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CLC IEC/TS 60034-30-2

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English Version

Rotating electrical machines - Part 30-2: Efficiency classes of variable speed AC motors (IE-code) (IEC/TS 60034-30-2:2016)

Machines électriques tournantes - Partie 30-2: Classes de rendement des moteurs à courant alternatif à vitesse variable (code IE) (IEC/TS 60034-30-2:2016)

Drehende elektrische Maschinen - Teil 30-2: Wirkungsgrad-Klassifizierung von Wechselstrommotoren mit variabler Drehzahl (IE-Code) (IEC/TS 60034-30-2:2016)

This Technical Specification was approved by CENELEC on 2021-08-16.

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

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European foreword

This document (CLC IEC/TS 60034-30-2:2021) consists of the text of IEC/TS 60034-30-2:2016 prepared by IEC/TC 2 "Rotating machinery".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of the International Technical Specification IEC/TS 60034-30-2:2016 was approved by CENELEC as a European Technical Specification 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 IEC 60034-5
IEC 60034-12	NOTE	Harmonized as EN 60034-12
IEC/TS 60034-25	NOTE	Harmonized as CLC/TS 60034-25
IEC/TS 60034-31	NOTE	Harmonized as CLC/TS 60034-31
ISO 25745-2	NOTE	Harmonized as EN ISO 25745-2

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60034-1	-	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1[1]	-
IEC/TS 60034-2-3[2]	-	Rotating electrical machines - Part 2-3: Specific test methods for determining losses and efficiency of converter-fed AC induction motors	EN IEC 60034-2-3	-
IEC 60034-30-1	-	Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)	EN 60034-30-1	-
IEC 61800-9-2	-	Adjustable speed electrical power drive systems - Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications - Energy efficiency indicators for power drive systems and motor starters	EN 61800-9-2	-

[1] A new edition and common modifications are currently under preparation. Stage of these documents at the time of publication: FprEN 60034-1 and FprEN 60034-1/prAA.
[2] This standard has been withdrawn and replaced with IEC 60034-2-3:2020.

IEC TS 60034-30-2

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Rotating electrical machines –
Part 30-2: Efficiency classes of variable speed AC motors (IE-code)



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Part 30-2: Efficiency classes of variable speed AC motors (IE-code)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ROTATING ELECTRICAL MACHINES –

Part 30-2: Efficiency classes of variable speed AC motors (IE-code)

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 60034-30-2, which is a technical specification, has been prepared by IEC technical committee 2: Rotating machinery.

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
2/1833/DTS	2/1850A/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60034 series, published under the general title *Rotating electrical machines*, can be found on the IEC website.

NOTE A table of cross-references of all IEC TC 2 publications can be found on the IEC TC 2 dashboard on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

This technical specification provides for the global harmonization of energy-efficiency classes of variable speed electric motors. It deals with all types of AC low-voltage electric motors that are rated for variable speed operation in their constant magnetic-flux speed-range (base speed-range). An electronic frequency converter provides variable voltage and variable frequency.

NOTE For the time being, IEC TS 60034-2-3, which is the testing basis of this document, is limited to induction motors. However, the relevant input-output procedure 3-C is already applicable to all kinds of variable speed AC motors. Future editions of IEC TS 60034-2-3 will have an expanded scope and include testing procedures for synchronous machines.

This technical specification regards energy efficiency classification of AC motors rated for variable voltage and frequency, namely induction motors and synchronous motors not covered in IEC 60034-30-1. It is harmonized with the future standard IEC 61800-9-2 where IE-classifications of frequency converters (complete drive modules = CDM) and IES-classifications of power drive systems (PDS) are defined.

An efficient motor alone does not necessarily result in an efficient PDS. Users should select the efficiency class in accordance with a given application depending on the actual load / speed operating points and related operating time.

It may not be energy efficient to select very high efficiency S1 motors for intermittent or short time duty or part load applications. The use of the Extended Product Approach (EPA) as described in the future standard series IEC 61800-9 will help applicative sectors for specification of energy efficiency performance of power driven equipment and parts.

It is not expected that all manufacturers will produce motors for all efficiency classes nor all ratings of a given class.

IE-codes are not limited to motors, but may in future be used to classify other components such as frequency converters and gearboxes. However, it is anticipated that other components are rated with a comparable system: IE1 meaning low efficiency up to IE5 meaning the highest efficiency.

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ROTATING ELECTRICAL MACHINES –

Part 30-2: Efficiency classes of variable speed AC motors (IE-code)

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1 Scope

This part of IEC 60034, which is a technical specification, specifies efficiency classes for variable speed rotating electric machines not covered in IEC 60034-30-1.

