OPERATION AND MAINTENANCE MANUAL

MDD MOTORS

VASCAT

www.vascat.com

CONTENTS

1. LEGAL NOTES AND SAFETY INSTRUCTIONS

1.1 Justification

VASCAT motors contain low-voltage parts and rotating elements that make them hazardous; they also contain hot surfaces. Users must take notice of all the hazard warning signs described in this manual (see section 1.3).

All tasks related to the transport, connection, commissioning and maintenance must be performed by responsible, skilled personnel (in accordance with the EN 50110-1 (VDE 0105-100) and IEC 60364 standards). Inappropriate procedures may cause serious personal injury and material damages.

VASCAT motors may only be used for the purposes specified in Section 1.4.

Furthermore, the site conditions must meet all the requirements given on the motor nameplate and in this document.

1.2 Target readership and purpose

The purpose of the operation manual is to provide all the information required for the appropriate mounting, commissioning and maintenance of the MDD motors and avoid hazards that may cause serious injury. The manual is targeted for any person or individual who handles or is responsible for operation of the motors dealt with in the manual.

All the individuals working with MDD three-phase motors must have this manual at their disposal and they must follow the relevant instructions and indications.

The operation and maintenance instructions must be read carefully before operating the machine. This will guarantee proper operation free from hazards and complications and will extend the service life of the machine.

These service instructions provide a description of the machine and information for its proper handling and operation from delivery to the end of its service life.

This manual must always be complete and perfectly legible.

1.3 Hazards and warning signs

The manual contains the information required for personnel safety and the prevention of material damages. All information related to personnel safety is highlighted in general with a warning triangle; however, the hints (to avoid only material damages) are not. Depending on the hazard level, the signs indicate hazards from major to minor as follows:

 **DANGER**
If no appropriate measures are taken, the result will be death or serious injury.

 **WARNING**
If no preventive measures are adopted, the result may be death or serious injury.

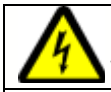
 **CAUTION**
If no appropriate measures are taken, the result may be serious injury.

PRECAUTION
If no appropriate measures are taken, the result may be material damages.

NB
The result may be an unwanted condition or situation if the corresponding safety instruction is not observed.

If several hazard levels are present at the same time, the most stringent instruction for each case will apply. If a safety instruction with a warning triangle warns of personal injury, the same instruction may also contain a warning of possible material damages.

Signs indicating the type of danger Warning or Caution in the manual that may be used together with the pictograms above are as follows:

 **VOLTAGE**
Indicates the presence of voltage on connection terminals or live parts.

 **HOT SURFACE**
Indicates the possibility of the contact surface having a very high temperature with the consequent risk of burns.

 **MOVING ROTATING PARTS**
Indicates the possibility of injury and trauma caused by contact with shafts and other rotating parts.

PRESENCE OF MAGNETIC FIELD

Indicates the existence of an intense magnetic field near or around the machine.

RISK FOR PERSONS WHO USE PACEMAKERS

Indicate the possibility of this type of device malfunctioning if the person stands near the machine.

1.4 Intended use

WARNING

VASCAT motors have been designed for industry plants. They comply with the requirements of the harmonised standards of the EN 60034 series.

Such pieces of equipment are devices designed to be mounted in machines in accordance with the current Machinery Directive. Commissioning is not allowed until the end product is checked and found to be compliant with said Directive (please see, among others, the EN 60204-1 standard).

VASCAT MDD motors must be used only for the applications provided in the catalogues and the related technical documentation.

If third-party products and parts are used, they must be previously approved by VASCAT.

Proper and safe operation of the products requires their proper transportation, storage, installation, mounting, assembly, operation and maintenance.

Allowed ambient conditions must be observed. The use of MDD motors in hazardous areas is strictly prohibited unless they have been designed specifically for said circumstance, in which case the indications and warnings given in the related documentation must be observed.

1.5 Skilled personnel

WARNING

VASCAT motors must be installed and operated in accordance with the specifications given in this document. Only skilled personnel in the context of the manual, i.e. individuals who have the required technical know-how and skills for handling, commissioning and starting the motors according to safety standards, shall be allowed to operate the motors.

Skilled personnel refers to those individuals who are capable of recognising the risks related to their field of activity and avoiding the related hazards.

1.6 Disclaimer

The indications given in the manual describe the product features, but no warranty is implied.

VASCAT declines all liability for damages and operating faults caused by the following:

- Failure to follow the operating instructions.
- Damages caused by inappropriate motor handling.
- Changes made to motors without prior authorisation.
- Operating errors.
- Carrying out inappropriate work on and with the motors.

The indications that refer to procedures and the connection details provided in the manual must be considered only as proposals and whether or not they are applicable must be studied for each case in particular. VASCAT does not guarantee their appropriateness in any case.

The data given in this manual is reviewed regularly and subsequent editions are published when corrections are necessary.

1.7 Scope of the documentation and external references

The manual contains all the information required for the correct handling, installation (electrical and mechanical), commissioning and subsequent maintenance of MDD series motors, together with the accessories required for proper operation.

It also describes the safety instructions to guarantee that no personal injuries or material damages will be caused during the entire process.

If the motor design includes any special features (considered as non-standard), additional documentation may be necessary. In those cases, the customer must check with VASCAT to make sure that he has all the relevant information.

This document provides no information about the technical data sheets or the specific technical data of the various MDD models or their characteristic curve.

To obtain said information, please log on to the VASCAT website at http://www.vascat.es.

2. DECLARATIONS OF CONFORMITY

VASCAT	**CE CONFORMITY DECLARATION** **MDD-SN/GA MOTORS**	

VASCAT S.A., CONFORMITY DECLARATION

The company VASCAT S.A., with registered offices in C/ Esquirol s/n - 08570 Torelló-SPAIN

DECLARES

The motors of the series MDD-SN/GA comply with the basic requirements set forth in the following Directives:

2014/35/UE – Low Voltage Directive
2006/42/CE- Machinery Directive
2014/30/UE– Electromagnetic Compatibility Directive
93/68/CEE – CE Marking Directive

These motors have been manufactured in compliance with the following standards:

- UNE-EN 60034-1
- UNE-EN 60034-5
- UNE-EN 60034-8
- UNE-EN 60034-9

In consequence to the above-mentioned standards, this declaration will no longer be valid when changes are made without our prior consent.

The specified product shall be installed as a part of a machine only. Commissioning of the product is not allowed until it has not been checked that the end product complies with above mentioned operation standards.

Torelló 01st April 2019

VASCAT, S.A.
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Josep Torras Homs
General Manager

VASCAT	**CE CONFORMITY DECLARATION** **MDD-SW/GW MOTORS**	

VASCAT S.A., CONFORMITY DECLARATION

The company VASCAT S.A., with registered offices in C/ Esquirol s/n - 08570 Torelló-SPAIN

DECLARES

The motors of the series MDD-SW/GW comply with the basic requirements set forth in the following Directives:

2014/35/UE – Low Voltage Directive
2006/42/CE- Machinery Directive
2014/30/UE– Electromagnetic Compatibility Directive
93/68/CEE – CE Marking Directive

These motors have been manufactured in compliance with the following standards:

- UNE-EN 60034-1
- UNE-EN 60034-5
- UNE-EN 60034-8
- UNE-EN 60034-9

In consequence to the above-mentioned standards, this declaration will no longer be valid when changes are made without our prior consent.

The specified product shall be installed as a part of a machine only. Commissioning of the product is not allowed until it has not been checked that the end product complies with above mentioned operation standards.

Torelló 01st April 2019

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VASCAT *Departament de R+D*	DECLARACIÓN DE CONFORMIDAD CON LAS DIRECTIVAS 2011/65/UE RoHS, 2012/19/UE WEEE Y REGLAMENTO 1907/2006/CE REACH *DECLARATION OF COMPLIANCE WITH THE EUROPEAN DIRECTIVES 2011/65/EU, 2012/19/EU WEEE AND EUROPEAN REGULATION 1907/2006/CE REACH*	Página 1/1 Fecha 08/05/17

Torelló, 08 de mayo de 2017

La firma VASCAT, S.A. con domicilio en C/ Esquirol s/n - 08570 Torelló

DECLARA

Que los productos fabricados por VASCAT,S.A. –Motores eléctricos de CC o CA para aplicaciones de velocidad variable - así como sus accesorios standard –Electroventiladores, Dinamos tacométricas, encóderes y frenos- , son conformes a la **Directiva Europea 2011/65/UE sobre restricciones a la utilización de determinadas sustancias peligrosas en aparatos eléctricos y electrónicos,** la **Directiva Europea 2012/19/UE sobre residuos de aparatos eléctricos y electrónicos** en lo concerniente al contenido en Plomo(Pb), Mercurio(Hg), Cadmio(Cd), Cromo Hexavalente (Cr 6+), Polibromobifenilos (PBB) y Polibromodifeniléteres (PBDE) y al **Reglamento Europeo 1907/2006/CE relativo al uso de sustancias SVHC en cantidades no superiores al 0.1% (REACH) en todo su proceso de fabricación aun siendo usuarios intermedios y no estando sujetos al registro.**

Torelló, May 08th 2017

VASCAT, S.A. with address in C/ Esquirol s/n - 08570 Torelló

DECLARE

That the products manufactured by VASCAT,S.A. –Electric DC and AC motors for variable speed operation- and their standard accessories – Electric blowers, tachodinamos, encoders and brakes -, are in compliance with ***European Directives 2011/65/EU about Restrictions of hazardous substances in waste from electrical and electronic equipment – RoHS,*** *the* ***European Directives 2012/19/EU about waste of electrical and electronic equipment – WEEE –*** *as related to the content of Lead(Pb), Mercury(Hg), Cadmium(Cd), Hexavalent Chromium (Cr 6+), Polybrominated biphenyls(PBB) and Polybrominated Diphenilethers (PBDE) and the* ***European Regulation 1907/2006/CE about SVHC substances in quantity not higher 0.1% (REACH) throughout its manufacturer process although being downstream user which are not summited to registration activity.***

Josep Torras Homs
Gerente / *General Manager*
VASCAT, S.A.

3. PRODUCT DESCRIPTION

VASCAT MDD motors and generators are synchronous AC electrical machines with internal permanent magnets (IPM), cooled by natural convection (SN/GA series) or fluid (SW/GW series). They have been specially designed to operate in high-dynamics applications that require speed variation. They must be powered exclusively by frequency converters.

3.1 General information

The following table shows the standard technical specifications of the MDD series:

Technical specifications	Description
Machine type	*MDD SN/SW: Synchronous interior permanent magnet (IPM) motor* *MDD GA/GW: Synchronous interior permanent magnet (IPM) generator*
Frame sizes (Shaft heights)	*132, 180, 250 and 315 mm*
No. of poles	*Shaft height 132 mm: 8 poles* *Shaft height 180 mm: 10 poles* *Shaft height 250 mm: 16 poles* *Shaft height 315 mm: 20 poles*
Protection rating (According to the IEC/EN 60034-5 standard)	*Complete version: IP54* *Frameless version: IP20 (final protection depends on the enclosure installed by the customer)*
Type of cooling (According to the IEC/EN 60034-6 standard)	*MDD SN/GA series: IC410* *MDD SW/GW series: IC97W*
Power-supply voltage	*Three-phase up to 500 VAC (please consult other voltages)*
Insulation class (According to the IEC/EN 60034-1 standard)	*Materials Class H - Operating temperature Class F*
Mounting type (According to the IEC/EN 60034-7 standard)	*Full version IM B3 or B35 (other types of assembly optional)*
Thermal protection (According to the IEC/EN 60034-11 standard)	*PTC probe on stator winding (other sensors optional)*
Temperature sensor	*KTY-84-130 linear sensor on stator winding (optional)*
Installation altitude (According to the IEC/EN 60034-1 standard)	*<1000 m above sea level*
Operating temperature (According to the IEC/EN 60034-1 standard)	*0 to +40ºC*
Vibration level (According to the IEC/EN 60034-14 standard)	*Class A (Class B optional)*
Shaft and flange types (According to the IEC/EN 60072-1 standard)	*Complete version: Solid shaft with keyway and B5 flange* *Frameless version: Hollow shaft with keyway* *(Other configurations optional)*
Bearings	*Complete version: Rigid ball bearings (other types optional)*
Paint	*Synthetic enamel RAL 7043 colour (other types optional)*
Feedback sensors	*EnDat ECN413 absolute optical encoder* *(Other types of sensors available on request)*

Table 1: General specifications of MDD machines

On many occasions, VASCAT, S.A. adapts its motors to the specific requirements of each customer/application. Therefore, the above table must be understood as a general reference only. The exact specifications of each motor can be found on the corresponding technical data sheet and the additional documentation provided to the customer (where applicable).

3.2 Reference standards

The MDD motors are designed and manufactured according to the Low Voltage Directive 2014/35/UE and they have been designed for their use in industrial applications as an incomplete machine or as a machine component as provided for in the 2006/42/CE Machinery Directive.

The following table summarises the main reference technical standards that have been taken into account for the design of these motors:

Standard	Description
IEC/EN 60034-1	*Rating and performance*
IEC/EN 60034-2	*Standard methods for determining losses*
IEC/EN 60034-5	*Degrees of protection*
IEC/EN 60034-6	*Cooling*
IEC/EN 60034-7	*Classification of construction types*
IEC/EN 60034-8	*Terminal markings and direction of rotation*
IEC/EN 60034-9	*Noise limits*
IEC/EN 60034-11	*Thermal protection*
IEC/EN 60034-14	*Mechanical vibration levels*
IEC/EN 60034-18	*Functional evaluation of insulation systems*
TS 60034-25	*Guidance for the design and performance of a.c. motors specifically designed for converter supply*
IEC/EN 60072-1	*Power series and dimensions of rotating electrical machines*

Table 2: Reference standards

In accordance with the current Machinery Directive, the commissioning of these motors is prohibited in the European Union until conformity of the installation has been confirmed in which the machine is to be installed (see EN 60204-1). If the electrical machine is to be used outside the European Union, the specific laws of the country in which it is located will apply. Furthermore, safety standards, local installation and industry-specific standards must be applied.

The data given in all the documentation provided by VASCAT includes tolerances regarding the most relevant parameters shown on the table 3:

Efficiency	Power factor	Slip	Inertia	Noise level	Torque	Speed	Power
-15% (1-η)	*-1/6 (1-cos φ)*	*+/-20%*	*+/-10%*	*+3 dB*	*-7%*	*+/-2%*	*-5%*

Table 3: Tolerances

3.3 Definitions

3.3.1 Duty

Three-phase induction motors are usually designed to deliver their rated power in continuous service with no overheating problems. However, most motors operate under a non-continuous type of service. Some motors are switched on for a few moments only, others work all day, but they only charge up briefly, etc. The EN 60034-1 standard defines 10 main service types and those summarised in the table below apply to MDD motors:

Duty	Description	Definition
S1	*Continuous duty*	*Operation under constant load, for a time duration enough to reach thermal balance.*
S2	*Short-time duty*	*Operation under constant load, for a time period shorter than required to reach thermal balance, followed by a standby period that is sufficient to cool down to ambient temperature.*
S3	*Intermittent periodic duty*	*A series of identical duty cycles consisting of a constant-load period followed by a stillstand period.*
S5	*Temporary intermittent duty with starting and electric braking*	*A series of identical duty cycles consisting of a start period, a constant-load period and an electric braking period, followed by a stillstand period.*
S6	*Continuous operation periodic duty under intermittent load*	*A series of identical duty cycles consisting of a constant-load period followed by a no-load operation period.*
S7	*Continuous operation periodic duty under intermittent load with electric braking*	*A series of identical duty cycles consisting of a start period, a constant-load period, a no-load period and an electric braking period.*

Table 4: Duty

3.3.2 Types of construction

The following are some of the mounting types applicable to the complete versions of the MDD motors, labelled in accordance with the IEC/EN 60034/7 standard.

