MT MOTORI ELETTRICI

Installation, operation, maintenance and safety manual for motors used in hazardous areas

1-II-2G

21-II-2D

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CAP. I – Introduction

MT – Motori Elettrici motors to be used in hazardous areas and explosive atmospheres (1-II-2G; 21-II-2D) are built in compliance with the ATEX 2014/34/EU European directive and with the main European standards on protection devices and systems for explosive atmospheres. More specifically, not only are they compliant with the main regulations defining the electrical and mechanical requirements for standard motors, but motors for explosive atmospheres also meet the following EN/IEC regulations:

Table 1.1 – Regulatory framework

Title	EU CENELEC	International IEC
Electric apparatus for explosive atmospheres caused by gas – Part 0: General rules	EN 60079-0	IEC 60079-0
Electric apparatus for explosive atmospheres caused by gas – Part 7: Protection method with increased "e" safety	EN 60079-7	IEC 60079-7
Electric apparatus for explosive atmospheres caused by gas – Part 15: “n” protection method	EN 60079-15	IEC 60079-15
Explosive atmospheres. Equipment dust ignition protection by enclosure "t".	EN 60079-31	IEC 60079-31
Rotating electric machines – Part 1: Nominal and operating features	EN 60034-1	IEC 60034-1
Rotating electric machines– Part 2: Methods for the determination, based on evidence, of leaks and rotating electric machines efficiency	EN 60034-2	IEC 60034-2
Rotating electric machines – Part 5: Protection class for rotating machines case	EN 60034-5	IEC 60034-5
Rotating electric machines – Part 6: Cooling methods	EN 60034-6	IEC 60034-6
Rotating electric machines – Part 7: Classification of construction forms and installation types as well as position of terminal boards	EN 60034-7	IEC 60034-7
Rotating electric machines – Part 9: Noise limits	EN 60034-9	IEC 60034-9
Rotating electric machines – Part 12: Starting features of asynchronous single-speed cage motors	EN 60034-12	IEC 60034-12
Case protection class	EN 60259	IEC 60259
Electric apparatus to be used with combustible dusts – Part 0: General prescriptions	EN 61241-0	IEC 61241-0
Electric apparatus to be used with combustible dusts – Part 1: Protection with “tD”cases	EN 61241-1	IEC 61241-1

The instructions contained in this manual refer to motors installed and stored with temperature between -20 °C and 40 °C. Motors to be used in hazardous areas and potentially explosive atmospheres are designed and built in compliance with the aforementioned requirements. If the motors are used improperly, modified and tampered with, **MT - Motori Elettrici** will not guarantee their efficiency. It is necessary to comply with the regulations on connections and on the use of the devices in hazardous areas. Only skilled and specialized staff is therefore allowed to operate with the aforementioned motors.

1.1 Hazardous areas classification (presence of explosive atmosphere)

In the following table different hazardous areas, groups, categories and protection classes are indicated.

Table 1.2 – Classification of hazardous areas

Marking for potentially explosive areas								
Presence of explosive atmosphere			Group	Category	Protection	Gas group	IP class	Gas/dust surface temperature
Gas	0	Continuous presence for long periods of time	II	1G	Ex ia “intrinsic safety”	IIA, IIB, IIC	IP20	T1=450°C T2=300°C **T3=200°C** **T4=135°C** T5=100°C T6=85°C
					Ex mA “Incapsulamento”	II	-	
	1	**Occasional presence during normal operation**	**II**	**2G**	**Ex e “increased safety”**	II	IP54	
					Ex d “explosion-proof cases”	IIA, IIB, IIC	-	
					Ex ib “intrinsic safety”	IIA, IIB, IIC	IP20	
					Ex mb "encapsulation”	-	-	
					Ex o “oil-cooled”	II	-	
					Ex p “pressurized cases”	II	IP4X	
					Ex q "protection with filling"	II	IP54	
	2	Rare presence for short periods of time	II	3G	Ex nA “Non-sparking”	II	IP54	
					Ex nC	IIA, IIB, IIC	IP54	
					Ex nL “limited energy”	IIA, IIB, IIC	IP54	
					Ex nR “limited breathing”	II	IP54	
Dusts	20	Continuous presence for long periods of time	II	1D	Ex iD “intrinsic safety"	-	IP6X	T450°C T300°C T200°C **T135°C** **T100°C** T85°C
	21	**Occasional presence during normal operation**	**II**	**2D**	**Ex tb “tb cases”**	-	IP6X	
					Ex mD “Encapsulation”	-	IP6X	
					Ex pD “pD pressurized cases”	-	IP6X	
	22	Rare presence for short periods of time	II	3D	Ex tD “tD cases”	-	IP6X	

The main features of this user's and maintenance manual are highlighted in **bold**.