The document only applies to machines that:

- have a rated power P_N from 0,12 kW to 1 000 kW;
- have a rated voltage U_N above 50 V up to 1 kV;
- have a rated speed n_N from 600 1/min up to 6 000 1/min regardless of the number of magnetic poles;
- are designed for cooling methods IC4A1A0 (IC410), IC4A1A1 (IC411), IC4A1A6 (IC416), or IC4A1A8 (IC418) according to IEC 60034-6;
- are capable of continuous operation at their rated operating point (torque/power, speed) with a temperature rise within the specified insulation temperature class;

NOTE 1 Most motors covered by this document are rated for duty type S1 (continuous duty). However, some motors that are rated for other duty cycles are still capable of continuous operation at their rated power and these motors are also covered. Motors rated between S3 and S10 with a cycle time of 80 % or more may be included.

- are rated for any ambient temperature within the range of – 20 °C to + 60 °C;

NOTE 2 The rated efficiency and efficiency classes are based on 25 °C ambient temperature according to IEC 60034-2-1 and IEC TS 60034-2-3.

NOTE 3 Motors rated for temperatures outside the range – 20 °C and + 60 °C are considered to be of special construction and are consequently excluded from this document.

NOTE 4 Smoke extraction motors with a temperature class of up to and including 400 °C are covered by this document.

- are rated for an operating altitude up to 4 000 m above sea level.

NOTE 5 The rated efficiency and efficiency class are based on a rating for altitudes up to 1 000 m above sea level.

The classification only covers machines designed for operation with sinusoidal fundamental current that are not designed to be operated direct on-line (grid), for example permanent magnet synchronous machines with and without additional reluctance torque, sinusoidal reluctance synchronous machines and synchronous machines with DC field windings. This also includes induction machines that are designed exclusively for variable speed operation.

Switched reluctance synchronous machines are not covered.

The procedures to determine losses at any speed and load point are given in IEC TS 60034-2-3. They apply to all converter operated motors.

No distinction is made between motor technologies, supply voltage or motors with increased insulation even though these motor technologies may not all be capable of reaching the higher efficiency classes. This makes different motor technologies fully comparable with respect to their energy efficiency potential.

The efficiency of power-drive systems (i.e. the combined losses of motor and power supply) and the losses of the driven load are not covered by this document, see IEC 61800-9-2.

Covered in this document are also:

- Motors with flanges, feet and/or shafts with mechanical dimensions different from IEC 60072-1.
- Geared motors including those incorporating non-standard shafts and flanges. However, the testing of efficiency is to be performed on the motor part of a geared motor only.
- Motors specifically built for operation in explosive environments according to IEC 60079-0. Such motors may not be able to reach the higher efficiency classes (due to safety requirements and possible design constraints of explosion proof motors such as increased air-gap, reduced starting current, enhanced sealing).

Excluded from this document are:

- Motors with mechanical commutators;
- Motors completely integrated with the driven machine (for example pumps, fans and compressors) that cannot be practically tested separately from the machine even with provision of a temporary end-shield and drive-end bearing. This means that motors included in this document must:
  a) share common components (apart from connectors such as bolts) with the driven unit (for example, a shaft or housing), and
  b) not be designed in such a way as to enable the motor to be separated from the driven unit as an entire motor that can operate independently of the driven unit, When the process of separation renders the motor inoperative, it is excluded from this document.

NOTE 6 Some motors used in horizontal, inclined and vertical transport of goods and people are specifically designed for this purpose. They are often integrated into a machine and are not brought to the market as individual products. These motors are excluded.

- Brake motors when the brake is an integral part of the inner motor construction and can neither be removed nor supplied by a separate power source during the testing of motor efficiency.

  Brake motors with a brake coil that is integrated into the flange of the motor are covered as long as it is possible to test motor efficiency without the losses of the brake (for example by dismantling the brake, removing the brake or by energizing the brake coil from a separate power source).
- Submersible motors specifically designed to operate wholly immersed in a liquid;
- Smoke extraction motors with a temperature class above 400 °C;
- Motors that are just soft-started with a frequency-converter and then operated on sinusoidal mains supply are rated according to IEC 60034-30-1;
- Motors that are designed for servo applications, i.e. applications where frequent overload or field-weakening operations or frequent speed or torque changes occur or no thermal steady state operation is reached.

NOTE 7 This document covers industrial motors which mostly run continuously at or near rated load, and whose speed is not changing often or rapidly. Such motors include those which drive compressors and conveyor belts, for example.

In order to achieve high efficiency at full load, magnetic flux densities within those motors are normally modest, often resulting in larger sizes and higher inertia rotors compared with standard efficiency machines.

On the other hand, motors for servo-drive applications, such as robot drives, machine tools and pick-and-place machines which experience frequent and rapid load and speed changes, often have low rotor inertia in order to achieve the required dynamic performance. Energy consumption in that case is mainly determined by the energy required for acceleration. Low inertia rotors tend to have higher losses in continuous operation, however.

Motors for servo-drives are therefore not covered by this IE-classification.

Motors are often regarded as servo motors when typically one of the following criteria is met:

Maximum speed criterion: $n_{\max} > a_0 \cdot e^{-a_1 \cdot P_N + a_2} + a_3$; with a_0 = 6 000 1/min; a_1 = 0,02 1/kW; a_2 = –0,4; a_3 = 3 200 1/min.

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