial tolerances



1	Connection face to electric machine rotor
2	Connection face to electric machine frame

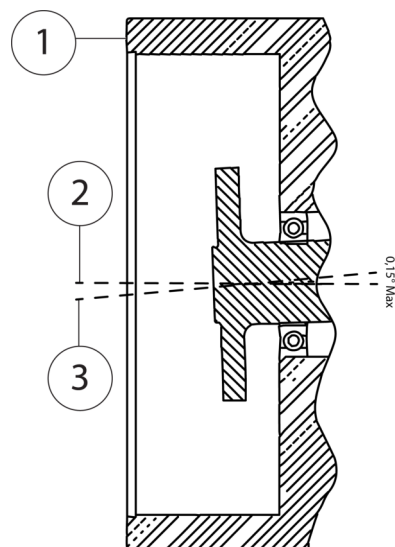
Allowed concentricity tolerances of connection interfaces



1	Centerline of electric machine frame connection interface
2	Centerline of electric machine rotor connection interface

Design principles

Allowed angular displacement tolerances of connection interfaces



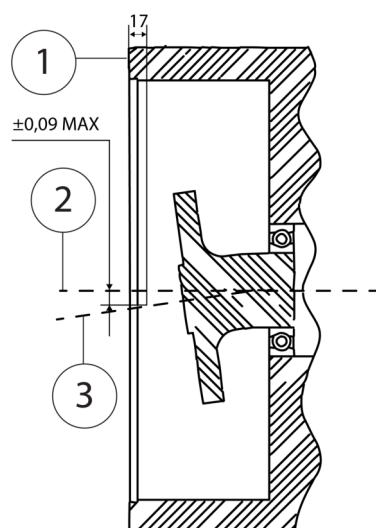
1	Connection face to electric machine frame
2	Centerline of electric machine frame connection interface
3	Centerline of electric machine rotor connection interface

Required radial stiffness of connection interface

When resultant force F_{tot} ($F_{mgn} + G$, see the Figures at the beginning of the Chapter) is applied to the system, the maximum allowed radial deformation of the rotor connection interface is 0,09mm in point P. See the Figure below.

It should be noted that some components, for example bearings and gears, can cause additional flexibility to rotor interface and it should be taken into account.

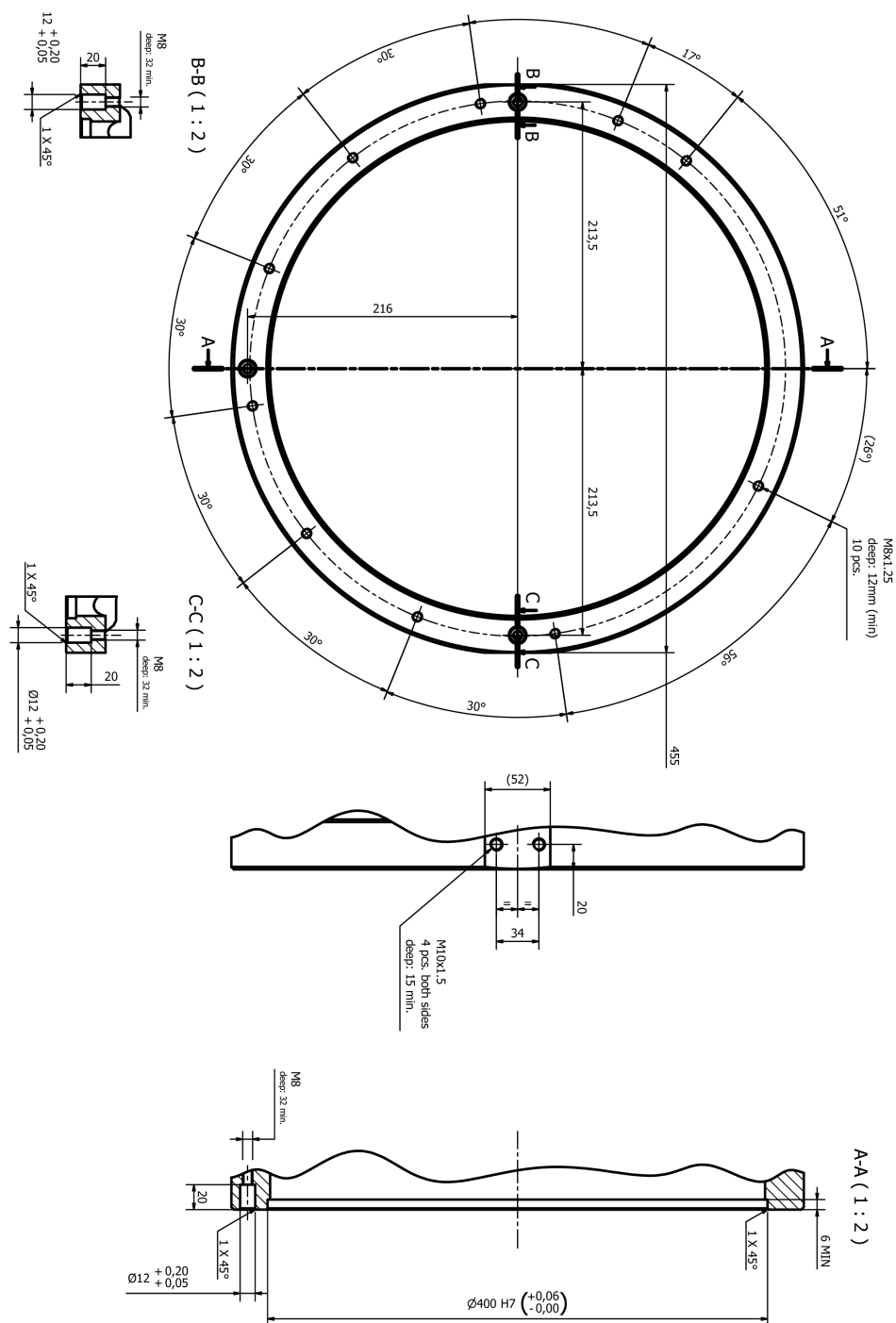
Required radial stiffness



The Figure below describes how to connect the electric machine frame to the interface.

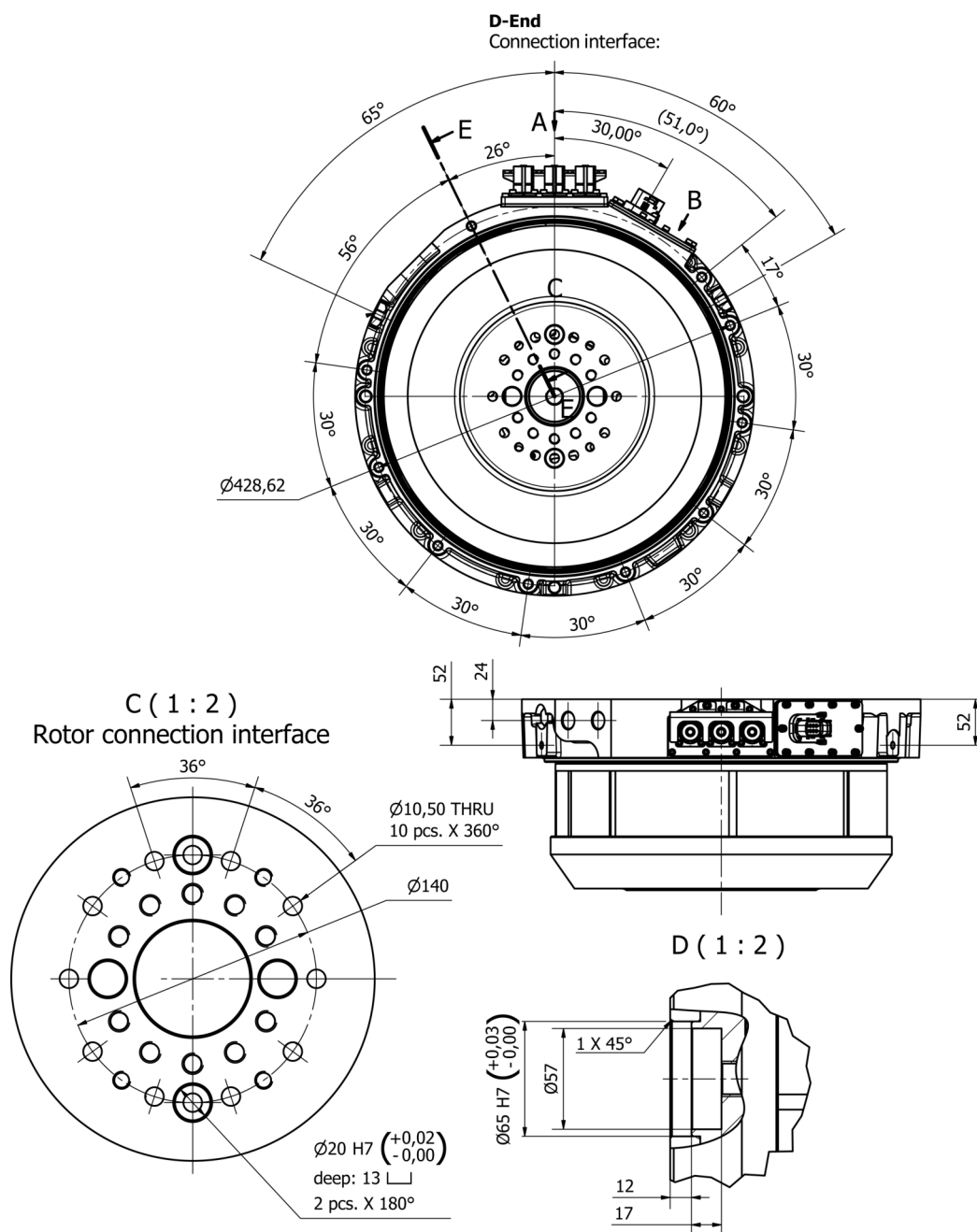
Design principles

Frame connection




The Figure below describes how to connect the electric machine rotor to the interface.

Design principles



Transportation and storage


Transportation

	Heavy equipment. Handle with care during transportation.
---	---

Electric machine is shipped in first class condition. It has been inspected and packed correctly to prevent damage from ordinary handling during shipment. During transportation, shocks, falls and humidity should be avoided. Protect the cooling holes for transportation.

The weight of the electric machine can be found on the machine rating plate, and in the product data sheet.





