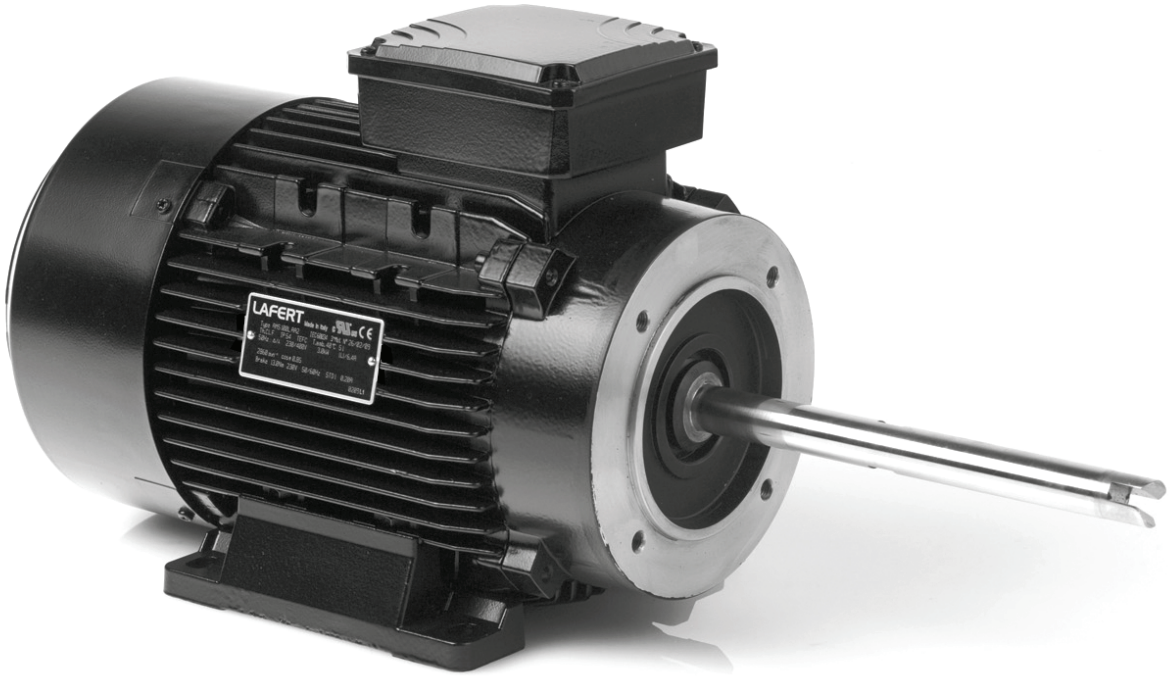
GENERAL INFORMATION



MISSION

The Lafert Group, a leading European Motor Company, is committed to continuous growth by being the global leading manufacturer of **customised engineered Electric Motors and Drives** with specific focus on Industry Automation, Energy Saving, and Renewables.

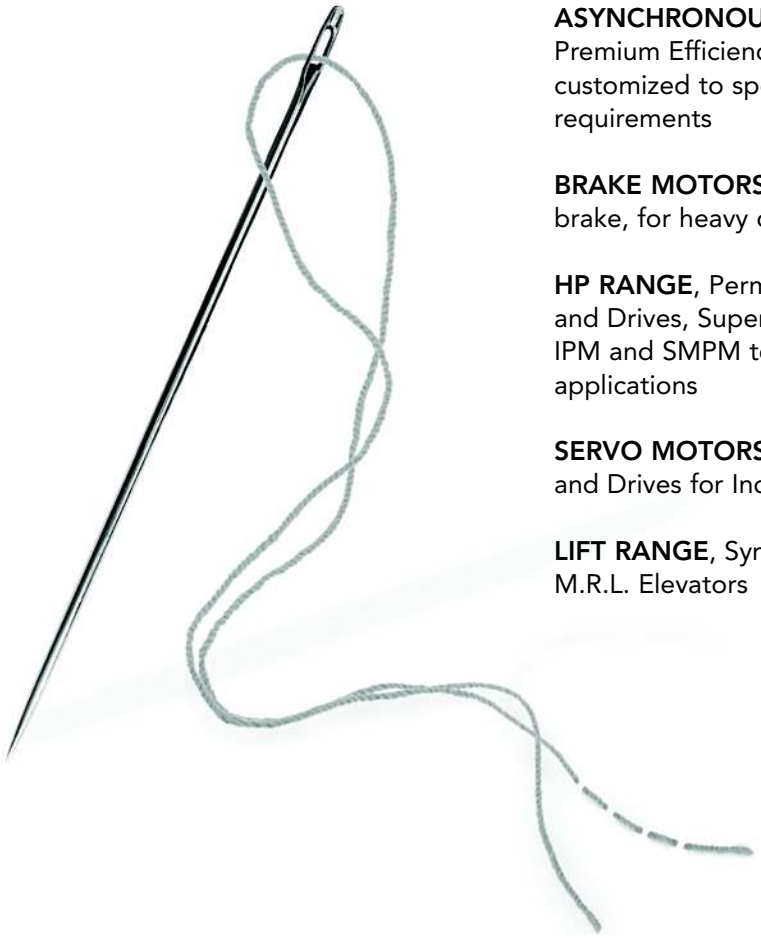
The Lafert Group will strive to be the ideal partner in the Electric Motors and Drives industry through focus on meeting specific customer demands. Mutually beneficial partnerships are developed by continuous process improvements utilising state-of-the-art products and techniques by a skilled, motivated and professional workforce.

CUSTOM MADE, CUSTOM PHILOSOPHY

Lafert specializes in the design and manufacture of customized electric motors produced to meet specific applications and needs of individual customers. **Over 90% of Lafert's output is non-standard motors.**

The control of the whole manufacturing process allows for any aspect of the motor to be modified. This gives the ability to engineer customized motors that fit the final application/work environment for maximum efficiency and reliability.

Lafert leverages over 50 years of experience in partnering with Global Companies from its 12 locations spread across Europe, North America, Asia and Australia.



ASYNCHRONOUS MOTORS, Three-phase Motors Premium Efficiency - IE3 and High Efficiency - IE2 customized to specific applications and OEM requirements

BRAKE MOTORS, Asynchronous Motors, DC and AC brake, for heavy duty applications

HP RANGE, Permanent Magnet Synchronous Motors and Drives, Super Premium Efficiency – IE4/IE5, IPM and SMPM technology, designed for HVAC applications

SERVO MOTORS & DRIVES, Brushless Servomotors and Drives for Industrial Automation

LIFT RANGE, Synchronous Gearless Machines for M.R.L. Elevators

ASYNCHRONOUS MOTORS

HIGH EFFICIENCY, ENERGY SAVING

AC motors have a significant impact on the total energy operation cost for industrial, institutional and commercial buildings. Today, the major factor influencing the motor industry is energy efficiency driven by both increasingly demanding legislation and industry's greater awareness of green issue responsibilities.

Premium Efficiency and High Efficiency Three-phase Motors meeting the requirements of IE3 and IE2 efficiency levels in accordance with IEC 60034-30-1:2014 and test method IEC 60034-2-1;2007.

Premium Efficiency IE3 motors provide compliance with the requirements of EU MEPS that has come into force January 1, 2015 and NEMA EPAct/EISA, which has been in force since December 2010 in the USA and January 2011 in Canada.

High Efficiency IE2 motors comply with the EU's IE2 efficiency requirements, mandatory for all systems (motor <7.5kW + machinery) installed in the EU from January 2013 and for all motors 7.5 to 375kW put into operation with a variable speed drive (VSD) from January 2015.

IE2 IE3 c UL Energy Verified ENERGY C US

BRAKE MOTORS

EXTENSIVE CONFIGURATION OPTIONS MATCH MOTORS TO APPLICATIONS

The harsher the working environment the greater the demand on engineering standards, and non-standard then becomes the norm. Custom-design and engineering fulfil this need to give the reliability and performance demanded.

The Lafert Brake Motor series is engineered according to the client's specification. Total control over all aspects of production permits **multiple design options** including flanges, shafts, brakes plus optimum resistance to external agents and offshore environments for paints, seals, and magnet surfaces.

The result is a range of AC motors with DC and AC brake, produced entirely in-house which incorporates Lafert's own technical solutions for achieving robustness and performance, combined with the option for application-specific customization.

IE1 IE2 c UL us

HP RANGE

THE IE4 AVAILABLE SOLUTION

High Performance (HP) is a generation of **PM (Permanent Magnet) Synchronous Motors, achieving IE4 and IE5 Super Premium Efficiency** level, that offer improved electrical efficiency at stable and reduced production costs without applying rare earth magnets.

