Draft for Public Comment

Form 36

DPC: 19/30408376 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000
Fax: +44 (0)20 8996 7400
www.bsigroup.com

Date: 17 December 2019
Origin: International

Latest date for receipt of comments: 31 January 2020

Project No. 2019/02145

Responsible committee: PEL/2 Rotating electrical machinery

Interested committees:

Title: Draft BS EN IEC 60034-1 Rotating electrical machines. Part 1: Rating and performance.

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ii) affects other national standard(s)
iii) requires additional national guidance or information

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Responsible Committee Secretary: Committee Service Centre (BSI)
Direct tel: 020 8996 7009
E-mail: csc@bsigroup.com

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at **https://standardsdevelopment.bsigroup.com/**. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex **(e.g. 3.1)**	Paragraph/Figure/ Table/Note	**Type of comment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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2/1964/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: **IEC 60034-1 ED14**	
DATE OF CIRCULATION: **2019-07-12**	CLOSING DATE FOR COMMENTS: **2019-10-04**
SUPERSEDES DOCUMENTS: **2/1963/RR**	

IEC TC 2 : ROTATING MACHINERY	
SECRETARIAT: United Kingdom	SECRETARY: Mr Charles Whitlock
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Rotating electrical machines – Part 1: Rating and performance

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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.
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International Standard IEC 60034-1 has been prepared by IEC technical committee 2: Rotating machinery.

This thirteenth edition cancels and replaces the twelfth edition published in 2010. It constitutes a technical revision.

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The main technical changes with regard to the previous edition are as follows:

Clause or subclause	Change
1.	Clarification of the scope
2.	General use of dated references
3.29	Clarification on identification of maximum and minimum current
3.34	Definition of main insulation
7.1	Clarification on bus transfer or fast reclosing
	Clarification on the capability to withstand impulse voltages
7.3	New clause on voltage deviation during starting
7.4	Extended variation of supply frequency
	Note added on design for operation with extended voltage and frequency
	Recommended derating added for high variations of voltage and frequency
8.3.1	Clarification on electrical supply during thermal tests added
9.1	Changes in table 16, especially inclusion of PM and reluctance synchronous machines
	Protective earth test added as part of type test
9.2	Requirement on test equipment for withstand voltage test added
	Test voltage for variable speed a.c. machines added
9.5	Extended to requirements on minimum locked rotor torque
10.	Section has been rearranged completely
11.1	Clarification on protective earth test after installation added
12.1	Clarification on the tolerances due to the accuracy of the test equipment
	Note on measurement uncertainty added
12.2	Change in the tolerance on efficiency
	Clarification on the tolerance on locked-rotor current
14	Improved name of clause

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The text of this standard is based on the following documents:

FDIS	Report on voting
2/1857/FDIS	2/1863/RVD

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

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

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 in the IEC TC 2 dashboard on the IEC website.

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

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

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ROTATING ELECTRICAL MACHINES –

Part 1: Rating and performance

1 Scope

This part of IEC 60034 is applicable to all rotating electrical machines except traction motors for electrically driven rail and road vehicles, which are covered by IEC 60349 and IEC 61377.

Machines within the scope of this document may 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 60027-1:1992+AMD1:1997+AMD2:2005, *Letter symbols to be used in electrical technology – Part 1: General*

IEC 60027-4:2006, *Letter symbols to be used in electrical technology – Part 4: Rotating electric machines*

IEC 60034-2 (all parts, -2-1:2014, -2-2:2010, -2-3:2019), *Rotating electrical machines – Part 2: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

IEC 60034-3:2019, *Rotating electrical machines – Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines*

IEC 60034-5:2019, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

IEC 60034-6:1991, *Rotating electrical machines – Part 6: Methods of cooling (IC code)*

IEC 60034-8:2007+AMD1:2014, *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 60034-15:2009, *Rotating electrical machines – Part 15: Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines*

IEC 60034-18 (all parts, -18-1:2010, -18-21:2012, -18-31:2012, -18-32:2010, -18-33:2010, -18-34:2012), *Rotating electrical machines – Part 18: Functional evaluation of insulation systems*

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IEC 60034-18-41:2014+AMD1:2019, *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 60034-18-42:2017+AMD1:2019, *Rotating electrical machines - Part 18-42: Qualification and acceptance tests for Type II electrical insulation systems used in rotating electrical machines fed from voltage converters*

