This is a preview - click here to buy the full publication

IEC 60034-1

Edition 15.0 2026-03

INTERNATIONAL STANDARD

Rotating electrical machines - Part 1: Rating and performance

ICS 29.160.01

ISBN 978-2-8327-1115-6

IEC 60034-1:2026-03(en)

This is a preview - click here to buy the full publication

CONTENTS

FOREWORD 6
1 Scope 9
2 Normative references 9
3 Terms, definitions and abbreviated terms 11
3.1 Terms and definitions 11
3.2 Abbreviated terms 17
4 Duty 17
4.1 Declaration of duty 17
4.2 Duty types 17
4.2.1 Duty type S1 – Continuous running duty 17
4.2.2 Duty type S2 – Short-time duty 18
4.2.3 Duty type S3 – Intermittent periodic duty 19
4.2.4 Duty type S4 – Intermittent periodic duty with starting 20
4.2.5 Duty type S5 – Intermittent periodic duty with electric braking 22
4.2.6 Duty type S6 – Continuous operation periodic duty 23
4.2.7 Duty type S7 – Continuous operation periodic duty with electric braking 25
4.2.8 Duty type S8 – Continuous operation periodic duty with related load/speed changes 26
4.2.9 Duty type S9 – Duty with non-periodic load and speed variations 27
4.2.10 Duty type S10 – Duty with discrete constant loads and speeds 28
5 Rating 31
5.1 Assignment of rating 31
5.2 Classes of rating 31
5.2.1 Rating for continuous running duty 31
5.2.2 Rating for short-time duty 31
5.2.3 Rating for periodic duty 31
5.2.4 Rating for non-periodic duty 31
5.2.5 Rating for duty with discrete constant loads and speeds 32
5.2.6 Rating for equivalent loading 32
5.3 Selection of a class of rating 32
5.4 Allocation of outputs to class of rating 33
5.5 Rated output 33
5.5.1 DC generators 33
5.5.2 AC generators 33
5.5.3 Motors 33
5.5.4 Synchronous compensators 33
5.6 Rated voltage 33
5.6.1 DC generators 33
5.6.2 AC generators 33
5.6.3 AC motors 33
5.7 Preferred combinations of voltages and outputs 34
5.8 Machines with more than one rating 34
6 Site conditions 34
6.1 General 34
6.2 Altitude 34
6.3 Maximum ambient air temperature 34
6.4 Minimum ambient air temperature 35

This is a preview - click here to buy the full publication

6.5 Water coolant temperature 35
6.6 Standstill, storage and transport 35
6.7 Purity of hydrogen coolant 35
7 Electrical operating conditions 35
7.1 Electric supply 35
7.2 Form and symmetry of voltages and currents 36
7.2.1 AC motors 36
7.2.2 AC generators 37
7.2.3 Synchronous machines 38
7.2.4 DC motors supplied from static power converters 38
7.3 Voltage during starting of AC motors 39
7.4 Voltage and frequency variations during operation 40
7.5 Three-phase AC machines operating on unearthed systems 43
7.6 Voltage (peak and gradient) withstand levels 43
7.7 Sudden short circuits 44
8 Thermal performance and tests 44
8.1 Thermal class 44
8.2 Reference coolant 44
8.3 Conditions for thermal tests 45
8.3.1 Electric supply 45
8.3.2 Temperature of machine before test 45
8.3.3 Temperature of coolant 45
8.3.4 Measurement of coolant temperature during test 45
8.4 Temperature rise of a part of a machine 46
8.5 Methods of measurement of temperature 46
8.5.1 General 46
8.5.2 Resistance method 46
8.5.3 Embedded temperature detector (ETD) method 46
8.5.4 Thermometer method 47
8.6 Determination of winding temperature 47
8.6.1 Choice of method 47
8.6.2 Determination by resistance method 48
8.6.3 Determination by ETD method 49
8.6.4 Determination by thermometer method 50
8.7 Duration of thermal tests 50
8.7.1 Rating for continuous running duty 50
8.7.2 Rating for short-time duty 50
8.7.3 Rating for periodic duty 50
8.7.4 Ratings for non-periodic duty and for duty with discrete constant loads 50
8.8 Determination of the thermal equivalent time constant for machines of duty type S9 51
8.9 Measurement of bearing temperature 51
8.10 Limits of temperature and of temperature rise 51
8.10.1 General 51
8.10.2 Indirect cooled windings 52
8.10.3 Direct cooled windings 56
8.10.4 Adjustments to take account of hydrogen purity on test 57

