Motors efficiency

New efficiency standards and directives applicable to motors in Europe

LEROY-SOMER™

Nidec
All for dreams

Foreword

Regulation 640/2009 of the directive, known as ErP, has been place in force since 2011, June 16th. Some non-EU countries, such as Switzerland and Turkey, apply almost identical regulations. Other countries have implemented or are intending to implement similar regulations (China, India, Taiwan, etc) also based on IEC 60034-30.

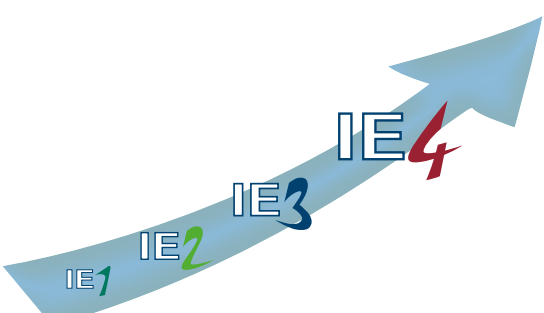
Regulation 640/2009, voted through in July 2009, has been modified twice since then.

Standard IEC 60034-30 dated September 2008 has been replaced by IEC 60034-30-1. The main changes compared to the previous version concern the scope, which has been expanded (power ratings from 0.12 to 1000 kW, number of poles from 2 to 8 poles, new IE4 efficiency class).

The aim of this new edition of the “New efficiency standards and directives applicable to motors in Europe” guide is to summarise the new standards and update the information from previous edition.

REMINDER: All 2, 4 and 6 pole motors placed on the EU market from 01/01/2015, rated between 7.5 kW and 375 kW, must be IE3 or IE2 with a variable speed drive.

Contents



IEC 60034-30-1 efficiency classification standard (1st half of 2014)

This standard replaces IEC 60034-30 from September 2008.

This concerns single-phase and three-phase electric motors, single-speed induction or permanent magnet type, with or without reinforced insulation, on a sinusoidal mains supply.

Scope:
- Power rating: 0.12 to 1000 kW
- Voltage: 50 to 1000 V
- Frequencies: 50 and 60 Hz
- No. of poles: 2, 4, 6 and 8 poles
- Designed to operate in continuous duty at rated power without exceeding the specified insulation class. Generally known as S1 duty.
- Marked for an ambient operating temperature between -20° and + 60°C.
- Marked for an operating altitude up to 4000 metres above sea level.

Notes:
- Motors designed to operate at temperatures outside the range -20 to + 60°C are usually specially designed and are therefore excluded from the scope of the standard.
- Motors for smoke extraction, with a temperature class of up to and including 400°C, are covered by this standard.
- Foot mounted, flange mounted, foot and flange mounted motors, with shafts with other dimensions than those in IEC 60072-1 are also covered.
- Motors for gearbox with direct or universal mounting are covered.

The following are excluded from this standard:
- Motors with 10 poles or more
- Motors which are fully integrated in a machine and cannot be tested separately from the machine. In other words, for a motor to be excluded, the process of separating one of the components should render the motor inoperative.
- Motors with built-in frequency inverter when the motor cannot be tested without the inverter.

IEC 60034-30-1 efficiency classification standard (1st half of 2014)

- Brake motors when the brake forms an integral part of the motor and can neither be removed nor supplied by a separate source during the test.
- Submersible motors specified to operate wholly immersed in a liquid.
- High-temperature motors for smoke extraction (temperature class above 400°C).

Notes:
- Motors ventilated by the machine (IC418) which can be tested with an external blower are concerned. IC416 motors (with a forced ventilation unit)
  are also affected.
- A motor with frequency inverter is not excluded when it can be separated from the inverter and tested independently of it.

This new standard introduces the IE5 efficiency class. This efficiency level is envisaged in the next edition of the standard even though, according to this very standard, it is acknowledged that it is currently impossible to achieve the efficiency class with existing technologies.

Standards currently in preparation

To respond to forthcoming changes in the ErP directive and market expectations, several “efficiency” standards are currently in preparation.