This uniquely engineered product combines the electrical design of Brushless Servomotors with the mechanical design of AC Induction Motors. The result is a compact motor primarily targeted toward HVAC applications in fans, compressors, and blowers, where there is emphasis on reducing the operating cost or weight and size of the motors.

The complete range 0.37 kW to 30 kW are supplied as s**tand-alone motors** (HPS/HPF) to be controlled by a separate drive or as **motor/drive integrated units** (HPI), specifically designed for their energy saving potential.

A separate catalogue is available.

IE4 IE5 c UL us

The Awards

2013 European New Product Innovation Leadership Award:
Electric Motors for HVAC Applications by Frost & Sullivan

2014 AHR Expo Innovation Awards:
Green Building Category

ADI Index Design 2012:
Best Italian design in manufacturing

SERVO MOTORS & DRIVES

PRECISION IS STANDARD, ONLY THE MOTOR IS CUSTOMIZED!

Lafert know-how in manufacturing permanent magnet motors is combined with the company's on-going drive for excellence and its ability to offer **non-standard solutions**, all of which is invested in this product range. On-going research and development, often in conjunction with customers, continues to bestow superior performance in terms of speed, accuracy and control **to satisfy application needs**.

The range of brushless Servo Motors is one of the most complete available on the market, with nominal torques 0.20 Nm to 150 Nm. Direct Drive Motors cover torques 10 Nm to 500 Nm.

Lafert's Servo Drive range includes standard products and custom solutions that ensure high performance and cost reductions for diverse applications across the fields of **Industrial Automation and battery-powered applications** such as the automated handling of material and/or people.

A separate catalogue is available.

LIFT RANGE

HIGHER & FASTER

Lafert's LIFT range has established the company internationally as one of leading manufacturer.The motor's innovative design, with its protected encoder and no external cabling, offers compactness and low weight, ideal for **home lift systems or new concept M.R.L..**

Its novel **inner rotor and fractional slot gearless technology** are of products of Lafert's in-house design and manufacturing expertise. It provides the highest levels of performance and energy efficiency plus enhanced response to satisfy today's needs and trends in the elevator market i.e. higher speed to greater heights.

Motors with torque up to 850 Nm for systems with a capacity load up to 1,600 kg, machines with TÜV SÜD Certifications, in compliance with the Specifications UNI EN 81-1:2010 and Lifts Directive 95/16/EC.

A separate catalogue is available.


CERTIFICATO DEL SISTEMA
DI GESTIONE PER LA QUALITÀ
QUALITY MANAGEMENT SYSTEM CERTIFICATE

LAFERT S.p.A.

UNI EN ISO 9001:2008
ISO 9001:2008

Progettazione e produzione di motori elettrici asincroni monofase e trifase e autofrenanti
Design development and production of asynchronous three-phase and single-phase motors, brake motors

CERMET

QUALITY SYSTEM CERTIFICATE

The strictness of our quality control assures the flawless operation and reliability of our products. Our quality is confirmed by the **Certificate ISO 9001:2008** awarded by CERMET, a certification body authorized by ACCREDIA.

SAFETY STANDARDS

Our motors comply with the requirements of the International Standard **IEC 60034** for rotating electrical machines as well as with the following European Directives: **Low Voltage Directive** (LV) 2014/35/EC, **Electromagnetic Compatibility Directive** (EMC) 2014/30/EC and **RoHS Directive** 2011/65/EC on the restriction of hazardous substances in electrical and electronic equipment.

All products comply with the requirements of the **Directive Machines** (MD) 2006/42/EC. In accordance with this Directive, induction motors are components and intended solely for integration into other machines. Commissioning is forbidden until conformity of the end-product with this Directive is proved.

CE The CE marking was applied for the first time in 1995.

When operating the motor, the observance of the Regulation EN 60204-1 and safety instructions indicated in our Operating Instructions must be complied with.

Motors complied with many other international standards are available on request:
Motors approved by UL Underwriters Laboratories Inc.

Motors approved by CSA

Motors approved by CQC (small motors)

EFFICIENCY STANDARDS

IE1 IE2 IE3 Efficiencies are harmonized to the **International Standard IEC 60034-30-1:2014** that states new efficiency levels: Standard Efficiency IE1, High Efficiency IE2 and Premium Efficiency IE3. The efficiency levels are in accordance with the testing method IEC 60034-2-1;2007.

ENERGY High Efficiency motors according to **EPAct** legislation.
Verified by UL Underwriters Laboratories Inc.

Energy Verified Premium Efficiency motors according to **EISA** Directive.
Verified by UL Environment.

Motors with China Energy Label.

INTERNATIONAL EFFICIENCY LEVELS: IE CODES

The International Standard **IEC 60034-30-1;2014** ensures an international common base for electric motor designing and classification, as well as for national legislative activities, increasing the level of harmonization in **MEPS** (Minimum Energy Performance Standard) all over the world. The IEC 60034-30-1 states the efficiency levels (IE codes) and requirements, provides test conditions and efficiency measurement methods specified in **IEC 60034-2-1;2007**. It doesn't state the motors to be supplied or the minimum efficiency level (MEPS). This depends on any national legislative activities and government targets to save energy and reduce environmental impact.

The efficiency levels provided by the standard for single speed and three-phase motors – brake included - 50 Hz or 50/60 Hz, with rated output 0.75kW to 375kW, 2, 4 or 6 poles, on the basis of continuous duty operation S1 or intermittent periodic duty operation S3 are the following:

• IE1 = Standard Efficiency **• IE2 = High Efficiency** **• IE3 = Premium Efficiency**

EFFICIENCY VALUES FOR 50 HZ ACCORDING TO IEC 60034-30-1:2014

Efficiency standard calculation: IEC 60034-2-1;2007

Output	Standard Efficiency - IE1			High Efficiency - IE2			Premium Efficiency - IE3		
kW	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles
0.12	45.0	50.0	38.3	53.6	59.1	50.6	60.8	64.8	57.7
0.18	52.8	57.0	45.5	60.4	64.7	56.6	65.9	69.9	63.9
0.20	54.6	58.5	47.6	61.9	65.9	58.2	67.2	71.1	65.4
0.25	58.2	61.5	52.1	64.8	68.5	61.6	69.7	73.5	68.6
0.37	63.9	66.0	59.7	69.5	72.7	67.6	73.8	77.3	73.5
0.40	64.9	66.8	61.1	70.4	73.5	68.8	74.6	78.0	74.4
0.55	69.0	70.0	65.8	74.1	77.1	73.1	77.8	80.8	77.2
0.75	72.1	72.1	70.0	77.4	79.6	75.9	80.7	82.5	78.9
1.1	75.0	75.0	72.9	79.6	81.4	78.1	82.7	84.1	81.0
1.5	77.2	77.2	75.2	81.3	82.8	79.8	84.2	85.3	82.5
2.2	79.7	79.7	77.7	83.2	84.3	81.8	85.9	86.7	84.3
3	81.5	81.5	79.7	84.6	85.5	83.3	87.1	87.7	85.6
4	83.1	83.1	81.4	85.8	86.6	84.6	88.1	88.6	86.8
5.5	84.7	84.7	83.1	87.0	87.7	86.0	89.2	89.6	88.0
7.5	86.0	86.0	84.7	88.1	88.7	87.2	90.1	90.4	89.1
11	87.6	87.6	86.4	89.4	89.8	88.7	91.2	91.4	90.3
15	88.7	88.7	87.7	90.3	90.6	89.7	91.9	92.1	91.2
18.5	89.3	89.3	88.6	90.9	91.2	90.4	92.4	92.6	91.7
22	89.9	89.9	89.2	91.3	91.6	90.9	92.7	93.0	92.2
30	90.7	90.7	90.2	92.0	92.3	91.7	93.3	93.6	92.9
37	91.2	91.2	90.8	92.5	92.7	92.2	93.7	93.9	93.3
45	91.7	91.7	91.4	92.9	93.1	92.7	94.0	94.2	93.7
55	92.1	92.1	91.9	93.2	93.5	93.1	94.3	94.6	94.1
75	92.7	92.7	92.6	93.8	94.0	93.7	94.7	95.0	94.6
90	93.0	93.0	92.9	94.1	94.2	94.0	95.0	95.2	94.9
110	93.3	93.3	93.3	94.3	94.5	94.3	95.2	95.4	95.1
132	93.5	93.5	93.5	94.6	94.7	94.6	95.4	95.6	95.4
160	93.7	93.8	93.8	94.8	94.9	94.8	95.6	95.8	95.6
200-375	94.0	94.0	94.0	95.0	95.1	95.0	95.8	96.0	95.8