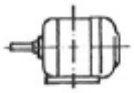
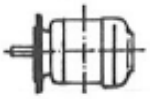
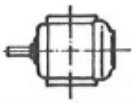
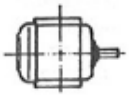
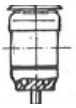
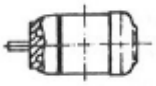
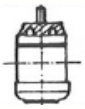
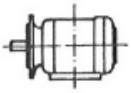
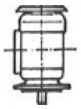
Type of construction	Enclosure	Mounting	Type of construction	Enclosure	Mounting
IM B3 IM1001		*Foot mounted, on lower horizontal plane*	IM V1 IM3011		*Flange mounted, shaft downward (with through holes)*
IM B5 IM3001		*Flange mounted, horizontally (with through holes)*	IM V3 IM3031		*Flange mounted, shaft downward (with through holes)*
IM B6 IM1051		*Foot mounted on vertical plane (shaft to the left)*	IM V5 IM1011		*Foot mounted on vertical plane (shaft downward)*
IM B7 IM1061		*Foot mounted on vertical plane (shaft to the right)*	IM V6 IM1031		*Foot mounted on horizontal plane (shaft downward)*
IM B8 IM1071		*Foot mounted on horizontal plane (shaft to the right)*	IM V18 IM3611		*Flange mounted, shaft downward (with threaded holes)*
IM B14 IM3601		*Flange mounted (with through holes)*	IM V19 IM3631		*Flange mounted, shaft upward (with threaded holes)*
IM B35 IM2001		*Flange and foot mounted (with through holes)*	IM V15 IM2011		*Flange mounted, (with through holes), shaft downward and feet*
			IM V36 IM2031		*Flange mounted (with through holes), shaft downward and feet*

Table 5: Mounting

3.3.3 Degree of protection IP

The degree of protection of electrical machines is defined in accordance with IEC/EN 60034-5. Said standard specifies the degree of protection of each machine using an 'IP' code, which comprises two digits:

- First digit: Indicates the degree of protection for contact and solid bodies.
- Second digit: Indicates the degree of protection for water.

The table below shows the meaning of each digit:

First digit	Protected against	Second digit	Protected against
0	*No special protection against the ingress of foreign objects.*	0	*No special protection against the ingress of water.*
1	*Accidental contact with large surfaces, e. g. the back of a hand. Ingress of foreign objects with a diameter greater than 50mm.*	1	*Dripping water (vertically falling drops)*
2	*Contact with fingers. Ingress of foreign objects with a diameter greater than 12mm.*	2	*Dripping water, when tilted up to 15 degrees from its vertical position.*
3	*Contact with tools, wires, etc. with a diameter greater than 2,5mm. Ingress of foreign objects with a diameter greater than 2,5mm.*	3	*Spraying water at any angle up to 60 degrees from its vertical position.*
4	*Contacts with tools, wires with a diameter greater than 1 mm. Ingress of foreign objects with a diameter greater than 1 mm.*	4	*Water splashing from any direction.*
5	*Complete protection against contact. Protection against harmful dust deposits.*	5	*Water jets from any direction.*
6	*Complete protection against contact. Complete protection against the ingress of dust.*	6	*Powerful water jets with increased pressure (sea).*
		7	*Protection against temporary immersion under the specified pressure and for the time specified.*
		8	*Continuous immersion.*

Table 6: IP code

For example, a machine defined as IP54 indicates complete protection against contact and water spraying from any direction.

3.3.4 Cooling Methods

The cooling methods used in electrical machines are regulated by the IEC/EN 60034-6 standard. In order to identify the cooling method used in each motor, it is also given a code similar to the IP protection rating. There are two types of code: complete code (e.g. IC9A7W7) and short code (e.g. IC97W). Both begin with the initials IC (International Cooling).

The table below shows the most common cooling methods for MDD motors:

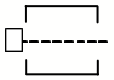
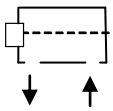
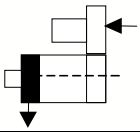
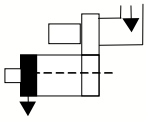
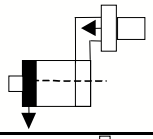
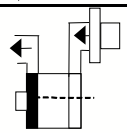
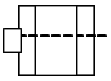
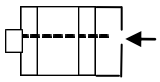
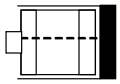
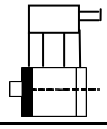
SHORT CODE	COMPLETE CODE	EN60034-6	DESCRIPTION
IC00	IC0A0		*Free circulation using the surrounding medium by means of free convection*
IC01	IC0A1		*Self-ventilated with integral fan cooling, Cooling air is blown through the motor by a fan mounted on the shaft*
IC06	IC0A6		*Separate ventilation with radial fitted fan unit, Cooling air is blown through the motor by a separately excited fan motor. The inlet side may be equipped with an air filter.*
IC16	IC1A6		*Circulation via pipe or duct, Cooling medium is supplied by external part*
IC17	IC1A7		*Single pipe ventilated, Cooling air is blown across the motor through the pipe connection with a separate customer provided external blower fan and discharges on the other side to open space.*
IC37	IC3A7		*Double pipe ventilated, Cooling air is blown across the motor through a pipe connecting by means of a separate customer provided external blower fan and discharges on the other side's pipe connecting.*
IC410	IC4A1A0		*Totally-enclosed nonventilated, Cooling without using a fan, only by natural ventilation and radiation on the totally enclosed motor surface.*
IC411	IC4A1A1		*Totally-enclosed fan-cooled, Cooling air is blown over the totally enclosed motor surface by a fan mounted on the shaft.*
IC416	IC4A1A6		*External surface cooling, Cooling air is blown over the totally enclosed motor surface by an separately excited fan motor.*
IC97W	IC9A7W7		*Cooling using an independent heat exchanger by means of liquid coolant or remote fluid*

Table 7: Cooling types

3.3.5 Vibration grade

The EN 60034-14 international standard specifies the factory acceptance vibration test procedures and vibration limits for certain electrical machines under specified conditions, when uncoupled from any load or prime mover.

The standard defines two vibration grades: Grade 'A' (machines with no special vibration requirements); and Grade 'B' (machines with special vibration requirements).

The table below shows the limits of maximum vibration magnitude in displacement, velocity and acceleration (RMS) for shaft height (H):

Vibration grade	Shaft height (mm)	56 ≤ H ≤ 132			132 < H ≤ 280			H > 280		
	Mounting	Displac. µm	Vel. mm/s	Accel. m/s²	Displac. µm	Vel. mm/s	Accel. m/s²	Displac. µm	Vel. mm/s	Accel. m/s²
A	*Free suspension*	*25*	*1.6*	*2.5*	*35*	*2.2*	*3.5*	*45*	*2.8*	*4.4*
	Rigid mounting	*21*	*1.3*	*2*	*29*	*1.8*	*2.8*	*37*	*2.3*	*3.6*
B	*Free suspension*	*11*	*0.7*	*1.1*	*18*	*1.1*	*1.7*	*29*	*1.8*	*2.8*
	Rigid mounting				*14*	*0.9*	*1.4*	*24*	*1.5*	*2.4*

Table 8: Vibration levels

When no grade is specified, machines complying with this standard shall be grade "A".

3.3.6 Insulation class

The insulation thermal class rating of an electrical machine is identified on the motor nameplate by means of a letter in accordance with the IEC/EN 60034-18 international standard.

The table below summarises the maximum allowed temperature in the insulation system of a winding in accordance with its insulation thermal class rating:

Thermal class rating	Thermal class
A	*105ºC*
E	*120ºC*
B	*130ºC*
F	*155ºC*
H	*180ºC*

Table 9: Insulation classes

3.3.7 Stress category severity

The table below describes the four stress categories defined in the IEC 6034-18-41 international standard:

Stress category	Overshoot Factor (OF) Up/Ua	Impulse Risetime
A – Benign	OF ≤ 1,1	0,3 µs
B – Moderate	1,1 < OF ≤ 1,5	
C – Severe	1,5 < OF ≤ 2,0	
D – Extreme	2,0 < OF ≤ 2,5	

Table 10: Phase-to-ground stress categories

3.3.8 Heating limits

The IEC60034-1 standard defines the maximum admissible heating (increase in temperature) for the windings as specified in the following table:

Thermal class	Coolant temperature	Heating (per element)	Operating temperature
B (130ºC)	< 40ºC	< 80ºC	< 120ºC
F (155ºC)	< 40ºC	< 105ºC	< 145ºC
H (180ºC)	< 40ºC	< 125ºC	< 165ºC

Table 11: Heating limits

In this regard the rated working conditions of the motor must be such that the operating temperature on the windings is always below the temperature specified by the insulation class of its composing materials. Therefore, the working thermal class of a motor can correspond to the following:

a) **The same thermal insulation class**. This would be the case of a motor built with **Class F** insulation (155°C) with a maximum working temperature of 140°C, corresponding to a **Class F**.

b) **A thermal class lower than the insulation class**. This would be the case of a motor built with **Class H** insulation (180°C) with a maximum working temperature of 140°C, corresponding to a **Class F**.

3.4 Nameplate

All MDD motors are provided with the following nameplate:

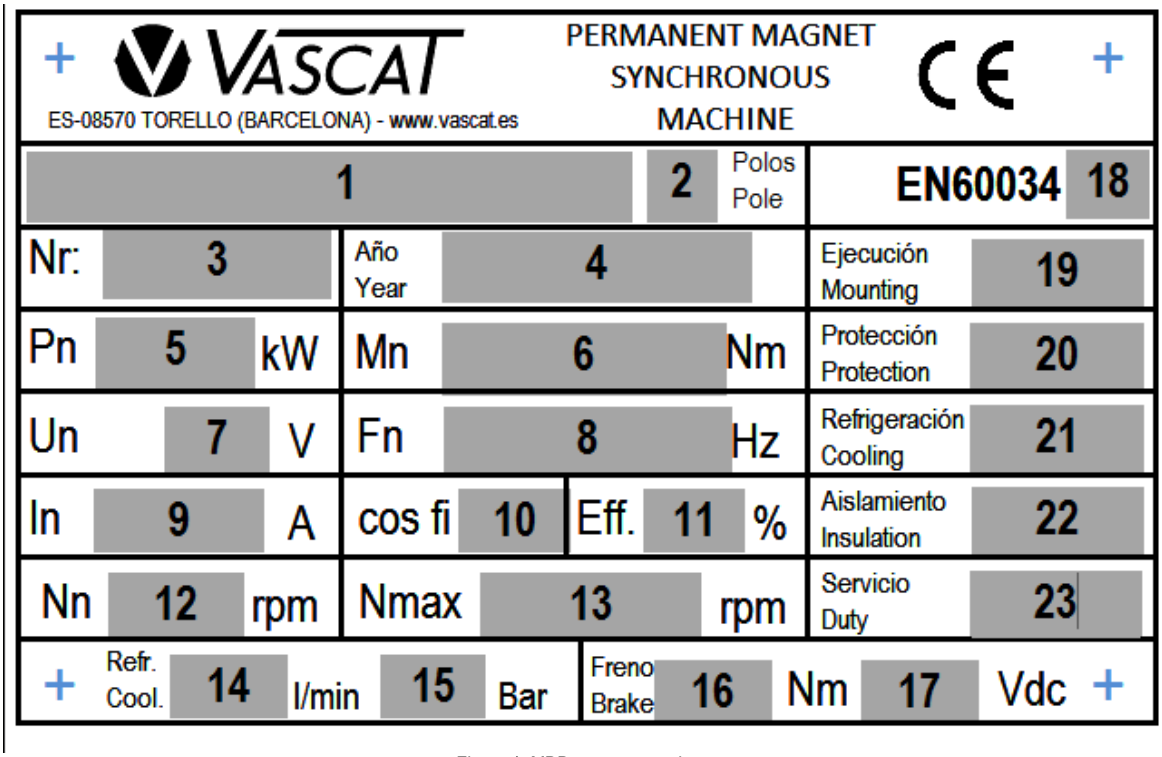


Figure 1: MDD motor nameplate:

The table below describes the included motor nameplate data:

Pos.	Description	Pos.	Description
1	*Motor type*	2	*No. of poles*
3	*Serial No.*	4	*Year of manufacture*
5	*Rated power PN in kW*	6	*Rated torque MN in Nm*
7	*Rated voltage UN in V*	8	*Rated frequency FN in Hz*
9	*Rated current IN in A*	10 / 11	*Power factor Cos φ / Efficiency in %*
12	*Rated speed n_N in rpm*	13	*Maximum mechanical speed n_{max} in rpm*
14 / 15	*Flow volume (l/min) and Pressure (Bar) of coolant (*)*	16 / 17	*Torque (Nm) and Voltage (V) of the brake (**)*
18	*EN60034 family of reference standards*	19	*Mounting type Code IM (EN60034-7)*
20	*Protection rating IP code (EN60034-5)*	21	*Cooling method IC code (EN60034-6)*
22	*Winding working temperature CL code (EN60034-1)*	23	*Duty S code (EN60034-1)*

Table 12

(*) Positions ***14 / 15*** are checked only if cooling is by fluid (SW/GW series).
(**) Positions ***16 / 17*** are checked only if there is a parking brake.

3.5 General specifications

3.5.1 Motor code

MDD series motors are coded as follows:

MDD	*SW*		*180*	*M*	*B2*
Motor type	*Series*		*Size*	*Length*	*Winding*
MDD Direct Drive Motor (Synchronous IPM)	***SN*** ***GA***	IC410 Cooling by natural convection	***132*** ***180*** ***250*** ***315*** Shaft height (mm)	***K*** ***S*** ***M*** ***L*** ***P*** ***Q*** ***X*** ***Y***	Defines the rated motor speed
	SW ***GW***	IC97W Cooling by circulating fluid			

Table 13: MDD machines codes

3.5.2 Ambient conditions

In their standard version, MDD machines are not suitable for working in saline or corrosive atmospheres or for installation outdoors.

3.5.3 Duty

The rated power assigned for continuous service (S1 duty type) assumes an ambient temperature between -20º and +40ºC and altitudes of up to 1000 m.

If the working conditions are different from those above, a derating factor (K1) must be applied to the rated torque and power (See table below):

Altitude	Temperature			
	30ºC	40ºC	50ºC	55ºC
1000 [m]	*1*	*1*	*0.92*	*0.86*
2000 [m]	*1*	*0.93*	*0.85*	*0.77*
3000 [m]	*0.93*	*0.85*	*0.76*	*0.69*
4000 [m]	*0.86*	*0.78*	*0.67*	*0.6*

Table 14: Declassing factors

In the MDD SW/GW series, unless specified otherwise, the powers assigned for continuous service (S1) with cooling by fluid (based on water) apply at a temperature of 18°C.