IEC TS 60034-25:2014, *Rotating electrical machines – Part 25: AC electrical machines used in power drive systems – Application guide*

IEC 60034-29:2008, *Rotating electrical machines – Part 29: Equivalent loading and superposition techniques – Indirect testing to determine temperature rise*

IEC 60034-30-1:2014, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated A.C. motors (IE-code)*

IEC 60034-33:202x, *Rotating electrical machines - Part 33: Specific technical requirements for hydro generators*

IEC 60038:2009, *IEC standard voltages*

IEC 60050-411:1996+AMD1:2007, *International Electrotechnical Vocabulary (IEV) – Chapter 411: Rotating machines*

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60072 (all parts, -1:1991, -2:1990, -3:1994), *Dimensions and output series for rotating electrical machines*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60204-11:2018, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV*

IEC 60335-1:2010, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

IEC 61293:1994, *Marking of electrical equipment with ratings related to electrical supply – Safety requirements*

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CISPR 11:2015, *Industrial, scientific and medical equipment – Radiofrequency disturbance characteristics – Limits and methods of measurement*

CISPR 14 (all parts, -1:2016, -2:2015), *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60050-411, some of which are repeated here for convenience, and the following apply.

NOTE 1 For definitions concerning cooling and coolants, other than those in 3.17 to 3.22, see IEC 60034-6.

NOTE 2 For the purposes of this document, the term 'agreement' means 'agreement between the manufacturer and purchaser'.

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

3.1
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 terminals.

[SOURCE: IEC 60050-411:1996, 411-51-23]

3.2
rating
set of rated values and operating conditions

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

3.3
rated output
value of the output included in the rating

3.4
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:modification indicated in italics]

3.5
no-load <operation>
state of a machine rotating with zero output power *(but under otherwise normal operating conditions)*

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[SOURCE: IEC 60050-411:1996, 411-51-02, modified: modification indicated in italics]

3.6
full load
load which causes a machine to operate at its rating

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

3.7
full load value
quantity value for a machine operating at full load

Note 1 to entry: This concept applies to power, torque, current, speed, etc.

[SOURCE: IEC 60050-411:1996, 411-51-11]

3.8
de-energized and rest
complete absence of all movement and of all electrical supply or mechanical drive

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

3.9
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]

3.10
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]

3.11
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]

3.12
locked-rotor torque
smallest measured torque the motor develops at its shaft and with the rotor locked, over all its angular positions, at rated voltage and frequency

[SOURCE: IEC 60050-411:1996, 411-48-06]

3.13
locked-rotor current
greatest steady-state r.m.s. current taken from the line with the motor held at rest, over all angular positions of its rotor, at rated voltage and frequency

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[SOURCE: IEC 60050-411:1996, 411-48-16]

3.14
pull-up torque <of an a.c. motor>
smallest 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.

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.

3.15
breakdown torque <of an a.c. 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.

3.16
pull-out torque <of a synchronous motor>
maximum torque which the synchronous motor develops at synchronous speed with rated voltage, frequency and field current

3.17
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]

3.18
coolant
medium, liquid or gas, by means of which heat is transferred

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

3.19
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]

3.20
secondary coolant
medium, liquid or gas, which, being at a lower temperature than the primary coolant, removes the heat given up by this primary coolant by means of a heat exchanger or through the external surface of the machine

[SOURCE: IEC 60050-411:1996, 411-44-04]

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3.21
direct cooled winding
inner cooled winding
winding mainly cooled by coolant flowing in direct contact with the cooled part through hollow conductors, tubes, ducts or channels which, regardless of their orientation, form an integral part of the winding inside the main insulation

Note 1 to entry: In all cases when 'indirect' or 'direct' is not stated, an indirect cooled winding is implied.

[SOURCE: IEC 60050-411:1996, 411-44-08]

3.22
indirect cooled winding
any winding other than a direct cooled winding

Note 1 to entry: In all cases when 'indirect' or 'direct' is not stated, an indirect cooled winding is implied.