EFFICIENCY VALUES FOR 60 HZ ACCORDING TO IEC 60034-30-1:2014

Efficiency standard calculation: IEC 60034-2-1;2007

0.12	57.5	62.0	48.0	59.5	64.0	50.5	62.0	66.0	64.0
0.18	62.0	66.0	52.5	64.0	68.0	55.0	65.6	69.5	67.5
0.25	64.0	68.0	57.5	68.0	70.0	59.5	69.5	73.4	71.4
0.37	70.0	70.0	62.0	72.0	72.0	64.0	73.4	78.2	75.3
0.55	72.0	74.0	66.0	74.0	75.5	68.0	76.8	81.1	81.7
0.75	77.0	78.0	73.0	75.5	82.5	80.0	77.0	85.5	82.5
1.1	78.5	79.0	75.0	82.5	84.0	85.5	84.0	86.5	87.5
1.5	81.0	81.5	77.8	84.0	84.0	86.5	85.5	86.5	88.5
2.2	81.5	83.0	78.5	85.5	87.5	87.5	86.5	89.5	89.5
3.7	84.5	85.0	83.5	87.5	87.5	87.5	88.5	89.5	89.5
5.5	86.0	87.0	85.0	88.5	89.5	89.5	89.5	91.7	91.0
7.5	87.5	87.5	86.0	89.5	89.5	89.5	90.2	91.7	91.0
11	87.5	88.5	89.0	90.2	91.0	90.2	91.0	92.4	91.7
15	88.5	89.5	89.5	90.2	91.0	90.2	91.0	93.0	91.7
18.5	89.5	90.5	90.2	91.0	92.4	91.7	91.7	93.6	93.0
22	89.5	91.0	91.0	91.0	92.4	91.7	91.7	93.6	93.0
30	90.2	91.7	91.7	91.7	93.0	93.0	92.4	94.1	94.1
37	91.5	92.4	91.7	92.4	93.0	93.0	93.0	94.5	94.1
45	91.7	93.0	91.7	93.0	93.6	93.6	93.6	95.0	94.5
55	92.4	93.0	92.1	93.0	94.1	93.6	93.6	95.4	94.5
75	93.0	93.2	93.0	93.6	94.5	94.1	94.1	95.4	95.0
90	93.0	93.2	93.0	94.5	94.5	94.1	95.0	95.4	95.0
110	93.0	93.5	94.1	94.5	95.0	95.0	95.0	95.8	95.8
150	94.1	94.5	94.1	95.0	95.0	95.0	95.4	96.2	95.8
185-375	94.1	94.5	94.1	95.4	95.4	95.0	95.8	96.2	95.8

GLOBALLY MINIMUM EFFICIENCY STANDARDS

Country	Product range	Law / Regulation	MEPS	Next steps
EUROPE	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 7.5 to 375 kW IE2 motors < 7.5 kW compulsory 01.01.2015	01.01.2017 - IE3 or IE2 (only with VSD) from 0.75 to 375 kW
SWITZERLAND	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 7.5 to 375 kW IE2 motors < 7.5 kW compulsory 01.01.2015	01.01.2017 - IE3 or IE2 (only with VSD) from 0.75 to 375 kW
TURKEY	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	EC 4/2014 60034-30-1:2014	IE3 or IE2 (only with VSD) motors from 7.5 to 375 kW IE2 motors < 7.5 kW compulsory 01.01.2015	01.01.2017 - IE3 or IE2 (only with VSD) from 0.75 to 375 kW
RUSSIA	up to 690 V ± 10%; 50 Hz 1 - 400 kW - All poles	GOST R 51677-2000	-	
USA	460 V ± 10%; 60 Hz 1 - 500 HP - 2-8 poles	Nema EPAct EISA 2007 (revision 2014)	IE3 compulsory 01.06.2016	
CANADA	460 V/575 V ± 10%; 60 Hz 1 - 500 HP - 2-8 poles	CSA C390-10	IE3 compulsory 01.06.2016	
MEXICO	460 V ± 10%; 60 Hz 1 - 200 HP - 2-6 poles	NOM-016-ENER 2010 CSA 390	IE2 compulsory 01.01.2011	Will follow USA model
BRAZIL	220/380/440/460/480 V ± 10%; 60 Hz 0.75 - 250 kW - 2-8 poles	NBR 17094-1:2013 Regulation 553	IE2 compulsory 08.12.2009	It is expected that the scope of regulation will be extended
CHILE	380/400/420/440/460/690 V ± 10%; 50 Hz 0.75 Kw - 7.5 kW - 2-6 poles	NCH 3086	IE2 compulsory 04.01.2011	
AUSTRALIA NEW ZEALAND	415 V/690 V ± 10%; 50 Hz 0.73 - 186 kW - 2-8 poles	AS/NZS 1359.5-2004	IE2 compulsory 01.04.2006	IE3 expected for near future
CHINA	380 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	GB 18613-2012	IE3 (GRADE 2) motors from 7.5 to 375 kW compulsory 01.09.2016	01.09.2017 - IE3 (GRADE 2) from 0.75 to 375 kW
HONG KONG	380 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	Mandatary Buildings Energy Efficiency Bill	IE3 or IE2 (only with VSD) motors from 7.5 to 375 kW IE2 motors < 7.5 kW compulsory 01.01.2015	01.01.2017 - IE3 or IE2 (only with VSD) from 0.75 to 375 kW
INDIA	415 V/690 V ± 10%; 50 Hz 0.37 - 315 kW - 2-8 poles	IS:12615	IE2 compulsory 01.06.2011	
ISRAEL	400 V ± 10%; 50 Hz 0.75 - 185 kW - 2-8 poles	IS:5289	IE2 compulsory 01.02.2008	
JAPAN	200/220/400/440 V ± 10%; 50/60 Hz 0.2 - 160 kW - 2-6 poles	JIS C 4210 JIS C 4212	IE3 compulsory 01.04.2015	
KOREA	up to 600 V ± 10%; 60 Hz 0.75 - 200 kW - 2-6 poles	IEC 60034-30-1:2014	IE3 motors from 15 to 200KW compulsory 01.01.2016	01.01.2017 - IE3 from 0.75 to 15 kW
SINGAPORE	415 V ± 10%; 50 Hz 1.1 - 90 kW - 2-4 poles	SS530:2006	IE2	Only government projects compulsory IE2
SAUDI ARABIA	380 V/ 400 V ± 5%; 60 Hz 0.75 -375 kW - 2-6 poles	SASO IEC 60034-30:2013	IE2 compulsory 01.07.2015	01.01.2017 - IE3
UNITED ARAB EMIRATES	400 V ± 10%; 50 Hz 0.75 - 375 kW - 2-6 poles	No regulation	-	

EU – COMMISSION REGULATION EC 4/2014

The **Commission Regulation EC 4/2014** specifies efficiency requirements for three-phase AC motors from 0.75 to 375kW, 2, 4 and 6 poles, and introduces in all countries of the European Community the following MEPS from 1st January 2015:
- motors from 7.5 to 375kW - **IE3 minimum efficiency or IE2 only for motors with variable speed drive (VSD**) and marked with specific label;
- motors < 7.5kW - **IE2 minimum efficiency**.

Motors to be exclusively exported out of the EEA (machine distributors or manufacturers) may be produced and distributed with IE1 and IE2 efficiency level even after relevant deadline. To that end, a statement will have to be made to the manufacturer.

Regulation-Standard	EC 4/2014 IEC 60034-30-1:2014
Testing Method	IEC 60034-2-1:2007
Product Range	• Three-phase squirrel cage asynchronous motors: 0.75 kW - 375 kW, 2,4 and 6 poles • Continuous duty S1 • Up to 1000 V • 50 Hz or 50/60 Hz
Minimum Efficiency	**Since 01.01.2015** **Energy Efficient (IE3) or (IE2) only with VSD - 7.5 to 375kW** **Energy Efficient (IE2) < 7.5kW**
Exclusions	• Multi Speed Motors • Brake Motors • Motors for explosive atmospheres
Future	01.01.2017 – IE3 or IE2 only with VSD – 0.75 to 375kW

USA – EISA 2007

The **Energy Independence and Security Act of 2007 (EISA)** was signed into law on Dec 2007 and enforced in Dec 2010 (last revision in 2014).
EISA replaces the previous EPAct (Energy Policy Act 1992) approved by the U.S. Congress in 1992, and sets Nema Super Premium Efficiency **IE3 as minimum level** for general purpose, three-phase AC industrial motors from 1 to 500HP which are manufactured or imported for sale in USA.

The U.S. **Department of Energy (DOE)** is responsible for establishing the rules to implement. The rating plate must be market with the motor's nominal full load efficiency (NEMA nominal efficiency) and the manufacturer's CC-number (compliance certificate number).