Scope:

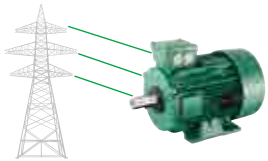
- IEC 60034-2-3: method for measuring the efficiency of a motor on a drive. Publication 1st half of 2014.
- IEC 60034-30-2: efficiency classes of variable speed AC motors. Publication 1st half of 2015.
- EN 50598-1: aims to define the guide used to apply the next part.
- EN 50598-2: aims to define the standard for the method of calculating and classifying PDS (Power Drive Systems).
- EN 50598-3: aims to take account of the environmental impact of the standard (PEP = Product Environmental Pfile). Vote scheduled for all three EN standards: 1st half of 2014.

Once voted through, the EN standards will be proposed to the International Electrotechnical Commission for a new IEC standard.

Comment:

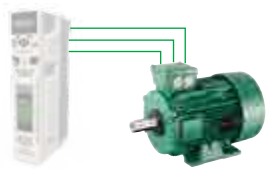
Leroy-Somer has cleverly anticipated the requirements of the standard, making PEPs available to its customers for all new high-efficiency motors placed on the market since 2011.

Standards currently in preparation



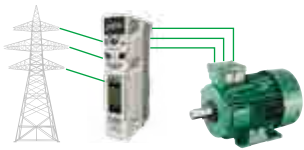
IEC 60034-2-1: efficiency measurements

IEC 60034-30: efficiency classes
Will be replaced by
IEC 60034-30-1 (early 2014)



IEC 60034-2-3: efficiency measurements (2014)

IEC 60034-30-2: efficiency classes (2015)



EN 50598-2: efficiency measurements and classes
(2015)

Modification of implementing regulation 640/2009 of the ErP directive

Since being voted through in July 2009, the implementing regulation has been rectified twice:

On 19 February 2011: an error concerning water-cooled motors was corrected.

On 6 January 2014, to avoid some interpretations of the regulation which created a loophole, regulation no. 4/2014 modifying regulation 640/2009 was voted through. It will come into force by July 2014 at the latest. Part of the scope has been modified:

"2. This regulation shall not apply to:
a) motors specified to operate wholly immersed in a liquid;

b) motors completely integrated into a product (for example, gear, pump, fan or compressor) of which the energy performance cannot be tested independently from the product;

c) motors specified to operate exclusively:
- *at altitudes exceeding 4000 metres above sea-level;*
- *where ambient air temperatures exceed 60°C;*
- *in maximum operating temperature above 400°C;*
- *where ambient air temperatures are less than -30°C for any motor or less than 0°C for a motor with water cooling;*
- *where the water coolant temperature at the inlet to a product is less than 0°C or exceeding 32°C; or*
- *in potentially explosive atmospheres as defined in directive 94/9/EC of the European Parliament and of the Council (3);*

d) brake motors."

It should also be noted that in annex 1, a paragraph has been inserted:
"Where the size of the rating plate makes it impossible to mark all the information referred to in point 1, only the nominal efficiency at full rated load and voltage shall be marked."

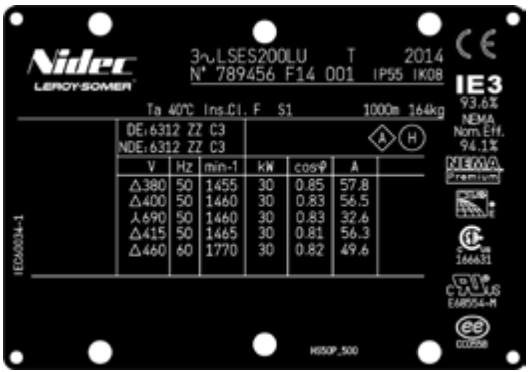
Comment: these corrections do not change Leroy-Somer's products or sales strategy, the company having always scrupulously applied the directive.

Planned new lots concerning motors in the ErP directive

Lot 30: will concern products not covered by regulation 640/2009 governing electric motors such as special motors for variable speed applications (asynchronous servomotors), permanent magnet motors, motors cooled by the machine being driven (fans), motors with variable speed drive from 0.2 to 1000 kW, motors connected to the mains supply from 0.75 to 1000 kW.

Lot 31: will concern products not covered by lot 30 and regulation 640/2009, especially compressor motors including small compressors, and their possible variants.

Comment: It is unlikely that these regulations will come into force before 2018.



