IEC 60243-2

Edition 3.0 2013-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage

Rigidité diélectrique des matériaux isolants – Méthodes d'essai – Partie 2: Exigences complémentaires pour les essais à tension continue

IEC 60243-2:2013

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX J

ICS 17.220.99; 29.035.01

ISBN 978-2-8322-1200-4

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRIC STRENGTH OF INSULATING MATERIALS – TEST METHODS –

Part 2: Additional requirements for tests using direct voltage

FOREWORD

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International Standard IEC 60243-2 has been prepared by technical committee 112: Evaluation and qualification of electrical insulation materials and systems

This third edition cancels and replaces the second edition published in 2001, and constitutes an editorial revision.

This standard shall be read in conjunction with IEC 60243-1.

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

CDV	Report on voting
112/245/CDV	112/266A/RVC

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 in the IEC 60243 series, published under the general title *Electric strength of insulating materials – Test methods*, can be found 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 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- withdrawn,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.

ELECTRIC STRENGTH OF INSULATING MATERIALS – TEST METHODS –

Part 2: Additional requirements for tests using direct voltage

1 Scope

This part of IEC 60243 gives requirements additional to those in IEC 60243-1 for the determination of the electric strength of solid insulating materials under direct voltage stress.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60243-1:2013, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 60243-1:2013 apply.

4 Significance of the test

In addition to the requirements of Clause 4 of IEC 60243-1:2013, the following points shall be considered when using direct-voltage tests.

For a non-homogeneous test specimen, with alternating voltage, the distribution of voltage stress within the test specimen is determined by impedance (largely capacitive). With an increasing direct voltage, the voltage distribution may still be largely capacitive but depends partly on the rate of voltage increase. The resistive voltage distribution, after constant voltage application, represents the steady-state condition. The choice between direct or alternating voltage depends upon the purpose for which the breakdown test is to be used and, to some extent, on the intended application of the material.

Upon direct voltage application, the following currents result: the capacitive current, the electric absorption current, the leakage current and, in some cases, partial discharge currents.

In addition, for materials with dissimilar layers or discontinuities, the voltage distribution across the test specimen is also influenced, as a result of interfacial polarization, by charges of opposite polarity, which may accumulate on the two sides of the interface and create local fields sufficiently strong to produce partial discharges and/or breakdown of the test specimens.

For most materials, the d.c. breakdown voltage is higher than the peak value of the power-frequency breakdown voltage; for many materials, particularly those which are non-homogeneous, the d.c. breakdown voltage will be three times higher than the a.c. breakdown voltage or even more.

5 Electrodes and test specimens

For the purposes of this standard, the electrode configurations and shape of test specimen of Clause 5 of IEC 60243-1:2013 are applicable.

6 Conditioning before tests

Clause 6 of IEC 60243-1:2013 is applicable.

7 Surrounding medium

Clause 7 of IEC 60243-1:2013 is applicable.

8 Electrical apparatus

8.1 Voltage source

The test voltage applied to the electrodes shall be provided by a power supply having the following characteristics and components.

A choice of voltage of either positive or negative polarity shall be provided, one of the connections to the electrodes being earthed.

The voltage ripple on the test voltage shall not exceed 2 % of the voltage at all values greater than 50 % of the breakdown voltage. The test voltage shall also be free from transients or other fluctuations exceeding 1 % of the applied voltage.

When testing test specimens of low capacitance, it may be necessary to add a suitable capacitor (for example, 1 000 pF) in parallel with the electrodes in order to reduce the influence of transients in initiating premature breakdowns.

The controls on voltage shall be capable of varying the test voltage smoothly and uniformly between zero and the maximum test voltage and with the requested rate of voltage rise. The rate of voltage rise shall be controllable within ±20 % of the specified rate. Steps in voltage rise shall not exceed 2 % of the expected breakdown voltage value. Controls which automatically increase the voltage at a selectable rate are preferable.

A current-sensitive interrupting device shall be used for switching off the direct voltage source.

For many materials, a dangerous voltage may persist across the test specimen for a considerable time after the d.c. test voltage is removed. Disconnection of the power supply to the direct voltage source does not necessarily result in the output voltage or the voltage at the electrodes being reduced to zero. For this reason, it is essential that the electrodes be short-circuited and connected to earth for a period equal to minimum twice the total charging time to ensure that the charge is dissipated. For some large test specimens it will be necessary to maintain the shorted condition for 1 h or even longer.

A current-limiting resistance shall be used in series with the test specimen to prevent damage to the high-voltage supply and to limit as far as possible the damage to the electrodes on the test specimen when breakdown takes place. The maximum current permitted will depend on the material under test and on the amount of damage to the electrodes which can be tolerated.

NOTE 1 The use of a very high-valued resistor may result in breakdown voltages which are higher than those obtained with a lower-valued resistor.

When making tests where the value or increase in the value of the current is used as a criterion for breakdown, means of measurement of current through the test specimen shall be provided.

8.2 Voltage measurement

The measurement of applied voltage shall be made across the electrodes. The other requirements of Clause 8 of IEC 60243-1:2013 shall be met.

9 Procedure

Clause 9 of IEC 60243-1:2013 is applicable.

10 Mode of increase of voltage

Unless otherwise specified, the voltage shall be applied in accordance with 10.1 (short-time test), 10.3 or 10.5 (slow and very slow rate-of-rise tests) or 10.6 (proof tests) of IEC 60243-1:2013.

11 Criterion of breakdown

Clause 11 of IEC 60243-1:2013 is applicable to direct voltage tests. Breakdown may be identified by a sudden increase in current or by the current exceeding a certain specified value.

12 Number of tests

Clause 12 of IEC 60243-1:2013 is applicable.

13 Report

Unless otherwise specified, the report shall include the following:

a) a complete identification of the material tested, a description of the test specimens and the method of preparation;

b) the polarity of the test voltage;

c) the median (central value) of the electric strengths and/or breakdown voltages;

d) the thickness of each test specimen (see 5.4 of IEC 60243-1:2013);

e) the surrounding medium during the test and its properties;

f) the electrode system;

g) the mode of application of the voltage;

h) the individual values of electric strength and/or breakdown voltage;

i) the temperature, pressure and humidity during tests in air or other gas; or the temperature of the surrounding medium when this is a liquid;

j) the conditioning treatment before test;

k) an indication of the type and position of breakdown.

Bibliography

IEC 60674-2, *Specification for plastic films for electrical purposes – Part 2: Methods of test*

IEC/TR 60727-1:1982, *Evaluation of electrical endurance of electrical insulation systems – Part 1: General considerations and evaluation procedures based on normal distributions*
(withdrawn)

IEC/TR 60727-2:1993, *Evaluation of electrical endurance of electrical insulation systems – Part 2: Evaluation procedures based on extreme-value distributions*
(withdrawn)

IEC 62539:2007, *Guide for the statistical analysis of electrical insulation breakdown data*

IEEE 930-1987 (R1995), IEEE guide for statistical analysis of electrical insulation voltage endurance data (Available from IEEE Operations Center, 445 Hoe Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA, or in some countries outside the USA, from local offices of the Global Info Center)

Special Technical Publication 926, Engineering Dielectrics, Volume IIB: *Electrical Properties of Solid Insulating Materials: Measurement Techniques – Chapter 7: Statistical Methods for the Evaluation of Electrical Insulating Systems, American Society for Testing and Materials*, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA