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Rotating electrical machines - Part 1: Rating and performance

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Rotating electrical machines - Part 1: Rating and performance

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60034-1 has been prepared by IEC technical committee 2: Rotating machinery. It is an International Standard.

This fifteenth edition cancels and replaces the fourteenth edition published in 2022. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

Clause, subclause or table number	Change
1	Clarification with respect to machines with integrated EMC-active components added
2	Normative references updated
3	Note on meaning of “agreement” deleted; list of abbreviations added
4.2.9, 4.2.10	References to IEC TS 60034-25 deleted, as converter duty is now defined in 3.36
5.1	Reference to IEC TS 60034-25 converted into note
6.6	Clarification of requirements
7.2.1	Reference to IEC TS 60034-25 converted into note
7.5	Clarification of requirements
7.6	Reference to IEC TS 60034-25 converted into note
8.1	Clarification of references
8.6.1	Clarification on choice of method for large machines
Table 11	Updated values for thermal class 200 (N)
8.10.3	Clarification of requirements
9.2	Clarification on test voltage for old machines after rewinding
Table 17	Items 9 and 10 merged and clarified
9.7	Clarification on overspeed test for machines held at stock added
Table 20	Clarification on test speed for converter duty machines
10.2	Clarification of term ‘digital form’
10.3	Note on QR code deleted
11.1	Reference to protective earth test added
13.1	Clarifying flowchart added
13.2.2	Clarification on motors with integrated VSD added
13.3	Clarification of requirements after consultation with ACEC
13.5	Clarification of requirements after consultation with ACEC
14	Note on safety converted to normal text

The text of this International Standard is based on the following documents:

Draft	Report on voting
2/2257/FDIS	2/2296/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts of 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

1 Scope

This part of IEC 60034 is applicable to all rotating electric machines, except rotating electric machines for rail and road vehicles, which are covered by the IEC 60349 series of standards.

Machines with integrated EMC-active components such as a variable frequency converter are considered being a power drive system (see the IEC 61800 series of standards). In such cases, this document applies to the motor component of the power drive system only.

Machines within the scope of this document can also be subject to superseding, modifying or additional requirements in other standards, for example, IEC 60079 and IEC 60092.

NOTE If particular clauses of this document are modified to meet special applications, for example machines subject to radioactivity or machines for aerospace, all other clauses apply insofar as they are compatible.

2 Normative references

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.

IEC 60027-1, *Letters symbols to be used in electrical technology - Part 1: General*

IEC 60027-4, *Letter symbols to be used in electrical technology - Part 4: Rotating electric machines*

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

IEC 60034-3, *Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines and for synchronous compensators*

IEC 60034-5, *Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification*

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

IEC 60034-8, *Rotating electrical machines - Part 8: Terminal markings and direction of rotation*

IEC 60034-12:2016, *Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60034-15, *Rotating electrical machines - Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines*

IEC 60034-18-41, *Rotating electrical machines - Part 18-41: Partial discharge free electrical insulation systems (Type I) used in rotating electrical machines fed from voltage converters - Qualification and quality control* tests

IEC 60034-18-42, *Rotating electrical machines - Part 18-42: Partial discharge resistant electrical insulation systems (Type II) used in rotating electrical machines fed from voltage converters - Qualification tests*

IEC 60034-27-4, *Rotating electrical machines - Part 27-4: Measurement of insulation resistance and polarization index of winding insulation of rotating electrical machines*

IEC 60034-29, *Rotating electrical machines - Part 29: Equivalent loading and superposition techniques - Indirect testing to determine temperature rise*

IEC 60034-30-1, *Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60034-30-3, *Rotating electrical machines - Part 30-3: Efficiency classes of high voltage AC motors (IE-code)*

IEC 60034-33, *Rotating electrical machines - Part 33: Synchronous hydrogenerators including motor-generators - Specific requirements*

IEC 60050-411:1996, *International Electrotechnical Vocabulary (IEV) - Part 411: Rotating* machinery

IEC 60060-1, *High-voltage test techniques - Part 1: General terminology and test requirements*

IEC 60085, *Electrical insulation - Thermal evaluation and designation*

IEC 60204-1, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

IEC 60204-11, *Safety of machinery - Electrical equipment of machines - Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV*

IEC 60335-1:2020, *Household and similar electrical appliances - Safety - Part 1: General requirements*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60417, *Graphical symbols for use on equipment - 12-month subscription to regularly updated online database comprising all graphical symbols published in IEC 60417*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests*

CISPR 11:2024, *Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement*

CISPR 14 (all parts), *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus*

CISPR 16 (all parts), S*pecification for radio disturbance and immunity measuring apparatus and methods*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60050-411, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

– IEC Electropedia: available at http://www.electropedia.org/

– ISO Online browsing platform: available at http://www.iso.org/obp

NOTE For definitions concerning cooling and coolants, other than those in 3.17 to 3.22, IEC 60034-6 applies.

