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BRITISH STANDARD

BS EN 60243-3:2002
IEC 60243-3:2001

Electrical strength of insulating materials — Test methods —

Part 3: Additional requirements for 1,2/50 μs impulse tests

The European Standard EN 60243-3:2001 has the status of a British Standard

ICS 17.220.99; 29.035.01

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National foreword

This British Standard is the official English language version of EN 60243-3:2001. It is identical with IEC 60243-3:2001. It supersedes BS EN 60243-3:1994 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/15, Material specifications, to Subcommittee GEL/15/5, Methods of test, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Cross-references

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 18 January 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 9 and a back cover.

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EUROPEAN STANDARD **EN 60243-3**

NORME EUROPÉENNE

EUROPÄISCHE NORM October 2001

ICS 17.220.99; 29.035.01 Supersedes EN 60243-3:1994

English version

Electrical strength of insulating materials - Test methods Part 3: Additional requirements for 1,2/50 µs impulse tests

(IEC 60243-3:2001)

Rigidité diélectrique des matériaux isolants -
Méthodes d'essai
Partie 3: Prescriptions complémentaires pour les essais aux ondes de choc 1,2/50 µs
(CEI 60243-3:2001)

Elektrische Durchschlagfestigkeit von isolierenden Werkstoffen -
Prüfverfahren
Teil 3: Zusätzliche Festlegungen für Stoßspannungsprüfungen (1,2/50 µs)
(IEC 60243-3:2001)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 15E/152/FDIS, future edition 2 of IEC 60243-3, prepared by SC 15E, Methods of test, of IEC TC 15, Insulating materials, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60243-3 on 2001-10-01.

This European Standard supersedes EN 60243-3:1994.

This part of EN 60243 is to be used in conjunction with EN 60243-1.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2002-07-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-10-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60243-3:2001 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

This International Standard is one of a series which deals with tests for electric strength of solid insulating materials. The series consists of three parts:

Part 1: Tests at power frequencies (IEC 60243-1)

Part 2: Additional requirements for tests using direct voltage (IEC 60243-2)

Part 3: Additional requirements for 1,2/50 µs impulse tests (IEC 60243-3)

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ELECTRIC STRENGTH OF INSULATING MATERIALS – TEST METHODS –

Part 3: Additional requirements for 1,2/50 μs impulse tests

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 1,2/50 μs impulse voltage stress.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60243. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However parties to agreements based on this part of IEC 60243 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of the IEC and the ISO maintain registers of currently valid International Standards.

IEC 60243-1:1998, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

3 Definitions

For the purpose of this part of IEC 60243, the following definitions, together with those given in clause 2 of IEC 60243-1, apply.

3.1
full impulse-voltage wave (and see figure 1)
aperiodic transient voltage that rises rapidly to a maximum value, then falls less rapidly to zero

3.2
peak value (of an impulse-voltage wave), U_P
maximum value of voltage

3.3
virtual peak value (of an impulse-voltage wave), U_1
value derived from a recording of an impulse-voltage wave on which high-frequency oscillations, or overshoot of a limited magnitude, may be present

3.4
virtual origin (of an impulse-voltage wave) O_1
point of intersection O_1 with the line of zero voltage of a line drawn through the points of 0,3 and 0,9 times the virtual peak value on the front of an impulse-voltage wave (see figure 1)

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3.5
virtual front time (of an impulse-voltage wave) t_1
equal to 1,67 times the interval t_f between the instants when the voltage is 0,3 and 0,9 times the peak value (t_f, figure 1).

3.6
virtual time to half-value t_2
time interval t_2 between the virtual origin O_1 and the instant on the tail when the voltage has decreased to half the peak value

4 Significance of the test

In addition to the information of clause 3 of IEC 60243-1, the following points are of importance in connection with impulse-voltage tests:

4.1 High-voltage equipment may be subjected to transient voltage stresses resulting from such causes as nearby lightning strokes. This is particularly true of apparatus such as transformers and switchgears used in electrical power transmission and distribution systems. The ability of insulating materials to withstand these transient voltages is important in establishing the reliability of apparatus insulated with these materials.

