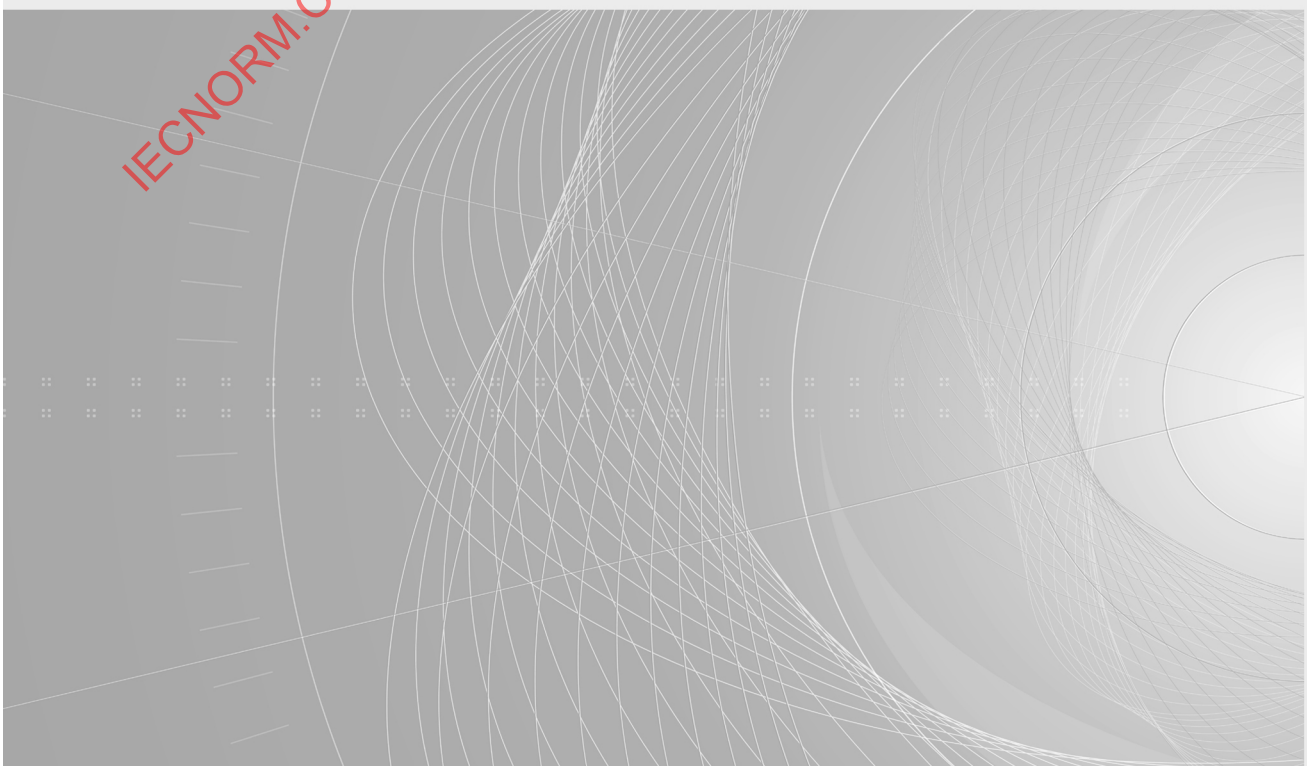
IEC 60034-11

Edition 3.0 2020-10
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Rotating electrical machines – Part 11: Thermal protection



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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Rotating electrical machines – Part 11: Thermal protection

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ROTATING ELECTRICAL MACHINES –

Part 11: Thermal protection

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

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60034-11 has been prepared by IEC technical committee 2: Rotating machinery.

This third edition cancels and replaces the second edition, published in 2004. This edition constitutes a technical revision.

The main changes with respect to the previous edition are

– the additional specification of winding temperature limits for temperature class 200 (N),
– the increased limits of maximum winding temperatures for overloads with rapid variation,
– the clarification that the motor winding may be permanently damaged after it has been exposed to temperatures according to Table 2,
– a clarification of scope,
– a clarification of the definition of indirect thermal protection,
– a clarifying note in Clause 6,
– the conversion of note 3 in Clause 6 into normal text including changes in wording,
– the incorporation of note 3 in Clause 5 into Clause 2,
– a clarification on the test methods for larger motors in 8.3.

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

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2/2011/FDIS	2/2019/RVD

Full information on the voting for the approval of this International Standard 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.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Thermal protection systems are based on the principle of protecting or monitoring the vulnerable machine parts against excessive temperatures. This requires the selection of the appropriate thermal protection device to suit both the type of protection required and the machine component to be protected. This document does not detail the protection methods available or specify the protection method to be used for particular applications, but instead it specifies the temperature of the protected parts that should not be exceeded if a fault or machine abuse occurs.

The requirements are not intended to guarantee a "normal" machine life for all conditions of use, but rather to avoid both failure and accelerated premature thermal ageing of the winding insulation. The requirements result from a compromise, since the level of protection should neither be set so low that it causes nuisance tripping nor so high that it allows continuous working at temperatures that will seriously affect the life of the winding insulation.

Normal insulation life can only be ensured by correct motor application and maintenance. Frequent operation at above the normal temperature limits, see IEC 60034-1, which cannot be prevented by built-in thermal protection without risking nuisance tripping may lead to a noticeable reduction in machine life. ~~It should be noted that~~ The life of the winding insulation is approximately halved for every 8 K to 10 K increase in the continuous operating temperature.

The requirement to incorporate thermal protection in a machine is a matter for agreement. The application of this document ~~should be~~ is a matter of agreement between the user and the machine manufacturer.

ROTATING ELECTRICAL MACHINES –

Part 11: Thermal protection

1 Scope

This part of IEC 60034 specifies requirements relating to the use of thermal protectors and thermal detectors incorporated into the stator windings or placed in other suitable positions in induction machines in order to protect them against serious damage due to thermal overloads. ~~It applies to machines manufactured in accordance with IEC 60034-12 with the voltage limits specified in IEC 60034-12. The protection of bearings and other mechanical parts is not included.~~ It applies to single-speed three-phase 50 Hz or 60 Hz cage induction motors in accordance with IEC 60034-1 and IEC 60034-12 that:

- have a rated voltage up to 1 000 V;
- are intended for direct-on-line or star-delta starting.

Not included are:

- direct protection of the rotor winding; the methods of protection only protect rotor windings indirectly; for large motors (particularly 2 pole motors) and for motors starting large inertia loads, special attention is given to rotor heating both when starting and especially after a "trip" has occurred;
- the protection of bearings and other mechanical parts;
- the protection methods to be used for particular applications.

NOTE 1 Although temperature values given in this document are higher than those specified in IEC 60034-1, they are not in conflict.

NOTE 2 Additional requirements may apply to particular motor types, such as those used in household appliances, or for motors used in explosive atmospheres.

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 60034-1:~~2004~~2017, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-12:~~2002~~2016, *Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

3.1
thermal protection
protection of windings of a machine against excessive temperature resulting from conditions of overload or loss of cooling

3.2
thermal protection system
system for the protection of a machine winding against excessive temperature resulting from conditions of overload or loss of cooling by means of either thermal protector(s) or thermal detector(s)

3.3
thermal detector
electrically insulated device that is only sensitive to temperature, capable of initiating a switching function in a protection system when its temperature reaches a predetermined level

3.4
thermal protector
electrically insulated device that is sensitive to the temperature of the machine winding which carries machine current, capable of directly switching off the machine when its temperature reaches a predetermined level

Note 1 to entry: Some thermal protectors are sensitive to both temperature and current, the combination of which activates the direct switching off of the machine.

3.5
thermal overload with slow variation
overload condition or loss of cooling that produces a rise of temperature that is sufficiently slow that the temperature of the thermal protector or detector follows it without appreciable delay

3.6
thermal overload with rapid variation
overload condition or loss of cooling that produces a rise of temperature that is too rapid for the temperature of the thermal protector or detector to follow without appreciable delay resulting in a significant temperature difference between the thermal device and the part to be protected

3.7
maximum temperature after tripping
maximum value of the temperature that is reached by the protected part of the machine during the period which follows tripping by the thermal protection system

3.8
direct thermal protection
form of protection where the part of the machine in which the thermal detector(s) or thermal protector(s) are incorporated is the part for which protection is being provided

3.9
indirect thermal protection
form of protection where the part of the machine in which the thermal detector(s) or thermal protector(s) are incorporated (e.g. the stator winding) is not the part for which protection is being provided (e.g. the rotor winding)

4 Thermal protection limits

Machines shall be capable of operating at rated output and at all operating conditions according to IEC 60034-1 without activation of the thermal protection device. The thermal protection device shall limit the winding temperature in accordance with Clause 5 or Clause 6.

5 Protection against thermal overloads with slow variation

When subjected to an overload or other misuse condition causing overheating with slow variation, the protection system shall operate to prevent the temperature of the machine winding from exceeding the values in Table 1.

Examples of the rise in temperature as a function of time are shown in Figure 1 and Figure 2.

Table 1 – Maximum winding temperatures for overloads with slow variation

Thermal class	130(B)	155(F)	180(H)	200(N)
Maximum insulated winding temperature °C	145	170	195	215

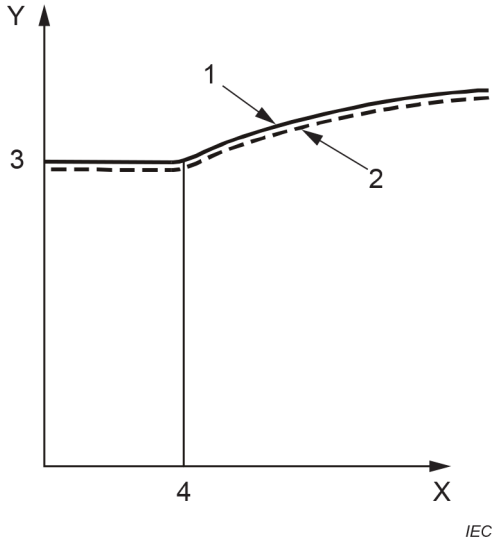
The winding temperature shall be determined by the resistance method in accordance with the requirements of 8.6.2 of IEC 60034-1:2017.

NOTE 1 The limit values in Table 1 exceed the thermal classification and thus will reduce the lifetime of the motor~~, if the motor is operated over a longer period of time with these values~~.

NOTE 2 The maximum temperature limits are based on experience. Some of the ways in which a thermal overload with slow variation may be caused are:

- Defects in ventilation or the ventilation system due to excessive dust in the ventilation ducts, or dirt on windings or frame cooling ribs, etc.
- An excessive rise in ambient temperature or the temperature of the cooling medium.
- Gradual increasing mechanical overload.
- Prolonged voltage drop, over-voltage or unbalance in the machine supply.
- Excessive duty on a motor rated for intermittent duty.
- Frequency deviations.

~~NOTE 3 The maximum temperature limits are based on experience taking into account factors such as ambient temperature, variations in supply voltage and normal requirements for starting motors.~~



Key

1 is the winding temperature in the vicinity of the thermal protector or detector

2 is the temperature of the thermal protector or detector

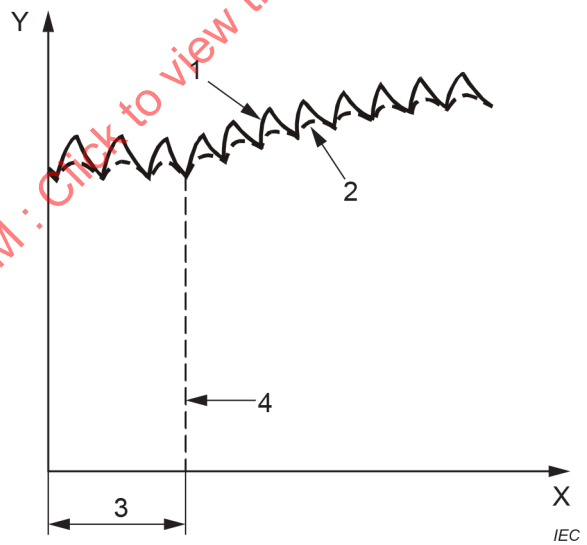
3 is the temperature when operating at normal duty

4 is the time at the beginning of the thermal overload

X axis is time

Y axis is temperature

Figure 1 – Example of thermal overload with slow variation and direct thermal protection



Key

1 is the winding temperature in the vicinity of the thermal detector or protector

2 is the temperature of the thermal detector or protector

3 is the interval with normal cycling frequency

4 is the time at the beginning of the thermal overload

X axis is time

Y axis is temperature

Figure 2 – Example of thermal overload with slow variation in the case of too intensive intermittent periodic duty with starting (duty S4) and direct thermal protection

6 Protection against thermal overloads with rapid variation

When a thermal overload with rapid variation is applied to the machine, the thermal protection system shall operate to prevent the temperature of the machine winding from exceeding the values given in Table 2.

A current overload relay does not normally provide protection against repeated rapid overload variations and the use of a thermal protection device should be considered

Examples of the rise in temperature as a function of time are shown in Figure 3 and Figure 4.

Table 2 – Maximum winding temperatures for overloads with rapid variation

Thermal class	130(B)	155(F)	180(H)	200(N)
Maximum insulated winding temperature °C	225	~~240~~ 250	~~260~~ 275	295

The winding temperature shall be determined by direct measurements such as thermocouples in accordance with the requirements of 8.5.3 of IEC 60034-1:2017.

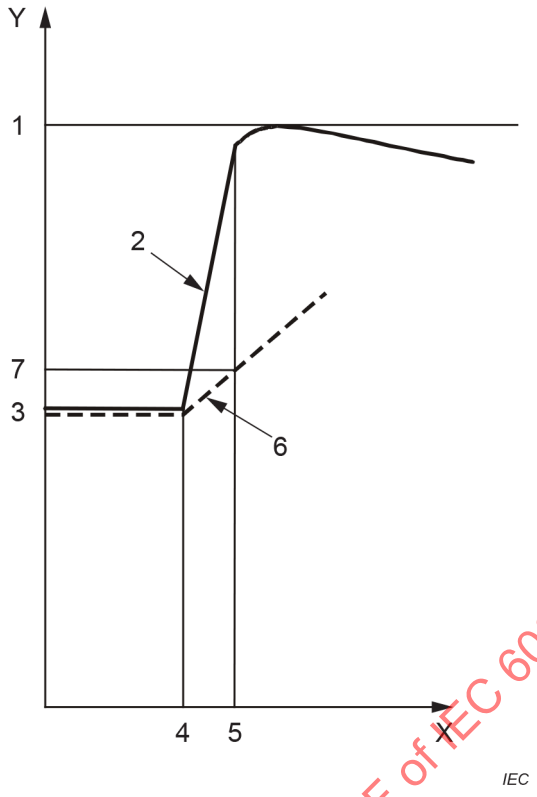
It is understood that the motor winding may be permanently damaged and may not be able to operate after it has been exposed to temperatures according to Table 2.

NOTE 1 Some of the ways in which a thermal overload with rapid variation may be caused are:

- Stalling the motor.
- Phase failure.
- Starting under abnormal conditions, for example, inertia too great, voltage too low, load torque abnormally high;
- Sudden and significant increase in load.
- Starting repeatedly during a short time.

NOTE 2 The maximum temperature limits are based on experience, taking into account factors such as ambient temperature, variations in supply voltage and normal requirements for starting motors.

~~NOTE 3~~ The temperatures in Table 2 ~~should~~ shall not be confused with the operating temperatures of the winding's thermal protector or thermal detector ~~operating temperatures~~ which have to be significantly below these values. The thermal protector shall be installed at a place where the highest temperatures are expected according to the application and the motor cooling system.



Key

1 is the maximum winding temperature after tripping

2 is the winding temperature in the vicinity of the thermal protector or detector

3 is the temperature when operating at normal duty

4 is the time at the beginning of the thermal overload

5 is the time at which tripping occurs

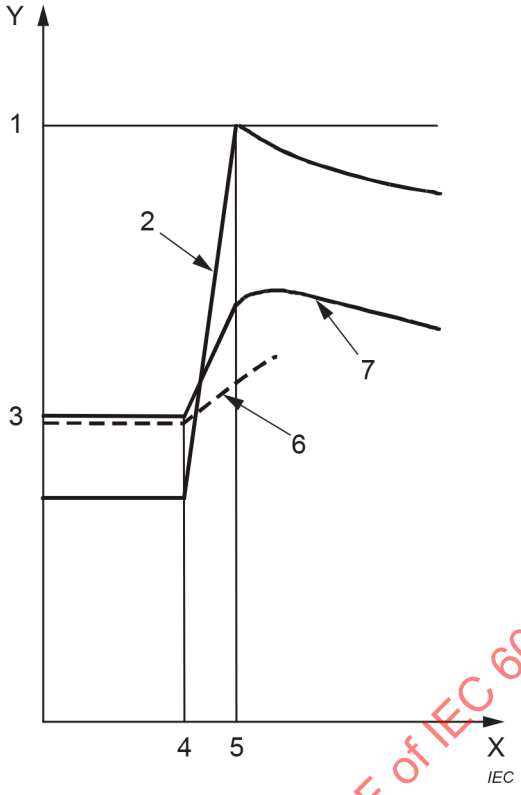
6 is the temperature of the thermal protector or detector

7 is the operating temperature of the thermal detector or protector

X axis is time

Y axis is temperature

Figure 3 – Example of thermal overload with rapid variation where the thermally critical part has direct thermal protection



Key

1 is the maximum temperature after tripping

2 is temperature of the part which is the thermally critical part for a thermal overload with rapid variation

3 is the temperature when operating at normal duty

4 is the beginning of thermal overload with rapid variation

5 is the tripping time

6 is the temperature of the thermal detector or protector incorporated in the thermally critical part for thermal overload with slow variation

7 is the temperature of the part which is not the thermally critical part of the thermal overload with rapid variation, but which is the thermally critical part for a thermal overload with slow variation

X axis is time

Y axis is temperature

Figure 4 – Example of thermal overload with rapid variation where the thermally critical part has indirect thermal protection

7 Restart after tripping

Before restarting a machine that has tripped, an investigation shall be made to try to identify the cause of the operation of the machine protection. When attempting to restart the machine, account shall be taken of the conditions stated in 6.3 or ~~8~~9.3 of IEC 60034-12:2016.

The methods of protection included in this document only protect rotor windings indirectly. For large motors (particularly 2 pole motors) and for motors starting large inertia loads, special attention needs to be given to rotor heating both when starting and especially after a "trip" has occurred.

NOTE The provision of the facility to enable machines to be automatically restarted after tripping is a matter for special agreement taking full account of all safety implications.

8 Type tests

8.1 General

Type tests are to verify the compliance of a thermal protection system with the requirements of this document.

Tests shall be made on a machine which is representative of the machine type. The proposed thermal protection system shall be installed.

Temperature sensors used for testing shall be located in positions representative of the location of the thermal detectors used by the thermal protection system.

8.2 Verification of temperature due to the thermal overloads with slow variation

Starting with the machine at operating temperature, the load shall be slowly increased so that the temperature of the winding increases at a rate of less than 1 K per 5 min. Temperatures shall be recorded at a minimum of 10 min intervals.

When the thermal protection system trips, the supply to the machine shall be switched off if it is not directly interrupted by the thermal protection device. The winding temperature shall be determined immediately after tripping in accordance with the requirements of 8.6.2 of IEC 60034-1:2017.

The winding temperatures specified in Table 1 shall not be exceeded.

8.3 Verification of temperature due to thermal overloads with rapid variation

Verification of the temperature is required only in cases where a motor is protected by built-in positive temperature coefficient thermistors (PTC) or via a thermostat and where it is not protected by a thermal protection device.

Starting with the machine at ambient temperature, with the rotor locked to prevent rotation, apply rated voltage to the windings.

At the end of the energised period, the maximum temperature of the winding shall be recorded. For manual re-set systems, the protector shall be re-closed as quickly as possible and power restored.

Protection systems with automatic resetting shall be operated for a minimum of 10 cycles, unless the change in peak temperature between two cycles is below 5 K.

The highest temperature attained shall not exceed the values in Table 2.

9 Routine tests

Devices used for thermal detection shall be tested for circuit continuity to assure that no damage has occurred during installation.

IEC 60034-11

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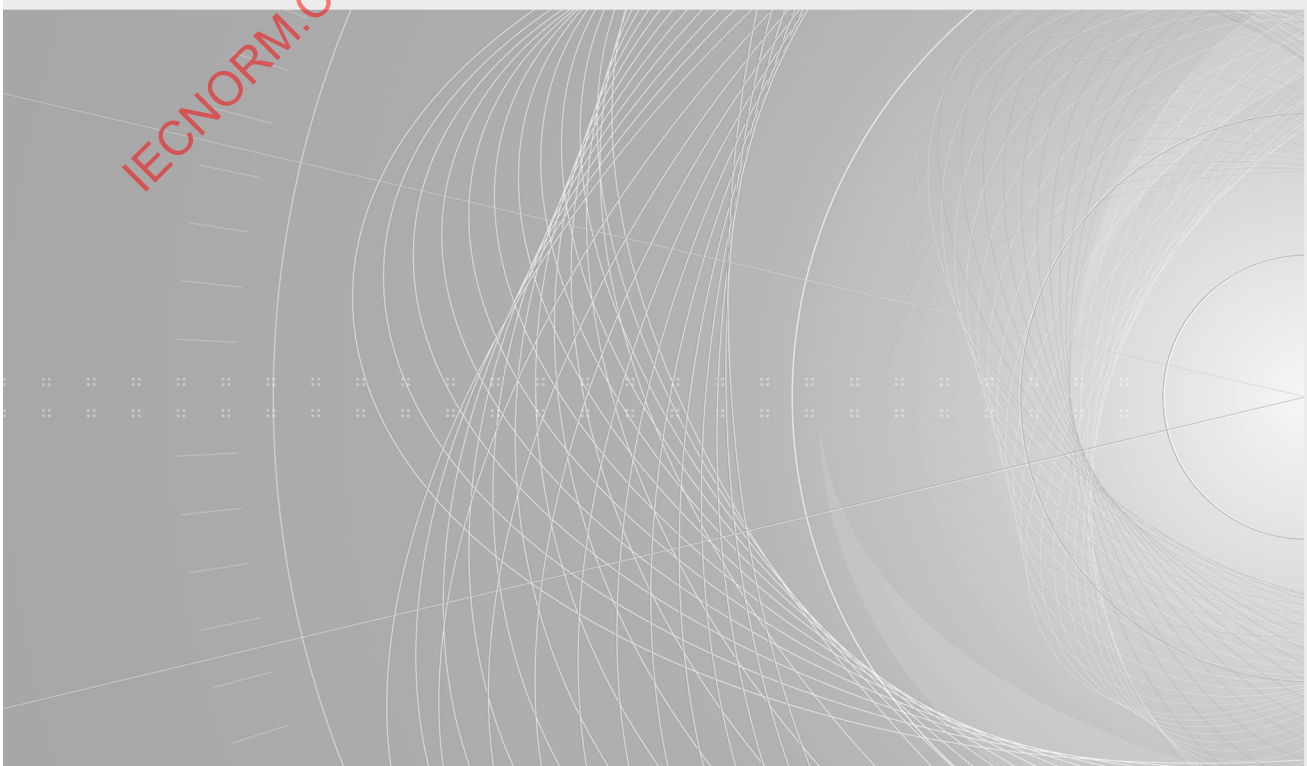
INTERNATIONAL STANDARD