Receiving and unpacking

	Do not touch the electric machine during the insulation resistance check. Discharge the electric machine afterwards.
---	---





Check upon arrival and unpacking

- The electric machine and the package must be inspected immediately upon arrival. Make sure that the rating plate data in the cover letter complies with the purchase order. Any external damage (in rotor, flanges, electrical interfaces and paint) must be photographed and reported immediately.
- It is recommended to measure the insulation resistance of the electric machine upon arrival, or before installing the electric machine. Reference value of 150 MΩ shall be exceeded in room temperature, otherwise contact Danfoss representative. Refer to Chapter [Insulation resistance test](#) on page 33.

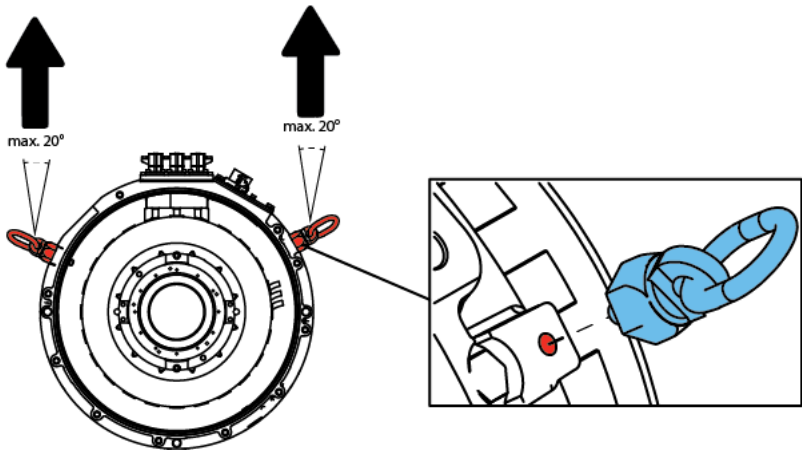
Lifting

	Use correct, adequately dimensioned lifting devices and inspect them before lifting.
	Do not lift from the shaft of the electric machine!
	Do not apply any excess weight on the electric machine when lifting.
	Use correct lifting slings. Use correct position and angle of lifting.

Transportation and storage

	See the electric machine rating plate for weight information.
	Lift the electric machine using the correct lifting lugs/eyes only.
	Do not go under a lifted load.
	Lifting slings cannot touch the electric machine during the lifting.

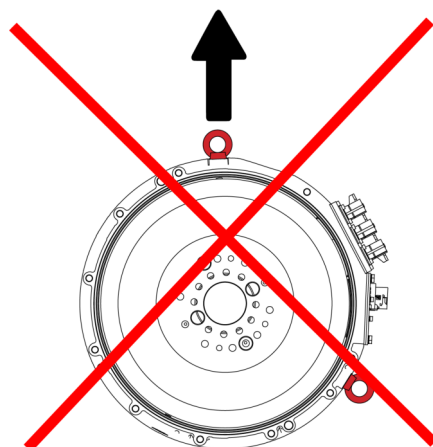
Lifting lugs/eyes/points for lifting slings and lifting position of the electric machine



Lifting eye type: ANSI B18.15.1M M10x16 is recommended in M10 bores. Not included in the delivery

Transportation and storage

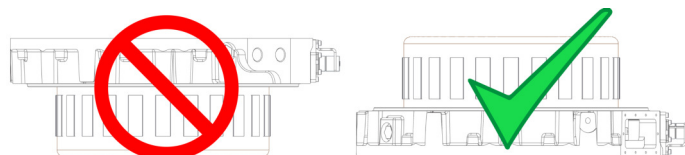
Not allowed lifting procedures



Storage

- Store the electric machine always indoors with the storage temperature above -20 °C and the relative humidity less than 60 %.
- The storage should be dry, dust free and vibration free.
- Treat the unprotected electric machine surfaces such as the shaft-end and flanges against corrosion. Seal the cable exit holes and cooling bores for storage.
- The electric machine must not be subject to any external vibrations during storage to avoid damage to the bearings.
- Use anti-condensation heaters, if fitted, or direct winding heating to avoid water condensing in the electric machine.
- Rotate the shaft of the electric machine by hand monthly at least ten revolutions to prevent grease migration. If necessary, use a tool, for example a spanner. Do not damage the shaft in any case.
- Do not keep the stator on its winding side down.

Storing stator



Extended storage

It is recommended to inspect the electric machine in storage at periodic intervals. Use attached storage checklist.

Rotate the shaft of the electric machine once a month.

Keep the electric machine in its installation position while in storage. For example, vertically installed electric machines should be stored in vertical position.

Installation

The following safety and information related symbols appear in this user guide and on the electric machine.

	Risk of electric shock when the connection box is open. When you work with power connections make sure that electricity is disconnected and rotor rotation is prevented.
	Magnetic and electromagnetic fields generated near the current-carrying conductors and permanent magnets in electric machines represent a health danger to persons with heart pacemakers, metal implants and hearing aids. Persons with a heart pacemaker, metal implants or hearing aids must consult a doctor before they enter the following areas: <ul style="list-style-type: none"> • Areas in which electric equipment and parts are operated. • Areas in which electric equipment with permanent magnets are stored, mounted, operated or repaired.
	Risk of electric shock when working with the electric machine. Use isolated electric tools.
	Only trained and qualified personnel familiar with the relevant safety requirements can work with the electric machine.
 	Use correct personal protective equipment when you are near the electric machine.
	Read the instructions in this user guide before you install the electric machine.




Installation

Required tools

Following tools are required to install the electric machine:

- Ratchet torque wrench.
- Hex head wrench kit with different metric sizes.
- Socket wrench kit with different metric sizes.
- Lifting slings with lifting eyes (with sufficient rated capacity) . Size according to machine type. See Chapter [Lifting](#) on page 29

Insulation resistance test

	Do not touch the electric machine during the insulation resistance check. Discharge the electric machine afterwards.
	Measure the insulation resistance of the electric machine before and after the installation of the electric machine.
	Use a voltage of 500 V in the insulation resistance test.

Measure the insulation resistance of the electric machine before and after the installation of the electric machine. Because of the structure of the electric machine, it is possible that the stator is damaged during the installation.

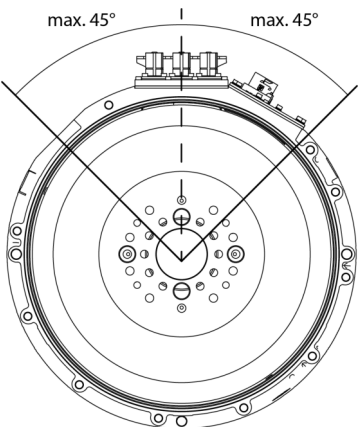
If the electric machine is in continuous use, it is recommended to do the insulation resistance test three or four times a year.

The reference value of 150 MΩ must be exceeded in room temperature. Contact Danfoss representative if the reference value is not exceeded. Reference value of 150 MΩ should not be exceeded at reference ambient temperature 25°C (measured with 500 V_{DC} / 1 min Megger).

Mechanical installation

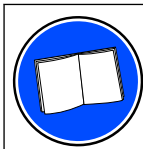
Allowed mounting positions

Allowed mounting position



Installation

Mounting the electric machine



Refer to Chapter [Allowed mounting positions](#) for the correct mounting positions of the electric machine.

Mount the electric machine on a correct supporting structure as discussed in Chapter [Supporting structure requirements](#).

Machine assembly



The rotor has a powerful magnetic field that can cause injuries or even death. Obey these instructions when you are near the rotor.

- Don't put any electric devices near the rotor.
- Don't put any steel parts near the outer or inner surfaces of the rotor.
- Handle the rotor carefully.
- Use non-magnetic tools.
- Persons with metallic, electronic or magnetic implants or devices in their body cannot go near the rotor.



Do not put the frame near the rotor before it is connected to the hydraulic cylinder. Magnetic force can pull the frame against the flywheel housing adapter.



Finger crushing hazard. When you work with the rotor, be careful with its strong magnetic field: do not put your fingers in between rotor and other components during the installation.



Use correct screw preload. See the preload values below.



Threadlocker is not included in the delivery.

Mount the electric machine on a correct supporting structure that is discussed in Chapter [Customer connection interface design instruction](#) on page 22.

Assembly procedure







1. Install flywheel adapter (2) to flywheel (1) with suitable screws (3) (not included in delivery). Use strong threadlocker (for example Loctite 278, not included in delivery). Use sufficient screw preload. Check preload from flywheel manufacturer.
2. Install flywheel housing adapter (4) to flywheel housing (1) with suitable screws (5) (not included in the delivery). Use strong threadlocker (for example Loctite 278, not included in delivery).

Installation

3. Assemble Enerpac BAD142 flange mount (6) with retainer nut (7) to Enerpac BRD-46 hydraulic cylinder (8).
4. Assemble hydraulic cylinder with flange mount to assembly tool cylinder holder (9) with M10X25 DIN 912 screws (10), 4 pcs.
5. Connect hydraulic cylinder to hydraulic hand pump with hydraulic hoses, see Enerpac instructions.
6. Assemble rotor bracket (12) to electric machine rotor (11) with M10X25 DIN 912 A4 stainless screws (13), 2 pcs.
7. Install 2 pcs. of alignment pins (14) in the electric machine rotor (11).
8. Assemble the assembly tool with Enerpac cylinder to (15) flywheel housing adapter with M10X25 DIN 912 screws (16), 4 pcs.
9. Lift the rotor carefully with lifting sling (not included in delivery) between the assembly tool (15) and the flywheel housing adapter.
10. Push the rotor carefully inside to flywheel housing adapter to correct position using the hydraulic cylinder.
11. Attach the rotor to the flywheel adapter with rotor connection screws (18), 10 pcs. and NordLock locking washer. (17), 10 pcs. Make sure that rotor aligns correctly to flywheel adapter and rotor can be rotated freely.
12. Remove the rotor bracket from the rotor and assembly tool with the Enerpac cylinder.
13. Install frame assemble pins (19), 3pcs. to flywheel housing adapter.
14. Assemble frame bracket (20) to frame (21) in correct position with M8x25 DIN 912 screws (22), 4 pcs.
15. Install O-ring (23) in frame (21).
16. Lift the frame using frame lifting points with suitable lifting eyes (not included in delivery) and slide frame on to frame assembly pins.
17. Assemble the assembly tool with Enerpac cylinder to flywheel housing adapter with M10X25 DIN 912 screws (24), 4 pcs.
18. Connect hydraulic cylinder piston to frame bracket. Make sure that the hydraulic cylinder is retracted fully inside. Make sure that hydraulic cylinder is not pressurized.
19. Push the frame carefully inside the rotor to correct position using the hydraulic cylinder, until the frame is tightly against flywheel housing adapter. Make sure that O-ring stays in place during assembly.
20. Connect the frame to flywheel housing adapter with M8x80 DIN 7991 screws (25), 10 pcs. Use strong threadlocker (for example, Loctite 278, not included in delivery).
21. Remove:
 1. Assembly tool with the Enerpac cylinder.
 2. Frame bracket with connection screws.
 3. Frame assembly pins.

Installation

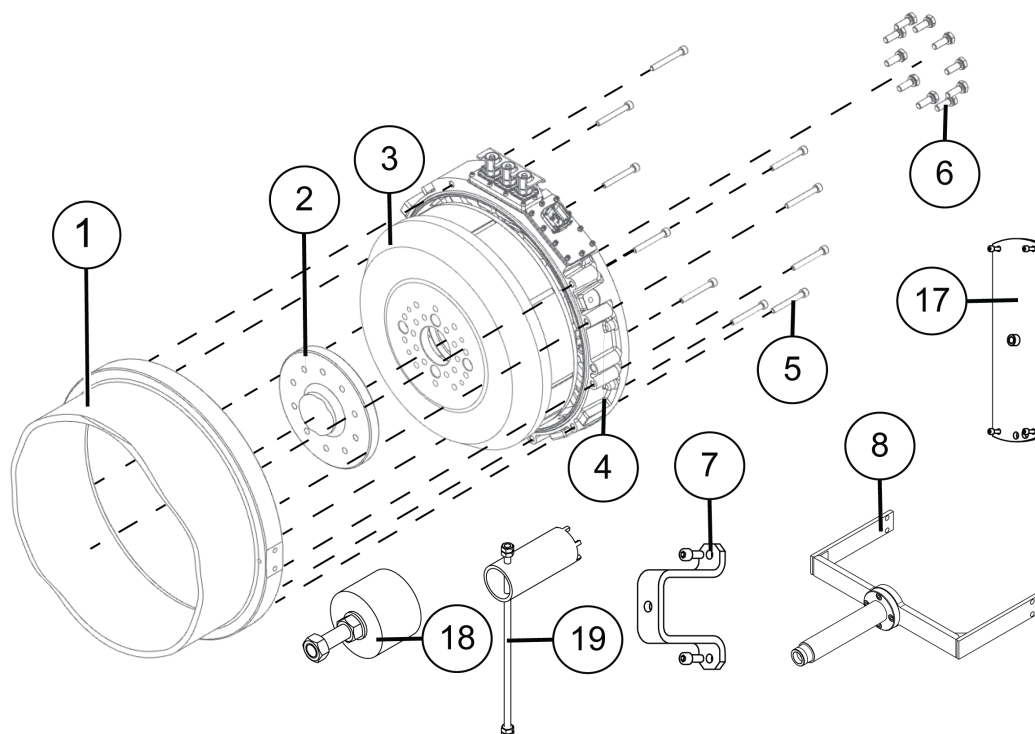
Installation procedure

	The rotor has powerful magnets. Persons with pacemakers cannot go near the rotor. Keep electronic devices and credit cards clear of the rotor.
	Do not put your fingers between components, as they might get crushed by sudden movement of the components caused by magnetic or other forces.
	Refer to flywheel manufacturer instructions for the screw preload. Flywheel attachment screws are not included in the delivery.
	Use strong threadlocker, for example Loctite 278. (Not included in the delivery)
	Connection interface screws are not included in the delivery.
	Brackets and installation tools not included in a standard delivery.

Installation

Installation overview

Installation overview



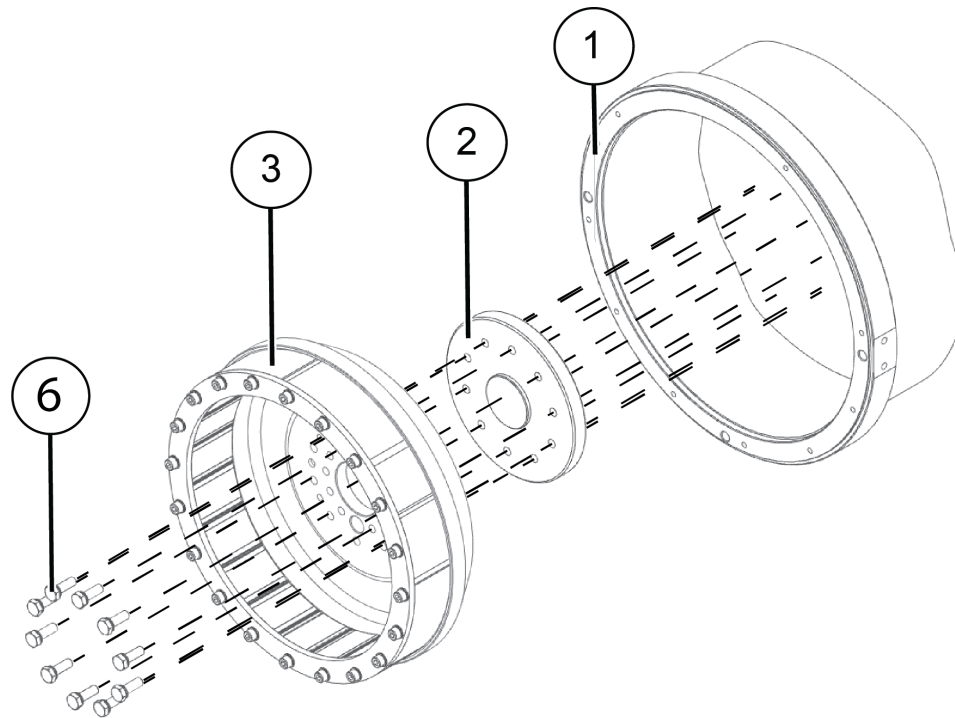
1	Frame / Stator connection interface (for example diesel engine flywheel housing and flywheel housing adapter)
2	Rotor connection interface (for example diesel engine flywheel adapter)
3	Rotor of the electric machine
4	Frame of the electric machine
5	Stator attachment screws
6	Rotor attachment screws (Nord-Lock locking washers recommended)
7	Rotor bracket
8	Assembly tool
17	Frame bracket
18	Tool 30671, bearing installation tool
19	Tool 30867, locknut installation tool

Flywheel and rotor installation

Installation

1. Install flywheel adapter (2) to flywheel housing (1) with suitable screws (6) (not included in delivery). Use strong threadlocker (for example Loctite 278, not included in delivery). Use sufficient screw preload (check preload from flywheel manufacturer).
2. Install flywheel housing adapter to flywheel housing (1) with suitable screws (not included in the delivery). Use strong threadlocker (for example Loctite 278, not included in delivery).

Rotor and flywheel installation procedure principle

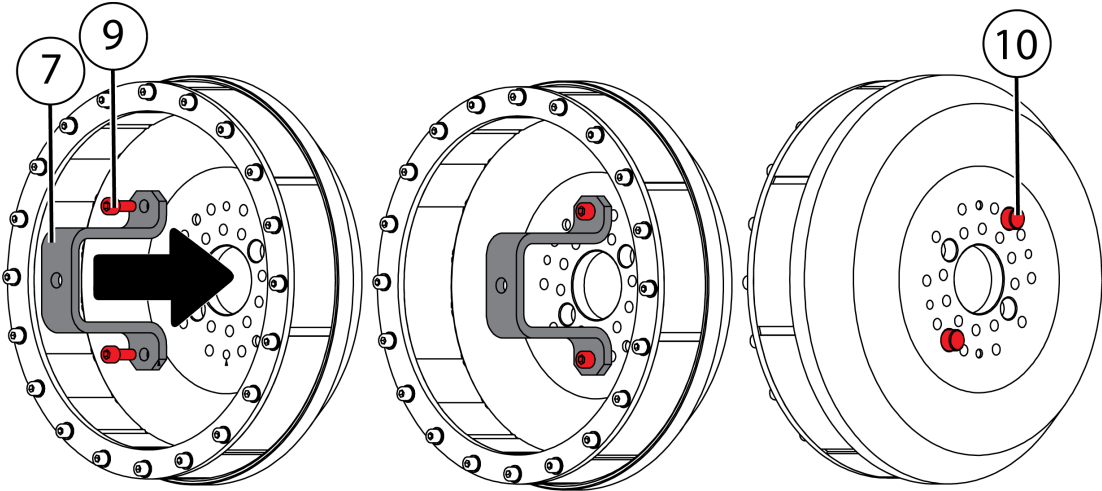


Rotor assembly tool assembly

1. Install the rotor bracket (7) on the rotor. Attach it with screws (9).
 2. Install the rotor alignment pins (10) on the rotor if necessary.
- See Figure below.

