

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



AMENDMENT 1  
AMENDEMENT 1

**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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## FOREWORD

This amendment has been prepared by IEC technical committee 33: Power capacitors and their applications.

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

FDIS	Report on voting
33/532/FDIS	33/538/RVD

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

The committee has decided that the contents of this amendment and the base publication 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- withdrawn,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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## 2 Normative references

*Replace the reference to IEC 60529 by the following:*

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

*Replace the reference to ISO 4046 by the following:*

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

## 3 Terms and definitions

### 3.22

#### class of safety protection

*Replace definition 3.22 by the following:*

### 3.22

#### **class of safety protection**

degree of safety protection identified by one of four codes to be marked on the capacitor

#### 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

<https://standards.iteh.ai/catalog/standards/sist/09b4a774-e9a2-45fd-83cb-a6aa392462f0/iec-60252-1-2010-amd1-2013>

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.

## 5.16 Destruction test

*Replace Subclause 5.16 by the following:*

## 5.16 Destruction test

### 5.16.1 General

This test is optional.

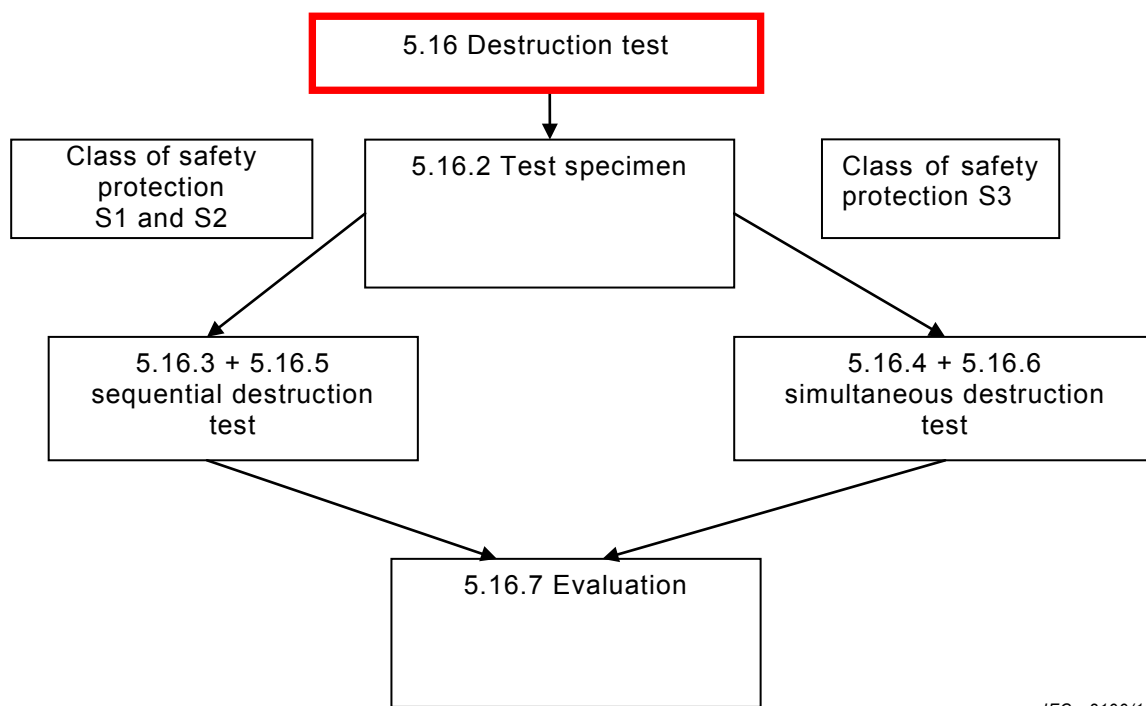
Refer to revised definition 3.22 for the appropriate test for each class of safety protection.

Capacitors marked S0 are not required to be tested in accordance with this subclause.

Capacitors fitted with overpressure disconnect device designated S1 and S2 shall be subjected to the sequential DC and AC test described in 5.16.3 and 5.16.5.