NORME INTERNATIONALE

Rotating electrical machines – Part 11: Thermal protection

Machines électriques tournantes – Partie 11: Protection thermique



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The requirement to incorporate thermal protection in a machine is a matter for agreement. The application of this document is a matter of agreement between the user and the machine manufacturer.

ROTATING ELECTRICAL MACHINES –

Part 11: Thermal protection

1 Scope

This part of IEC 60034 specifies requirements relating to the use of thermal protectors and thermal detectors incorporated into the stator windings or placed in other suitable positions in induction machines in order to protect them against serious damage due to thermal overloads. It applies to single-speed three-phase 50 Hz or 60 Hz cage induction motors in accordance with IEC 60034-1 and IEC 60034-12 that:

- have a rated voltage up to 1 000 V;
- are intended for direct-on-line or star-delta starting.

Not included are:

- direct protection of the rotor winding; the methods of protection only protect rotor windings indirectly; for large motors (particularly 2 pole motors) and for motors starting large inertia loads, special attention is given to rotor heating both when starting and especially after a "trip" has occurred;
- the protection of bearings and other mechanical parts;
- the protection methods to be used for particular applications.

NOTE 1 Although temperature values given in this document are higher than those specified in IEC 60034-1, they are not in conflict.

NOTE 2 Additional requirements may apply to particular motor types, such as those used in household appliances, or for motors used in explosive atmospheres.

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

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3.2
thermal protection system
system for the protection of a machine winding against excessive temperature resulting from conditions of overload or loss of cooling by means of either thermal protector(s) or thermal detector(s)

3.3
thermal detector
electrically insulated device that is only sensitive to temperature, capable of initiating a switching function in a protection system when its temperature reaches a predetermined level

3.4
thermal protector
electrically insulated device that is sensitive to the temperature of the machine winding which carries machine current, capable of directly switching off the machine when its temperature reaches a predetermined level

Note 1 to entry: Some thermal protectors are sensitive to both temperature and current, the combination of which activates the direct switching off of the machine.

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overload condition or loss of cooling that produces a rise of temperature that is sufficiently slow that the temperature of the thermal protector or detector follows it without appreciable delay

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thermal overload with rapid variation
overload condition or loss of cooling that produces a rise of temperature that is too rapid for the temperature of the thermal protector or detector to follow without appreciable delay resulting in a significant temperature difference between the thermal device and the part to be protected

3.7
maximum temperature after tripping
maximum value of the temperature that is reached by the protected part of the machine during the period which follows tripping by the thermal protection system

3.8
direct thermal protection
form of protection where the part of the machine in which the thermal detector(s) or thermal protector(s) are incorporated is the part for which protection is being provided

3.9
indirect thermal protection
form of protection where the part of the machine in which the thermal detector(s) or thermal protector(s) are incorporated (e.g. the stator winding) is not the part for which protection is being provided (e.g. the rotor winding)

4 Thermal protection limits

Machines shall be capable of operating at rated output and at all operating conditions according to IEC 60034-1 without activation of the thermal protection device. The thermal protection device shall limit the winding temperature in accordance with Clause 5 or Clause 6.

5 Protection against thermal overloads with slow variation

When subjected to an overload or other misuse condition causing overheating with slow variation, the protection system shall operate to prevent the temperature of the machine winding from exceeding the values in Table 1.

Examples of the rise in temperature as a function of time are shown in Figure 1 and Figure 2.

Table 1 – Maximum winding temperatures for overloads with slow variation

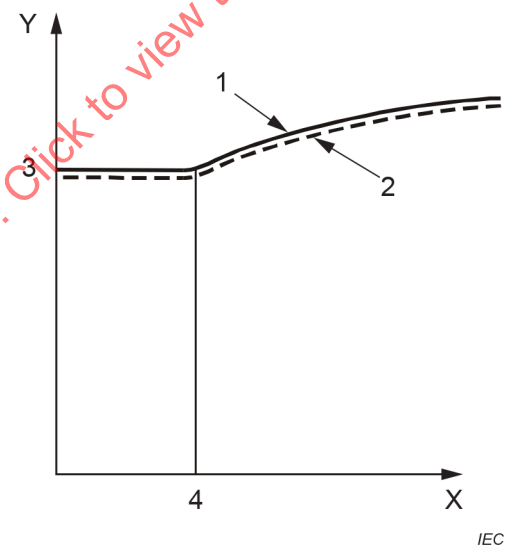
Thermal class	130(B)	155(F)	180(H)	200(N)
Maximum insulated winding temperature °C	145	170	195	215

The winding temperature shall be determined by the resistance method in accordance with the requirements of 8.6.2 of IEC 60034-1:2017.