Regulation-Standard	EPAct 2007 EISA (NEMA-MG-1)
Testing Method	IEEE 112-B or CSA390-10
Product Range	• Asynchronous three-phase motors: 1HP-500HP, 2,4,6 e 8 poles • Continuous duty S1; up to 600V; 60Hz • Configuration NEMA design A, B and C or IEC design N and H • *Partial motors*
Minimum Efficiency	Since 01.06.2016 **NEMA Premium (IE3)**
Exclusions	• Multi Speed Motors • Not line start motors • Intermittent duty • TEAO enclosures
Future	No further changes are expected in the near future

CANADA - ENERGY EFFICIENCY ACT

Canada has had minimum energy performance standards in place since 1995. These standards were amended in 1997 to include Explosion Proof Motors and Integral Gear Assembly Motors.

The regulation regarding electric motors was progressively revised and, as of June 2016, has a more stringent scope; the **minimum efficiency level** is **IE3**.

The rating plate must show NEMA nominal efficiency at 100% load and the safety certificate marking, such us CSA.

Regulation-Standard	EEA C390-10 (Nema-MG-1)
Testing Method	CSA C390-10
Product Range	• Asynchronous three-phase motors: 1HP-500HP, 2,4,6 e 8 poles • Continuous duty S1; up to 600V; 60Hz • Configuration NEMA design A, B and C or IEC design N and H • *Partial motors*
Minimum Efficiency	Since 01.06.2016 **NEMA Premium (IE3)**
Exclusions	• Multi Speed Motors • Not line start motors • Intermittent duty • TEAO enclosures
Future	No further changes to the regulations are expected in the near future

AUSTRALIA – MEPS SCHEME

The **Australian MEPS Scheme** was announced in 2001 by the Australian Greenhouse Office (AGO), and was revised in 2006. All motors covered by the scheme that will be sold in the Australian and New Zealand markets must be registered in a National online database system, www.energyrating.gov.au/appsearch/motors.asp.

Standards AS/NZS 1359,5:2004 stipulates two efficiency levels: the **compulsory minimum efficiency level IE2** or better, and a **voluntary high efficiency level IE3** or better.

The scheme is monitored by a regulatory body which conducts random testing to ensure compliance. Importing unregistered motors is subject to strict penalties.

Regulation-Standard	AS/NZS 1359,5:2004
Testing Method	Method A (equivalent to IEC60034-2-1:2007 and IEEE112-B) or Method B (equivalent to the old IEC 60034-2)
Product Range	• The phase electric motors: 0.73kW -186kW, 2 to 8 poles, Up to 1100V 50Hz
Minimum Efficiency	Since 2001 (2002 in New Zealand), revision in both countries 2006 **Energy Efficient (IE2)**
Exclusions	• Submersible motors • Integral geared motor systems • Multispeed motors • Intermittent duty motors
Future	IE3 expected for near future

BRAZIL – PBE LABELING PROGRAM

The **PBE Brazilian Labeling Program** has been in force since December 2009 and is overseen by INMETRO. From 2012 the **minimum efficiency level** is **IE2**.
All motors covered by NBR standards must be provided with specific rating plate marking and additional stickers depending on a degree of protection.

All motors must be registered on the INMETRO, website at www.inmetro.gov.br.

Regulation-Standard	553/NBR17094-1
Testing Method	NBR17094
Product Range	• Electric Motors, single speed for continuous duty IEC design N or Nema Design A,B or C, TEFC and Exn 0.75kW-185kW, 2&4 poles; 0.75kW-150kW 6 poles; 0.75kW-110kW 8 poles, Up to 600V 60Hz
Minimum Efficiency	Since 2012 **Energy Efficient (IE2)**
Exclusions	• Servo Motors • Permanent Magnet Motors • IP23 • S2 to S10 according to NBR 7094.2003 • Exd(e), EX(e), DIP
Future	It is expected that the scope of regulation will be extended

CHINA – ENERGY LABEL SCHEME

The **China Energy Label Scheme** has been mandatory since 01.09.2008 and was revised in 2012. From 01.09.2016 motors must meet **Grade 2 (IE3)** requirements. China has taken a major step towards harmonizing its national standards with IEC standards.

Standard GB/T1032 defining the efficiency measuring method, has been updated and brought in line with IEC 60034-2-1 and the grades are in line with efficiency classes defined in IEC 60034-30-1.

In addition to energy efficiency requirements, low power motors are subject to CCC certification.

Regulation-Standard	GB 18613-2012
Testing Method	IEC 60034-2-1, efficiency grades in line with IEC 60034-30-1 (IE2,IE3)
Product Range	• Three phase electric induction motors, design N, TEFC 0.75kW to 375kW 2 to 6 poles, Up to 1000V 50Hz
Minimum Efficiency	Since 01.09.2016 **Energy Efficient (IE3) - Grade 2:** 7.5 to 375kW
Exclusions	• Marine motors • Brake motors • Motors completely integrated into a machine • Motors with electro-magnetic braking incorporated • Motors with a duty type other than S1, or S3 with cyclic factor of 80% or higher • Multispeed motors • Inverter fed motors
Future	IE3 (Grade 2) from 01.09.2017: 0.75kW-375kW

KOREA – MEPS SCHEME

The **Korean MEPS Scheme** was introduced on 01.07.2008 by the Ministry of Commerce, Industry and Energy (MOCIE) and implemented in three steps. Certification is granted by the Korea Energy Management Corporation (KEMCO).

Korean MEPS is identical to **IE3 (60HZ)**. A specific sticker is required and all motors must be registered with the authorities. Motors that do not have the MEPS sticker will not be allowed into Korea.

Regulation-Standard	IEC 60034-30-1
Testing Method	IEC60034-2-1 or IEEE112-B
Product Range	• Three phase induction motor, single speed, foot or flange design A or B 0.75kW-200kW (2,4 poles); 0.75kW-160kW (6 poles) 0.75kW-110kW (8 poles) Up to 600V 60Hz
Minimum Efficiency	Since 01.01.2016 **Energy Effecient (IE3) :15 to 200kW**
Exclusions	• TENV motors • Air over motors • Permanent Magnet motors
Future	IE3 from 01.01.2017: 0.75kW-200kW

REST OF THE WORLD

Many Countries are recognizing the importance of Energy Efficiency in electric motors and its potential economic and environmental impact and are working on developing mandatory minimum energy performance standards to be implemented in the near future.
These standards are expected to follow the IEC60034-30-1 classification.

CONDITIONS OF INSTALLATION

The motors comply with the relevant standards and regulations, especially:

ELECTRICAL	Rating and performance	IEC 60034-1
	Methods for determining losses and efficiency using tests	IEC 60034-2
	Standard method for determing losses and efficiency from tests	IEC 60034-2-1
	Efficiency classes of single speed, three-phase, cage-induction motors (IE-code)	IEC 60034-30
	Terminal markings and direction of rotation	IEC 60034-8
	Starting performance	IEC 60034-12
	Standard voltages	IEC 60038
	Insulating materials	IEC 60085

MECHANICAL	Dimensions and output ratings	IEC 60072
	Mounting dimensions and relationship frame sizes-output ratings, IM B3, IM B5, IM B14	IEC 60072
	Cylindrical shaft ends for electric motors	IEC 60072
	Degrees of protection	IEC 60034-5
	Methods of cooling	IEC 60034-6
	Mounting arrangements	IEC 60034-7
	Noise limits	IEC 60034-9
	Mechanical vibration	IEC 60034-14
	Mounting flanges	DIN 42948
	Tolerances of mounting and shaft extensions	DIN 42955
	Classification of environmental conditions	IEC 60721-2-1
	Mechanical vibration; balancing	ISO 8821

The motors are designed for operation at **altitudes ≤ 1000 m** above sea-level and at **ambient temperatures of up to 40° C**. Exceptions are indicated on the rating plate. The motors conform to **degree of protection IP 55** to IEC 60034-5[1)]. Higher protection on request.

The standard design for horizontal mounting is suitable for indoor and protected outdoor installation, climate group **moderate** (see page 21) (temperature of coolant -20° to +40° C). For unprotected outdoor installation or severe climatic conditions (moisture category wet, climate group **worldwide**, extremely dusty site conditions, aggressive industrial atmosphere, danger of storm rain and coastal climate, danger of attack by termites, etc.), as well as vertical mounting, special protective measures are recommended, such as:

- Protective cowl (for vertical shaft-down motors)
- For vertical shaft-up motors additional bearing seal and flange drainage
- Special paint finish
- Treatment of winding with protective moisture-proof varnish
- Anti-condensation heating (possibly winding heating)
- Condensation drain holes

The special measures to be applied have to be agreed with the factory once the conditions of installation have been settled.