This is a preview - click here to buy the full publication

8.10.5 Permanently short-circuited windings, magnetic cores and all structural components (other than bearings) whether or not in contact with insulation 57
8.10.6 Commutators and sliprings, open or enclosed and their brushes and brushgear 57
9 Other performance and tests 59
9.1 Routine tests 59
9.2 Withstand voltage test 60
9.3 Occasional excess current 64
9.3.1 General 64
9.3.2 Generators 64
9.3.3 Motors (except commutator motors and permanent magnet motors) 64
9.3.4 Commutator machines 64
9.4 Momentary excess torque for motors 64
9.4.1 Polyphase induction motors and DC motors 64
9.4.2 Polyphase synchronous motors 65
9.4.3 Other motors 65
9.5 Pull-up torque and locked-rotor torque for cage induction motors with direct online starting 65
9.6 Safe operating speed of cage induction motors 65
9.7 Overspeed 66
9.8 Short-circuit current for synchronous machines 67
9.9 Short-circuit withstand test for synchronous machines 67
9.10 Commutation test for commutator machines 68
9.11 Total harmonic distortion (THD) for synchronous machines 68
9.11.1 General 68
9.11.2 Limits 68
9.11.3 Tests 68
9.12 Protective earth test 69
9.13 Measurement of insulation resistance and polarization index of winding insulation 69
9.14 Shaft-voltage test 70
10 Information requirements 70
10.1 General 70
10.2 Product documentation 70
10.3 Rating plate 70
10.4 Information content 71
10.4.1 General 71
10.4.2 Minimum information requirements 71
10.4.3 AC machines 72
10.4.4 All DC machines 72
10.4.5 Machines over 5 kW (or 5 kVA) rated output 72
10.4.6 Optional information 72
11 Miscellaneous requirements 73
11.1 Protective earthing of machines 73
11.2 Shaft-end key(s) 74
12 Tolerances 75
12.1 General 75
12.2 Tolerances on values of quantities 75

This is a preview - click here to buy the full publication

13 Electromagnetic compatibility (EMC) 76
13.1 General 76
13.2 Immunity 78
13.2.1 Machines not incorporating electronic circuits 78
13.2.2 Machines incorporating electronic circuits 79
13.3 Emission 79
13.4 Immunity tests 79
13.5 Emission measurements 79
14 Application requirements 80
Annex A (informative) Guidance for the application of duty type S10 and for establishing the value of relative thermal life expectancy 81
Annex B (informative) Electromagnetic compatibility (EMC) limits 82
Bibliography 83

Figure 1 – Continuous running duty – Duty type S1 18
Figure 2 – Short-time duty – Duty type S2 19
Figure 3 – Intermittent periodic duty – Duty type S3 20
Figure 4 – Intermittent periodic duty with starting – Duty type S4 21
Figure 5 – Intermittent periodic duty with electric braking – Duty type S5 23
Figure 6 – Continuous operation periodic duty – Duty type S6 24
Figure 7 – Continuous operation periodic duty with electric braking – Duty type S7 25
Figure 8 – Continuous operation periodic duty with related load/speed changes – Duty type S8 27
Figure 9 – Duty with non-periodic load and speed variations – Duty type S9 28
Figure 10 – Duty with discrete constant loads – Duty type S10 30
Figure 11 – Voltage and frequency limits for motors and for generators except generators or synchronous compensators within the scope of IEC 60034-3 and hydrogenerators within the scope of IEC 60034-33 42
Figure 12 – Worst case increase in temperature rise ($\Delta\theta$) and recommended reduction of output power (ΔP) of motors as a function of the combined change of voltage and frequency $|\Delta\varnothing|$ (indicative guideline to users of motors and generators only) 43
Figure 13 – Factor K as a function of rated power in kW for determining $R_{\mathrm{PE,M}}$ 69
Figure 14 – Flowchart clarifying the EMC requirements 78

Table 1 – Preferred voltage ratings 34
Table 2 – Unbalanced operating conditions for synchronous machines 38
Table 3 – CCC symbol designation 39
Table 4 – Primary functions of machines 41
Table 5 – Reference coolant (see also Table 11) 44
Table 6 – Time interval 49
Table 7 – Measuring points 51
Table 8 – Limits of temperature rise of windings indirectly cooled by air 53
Table 9 – Limits of temperature rise of windings indirectly cooled by hydrogen 54
Table 10 – Adjustments to limits of temperature rise at the operating site of indirect cooled windings to take account of non-reference operating conditions and ratings 55
Table 11 – Assumed maximum ambient temperature 56

