Rotating electrical machines -- Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE code)

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60034-30:2009 sisaldab Euroopa standardi EN 60034-30:2009 ingliskeelset teksti.	This Estonian standard EVS-EN 60034-30:2009 consists of the English text of the European standard EN 60034-30:2009.
Standard on kinnitatud Eesti Standardikeskuse 29.05.2009 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 29.05.2009 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 26.03.2009.	Date of Availability of the European standard text 26.03.2009.
Standard on kättesaadav Eesti standardiorganisatsioonist.	The standard is available from Estonian standardisation organisation.

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Rotating electrical machines - Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)

(IEC 60034-30:2008)

Machines électriques tournantes - Partie 30: Classes de rendement pour les moteurs à induction triphasés à cage, mono vitesse (Code IE) (CEI 60034-30:2008)

Drehende elektrische Maschinen - Teil 30: Wirkungsgrad-Klassifizierung von Drehstrommotoren mit Käfigläufern, ausgenommen polumschaltbare Motoren (IE-Code) (IEC 60034-30:2008)

This European Standard was approved by CENELEC on 2009-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 2/1518/FDIS, future edition 1 of IEC 60034-30, prepared by IEC TC 2, Rotating machinery, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60034-30 on 2009-03-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2009-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-03-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60034-30:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60034-5	NOTE	Harmonized as EN 60034-5:2001 (not modified).
IEC 60034-12	NOTE	Harmonized as EN 60034-12:2002 (not modified).
IEC/TS 60034-17	NOTE	Harmonized as CLC/TS 60034-17:2004 (not modified).
IEC/TS 60034-25	NOTE	Harmonized as CLC/TS 60034-25:2008 (not modified).
IEC 60079-0	NOTE	Harmonized as EN 60079-0:2006 (modified).

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60034-1	-[1)]	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	2004[2)]
IEC 60034-2-1	-[1)]	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	EN 60034-2-1	2007[2)]
IEC 60034-6	-[1)]	Rotating electrical machines - Part 6: Methods of cooling (IC Code)	EN 60034-6	1993[2)]
IEC 60072-1	-[1)]	Dimensions and output series for rotating electrical machines - Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1 080	-	-

[1)] Undated reference.

[2)] Valid edition at date of issue.

CONTENTS

INTRODUCTION

This International Standard provides for the global harmonization of energy-efficiency classes for electric motors.

Electric motor applications in industry consume between 30 % and 40 % of the generated electrical energy worldwide. Improving efficiency of the complete drive system (i.e. motor and adjustable-speed drives) including the application (or process) is therefore a major concern in energy-efficiency efforts. The total energy saving potential of an optimized system is assumed to be around 30 % to 60 %.

According to the findings of the IEA 7 July 2006 Motor Workshop, electric motors with improved efficiency in combination with frequency converters can save about 7 % of the total worldwide electrical energy. Roughly one quarter to one third of these savings come from the improved efficiency of the motor. The remaining part results from system improvements.

Many different energy efficiency standards for cage induction motors are already in use (NEMA, EPACT, CSA, CEMEP, COPANT, AS/NZS, JIS, GB and others) with new classes currently being developed. It becomes increasingly difficult for manufacturers to design motors for a global market and for customers to understand differences and similarities of standards in different countries.

Motors from 0,75 kW up to 375 kW make up the vast majority of installed motor population and are covered by this standard as shown in Figure 1.

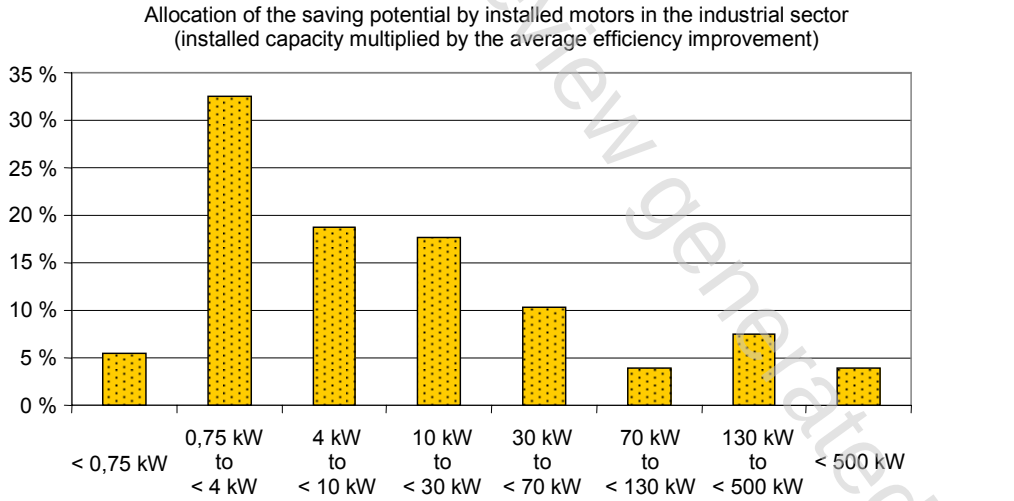

Figure 1 – Allocation of the saving potential by installed motors in the industrial sector

In some countries smaller motors are included in energy efficiency regulations. Most of these motors are not three-phase, cage-induction machines. Also they typically do not run continuously so their energy saving potential is rather limited.

