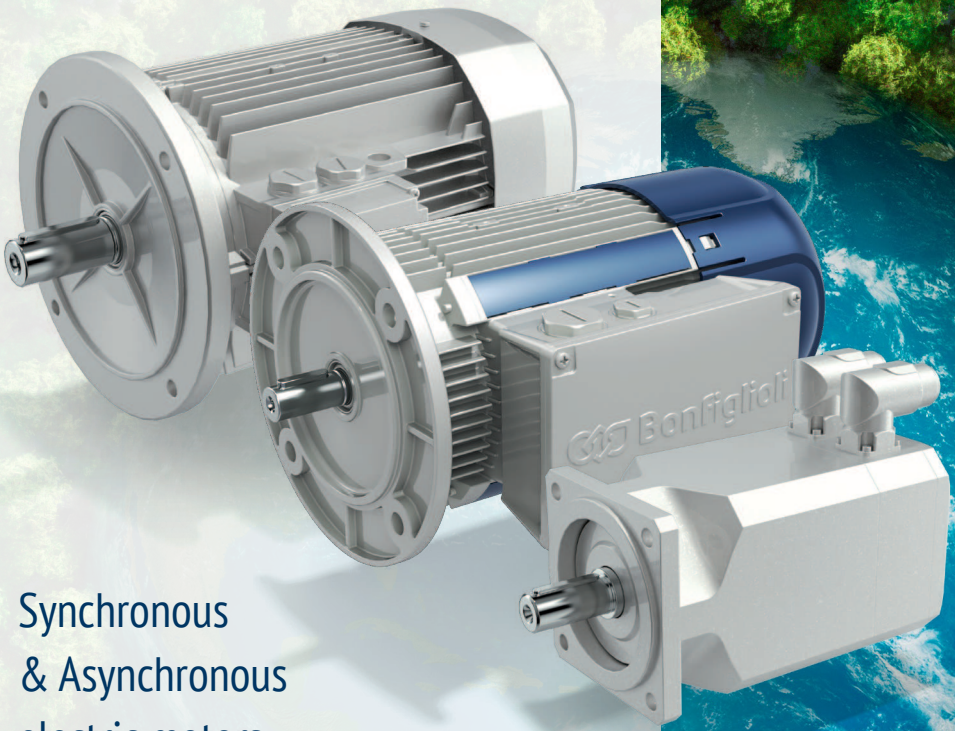
Bonfiglioli

Forever Forward



Synchronous
& Asynchronous
electric motors

Energy efficiency worldwide

Bonfiglioli guidelines

PRODUCTS &
SOLUTIONS

Energy and environmental policy

The advent of the culture of energy reduction

Since the end of the second millennium, there has always been great interest in improving the energy efficiency of energy-using devices in European countries. Over the years, the topic of "energy savings" has become widespread and is growing globally, starting from the industrial sector all the way to the most varied domestic appliances. It's easy to understand the impact that energy consumption and optimization have on industrial growth, structural changes, lifestyle improvements and, simply put, on energy prices.

Initially implemented by individual countries as an attempt to reduce energy consumption, energy efficiency standards and labeling have now become a global issue with several international agencies involved. In addition, some countries have formed sub-groups to harmonize their testing and energy efficiency standards (e.g. Australia/New Zealand and Canada/Mexico/USA).

Energy-efficiency labels and standards can be applied to any product that consumes energy, directly or indirectly, as it provides its services.
Energy efficiency standards can be either mandatory or voluntary; they can be in the form of minimum allowable energy efficiency or a maximum allowable energy use.

The impact of electric motors on electric consumption

According to the U.S. Department of Energy (DOE), electric motors are responsible for half the energy used in the U.S. manufacturing sector, and the International Energy Agency (IEA) estimates that electric motor-driven systems account for more than 40 percent of global electricity consumption.

To promote energy savings, increase efficiency, and reduce operating costs for manufacturing operations, many countries and regions around the world have established minimum efficiency performance standards (MEPS) for motors used in industrial, commercial, and residential applications. The ability to establish and enforce MEPS, however, depends on a standardized testing and classification system for motor efficiency.