[SOURCE: IEC 60050-411:1996, 411-44-09]

3.23
supplementary insulation
independent insulation applied in addition to the main insulation in order to ensure protection against electric shock in the event of failure of the main insulation

3.24
moment of inertia
sum (integral) of the products of the mass elements of a body and the squares of their distances (radii) from a given axis

3.25
thermal equilibrium
state reached when the temperature rises of the several parts of the machine do not vary by more than a gradient of *1 K per half hour*

Note 1 to entry: Thermal equilibrium may be determined from the time-temperature rise plot when the straight lines between points at the beginning and end of two successive intervals of half hour each have a gradient of 1 K or less per half hour or 2 K or less per hour.

[SOURCE: IEC 60050-411:1996, 411-51-08, modified: modification indicated in italics]

3.26
thermal equivalent time constant
time constant, replacing several individual time constants, which determines approximately the temperature course in a winding after a step-wise current change

3.27
encapsulated winding
winding which is completely enclosed or sealed by moulded insulation

[SOURCE: IEC 60050-411:1996, 411-39-06]

3.28
rated form factor of direct current supplied to a d.c. motor armature from a static power converter
ratio of the r.m.s. maximum permissible value of the current $I_{\mathrm{rms,maxN}}$ to its average value I_{avN} (mean value integrated over one period) at rated conditions:

$$k_{\mathrm{fN}} = \frac{I_{\mathrm{rms,\,maxN}}}{I_{\mathrm{avN}}}$$

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3.29
current ripple factor
ratio of the difference between the maximum value I_{max} and the minimum value I_{min} of an undulating current to two times the average value I_{av} (mean value integrated over one period):

$$q_i = \frac{I_{max} - I_{min}}{2 \times I_{av}}$$

Note 1 to entry: For small values of current ripple, the ripple factor may be approximated by the following expression:

$$q_i = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

Note 2 to entry: The above expression may be used as an approximation if the resulting calculated value of q_i is equal to or less than 0,4.

The basis for determining this variation should be by oscillograph measurement (or a comparable device) and not by ammeter readings. A line should be drawn on the oscillogram through the consecutive peaks of the current wave. This line is the envelope of the current wave. The variation is the difference between the maximum (I_{max}) and minimum (I_{min}) ordinates of this envelope.

3.30
tolerance
permitted deviation between the declared value of a quantity and the measured value

3.31
type test
test of one or more machines made to a certain design to show that the design meets certain specifications

Note 1 to entry: The type test may also be considered valid if it is made on a machine which has minor deviations of rating or other characteristics. These deviations should be subject to agreement.

[SOURCE: IEC 60050-411:1996, 411-53-01]

3.32
routine test
test to which each individual machine is subjected during or after manufacture to ascertain whether it complies with certain criteria

[SOURCE: IEC 60050-411:1996, 411-53-02]

3.33
runaway speed
maximum speed attained by the engine/generator set after removal of the full load of the generator if the speed regulator does not function

Note 1 to entry: For motors, the maximum overspeed at loss of supply is meant that a motor might reach driven by the coupled equipment

[SOURCE: IEC 60050-411:1996, 811-17-23]

3.34
main insulation
main insulation is the basic insulation (see IEC 60664-1) of a rotating electrical machine

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4 Duty

4.1 Declaration of duty

It is the responsibility of the purchaser to declare the duty. The purchaser may describe the duty by one of the following:

a) numerically, where the load does not vary or where it varies in a known manner;

b) as a time sequence graph of the variable quantities;

c) by selecting one of the duty types S1 to S10 that is no less onerous than the expected duty.

The duty type shall be designated by the appropriate abbreviation, specified in 4.2, written after the value of the load.

An expression for the cyclic duration factor is given in the relevant duty type figure.

The purchaser normally cannot provide values for the moment of inertia of the machine (J_M) or the relative thermal life expectancy (TL), see Annex A. These values are provided by the manufacturer.

Where the purchaser does not declare a duty, the manufacturer shall assume that duty type S1 (continuous running duty) applies.

4.2 Duty types

4.2.1 Duty type S1 – Continuous running duty

Operation at a constant load maintained for sufficient time to allow the machine to reach thermal equilibrium, see Figure 1.

The appropriate abbreviation is S1.