Chapter II – Scope of application

This manual applies to the following motors manufactured by **MT – Motori Elettrici.**

Series TN 2 poles 56 ÷200
Series TN 4 poles 56 ÷200
Series TN 4 poles 56 ÷200
Series DN 2-4 poles 63 ÷ 160
Series DN 4-6 poles 71 ÷ 160
Series DN 4-8 poles 63 ÷ 160
Series DN 2-6 poles 71 ÷ 160
Series DN 2-8 poles 63 ÷ 160
Series DN 6-8 poles 71 ÷ 160
Series MN 2 poles 56 ÷ 100
Series MN 4 poles 56 ÷ 100
Series MN 6 poles 63 ÷ 100

TN = three-phase single speed motors
DN = three-phase double speed motors
MN = single-phase single speed motors

These motors will be operated in hazardous areas 1 and 21 (see table 1.2). As to single-phase motors, the capacitor must be placed in a safe area with no explosion hazard.

2.1 Designation

Motor designation is composed of different alphanumeric fields (see also annex 2):

- *type*: 2 letters identifying the motor family/series;
- *frame size*: 2 or 3 numbers and - sometimes - a letter, identifying the motor frame size based on the IEC standard;
- *variant*: 1 letter indicates a different power for the same motor class and speed;
- *poles*: composed of a slash and one or more numbers indicating the motor poles.

Example: TN90LB/4

2.2 Plate

Find the different items indicated on “Ex e” (II-2G zone) and “Ex tb” (II-2D zone) motor plates below.

Table 2.1 – Plate data

Item	Description
Type	Set of alphanumeric digits identifying motor frame size and poles (see par. 2.3).
Nr.	Motor serial number
Prot. IP	IP protection class
Serv.	Service type In compliance with EN 60034-1.
cosφ	Power factor
Is.Cl.	Isolation class (F or H)
V Δ/Y	Voltage supply
Hz	Frequency
HP	Power in HP
kW	Power in kW
min^{-1}	Nominal rotation speed
A Δ/Y	Current intensity value
CE	Compliance with European directives mark
Ex	Explosion protection mark
II	Group (surface systems other than mines)
2	Category (high protection class)
G	Explosive atmosphere due to the presence of gas
D	Explosive atmosphere due to the presence of dust
Ex e	Protection type (gas)
Ex tb	Protection type (dust)
T3-T4	Motor temperature class
T amb	Ambient temperature
I_A/I_N	Starting and nominal current ratio
t_E	Time required for a current carrying stator or rotor winding with alternating current I_A, to reach the maximum temperature starting from balance temperature under standard operating conditions with maximum ambient temperature.

The following information is also provided on the plate: the number of the body releasing product quality warranty; the certification number; the warning **WARNING – DO NOT OPEN WHEN ENERGIZED**.

Chapter III – Installation and operation

Always check the information written in the technical documents and make sure it matches the features of the environment where the motor will be installed. **MT – Motori Elettrici** supplies tested motors, which are ready to be installed.

3.1 Reception and storage

It is recommended to check the motor upon reception in order to make sure there are no transport damages. Do not operate motors that display damages or are not considered as suitable for the intended use. In case of doubt, please contact **MT – Motori Elettrici**. Carefully check the motor plate data in order to make sure the motor meets the requirements specified in the order and that the motor has the right features for the installation. More specifically, check that the wording on the use in potentially explosive atmospheres is correct for the use required. If the motor is not operated immediately, it has to be stored indoor, in a safe and dry place, without any dust, vibrations and corrosive agents. Before starting the motor after long periods of inactivity or storage, it is recommendable to check insulation to ground by testing it with the specific tool for dielectric strength. Perform the aforementioned check outside of potentially explosive areas.