Minimum energy performance standards (MEPS)

Sometimes also referred to as Minimum Energy Efficiency Requirements (MEER), they are regulatory measures applied in a certain country or region, and specifying performance requirements for energy using devices.
They establish energy efficiency limits that products must meet or exceed before they can be sold. A MEPS generally requires the use of a particular test procedure that specifies how performance is measured.

The EU Ecodesign Directive is the primary means for setting MEPS in the EU. MEPS are usually reviewed, in consultation with the industries concerned, and updated in line with technological advances.
Along with energy rating labeling, MEPS should ideally give the industry the motivation to constantly improve the energy efficiency of products on the market.

Energy efficiency standards

To harmonize efficiency classifications for motors manufactured and sold in the global market, the International Electrotechnical Commission (IEC) introduced Standard IEC 60034-30:2008, which was updated in 2014 and is now referred to as IEC 60034-30-1:2014, "Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors."

In addition to defining efficiency classes for electric motors, the IEC has also developed a standard that specifies how to determine motor efficiencies and losses based on established testing methods. This standard, IEC 60034-2-1 : 2014, ensures an international common base for electric motor designing and classification, as well as for national legislative activities and provides the basis for defining the efficiency classes in IEC 60034-30-1.

Both standards were developed in conjunction with the National Electrical Manufacturers Association (NEMA), the Japan Electrical Manufacturers Association (JEMA), and the European Committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP).

History of energy efficiency standards

IEC 60034-2-1 : 2007: harmonizes the procedures for the measurement of efficiencies.
IEC 60034-30 : 2008: specifies efficiency classes and forms the basis for the various national efficiency requirements.
IEC 60034-2-1: 2014: is intended to establish methods of determining efficiencies from tests, and to specify methods of obtaining specific losses.
IEC 60034-30-1: 2014: takes a step further in widening the scope of motors subject to efficiency classes and introduces the IE4 class. VSD-driven motors are out of the scope of this standard and will be dealt with in a standard of its own.

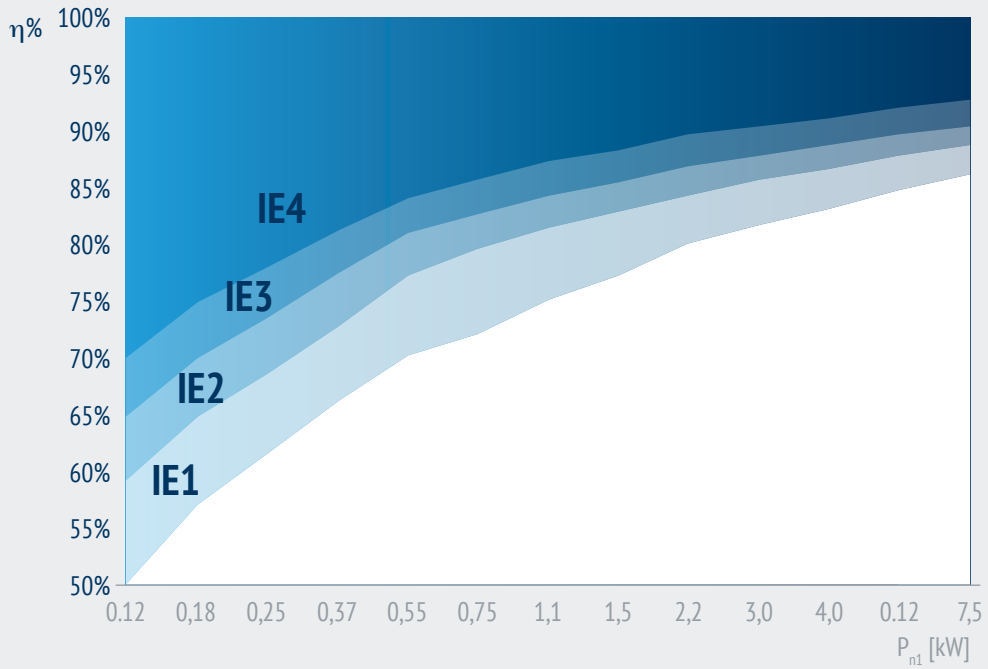
The IE classes are shown in the following table:

Class type	Class number
Standard efficiency	IE1
High efficiency	IE2
Premium efficiency	IE3
Super premium efficiency	IE4

The step forward - IE4 and IE5

Motors belonging to efficiency class IE4 achieve an even further improvement of efficiency.
At present, Bonfiglioli is already on track with its synchronous motors for inverter operation and is continuously improving and enhancing the performance of its asynchronous three phase induction motors.
IE5 is to be incorporated in the next edition of IEC 60034-30-1, with the goal to obtain an energy loss reduction of 20% compared to IE4.