NOTE 1 The limit values in Table 1 exceed the thermal classification and thus will reduce the lifetime of the motor.

NOTE 2 The maximum temperature limits are based on experience. Some of the ways in which a thermal overload with slow variation may be caused are:

- Defects in ventilation or the ventilation system due to excessive dust in the ventilation ducts, or dirt on windings or frame cooling ribs, etc.
- An excessive rise in ambient temperature or the temperature of the cooling medium.
- Gradual increasing mechanical overload.
- Prolonged voltage drop, over-voltage or unbalance in the machine supply.
- Excessive duty on a motor rated for intermittent duty.
- Frequency deviations.



Key

1 is the winding temperature in the vicinity of the thermal protector or detector

2 is the temperature of the thermal protector or detector

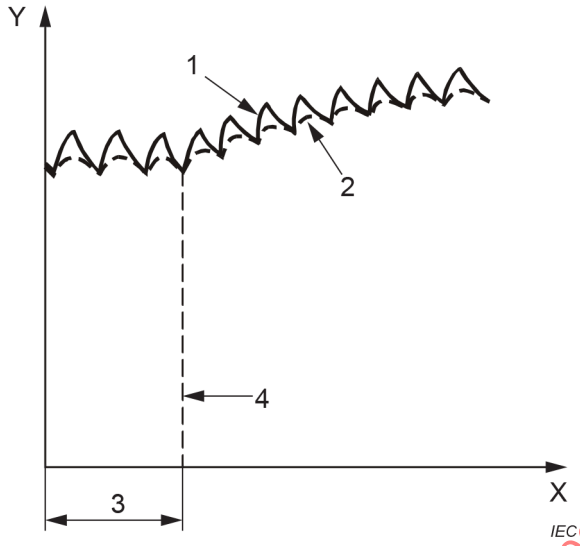
3 is the temperature when operating at normal duty

4 is the time at the beginning of the thermal overload

X axis is time

Y axis is temperature

Figure 1 – Example of thermal overload with slow variation and direct thermal protection



Key

1 is the winding temperature in the vicinity of the thermal detector or protector

2 is the temperature of the thermal detector or protector

3 is the interval with normal cycling frequency

4 is the time at the beginning of the thermal overload

X axis is time

Y axis is temperature

Figure 2 – Example of thermal overload with slow variation in the case of too intensive intermittent periodic duty with starting (duty S4) and direct thermal protection

6 Protection against thermal overloads with rapid variation

When a thermal overload with rapid variation is applied to the machine, the thermal protection system shall operate to prevent the temperature of the machine winding from exceeding the values given in Table 2.

A current overload relay does not normally provide protection against repeated rapid overload variations and the use of a thermal protection device should be considered

Examples of the rise in temperature as a function of time are shown in Figure 3 and Figure 4.

Table 2 – Maximum winding temperatures for overloads with rapid variation

Thermal class	130(B)	155(F)	180(H)	200(N)
Maximum insulated winding temperature °C	225	250	275	295

The winding temperature shall be determined by direct measurements such as thermocouples in accordance with the requirements of 8.5.3 of IEC 60034-1:2017.

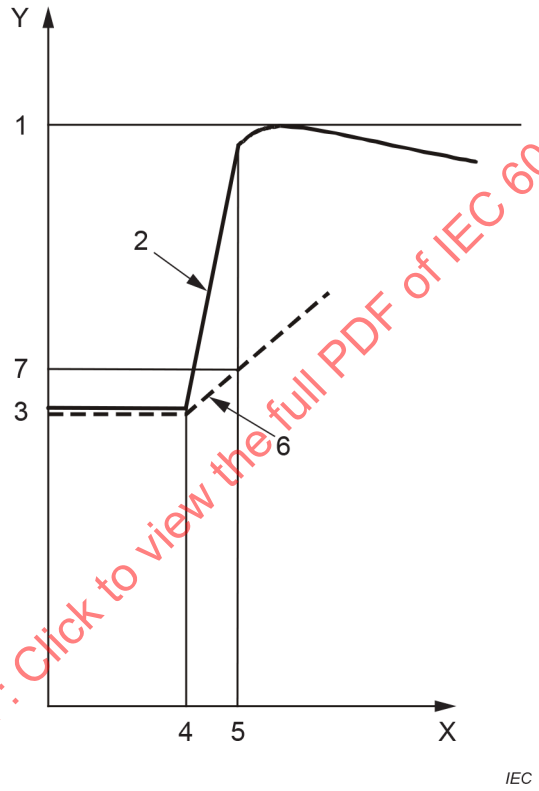
It is understood that the motor winding may be permanently damaged and may not be able to operate after it has been exposed to temperatures according to Table 2.

NOTE 1 Some of the ways in which a thermal overload with rapid variation may be caused are:

- Stalling the motor.
- Phase failure.
- Starting under abnormal conditions, for example, inertia too great, voltage too low, load torque abnormally high;
- Sudden and significant increase in load.
- Starting repeatedly during a short time.

NOTE 2 The maximum temperature limits are based on experience, taking into account factors such as ambient temperature, variations in supply voltage and normal requirements for starting motors.

The temperatures in Table 2 shall not be confused with the operating temperatures of the winding's thermal protector or thermal detector which have to be significantly below these values. The thermal protector shall be installed at a place where the highest temperatures are expected according to the application and the motor cooling system.