Installation

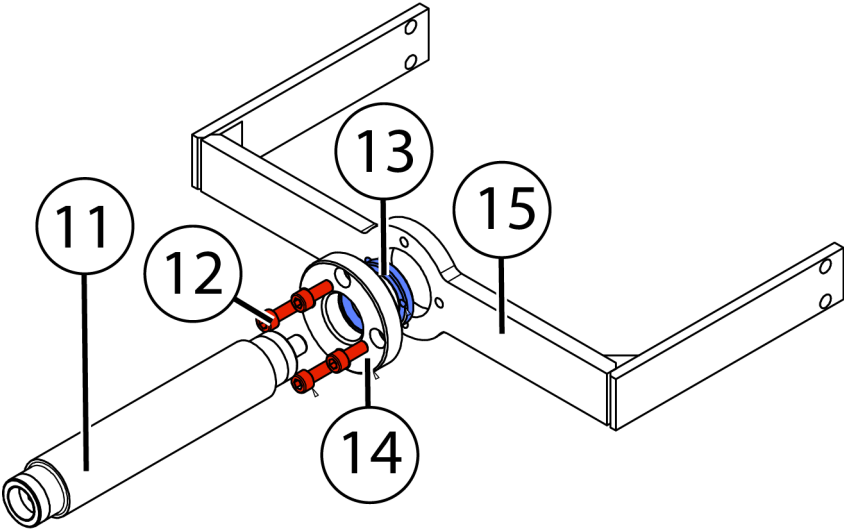
Rotor bracket and rotor alignment pin installation



7	Rotor bracket
9	M10X25 DIN 912 A4 screws, 2 pcs. Use stainless steel screws.
10	Rotor alignment pin, 2 pcs. Optional.

3. Assemble the rotor assembly tool (8). See Figure below.

Rotor assembly tool (8) assembly



11	Enerpac BRD-46 hydraulic cylinder
12	M10X25 DIN 912 screws, 4 pcs
13	Enerpac retainer nut
14	Enerpac BSS5904D flange mount
15	Assembly tool cylinder holder

4. Install the rotor assembly tool (8) on the rotor (3).

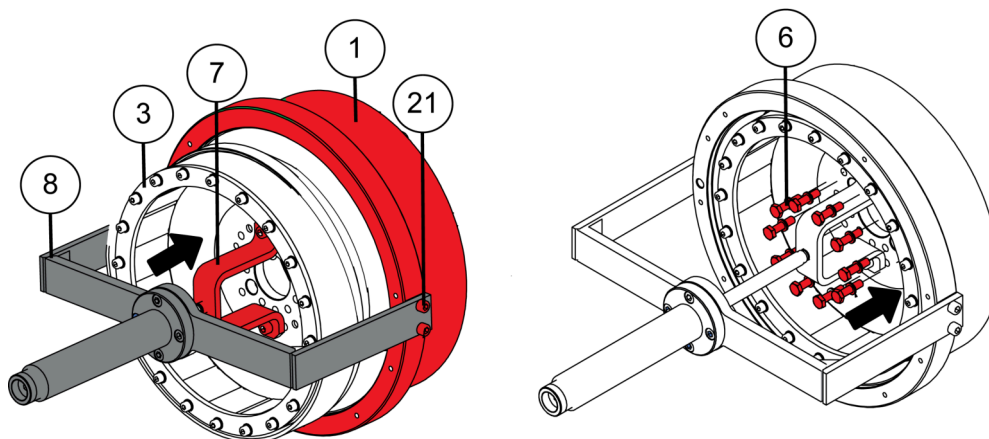
5. Lift the rotor next to the frame / stator connection interface (1) with the rotor connection interface (2).

6. Attach the assembly tool on the frame / stator connection interface with screws (21).

Installation

- 7.** Connect a hydraulic hand pump to the Enerpac BRD-46 hydraulic cylinder (11) of the rotor assembly tool.
- 8.** Pump pressure in Enerpac BRD-46 hydraulic cylinder with the hydraulic hand pump until the rotor, frame / stator connection interface and the rotor connection interface are firmly together.
- 9.** Fasten the rotor on the rotor connection interface with screws (6).
- 10.** Remove the rotor assembly tool (8) and the rotor bracket when most screws are in place.
- 11.** Install the rest of the screws as the rotor bracket prevents some of them being installed.

Rotor installation with rotor assembly tool



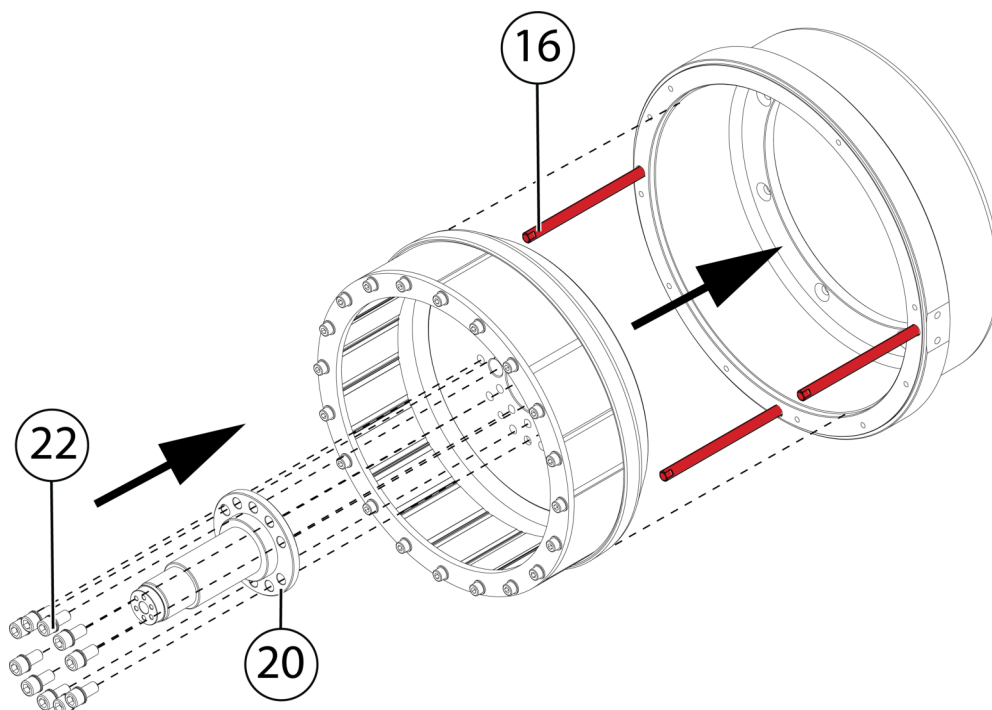
21	M10X25 DIN 912 screws, 4 pcs
----	------------------------------

Installation

Preparations for the frame installation

1. Install the shaft (20) in the stator. Fasten it with bolts (21). Note: Shaft is an optional part, and some electric machines do not have it.
2. Install the frame assembly pins (16) in the frame / stator connection interface.

Installing frame assembly pins and shaft



16	Frame assembly pin, 3 pcs
20	Shaft 18364, optional
22	Fastening bolts 15999

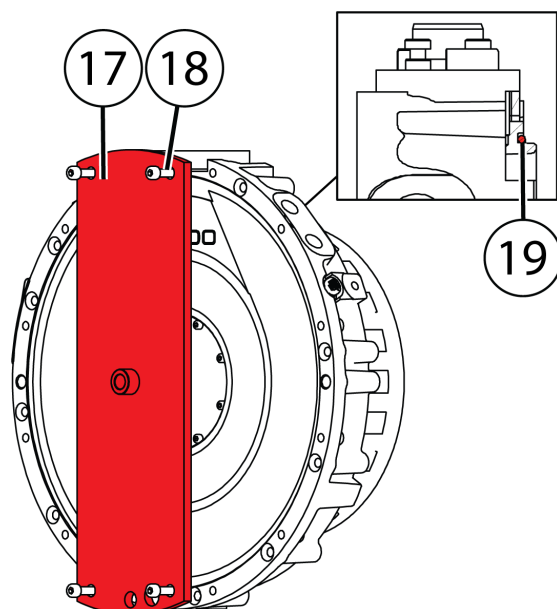
3. Install the frame bracket (17) on the frame of the electric machine. Fasten it with screws (18).

4. Install the o-ring (19).

See Figure below.

Installation

Frame bracket installation



17	Frame bracket
18	M8x25 DIN 912 screw
19	O-ring, D400x3

Frame installation

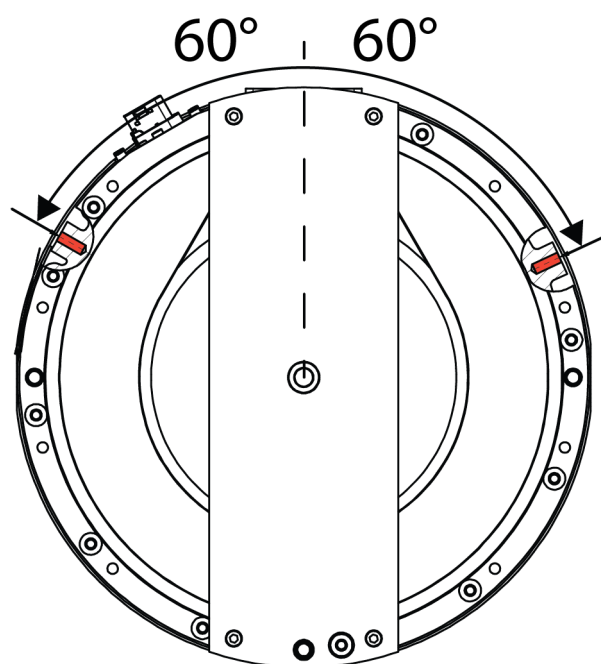


Do not push the frame too close to the rotor before the assembly tool is installed and the hydraulic cylinder is pressurized. Magnetic force can pull the frame in forcefully and damage it.

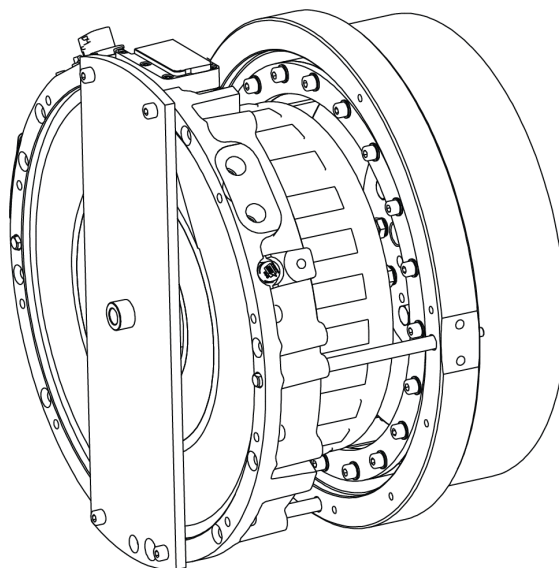
Lift the frame next to the rotor and put in the position shown in the figure below. Make sure that the frame assembly pins go into the correct holes of the frame.