New efficiency standards and directives applicable to motors in Europe

Main energy regulations worldwide

Country	Standard	Regulation	Approval mark if necessary	Registration compulsory	Power	No. of poles	2013	2014	2015	2016	2017
EUROPE	IEC60034-2-1 IEC60034-30	ErP 640/2009	CE		0,75kW-375kW	2, 4, 6	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
SWISS	IEC60034-2-1 IEC60034-30	ordonnance 730.01			0,75kW-375kW	2, 4, 6					
TURKEY	IEC60034-2-1 IEC60034-30	SGM 2012/2			0,75kW-375kW	2, 4, 6					
ISRAEL	IEC60034-2-1 IEC60034-30	SI 5289			0,75kW-185kW	2,4,6,8					
USA	MG1 112-11 IEEE 112-B	EISA 10CFR431.31	ee	X	1 HP-200HP	2, 4, 6	**IE3**	**IE3**	**IE3**	**IE3**	**IE3**
CANADA	C747-09 C390-10	LC 1992 ch.36		X	1 HP-200HP	2, 4, 6					
MEXICO	MG1 112-11 IEEE 112-B	CONUEE NOM-016-ENER	NOM-SOD	X	1 HP-200HP	2, 4, 6					
BRAZIL	NBR 17094-3 NBR 5383-1	INMETRO		X	0,75kW-185kW	2,4,6,8	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
INDIA	IS 12615				0,75kW-375kW	2, 4, 6	*IE2*	*IE3*	*IE3*	*IE3*	*IE3*
South KOREA	KSC IEC60034-2-1	KEMCO		X	0,75kW-200kW	2,4,6,8	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
CHINA	GB18613-2012	CER		X	0,75kW-375kW	2, 4, 6	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
AUSTRALIA	IEC60034-2-1 IEEE 112-B	E3		X	0,75kW-185kW	2,4,6,8	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
NEW ZEALAND	IEC60034-2-1 IEEE 112-B	EECA		X	0,75kW-185kW	2,4,6,8	**IE2**	**IE2**	**IE3**	**IE3**	**IE3**
JAPAN	JIS C4034-2-1 JIS C4034-30				0,20kW-160kW	2, 4, 6	*IE2*	*IE2*	**IE3**	**IE3**	**IE3**
TAIWAN	CNS 14400				0,75kW-200kW	2, 4, 6	*IE2*	*IE2*	**IE3**	**IE3**	**IE3**

voluntary
COMPULSORY

Check with the sales department whether the selected product is registered in the destination country.

Notes

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE2 - 50 Hz “HIGH” level

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3000	4/1500	6/1000	8/750
0.12	53.6	59.1	50.6	39.8
0.18	60.4	64.7	56.6	45.9
0.20	61.9	65.9	58.2	47.4
0.25	64.8	68.5	61.6	50.6
0.37	69.5	72.7	67.6	56.1
0.40	70.4	73.5	68.8	57.2
0.55	74.1	77.1	73.1	61.7
0.75	77.4	79.6	75.9	66.2
1.1	79.6	81.4	78.1	70.8
1.5	81.3	82.8	79.8	74.1
2.2	83.2	84.3	81.8	77.6
3	84.6	85.5	83.3	80.0
4	85.8	86.6	84.6	81.9
5.5	87.0	87.7	86.0	83.8
7.5	88.1	88.7	87.2	85.3
11	89.4	89.8	88.7	86.9
15	90.3	90.6	89.7	88.0
18.5	90.9	91.2	90.4	88.6
22	91.3	91.6	90.9	89.1
30	92.0	92.3	91.7	89.8
37	92.5	92.7	92.2	90.3
45	92.9	93.1	92.7	90.7
55	93.2	93.5	93.1	91.0
75	93.8	94.0	93.7	91.6
90	94.1	94.2	94.0	91.9
110	94.3	94.5	94.3	92.3
132	94.6	94.7	94.6	92.6
160	94.8	94.9	94.8	93.0
200 up to 1000	95.0	95.1	95.0	93.5