Key

1 is the maximum winding temperature after tripping

2 is the winding temperature in the vicinity of the thermal protector or detector

3 is the temperature when operating at normal duty

4 is the time at the beginning of the thermal overload

5 is the time at which tripping occurs

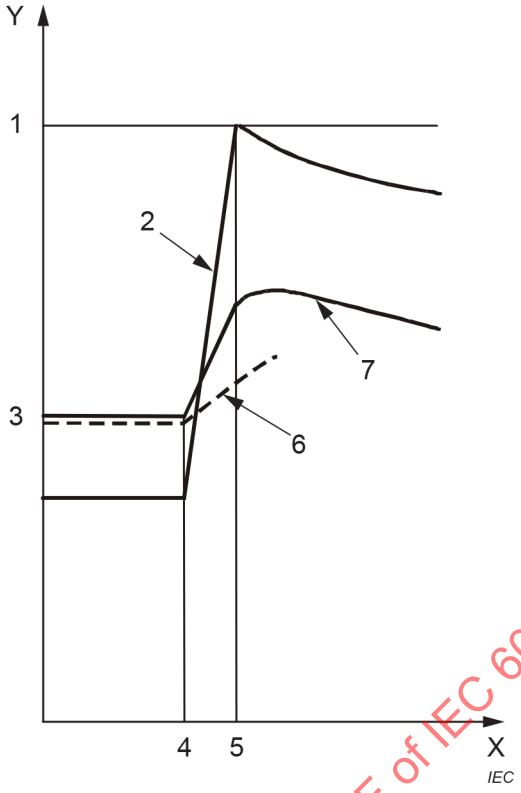
6 is the temperature of the thermal protector or detector

7 is the operating temperature of the thermal detector or protector

X axis is time

Y axis is temperature

Figure 3 – Example of thermal overload with rapid variation where the thermally critical part has direct thermal protection



Key

1 is the maximum temperature after tripping

2 is temperature of the part which is the thermally critical part for a thermal overload with rapid variation

3 is the temperature when operating at normal duty

4 is the beginning of thermal overload with rapid variation

5 is the tripping time

6 is the temperature of the thermal detector or protector incorporated in the thermally critical part for thermal overload with slow variation

7 is the temperature of the part which is not the thermally critical part of the thermal overload with rapid variation, but which is the thermally critical part for a thermal overload with slow variation

X axis is time

Y axis is temperature

Figure 4 – Example of thermal overload with rapid variation where the thermally critical part has indirect thermal protection

7 Restart after tripping

Before restarting a machine that has tripped, an investigation shall be made to try to identify the cause of the operation of the machine protection. When attempting to restart the machine, account shall be taken of the conditions stated in 6.3 or 9.3 of IEC 60034-12:2016.

The methods of protection included in this document only protect rotor windings indirectly. For large motors (particularly 2 pole motors) and for motors starting large inertia loads, special attention needs to be given to rotor heating both when starting and especially after a "trip" has occurred.

NOTE The provision of the facility to enable machines to be automatically restarted after tripping is a matter for special agreement taking full account of all safety implications.

8 Type tests

8.1 General

Type tests are to verify the compliance of a thermal protection system with the requirements of this document.

Tests shall be made on a machine which is representative of the machine type. The proposed thermal protection system shall be installed.

Temperature sensors used for testing shall be located in positions representative of the location of the thermal detectors used by the thermal protection system.

8.2 Verification of temperature due to the thermal overloads with slow variation

Starting with the machine at operating temperature, the load shall be slowly increased so that the temperature of the winding increases at a rate of less than 1 K per 5 min. Temperatures shall be recorded at a minimum of 10 min intervals.

When the thermal protection system trips, the supply to the machine shall be switched off if it is not directly interrupted by the thermal protection device. The winding temperature shall be determined immediately after tripping in accordance with the requirements of 8.6.2 of IEC 60034-1:2017.

The winding temperatures specified in Table 1 shall not be exceeded.

8.3 Verification of temperature due to thermal overloads with rapid variation

Verification of the temperature is required only in cases where a motor is protected by built-in positive temperature coefficient thermistors (PTC) or via a thermostat and where it is not protected by a thermal protection device.

Starting with the machine at ambient temperature, with the rotor locked to prevent rotation, apply rated voltage to the windings. At the end of the energised period, the maximum temperature of the winding shall be recorded. For manual re-set systems, the protector shall be re-closed as quickly as possible and power restored.

Protection systems with automatic resetting shall be operated for a minimum of 10 cycles, unless the change in peak temperature between two cycles is below 5 K.

The highest temperature attained shall not exceed the values in Table 2.

9 Routine tests

Devices used for thermal detection shall be tested for circuit continuity to assure that no damage has occurred during installation.

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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MACHINES ÉLECTRIQUES TOURNANTES –

Partie 11: Protection thermique

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La Norme internationale IEC 60034-11 a été établie par le comité d'études 2 de l'IEC: Machines tournantes.

Cette troisième édition annule et remplace la deuxième édition, parue en 2004. Cette édition constitue une révision technique.

Par rapport à l'édition précédente, les modifications majeures sont les suivantes

– spécification supplémentaire relative aux limites de température de l'enroulement pour la classe thermique 200 (N),
– augmentation des limites des températures maximales d'enroulement pour surcharges à évolution rapide,
– précision concernant l'enroulement du moteur qui peut être endommagé de façon permanente après une exposition aux températures mentionnées dans le Tableau 2,

– précision du domaine d'application,
– précision de la définition de protection thermique indirecte,
– note explicative à l'Article 6,
– conversion de la Note 3 de l'Article 6 en un texte normal, y compris les modifications de caractères,
– insertion de la Note 3 de l'Article 5 dans l'Article 2,
– précision, au 8.3, concernant les méthodes d'essai pour les moteurs plus importants.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
2/2011/FDIS	2/2019/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60034, publiées sous le titre général *Machines électriques tournantes*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous «http://webstore.iec.ch» dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Les systèmes de protection thermique sont fondés sur le principe de la protection ou de la surveillance des organes de machine vulnérables contre des températures excessives. Cela exige la sélection d'un dispositif de protection thermique adapté à la fois au type de protection exigé et à l'élément de la machine à protéger. La présente norme ne spécifie pas les méthodes de protection disponibles ni la méthode de protection à utiliser pour des applications particulières. Elle spécifie en revanche, pour les organes de machine protégés, la température qu'il convient de ne pas dépasser en cas de défaut ou de dépassement des caractéristiques.