If the working conditions differ from those above, a derating factor called K1 must be applied to the torque and power with regard to the values given on the specifications plate, as shown in the graph below:

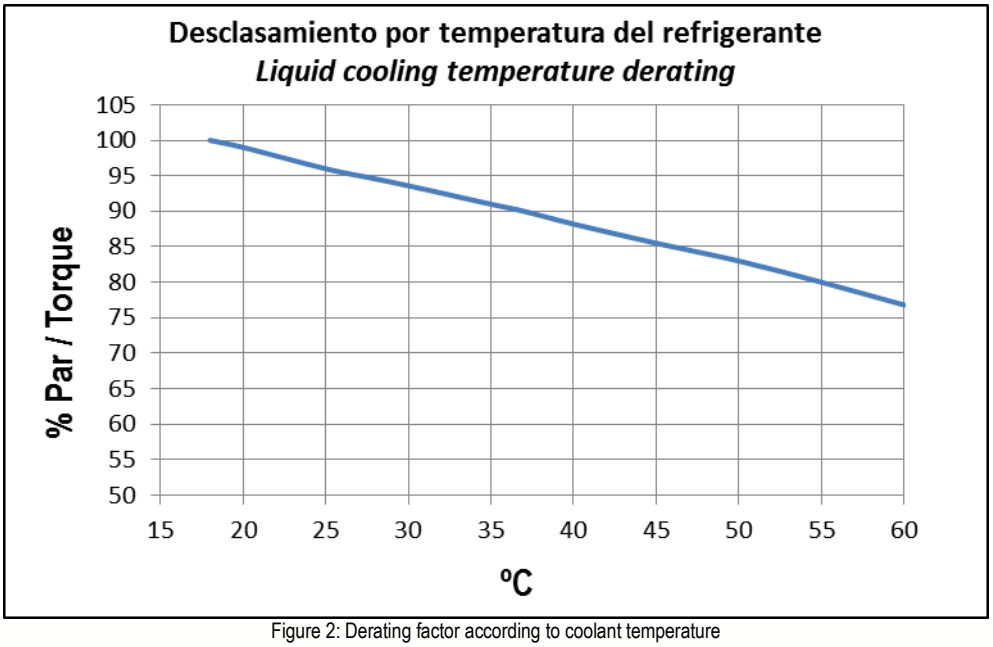


Figure 2: Derating factor according to coolant temperature

If the motor does not work in continuous service (S1), but rather in an S2 Short-time duty type, a multiplication factor must be applied (K2) to the torque and power specified on the nameplate (S1 Service) to determine the torque available for this service. The K2 factor is determined by the duration of the service according to the graph below.

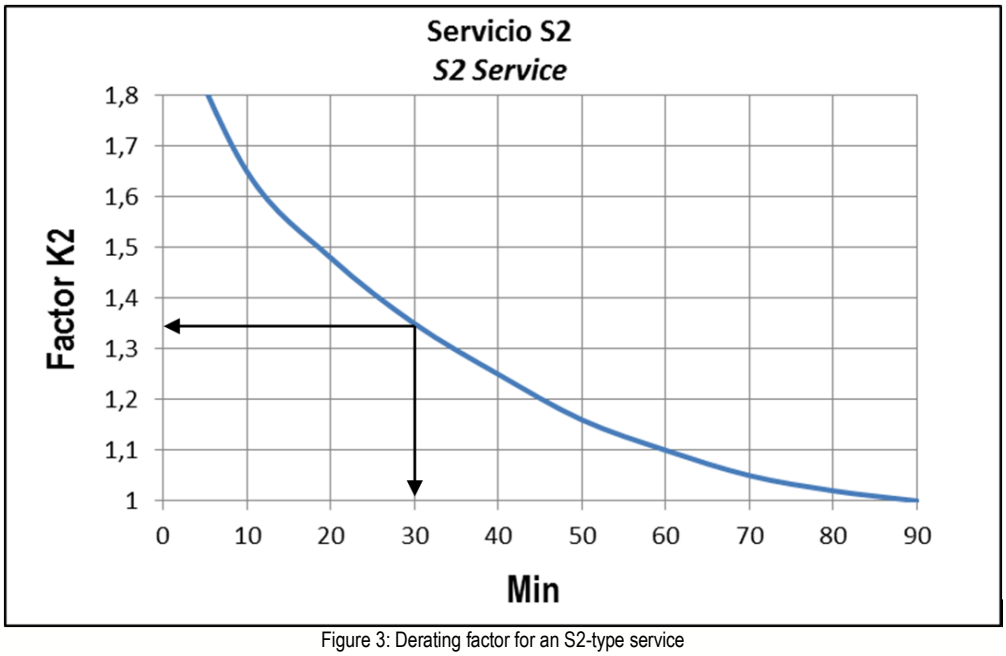


Figure 3: Derating factor for an S2-type service

3.6 Mechanical specifications

3.6.1 Types of construction

Available construction types for MDD motors (with complete version) are detailed in the table below:

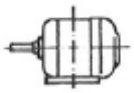
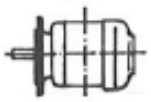
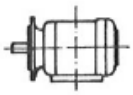
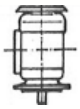
EN 60034-7		132	180	250	315
	IM B3 IM 1001	*OK*	*OK*	*OK*	*OK*
	IM V5 IM 1011	*OK*	*OK*	*OK*	*OK*
	IM V6 IM 1031	*OK*	*OK*	*OK*	*OK*
	IM B5 IM 3001	*OK*	*OK*	*C*	*X*
	IM V1 IM 3011	*OK*	*OK*	*OK*	*C*
	IM V3 IM 3031	*OK*	*OK*	*OK*	*C*
	IM B3/B5 IM 2001	*OK*	*OK*	*OK*	*OK*
	IM V1/V5 IM 2011	*OK*	*OK*	*OK*	*C*
	IM V3/V6 IM 2031	*OK*	*OK*	*OK*	*C*

Table 15: Available construction types for MDD motors

OK: Construction possible **X: Construction not possible** **C: Consult**

3.6.2 Degree of protection IP

MDD motors are defined with the following IP degrees:

Motor	Complete version	Frameless version
MDD SN/GA	*IP54*	*IP20**
MDD SW/GW	*IP54*	*IP20**

Table 16: Degree of protection of MDD motors

(*) Final protection depends on the enclosure installed in the frameless kit.

Motors that comply with the IP54 protection rating or higher can be installed in damp and dusty industrial environments

3.6.3 Cooling Method

The table below summarises the available cooling methods for the MDD motors:

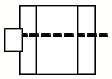
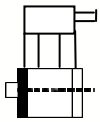
COOLING	EN60034-6	MDD SN	MDD SW
IC410		OK	X
IC97W		X	OK

Table 17: Available cooling methods for MDD motors

OK: Construction possible **X: Construction not possible**

3.6.4 Balancing and vibration grade

VASCAT motors are defined as A-grade vibration level machines (according to EN 60034-14). B-grade can also be supplied on request.

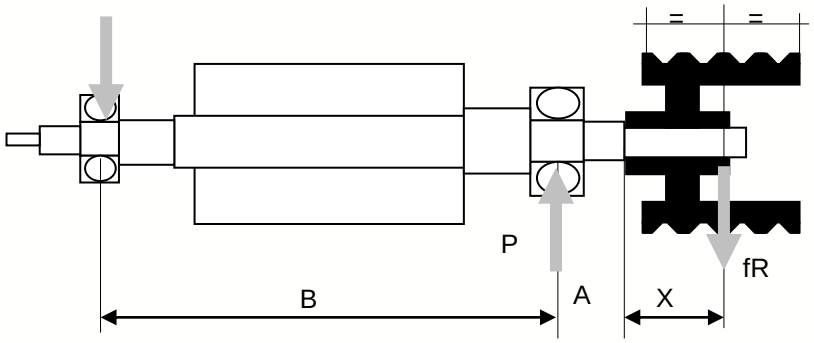
3.6.5 Bearings

MDD motors with solid shaft and complete version (not available for 315 frame size) include different bearings types depending on their frame size (shaft height). The table below summarises the bearings considered standard for each of them:

Motor type	Bearing		max n	n	L10h	C	max P	A	B	max X	max Fr
			rpm	rpm	h	N	N	mm	mm	mm	N (**)
MDD Sx/Gx 132	*D.E.*	*6310ZZC3*	*6300*	1500	20000	*61800*	5080	36,5	310,5	110	2800
	N.D.E.	*6208ZZC3*	*8500*	1500	20000	*30700*	2524	36,5	310,5	110	4300
MDD Sx/Gx 180	*D.E.*	*6220ZZC3*	*5300*	1000	20000	*122000*	11481	20	330	80	7000
	N.D.E.	*6310ZZC3*	*6300*	1000	20000	*61800*	5816	20	330	80	15400
MDD Sx/Gx 250	*D.E.*	*6320ZZC3*	*3000*	800	20000	*163000*	16523	20	390	80	51600
	N.D.E.	*6316ZZC3*	*3800*	800	20000	*122000*	12367	20	390	80	7900

Table 18: Technical specifications of MDD motor bearings

N.D.E. = Rear / Non Drive End DE = Front / *Drive End*



TERMINOLOGY:

max n = Maximum speed
n = Working speed
L10h = Bearing service life, in h
C = Rated dynamic load of bearing
max P = Radial load admissible on bearing for L10h and n
max Fr = Maximum radial force on pulley

(*)Supply on request
(**) The maximum radial force on the pulley is lower than the values of the selected set of bearings
(***) Ball bearings without blanking plates.
Ball bearings with ZZ blanking plates are greased for their entire service life.
Roller and ball bearings without blanking plates must be greased regularly with KP2N-40 lithium soap-based grease according to DIN51825.

PRECAUTION

If the admissible loads are exceeded for the forces on the end of the shaft, damages may occur to the mounting parts and the machine. Damages may also occur to the cylindrical roller bearings when the transversal forces are lower than the established minimum.

Check the admissible loads according to the data given in the catalogue.

Radial load according to speed

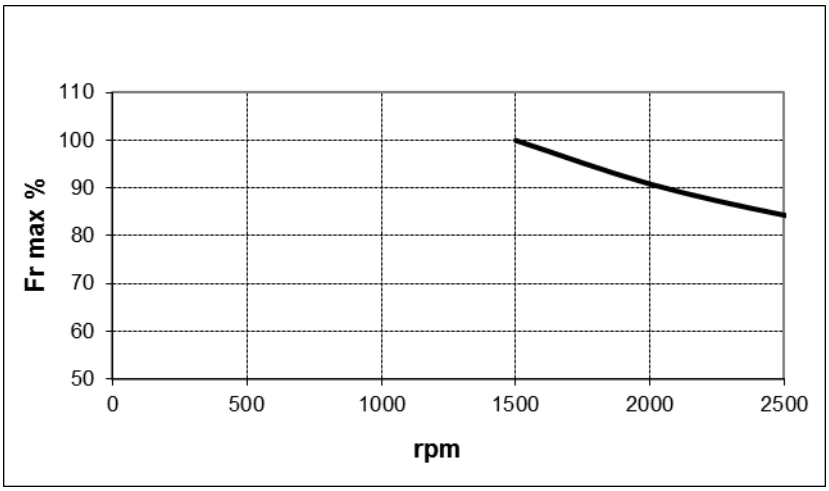


Figure 4: Admissible radial loads

MDD motors carry a standard earth connection brush to prevent problems caused by bearing currents. There is also the option (on request) of incorporating bearings insulated with external greasing. VASCAT recommends incorporating this type of bearing in motors with powers that are equal to or greater than 100 kW.

A motor may need some type of special work (considered as non-standard) that includes a bearing different to those specified above. In said case, the customer must check with VASCAT to make sure that he has all the relevant information.

3.7 Electrical specifications

3.7.1 Windings and insulation

MDD motor coil windings are made up of copper wires with two coats of polyamide varnish > 220°C and/or THEIC-Polyamide with Amide-Imide > 200°C, rated with H-type insulation class.

The winding encapsulation is made of bi-component epoxy resins, also class H.

The windings are insulated from the stator core using NMN sandwich-type paper (Nomex-Mylar-Nomex). The outer parts of the sandwich (Nomex) are fibres, whereas the core (Mylar) is a plastic film of polyethylene terephthalate. Special care is also taken with the insulation between each phase.

This insulation system guarantees appropriate dielectric resistance for the motor to work with frequency converters, even on the most critical applications.

3.7.2 Connections

The connections between the windings and the terminal box are made using a flexible cable coated with ETFE capable of withstanding up to 150°C. The connections are welded using a FUSBAT650 rod. The welds of the contacts are also protected by a double layer of fibreglass insulation pipe with class-H acrylic impregnation.

3.7.3 Power-supply conditions

MDD motors are designed to work with a power supply via frequency converters and they can withstand BUS DC voltages (after rectifying the mains voltage) of up to 700 VDC (500 VAC).

With regard to admissible voltage surges, MDD motors can withstand the Impulse Voltage Insulation Class IVIC C/B according to the IEC 60034-18-42:

Impulse insulation class	Maximum allowable peak/peak operating voltages	
	Phase / phase C	*Phase / Ground B*
IVIC C/B	*5,9 [U_N]*	*3,1 [U_N]*

Table 19: Maximum allowable operating voltage at machine terminals

Furthermore, the drive switching frequency connected to a MDD motor must be at least as summarised in the following table:

Power	Rated frequency	Switching frequency
P > 100 kW	*>40 Hz*	*4 kHz*
	≤ 40 Hz	*2 kHz*

Table 20: Admissible switching frequency

Otherwise, the rated features of the motor, shown on its nameplate, must be derated. Please check with VASCAT to determine the resulting values.

3.7.4 Standard thermal protection

MDD motors include a PTC140-type thermistor on their stator windings for motor frame sizes smaller than 160 and PTC155 for the bigger ones. It is a solid-state device whose resistance varies significantly with temperature and provides a *Contact Open (OFF) / Contact Closed (ON)* type logical signal depending on whether or not the temperature of the motor windings exceeds the reference temperature of the sensor.