The corresponding conditions of installation have to be clearly indicated in the order.

1) IP54 for brake motors AMS and for AMBZ, AMBY from size 63 to 132

ELECTRICAL TOLERANCES

For industrial motors to **EN 60034-1**, certain tolerances must be allowed on guaranteed values, taking into consideration the necessary tolerances for the manufacture of such motors and the materials used. The standard includes the following remarks:

1- It is not intended that guarantees necessarily have to be given for all or any of the items involved. Quotations including guaranteed values subject to tolerances should say so, and the tolerances should be in accordance with the table.
2- Attention is drawn to the different interpretation of the term guarantee. In some countries a distinction is made between guaranteed values and typical or declared values.
3- Where a tolerance is stated in only one direction, the value is not limited in the other direction.

Values for	Tolerance
Efficiency (η) (by indirect determination)	- 0.15 (1 - η) at $P_N \leq 150$ kW - 0.1 (1 - η) at $P_N > 150$ kW
Power factor ($\cos \varphi$)	$\frac{1 - \cos \varphi}{6}$, minimum 0.02, maximum 0.07
Slip (s) (at rated load and at working temperature)	± 20 % of the guaranteed slip at $P_N \geq 1$ kW ± 30 % of the guaranteed slip at $P_N < 1$ kW
Breakaway starting current (I_A) (in the starting circuit envisaged)	+ 20 % of the guaranteed starting current (no lower limit)
Breakaway torque (M_A)	- 15 % and + 25 % of the guaranteed breakaway torque (+ 25 % may be exceeded by agreement)
Pull-up torque (M_S)	- 15 % of the guaranteed value
Pull-out torque (M_K)	- 10 % of the guaranteed value (after allowing for this tolerance, M_K/M_N not less than 1.6)
Moment of inertia (J)	± 10 % of the guaranteed value

MECHANICAL TOLERANCES

According to **IEC 60072-1**, the following tolerances on mechanical dimensions of electric motors are permitted:

Parameter	Code	Tolerance	
Shaft height	H	- up to 250 - over 250	-0.5 mm -1 mm
Diameter of shaft end[1)]	D-DA	- from 11 to 28 mm - from 38 to 48 mm - from 55 to 100 mm	j6 k6 m6
Hub key width	F-FA		h9
Flange spigot	N	- up to 132 - over size 132	j6 h6

1) Centering holes in shaft extension to DIN 332 part 2

DEGREES OF PROTECTION

Degrees of mechanical protection for machines are designated in accordance with **IEC 60034-5** by the letters **IP** and two characteristic numerals.

First numeral: Protection against contact and ingress of foreign bodies

IP	Description
0	No special protection
1	Protection against solid foreign bodies larger than 50 mm (Example: inadvertent contact with the hand)
2	Protection against solid foreign bodies larger than 12 mm (Example: inadvertent contact with the fingers)
3	Protection against solid foreign bodies larger than 2.5 mm (Example: Wires, tools)
4	Protection against solid foreign bodies larger than 1 mm (Example: Wires, bands)
5	Protection against dust (harmful deposits of dust)
6	Complete protection against dust

Second numeral: Protection against ingress of water

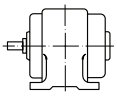
IP	Description
0	No special protection
1	Protection against vertically falling water drops (condensation)
2	Protection against dropping water when inclined by up to 15°
3	Protection against waterspray at up to 60° from vertical
4	Protection against water splashed from any direction
5	Protection against water projected by a nozzle from any direction
6	Protection against heavy seas or water projected in powerful jets
7	Protection when submerged between 0.15 and 1 m.
8	Protection when continuously submerged in water at conditions agreed between the manufacturer and the user

MOUNTING ARRANGEMENTS

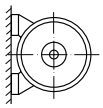
Mounting arrangements for rotating electrical machines are designated according to **IEC 60034-7**, *Code I* (in brackets Code II).

Foot mounting

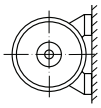
IM B3 (IM 1001)



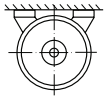
IM B6 (IM 1051)



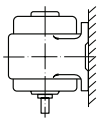
IM B7 (IM 1061)



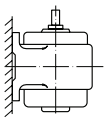
IM B8 (IM 1071)



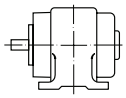
IM V5 (IM 1011)



IM V6 (IM 1031)

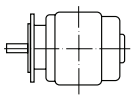


IM B34 (IM 2101)
Flange type C to DIN 42 948 at drive end

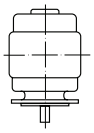


Flange mounting

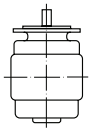
IM B5 (IM 3001)
Flange type A to DIN 42 948 at drive end



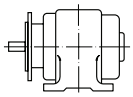
IM V1 (IM 3011)
Flange type A to DIN 42 948 at drive end



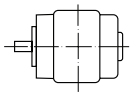
IM V3 (IM 3031)
Flange type A to DIN 42 948 at drive end



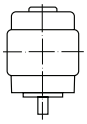
IM B35 (IM 2001)
Flange type A to DIN 42 948 at drive end



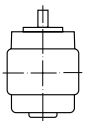
IM B14 (IM 3601)
Flange type C to DIN 42 948 at drive end



IM V18 (IM 3611)
Flange type C to DIN 42 948 at drive end

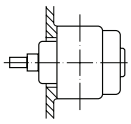


IM V19 (IM 3631)
Flange type C to DIN 42 948 at drive end

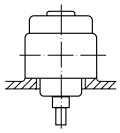


Motors without endshield

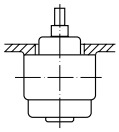
IM B9 (IM 9101)
without endshield and without ball bearings on drive end



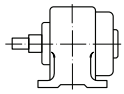
IM V8 (IM 9111)
without endshield and without ball bearings on drive end



IM V9 (IM 9131)
without endshield and without ball bearings on drive end



IM B15 (IM 1201)
without endshield and without ball bearings on drive end



All standard motors can be installed according to the following mounting arrangements:

Frame Size	B3	B5	B35	Based on B5		Based on B3					Based on B35	
				V1	V3	V5	V6	B6	B7	B8	V15	V36
56-160	√	√	√	√	√	√	√	√	√	√	√	√
180-225	√	√	√	√	*	*	*	*	*	*	*	*
250-315	√	*	√	*	*	*	*	*	*	*	*	*

* for high loads refer to us

It is essential to state the desired mounting arrangement when ordering, as the constructive design depends partly on the mounting arrangement.

MATERIALS

Motor parts	Frame size	Material
Motor housing	56 - 160 180 - 315	Aluminium alloy Cast iron
Endshield	56 - 160 180 - 315	Aluminium alloy* Cast iron
Flanged endshield	56 - 160 180 - 315	Aluminium alloy* Cast iron
Fan cover	56 - 112 56 - 112 132 - 315	Plastics Sheet steel (optional) [1)] Sheet steel
Fan	56 - 315 56 - 160	Plastics Aluminium alloy (optional)
Terminal box	56 - 112 56 - 112 132 - 160 180 - 315	Plastics Aluminium alloy (optional) [2)] Aluminium alloy Cast iron

1) Standard for brake motors type AMBY and AMBZ and for AMS 112
2) For three-phase motors only

* Cast iron option for 112-132

PAINT FINISH

NORMAL FINISH

Suitable for climate group **Moderate** to IEC 60721-2-1, e.g. indoor and outdoor installation.
For short periods: up to 100% rel. humidity at temperatures up to +30° C.
Continuously: up to 85% rel. humidity at temperatures up to +25° C.
Standard paint color: RAL 9005.

SPECIAL FINISH K1

Suitable for climate group **Worldwide** to IEC 60721-2-1, e.g. outdoor installation in corrosive chemical and marine atmospheres.
For short periods: up to 100% rel. humidity at temperatures up to +35° C.
Continuously: up to 98% rel. humidity at temperatures up to +30° C.

BEARINGS

CLASSIFICATION OF BEARINGS (STANDARD DESIGN) [1)]

Bearings for standard design have permanent lubrication. Ball bearings to ISO15 (DIN 625).