This is a preview - click here to buy the full publication

Table 12 – Adjusted limits of temperature rise at the test site ($\Delta\theta_T$) for windings indirectly cooled by air to take account of test site operating conditions 57
Table 13 – Limits of temperature of directly cooled windings and their coolants 58
Table 14 – Adjustments to limits of temperature at the operating site for windings directly cooled by air or hydrogen to take account of non-reference operating conditions and ratings 58
Table 15 – Adjusted limits of temperature at the test site θ_T for windings directly cooled by air to take account of test site operating conditions 59
Table 16 – Minimum routine tests for machines assembled and tested in the factory of the manufacturer 60
Table 17 – Withstand voltage tests 62
Table 18 – Test voltage factors for machines with an assigned IVIC according to IEC 60034-18-41 and IEC 60034-18-42 63
Table 19 – Maximum safe operating speed (min^{-1}) of three-phase single-speed cage induction motors for voltages up to and including 1 000 V 66
Table 20 – Overspeeds 67
Table 21 – Cross-sectional areas of earthing conductors 74
Table 22 – Schedule of tolerances on values of quantities 75
Table B.1 – Electromagnetic emission limits per CISPR 11 Class B Group 1 82
Table B.2 – Electromagnetic emission limits per CISPR 11 Class A Group 1 82

This is a preview - click here to buy the full publication

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

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 is a preview - click here to buy the full publication

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.

This is a preview - click here to buy the full publication

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.

This is a preview - click here to buy the full publication

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*

This is a preview - click here to buy the full publication

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*

This is a preview - click here to buy the full publication

Bibliography

IEC 60034-7, *Rotating electrical machines - Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)*

IEC 60034-9, *Rotating electrical machines - Part 9: Noise limits*

IEC 60034-11, *Rotating electrical machines - Part 11: Thermal protection*

IEC 60034-14, *Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity*

IEC 60034-18-1:2022, *Rotating electrical machines - Part 18-1: Functional evaluation of insulation systems - General guidelines*

IEC 60034-18-21, *Rotating electrical machines - Part 18-21: Functional evaluation of insulation systems - Test procedures for wire-wound windings - Thermal evaluation and classification*

IEC 60034-18-31, *Rotating electrical machines - Part 18-31: Functional evaluation of insulation systems - Test procedures for form-wound windings - Thermal evaluation and classification of insulation systems used in rotating machines*

IEC 60034-18-32:2022, *Rotating electrical machines - Part 18-32: Functional evaluation of insulation systems (Type II) - Electrical endurance qualification procedures for form-wound windings*

IEC 60034-18-34:2012, *Rotating electrical machines - Part 18-34: Functional evaluation of insulation systems - Test procedures for form-wound windings - Evaluation of thermomechanical endurance of insulation systems*

IEC 60034-19:2014, *Rotating electrical machines - Part 19: Specific test methods for d.c. machines on conventional and rectifier-fed supplies*

IEC TS 60034-24:2009, *Rotating electrical machines - Part 24: Online detection and diagnosis of potential failures at the active parts of rotating electrical machines and of bearing currents - Application guide*

IEC TS 60034-25:2022, *Rotating electrical machines - Part 25: AC electrical machines used in power drive systems - Application guide*

IEC 60034-27 (all parts), *Rotating electrical machines - Part 27: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machines*

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

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60092 (all parts), *Electrical installations in ships*

IEC TS 61800-8, *Adjustable speed electrical power drive systems - Part 8: Specification of voltage on the power interface*

IEC 60276:2018, *Carbon brushes, brush holders, commutators and slip-rings - Definitions and nomenclature*

This is a preview - click here to buy the full publication

IEC 60349 (all parts), *Electric traction - Rotating electrical machines for rail and road vehicles*

IEC 60884-2-4, *Plugs and socket-outlets for household and similar purposes - Part 2-4: Particular requirements for plugs and socket-outlets for SELV*

IEC 61148:2011, *Terminal markings for valve device stacks and assemblies and for power conversion equipment*

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment - Part 1: General*

IEC GUIDE 115:2021, *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*

ISO/IEC 18004:2015, *Information technology - Automatic identification and data capture techniques - QR Code bar code symbology specification*

_____