

INTERNATIONAL STANDARD

NORME INTERNATIONALE



AC motor capacitors –
Part 1: General – Performance, testing and rating – Safety requirements –
Guidance for installation and operation

Condensateurs des moteurs à courant alternatif –
Partie 1: Généralités – Caractéristiques fonctionnelles, essais et valeurs
assignées – Règles de sécurité – Lignes directrices pour l'installation et
l'utilisation

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

AC MOTOR CAPACITORS –

Part 1: General – Performance, testing and rating – Safety requirements – Guidance for installation and operation

FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 60252-1 edition 2.1 contains the second edition (2010) [documents 33/470/FDIS and 33/473/RVD] and its amendment 1 (2013) [documents 33/532/FDIS and 33/538/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 60252-1 has been prepared by IEC technical committee 33: Power capacitors and their applications.

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

- the definition of “segmented capacitors” has been added, in 3.6;
- the definition of “classes of operation “ has been clarified, with the addition of the concept of “probable life” with reference to statistics, in 3.9;
- the following wording “Operation above the rated voltage will reduce the life expectancy of the capacitor” has been introduced in 6.1;
- some clarifications have been added to Clause 8, Marking, mainly for small capacitors.

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

A list of all parts of IEC 60252 series, under the general title *AC motor capacitors* can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site 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- withdrawn,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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AC MOTOR CAPACITORS –

Part 1: General – Performance, testing and rating – Safety requirements – Guidance for installation and operation

1 Scope and object

This part of IEC 60252 applies to motor capacitors intended for connection to windings of asynchronous motors supplied from a single-phase system having a frequency up to and including 100 Hz, and to capacitors to be connected to three-phase asynchronous motors so that these motors may be supplied from a single-phase system.

This standard covers impregnated or unimpregnated capacitors having a dielectric of paper, plastic film, or a combination of both, either metallized or with metal-foil electrodes, with rated voltages up to and including 660 V.

Motor start capacitors are covered by IEC 60252-2.

NOTE The following are excluded from this standard:

- shunt capacitors of the self-healing type for a.c. power systems of up to and including 1 000 V nominal voltage (see IEC 60831-1);
- shunt capacitors of non-self-healing type for a.c. power systems of up to and including 1 000 V nominal voltage (see IEC 60931-1);
- shunt capacitors for a.c. power systems having a nominal voltage above 1 000 V (see IEC 60871-1);
- capacitors for induction heat-generating plants, operating at frequencies between 40 Hz and 24 000 Hz (see IEC 60110-1);
- series capacitors (see IEC 60143);
- coupling capacitors and capacitor dividers (see IEC 60358);
- capacitors to be used in power electronic circuits (see IEC 61071);
- small a.c. capacitors to be used for fluorescent and discharge lamps (see IEC 61048);
- capacitors for suppression of radio interference (IEC publication under consideration);
- capacitors intended to be used in various types of electrical equipment and thus considered as components;
- capacitors intended for use with d.c. voltage superimposed on a.c. voltage.

The object of this standard is

- a) to formulate uniform rules regarding performance, testing and rating;
- b) to formulate specific safety rules;
- c) to provide a guidance for installation and operation.

2 Normative references

The following referenced documents are indispensable for the application 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 60062, *Marking codes for resistors and capacitors*

IEC 60068 (all parts), *Environmental testing*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60309-1, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code)*

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end products*

ISO 4046:2002, *Paper, board, pulps and related terms – Vocabulary*

3 Terms and definitions

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

3.1

motor running capacitor

a power capacitor which, when used in conjunction with an auxiliary winding of a motor, assists the motor to start and improves the torque under running conditions

NOTE The running capacitor is usually connected permanently to the motor winding and remains in circuit throughout the running period of the motor. During the starting period, if it is in parallel with the starting capacitor, it helps to start the motor.

3.2

motor starting capacitor

a power capacitor which provides a leading current to an auxiliary winding of a motor and which is switched out of circuit once the motor is running

3.3

metal foil capacitor

a capacitor, the electrodes of which consist of metal foils or strips separated by a dielectric

3.4

metallized capacitor

a capacitor, in which the electrodes consist of a metallic deposit on the dielectric

3.5

self-healing capacitor

a capacitor, the electrical properties of which, after local breakdown of the dielectric, are rapidly and essentially self-restored

3.6**segmented film capacitor**

a metallised capacitor with a repeating pattern on the metallic deposit on at least one layer, designed to isolate sections of the capacitor in the event of localised faults occurring in the dielectric

3.7**discharge device of a capacitor**

a device which may be incorporated in a capacitor, capable of reducing the voltage between the terminals effectively to zero, within a given time, after the capacitor has been disconnected from a network

3.8**continuous operation**

operation with no time limit within the normal life of the capacitor

3.9**class of operation**

the minimum probable total life for which the capacitor has been designed at rated duty, voltage, temperature and frequency

NOTE 1 Four classes have been foreseen

Class A – 30 000 h

Class B – 10 000 h

Class C – 3 000 h

Class D – 1 000 h

These classes of operation are intended to represent a probable failure rate not exceeding 3 % during the life of the product.