Its operation curve is as follows:

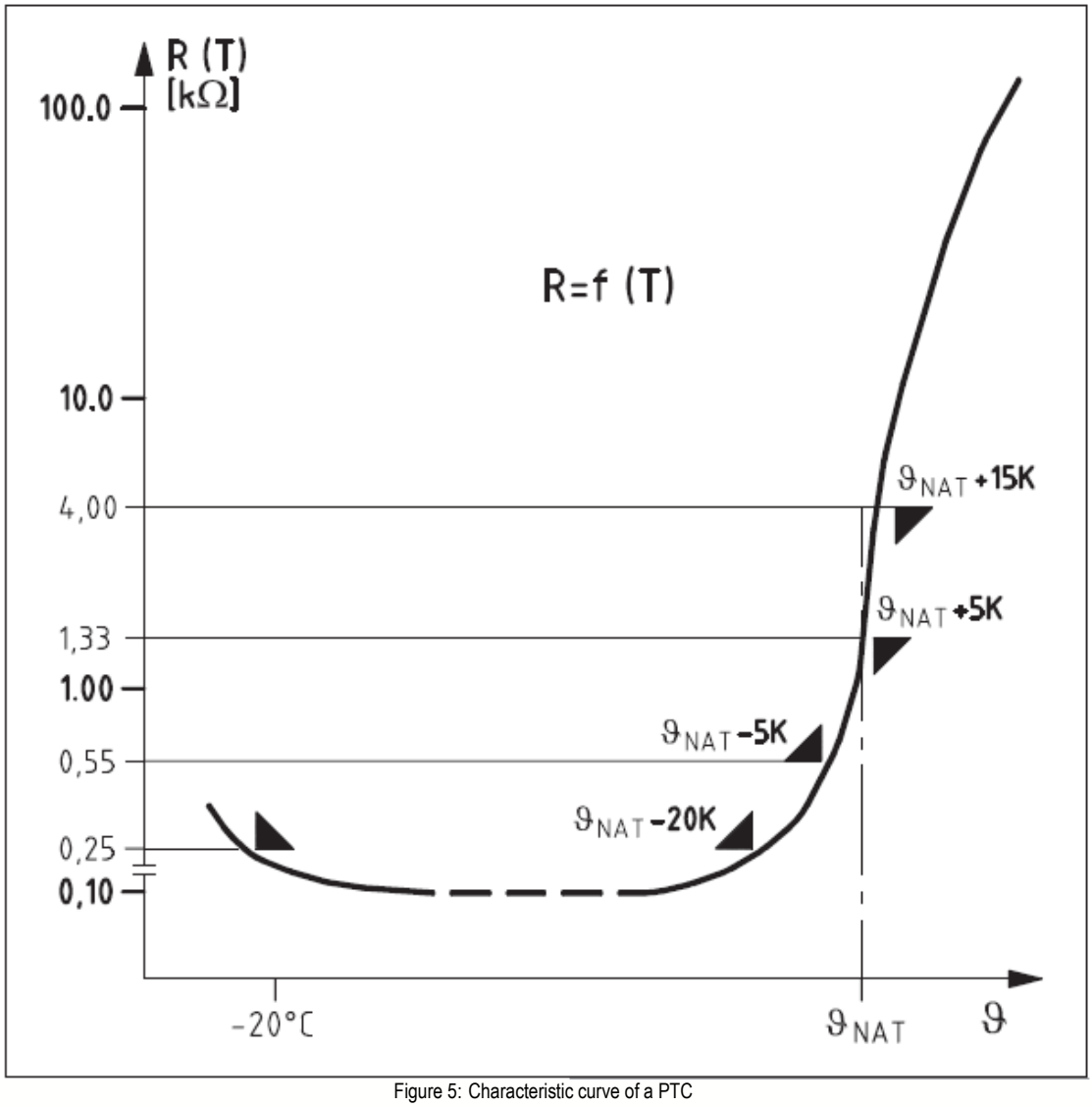


Figure 5: Characteristic curve of a PTC

Said ON/OFF logical signal can be used by an external control circuit to process an alarm system to prevent the motor from overheating.

3.7.5 Optional thermal sensors

The installation of other types of linear temperature probes is also possible on request. For example, KTY84-130 or Pt100 sensors can be installed on the windings for monitoring the operating temperature at all times. The following graphs correspond to said sensors.

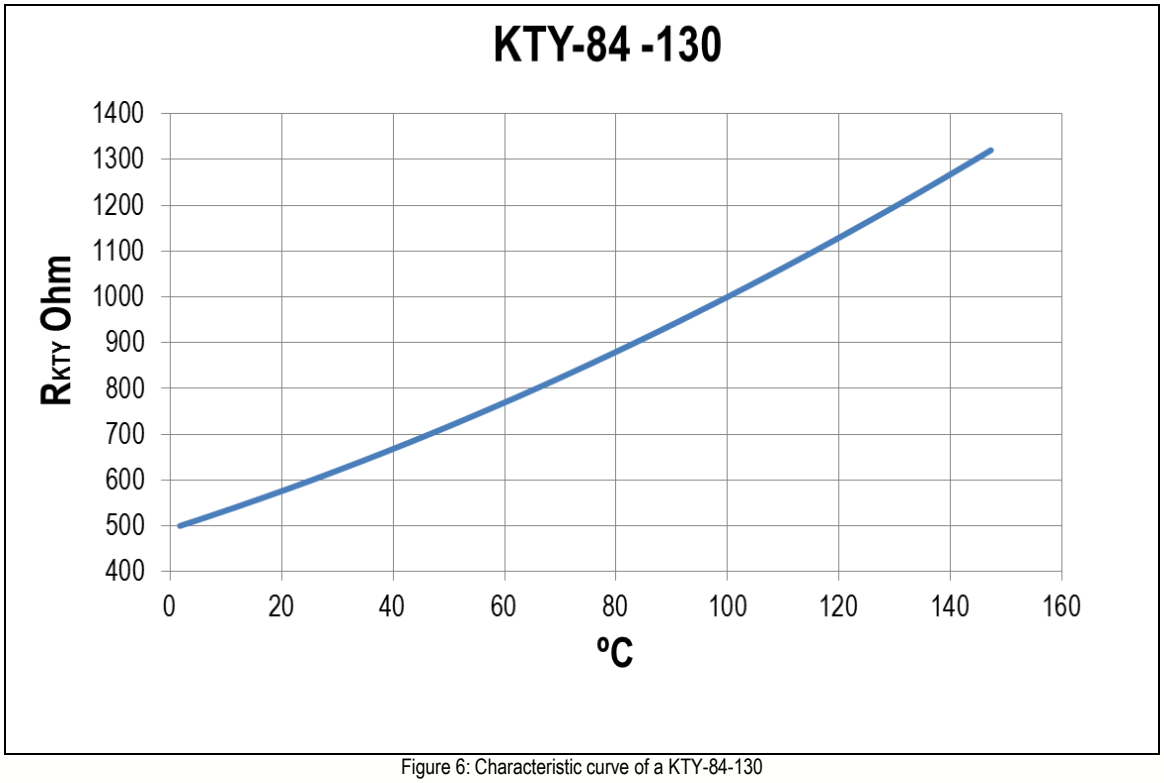


Figure 6: Characteristic curve of a KTY-84-130

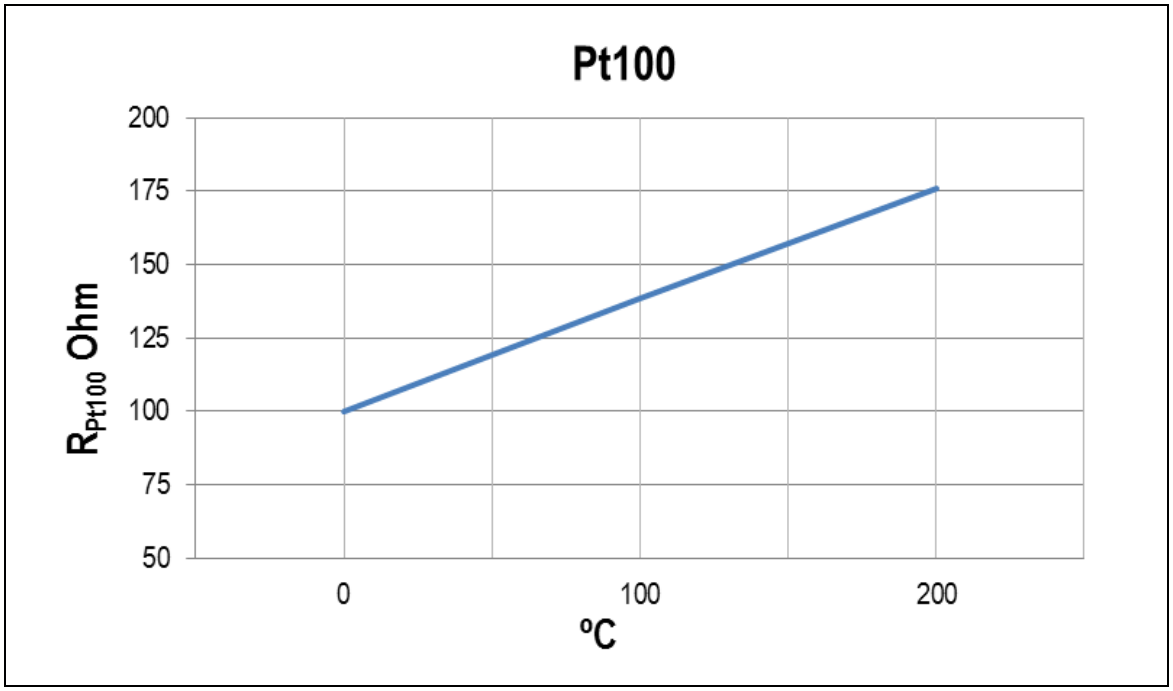


Figure 7: Characteristic curve of a Pt100

PT100 sensors can also be fitted as an option on the bearings.

3.7.6 Anti-condensation heaters

As an option (on request), one or two heating elements can be installed on the winding heads to prevent condensation on the motor windings when the motor is to be installed at a site with high relative humidity (> 85%).

The standard VASCAT type is 50 W 230 VAC.

3.7.7 Liquid cooling

Recommended cooling specifications:

The recommended coolant is water (preferably deionised) in a closed circuit with an antifreeze and anti-corrosion additive, such as Tyfocor in a solution at 20-25%. For ambient temperatures of between -9°C and -20°C, increase the concentration of antifreeze additive up to 30%.

	Quality of the water used as a coolant for motors with aluminium, stainless steel pipes + cast iron or steel sleeve
Chloride ions	*< 40 ppm, can be reached by adding deionised water*
Sulphate ions	*< 50 ppm*
Nitrate ions	*< 50 ppm*
pH value	*6…9 (for aluminium 6….8)*
Electrical conductivity	*< 500 µS/cm*
Total hardness	*< 170 ppm*

Table 21: Connectors

NB: It is recommended to use deionised water with reduced conductivity (5…10µS/cm).

	Coolant quality
Coolant water	According to above table
Protection against corrosion	0.2 to 0.25% inhibitor, Nalco TRAC100 (previously 0GE056)
Antifreeze protection	*When necessary, 20-30% Antifrogen N (from the Clariant company)*
Dissolved solids	*< 340 ppm*
Size of particles in coolant	*< 100µm*

Table 22: Connectors

NB: The inhibitor is not necessary if the concentration of Antifrogen N is > 20%.

NB
Biocides must not be mixed with Antifrogen N.

PRECAUTION
Storage or transport The cooling circuit must be drained when the motor is stored or out of service for long periods or when the motor is being transported.

PRECAUTION
Frosts If there is a risk of frosts, preventive measures must be taken during operation, storage and transport (antifreeze, draining and blowing with air, etc.). Do not mix different types of antifreeze.

PRECAUTION
Condensation To prevent the risk of condensation, the coolant inlet temperature must be at least: $T_{coolant} > T_{ambient} - 5\ K$

Connectors:

For cooling SW/GW series motors, the following connections are used depending on motor shaft height:

Motor	Connector
MDD SW/GW 132	***G 1/4"***
MDD SW/GW 180	***G 3/8"***
MDD SW/GW 250	***G 1/2"***

Table 23: Connectors

When using stainless steel cooling circuits, the connectors that are used should be made of the same material.

PRECAUTION
Filter Filter should be fitted on the inlet pipe to protect the motor from foreign bodies or agents. The size of the filter holes must not exceed 100 µm. Fit a pressure valve downstream of the filter for additional protection. Consult the technical data sheets of the motors for coolant pressure and flow volume values.

3.8 Accessories

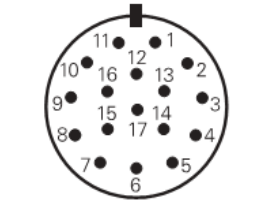
3.8.1 Feedback sensors

MDD series motors can be fitted with different types of feedback sensors. As standard models, VASCAT offers the following encoders:

Specifications	ECN 413 EnDat
Number of pulses per revolution	*512 / 2048*
VDC power supply voltage	*5*
Output logic	*Sin/Cos 1Vpp*
Output voltage High level	-
Low level	-
Max. output frequency	*200 kHz*
Load capacity	*160 mA*
Maximum cable length	*150 m*
Short-circuit protection	*Yes*
Operating temperature	*-10 / 100ºC*
Protection rating	*IP64*
Hollow shaft diameter	*12 mm*
Male connector (encoder side)	*CONIN M23 17 poles with clockwise numbering*

PINS

PIN No.	Signal
1	Sensor Up
2	-
3	-
4	0V sensor
5	-
6	-
7	Up
8	CLOCK +
9	CLOCK -
10	0V supply
11	Inside shield
12	B+
13	B-
14	DATA +
15	A+
16	A-
17	DATA -



ENCODER (MACHO) / ENCODER (PIN)

*Cable screen on cable + connector versions.

Table 24: Standard feedback sensor on MDD motors

Blind hollow shaft encoders are used with an anti-turn strap system on the stator, mounted to the motor shaft using a ring clamp.

When specifically requested by the customer, other types of encoders and/or servo sensors can be fitted. Please check with VASCAT for each specific case.

3.8.2 Parking brake

MDD series motors can be fitted, as an option, with an electromagnetic parking brake to immobilise the motor load safely and in a way that is 100% external to the operation of the motor itself. On certain occasions, this is necessary for safety reasons, e.g. when it is necessary to block the movement of the machine to work on the interior safely or when there is a fault in the converter power supply or other mechanical devices of the installation.

The brake model will be defined according to each specific application. Please check with VASCAT for more details.

3.8.3 Noise level

In view of the low speed and absence of forced ventilation, the main source of noise on MDD motors is the converter switching frequency

The technical data sheets VASCAT provides for each motor show the noise level in dB issued by each model under VASCAT test conditions (switching frequency 4 kHz).

The machines directive specifies a noise level of 80 dB at work posts. The user is responsible for guaranteeing said level using the installation of external absorption devices if necessary.

4. SHIPMENT, RECEPTION, TRANSPORT AND STORAGE

4.1 Shipment

MDD motors are shipped in completely closed packaging, including a wooden pallet that has been given phytosanitary treatment. The specific type of packaging may vary according to the destination and the type of transport used.

In general, for road transport, the packaging consists of a box of dual-layer corrugated cardboard, clipped and tied with a heat-sealed strap on the palate; for transport by sea or air, it consists of a wooden box that has been given phytosanitary treatment fastened to the pallet using nails or screws.

By request, other types of packaging may be considered according to the customer's specifications.

Please check with VASCAT for more details of each shipment.

4.2 Reception

When the goods have been received, the customer is responsible for checking that the packaging has not been damaged and is in perfect condition. If that is not the case, the circumstance must be recorded on the haulier's delivery documentation and a claim must be filed immediately with the haulage company for the damages that have been caused.

When it has been removed from the packaging, the material must be checked to ensure that it has been delivered in accordance with the details on the documents sent with the shipment, together with the fact that it is in a correct state of repair. Otherwise, a claim must be filed immediately with VASCAT for the faults that have been seen or for an incomplete shipment.

VASCAT declines all responsibility for damages claimed thereafter.

NB
Do not start up a machine that has been damaged under any circumstances.

