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;2014**. 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;2014

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;2014

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 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
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 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
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 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
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	IE3 compulsory 01.06.2016	No further changes expected
CANADA	460 V/575 V ± 10%; 60 Hz 1 - 500 HP - 2-8 poles	CSA C390-10	IE3 compulsory 01.06.2016	No further changes expected
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 0.75 - 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 - 315 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 0.75 to 375 kW compulsory 01.01.2017	No further changes expected
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 0.75 to 200KW compulsory 01.01.2017	No further changes expected
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	IE3 compulsory 01.01.2017	No further changes expected
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 2017:
- motors from 0.75 to 375kW - **IE3 minimum efficiency or IE2 only for motors with variable speed drive (VSD**) and marked with specific label.

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 60034-2-1:2014
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
Meps	**Since 01.01.2017** **Energy Efficient (IE3) or (IE2) only with VSD - 0.75 to 375kW**
Exclusions	• Brake Motors • Motors for explosive atmospheres
Future	No further changes are expected in the near future

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 IEC60034-2-1:2014 and IEEE112-B) or Method B (equivalent to the old IEC 60034-2)
Product Range	• The phase electric motors: 0.73kW -185kW, 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 • Motors rated for short duty cycles
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 thet 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 : 7.5-375kW**
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 1.7.2008 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 01.01.2017 **Energy Effecient (IE3) : 0.75 to 200kW**
Exclusions	• TENV motors • Air over motors • Permanent Magnet motors
Future	No further changes are expected in the near future

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.