Installation

Frame lifting



Frame position before installation

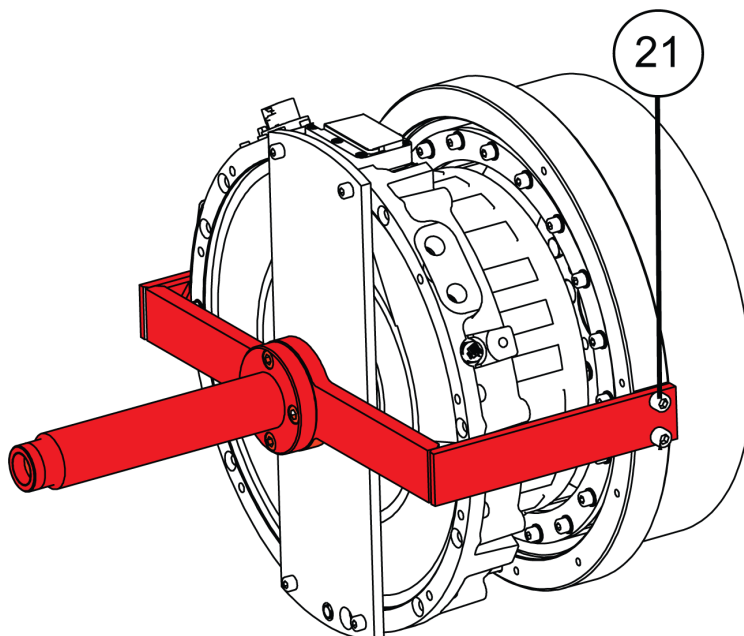


This step of the installation is very dangerous for the fingers as they can be cut off by the components moved by the magnetic forces. Do not put your fingers between the stator and rotor.

Install the assembly tool on the frame / stator connection interface and fasten it with screws. See Figure below.

Installation

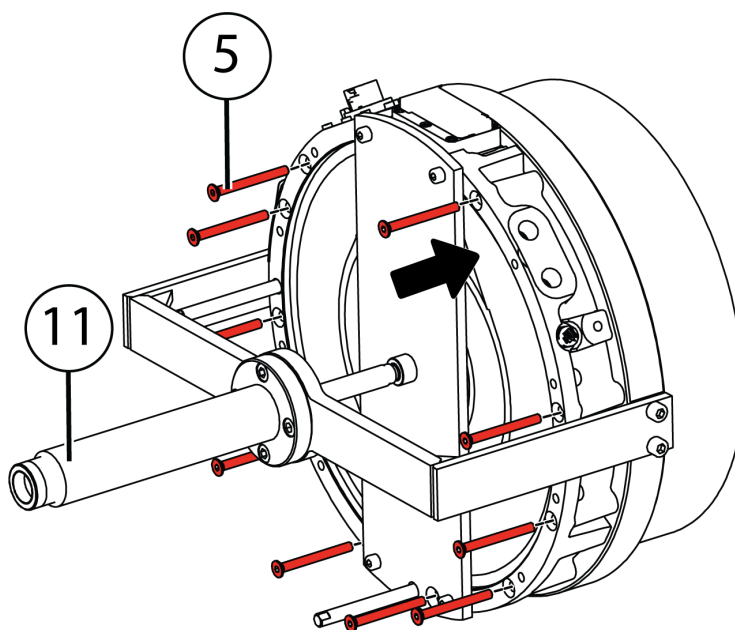
Assembly tool installation



21	M10X25 DIN 912 screws, 4 pcs
----	------------------------------

1. Connect a hydraulic hand pump to the Enerpac BRD-46 hydraulic cylinder (11) of the rotor assembly tool.
2. Pump pressure in Enerpac BRD-46 hydraulic cylinder with the hydraulic hand pump until the frame and the frame / stator connection interface are firmly together.
3. Fasten the frame on the frame / stator connection interface with screws (20).
4. Remove the assembly tool and the frame bracket.

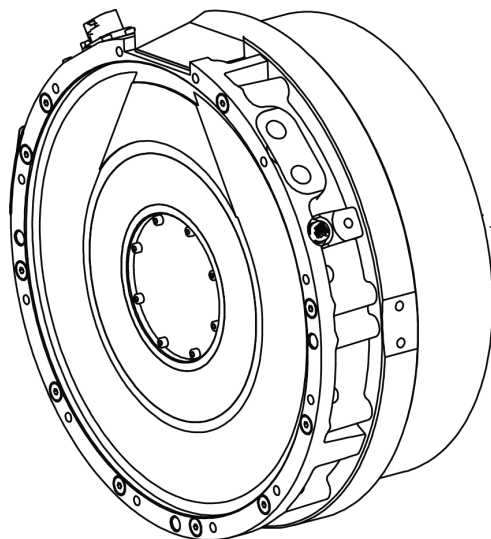
Frame fastening



5	M8 DIN 912 screw, 10 pcs (client determines the length)
---	---

Installation

Assembled electric machine

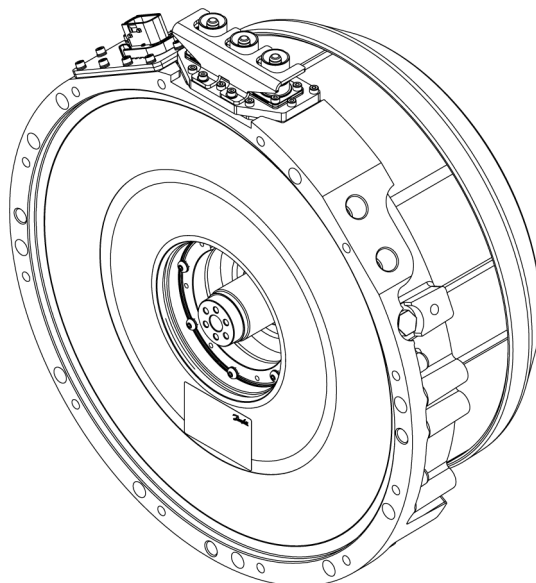


Bearing installation



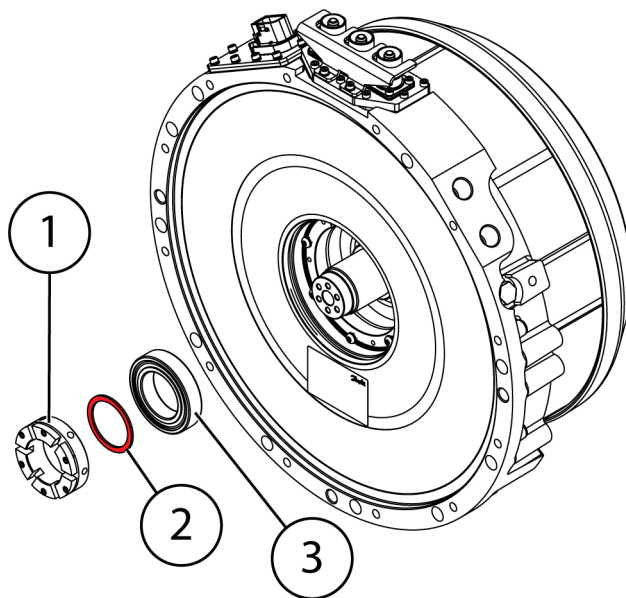
This procedure applies only if the electric machine has bearings.

Assembled electric machine before bearing or resolver installation



Installation

Bearing installation



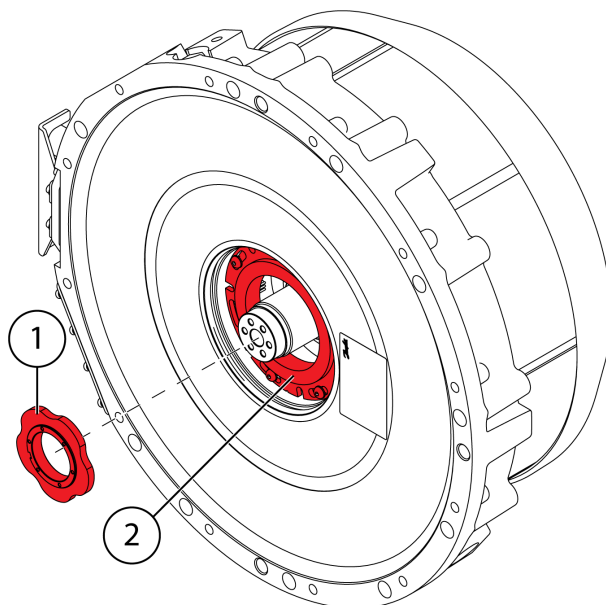
1. Install the bearing (3) with the tool 30671.
2. Install the spacer (2).
3. Install the locknut (1). Tighten it with the tool 30867. Tighten the axial bolts of the locknut according to the manufacturer [Instructions](#). The locknut is of type Schaeffler AM-45.

Resolver installation



This procedure applies only if the electric machine has a resolver.

Resolver installation

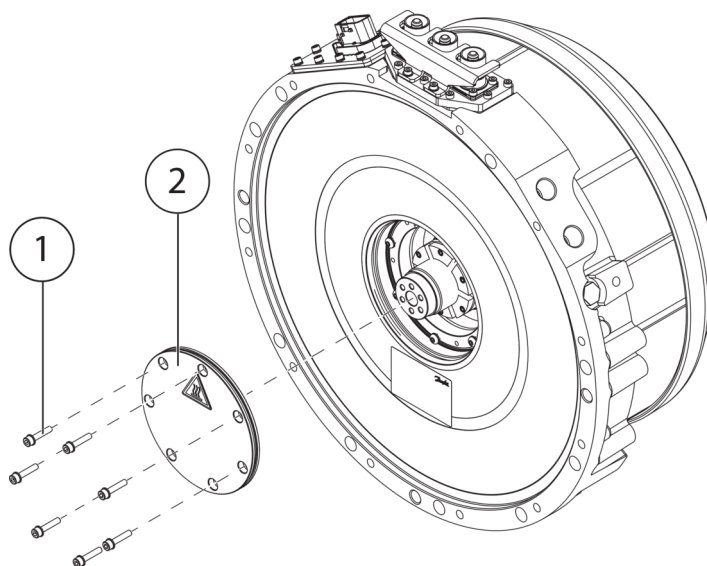


Installation

1. Install the resolver adapter and rotor assembly (1) on the shaft. Note that the resolver stator (2) is installed by Danfoss. Make a heatshrink joint to fasten the adapter on the shaft: heat to temperature of 150°C and put heat resistant Loctite glue on the contact area. Push the adapter against the shoulder of the shaft.

Cover installation

Cover installation



1. Install the seal 18412 on the cover (2).
2. Install the cover (2) and fasten it with bolts (1).

Cooling connections

	Make sure that cooling liquid runs freely into and out from the electric machine.
	To prevent damage to the cooling connectors, refer to the documentation of the manufacturer for the correct tightening torque of the cooling liquid nipples.
	When selecting cooling liquid nipples, choose nipples that can resist galvanic corrosion.
	Cooling connectors have G1/2 bores, depth 18.