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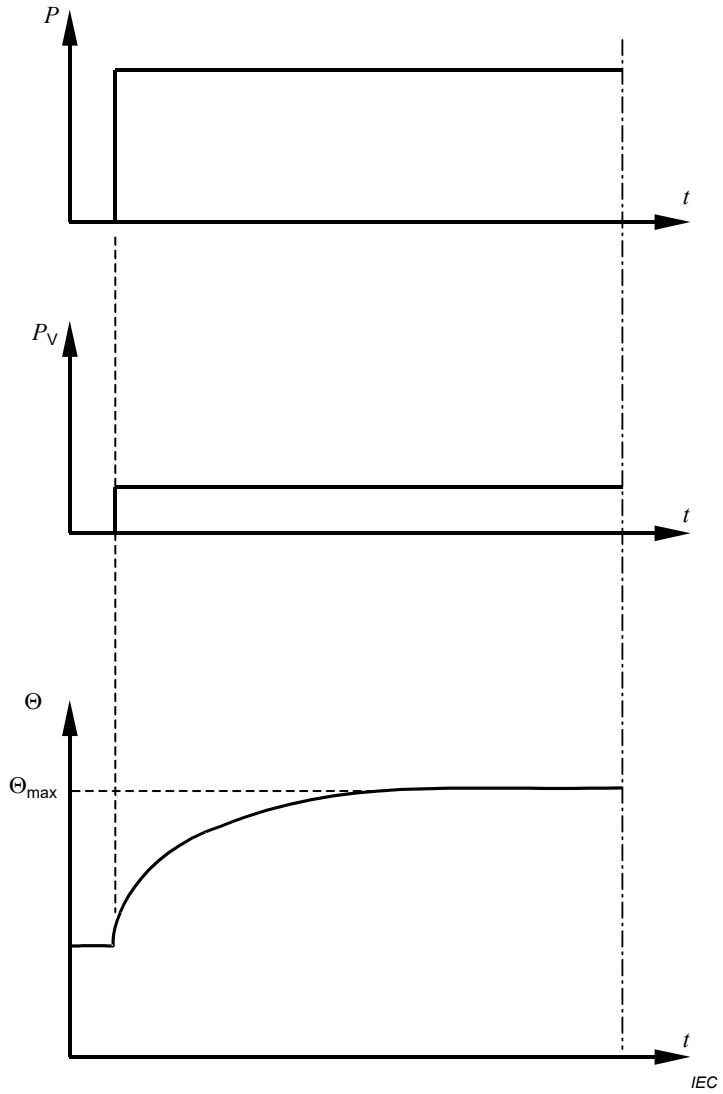

Key

P	load
P_V	electrical losses
$Θ$	temperature
$Θ_{max}$	maximum temperature attained
t	time

Figure 1 – Continuous running duty – Duty type S1

4.2.2 Duty type S2 – Short-time duty

Operation at constant load for a given time, less than that required to reach thermal equilibrium, followed by a time de-energized and at rest of sufficient duration to re-establish machine temperatures within 2 K of the coolant temperature, see Figure 2.

The appropriate abbreviation is S2, followed by an indication of the duration of the duty,

Example: S2 60 min.

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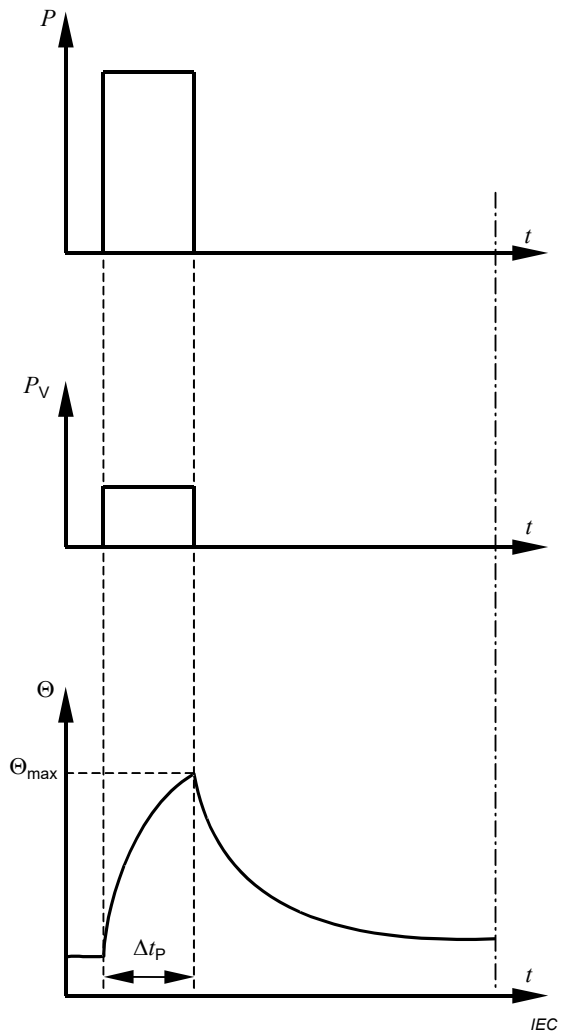