		IE2 Motors		IE3 Motors	
Frame size	Poles	DE - NDE	Dimension	DE - NDE	Dimension
56	2 - 4	6201-2Z	12x32x10	6201-2Z	12x32x10
63	2 - 4	6202-2Z	15x35x11	6202-2Z	15x35x11
71	2 - 8	6203-2Z	17x40x12	6203-2Z	17x40x12
80	2 - 8	6204-2Z	20x47x14	6204-2Z	20x47x14
90	2 - 8	6205-2Z	25x52x15	6205-2Z	25x52x15
100	2 - 8	6206-2Z	30x62x16	6206-2Z	30x62x16
112	2 - 8	6306-2Z	30x72x19	6306-2Z	30x72x19
132	2 - 8	6208-2Z	40x80x18	6208-2Z	40x80x18
160	2 - 8	6309-2Z	45x100x25	6309-2Z	45x100x25
180	2 - 8	6311 C3	55x120x29	6311 C3	55x120x29
200	2 - 8	6312 C3	60x130x31	6312 C3	60x130x31
225	2 - 8	6313 C3	65x140x33	6313 C3	65x140x33
250	2 - 8	6314 C3	70x150x35	6314 C3	70x150x35
280	2 - 8	6316 C3	80x170x39	6316 C3	80x170x39
315	2	6317 C3	85x180x41	6317 C3	85x180x41
315	4 - 8	NU319 - 6319 C3	95x200x45	NU319 - 6319 C3	95x200x45

[1)] With regard on bearings for special design, consult us

LUBRICATION

Permanent lubrication up to 160 frame
180 frame up with regreasing facility lubrication nipple is a flat M10x1 to DIN 3404

ROLLER BEARINGS

Roller bearings available as an option. Please consult us.

BEARING ARRANGEMENT

Frame size	Bearing DE	Bearing NDE	Spring-loaded
56 - 160 Standard motors	Non-locating bearing	Non-locating bearing	Non-drive end
63 - 160 Brake motors	Non-locating bearing	Locating bearing	Drive end
180 - 315 Standard motors	Locating bearing	Non-locating bearing	Non-drive end

RELUBRICATION INTERVALS

Relubrication intervals for operating temperatures up to 70° C (hours)

	3000 RPM		1500 RPM		1000 RPM		Quantity
Frame Size	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	gr
180	4.000	2.000	9.000	4.500	13.000	7.500	15
200	3.500	1.750	8.000	4.000	12.000	6.000	20
225	3.000	1.500	7.500	3.750	11.000	5.500	23
250	2.000	1.000	7.000	3.500	10.000	5.000	26
280	1.500	750	6.500	3.250	9.000	4.500	40
315	1.000	500	4.000	2.000	8.000	4.000	55

BELT DRIVE

The data apply only to the normal drive end shaft extension of IM B3 motors with one speed.
Calculation of belt drive:

$$F_R = \frac{19120 \cdot P \cdot k}{D_1 \cdot n}$$

F_R = Radial shaft load in N
P = Output in kW
n = Speed in min^{-1}
D_1 = Pulley diameter in m
k = Belt tension factor, varying with the type of belt, assumed to be approximately:
3-4 for normal flat belt without idler pulley
2-2.5 for normal flat belt with idler pulley
2.2-2.5 for V-belt
For exact data apply to the belt manufacturer.

PERMISSIBLE AXIAL FORCES

Maximum permissible axial forces without additional radial forces*

Frame size	Horizontal shaft				Vertical shaft - force upwards				Vertical shaft - force downwards			
	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN	3000 min $^{-1}$ kN	1500 min $^{-1}$ kN	1000 min $^{-1}$ kN	750 min $^{-1}$ kN
56	0.16	0.21	-	-	0.18	0.22	-	-	0.15	0.19	-	-
63	0.19	0.26	-	-	0.21	0.28	-	-	0.17	0.24	-	-
71	0.23	0.33	0.33	0.37	0.26	0.35	0.36	0.39	0.21	0.30	0.31	0.34
80	0.32	0.44	0.46	0.50	0.34	0.47	0.48	0.53	0.29	0.41	0.43	0.47
90	0.34	0.48	0.49	0.54	0.38	0.47	0.53	0.58	0.31	0.44	0.46	0.51
100	0.48	0.68	0.70	0.77	0.54	0.74	0.76	0.83	0.43	0.62	0.64	0.71
112	0.48	0.68	0.70	0.77	0.56	0.75	0.77	0.84	0.40	0.60	0.62	0.69
132 S	0.80	1.13	1.16	1.28	1.00	1.32	1.36	1.47	0.61	0.93	0.97	1.08
132 M	0.78	1.09	1.13	1.24	0.99	1.30	1.33	1.45	0.58	0.89	0.92	1.03
160 M	0.84	1.18	1.21	1.33	1.18	1.52	1.56	1.68	0.50	0.83	0.87	0.99
160 L	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
180	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
200	0.82	1.15	1.18	1.30	1.18	1.51	1.55	1.67	0.46	0.79	0.82	0.94
225	1.10	1.60	1.90	2.40	2.10	2.60	2.90	3.40	0.30	0.70	1.00	1.50
250	1.00	1.60	2.00	2.50	2.30	2.70	3.20	3.70	0.20	0.60	1.10	1.50
280	1.70	1.90	2.40	2.90	2.90	3.10	3.60	3.70	0.15	0.30	0.80	1.00
315	2.00	14.00	14.00	14.00	3.60	8.00	9.20	7.40	1.00	1.90	2.40	2.90

Values for 50 Hz. For service on 60 Hz, reduce values by 10%

* Consult according to direction of force

PERMISSIBLE RADIAL FORCES

Without additional axial force (Ball bearings)

Nominal life = 20.000 h (Lh10)

F_R = permissible radial force in kN in load point corresponding to half shaft extension

Frame size	3000 min^{-1} kN	1500 min^{-1} kN	1000 min^{-1} kN	750 min^{-1} kN
56	0.34	0.42	-	-
63	0.38	0.48	-	-
71	0.46	0.58	0.67	0.73
80	0.59	0.83	0.86	0.94
90	0.67	0.94	0.97	1.07
100	0.92	1.29	1.33	1.47
112	0.93	1.30	1.34	1.48
132 S	1.35	1.90	1.96	2.15
132 M	1.40	1.97	2.03	2.23
160 M	1.55	2.17	2.23	2.46
160 L	1.58	2.22	2.29	2.52
180 M	3.00	4.44	4.55	4.76
180 L	3.02	4.47	4.58	4.79
200	5.24	6.85	8.01	8.94
225	6.11	7.80	9.09	10.12
250	6.79	8.82	10.31	11.45
280 S	7.76	11.90	13.87	15.44
280 M	7.79	11.99	13.97	15.55
315 S/M	7.02	11.35	13.40	15.13
315 L	7.03	11.37	13.35	15.09

SPECIAL ENDSHIELDS AND FLANGES

Full range of smaller sized and over sized flanges

Frame size	Smaller sized Flange		Over sized Flange	
	IM B5 [1]	IM B14	IM B5	IM B14
56	NA	NA	NA	63
63	56	56	71 [3]	71-80
71	56-63	63	80-90	80-90
80	63-71	63-71	NA	90-100
90 S-L	63-71	71-80	100 [3]	100-112
100 L	71-80	90	NA	132
112 M	80 [2] -90 [2]	90	132 [7]	132
132 S	112 [2]	112	NA	160 [1] [4]
132 M	112	112	160 [4]	160
160 M	NA	132	NA	NA
160 L	NA	132	NA	NA

Possibility to fit over sized bearings

Frame size	IM B3	IM B5	IM B14
56	NA	NA	NA
63	6203-6205	6203	6203-6205
71	6204-6205	6204-6205	6204-6205
80	6205-6206	6205-6206	6205-6206
90 S-L	6206	6206-6308	6206
100 L	6306	6306-6208	6306
112 M	6208	6208	6208
132 S	6308-6309	6308	6308 [4]
132 M	6308-6309	6308-6309	6309
160 M	NA	6310	6310
160 L	NA	6310	6310

For higher output (progressive motor) please consult us

Aluminium endshields and flanges with steel insert

Frame size	Endshield DE	Endshield NDE	IM B5	IM B14
71	A	A	A	NA
80	A	A	A	A
90 S-L	A	A	NA	NA
100 L	A	A	A	NA
112 M	A	A	A	NA
132 S	NA	NA	NA	NA
132 M	NA	NA	A [5]	NA
160 M	NA	NA	NA	NA
160 L	NA	NA	NA	NA

Cast iron endshields and flanges

Frame size	Endshield DE	Endshield NDE	IM B5	IM B14	Regreasing device DE	Regreasing device NDE	Regreasing device IM B5	Regreasing device IM B14
71	NA	NA	NA	NA	NA	NA	NA	NA
80	A [6]	A [6]	NA	NA	NA	NA	NA	NA
90 S-L	A [6]	A [6]	NA	NA	NA	NA	NA	NA
100 L	A [6]	A [6]	NA	NA	NA	NA	NA	NA
112 M	A [6]	A [6]	NA	NA	NA	NA	NA	NA
132 S	A	A	A	A	NA	NA	A	A
132 M	A	A	A	A	A	A	A	A
160 M	A	A	A	A	A	A	A	A
160 L	A	A	A	A	A	A	A	A

A Available NA Not available

1) Not available for all motor ratings; consult us
2) Cast iron endshield with radial slotted holes
3) Not interchangeable with standard execution
4) Cast iron endshield
5) Only with oversized bearing (6308)
6) Special mechanical design
7) Only with oversized bearing (6208)

COOLING

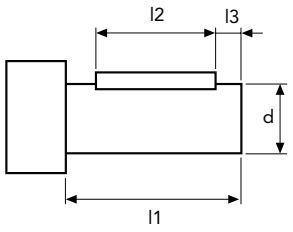
Surface cooling, independent of the direction of rotation.
Motors type AM available without internal fan as type AG, e.g. for installation in a directed air stream (outputs on request).