In some countries 8-pole motors are included in energy efficiency regulations. However, their market share is already very low (1 % or less). Due to increasing acceptance of variable-speed drives and the low cost associated with 4- and 6-pole standard motors it is expected that 8-pole motors will even further disappear from the general market in the future. Therefore, this standard does not include provisions for 8-pole motors.

For a given output power and frame size it is generally easier to reach a high motor efficiency when the motor is designed for and operated at 60 Hz mains supply frequency rather than at 50 Hz.

NOTE 1 As the utilization and size of motors are related to torque rather than power the theoretical output power increases linearly with speed, i.e. by 20 % from 50 Hz to 60 Hz.

I^2R winding-losses are dominant especially in small and medium sized induction motors. They basically remain constant for 50 Hz and 60 Hz as long as the torque is kept constant. Although windage, friction and iron losses increase with frequency, they play a minor role in these motors. Therefore, at 60 Hz, the losses increase less than the 20 % output-power increase compared to 50 Hz and the efficiency improves.

In practice, both 60 Hz and 50 Hz output power designations should conform to standard power levels in accordance with IEC 60072-1 and local standards like EN 50347. Therefore, an increased rating of motor power by 20 % is not always possible. However, the general advantage of 60 Hz still applies if the motor design is optimized for the respective supply frequency rather than just re-rated.

The difference in efficiency between 50 Hz and 60 Hz varies with the number of poles and the size of the motor. In general, the 60 Hz efficiency of three-phase, cage-induction motors in the output power range from 0,75 kW up to 375 kW is between 2,5 % to less than 0,5 % points greater when compared to the 50 Hz efficiency. Only large 2-pole motors may experience a reduced efficiency at 60 Hz due to their high share of iron, windage and friction losses.

In this standard, the nominal 50 Hz limits of Standard (IE1) and High Efficiency (IE2) are based on the CEMEP-EU EFF2 and EFF1 limits respectively. However, they have been adjusted to take the different test procedures into account (CEMEP: Additional load losses P_{LL} flat 0,5 % of input power; in this standard P_{LL} is determined from test).

The nominal 50 Hz limits for Premium Efficiency (IE3) are set with the losses about 15 % to 20 % lower compared to the limits for High Efficiency (IE2).

The nominal 60 Hz limits for Standard Efficiency (IE1) are identical to Brazilian regulations. The nominal 60 Hz limits for High Efficiency (IE2) and for Premium Efficiency (IE3) are identical to US American EPAct regulations.

A new Super-Premium class (IE4) is envisaged for future editions of this standard.

It is not expected that all manufacturers will produce motors for all efficiency classes or all ratings for a given class.

Users should select the efficiency class in accordance with the application depending on the actual operating hours. It may not be energy efficient to select High- or Premium-Efficiency motors for intermittent or short-time duty.

NOTE 2 An application guide with more details is planned to be released as an IEC publication soon.

In order to achieve a significant market share it is essential for high-efficiency motors to meet national/regional standards for assigned output powers in relation to mechanical dimensions (frame-size, flanges, etc.). There are a number of national/regional frame assignment standards (EN 50347, JISC 4212, NBR 7094, NEMA MG1, SANS 1804 and others) but there is no IEC standard. As this standard (IEC 60034-30) defines energy-efficiency classes independent of dimensional constraints it may not be possible in all markets to produce motors with higher efficiency classes and maintain the mechanical dimensions of the national/regional standards.

Regulators should consider the above constraints as well as the field of applications as detailed in Clause 4 when assigning minimum energy-efficiency performance standards (MEPS).

ROTATING ELECTRICAL MACHINES –

Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)

1 Scope

This part of IEC 60034 specifies efficiency classes for single-speed, three-phase, 50 Hz and 60 Hz, cage-induction motors that:

- have a rated voltage U_N up to 1 000 V;

  NOTE The standard also applies to motors rated for two or more voltages and/or frequencies.
- have a rated output P_N between 0,75 kW and 375 kW;
- have either 2, 4 or 6 poles;
- are rated on the basis of either duty type S1 (continuous duty) or S3 (intermittent periodic duty) with a rated cyclic duration factor of 80 % or higher;
- are capable of operating direct on-line;
- are rated for operating conditions in accordance with IEC 60034-1, Clause 6.

Motors with flanges, feet and/or shafts with mechanical dimensions different from IEC 60072-1 are covered by this standard.

Geared motors and brake motors are covered by this standard although special shafts and flanges may be used in such motors.

Excluded are:

- Motors made solely for converter operation in accordance with IEC 60034-25.
- Motors completely integrated into a machine (for example pump, fan and compressor) that cannot be tested separately from the machine.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-2-1, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-6, *Rotating electrical machines – Part 6: Methods of cooling (IC Code)*

IEC 60072-1, *Dimensions and output series for rotating electrical machines – Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080*