4.3 Transport

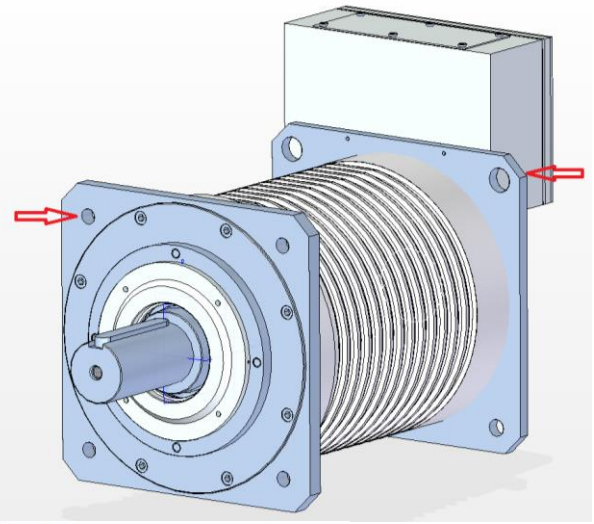
The machine must be transported always in accordance with the following instructions:

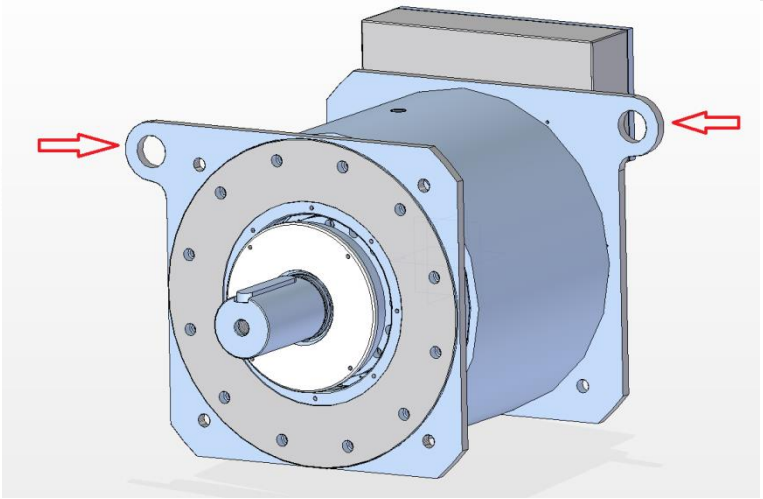
WARNING

Transport and lifting of the machine by the eyebolts only

For correct motor handling, use the eye bolts or holes on the top of the housing (depending on each motor type), which have been fitted exclusively for said purpose. Therefore, do not lift the motor using the shaft or the terminal box casing under any circumstances.

To lift the machine, use guide devices (cables, chains or slings) with safety hooks on the ends. See diagram:





The lifting device and guide devices must have sufficient load capacity to lift the machine. Please see that technical data sheet for the motor to know how much each model weighs.

Sudden movements and knocks must be avoided during transport.

4.4 Storage

PRESENCE OF MAGNETIC FIELD

Choose the place for storing the motor carefully since, as it emits a magnetic field, it could seriously affect other devices nearby.

RISK FOR PERSONS WHO USE PACEMAKERS

Prevent people who use pacemakers or similar devices from working near the place in which the machine is stored.

MDD motors can be stored for long periods (up to 2 years) without their specifications being affected. They must be stored in a dry, dust-free place with no aggressive atmosphere or vibrations and no sudden temperature changes.

PRECAUTION

Damages caused by outdoor storage
The machine may be damaged if it is stored outdoors.

The machine must be stored only in indoor areas that meet the following conditions:

- They must be dry, dust-free, icing proof and have no vibrations. The relative humidity of the air must be below 60%; in accordance with EN 60034-1, the temperature must not be below -15ºC.
- It must be well ventilated.
- It must provide protection against extreme bad weather.
- The ambient air must not contain aggressive gases.

The machine must be protected against knocks and humidity and its entire surface must be appropriately covered.

If the machine cannot be stored in a dry place, the following measures must be adopted:

- Cover the machine using a plastic film or similar with a drying material (silica gel) inside.
- Package the unit in a sealed box.
- Place several bags of drying agents in the sealed box. Check the drying product regularly and replace it as necessary.
- Control the humidity level in the sealed packaging by placing indicators that show the air humidity level in the packaging at different levels.

If the machine is to be stored for a relatively long period (more than 6 months), it must be checked regularly (every 3 months) to ensure that it is in a perfect state of repair and that there are no faults. The required maintenance work must be carried out and the storage enclosure must be climate-controlled.

Before packaging the motor, VASCAT applies a thin film of blue removable lacquer on the end of the shaft and the machined surfaces. This product protects the materials against corrosion. If it is to be stored for a long period, do not remove the protective film.

PRECAUTION
Damage caused by condensation water Condensation water may gather in the machine owing to important variations in ambient temperature, direct sunlight or high air humidity levels during storage. If the stator winding is damp, its insulation resistance is reduced. This leads to disruptive discharges that can destroy the winding. Furthermore, condensation water may form oxide or mould inside the machine. This is why it is important to follow VASCAT's storage recommendations.

5. INSTALLATION AND START-UP

PRESENCE OF MAGNETIC FIELD

Choose the place for storing the motor carefully since, as it emits a magnetic field, it could seriously affect other devices nearby.

RISK FOR PERSONS WHO USE PACEMAKERS

Workers fitting and commissioning the motor must not use pacemakers.

PRECAUTION

Damage caused to bearings as a result of long storage periods

If the machine has been stored for more than 3 years in good conditions (dry, dust-free place, etc.), the grease on the bearings must be changed, if they need re-greasing, or the bearing should be changed if it is a bearing with lubrication for its entire service life. If the machine has been stored in poor conditions, the change or re-greasing of the bearings may be necessary before the aforementioned period.

The following describes the conditions that are necessary for the installation and start-up of the machine.

5.1 Motor installation

5.1.1 Site

A correct site is essential for guaranteeing a long motor service life. The use of the motor in an incorrect site could shorten its service life considerably. The following are some points to bear in mind when choosing the correct site for the motor:

a) The chosen site must comply with the ambient temperature range and altitude for which the motor was selected (for more details, see section 3.5.3).

HOT SURFACE

The exterior surface of the motors can reach temperatures of more than 60°C and, therefore, the appropriate precautions must be taken to avoid accidental contact (the motor bears a plate indicating said circumstance).

b) The site must have a humidity level of less than 85% to prevent condensation appearing on the surface. If the humidity levels at the site exceed 85%, the motor must be fitted with anti-condensation heaters (see section 3.7.6).

c) Ensure the free convection of air around the motor (SN and GA series) and that the temperature of the surfaces that receive the thermal radiation from the motor is not higher than 40°C.

PRECAUTION
Damage to the motor caused by poor convection and/or radiation. Damages may be caused to the motor if there is insufficient cooling caused by positioning the motor in an inadequate place. If the motor does not have sufficient cooling, the windings may overheat and the corresponding consequences may arise.

5.1.2 Mounting

Correct mounting is essential to guarantee a long service life for the motor. The following are essential issues that need to be taken into account when anchoring the motor correctly:

IM B3 Foot-mounting:

a) Ensure that the support base is correctly levelled: the motors must be mounted on a solid, flat base that is perfectly level. If the base is not made up of one single compact surface, the motor feet support services must be on the same level. To level the machine correctly, the feet may have to be gauged using steel plates to avoid the appearance of mechanical tension.

PRECAUTION
Damages caused to the motor by the incorrect levelling of the support base The incorrect levelling of the motor reduces the service life of the bearings and other parts of the transmission.

b) Use an appropriate base for the assembly work: Make sure that the base on which the motor is to be located meets the following specifications:

- The dimensions of the base correspond to those of the motor feet. Make sure that the entire area of each of the 4 motor feet rests perfectly on a solid base.
- Make sure that the base is capable of supporting the weight of the motor without problem. If the base were to go out of shape over time, the motor may not be level, which would reduce the service life of the motor substantially, especially the bearings.
- Make sure that the base is sufficiently heavy-duty to counter the torque provided by the motor without noticeable deformation.
- Make sure that the base is sufficiently rigid for there to be no resonances in the motor operation speed range.

c) Make sure that there are no additional loads on the motor: Consideration must be given to the weight of the couplings and pulleys and the resulting axial and radial loads to ensure that the motor bearings are dimensioned correctly (the maximum admissible radial loads for each motor are specified in the Table 18).

d) Fastening the feet: When the motor has been installed on a base that meets all the aforementioned, the motor must be firmly fastened in position using the 4 holes machined on the feet (for said purpose) and bolts of the appropriate size for said holes. The diameters of the holes machined on the motor feet comply with the motor shaft height according to the EN 60072 standard. The leg bolts must be selected according to the loads applied to the motor and in compliance with the ISO 898-1 standard, which defines the mechanical properties of the bolts according to their quality.

Fastening using IM B5 or IM B14 flanges or frameless mounting (rotor + stator kit):

a) Remove the anti-rust varnish: First of all, clean the surface of the flange before fastening.

b) Connect and fastened the counter-flange: For correct fastening, use bolts with an appropriate diameter in accordance with the dimensions of the flange as per the EN 60072 standard.

c) Make sure of the perpendicularity of the machine shaft and the counter-flange plane: Perpendicularity errors must be below 0.05 mm.

d) Make sure that the counter-flange is appropriate: In accordance with section b) of the IM B3 assembly.

NB
Application of additional loads on the flange The motor flange is dimensioned only to support its own weight. If there are additional loads, the flange may not be sufficiently heavy duty and, therefore, faults may occur that affect the motor and the machine to which it is coupled.

5.1.3 Machine coupling

The motor must be coupled to the machine very carefully since it is fundamental in order to ensure the correct service life of the motor.

Before mounting the coupling, remove the protective lacquer and clean the surface well.

PRECAUTION
Damages to the motor bearings Prevent solvent from entering the interior of the bearings since they could be damaged.

If the motor works with a direct drive (coupled directly to the load), the appropriate coupling must be used to compensate the alignment errors and radial forces that are applied. Please check with VASCAT S.A. in case of doubt.

In any case, make sure that the alignment between the motor shaft and that of the machine corresponds to the coupling between both parts.

PRECAUTION
Damages to the shaft and bearings Excessive misalignment can cause overloads on the bearings and break the shaft or cause the bearings to seize up through fatigue. The customer is responsible for ensuring the correct alignment of both shafts.

VASCAT motors and rotors are dynamically balanced using a half-key on the end of the shaft (in accordance with the 60034-14 standard). To ensure the correct balance of the entire transmission unit, all the parts of the transmission system must also be balanced (pulley, coupling, etc.).

The installation of the coupling or the transmission element must be made gently without knocking, previously heating the pulley or using an appropriate tool (please see Figure 9).

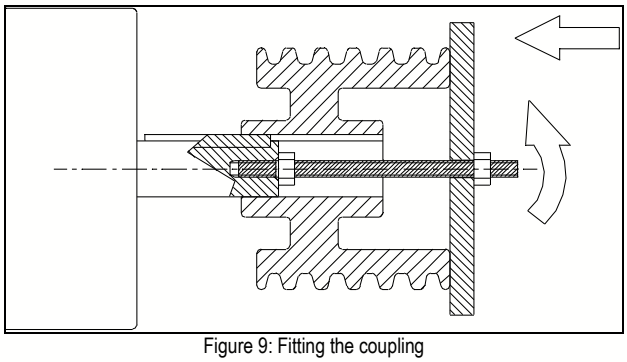


Figure 9: Fitting the coupling

PRECAUTION
Damages to the motor bearings If the motor shaft is knocked, the bearings may be damaged.

If belts are used for the transmission of the torque or a gear with radial load, make sure that the admissible radial load is not exceeded on the motor shaft. The specific data for the admissible radial loads for each size of motor can be found in the Table 18 description of the bearings given in previous sections.

PRECAUTION
Damages to the motor bearings If the maximum value of the admissible radial load is exceeded, the shaft may break and the bearings may seize up due to fatigue. The customer is responsible for making sure that the tension of the transmission belts does not exceed the established limits.

Frameless mounting (rotor + stator kit):

1. Units supplied with blocking parts

Blocking parts maintain the concentricity between rotor and stator, preventing the ferromagnetic attraction from sticking the rotor magnets in the stator. They must be removed after the stator has been mounted on the bench with the rotor inserted in the machine shaft.

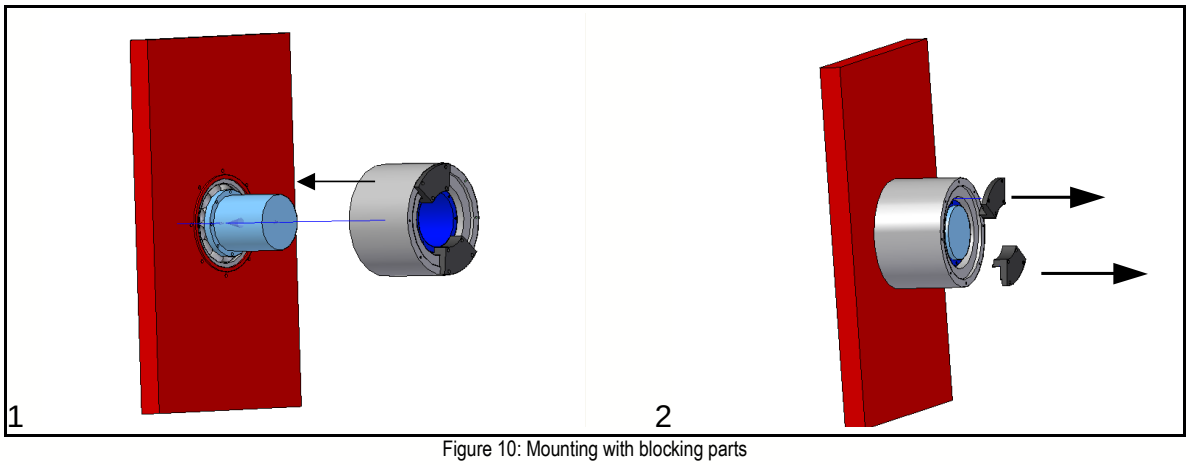


Figure 10: Mounting with blocking parts

2. Units supplied without blocking parts

In this case, the stators and rotors are supplied separately.

The motor shaft must protrude slightly from the stator to allow the insertion of the rotor after the stator has been fastened to the bench.