3.1.1
rated value
quantity value assigned, generally by a manufacturer, for a specified operating condition of a machine

Note 1 to entry: The rated voltage or voltage range is the rated voltage or voltage range between lines at the machine terminals.

[SOURCE: IEC 60050-411:1996, 411-51-23, modified – Note 1 to entry has been added.]

3.1.2
rating
set of rated values and operating conditions

[SOURCE: IEC 60050-411:1996, 411-51-24]

3.1.3
rated output
<of a machine> value of the output included in the rating

3.1.4
load
all the values of the, in case of a generator, electrical and, in case of a motor, mechanical quantities that signify the demand made on a rotating machine by an electrical circuit or a mechanism at a given instant

[SOURCE: IEC 60050-411:1996, 411-51-01, modified – “in case of a generator” and “in case of a motor” have been added.]

3.1.5
no-load
<operation> state of a machine rotating with zero output power (but under otherwise normal operating conditions)

[SOURCE: IEC 60050-411:1996, 411-51-02, modified – “(but under otherwise normal operating conditions)” has been added.]

3.1.6
full load
load which causes a machine to operate at its rating

[SOURCE: IEC 60050-411:1996, 411-51-10]

3.1.7
full load value
quantity value for a machine operating at full load

Note 1 to entry: This concept applies to power (for example “full load power”), torque, current, speed, etc.

[SOURCE: IEC 60050-411:2007, 411-50-25, modified – Note 1 to entry has been added.]

3.1.8
rest and de-energized
complete absence of all movement and of all electrical supply or mechanical drive

[SOURCE: IEC 60050-411:1996, 411-51-03]

3.1.9
duty
statement of the load(s) to which the machine is subjected, including, if applicable, starting, electric braking, no-load and rest and de-energized periods, and including their durations and sequence in time

[SOURCE: IEC 60050-411:1996, 411-51-06]

3.1.10
duty type
continuous, short-time or periodic duty, comprising one or more loads remaining constant for the duration specified, or a non-periodic duty in which generally load and speed vary within the permissible operating range

[SOURCE: IEC 60050-411:1996, 411-51-13]

3.1.11
cyclic duration factor
ratio between the period of loading, including starting and electric braking, and the duration of the duty cycle, expressed as a percentage

[SOURCE: IEC 60050-411:1996, 411-51-09]

3.1.12
locked-rotor torque
minimum measured torque the motor develops at its shaft end with the rotor locked, over all its angular positions, at rated voltage and frequency

[SOURCE: IEC 60050-411:1996, 411-48-06, modified – “smallest” has been replaced with “minimum”.]

3.1.13
locked-rotor current
greatest steady-state root mean square (RMS) current taken from the line with the rotor locked, over all angular positions of its rotor, at rated voltage and frequency

[SOURCE: IEC 60050-411:1996, 411-48-16, modified – “motor held at rest” has been replaced with “rotor locked”.]

3.1.14
pull-up torque
<of an AC motor> minimum steady-state asynchronous torque which the motor develops between zero speed and the speed which corresponds to the breakdown torque, when the motor is supplied at the rated voltage and frequency

Note 1 to entry: This definition does not apply to those asynchronous motors of which the torque continually decreases with increase in speed.

Note 2 to entry: In addition to the steady-state asynchronous torques, harmonic synchronous torques, which are a function of rotor load angle, will be present at specific speeds. At such speeds, the accelerating torque may be negative for some rotor load angles.

Note 3 to entry: Experience and calculation show this to be an unstable operating condition, and therefore, harmonic synchronous torques do not prevent motor acceleration, and are excluded from this definition.

[SOURCE: IEC 60050-411:1996, 411-48-42, modified – “smallest” has been replaced with “minimum”. Note 2 to entry has been modified. Note 3 to entry has been added.]

3.1.15
breakdown torque
<of an AC motor> maximum steady-state asynchronous torque which the motor develops without an abrupt drop in speed, when the motor is supplied at the rated voltage and frequency

Note 1 to entry: This definition does not apply to motors with torques that continually decrease with increase in speed.

[SOURCE: IEC 60050-411:1996, 411-48-43]

3.1.16
pull-out torque
<of a synchronous motor> maximum torque which the synchronous motor develops at synchronous speed with rated voltage, frequency and field current

[SOURCE: IEC 60050-411:1996, 411-48-44]

3.1.17
cooling
procedure by means of which heat resulting from losses occurring in a machine is given up to a primary coolant, which may be continuously replaced or may itself be cooled by a secondary coolant in a heat exchanger

[SOURCE: IEC 60050-411:1996, 411-44-01]

3.1.18
coolant
medium, liquid or gas, by means of which heat is transferred

[SOURCE: IEC 60050-411:1996, 411-44-02]

3.1.19
primary coolant
medium, liquid or gas, which, being at a lower temperature than a part of a machine and in contact with it, removes heat from that part

[SOURCE: IEC 60050-411:1996, 411-44-03]