IE efficiency classes for 4-pole motors at 50 Hz



Electrical motor efficiency is the ratio between the mechanical output power and the electrical input power:
$\eta = P_{n1} / (V_n \cdot I_n \cdot 1000)$

Parameters:
V_n = Rated voltage [V]
P_{n1} = Motor output power [kW]
I_n = Rated current [A]

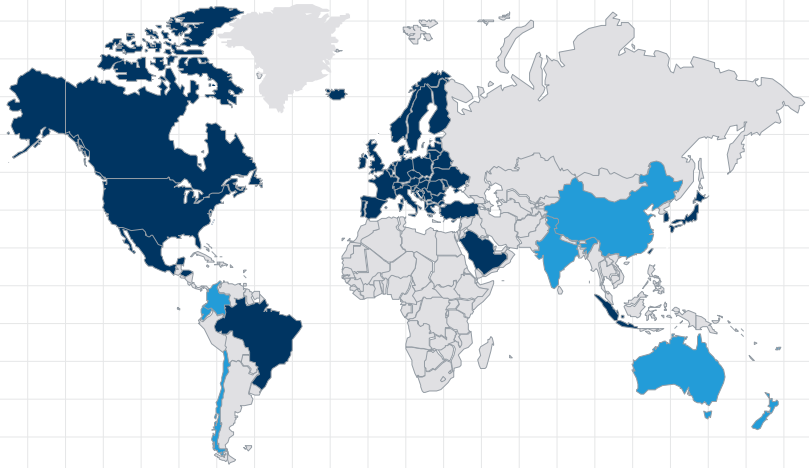
A well dimensioned electric motor which operates in its high efficiency region should be chosen in order to obtain a highly efficient system.

Energy efficiency schemes

Though the IEC efficiency standards are internationally relevant, differences in implementation still exist. The following table shows the correlation between the IE efficiency classes and regional efficiency schemes in different parts of the world. Notice that IE1, "standard efficiency", has become substandard in basically all the regions mentioned, with the exception of some LATAM countries.
Despite there were no imperative timelines for establishing IE4 regionally until recently, it is important to acknowledge that minor changes are forseen for European countries. Specifically, all the asynchronous three-phase electric motors with a power equal to or greater than 75kW must comply with IE4 standard, starting from July 2021.

International efficiency regulations

Global minimum efficiency map



Global efficiency classes

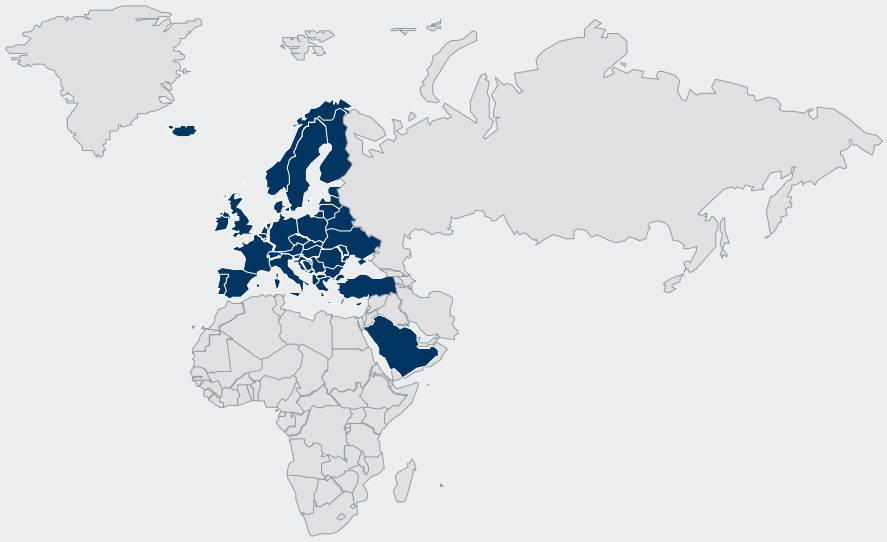
IEC 60034-30-1	IE1	IE2	IE3	IE4
NEMA MG-1	Standard	High	Premium	Super Premium
GB 18613		Grade 3	Grade 2	Grade 1
NBR 17094-1		IR2	IR3	
AS/NZS 1359,5	IE1	IE2	IE3	
IS 12615	IE1	IE2	IE3	IE4
SASO 2893	IE1	IE2	IE3	IE4
KS C IEC 60034	IE1	IE2	IE3	IE4
JIS C 4034-30	IE1	IE2	IE3	IE4