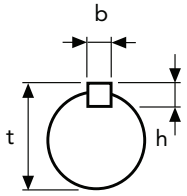
VIBRATION

The amplitude of vibration in electric motors is governed by **EN 60034-14** *Mechanical vibration of rotating electrical machines with shaft heights 56 and larger - methods of measurement and limits.*
Standard motors are designed to vibration grade A (normal). Vibration grade B is available at extra cost.

Rotors are at present dynamically balanced with **half** key fitted as per DIN ISO 8821. Other balancing only on request.
The motors are identified as follows:

"H" or "blank" means balanced with *half key*
"F" means balanced with *full key*
"N" means *no key*





POSITION AND DIMENSIONS OF KEY

Frame size	Poles	d x l1	b x h	l2	l3	t
56		9 x 20	3 x 3	15	2.5	10.2
63		11 x 23	4 x 4	15	4	12.5
71		14 x 30	5 x 5	20	6	16
80		19 x 40	6 x 6	30	6	21.5
90		24 x 50	8 x 7	40	6	27
100		28 x 60	8 x 7	50	6	31
112		28 x 60	8 x 7	50	6	31
132		38 x 80	10 x 8	70	6	41
160		42 x 110	12 x 8	100	6	45
180		48 x 110	14 x 9	90	5	51.5
200		55 x 110	16 x 10	90	5	59
225	2	55 x 110	16 x 10	90	5	59
225	4	60 x 140	18 x 11	110	5	64
250	2	60 x 140	18 x 11	110	5	64
250	4	65 x 140	20 x 11	110	5	74.5
280	2	65 x 140	18 x 11	110	5	69
280	4	75 x 140	20 x 12	140	5	85
315	2	65 x 140	18 x 11	125	5	69
315	4	80 x 170	22 x 14	160	5	85

Dimensions in mm.
For larger shafts in special design the dimensions l2 and l3 are maintained.

ANTI-CONDENSATION HEATER

On request, motors which due to strong temperature fluctuations are exposed to condensation during standstill, can be fitted against surcharge with an anti-condensation heater (space heater).
For supply voltage and heater rating please refer to the following table:

Frame size	Supply voltage (V)	Heater rating per motor (W)
112 - 160	110 or 230	25
180 - 225	110 or 230	50
250 - 280	110 or 230	50
315	110 or 230	75

During operation of the motor, the heating must be switched off.

NOISE

The noise level of an electrical machine is determined by measuring the sound pressure level in accordance with curve A of the sound level meter to EN 60651 and is indicated in dB (A).
The permitted noise levels of electrical machines are fixed in EN 60034-9 (IEC 34-9). The noise level of our motors is well below these limit values.
Air-borne sound measurements are carried out in an anechoic testing chamber to EN 21680-ISO 1680.
Speed corresponding to a mains frequency of 50 Hz and the number of poles.

NOISE LEVELS

The noise values listed below refer to 50 Hz at rated voltage with a tolerance of up to + 3 dB(A).
Values for pole-changing motors on request. For 60 Hz supply values are 3-5 dB(A) higher.
Sound pressure level L_{pA} and sound power level L_{WA} for three-phase single-speed motors with dimensions and output ratings to IEC 60072

Frame size	2 poles		4 poles		6 poles		8 poles	
	LWA	LpA	LWA	LpA	LWA	LpA	LWA	LpA
56	57	48	47	38				
63	58	49	47	38				
71	61	52	51	42	49	40		
80	72	60	60	48	52	40	47	35
90	74	62	61	49	58	46	54	42
100	78	66	62	50	62	51	58	46
112	80	68	65	53	65	53	58	46
132	81	72	71	59	69	57	64	52
160	87	74	75	62	71	58	69	56
180	90	77	78	66	74	62	72	60
200	91	78	80	68	77	65	74	62
225	92	80	88	76	80	68	75	64
250	93	81	88	76	80	68	75	64
280	93	82	89	79	83	71	81	70
315	93	82	89	79	83	71	81	70

RATED VOLTAGE

For the rated voltage of the motors, **EN 60034-1** allows a **tolerance of ± 5 %**. According to **IEC 60038**, the mains voltages may have a **tolerance of ± 10 %**.

Therefore the three-phase motors are designed for the following rated voltage ranges (exceptions are shown in the data tables):

Mains voltage to IEC 60038	Rated voltage range of motor
230 V ± 10%	218-242 V ± 5%
400 V ± 10%	380-420 V ± 5%
690 V ± 10%	655-725 V ± 5%

Within the rated motor voltage range, the permissible maximum temperature is not exceeded. When the motors are operated at the limits of the voltage tolerance, the permissible overtemperature of the stator winding may be exceeded by 10 K.

Nameplates are marked with the maximum rated currents within the stated voltage ranges.

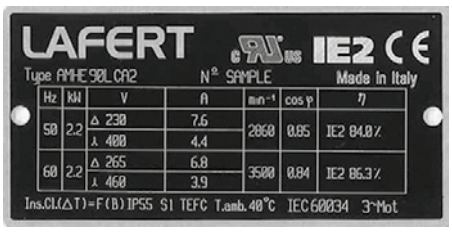
For brake motors, for motors in 500 V, 50 Hz design, and all not standard voltages, no voltage range is marked. The voltage tolerances to EN 60034-1 apply.

RATED FREQUENCY

Three-phase 50 Hz motors can also be operated on 60 Hz mains, provided the mains voltage increases proportionally to the frequency. The relative values for starting and breakaway torque remain nearly unchanged and slightly increase for the starting current. The rated speed increases by the factor 1.2 and output by factor 1.15. Should a motor designed for 50 Hz be operated at 60 Hz without the voltage being increased, the rated output of the motor cannot be increased. Under these operating conditions, rated speed increases by factor 1.2. The relative values for starting and breakaway torque are reduced by factor 0.82 and for starting current by factor 0.9.

Additionally to the voltage range for 50 Hz operation, three-phase single-speed motors (not brake motors) are also marked with the voltage range for 60 Hz operation.

Nameplates examples:



RATED CURRENT

For three-phase motors the rated currents listed in the data tables apply to an operating voltage of 400 V. The conversion to other operating voltages, with output and frequency remaining unchanged, is to be made as follows:

Nominal voltage (V)	230	380	**400**	440	500	660	690
Conversion factor x I_N	1.74	1.05	**1.0**	0.91	0.80	0.61	0.58

RATED TORQUE

$$\text{Rated torque in Nm} = 9550 \times \frac{\text{Rated power in kW}}{\text{Rated speed in min}^{-1}}$$

OUTPUT

The outputs stated in this catalogue are for constant load in continuous running duty S1 according to EN 60034-1, based on an ambient temperature of 40° C and installation at altitudes up to 1000 m above sea level.

For severe operating conditions, e.g. high switching rate, long run-up time or electric braking, a thermal reserve is necessary, which could call for higher thermal class or the use of a motor with a higher rating. In these cases we recommend to enquire with detailed information on the operating conditions.

OVERLOAD

At operating temperature three-phase motors are capable of withstanding an overload for 15 seconds at 1.5 times the rated torque at rated voltage. This overload is according to EN 60034-1 and will not result in excessive heating.
Utilizing thermal class F, motors can be operated continuously with an overload of 12%. Nevertheless this is not valid for motors which to catalogue are utilized to thermal class F.

CONNECTION

Motor output at 50 Hz	**230 V Δ 400 V Y**	**400 V Δ 690 V Y**	**500 V Y**	**500 VΔ**	**690 VΔ**
under 3 kW	standard	on request	on request	on request	-
4 to 5.5 kW	standard	standard	on request	on request	on request
≥ 7.5 kW	on request	standard	on request	on request	on request

INSULATION AND TEMPERATURE RISE

Class F insulation to EN 60034-1 is used throughout.
In standard design motors are intended for operation at 40° C ambient temperature with class B temperature rise only, with an overtemperature limit of 80 K. This also applies for the rated voltage range to IEC 60038. Exceptions are shown on the data tables.