4.2 Transient voltages caused by lightning may be of either positive or negative polarity. In a symmetrical field between identical electrodes, the polarity has no effect on the electric strength. However, with dissimilar electrodes, there may be a pronounced polarity effect. When assymetrical electrodes are used for testing materials with which the tester has no previous experience or knowledge, it is recommended that comparative tests be made with both directions of polarity.

4.3 The standard wave shape is a 1,2/50 μs wave, reaching peak voltage in approximately 1,2 μs, and decaying to 50 % of peak value in approximately 50 μs after the beginning of the wave. This wave is intended to simulate a lightning stroke that may strike a system without breakdown.

NOTE If the object being tested has appreciable inductive characteristics, it may be difficult or impossible to attain the specified wave shape with less than 5 % oscillations, as prescribed in 8.2.2.. However, the procedures given in this publication are expected ordinarily to be applied to configurations of test specimens and electrodes which are primarily capacitive. Testing of more complex configurations, such as between coils of completed apparatus or models of such apparatus, should be performed in accordance with the specifications for that apparatus.

4.4 Because of the short time involved, dielectric heating, other thermal effects, and the influence of injected space-charges may be reduced during impulse testing of most materials. Thus, impulse tests usually give higher values than the peak voltage of short-term ac tests. From comparisons of the impulse electric strength with the values drawn from longer time tests, inferences may be drawn as to the modes of failure under the various tests for a given material.

5 Electrodes and test specimens

Clause 4 of IEC 60243-1 is applicable.

6 Conditioning before tests

Clause 5 of IEC 60243-1 is applicable.

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7 Surrounding medium

Clause 6 of IEC 60243-1 is applicable.

8 Electrical apparatus

8.1 Voltage source

The test voltage applied to the electrodes shall be provided by an impulse generator having the following characteristics.

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

8.1.2 Controls within the generator shall be capable of adjusting the shape of the wave applied to the test specimen under test to have a virtual front time t_1 of 1,2 μs ± 0,36 μs, and virtual time to half-value t_2 of 50 μs ± 10 μs (see figure 1).

8.1.3 The voltage capability and energy-storage capacity of the generator shall be sufficient to apply impulse waves of the proper shape to any test specimens to be tested, up to the breakdown voltage or specified proof voltage of the material.

8.1.4 The peak value of the voltage is taken as the virtual peak value, provided that the conditions of 8.2.2 are satisfied.

8.2 Voltage measurement

8.2.1 Provisions shall be made for recording the voltage wave as applied to the test specimen, and for measuring the virtual peak voltage, the virtual front time, and the virtual time to half-value within ±5 % of the true values.

8.2.2 If the voltage wave has oscillations with a magnitude of no more than 5 % of the peak value, and a frequency of at least 0,5 MHz, a mean curve may be drawn, the maximum amplitude of which is the virtual peak value. If the oscillations are of greater magnitude, or of lower frequency, the voltage wave is not acceptable for a standard test.

9 Procedure

Clause 8 of IEC 60243-1 is applicable.

10 Application of voltage

10.1 Breakdown test

Breakdown tests shall be in accordance with clause 10 of IEC 60243-1.

10.1.1 The voltage impulses shall be applied in an increasing series of sets of three waves of equal peak voltages. The peak voltage of the initial set should be approximately 70 % of the expected breakdown voltage.

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10.1.2 Increase the peak voltage of successive sets by 5 % to 10 % of the peak value of the first set. Table 1 of IEC 60243-1 is applicable.

10.1.3 Allow sufficient time between successive impulses for the generator to become completely charged. Normally a time of three times the charging time constant for the generator is sufficient.

10.1.4 Sufficient time shall also be allowed between successive impulses to allow dissipation of any injected space-charge. For many materials, the charging time of the generator will cover this eventuality. For materials having a longer space-charge retention time, the necessary time shall be specified in the material specification sheet. If this information is not known, but a long space-charge retention period is suspected, then additional tests should be run with longer intervals between impulses, to determine if a significant difference in breakdown values is obtained.

10.1.5 A valid test on a test specimen is one in which impulse waves are applied at at least two voltage levels without breakdown, before breakdown occurs at the third or a subsequent level.