Actual efficiency by countries table

Country	Efficiency class	Required level	Future
Europe	IEC 60034-30	IE3	01/07/2021: exceptions reduction on standard.*
U.S.A.	NEMA MG-1	Nema premium	Additional rulings are expected to mandate higher efficiency req. on frame size NEMA 42-48-56
Canada	NEMA MG-1	Nema premium	A regulation for small electric motors (0,25 - 3 HP) with Premium Efficiency (IE3) is planned
Mexico	NEMA MG-1	Nema premium	Mexico orients itself toward US requirements
Brazil	NBR 17094-1	IR3 → IE3	No update planned
South Korea	KS C IEC 60034	IE3	No update planned
Japan	JIS C 4034-30	IE3	No update planned
Singapore	IEC 60034-30	IE3	No update planned
Saudi Arabia	SASO 2893	IE3	No update planned
Taiwan	IEC 60034-30	IE3	No update planned
China	GB 18613	Grade 3 → IE2	GB 18613 will be revised during 2020 and Grade 2 (IE3) could become mandatory from 2021
India	IS 12615	IE2	India orients itself toward European requirements
Australia	AS/NZS 1359.5	IE2	Consultation Regulation Impact Statement – Electric Motors, is expected to be published in 2020
Ecuador	IEC 60034-30	IE2	No update planned
Colombia	IEC 60034-30	IE2	31/08/2020 IE3 on 7.5 kW – 375 kW 31/08/2021 IE3 on 0.75 – 375 Kw
Chile	IEC 60034-30	IE2	No update planned
Peru	-	-	No update planned
Argentina	-	-	No update planned

* *From 1st July 2021 onwards, the new rule will applies to 3-phase induction motors rated:*
*1) **for continuous duty i.e. duty class S1, S3≥80%, S6≥80%**. All others duty cycle are considered an exception (ex: S3-25%, S2-30min, S9, etc..).*
*2) **as brake motors** so designed that the efficiency of the motor can be determined independently of the brake are no longer exempted.*
*3) **as 8 pole motors**. Multipole are considered an exception.*
*4) **as designed for inverter (VSD) operation**. That means that the actual IE2 + VSD with power rated between 0,75kW ≤ Pw ≤ 375kW need to be at least IE3 from 1st July 2021 ahead.*
*5) **with power between 0,12kW ≤ Pw ≤ 1000kW**. In particular, any IE1 motors with a power rated between 0,12kW ≤ Pw ≤ 0,55kW which is not considered exempted from the new regulation need to be shifted at least to a IE2 efficiency class. Any IE1 or IE2 motors with a power rated between 0,75kW ≤ Pw ≤ 1000kW which is not considered exempted from the new regulation need to be shifted at least to a IE3 efficiency class.*

Exceptions | EMEA



Country	EU	Switzerland	Turkey	Saudi Arabia
Efficiency	IE3	IE3	IE3	IE3
Non-continuous duty	•	•	•	•
Designed for inverter (VSD) operation	•	•	•	•
Brake motors	•	•	•	
Two speed/Multi-speed/Switchable pole	•	•	•	•
8 pole motor	•	•	•	
Gearmotor				
High-slip/Torque				•
Supplied exclusively for exported equipment				
At altitudes exceeding 4000 meters	•	•	•	•
At altitudes exceeding 1000 meters				
Ambient < -30°C	•	•	•	
Ambient < -20°C				•
Ambient < -15°C				
Ambient > +40°C				
Ambient > +60°C	•	•	•	•
Thermal class H or above				
TENV Totally Enclosed Non-Ventilated	•	•	•	

• This symbol represents an exception to the actual energy regulation. If the e-motor matches with at least one of this characteristics is considered out of the regulation.