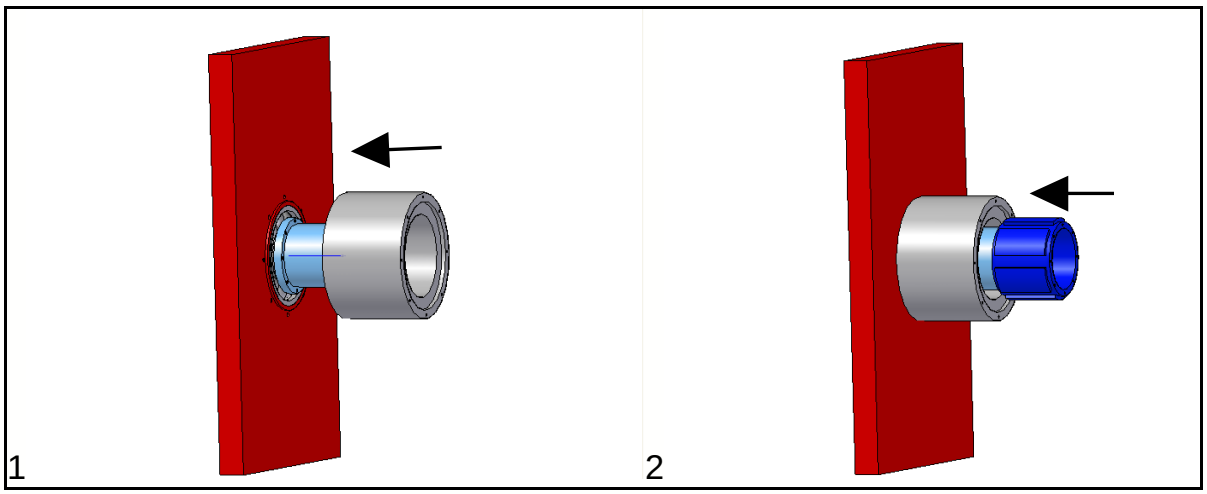


Figure 11: Mounting without blocking parts

In some cases, the use of alignment tools is recommended for inserting the rotor, as shown in the following figure:

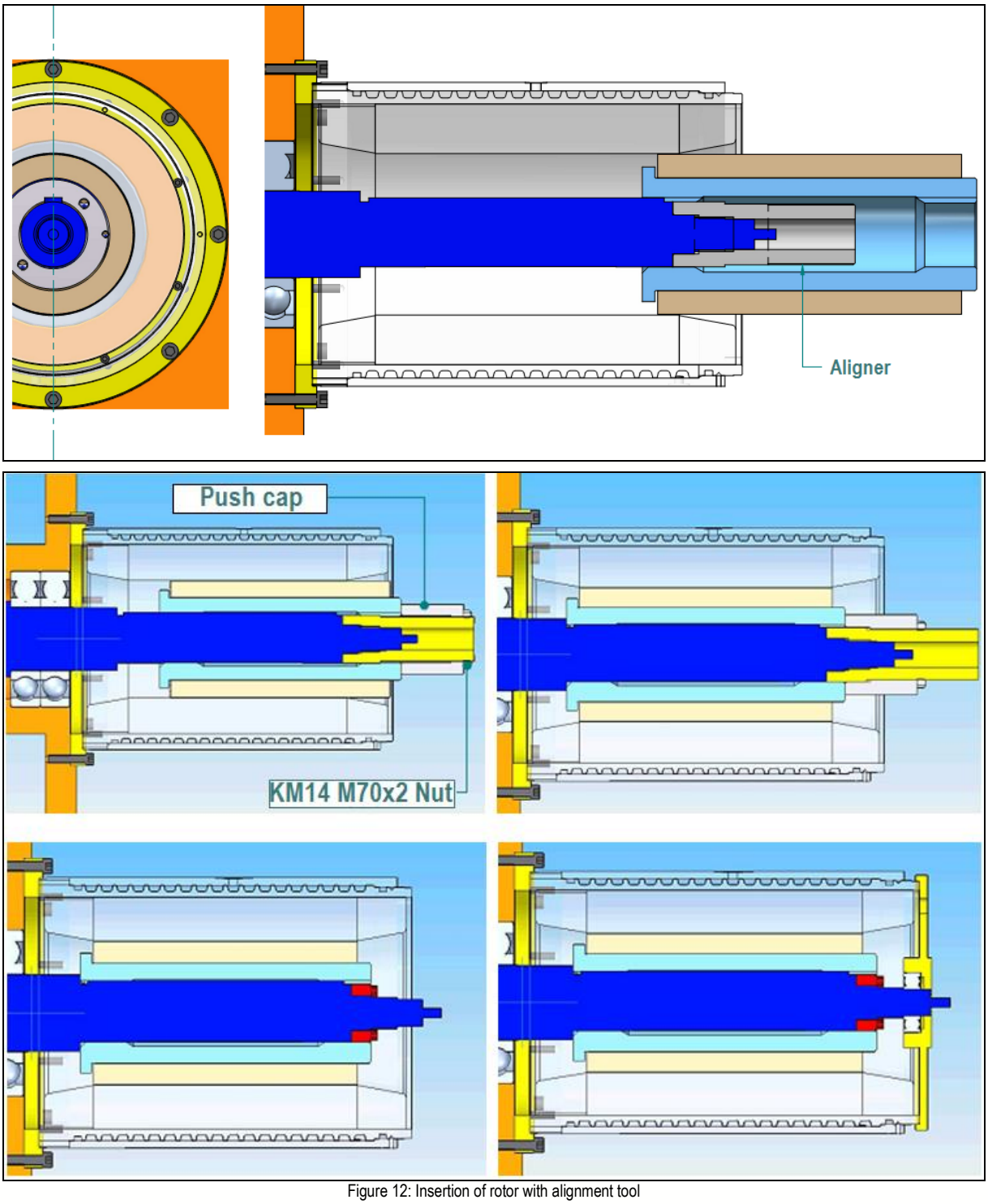


Figure 12: Insertion of rotor with alignment tool

With frameless mounting, the bearings that support the motor and rotor shaft must be selected according to the weight and loads affecting the unit. Please check with VASCAT in case of doubt.

5.1.4 Start-up of the cooling circuit

Make sure that the composition, flow volume and temperature of the coolant are as specified in this manual (see section 3.7.6) and the motor technical data sheet and check that the required volume of coolant is available.

Make sure that the coolant inlet and outlet are positioned on the exterior of the casing, one on the DE side and the other on the NDE side.

Connect the cooling circuit pipes (usually hoses) to the motor sleeve using the connectors and make sure they are coupled together correctly to prevent leaks. The end-user must choose the most appropriate inlet and outlet connectors.

Make sure that the maximum working pressure does not exceed 4 bars.

The coolant must be circulating as from 1 minute before the motor is started up to 10 minutes after disconnection to evacuate the residual heat of the motor and prevent the coolant from overheating.

PRECAUTION
Keeping the coolant in circulation with the motor disconnected for more than 10 minutes may cause water condensation inside the motor with serious consequences for the winding insulation.

5.2 Electrical connections

WARNING

All the work must be carried out by skilled personnel and when the motors are completely stopped and isolated from the mains. Always check that there is no voltage!

PRECAUTION

Damage to the windings

Before the connection, check the status of the insulation elements of the windings with regard to earth, since long or inappropriate storage or transport may have caused the motor to absorb humidity, which affects the capacity for insulation.

The reference values for the installation considered safe by VASCAT are as follows:

Parameters	Reference values
Recommended measurement voltage	*500 V*
Minimum insulation resistance with new or repaired windings	*60 MΩ*

Table 25: Insulation reference values for MDD motors

If the humility or dirt returns a value below the specified figure, the windings must be cleaned or dried until measurements in the safe range are obtained.

WARNING

Dangerous voltage

When measuring the resistance of the winding insulation and just after the measurement, the terminals are live. Contact with any live part may cause serious injury or even death.

Do not touch the terminals during the measurement process or immediately afterwards. Before any contact, discharge the terminals to earth using an insulated cable.

5.2.1 Connection strips and terminals

MDD motors have a terminal box with the corresponding electrical connection strip and connection bolts for the current of each motor.

The following table summarises the different types of terminal boxes, strips and terminals that correspond to the standard execution of each size of the MDD motors.

MOTOR	CABLE SECTION	TERMINAL	TERMINAL STRIP	TIGHTENING TORQUE	TERMINAL BOX
MDD 132	1x2.5	1 of 4-6 M8	M8	8Nm	180x180x60
	2x2.5	1 of 4-6 M8	M8	8Nm	180x180x60
	2x6	2 of 4-6 M8	M8	8Nm	180x180x60
MDD 180	1x6	1 of 16 M12	M12	20Nm	300x200x120
	1x10	1 of 16 M12	M12	20Nm	300x200x120
	1x16	1 of 16 M12	M12	20Nm	300x200x120
	2x6	1 of 16 M12	M12	20Nm	300x200x120
	2x10	1 of 25 M12	M12	20Nm	300x200x120
	2x16	1 of 35 M12	M12	20Nm	300x200x120
MDD 250	2x10	1 of 35 M16	M12 bars	20Nm	400x200x160
	4x10 / 2x16	1 of 50 M16	M12 bars	20Nm	400x200x160
	8x10 / 4x16	2 of 50 M16	M12 bars	20Nm	400x200x160
	8x16	2 of 70 M16	M12 bars	20Nm	400x200x160
MDD 315	2x10	Only available in frameless version			
	5x10 / 2x16				
	10x10 / 5x16				
	10x16				

Table 26: Standard terminals and terminal boxes on MDD motors

By request, modifications can be made to the values specified in the table.

The motor power connections must be made with a cable section that corresponds to the rated current of the motor and in accordance with the schematic provided on the interior of the terminal box cover of each motor.

5.2.2 Connection diagrams

The connection schematics of the terminals in the terminal box for standard versions of the MDD motors are as follows:

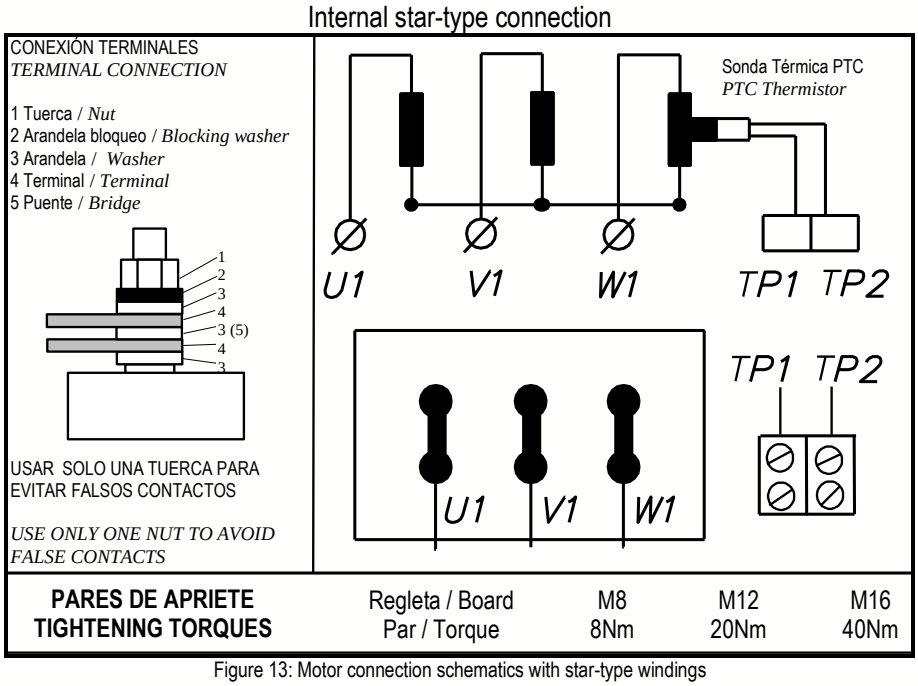


Figure 13: Motor connection schematics with star-type windings

When other optional elements are incorporated (e.g. additional sensors, anti-condensation heaters, etc.), these schematics may vary slightly.

5.2.3 Power cables

The inputs of the power cables that are to be connected on the motor terminal box strip and the converter terminals must comply with current regulations. For the protection rating, type of cable-laying, allowed cable diameter, connection, etc., VASCAT recommends the use of symmetrical structure screened cables in accordance with technical specification IEC TS 60034-25.

The cable screen must be made up of the maximum possible number of individual conductors and it must have good conductivity. Twisted copper or aluminium screens are particularly suitable.

The following shows a schematic with the various examples of screened cables and their connections:

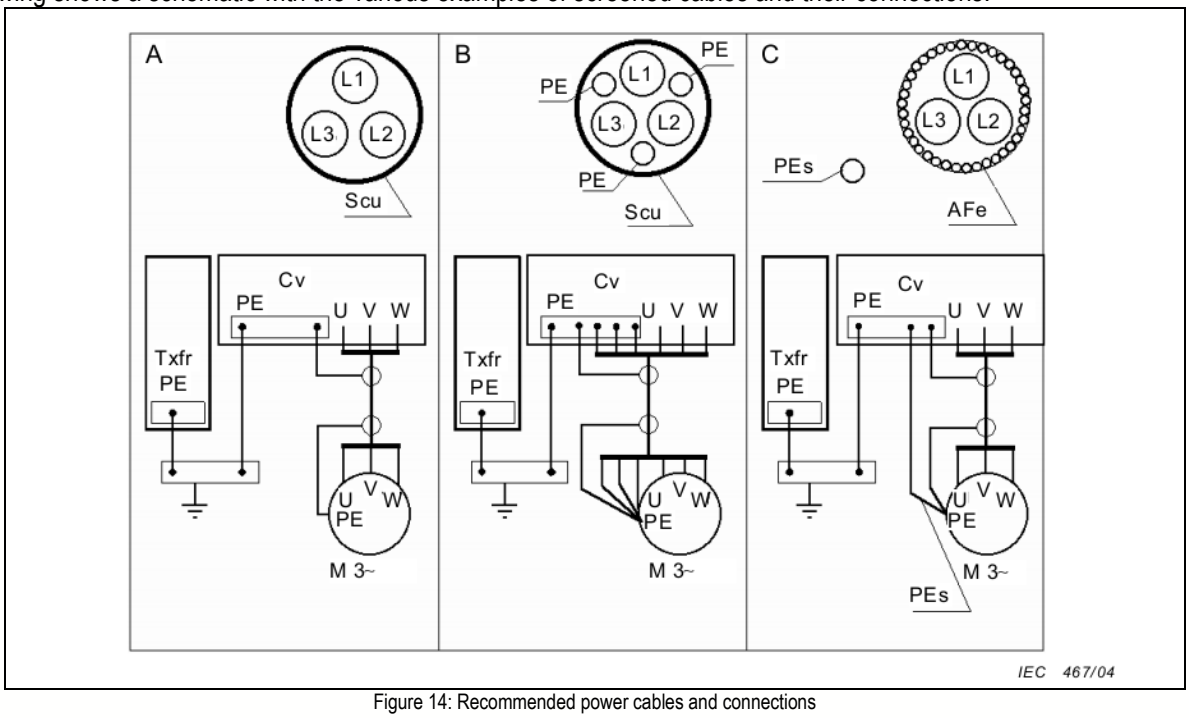


Figure 14: Recommended power cables and connections

Scu - Copper or aluminium screen AFe -Steel structure Txfr - transformer Cv – Converter PEs – Separate earth cable

As shown in the above figure, the power cable screen must be connected on both sides (motor and converter).

The screen connections must be made bearing in mind that they must cover a wide surface of the screen to create a 360° contact using gland boxes for low impedance through a wide range of power levels. Make sure that the screen is HF (for high frequencies). All the foregoing effectively reduces the voltages of the shaft and the housing, creating good derivation of the high frequency currents. This will reduce the currents that will pass through the bearings. Consideration must be given to the fact that the ends of the unscreened cable must be kept as short as possible.

PRECAUTION
Damages to the motor bearings If the distribution of the earth conductors is not appropriate, current may flow through the bearings and deteriorate the parts of the bearing in only a few months.