Connect the electric machine properly to the cooling circuit. Make sure that the coolant flow is equal or higher than rated and the coolant temperature at the inlet of the machine cooling is lower or equal to the

Installation

rated temperature. For more information, see Chapter [Recommended coolants](#) and product data sheet. Rated values can be found in the electric machine rating plate.

Use only suitable and high-class connection parts and seals to connect the electric machine to the water circuit. Check for possible leaks after the piping and joints have been connected.

It is recommended to use coolant connector equipped with o-ring seal or to use sealing washer (for example Usit or Bonded seals) in the connection. In addition, it is recommended to use thread sealant (Loctite 577 or similar) at the coolant connections to prevent loosening. Loosening can be caused by vibration or temperature variations.




The electric machines are equipped with at least three PT100 temperature sensors in the windings. The amount of the sensors depend on the options chosen. The temperature signal(s) can be read out from the measurement connector of the machine.

You can connect the temperature signal to the temperature monitoring pin in the inverter (EC-C) and make sure that the inverter has the electric machine temperature protection feature activated.

Electrical installation

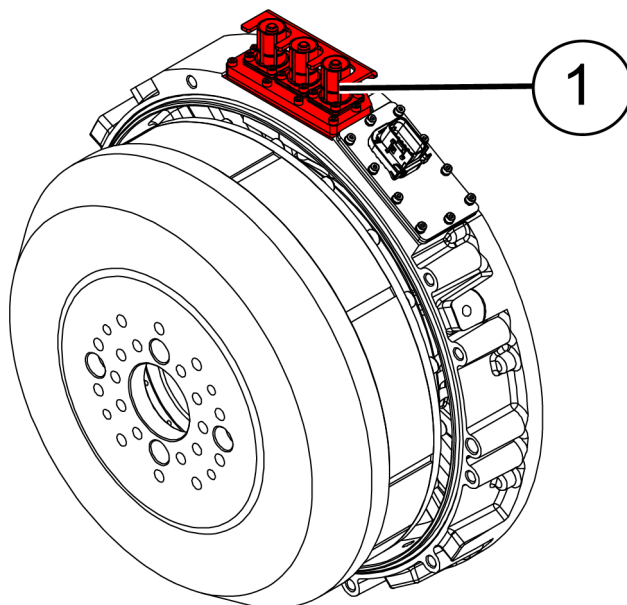
Power connections

High voltage connection

	Risk of electric shock. When you work with power connections make sure that electricity is disconnected and that the rotation of the rotor is prevented.
	Mating connectors of the high voltage cables are not part of a standard delivery.
	The order of the phases is marked on the power terminal with stickers.

Installation

High voltage connection

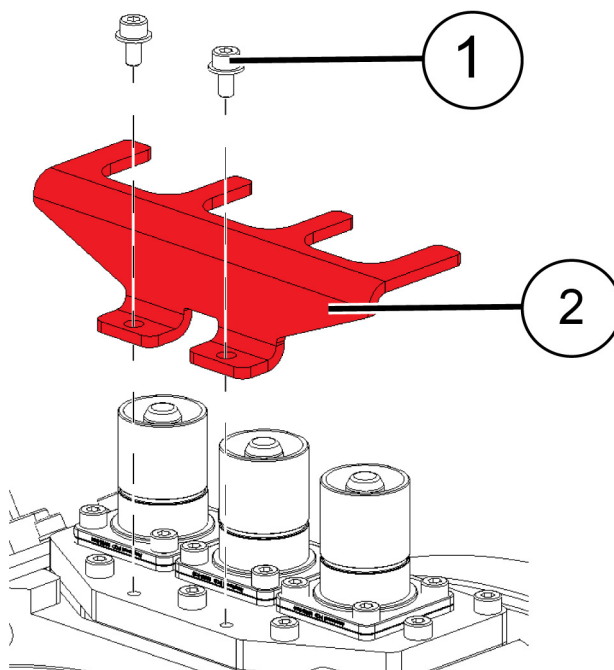


- | | |
|----|--|
| 1. | <p>Power terminal
Connector type: AMPHENOL HVBI005R10AMHARD
Mating connector: AMPHENOL HVBI-7-05R10-XFC-XXXX-FG/PC (straight plug)
AMPHENOL HVBI-9-05R10-XFC-XXXX-FG/PC (right angle plug)</p> |
|----|--|

Installing the high voltage cables

1. Remove the power terminal shield. See the Figure below.
2. Install the high voltage cables. Refer to the instructions of the manufacturer of the mating connectors.
3. Install the power terminal shield back.

Power terminal shield



Installation

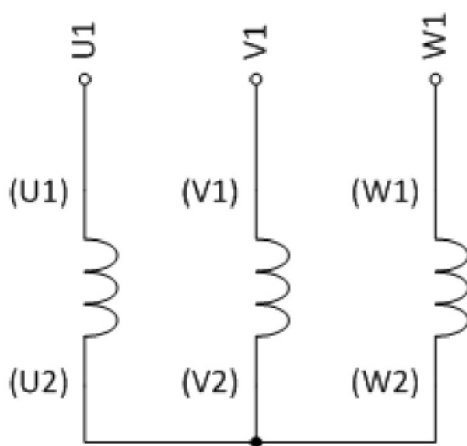
1	Fasteners
2	Power terminal shield

Connection diagram

The electric machines are intended to be powered and controlled by three-phase alternating current, supplied by an inverter or inverters. The electric machine is not suitable for direct online use.

The amount of inverters depends on the electric machine and converter current ratings.

Connection diagram



Low voltage connections

Low voltage connector details

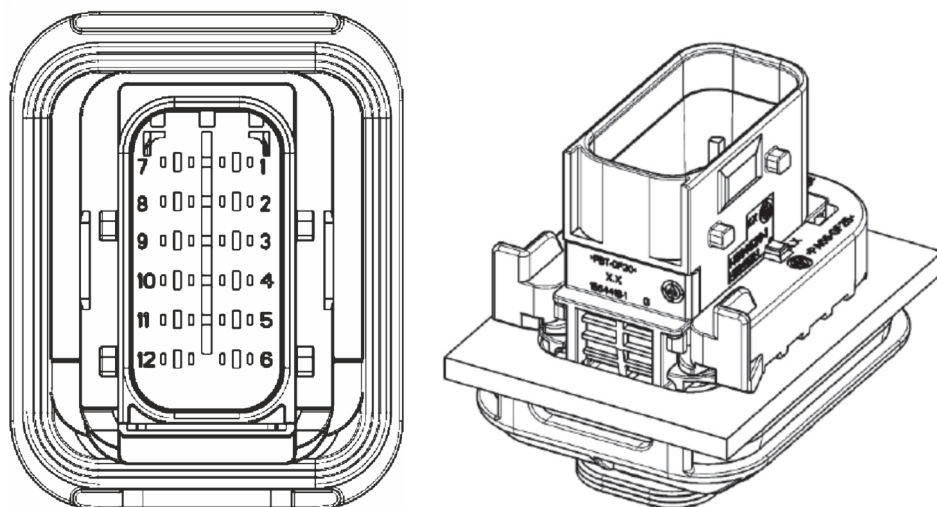
The electric machine has a low voltage (measurement signal) connector which is used to read out inbuilt temperature and rotation sensor (resolver) data from the electric machine. Optionally the connector is replaced with a connection box (option +LVB1). The temperature data comes from PT100 sensors located in the stator windings. Check from the rating plate which pin configuration is valid. Find the configuration for temperature and resolver measurements option in rating plate type field. The electric machine has three PT100 sensors in windings as a standard option.

The measurement connector has these components:

- 12 pin TE HDSCS for temperature surveillance
- Connector type: TE 115645201
- Pin type of connector: TE 9642703 (gold plated)
- Mating female connector type: TE 117036391
- Pin type for the mating connector: TE 12413813 (use gold plated pins)

Installation

Pin configuration of the connector TE 115645201



Default pin configuration

Pin	Description
1	-
2	-
3	-
4	Temperature, PT100, windings
5	Temperature, PT100, windings
6	Temperature, PT100, windings
7	-
8	-
9	-
10	GND, Temperature, PT100, windings (corresponds to pin4 PT100)
11	GND, Temperature, PT100, windings (corresponds to pin5 PT100)
12	GND, Temperature, PT100, windings (corresponds to pin6 PT100)

Pin configuration with resolver (RES1)






Pin	Description
1	Resolver, RES_COSN
2	Resolver, RES_SINN
3	Resolver, EXCN
4	Temperature, PT100, windings
5	Temperature, PT100, windings
6	Temperature, PT100, windings
7	Resolver, RES_COSP
8	Resolver, RES_SINP
9	Resolver, EXCP
10	GND, Temperature, PT100, windings (corresponds to pin4 PT100)
11	GND, Temperature, PT100, windings (corresponds to pin5 PT100)

Installation

Pin	Description
12	GND, Temperature, PT100, windings (corresponds to pin6 PT100)

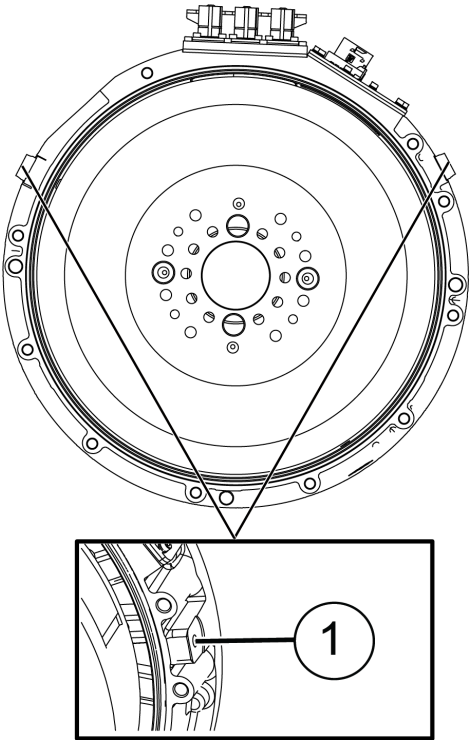
The shielded measurement cable shield can be connected to a low voltage grounding connection point. See Chapter [Grounding connections](#) on page 52 for more information.