3.2 Installation

Do not work on the motor if energized. Perform all installation operations outside of potentially explosive areas. Always check certifications and technical data. Verify compatibility between motor, atmosphere and zone. Install the motor in compliance with the EN 1127-1 standard (explosive atmospheres - Explosion prevention and explosion protection - main notions and methods); IEC/EN 60079-14 (electric constructions for explosive atmospheres due to the presence of gas Part 14: Electric systems in environments with explosion hazard due to the presence of gas (other than mines); IEC/EN 60079-17 (check and maintenance of electric systems); IEC/EN 61241-14 (electric constructions to be used in presence of combustible dust Part 14: selection and installation). Install the motor in a well-ventilated environment, avoiding installing it close to walls or other machines preventing air to flow. Accurately avoid every situation that can compromise thermal exchange between motor and surrounding environment (heat sources nearby; air channels bottlenecks, etc.). For outdoor installations, protect the motor against weather events and sunlight. For vertical axis installation with fan cover on top, undertake the necessary measures to protect the motor against fluid infiltrations or object infiltrations through the fan cover holes. Plan regular inspections and maintenance during operation. The motor must always be perfectly aligned: make sure the coupling joint is stable and has no vibrations, which may damage the bearings. Motor pulleys coupling must be carefully balanced and mounted with particular care in order to avoid bearing damages. Mount and remove the motor avoiding impacts and shocks, which may damage both visible external parts of the motor and non-visible internal parts, such as - for instance - the bearings. In case of direct coupling, make sure the motor shaft is aligned with the coupled unit shaft (e.g. gearbox); in case of belt drive, keep the smallest clearance as possible and avoid excessive tensions in order not to apply excessive radial loads onto the bearings (tables 3.5 and 3.6).

3.3 Electric connection

Electric connections must exclusively be carried out by specialized and skilled staff in compliance with current standards - more specifically EN 60079-14 and EN 60079-17. Motor metal parts must be connected to the ground with a cable having a suitable cross-section and using the specific connection positions in the terminal board and outside on the case, marked with the ground symbol ⏚. The ground connection must be carried out in compliance with local regulations before powering the motor. Once the connection has been carried out, it is always necessary to close the terminal board cover by suitably fastening the four fastening screws. The power and ground cables must be compliant with cable connection requirements and the section of cables contained in EN60204-1 (Machinery safety - Electric equipment for machines Part 1: General rules).

As to the selection of cables to be connected to the terminal board, we hereby report a table showing the motor power absorption in the left column (also indicated on the plate), whereas the cable length is indicated in the first line (known to the installer).

Table 3.1 – Selection of cables based on their length and motor Amps absorption

	0-1 m	**1-2 m**	**2-3 m**	**3-4 m**	**4-5 m**	**5-6 m**	**6-7 m**	**7-8 m**
240-350 A	1 AWG	1 AWG	1 AWG	1 AWG	1 AWG	1 AWG	1 AWG	1 AWG
180-240 A	2 AWG	2 AWG	2 AWG	1 AWG	1 AWG	1 AWG	1 AWG	1 AWG
150-180 A	2 AWG	2 AWG	2 AWG	2 AWG	1 AWG	1 AWG	1 AWG	1 AWG
120-150 A	5 AWG	5 AWG	2 AWG	2 AWG	2 AWG	2 AWG	2 AWG	1 AWG
100-120 A	5 AWG	5 AWG	5 AWG	2 AWG	2 AWG	2 AWG	2 AWG	2 AWG
80-100 A	5 AWG	5 AWG	5 AWG	5 AWG	2 AWG	2 AWG	2 AWG	2 AWG
60-80 A	8 AWG	8 AWG	8 AWG	5 AWG	5 AWG	5 AWG	2 AWG	2 AWG
40-60 A	8 AWG	8 AWG	8 AWG	8 AWG	5 AWG	5 AWG	5 AWG	5 AWG
20-40 A	10 AWG	8 AWG	8 AWG	8 AWG	8 AWG	8 AWG	8 AWG	5 AWG
8-20 A	14 AWG	10 AWG	10 AWG	10 AWG	10 AWG	10 AWG	8 AWG	8 AWG
0-8 A	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG	14 AWG
1 AWG = 42mm^2				2 AWG = 33 mm^2				
5 AWG = 17 mm^2				8 AWG = 8 mm^2				
10 AWG = 6 mm^2				14 AWG = 2 mm^2				