The following two figures show the recommended terminations for screened cables:

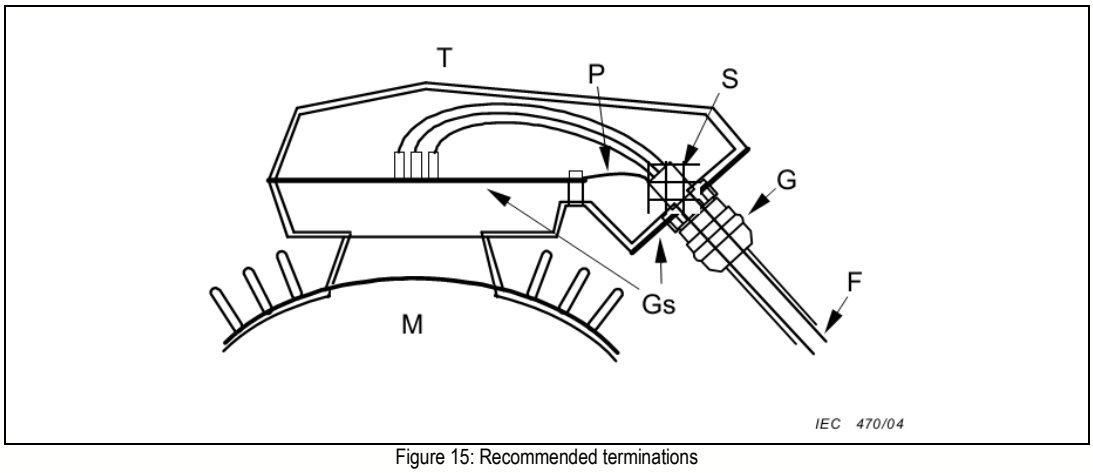


Figure 15: Recommended terminations

T – Conductor material terminal box S – Cable screen P – Earth cableM – Motor body
Gs – Conductor seals G – EMC gland seal F – Continuous Faraday box

The connection between the power cable screen and the motor terminal box must be made using either of the two methods shown in the following figures (on the left with an EMC gland seal and, on the right, with the screen connected to the terminal box using a flange):

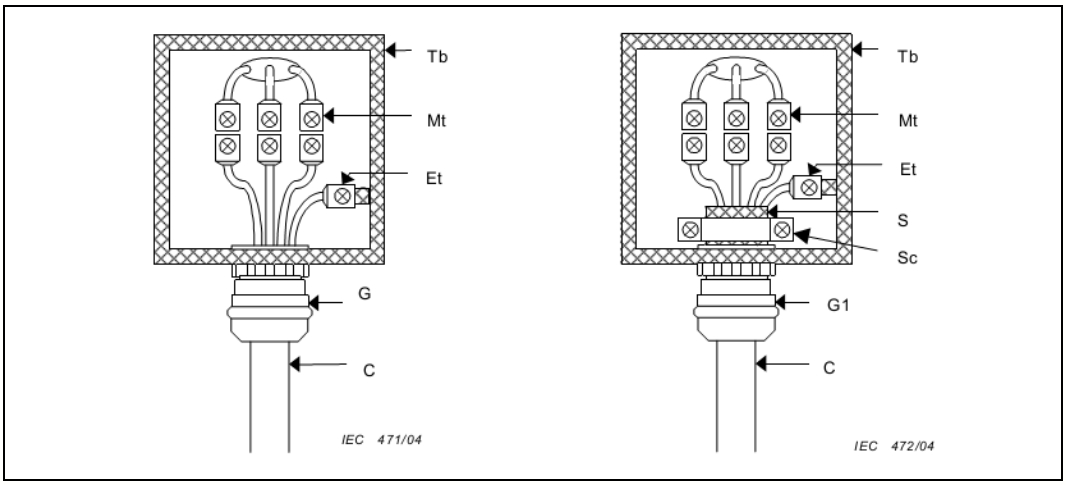


Figure 16: Recommended connections in the terminal box

Tb – Terminal box Mt – Motor terminals Et – Earth terminal S – Cable screen
Sc – Screen bracket G – EMC gland seal G1 – NON-EMC GLAND SEAL C - Cable

The earth protection conductor must be connected to the terminal indicated for said function.

DANGER

A poor earth connection involves a severe risk of electrocution through accidental contact with the motor surface.

5.2.4 Connections for the thermal sensors and accessories

To connect the thermal sensors, use terminals of 1.5 mm^2 on the tip and connect them to the corresponding nylon strip.

Where necessary, connect the encoder according to the schematic provided on the interior of the terminal box.

Where necessary, connect the brake cables in accordance with the voltage specified on the motor specifications plate. The connection is made using a nylon strip attached to the brake body.

5.2.5 Final checks

Before closing the terminal box, check that:

- The electric connections in the terminal box are fastened tight in accordance with the above and the fastening torques given in Table 26.
- There are no protruding wire ends.
- The power cable screens are correctly connected.
- The interior of the terminal box is clean and free from leftover cables.
- All the seals and blanking surfaces are intact.
- The connection cables are positioned in such a way that they leave a certain amount of room for movement and that none of the cables are tight or connected in a 'forced' way.
- The connections between the terminals and the cables are correct.
- The inputs that are not used are fully closed.

After closing the terminal box cover:

- Make sure that the closing elements are fastened tight.

5.3 Start-up

5.3.1 Preliminary checks

Before starting the motor, check the following:

- The motor is correctly aligned, fastened and coupled (the belt tension is correct in the case of belt transmission or the radial profile and tooth flank profile is adequate in the case of gear transmission).
- All the necessary measures are in place to prevent direct contact with moving or live parts.
- Service conditions correspond to the information provided on the motor specifications plate.
- The earth and equipotential connections have been made correctly.
- The electrical connections are tightly bolted.
- All the power cables and their respective shields are correctly connected.
- The other cables (cables from the encoder and brake, etc.) are also correctly connected.
- The frequency converter configuration guarantees that the maximum rotation speed shown on the motor specifications plate will not be exceeded.
- The liquid cooling system (SW and GW series) operates correctly (flow volume, pressure, temperature, etc.). Also check that there is free air convection around the motor (SN and GA series).
- If there is a brake, check that it works correctly.
- The motor is connected to operate in the correct rotation direction.
- There is a correct reading of the motor safety devices (thermal sensors).
- The frequency converter is correctly configured: Check the drive configuration data with the specifications plate and the technical datasheet.

5.3.2 Start-up

WARNING

Qualified personnel

All the preliminary work must be carried out by skilled personnel and when the motors are completely stopped and isolated from the mains. Always check that there is no voltage!

If the mains power cables are connected make sure there is no voltage and that no power voltage can be applied in any way.

PRECAUTION

Damage to the motor

Before starting up the motor, check that there are no elements blocking the rotation of the motor.

MOVING ROTATING PARTS

During start-up and while the motor is in operation, the customer is responsible for taking precaution to avoid accidental contact with the rotating parts.

Proceed as follows to start up the motor:

1- Start-up the drive auto-tuning procedure so that it can recognise the motor (see drive documentation for more details).

2- If the auto-tuning procedure is completed successfully, start the motor rotating at low speed. Check that the motor behaves satisfactorily and that there are no strange noises or vibrations.

3- Gradually increase speed to rated values.

4- After several hours in operation, check that the thermal behaviour of the motor corresponds to the motor service type. If in doubt, please contact VASCAT.

6. MAINTENANCE

This chapter describes the preventive maintenance operations for MDD motors. VASCAT declines all responsibility for faulty maintenance performed by the end user.

PRESENCE OF MAGNETIC FIELD

The presence of intense magnetic fields that may alter the operation of other devices must be taken into account during maintenance work.

RISK FOR PERSONS WHO USE PACEMAKERS

Workers fitting and commissioning the motor must not use pacemakers.

6.1 Safety instructions

WARNING

Skilled personnel

All the cleaning and maintenance work must be carried out by skilled personnel in observance of the safety regulations that apply to the machine coupled to the motor and when the motors are completely stopped and isolated from the mains.

Always check that there is no voltage! If the mains power cables are switched-on, make sure there is no power voltage and that no voltage can be applied in any way.

6.2 Maintenance operations and frequency

Activities	Service intervals and terms
Basic inspection	*Every 500 service hours or at least every 6 months*
Re-greasing of the bearings (Only on motors where it is necessary)	*See regular lubrication label and re-greasing equation (section 6.2.3 of this manual)*
Replacement of bearings	*Replacement after 20,000 service hours*

Table 27: Maintenance activities

NB

Damage to the motor as a result of poor cooling

If the cooling conditions are not adequate, unwanted overheating may occur and damage the motor.

NB
Damages to the motor bearings If the motor bearings are not re-greased adequately or as regularly as required, the bearings may be damaged irreparably. The bearings have a specific service life. When they have reached the end of their service life, they must be replaced by new bearings that are equivalent to the originals. Otherwise, the motor may be seriously damaged.

6.2.1 Basic inspection

After assembling the motor or after repairing a breakdown, the motor must be inspected approximately every 500 operating hours or at least every six months.

This inspection must consist of basically the following:

With the machine on:

- Check that the motor works according to its rated mechanical and electrical values and that there are no strange noises, vibrations or irregular rotation.

With the machine off:

- Check that no cracks appear in the motor fastening elements.
- Check that the connection terminals in the terminal box maintain an adequate fastening torque as specified in the Table 26.
- If faults are found during the inspection, they must be corrected immediately.

Besides this basic inspection, a number of maintenance tasks must be carried out to ensure that the motor has a long service life. The maintenance operations recommended by VASCAT are as follows:

6.2.2 Review of cooling conditions

It is important to check the correct operation of the liquid cooling circuit (MDD SW/GW series) and make sure that there are no elements interfering with the free convection of air around the machine (MDD SN/GA series).

6.2.3 Re-greasing of the bearings

MDD motors include deep groove ball bearings with blanking plates as standard, greased for their entire service life. Accordingly, re-greasing operations are not required.

As an option, electrically insulated ball or roller bearings can be installed and they must be re-greased regularly.

The grease that is to be used on insulated bearings with no blanking plates and roller bearings must be KPHC2N-30L lithium soap-based grease according to DIN51825 or equivalent.

To determine the amount of grease that is to be inserted during the re-greasing operation, VASCAT provides the customer with the following equation as a guide for determining the grams of grease necessary:

$$m = D \cdot B \cdot x$$

Where:

m: Amount of grease to be inserted during the re-greasing operation [gr]
D: Exterior diameter of the bearing to be greased [mm]
B: Width of the bearing in question [mm]
x: Factor that will depend on the re-greasing frequency (0.002 weekly, 0.003 monthly and 0.004 annually).

VASCAT recommends re-greasing every 500 hours or once a month.

The greasing nipples VASCAT fits to its motors comply with the DIN 71412 standard and are zinc-coated. The types used in standard procedures are as follows:

Figure 17: Standard greasing nipples on MDD motors

NB

Damages to the motor bearings

If greasers containing different thickeners and basic oils are mixed together, the lubricant properties of the resulting grease may be inferior. The same type of grease must be used to lubricate the bearings at all times. Otherwise, the bearings may be damaged.

MOVING ROTATING PARTS

During the re-greasing operation, the customer is responsible for taking the necessary precautions to avoid accidental contact with the rotating parts.

6.2.4 Replacement of bearings

Both the bearings that have been greased for all their service life and those that need to be greased regularly, as well as hermetic parts that are subjected to wear and tear (seals and joints, etc.), where applicable, must be replaced after 20,000 operating hours.

Bearings of the same type as the originals must be installed. Standard bearings for each motor type may be consulted at Table 18.

The procedure for replacing bearings must be carried out as follows:

1. Disassemble the motor from its location and place it in a safe and clean place.

2. Remove the accessories (brake and/or encoder, where applicable) from the motor very carefully so as not to damage them and then remove the terminal box and fan. See following sections for more details.

3. Unscrew the motor seals and covers and remove them.

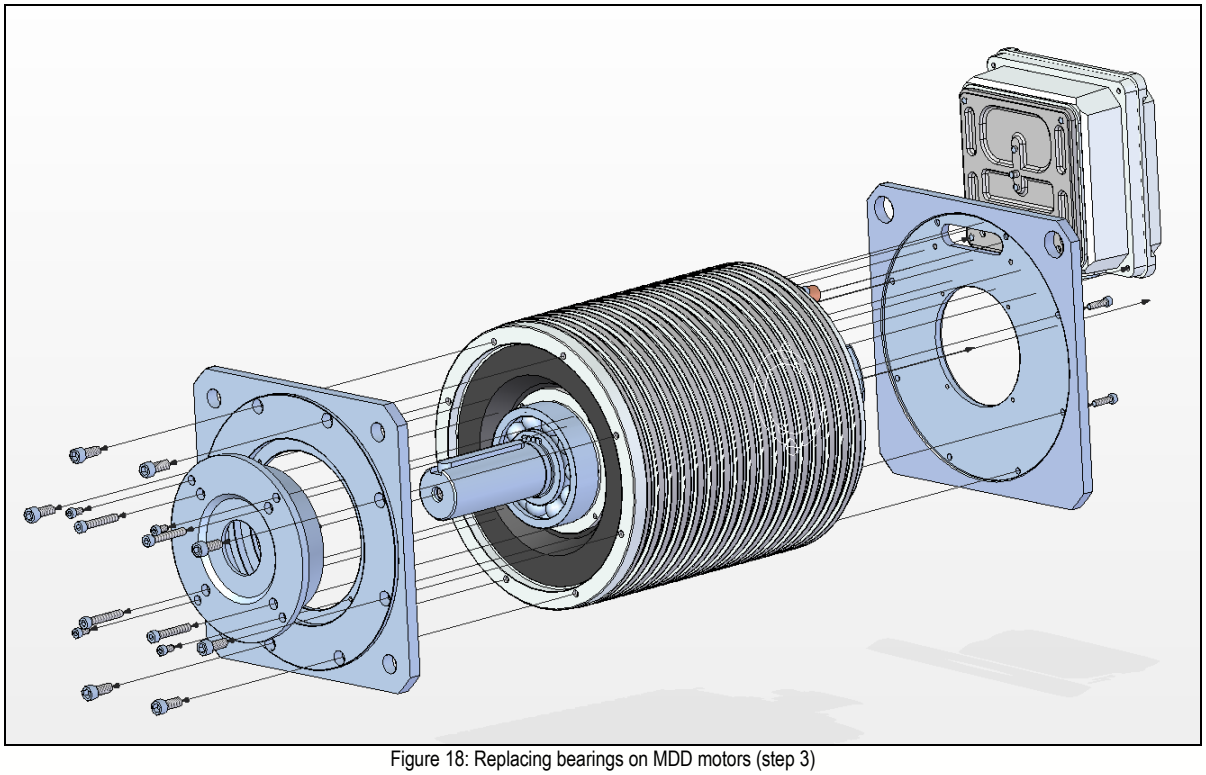


Figure 18: Replacing bearings on MDD motors (step 3)

4. Move the rotor in an axial direction to the side on which the bearing that is to be released is located without removing it completely.

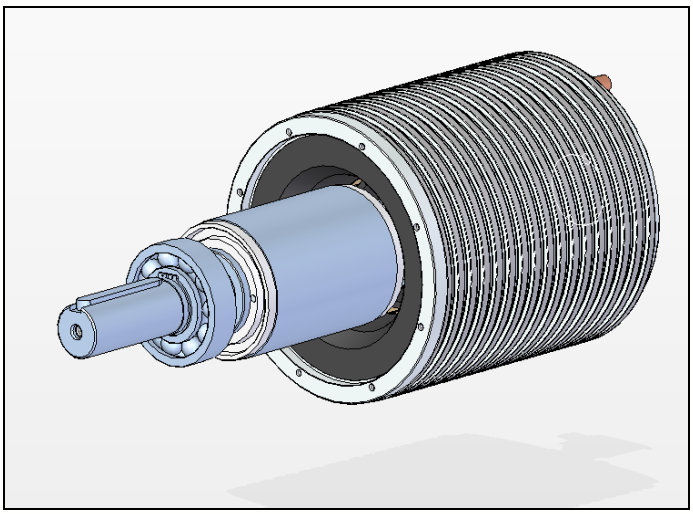


Figure 19: Replacing bearings on MDD motors (step 4)

5. Remove the bearing shim washers.

6. Remove the bearing from the shaft using a thrust extractor and taking care not to damage the shaft.

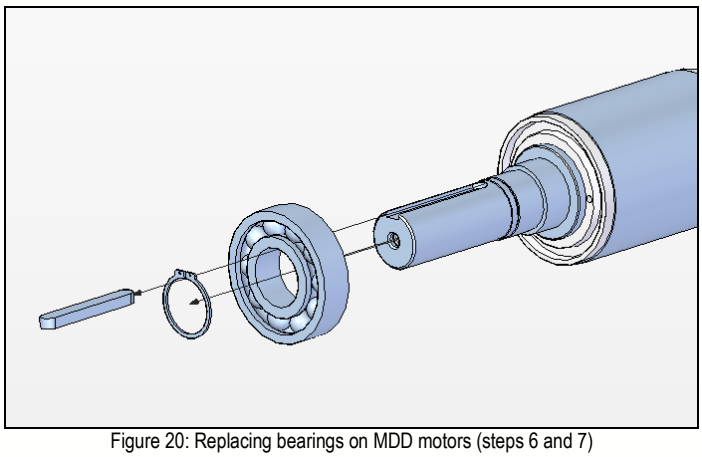


Figure 20: Replacing bearings on MDD motors (steps 6 and 7)

7. Heat the new bearing to 70°C to make it dilate and easier to insert in the shaft.

8. Insert the new bearing in the shaft. The hot bearing must be inserted fully without the need for hitting it. This operation must be performed as quickly as possible. Do not let the bearing cool down.