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE2 - 60 Hz “HIGH” level

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3600	4/1800	6/1200	8/900
0.12	59.5	64.0	50.5	40.0
0.18	64.0	68.0	55.0	46.0
0.25	68.0	70.0	59.5	52.0
0.37	72.0	72.0	64.0	58.0
0.55	74.0	75.5	68.0	62.0
0.75	75.5	78.0	73.0	66.0
1.1	82.5	84.0	85.5	75.5
1.5	84.0	84.0	86.5	82.5
2.2	85.5	87.5	87.5	84.0
3.7	87.5	87.5	87.5	85.5
5.5	88.5	89.5	89.5	85.5
7.5	89.5	89.5	89.5	88.5
11	90.2	91.0	90.2	88.5
15	90.2	91.0	90.2	89.5
18.5	91.0	92.4	91.7	89.5
22	91.0	92.4	91.7	91.0
30	91.7	93.0	93.0	91.0
37	92.4	93.0	93.0	91.7
45	93.0	93.6	93.6	91.7
55	93.0	94.1	93.6	93.0
75	93.6	94.5	94.1	93.0
90	94.5	94.5	94.1	93.6
110	94.5	95.0	95.0	93.6
150	95.0	95.0	95.0	93.6
185	95.4	95.0	95.0	93.6
220 up to 335	95.4	95.4	95.0	93.6
375 up to 1000	95.4	95.8	95.0	94.1

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE3 - 50 Hz “PREMIUM”

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3000	4/1500	6/1000	8/750
0.12	60.8	64.8	57.7	50.7
0.18	65.9	69.9	63.9	58.7
0.20	67.2	71.1	65.4	60.6
0.25	69.7	73.5	68.6	64.1
0.37	73.8	77.3	73.5	69.3
0.40	74.6	78.0	74.4	70.1
0.55	77.8	80.8	77.2	73.0
0.75	80.7	82.5	78.9	75.0
1.1	82.7	84.1	81.0	77.7
1.5	84.2	85.3	82.5	79.7
2.2	85.9	86.7	84.3	81.9
3	87.1	87.7	85.6	83.5
4	88.1	88.6	86.8	84.8
5.5	89.2	89.6	88.0	86.2
7.5	90.1	90.4	89.1	87.3
11	91.2	91.4	90.3	88.6
15	91.9	92.1	91.2	89.6
18.5	92.4	92.6	91.7	90.1
22	92.7	93.0	92.2	90.6
30	93.3	93.6	92.9	91.3
37	93.7	93.9	93.3	91.8
45	94.0	94.2	93.7	92.2
55	94.3	94.6	94.1	92.5
75	94.7	95.0	94.6	93.1
90	95.0	95.2	94.9	93.4
110	95.2	95.4	95.1	93.7
132	95.4	95.6	95.4	94.0
160	95.6	95.8	95.6	94.3
200 up to 1000	95.8	96.0	95.8	94.6

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE3 - 60 Hz “PREMIUM”

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3600	4/1800	6/1200	8/900
0.12	62.0	66.0	64.0	59.5
0.18	65.6	69.5	67.5	64.0
0.25	69.5	73.4	71.4	68.0
0.37	73.4	78.2	75.3	72.0
0.55	76.8	81.1	81.7	74.0
0.75	77.0	83.5	82.5	75.5
1.1	84.0	86.5	87.5	78.5
1.5	85.5	86.5	88.5	84.0
2.2	86.5	89.5	89.5	85.5
3.7	88.5	89.5	89.5	86.5
5.5	89.5	91.7	91.0	86.5
7.5	90.2	91.7	91.0	89.5
11	91.0	92.4	91.7	89.5
15	91.0	93.0	91.7	90.2
18.5	91.7	93.6	93.0	90.2
22	91.7	93.6	93.0	91.7
30	92.4	94.1	94.1	91.7
37	93.0	94.5	94.1	92.4
45	93.6	95.0	94.5	92.4
55	93.6	95.4	94.5	93.6
75	94.1	95.4	95.0	93.6
90	95.0	95.4	95.0	94.1
110	95.0	95.8	95.8	94.1
150	95.4	96.2	95.8	94.5
185 up to 1000	95.8	96.2	95.8	95.0

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE4 - 50 Hz “SUPER PREMIUM”