Key

P	load
P_V	electrical losses
$Θ$	temperature
$Θ_{max}$	maximum temperature attained
t	time
$Δt_P$	operation time at constant load

Figure 2 – Short-time duty – Duty type S2

4.2.3 Duty type S3 – Intermittent periodic duty

NOTE Periodic duty implies that thermal equilibrium is not reached during the time on load.

A sequence of identical duty cycles, each including a time of operation at constant load and a time de-energized and at rest, see Figure 3. In this duty, the cycle is such that the starting current does not significantly affect the temperature rise.

The appropriate abbreviation is S3, followed by the cyclic duration factor.

Example: S3 25 %.

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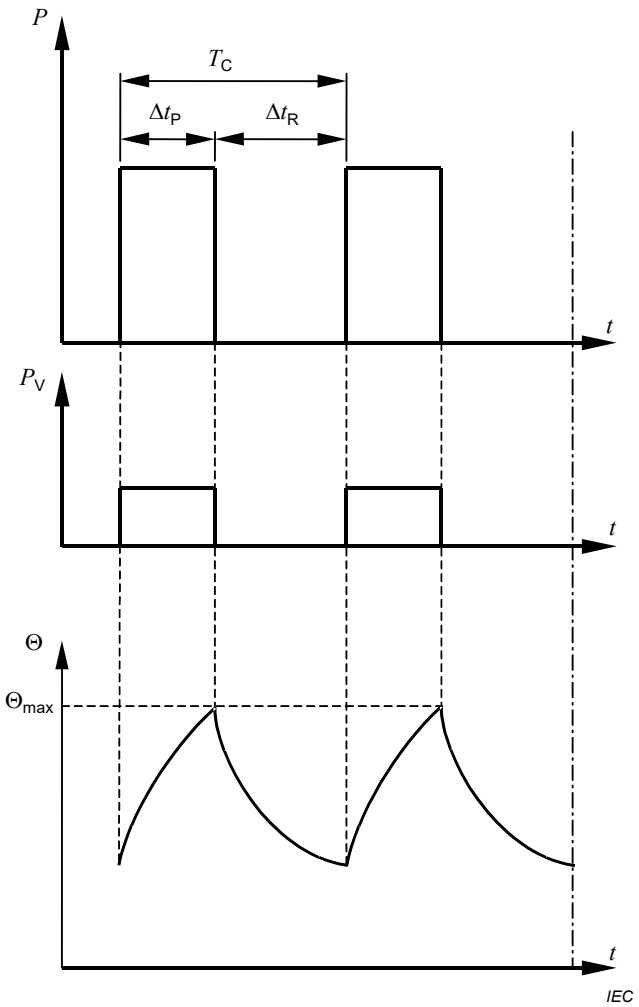

Key

P	load
P_V	electrical losses
Θ	temperature
Θ_{max}	maximum temperature attained
t	time
T_C	time of one load cycle
Δt_P	operation time at constant load
Δt_R	time de-energized and at rest

Cyclic duration factor = $\Delta t_P / T_C$

Figure 3 – Intermittent periodic duty – Duty type S3

4.2.4 Duty type S4 – Intermittent periodic duty with starting

NOTE Periodic duty implies that thermal equilibrium is not reached during the time on load.

A sequence of identical duty cycles, each cycle including a significant starting time, a time of operation at constant load and a time de-energized and at rest, see Figure 4.

The appropriate abbreviation is S4, followed by the cyclic duration factor, the moment of inertia of the motor (J_M) and the moment of inertia of the load (J_{ext}), both referred to the motor shaft.