9. Reassembled the *Seeger* shim washers.

10. Re-insert the rotor in the stator, taking care not to damage the windings.

11. Fit and screw up the covers and seals.

12. Refit the motor accessories.

6.3 Replacing the encoder

The procedure for replacing the encoder must be carried out as follows:

6.3.1 Hollow blind shaft encoder

1. Remove the protection
2. Remove the encoder

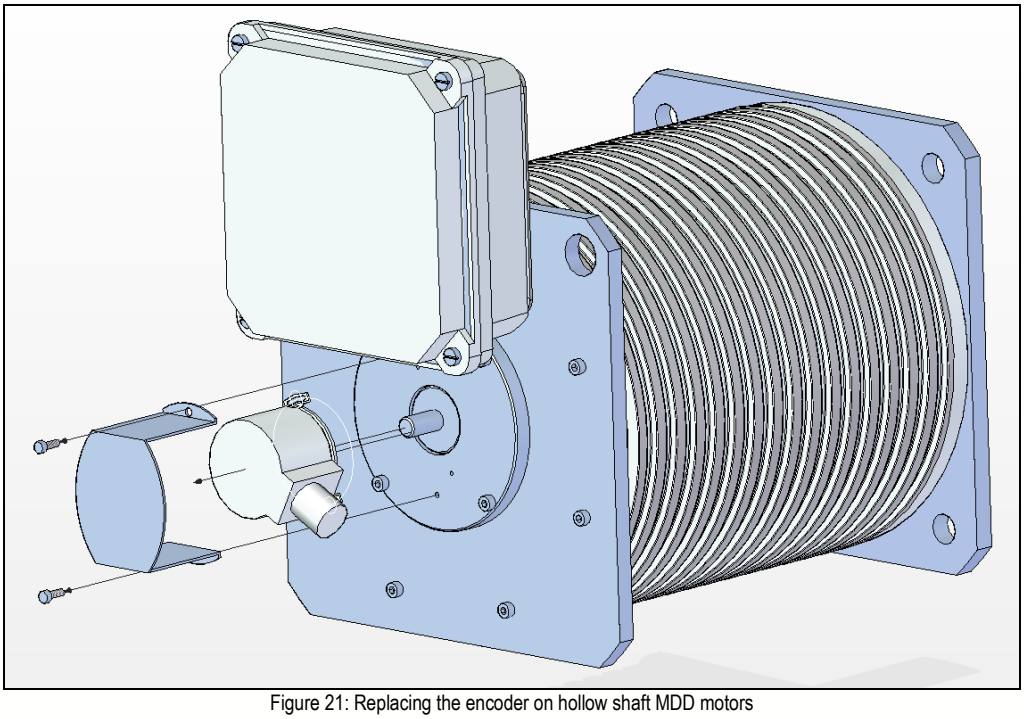


Figure 21: Replacing the encoder on hollow shaft MDD motors

6.4 Replacing the brake and/or lining

The procedure for replacing the brake must be carried out as follows:

1. Remove the encoder protection
2. Remove the encoder (b) from its support (c)
3. Remove the encoder support (c) from the brake stator (d)
4. Remove the entire brake stator (d) from the motor and replace it with a new one if necessary
5. Remove the rotor (e) by sliding it through the bushing that remains coupled to the shaft by a *Seeger* ring.
6. If the rotor lining is worn, replace it with a new one.
7. If only the rotor lining has to be changed, it is not necessary to remove the brake encoder unit. It will be sufficient to directly remove the brake stator (d).

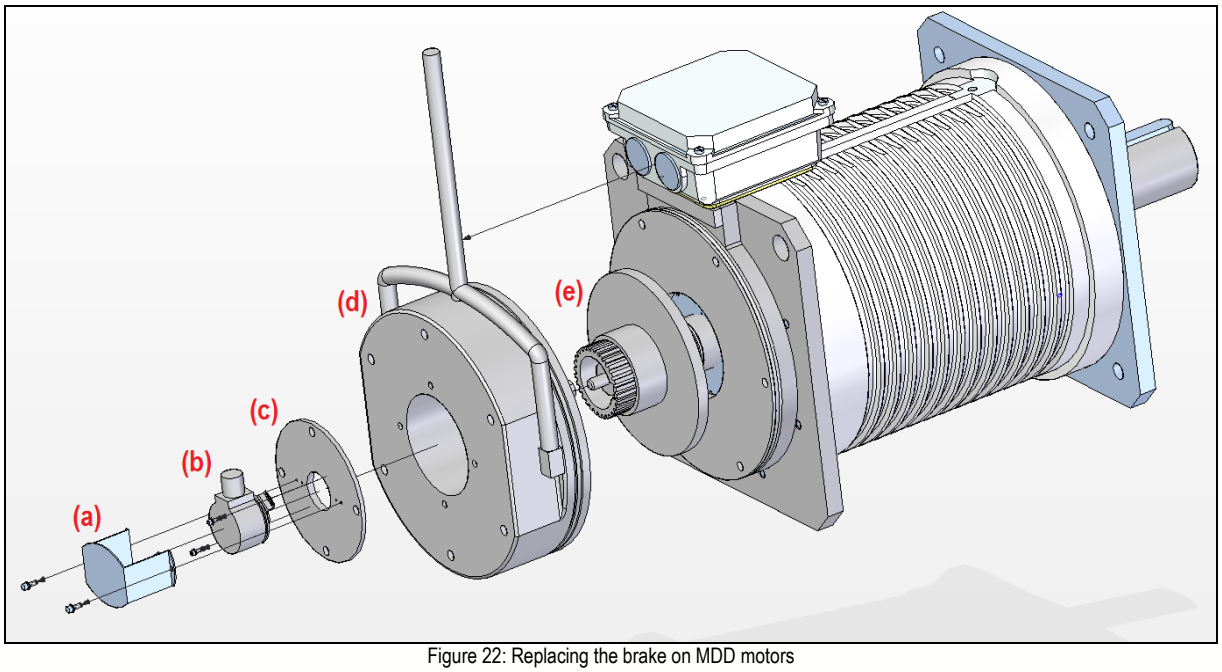


Figure 22: Replacing the brake on MDD motors

6.5 Original spares

VASCAT supplies subunits of the full motor as original spares for MDD motors.

The spare subunits that are available are listed in the following table:

Spares	Subunits
1	*Stator subunit*
2	*Rotor subunit*
3	*Pulley cover*
4	*Rear cover*
5	*Terminal box unit*

Table 28: Spare subunits

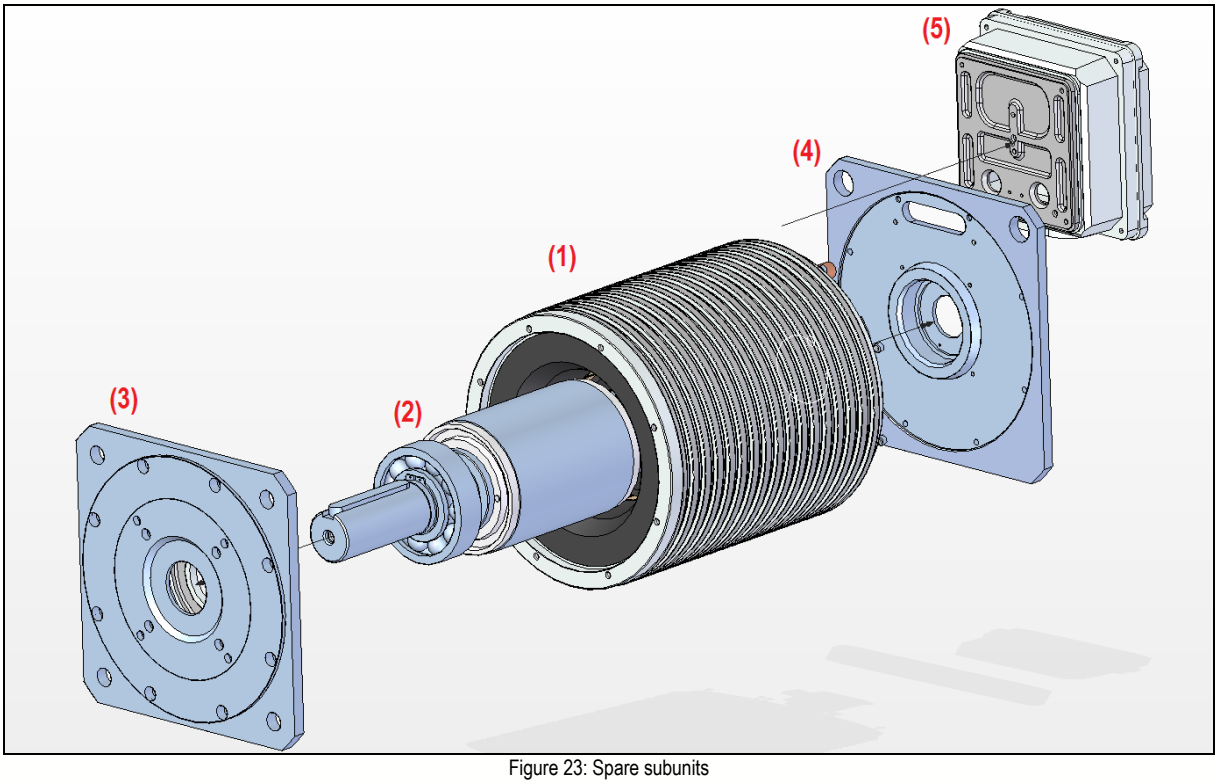


Figure 23: Spare subunits

When a specific original spare is required for a motor from the MDD series, the following information must be provided:

1. Motor type (by default, MDD).
2. Series (SN, SW, GA, GW).
3. Size (in reference to shaft height).
4. Length (K, S, M, L, P or X).

These initial 4 points refer to the name of the motor and are summarised in the following table:

MDD	*SN*	*180*	*M*
Motor type	***Series***	***Size***	***Length***

Table 29: MDD motor codes

Besides the initial 4 points, the following must also be specified:

5. Motor serial number.
6. Year of manufacturing.

All the information can be found on the motor name plate.

6.6 Operating faults

If faults appear during the operation of the motor, first of all check the possibility of the errors given in the following tables. If the fault cannot be eliminated with any of the following measures, please contact the technical service at VASCAT.

VOLTAGE

All the work must be carried out with no voltage connected.

HOT SURFACE

Hot motor surfaces. Therefore, cooling times must be observed.

6.6.1 Electrical faults

Fault	Probable cause	Corrective action
Motor doesn't start	Excessive load	Reduce load
	Power connection problems	Check the frequency converter, power cables and phase sequence.
	Problems with encoder connections	Check encoder cables and converter alarms
	Converter disabled	Check message on converter
Motor starts up with difficulty	Excessive load	Reduce load
	Power connection problems	Check the frequency converter, power cables and phase sequence.
	Short-circuit between turns or phase short-circuit on stator winding.	Check the elements of each winding phase (milliohmmeter) and the insulation elements (between phases and earth using a megaohmmeter at 250 V). Repair the winding after consulting VASCAT.
Incorrect motor rotation direction.	Change of motor power cable polarity	Swap two motor connection phases
Buzzing noise on start-up	Interruption of a phase in the power cable after connection	Check the frequency converter and power cables
	Short-circuit between turns or phase short-circuit on stator winding.	Check the elements of each winding phase (milliohmmeter) and the insulation elements (between phases and earth using a megaohmmeter at 250 V). Repair the winding after consulting VASCAT.
Buzzing noise during operation	Overload	Reduce load
	Interruption of a phase in the power cable after connection	Check the frequency converter and power cables
	Short-circuit between turns or phase short-circuit on stator winding.	Check the elements of each winding phase (milliohmmeter) and the insulation elements (between phases and between phases earth using a megaohmmeter at 250 V). Repair the winding after consulting VASCAT.

Table 30: Electrical faults (1)

Fault	Probable cause	Corrective action
Overheating during load-free operation	Converter output voltage too high, frequency too low	Check adjustments on frequency converter and perform auto-tuning
	Motor designed to be connected in star format but is connected in triangle format	Correct connection in terminal box
	Cooling circuit stopped or not working.	Activate cooling circuit
	Cooling circuit broken or obstructed. Insufficient flow volume due to blocked channels	Repair circuit
	Cooling liquid is preheated	Make sure that the coolant enters the circuit at the temperature recommended by VASCAT.
Overheating with load	Excessive load	Reduce load
	Converter output voltage too high, frequency too low	Check adjustments on frequency converter and perform auto-tuning
	Power connection problems	Check the frequency converter and power cables
	Motor designed to be connected in star format but is connected in triangle format	Correct connection
	Cooling circuit stopped or not working.	Activate cooling circuit
	Cooling circuit broken or obstructed. Insufficient flow volume due to blocked channels	Repair circuit
	Cooling liquid is preheated	Make sure that the coolant enters the circuit at the temperature recommended by VASCAT.
Overheating on certain winding sections	Short-circuit between turns or phase short-circuit on stator winding.	Determine the winding elements and insulation elements. Repair them after checking with manufacturer

Table 31: Electrical faults (2)

NB: Because the machine is powered from a frequency converter, please also check the frequency converter service instructions in the event of electrical faults.

6.6.2 Mechanical faults

Fault	Probable cause	Corrective action
Rubbing noise	Rotating parts are rubbing together	Determine the cause and readjust the parts
	Foreign bodies in the motor	If so, repair by manufacturer
	Damage to bearings	Change bearings
Excessive radial vibrations	Rotor imbalance	Uncouple rotor and rebalance it
	Non-concentric rotor, shaft bent	Contact factory
	Non-concurrent shaft alignment	Align motor-machine system.
	Imbalance on coupled machine	Rebalance coupled machine
	Vibrations transmitted by gear	Correct gear
	Resonance with foundations	Reinforce foundations after checking with factory
	Changes to foundations	Determine cause and eliminate it. Realign machine
Excessive axial vibrations	Faulty angular alignment	Align group of machines and check alignment
	Blows transmitted by coupled machine	Examine coupled machine
	Vibrations transmitted by gear	Correct gear
	Resonance with foundations	Reinforce foundations after checking with factory
	Changes to foundations	Determine cause and eliminate it. Realign machine

Table 32: Mechanical faults

6.7 Technical support and service

For more information or specific technical support, please contact:

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