Failures considered are: short-circuits, interruptions, leakage of liquid, capacitance drifts exceeding 10 % out of the rated tolerance limits

A capacitor may have more than one class with corresponding voltages.

NOTE 2 Classes of operation have a statistical value (the “law of big numbers”): it is not possible to transfer automatically data coming from a limited quantity to a whole population or even to a batch of capacitors. The purchaser and the manufacturer should agree upon to confront the case of a true failure rate larger than 3 %.

3.10**minimum permissible capacitor operating temperature**

minimum permissible temperature on the outside of the case at the moment of switching on the capacitor

3.11**maximum permissible capacitor operating temperature**

t_c

maximum permissible temperature of the hottest area of the outside of the capacitor case during operation

3.12**rated voltage of a capacitor**

U_N

r.m.s. value of the alternating voltage for which the capacitor has been designed

3.13**rated frequency of a capacitor**

f_N

highest frequency for which the capacitor has been designed

3.14**rated capacitance of a capacitor** C_N

capacitance value for which the capacitor has been designed

3.15**rated current of a capacitor** I_N

r.m.s. value of the alternating current at the rated voltage and frequency for which the capacitor has been designed

3.16**rated output of a capacitor** Q_N

reactive power derived from the rated values of capacitance, frequency and voltage (or current)

3.17**capacitor losses**

active power dissipated by a capacitor

NOTE Unless otherwise stated, the capacitor losses will be understood to include losses in fuses and discharge resistors forming an integral part of the capacitor.

3.18**tangent of loss angle (tan delta) of a capacitor**

ratio between the equivalent series resistance and the capacitive reactance of a capacitor at specified sinusoidal alternating voltage and frequency

3.19**capacitive leakage current (only for capacitors with a metal case)**

current flowing through a conductor connecting the metallic case to earth, when the capacitor is energized from an a.c. supply system with an earthed neutral

3.20**type of capacitor**

capacitors are considered to be of the same type when of similar constructional form, the same constructional technology, same rated voltage, same climatic category and same kind of operation. Capacitors of the same type can differ only in rated capacitance and size. Minor differences between terminations and mounting devices are permitted

NOTE The same construction includes, for example, the same dielectric material, dielectric thickness and type of case (metal or plastic).

3.21**model of capacitor**

capacitors are considered to be of the same model when they are of the same construction and have the same functional and dimensional characteristics within the tolerance limits and are consequently interchangeable

3.22**class of safety protection**degree of safety protection identified by one of ~~three~~ four codes to be marked on the capacitor

~~(P2) — indicates that the capacitor type has been designed to fail in the open-circuit mode only and is protected against fire or shock hazard. Compliance is verified by the test described in 5.16.~~

~~(P1) indicates that the capacitor type may fail in the open-circuit or short-circuit mode and is protected against fire or shock hazard. Compliance is verified by the test described in 5.16.~~

~~(P0) indicates that the capacitor type has no specific failure protection~~

3.22.1

(S0) class of safety protection

degree of safety protection indicating that the capacitor type has no specific failure protection

Note 1 to entry: Formerly referred to as P0.

3.22.2

(S1) class of safety protection

degree of safety protection indicating that the capacitor type may fail in the open-circuit or short-circuit mode and is protected against fire or shock hazard

Note 1 to entry: Compliance is verified by the test described in 5.16.3 and 5.16.5.

Note 2 to entry: Formerly referred to as P1.

3.22.3

(S2) class of safety protection

degree of safety protection indicating that the capacitor type has been designed to fail in the open-circuit mode only and is protected against fire or shock hazard

Note 1 to entry: Compliance is verified by the test described in 5.16.3 and 5.16.5.

Note 2 to entry: formerly referred to as P2.

3.22.4

(S3) class of safety protection

degree of safety protection indicating that the capacitor is of segmented film construction as defined in 3.6

Note 1 to entry: This capacitor type is required to fail with low residual capacitance ($<1\% C_N$) and has protection against fire and shock hazard. Compliance is verified by the test described in 5.16.4 and 5.16.6.

4 Service conditions

4.1 Normal service conditions

This standard gives requirements for capacitors intended for use under the following conditions:

- a) altitude: not exceeding 2 000 m;
- b) residual voltage at energization: shall not exceed 10 % rated voltage (see 7.4, note);
- c) pollution: capacitors included in the scope of this standard are designed for operation in lightly polluted atmospheres;

NOTE The IEC has not yet established a definition for "lightly polluted". When this definition is established by the IEC, it will be incorporated in this standard.

- d) operating temperature: between -40 °C and $+100\text{ °C}$ (see 3.10 and 3.11).

The preferred minimum and maximum permissible capacitor operating temperatures are as follows:

- minimum temperatures: -40 °C , -25 °C , -10 °C and 0 °C ;
- maximum temperatures: 55 °C , 70 °C , 85 °C and 100 °C .