Grounding connections

	Ground the electric machine from its frame to make sure it functions correctly and safely.
	Ground the cable shields of the power cables to make sure the electric machine functions correctly and safely.
	Ground the cable shields of the low voltage cables to make sure the electric machine functions correctly and safely.
	It is recommended to perform a ground bond test after installing the electric machine to make sure the electric machine is correctly grounded.
	The grounding points on the frame of the electric machine are for safety grounding, and signal cables and power cable shields have their own grounding points.

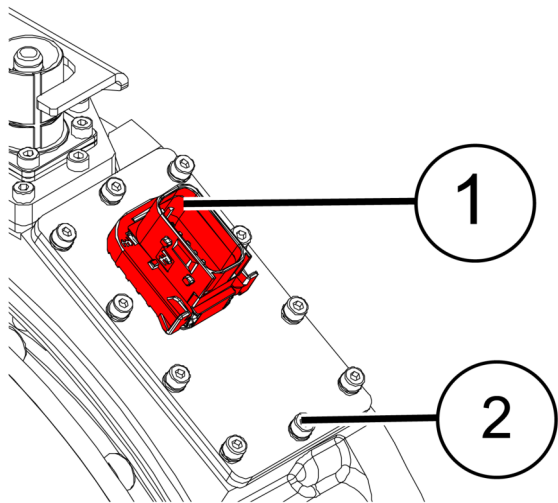
Installation

The machine enclosure grounding point, safety grounding



1	Grounding point
---	-----------------

Low voltage cable grounding points



1	The grounding pin of the low voltage connector.
2	Cable shield grounding point.

Testing the power cable shield grounding (earthing)

The power cable shields are grounded (earthed) through the connection terminal and further to the electric machine enclosure. After the cable gland assembly and power cable installations, and any time when needed, make sure that the grounding (earthing) connections are correct.

Installation

1. Connect one terminal of the measurement device to the cable shield of one power cable (in the inverter end of the cable)
2. Connect the other terminal of the measurement device to the cable shield of an other power cable. You can also use the machine enclosure grounding point for the measurement.
3. Measure the resistance between the two cable shields or between the cable shield and the enclosure grounding point.
4. Change the measurement device terminal(s) to the shield of different power cable and repeat the measurement until all cables have been measured.

Testing the low voltage (measurement signal) cable shield grounding (earthing)

The low voltage (measurement signal) cable shield is connected to the grounding (earthing) point. After cable installation, and any time when needed, make sure that the grounding (earthing) connection is valid.

1. Connect one terminal of the measurement device to the low voltage cable shield (in the non-machine end of the cable).
2. Connect the other terminal of the measurement device to the machine enclosure grounding point.
3. Measure the resistance between the cable shield and the enclosure grounding point.

Operation

	Only trained and qualified personnel familiar with the relevant safety requirements are allowed to operate the electric machine.
	Do not use the electric machine without properly dimensioned and operating cooling system. Maximum operation temperature, current and rotational speed of the electric machine must not be exceeded to avoid permanent damage.
	The surface of the electric machine might be hot. Do not touch the electric machine during operation.
	Entanglement hazard! Do not touch the electric machine during operation.
	Use the anti-condensation heater, if fitted, when the electric machine is not in use. This prevents condensation and possible damage to the electric machine.
	Use sufficient personal protective equipment when you are near the electric machine.
	Read the instructions in this user guide before you install the electric machine.

Operation

Operation conditions

The electric machine should be used for its intended purpose only and within limits specified by the manufacturer, concerning:

- Loading.
- Cooling.
- Speed range.
- Service interval.
- Ambient condition such as temperature and moisture.

The electric machine is designed for the following conditions:

- Ambient temperature limits: -40°C...+65°C.
- Maximum altitude 1000 m above sea level.
- Maximum coolant liquid temperature at the inlet of the coolant circuit, see product data sheet.
- Coolant liquid must be water- glycol mixture with maximum of 50 % glycol content. See Chapter [Recommended coolants](#).

If electric machine operation limits are exceeded, please contact Danfoss representative.

Condition monitoring during operation

	Supervise the electric machine during operation to make sure that the electric machine operates correctly and has a designed lifetime.
	If you notice any deviations from the normal operation, for example elevated temperatures, noise or vibration, stop the electric machine. Find the reason for the deviation and repair the electric machine. Refer to Chapter Troubleshooting on page 61.
	The maximum allowed winding temperature of the electric machine is shown on the rating plate and in the data sheet.

Recommended coolants

	Ethylene glycol is a toxic compound. Avoid exposure to the coolant.
	Copper ions concentration of more than approx. 0.06 ppm causes <i>copper induced pitting corrosion</i>. Do not use copper components in the cooling system.
	Hard piping made of metal is recommended for the coolant instead of soft piping as rubber hoses.

Operation



Use correct personal protective equipment when you handle the coolant.

Glycol coolant options:

- Ethylene glycol based Glysantin® G48® (includes also corrosion inhibitors).
- Propylene glycol based coolants, like Splash® RV&Marine antifreeze.

Emergency operation

The electric machine should be operated within the operation limits and in the conditions specified by the manufacturer. However, it can be used with some limitations in the following fault/emergency situations.

Cooling of the electric machine fails

The cooling system failure can be caused by dregs (sediment) accumulating to the cooling system tubes. Try opening the possible blockage by changing the coolant flow direction. See also Chapter [Cooling system maintenance](#).

If the cooling of the electric machine fails, limited operation is still possible with no coolant flow. The operation speed must be limited to half (1/2) of the rated speed and maximum 20 % of the nominal torque may be used. In such case, the electric machine may be operated for maximum one hour. Repair the cooling system as soon as possible. For further information, contact Danfoss representative.

The temperature measurement of the electric machine fails

Contact Danfoss service.

Danfoss service contact information

Contact Danfoss service at <https://danfosseditron.zendesk.com/hc/en-gb> or send email to editron.service@danfoss.com.

Maintenance

This Chapter contains necessary information for the qualified and trained personnel to carry out regular maintenance work.

	Do not disassemble the electric machine. Only procedures described in this user guide may be done.
	Only trained and qualified personnel familiar with the relevant safety requirements are allowed to do maintenance to the electric machine.
	Risk of electric shock when the connection box is open. Voltage may be connected to the anti-condensation heater.
 	Use correct personal protective equipment when you are near the electric machine.
	Read the instructions in the user guide before you start to work with the electric machine. To make sure that the operation of the electric machine is safe and reliable, obey the maintenance instructions.

Regular maintenance

	Inspect the electric machine at regular intervals. Use the Storage, installation and maintenance checklists on page 64.
--	--

Maintenance



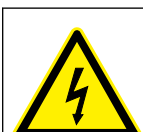
Do not attempt to tighten bolts or screws that are not discussed in this user guide and that are not needed for normal installation and maintenance procedures. The sealing of the bolts and screws can break.

Correct supervision and maintenance of the electric machine makes sure that the electric machine has reliable operation and designed lifetime.

Maintenance schedule

Object		Check/Task	Weekly	Monthly	Yearly
General construction	Operation	Noise, vibration. If clearly increased, contact Danfoss.	X		
	Mounting	Bolt tightness. Tighten to proper value if necessary. Applies to bolts and screws that are discussed in this manual. See Chapter Tightening torques .			X
	Enclosure and connected parts	Check cleanliness. Clean if necessary. See Chapter Cleaning .		X	
	Shaft seals	Check the wear. Replace if necessary.			X
Electrical system	Cables	Wearing of the cables. Replace if necessary.		X	
	Electrical connections	Check connections. Make sure that sufficient tightening torque is applied to cable glands. See Chapter Tightening torques .			X
	Groundings (earthings)	Check groundings (earthings). Make sure that the connection resistance is valid. Re-connect if necessary.			X
Cooling system	Operation	Functioning. Cooling system functions as specified.	X		
	Tubing and connection tightness	No visible leakage. If leaking, tighten connections appropriately, or replace parts.		X	
	Ventilation plug	Cleanliness. Clean if necessary See Chapter Cooling system maintenance .		X	
	Coolant flow	Coolant flow direction. Change direction by changing the connections or flow direction from the pump. See Chapter Cleaning .			X
	Coolant quality	Coolant as specified. Proper glycol used, and water/glycol mixture appropriate. Refill if necessary. See Chapter Cooling system maintenance .			X

Cleaning



Risk of electric shock if the electric machine is cleaned against instructions allowing water to go in to the electric machine.

Keep the electric machine clean. For cleaning, use non-abrasive and non-corrosive cleaning products.
Make sure that the detergent may be used for aluminum.


Cooling system maintenance

The electric machine cooling system requires certain regular maintenance activities.

It is recommended to change the direction of the coolant liquid flow yearly. This is done by changing the order of the coolant connections, or changing the coolant pump direction. The reason for changing the coolant flow direction is to prevent possible dregs (sediment) accumulating to the cooling system.

The quality of the coolant must be checked yearly. The mixture of water and glycol as well as the type of the glycol used must be as specified. See Chapter [Recommended coolants](#).

Dismounting

	<p>Make sure that the mating structure is not damaged. Do not pluck any bores or use at headed bolts or rods for pushing the electric machine out of the mating structure.</p>
---	---

See Chapter [Mounting the electric machine](#) on page 34. Dismount the electric machine in reverse order.

Troubleshooting

Some difficulties may occur while operating the electric machine. Possible causes and actions are given in the Table below. If the situation occurs, it should be corrected as soon as possible. These instructions do not cover all details or variations in the equipment nor provide information for every possible condition to be met in connection with installation, operation or maintenance.

For more information, contact Danfoss service at <https://danfossedatron.zendesk.com/hc/en-gb> or send email to editron.service@danfoss.com.

Troubleshooting chart

Symptom	Possible cause	Action
Excessive vibration, noise	Imbalance at connected electric machine or the powertrain components.	Check the balance and installation of the actuator and drivetrain components.
	Attachment bolts are loose.	Replace and tighten the bolts.
	Imbalance at the electric machine.	Contact Danfoss.
	Particles inside the electric machine.	Contact Danfoss.
Electric machine overheating	Overload.	Reduce load. Check the electric machine model description and rating plate, check the inverter limits.
	Cooling system failure.	Check the cooling system integrity, flow and fluid temperature. Change the cooling flow direction to flush the cooling system from sediment possibly accumulated. See also Chapter Emergency operation .
	Leakage in the cooling system.	Check the cooling system circuit and connections.
	Rigid particles inside the electric machine cooling channel.	Try pulsating coolant to open the channels. Contact Danfoss.
	Wrong electric machine parameters in the inverter.	Check and correct the machine parameters from the inverter.
	Winding short circuit.	Replace the electric machine.
Electric machine does not work properly or the performance is poor	Wrong electric machine parameters in the inverter.	Check and correct the parameters from the inverter.
	Demagnetization of magnets due to overheating.	Measure the winding resistance, refer to manufacturer data. Replace the electric machine if necessary.
	Insulation fault.	Measure the insulation resistance, refer to manufacturer limits. See Chapter Insulation resistance test . Replace the electric machine if necessary.
Temperature measurement failure	The PT100 sensor is faulty.	Measure the resistance of the PT100 sensor, see Chapter Low voltage connections . If the sensor is faulty, read out the signal from an other sensor. Contact Danfoss. See also Chapter Emergency operation .