Depending on the line conductor section, the ground conductor section must be:

3.2 – Ground connection

S - Line conductor section	H – Ground conductor section
S ≤ 16 mm^2	H = S
16 mm^2 < S ≤ 35 mm^2	16 mm^2
S < 35 mm^2	H ≥ 0,5 S

Table 3.3 – Wiring diagram three-phase single speed motor

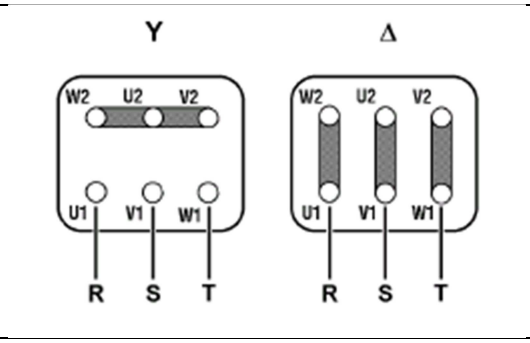


Table 3.4 – Wiring diagram three-phase double speed motor with single winding

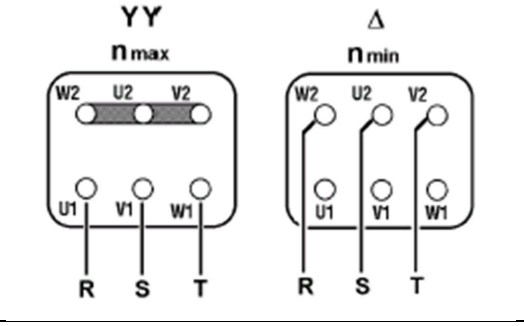


Table 3.5 – Wiring diagram three-phase double speed motor with double winding

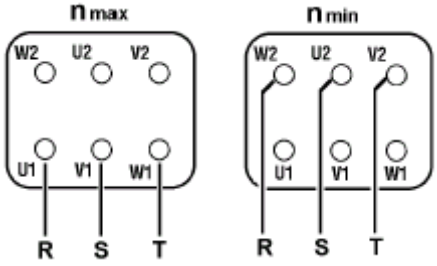
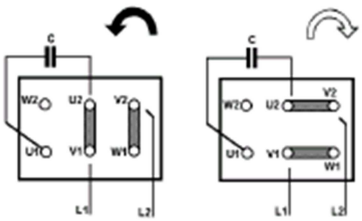
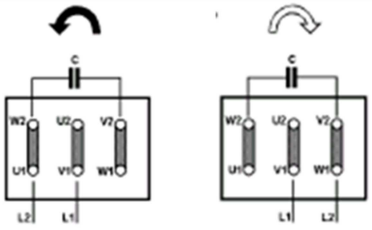


Table 3.6 – Wiring diagram single-phase motor (put the capacitor in a safe zone with no explosion hazard).

Standard	Symmetric
	

All motors to be mounted in hazardous areas must be protected by overloads (IEC/EN 60079-14 and IEC/EN 61241-14). Install thermal overload protections in compliance with the maximum operation time t_E indicated on the plate.

Always check that the seal between cover and terminal board and between terminal board and case are in good conditions.

When the motor is connected to the power network it is necessary to comply with the following requirements:

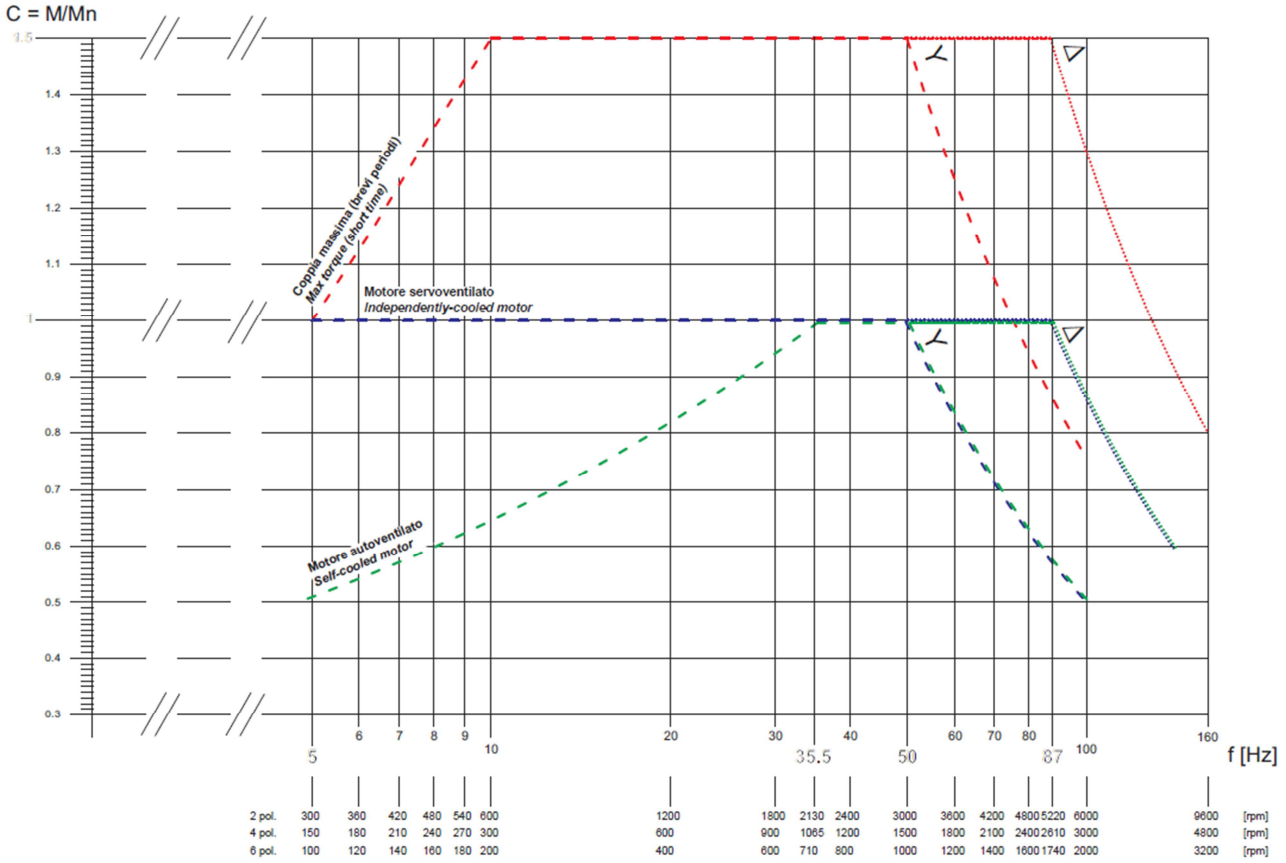
- Make sure there is no explosive atmosphere;
- Make sure the power cable is not being energized when connecting it to the terminal board;
- Do not loosen the bolts fastening the motor winding cables during power connection operations in order to avoid reducing the distance between neighbouring cables and in order not to create play between bolt and cable;
- Make sure the cable connection is stable;
- Fasten the cable gland/s well;

3.4 Operation

MT – Motori Elettrici motors are designed and built to operate in environments with temperature values ranging from – 20 °C and 40 °C; maximum 1000 m altitude above sea level; tolerance for voltage supply +/- 5% and for frequency +/- 2% (EN 60034-1). Only use the motor for the applications it was designed and built for. Comply with plate data. Non-compliance with the instructions provided in this manual and with the reference standards may make the motor not suitable for use in hazardous areas. Always comply with the prescriptions in order not to compromise safety.

3.5 Inverter use

MT - Motori Elettrici motors that can be used with inverter belong to the TN and DN series and range from frame size 56 to 200. All single-phase motors are therefore excluded. Motors to be used with an inverter must be equipped with three passive thermal overload protections embedded in the windings (one for each phase). These protections must be connected to a suitable release device that can cut off motor power in case the winding temperature reaches the protection threshold temperature. It is possible to supply thermal overload protections with different threshold values, always in compliance with the maximum motor surface temperature value. In case of operation of the thermal overload protection, the motor must not be powered automatically again. To select a motor for inverter use, it is necessary to know the use of the motor, more specifically the relationship between resistive load and frequency of use. To this purpose an operation chart of **MT – Motori Elettrici** motors with inverter has been drafted, where the applicable load for the motor is indicated. The load can be constantly applied (and it is represented as the ratio between the actual torque and the nominal torque, also defined as nominal torque de-rating coefficient C) depending on the inverter output frequency.