Capacitors with segmented film as defined in 3.6 and designated S3 class of safety protection shall be subjected to the simultaneous DC and AC test described in 5.16.4 and 5.16.6.

For capacitors designated S1, S2 and S3 refer to Figure 1.



IEC 2199/13

**Figure 1 – Destruction test**  
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**5.16.2 Test specimens**

The test is to be carried out on 10 samples, with a similar specimen of 10 samples held in reserve for possible retest. Half the test specimens (5) shall have passed the test according to 5.4.1. The remaining five capacitors shall have passed the endurance test described in 5.13 (group 2).

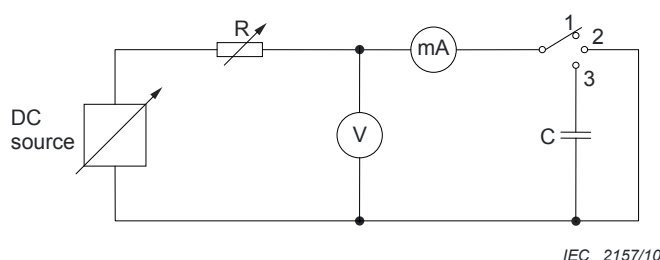
For capacitors with a metal case, the metal case shall be connected to one of the terminals of the voltage source.

If a distinction can be made between the capacitor terminals, the group shall be subdivided into two subgroups. The first subgroup shall have terminal A connected to the case, the second subgroup shall have terminal B connected to the case.

**5.16.3 Test apparatus for sequential DC and AC test (capacitor type S1 and S2)**

**5.16.3.1 Test apparatus for d.c. conditioning**

Apparatus for carrying out the d.c. conditioning is shown in Figure 2. The d.c. source shall be capable of delivering an open-circuit voltage equivalent to  $10 U_N$  and have a sustained short circuit capability greater than 50 mA.



IEC 2157/10

**Figure 2 – Test apparatus for d.c. conditioning**

The d.c. source is adjusted to provide an open-circuit voltage equivalent to  $10 U_N$  with the switch in position 1.

A variable resistor  $R$  is adjusted to provide a current of 50 mA with the switch in position 2. DC voltage is applied to the test capacitor with the switch in position 3.

### 5.16.3.2 Test apparatus for a.c. destruction test

- The instantaneous short-circuit current of the a.c. supply shall be at least 300 A.
- A 25 A slow-blow fuse and adjustable inductance ( $L$ ) shall be inserted between the a.c. source and the capacitor (see Figure 3).

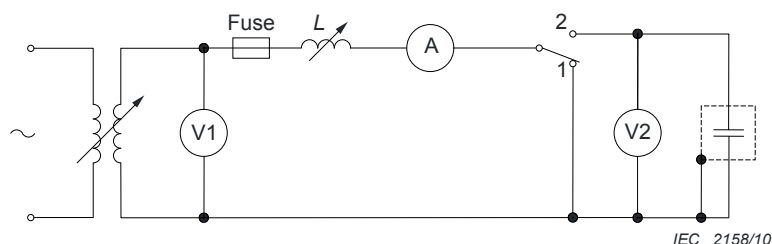


Figure 3 – Test apparatus for a.c. destruction test

The inductor shall be so adjusted that, with the switch in position 1 and a voltage of  $1,3 U_N$  applied across the voltmeter V1, a current equal to 1,3 times the capacitor rated current ( $I_N$ ) flows.

(standards.iteh.ai)

The capacitor is energized with the switch in position 2.

IEC 60252-1:2010/AMD1:2013

NOTE The variable inductor  $L$  in Figure 3 may be replaced by the arrangement shown in Figure 4 whereby T2 is a fixed ratio transformer and  $L_f$  is a fixed inductor. A variable ratio transformer T1 is used to adjust the inductive current.