P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3000	4/1500	6/1000	8/750
0.12	66.5	69.8	64.9	62.3
0.18	70.8	74.7	70.1	67.2
0.20	71.9	75.8	71.4	68.4
0.25	74.3	77.9	74.1	70.8
0.37	78.1	81.1	78.0	74.3
0.40	78.9	81.7	78.7	74.9
0.55	81.5	83.9	80.9	77.0
0.75	83.5	85.7	82.7	78.4
1.1	85.2	87.2	84.5	80.8
1.5	86.5	88.2	85.9	82.6
2.2	88.0	89.5	87.4	84.5
3	89.1	90.4	88.6	85.9
4	90.0	91.1	89.5	87.1
5.5	90.9	91.9	90.5	88.3
7.5	91.7	92.6	91.3	89.3
11	92.6	93.3	92.3	90.4
15	93.3	93.9	92.9	91.2
18.5	93.7	94.2	93.4	91.7
22	94.0	94.5	93.7	92.1
30	94.5	94.9	94.2	92.7
37	94.8	95.2	94.5	93.1
45	95.0	95.4	94.8	93.4
55	95.3	95.7	95.1	93.7
75	95.6	96.0	95.4	94.2
90	95.8	96.1	95.6	94.4
110	96.0	96.3	95.8	94.7
132	96.2	96.4	96.0	94.9
160	96.3	96.6	96.2	95.1
200	96.5	96.7	96.3	95.4
250	96.5	96.7	96.5	95.4
315 up to 1000	96.5	96.7	96.6	95.4

Efficiency tables according to IEC 60034-30-1

Rated efficiency limits (%) for IE4 - 60 Hz “SUPER PREMIUM”

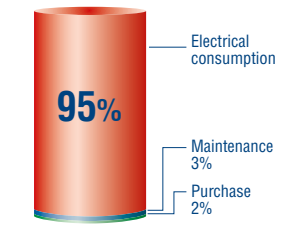
P_N kW	Number of poles/synchronous speed min^{-1}			
	2/3600	4/1800	6/1200	8/900
0.12	66.0	70.0	68.0	64.0
0.18	70.0	74.0	72.0	68.0
0.25	74.0	77.0	75.5	72.0
0.37	77.0	81.5	78.5	75.5
0.55	80.0	84.0	82.5	77.0
0.75	82.5	85.5	84.0	78.5
1.1	85.5	87.5	88.5	81.5
1.5	86.5	88.5	89.5	85.5
2.2	88.5	91.0	90.2	87.5
3.7	89.5	91.0	90.2	88.5
5.5	90.2	92.4	91.7	88.5
7.5	91.7	92.4	92.4	91.0
11	92.4	93.6	93.0	91.0
15	92.4	94.1	93.0	91.7
18.5	93.0	94.5	94.1	91.7
22	93.0	94.5	94.1	93.0
30	93.6	95.0	95.0	93.0
37	94.1	95.4	95.0	93.6
45	94.5	95.4	95.4	93.6
55	94.5	95.8	95.4	94.5
75	95.0	96.2	95.8	94.5
90	95.4	96.2	95.8	95.0
110	95.4	96.2	96.2	95.0
150	95.8	96.5	96.2	95.4
185	96.2	96.5	96.2	95.4
220	96.2	96.8	96.5	95.4
250 up to 1000	96.2	96.8	96.5	95.8

Conclusion

Given that electricity consumption represents 95% of the overall cost of a drive system and in view of commitments to reduce electricity consumption and CO_2 emissions made by the majority of countries worldwide, the release onto the market of high-efficiency motors or systems makes perfect sense.

In industry, electric motors account for 70% of electricity consumption.

Energy regulations should be considered, not as a constraint, but as an opportunity to release onto the market high-performance machines which are distinguished by their high levels of energy efficiency.



Total cost of an induction motor over 10 years

Notes

LEROY-SOMER™

www.leroy-somer.com

Connect with us at:

twitter.com/Leroy_Somer_en

facebook.com/leroysomer.nidec.en

youtube.com/user/LeroySomerOfficiel

linkedin.com/company/44575

Moteurs Leroy-Somer SAS. Headquarters: Bd Marcellin Leroy, CS 10015, 16915 Angoulême Cedex 9, France. Share Capital: 65 800 512 €, RCS Angoulême 338 567 258.

Nidec

All for dreams

5142 en - 2017.10 / c