MT – Motori Elettrici motors corresponding to the type and series mentioned at the beginning of this paragraph are designed to operate in frequency ranges from 5 ÷ 100 Hz. It is however recommended to use forced ventilation in applications where the frequency goes below 40 Hz, due to the scarce air inflow provided by self-ventilation at low rotation speed levels.

Table 3.7 – Temperature classes and thermal overload protections

Temperature class	T4	T3
θ thermal overload protection operation	120 ±5 % °C	170 ±5 % °C

3.6 – Special conditions for safe use

- In case of delivery of the motor without cable glands the user must use proper ATEX certified devices;
- The temperature of the cable must be at least 80°C;
- The use of motor with brakes is not possible without the ATEX certification of the whole assembly;
- The electric motors can be powered by frequency converter certified as a safety device under the ATEX Directive 2014/34/EU. These inverters must be marked with the following minimum marking II (2) G. These inverters must guarantee an overcurrent protection in compliance with the tE time or a maximum temperature protection through the acquisition of the signal to be installed on the thermal motor. protection.

Chapter IV – Maintenance

Overhaul and repair operations can only be carried out by skilled and specialized staff in compliance with EN 60079-17 and EN 60079-19 standards on repair and maintenance of electric apparatuses in hazardous areas. Only skilled staff knowing all of the regulations and standard on connection and use of electric devices in zones with potentially explosive areas are authorized to operate this kind of apparatuses. Do not open the motor nor the terminal board while the motor is being energized and in an explosive atmosphere. It is necessary to keep the motor and any possible accessories clean and have no traces of dust, oil, dirt or other impurities. Always make sure the air channel for cooling is not obstructed in order to avoid overheating Inspect the motor on a regular basis. Make sure the motor works without any vibrations or strange noise. Make sure the tension of any possible drive belts is correct. Make sure the motor fastening elements are fastened correctly. Check the shaft seal conditions and, if necessary, replace the seals. For Ex tb motors it is necessary to carry out a detailed inspection in compliance with IEC/EN 60079-17.

4.1 Bearings

Bearings are shielded and self-lubricated for life. It is therefore not necessary to have additional lubrication.

Table 3.5 – Bearing average life with ambient temperature ranging from 25 °C to 40°C

Motor	Poles	Operating hours at 25 °C	Operating hours at 40 °C
71	2	67000	42000
71	4-8	100000	56000
80-90	2	100000	65000
80-90	4-8	100000	96000
100-112	2	89000	56000
100-112	4-8	100000	89000
132	2	67000	42000
132	4-8	100000	77000
160	2	60000	38000
160	4-8	100000	74000
180	2	55000	34000
180	4-8	100000	70000
200	2	41000	25000
200	4-8	95000	60000

The life of bearings also depends on axial and radial loads applied onto the shaft. The table below shows maimum radial loads (N)

Table 3.6 – Maximum radial and axial loads on the centre line of the motor shaft overhang.

RPM	Motor size																					
	56		63		71		80		90		100		112		132		160		180		200	
	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass	Rad	Ass
3000	240	100	300	120	470	190	600	250	650	330	1000	470	1300	600	2000	1000	2500	1200	3000	1500	4200	1900
1500	310	140	360	160	530	250	700	330	850	450	1200	630	1600	800	2500	1300	3100	1700	4000	2000	5300	2500
1000	350	170	370	200	550	310	750	400	950	560	1400	800	1900	1000	3000	1600	3700	2000	4500	2300	6000	3100
750	380	190	400	220	600	330	800	450	1000	600	1510	850	2000	1100	3100	1800	4000	2300	5000	2600	6700	3500

4.2 Spare parts

Spare parts must be original, with suitable certification and approved by **MT – Motori Elettrici**. In case of doubt, contact **MT – Motori Elettrici** for all parts.