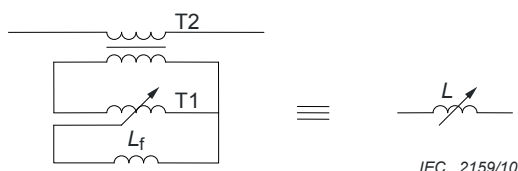
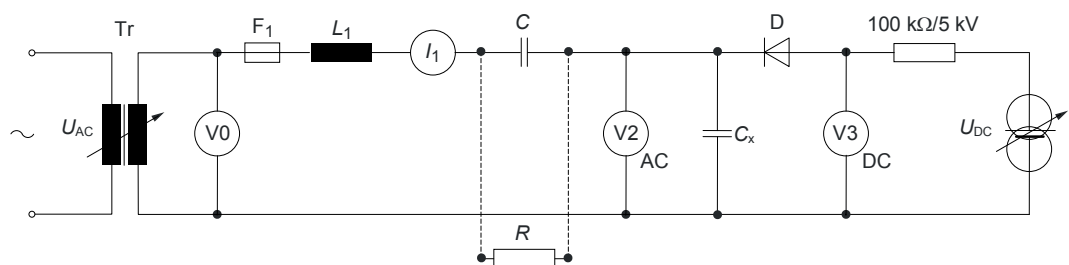


Figure 4 – Arrangement to produce the variable inductor  $L$  in Figure 3

### 5.16.4 Test apparatus for simultaneous DC and AC test (capacitor type S3)

Apparatus for carrying out the simultaneous DC and AC test is shown in Figure 5. The d.c. source ( $U_{dc}$ ) shall be capable of delivering an open-circuit voltage equivalent to  $10 U_N$  and shall have a sustained short-circuit capability greater than 50 mA but limited to 50 mA during the test.



Tr	Transformer (AC power supply) with sufficient capacity to supply an instantaneous short-circuit current of at least 300 A
F <sub>1</sub>	Slow-blow fuse, rated 25 A
L <sub>1</sub>	Inductor of approximately 10 mH for grid decoupling (resonant free in all switching modes)
C	Capacitor for DC decoupling: $C \geq 10 \times C_x$ (e.g. $C = 330 \mu\text{F} \rightarrow C_{x\text{max}} = 33 \mu\text{F}$ )/ $U_{\text{cmax}} = 5 \text{ kV}$
C <sub>x</sub>	Capacitor under test
D	High voltage diode for AC decoupling
I <sub>1</sub>	AC current: $1,3 \times I_R$ at the beginning of the test when the capacitor is full operative ( $I_R =$ Rated current of the capacitor under test)
V2	AC test voltage: $1,3 \times U_R$ ( $U_R =$ Rated voltage of the capacitor under test)
V3	DC test voltage: Voltage increase from 0 V to max. $10 \times U_R$ at a rate of 200 V/min ( $U_R =$ Rated voltage of the capacitor under test)
R	Resistor for capacitor discharging at the end of the test

**Figure 5 – Test apparatus for simultaneous DC and AC**

### 5.16.5 Test procedure for sequential DC and AC test (capacitor type S1 and S2)

#### 5.16.5.1 General

The test shall be conducted in four stages:

- 5.16.5.2 Preparation and pre-conditioning,
- 5.16.5.3 DC conditioning,
- 5.16.5.4 AC destruction test,
- 5.16.7 Evaluation of the failure.

NOTE The purpose of the d.c. conditioning is to produce a dielectric breakdown condition. It is not the intention that d.c. conditioning is used to create open-circuit capacitors.

#### 5.16.5.2 Preparation and pre-conditioning

All the test specimens shall be prepared and pre-conditioned as follows:

The capacitors shall be wrapped closely in tissue paper complying with 6.86 of ISO 4046:2002 and mounted within an "air circulating" test chamber at  $t_c + 10 \text{ }^\circ\text{C}$ . The temperature deviation shall not exceed  $\pm 2 \text{ }^\circ\text{C}$ . In preparation for the destruction test, the specimens shall have rated voltage ( $U_N$ ) applied for 2 h at  $t_c + 10 \text{ }^\circ\text{C}$ .

No open-circuit or short-circuit capacitors are permitted. If this occurs, the type shall be declared a failure.

#### 5.16.5.3 DC conditioning

Five capacitors that have passed the endurance test (group 2) shall be pre-heated to a temperature of  $t_c + 10 \text{ }^\circ\text{C}$  before d.c. conditioning. The remaining five capacitors, having passed the test in 5.4.1 shall be tested at room temperature.