Aftersales

Service policy

Maintenance and service of the electric machine is limited to the procedures described in this user guide.

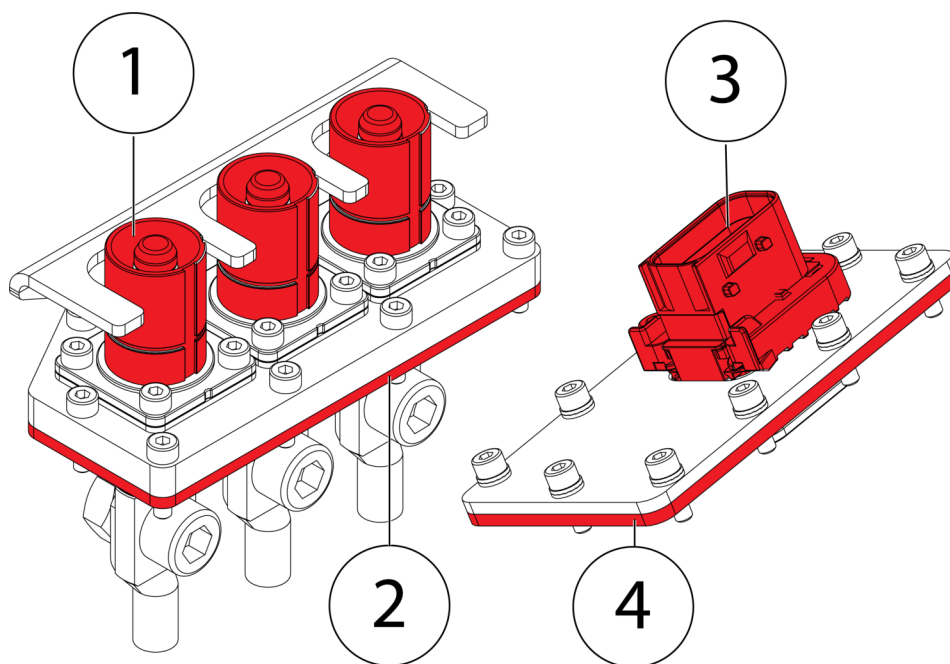
If the electric machine has service parts available, you can find them in Chapter [Service parts](#) on page 62.

For further information, go to <https://danfosseditron.zendesk.com/hc/en-gb> or send email to editron.service@danfoss.com.

Service parts

The recommended service parts are listed in this Section. Quantity describes the number of components in a single electric machine. Maintenance procedures not described in this user guide require special tools and instructions. Contact Danfoss for more information and purchasing.

Service parts



Position	Part	Order number
1	HV connector (standard option). AMPHONEL ART. NO. HVBI005R10AMHARD	14977
	HV connector (+HVC1 -option). AMPHENOL ART. NO. HVBI003R8AMHARD19127101	15687
2	Seal for HV connector plate. T=3	14965
3	LV connector. TE 1-1564520-1 12 PIN ASSEMBLY FOR 3mm PLATE	11033
4	Seal for LV connector plate. SEAL. GASKET. T=3	14956

Disposal

Dispose of the electric machine and any of its parts by appropriate means in accordance with local laws and regulations.

Storage, installation and maintenance checklists

Electric machine installation checklist

Date:

Electric machine and customer information

Customer:	Electric machine type (from the rating plate):
Customer reference:	Electric machine serial number:
Service reference:	Date installed:

N.A = Procedure not applicable PASS = Procedure passed FAIL = Procedure failed

Installation checklist

	Approval	N.A	PASS	FAIL
General				
Electric machine type is correct		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric machine is undamaged		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Insulation resistance check	>150MΩ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental conditions as specified (see data sheet)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical installation				
Supporting structure as required		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shaft alignment as specified (see chapter Shaft alignment and load).		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooling circuit connected and coolant flowing		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Used coolant:				
Power connections				
Cable connector assembly as specified with correct cable diameter		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The phase connections order is correct (U, V, W -> L1, L2, L3)		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grounding				
Electric machine enclosure grounding connected		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low voltage cable shield grounding connected		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power cable shield connection resistances to ground (electric machine enclosure) measured and valid		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Storage, installation and maintenance checklists

Installation checklist (continued)

	Approval	N.A	PASS	FAIL
Low voltage cable shield grounding resistances measured and valid		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes: <ul style="list-style-type: none"> • • • • • • • • • • • • • Date: Signature:				

Do not try to tighten bolts or screws that are not discussed in the product manual and that are not needed for the normal installation procedures. Sealing of the screws may break.

Electric machine weekly maintenance checklist

Date:

Electric machine and customer information

Customer:	Electric machine type (from the rating plate):
Customer reference:	Electric machine serial number:
Service reference:	Date installed:

N.A = Procedure not applicable PASS = Procedure passed FAIL = Procedure failed

Electric machine weekly maintenance checklist

	N.A	PASS	FAIL
General construction			
Noise or vibration during operation in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooling system			

Storage, installation and maintenance checklists

Electric machine weekly maintenance checklist (continued)

	N.A	PASS	FAIL
Functioning of the cooling system in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes: <ul style="list-style-type: none"> 			

Electric machine monthly maintenance checklist

Date:

Electric machine and customer information

Customer:	Electric machine type (from the rating plate):
Customer reference:	Electric machine serial number:
Service reference:	Date installed:

N.A = Procedure not applicable PASS = Procedure passed FAIL = Procedure failed

Electric machine monthly maintenance checklist

	N.A	PASS	FAIL
General construction			
Noise or vibration during operation in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleanliness of the enclosure and connected parts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical system			
Weariness of the cables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooling system			
Functioning of the cooling system in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tightness of the ventilation plug	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Storage, installation and maintenance checklists

Electric machine monthly maintenance checklist (continued)

	N.A	PASS	FAIL
Cleanliness of the ventilation plug	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes: <ul style="list-style-type: none"> • • • • • • • • • • • • • • • 			

Electric machine yearly maintenance checklist

Date:

Electric machine and customer information

Customer:	Electric machine type (from the rating plate):
Customer reference:	Electric machine serial number:
Service reference:	Date installed:

N.A = Procedure not applicable PASS = Procedure passed FAIL = Procedure failed

Electric machine yearly maintenance checklist

	Acceptance	N.A	PASS	FAIL
General construction				
Noise or vibration during operation in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleanliness of the enclosure and connected parts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical system				
Weariness of the cables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical connections in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooling system				
Coolant flow direction changed and connection checked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coolant quality as specified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Used coolant:				
Functioning of the cooling system in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tightness of the tubing and connections (no leakages)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleanliness of the ventilation plug	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grounding				
Power cable shield connection resistances to ground (electric machine enclosure) checked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Storage, installation and maintenance checklists

Electric machine yearly maintenance checklist (continued)

	Acceptance	N.A	PASS	FAIL
Low voltage cable shield grounding resistances checked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Notes: <ul style="list-style-type: none"> • • • • • • • • • • • • • 				

Do not try to tighten bolts or screws that are not discussed in the product manual and that are not needed for the normal installation procedures. Sealing of the screws may break.

For cleaning instructions, refer to Chapter [Cleaning](#) on page 59.

Used service parts

Part description	Part type	Quantity	Item (order) number
–			
–			
–			
–			
–			
Notes: <ul style="list-style-type: none"> • • • • • • • • • • • • • Date: Signature:			

Electric machine storage checklist

Date:

Electric machine and customer information

Customer:	Electric machine type (from the rating plate):
Customer reference:	Electric machine serial number:
Service reference:	Date installed:

Storage, installation and maintenance checklists

This storage checklist is used when storing the electric machine. Regular inspection is required. See specifications for storage in this User Guide or in the Data Sheet.

Fill in the date of each inspection to the Table below.

Storage checklist

Procedure	Date	Date	Date	Date	Date
Storage base as specified (vibration free)					
Storage temperature and humidity as specified					
Electric machine type and serial number is correct					
Electric machine supported correctly					
Shaft rotated as specified (10 rotations monthly)					

Products we offer:

- Cartridge valves
- DCV directional control valves
- Electric converters
- Electric machines
- Electric motors
- Gear motors
- Gear pumps
- Hydraulic integrated circuits (HICs)
- Hydrostatic motors
- Hydrostatic pumps
- Orbital motors
- PLUS+1® controllers
- PLUS+1® displays
- PLUS+1® joysticks and pedals
- PLUS+1® operator interfaces
- PLUS+1® sensors
- PLUS+1® software
- PLUS+1® software services, support and training
- Position controls and sensors
- PVG proportional valves
- Steering components and systems
- Telematics

Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electric components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market as well as the marine sector. Building on our extensive applications expertise, we work closely with you to ensure exceptional performance for a broad range of applications. We help you and other customers around the world speed up system development, reduce costs and bring vehicles and vessels to market faster.

Danfoss Power Solutions – your strongest partner in mobile hydraulics and mobile electrification.

Go to www.danfoss.com for further product information.

We offer you expert worldwide support for ensuring the best possible solutions for outstanding performance. And with an extensive network of Global Service Partners, we also provide you with comprehensive global service for all of our components.

Local address:

Hydro-Gear

www.hydro-gear.com

Daikin-Sauer-Danfoss

www.daikin-sauer-danfoss.com

**Danfoss
Power Solutions (US) Company**
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

**Danfoss
Power Solutions GmbH & Co. OHG**
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

**Danfoss
Power Solutions ApS**
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

**Danfoss
Power Solutions Trading
(Shanghai) Co., Ltd.**
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
Phone: +86 21 2080 6201

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequent changes being necessary in specifications already agreed. All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.