Temperature rise (ΔT*) and maximum temperatures at the hottest points of the winding (T_{max}) according to the temperature classes of EN 60034-1.

	ΔT*	T_{max}
Class B	80 K	125° C
Class F	105 K	155° C
Class H	125 K	180° C

*Measurement by resistance method

Output reduction at ambient temperatures over 40° C

Ambient temperature	45° C	50° C	55° C	60° C
Class B Reduction of nominal output to approx.	95 %	90 %	85 %	80 %

When a winding is utilized to temperature class F (105K), no output reduction is required up to an ambient temperature of 55° C. *This does not apply to motors which in their standard design are already utilized to thermal class F.*

Installation at altitudes of more than 1000 m above sea level (see also EN 60034-1)

Altitude of installation	2000 m	3000 m	4000 m
At 40°C ambient temperature and thermal class B Rated output reduced to approx.	92 %	84 %	76 %
At 40°C ambient temperature and thermal class F Rated output reduced to approx.	89 %	79 %	68 %
Full nominal output to data tables with thermal class B and ambient temperature of	32° C	24° C	16° C
Full nominal output to data tables with thermal class F and ambient temperature of	30° C	19° C	9° C

STARTING RATE

The permissible number of starts per hour can be taken as given in the table below, provided the following conditions are met.
Additional moment of inertia ≤ moment of inertia of the rotor: load torque rising with the square of the speed up to nominal torque; starts at even intervals.

Shaft height	Permissible no. of starts per hour for		
	2 poles	4 poles	≥ 6 poles
56 - 71	100	250	350
80 - 100	60	140	160
112 - 132	30	60	80
160 - 180	15	30	50
200 - 225	8	15	30
250 - 315	4	8	12

For permissible number of starts for pole-changing motors and brake motors please consult us, indicating the complete operating conditions.

For the motors AMME and AMDE series, time between stop and restart of the motor must be higher than 15 s.

THERMAL PROTECTION

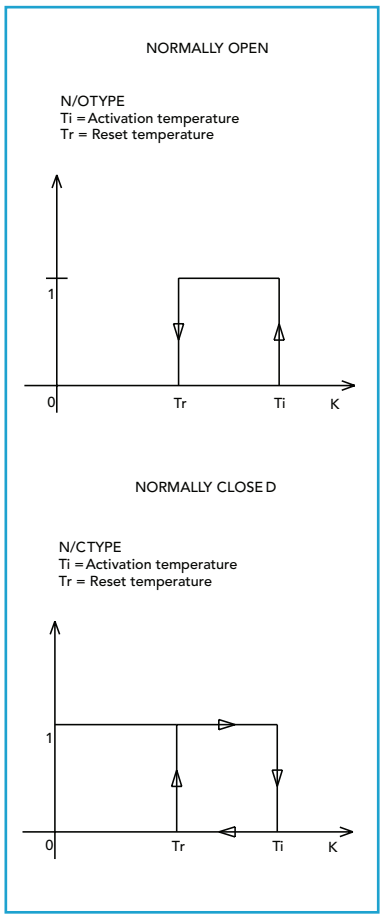
The decision on a particular type of thermal protection should be taken according to the actual operating conditions. Motors may be protected by means of current-dependent thermal protection switches, overcurrent relays and temperature detectors.

Thermal protection is possible as follows:

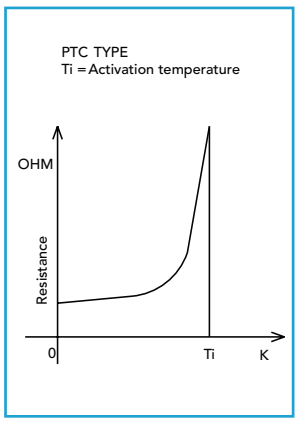
- Thermal protection switch with bimetal release
- Thermistor protection with semiconductor temperature detectors (PTC) in the stator winding in connection with release (if required, with additional motor protection switch).
- Bimetal temperature detector as N/C or N/O in the stator winding (if required, with additional motor protection switch).
- Resistance thermometer for monitoring winding and bearing temperature.

Should protection of the motor be required, we install protection switch with bimetal release (semiconductor temperature detectors on request).

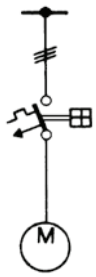
Operating specifications
Thermal cut-out



Operating specifications
of the thermistors



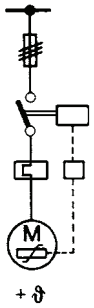
EXAMPLES OF CONNECTION



Protection method

Motor protection switch with thermal and electromagnetic overcurrent release

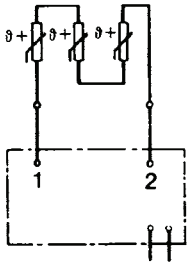
Protection against:
- Overload in continuous service
- Locked rotor



Contactor with overcurrent relay
Thermistor protection and fuse

In service against:
- Overload in continuous service
- Long starting and braking periods
- High switching rate

In case of fault against:
- Obstruction of cooling
- Increased ambient temperature
- Single-phase operation
- Frequency fluctuations
- Switching against locked rotor



Semiconductor temperature detector with release

In service against:
- Overload in continous service
- Long starting and braking periods
- High switching rate

In case of fault against:
- Obstruction of cooling
- Increased ambient temperature
- Single-phase operation
- Frequency fluctuations
- Switching against locked rotor

AUXILIARIES

Encoder (standard design)

Pulses per revolution	200-2048
Max outputs frequency	100 kHz
Power supply	$5V_{dc}$
Electronics	line driver
Current consumption without load	100 mA
Outputs	2 signals with rectangular pulses $\overline{A}$, $\overline{B}$ 2 signals with inverted rectangular pulses A, B zero pulse and inverted zero pulse
Pulse displacement between outputs	90°
Protection	IP 54
Max speed	3000 (6000) min^{-1}
Operating temperature	-10°C ÷ 85°C

MOTORS FOR NORMAL CONTINUOUS DUTY (S1) AND NORMAL OPERATING CONDITIONS

Quotation (if submitted): No./Date
Quantity: Units
Efficiency level to IEC 60034-30-1; 2014: IE code
Designation: Type
Output (for pole-changing motors, outputs referred to speeds): kW
Speed (for pole-changing motors, outputs referred to speeds): min-1
Direction of rotation (viewed on drive end)
Mounting arrangement (to IEC 60034-7)
Degree of protection, motor/terminal box (to IEC 60034-5)
Mains voltage: V
Mains frequency: Hz
Method of starting (direct-on-line or Y-Δ)
Location of terminal box
Machine to be driven

ADDITIONAL INFORMATION FOR SPECIAL DESIGNS

Double shaft or non-standard shaft extension
Radial sealing ring
Paint coating
Corrosive protection level
Vibration level
Anti-condensation heating
Temperature detectors (PTC, PTO, ...)
Noise requirements
Mechanical or electrical brake
Special requests

ADDITIONAL INFORMATION FOR SPECIAL DUTIES

S 2: ... min (short-time duty)
S 3: ... % - ... min (intermittent duty)
S 4: ... % - J_M ... kgm^2 - J_{ext} ... kgm^2 (intermittent duty with starting)
S 5: ... % - J_M ... kgm^2 - J_{ext} ... kgm^2 (intermittent duty with electric braking)
S 6: ... % - min (continuous-operation periodic duty with intermittent load)
S 7: .J_M ... kgm^2 - J_{ext} ... kgm^2 (continuous-operation periodic duty with electric braking)
S 8: .J_M ... kgm^2 - J_{ext} ... kgm^2 (continuous-operation periodic duty with speed changes)
S 9: ... kW (continuous duty with non-periodic load and speed variations).
For this duty type suitable full load values should be taken as the overload concept.
S10: p/Δt .... r .... TL (Duty with discrete constant loads).

ADDITIONAL INFORMATION FOR SPECIAL OPERATING CONDITIONS

Starting conditions (no-load or loaded starting)
Shock loads
Load torque curve during run-up (characteristic)
Moment of inertia (J_{ext}) referred to the motor shaft: kgm^2
Description of the type of drive (direct coupling, flat or V-belt, straight or helical gears, sprocket, crank, eccentric cam, etc.)
Radial force (or diameter of drive element): N
Direction of force and point of application (distance from shaft shoulder or width of drive element): mm
Axial force and direction of application (pull/thrust): N
Ambient conditions (e.g. increased humidity, dust accumulation, corrosive gases or vapours, increased or extremely low ambient temperature, outdoor installation, installation at altitudes over 1000 m above sea level, external vibration, etc.)