The voltage of a d.c. source (see Figure 2) shall be raised from zero to a maximum of  $10 U_N$  at a rate of approximately 200 V/min until a short-circuit occurs or  $10 U_N$  has been reached.

Capacitors shall be removed from d.c. conditioning when the voltage indicated on the voltmeter is zero or  $10 U_N$  has been reached and maintained for a period of 5 min or other period as defined by the manufacturer.

A capacitor that becomes open-circuit after the d.c. conditioning shall be replaced by another sample and not counted. The d.c. conditioning test may be repeated on new samples until all the 10 reserve specimens referred to in 5.16.1 have been used up. If the required number of



capacitors with dielectric breakdown cannot be achieved, then the test shall be regarded as failed.

#### 5.16.5.4 AC destruction test

With the capacitors maintained at the d.c. conditioning temperature, they shall then have applied an a.c. voltage of  $1,3 U_N$  (see Figure 3) . If the capacitor clears (becomes operative) or becomes open-circuit, the voltage shall be maintained for 5 min. If the capacitor is still operative after 5 min then the d.c. conditioning shall be repeated.

If the capacitor becomes short-circuit then the test shall be maintained for 8 h.

### 5.16.6 Test procedure for simultaneous DC and AC test (capacitor type S3)

#### 5.16.6.1 Preparation and pre-conditioning

Same as 5.16.5.2.

#### 5.16.6.2 Simultaneous DC and AC test

Five capacitors that have passed the endurance test (group 2) shall be pre-heated to a temperature of  $t_c + 10$  °C before testing. The remaining five capacitors, having passed the test in 5.4.1 shall be tested at room temperature.

Apply a constant a.c. voltage of  $1,3 U_N$  at  $U_{ac1}$  ( $V_2$ ) and measure the initial current ( $I_1$ ).

The voltage of a d.c. source  $U_{dc1}$  ( $V_3$ ) shall be raised from zero to a maximum of  $10 U_N$  at a rate of approximately 200 V/min until the capacitor becomes inoperative or  $10 U_N$  has been reached.

[IEC 60252-1:2010/AMD1:2013](https://standards.iteh.ai/catalog/standards/sist/09b4a774-e9a2-45fd-83cb-2e022e110152/iec-60252-1-2010/amd1-2013)

<https://standards.iteh.ai/catalog/standards/sist/09b4a774-e9a2-45fd-83cb-2e022e110152/iec-60252-1-2010/amd1-2013>

The capacitor shall be considered as failed if it does not become inoperative (capacitance  $<1$  %  $C_N$ ) within 5 minutes at  $10 U_N$ .

The d.c. current shall be limited to 50 mA.

NOTE Inoperative means the current is lower than 1 % of the initial current measured at the same a.c. voltage and frequency as the initial measurement.

#### 5.16.7 Evaluation of the failure

After completion of the test, the tissue paper shall not have burnt on any test specimen; however, it may be discoloured by escaping substances.

Each capacitor shall meet the following:

- escaping liquid material may wet the outer surface of the capacitor, but not fall away in drops;
- internal live parts shall not be accessible to the standard test finger (see Figure 1 of IEC 60529:2001);
- burning or scorching of the tissue paper shall not be evident, since this would indicate that flames or fiery particles have been emitted from the openings;
- the capacitor shall withstand the test of 5.8 with the voltage being reduced to 0,8 times the value indicated.

The test is concluded when 10 capacitors have become short circuit or open circuit (for capacitors type S1), open circuit (for capacitors type S2) or inoperative with capacitance measuring  $<1$  %  $C_N$  (for capacitors type S3).

If one of the test specimens does not satisfy the criteria according to a) or d) above, the test may be repeated once on a further 10 samples. However, all capacitors shall pass the repeat test.

If more than one capacitor does not satisfy the criteria according to a) or d), then the test shall be regarded as failed. All capacitors must satisfy the requirements of b) and c).

## 8 Marking

*Replace item k) with:*

k) class of safety protection, for example, S0, S1, S2, S3;

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