Les exigences n'ont pas pour objet de garantir une durée de vie «normale» aux machines, quelles que soient leurs conditions d'utilisation, mais plutôt d'éviter à la fois des défaillances et un vieillissement thermique prématuré accéléré de l'isolation de l'enroulement. Les exigences résultent d'un compromis dans la mesure où il convient que le niveau de protection ne soit placé ni trop bas pour ne pas provoquer de déclenchement intempestif, ni trop haut, afin de ne pas permettre un fonctionnement permanent à des températures préjudiciables à la durée de vie de l'isolation de l'enroulement.

Une durée de vie normale de l'isolation ne peut être garantie que par une utilisation correcte et une bonne maintenance du moteur. Le fonctionnement fréquent au-delà des limites de température normale (voir l'IEC 60034-1) qui ne peut être évité par une protection thermique incorporée sans risquer de déclenchement intempestif, peut entraîner une réduction notable de la durée de vie de la machine. La durée de vie de l'isolation de l'enroulement est approximativement réduite de moitié à chaque augmentation de 8 K à 10 K de la température de fonctionnement continu.

L'exigence relative à l'incorporation d'une protection thermique dans une machine fait l'objet d'un accord. L'application de la présente norme fait l'objet d'un accord entre l'utilisateur et le fabricant de la machine.

MACHINES ÉLECTRIQUES TOURNANTES –

Partie 11: Protection thermique

1 Domaine d'application

La présente partie de l'IEC 60034 spécifie les exigences relatives à l'utilisation de protecteurs et détecteurs thermiques incorporés dans les enroulements statoriques, ou autres emplacements adaptés, dans les machines à induction afin de les protéger contre de graves dommages dus aux surcharges thermiques. Elle s'applique aux moteurs triphasés à induction à cage à une seule vitesse fonctionnant à 50 Hz ou 60 Hz conformément à l'IEC 60034-1 et à l'IEC 60034-12 qui:

- ont une tension assignée jusqu'à 1 000 V;
- sont prévus pour un démarrage direct ou étoile-triangle.

Elle ne concerne pas:

- la protection directe de l'enroulement rotorique; les méthodes de protection ne protègent qu'indirectement les enroulements rotoriques; pour les gros moteurs (en particulier les moteurs à deux pôles) et pour les moteurs ayant des charges de grande inertie. Une attention particulière est portée à l'échauffement du rotor au démarrage, et surtout après un déclenchement;
- la protection des paliers et autres organes mécaniques;
- les méthodes de protection à utiliser pour des applications spécifiques.

NOTE 1 Bien que les valeurs de température données dans le présent document soient supérieures à celles spécifiées dans l'IEC 60034-1, elles ne sont pas conflictuelles.

NOTE 2 Certains types de moteurs, comme les moteurs pour application domestique ou pour atmosphères explosives peuvent faire l'objet d'exigences complémentaires.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60034-1:2017, *Machines électriques tournantes – Partie 1: Caractéristiques assignées et caractéristiques de fonctionnement*

IEC 60034-12:2016, *Machines électriques tournantes – Partie 12: Caractéristiques de démarrage des moteurs triphasés à induction à cage à une seule vitesse*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
protection thermique
protection des enroulements d'une machine contre une température excessive résultant de conditions de surcharge ou de perte de refroidissement

3.2
système de protection thermique
système destiné à la protection des enroulements d'une machine contre une température excessive résultant de conditions de surcharge ou de perte de refroidissement au moyen de protecteur(s) ou de détecteur(s) thermique(s)

3.3
détecteur thermique
dispositif isolé électriquement, sensible uniquement à la température et prévu pour déclencher une fonction de commutation dans un système de protection lorsque sa température atteint un niveau prédéterminé

3.4
protecteur thermique
dispositif isolé électriquement, sensible à la température de l'enroulement de la machine, qui est parcouru par le courant de la machine, et prévu pour arrêter directement la machine lorsque sa température atteint un niveau prédéterminé

Note 1 à l'article: Certains protecteurs thermiques sont sensibles à la fois à la température et au courant de la machine, la combinaison de ces deux paramètres active l'arrêt direct de la machine.

3.5
surcharge thermique à évolution lente
condition de surcharge ou perte de refroidissement produisant un échauffement suffisamment lent pour que la température du protecteur ou du détecteur thermique la suive sans retard notable

3.6
surcharge thermique à évolution rapide
condition de surcharge ou perte de refroidissement produisant un échauffement trop rapide pour que la température du protecteur ou du détecteur thermique la suive sans retard notable, il en résulte un écart important de température entre le dispositif thermique et l'organe à protéger

3.7
température maximale après déclenchement
valeur maximale de température atteinte par l'organe protégé de la machine pendant la période qui suit le déclenchement par le système de protection thermique

3.8
protection thermique directe
mode de protection appliqué lorsque l'organe de la machine, auquel le ou les détecteurs ou protecteurs thermiques sont incorporés, est l'organe bénéficiant de la protection

3.9
protection thermique indirecte
mode de protection appliqué lorsque l'organe de la machine, auquel le ou les détecteurs ou protecteurs thermiques sont incorporés (par exemple, l'enroulement statorique), n'est pas l'organe bénéficiant de la protection (par exemple, enroulement rotorique)