We take no responsibility for the information herein is up to date and complete.
Countries that are not yet following the official MEPS, may face strong variations in a short time.

Exceptions | APAC

Country	India	China	Au/NZ	South Korea	Singapore	Japan	Taiwan
Efficiency	**IE2**	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**	**IE3**
Non-continuous duty	●6	●	●1	●	●7	●	●
Designed for inverter (VSD) operation		●9		●4		●3	●
Brake motors	●5	●			●		
Two speed/Multi-speed/Switchable pole	●	●	●	●	●	●	●
8 pole motor		•			●	●	●
Gearmotor			●8				
High-slip/Torque			●		●	●2	
Supplied exclusively for exported equipment			●		●		
At altitudes exceeding 4000 meters	●		●				
At altitudes exceeding 1000 meters		●			●	●	
Ambient < -30°C					●		
Ambient < -20°C	●	●	●			●	
Ambient < -15°C				●			●
Ambient > +40°C		●		●		●	●
Ambient > +60°C	●		●		●		
Thermal class H or above						●	
TENV Totally Enclosed Non-Ventilated	●	●					

1 Motors rated for duty cycle S2 as stated on Regulation CEI EN 60034- 1 / IEC 34-1
2 0.75 to < 110 kW: ≥ 5%; >110 kW: ≥ 3%
3 Only applies to motors using a forced-cooling fan
4 Not inverter (VSD) motors used in pump, fan or blower applications
5 The motor is integrated with the gear unit so that if it's not possible to test the motor independently, then it is not covered
6 Motors rated for duty cycles S2 and above with an equivalent S1 duty are also covered. These motors must also be marked with the equivalent S1 duty output and its corresponding IE class.
7 Motors rated for duty cycles S6 and S9 must also be marked IE3
8 All gearmotors without motor flange are exempt. All motors for which the gear unit housing constitutes the A-side end shield. (The motor and the gear unit form a unit. It means that they cannot be separated without the motor losing its functionality.
9 All motors designed "only" for frequency inverter operation are exempt. The nameplate only lists the torque and not the power rating.

● This symbol represents an exception to the actual energy regulation. If the e-motor matches with at least one of this characteristics is considered out of the regulation.

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Exceptions | AME

Country	USA	Canada	Mexico	Brazil	Argentina	Chile	Peru	Ecuador	Colombia
Efficiency	IE3	IE3	IE3	IE3	IE0	IE2	-	IE2	IE2
Non-continuous duty	•	•	•	•	•	•	•	•	•
Designed for inverter (VSD) operation	•	•	•	•	•	•			•
Brake motors			•			•			
Two speed/Multi-speed/Switchable pole	•	•	•	•	•	•	•	•	•
8 pole motor					•	•	•		
Gearmotor					•				
High-slip/Torque	•	•							
Supplied exclusively for exported equipment									
At altitudes exceeding 4000 meters								•	
At altitudes exceeding 1000 meters	•	•		•					•
Ambient < -30°C									
Ambient < -20°C								•	
Ambient < -15°C	•	•		•					•
Ambient > +40°C	•	•		•					•
Ambient > +60°C								•	
Thermal class H or above									
TENV Totally Enclosed Non-Ventilated			•	•	•				

• This symbol represents an exception to the actual energy regulation. If the e-motor matches with at least one of this characteristics is considered out of the regulation.