10.1.6 The electric strength shall be based on the virtual peak voltage of the last set of three waves which was applied without breakdown. The breakdown voltage is the nominal voltage of the next set of waves causing breakdown.

10.1.7 When using asymmetrical electrode systems, preliminary tests shall be conducted to determine the polarity which yields the lower breakdown voltage. If significant differences are obtained, the polarity giving the lower test results should be used.

10.2 Proof tests

One set of three impulses of specified proof voltage (virtual value) shall be applied to the test specimen in accordance with 10.1 of IEC 60243-1. When necessary for calibration purposes, up to three impulses with peak voltages not exceeding 80 % of the proof voltage may be applied prior to the application of the proof voltage waves.

11 Criterion of breakdown

Clause 10 of IEC 60243-1 is applicable. The impulse breakdown voltage is the nominal peak voltage that the wave causing breakdown would have reached had breakdown not occurred. The withstand voltage is the highest nominal peak voltage of a set of three impulses which did not cause breakdown.

12 Number of tests

Clause 11 of IEC 60243-1 is applicable.

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13 Test report

13.1 Full 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 their preparation;

b) the polarity of the impulse waves;

c) the median (central value) of the electric strengths in kV/mm and/or of the breakdown voltages in kV (not that used for proof testing);

d) the thickness of each test specimen (see 4.4 of IEC 60243-1);

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

f) the electrode system with polarity of electrodes when they are dissimilar;

g) the individual values of electric strength in kV/mm and/or breakdown voltage in kV (not that used for proof testing);

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

i) the conditioning treatment before test;

j) the initial nominal peak-voltage level for each test specimen;

k) an indication of the type and position (for example, at the electrode edge) of breakdown on the test specimen, and which impulse of the last set of three impulses resulted in breakdown for each test specimen;

l) the position on the voltage wave (wave-front, peak, or wave-tail) of breakdown for each test specimen.

13.2 Short report

When the shortest statement of results is required, the first six items and the lowest and highest values shall be included.

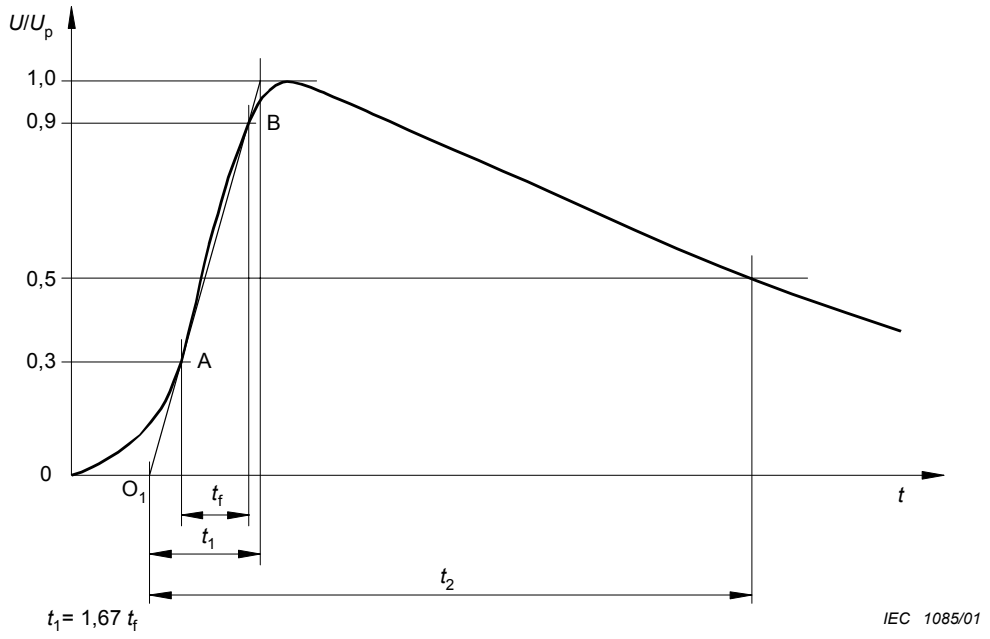

Figure 1 – Full impulse-voltage wave

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60243-1	1998	Electrical strength of insulating materials - Test methods Part 1: Tests at power frequencies	EN 60243-1	1998

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