Example: S4 25 % J_M = 0,15 kg × m^2 J_{ext} = 0,7 kg × m^2.

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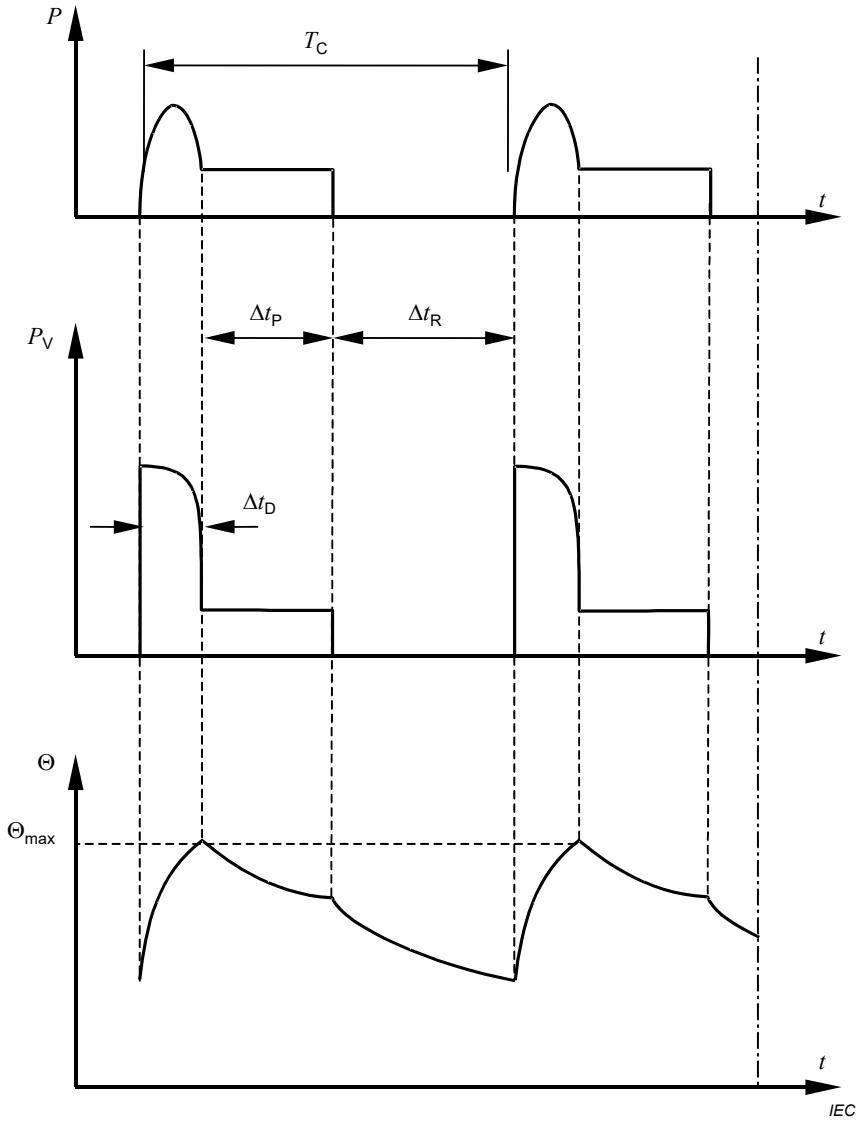

Key

P	load	t	time
P_V	electrical losses	T_C	time of one load cycle
Θ	temperature	Δt_D	starting/accelerating time
Θ_{max}	maximum temperature attained	Δt_P	operation time at constant load
		Δt_R	time de-energized and at rest

Cyclic duration factor = $(\Delta t_D + \Delta t_P)/T_C$

Figure 4 – Intermittent periodic duty with starting – Duty type S4

4.2.5 Duty type S5 – Intermittent periodic duty with electric braking

NOTE Periodic duty implies that thermal equilibrium is not reached during the time on load.

A sequence of identical duty cycles, each cycle consisting of a starting time, a time of operation at constant load, a time of electric braking and a time de-energized and at rest, see Figure 5.

The appropriate abbreviation is S5, followed by the cyclic duration factor, the moment of inertia of the motor (J_M) and the moment of inertia of the load (J_{ext}), both referred to the motor shaft.

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