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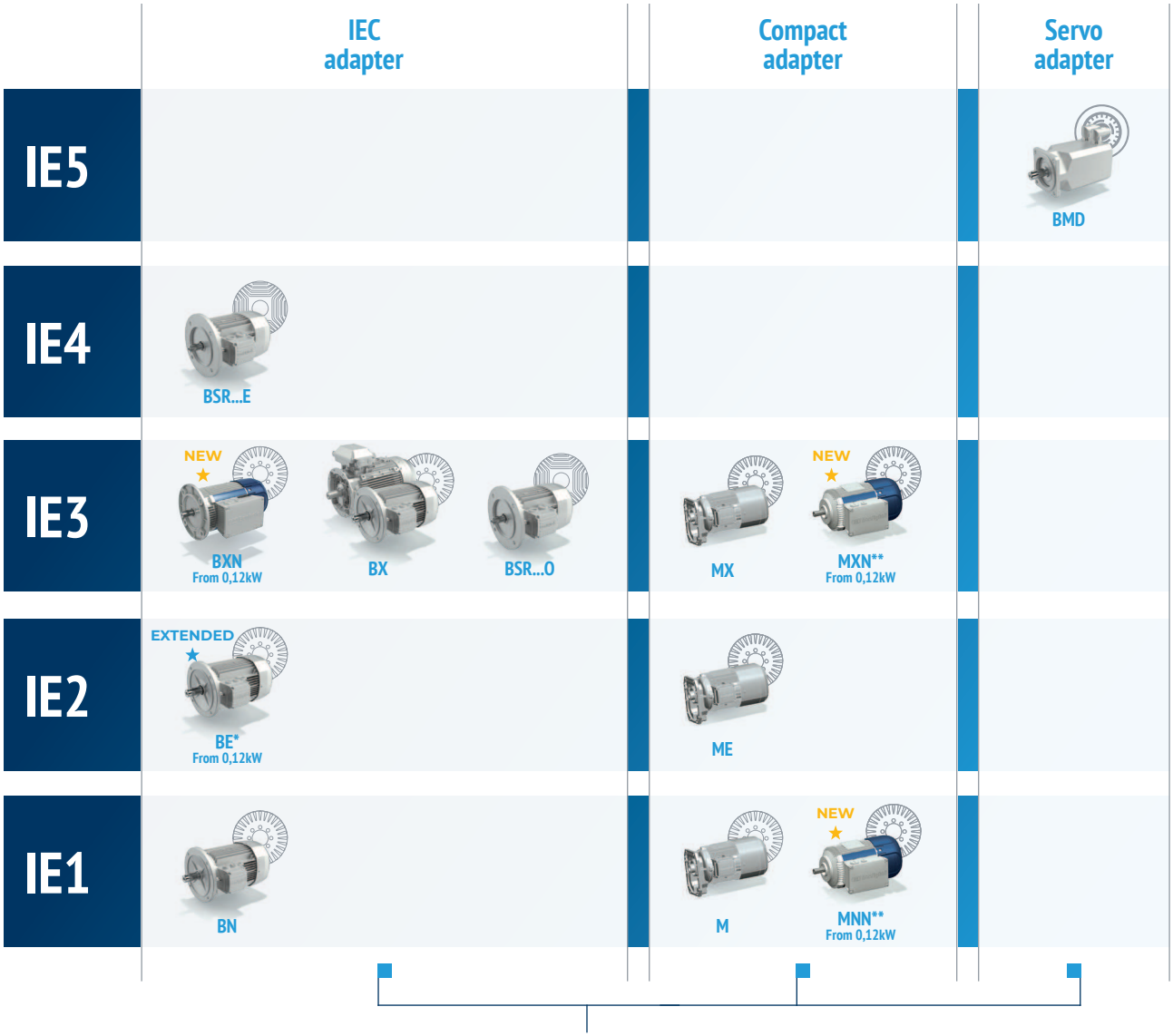
Products for all your needs

Bonfiglioli offers a great set of opportunities to match your application requirements around the world: you just need to choose your solution.



Complete your solution

Frequency Inverters

Regenerative Inverters

Asynchronous Technology

Reluctance Technology

Permanent Magnets

* BE Release to market by Q1 2021 for powers between 0,12 and 0,55 kW included. In addition, the brake option will be released for the 4 poles BE e-motor series on powers between 0,12 and 7,5kW included.

** MXN/MNN fits on brand new EVOX-CP coaxial

Bonfiglioli Worldwide Locations

Australia
Bonfiglioli Transmission (Aust.) Pty Ltd.
2, Cox Place Glendenning NSW 2761
Locked Bag 1000 Plumpton NSW 2761
Tel. +61 2 8811 8000

Brazil
Bonfiglioli Redutores do Brasil Ltda.
Travessa Cláudio Armando 171 - Bloco 3 - CEP 09861-730
Bairro Assunção - São Bernardo do Campo - São Paulo
Tel. +55 11 4344 2322

China
Bonfiglioli Drives (Shanghai) Co. Ltd.
#68, Hui-Lian Road, QingPu District,
201707 Shanghai
Tel. +86 21 6700 2000

France
Bonfiglioli Transmission s.a.
14 Rue Eugène Pottier
Zone Industrielle de Moimont II - 95670 Marly la Ville
Tel. +33 1 34474510

Germany
Bonfiglioli Deutschland GmbH
Sperberweg 12 - 41468 Neuss
Tel. +49 0 2131 2988 0
Bonfiglioli Vectron GmbH
Europark Fichtenhain B6 - 47807 Krefeld
Tel. +49 0 2151 8396 0
O&K Antriebstechnik GmbH
Ruhrallee 8-12 - 45525 Hattingen
Tel. +49 0 2324 2050 1

India
Bonfiglioli Transmissions Pvt. Ltd.
Mobile, Wind
AC 7 - AC 11 Sidco Industrial Estate
Thirumudivakkam Chennai - 600 044
Tel. +91 844 844 8649
Industrial
Survey No. 528/1, Perambakkam High Road Mannur Village,
Sriperumbudur Taluk Chennai - 602 105
Tel. +91 844 844 8649
Industrial
Plot No.A-9/5, Phase IV MIDC Chakan,
Village Nighoje Pune - 410 501
Tel. +91 844 844 8649

Italy
Bonfiglioli S.p.A.
Headquarters
Via Bazzane, 33 - 40012 Calderara di Reno
Tel. +39 051 647 3111
EVO - Industrial
Via Bazzane, 33/A - 40012 Calderara di Reno
Tel. +39 051 6473111
Mobile, Wind
Via Enrico Mattei, 12 Z.I. Villa Selva - 47100 Forlì
Tel. +39 0543 789111
Bonfiglioli Riduttori S.p.A.
Via Bazzane, 33 - 40012 Calderara di Reno
Tel. +39 051 6473111
Bonfiglioli Mechatronic Research S.p.A
Via Unione 49 - 38068 Rovereto
Tel. +39 0464 443435/36

New Zealand
Bonfiglioli Transmission (Aust.) Pty Ltd.
88 Hastie Avenue, Mangere Bridge, 2022 Auckland
PO Box 11795, Ellerslie
Tel. +64 09 634 6441

Singapore
Bonfiglioli South East Asia Pte Ltd.
8 Boon Lay Way, #04-09,
8@ Tadehub 21, Singapore 609964
Tel. +65 6268 9869

Slovakia
Bonfiglioli Slovakia s.r.o.
Robotnícka 2129
Považská Bystrica, 01701 Slovakia
Tel. +421 42 430 75 64

South Africa
Bonfiglioli South Africa Pty Ltd.
55 Galaxy Avenue, Linbro Business Park, Sandton,
Johannesburg, 2090 South Africa
Tel. +27 11 608 2030

Spain
Tecnotrans Bonfiglioli, S.A.
Pol. Ind. Zona Franca, Sector C, Calle F, n° 6
08040 Barcelona
Tel. +34 93 447 84 00

Turkey
Bonfiglioli Turkey Jsc
Atatürk Organize Sanayi Bölgesi, 10007 Sk. No. 30
Atatürk Organize Sanayi Bölgesi, 35620 Çiğli - Izmir
Tel. +90 0 232 328 22 77

United Kingdom
Bonfiglioli UK Ltd.
Unit 1 Calver Quay, Calver Road, Winwick
Warrington, Cheshire - WA2 8UD
Tel. +44 1925 852667

USA
Bonfiglioli USA Inc.
3541 Hargrave Drive
Hebron, Kentucky 41048
Tel. +1 859 334 3333

Vietnam
Bonfiglioli Vietnam Ltd.
Lot C-9D-CN My Phuoc Industrial Park 3
Ben Cat - Binh Duong Province
Tel. +84 650 3577411

Bonfiglioli
Forever Forward

We have a relentless commitment to excellence, innovation and sustainability. Our team creates, distributes and services world-class power transmission and drive solutions to keep the world in motion.

HEADQUARTERS
Bonfiglioli S.p.A.
Via Bazzane, 33
40012 Calderara di Reno
Bologna (Italy)
www.bonfiglioli.com