IS 2824 (2007): Method for determining of the proof and the comparative tracking indices of solid insulating materials [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]

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IS 2824 : 2007
IEC 60112 : 2003

भारतीय मानक

ठोस रोधन सामग्री का विद्युतरोधन और तुलनात्मक ट्रैकिंग सूचकांक ज्ञात करने की पद्धति

(दूसरा पुनरीक्षण)

Indian Standard

METHOD FOR THE DETERMINATION OF THE PROOF AND THE COMPARATIVE TRACKING INDICES OF SOLID INSULATING MATERIALS

(Second Revision)

ICS 19.080; 29.035.01

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 8

NATIONAL FOREWORD

This Indian Standard (Second Revision) which is identical with IEC 60112 : 2003 'Method for the determination of the proof and the comparative tracking indices of solid insulating materials' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Solid Electrical Insulating Materials and Insulating Systems Sectional Committee and approval of the Electrotechnical Division Council.

This standard was originally published in 1964 and subsequently revised in 1975 with considerable assistance derived from IEC Publication 112 (1971). This second revision has been undertaken to harmonize this standard with latest edition of IEC 60112 : 2003.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standards, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60589 : 1977 Methods of test for the determination of ionic impurities in electrical insulating materials by extraction with liquids	IS 10581 : 1983 Methods of test for the determination of ionic impurities in electrical insulating materials by extraction with liquids	Technically Equivalent
ISO 293 : 1986 Plastics — Compression moulding test specimens of thermoplastic materials	IS 13360 (Part 2/Sec 1) : 1992 Plastics — Methods of test: Part 2 Sampling and preparation of test specimens, Section 1 Compression moulding test specimens of thermoplastic materials	do
ISO 294-1 : 1996 Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multi-purpose and bar test specimens	IS 13360 (Part 2/Sec 3) : 2000 Plastics — Methods of testing: Part 2 Sampling and preparation of test specimens, Section 3 Injection moulding of test specimens of thermoplastic materials — General principles	Identical
ISO 294-3 : 2002 Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates	IS 13360 (Part 2/Sec 7) : 2000 Plastics — Methods of testing: Part 2 Sampling and preparation of test specimens, Section 7 Injection moulding of test specimens of thermoplastic materials — Small plates (*first revision*)	do

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Indian Standard

METHOD FOR THE DETERMINATION OF THE PROOF AND THE COMPARATIVE TRACKING INDICES OF SOLID INSULATING MATERIALS

(Second Revision)

1 Scope

This International standard specifies the method of test for the determination of the proof and comparative tracking indices of solid insulating materials on pieces taken from parts of equipment and on plaques of material using alternating voltages.

The standard provides for the determination of erosion when required.

NOTE 1 The proof tracking index is used as an acceptance criterion as well as a means for the quality control of materials and fabricated parts. The comparative tracking index is mainly used for the basic characterization and comparison of the properties of materials.

Test results cannot be used directly for the evaluation of safe creepage distances when designing electrical apparatus.

NOTE 2 This test discriminates between materials with relatively poor resistance to tracking, and those with moderate or good resistance, for use in equipment which can be used under moist conditions. More severe tests, of longer duration are required for the assessment of performance of materials for outdoor use, utilizing higher voltages and larger test specimens (see the inclined plane test of IEC 60587). Other test methods such as the inclined method may rank materials in a different order from the drop test given in this standard.

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 60589:1977, *Methods of test for the determination of ionic impurities in electrical insulating materials by extraction with liquids*

IEC Guide 104:1997, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO 293:1986, *Plastics – Compression moulding test specimens of thermoplastic materials*

ISO 294-1:1996, *Plastics – Injection moulding of test specimens of thermoplastic materials – Part 1: General principles, and moulding of multi-purpose and bar test specimens*

ISO 294-3:2002, *Plastics – Injection moulding of test specimens of thermoplastic materials – Part 3: Small plates*

ISO 295:1991, *Plastics – Compression moulding of test specimens of thermosetting materials*

3 Terms and definitions

For the purposes of this International Standard, the following definitions apply:

3.1
tracking
progressive formation of conducting paths, which are produced on the surface and/or within a solid insulating material, due to the combined effects of electric stress and electrolytic contamination

3.2
tracking failure
failure of insulation due to tracking between conducting parts

NOTE In the present test, tracking is indicated by operation of an over-current device due to the passage of a current of at least 0,5 A for at least 2 s across the test surface and/or within the specimen.

3.3
electrical erosion
wearing away of insulating material by the action of electrical discharges

3.4
air arc
arc between the electrodes above the surface of the specimen

3.5
comparative tracking index
CTI
numerical value of the maximum voltage at which five test specimens withstand the test period for 50 drops without tracking failure and without a persistent flame occurring and including also a statement relating to the behaviour of the material when tested using 100 drops (see 11.4)

NOTE 1 The criteria for CTI may also require a statement concerning the degree of erosion.

NOTE 2 Although a non-persistent flame is allowed in the test without constituting failure, materials which generate no flame at all are preferred unless other factors are considered to be more important. See also Annex A.

3.6
persistent flame
in case of dispute – one which burns for more than 2 s

3.7
proof tracking index
PTI
numerical value of the proof voltage in volts at which five test specimens withstand the test period for 50 drops without tracking failure and without a persistent flame occurring

NOTE Although a non-persistent flame is allowed in the test without constituting failure, materials which generate no flame at all are preferred unless other factors are considered to be more important. See also Annex A.

4 Principle

The upper surface of the test specimen is supported in an approximately horizontal plane and subjected to an electrical stress via two electrodes. The surface between the electrodes is subjected to a succession of drops of electrolyte either until the over-current device operates, or until a persistent flame occurs, or until the test period has elapsed.

The individual tests are of short duration (less than 1 h) with up to 50 or 100 drops of about 20 mg of electrolyte falling at 30 s intervals between platinum electrodes, 4 mm apart on the test specimen surface.

An a.c. voltage between 100 V and 600 V is applied to the electrodes during the test.

During the test, specimens may also erode or soften, thereby allowing the electrodes to penetrate them. The formation of a hole through the test specimen during a test is to be reported together with the hole depth (test specimen thickness). Retests may be made using thicker test specimens, up to a maximum of 10 mm.

NOTE The number of drops needed to cause failure by tracking usually increases with decreasing applied voltage and, below a critical value, tracking ceases to occur.

5 Test specimen

Any approximately flat surface may be used, provided that the area is sufficient to ensure that during the test no liquid flows over the edges of the test specimen.

NOTE 1 Flat surfaces of not less than 20 mm × 20 mm are recommended to reduce the probability of electrolyte loss over the specimen edge although smaller sizes may be used, subject to no electrolyte loss, e.g. ISO 3167, 15 mm × 15 mm multi-purpose test specimens.

NOTE 2 It is preferable to use separate test specimens for each test. If several tests are to be made on the same test piece, care should be taken to ensure that the testing points are sufficiently far from each other so that splashes or fumes from the testing point will not contaminate the other areas to be tested.

The thickness of the test specimen shall be 3 mm or more. Individual pieces of material may be stacked to obtain the required thickness of at least 3 mm.

NOTE 3 The values of the CTI obtained on specimens with a thickness below 3 mm may not be comparable with those obtained on thicker specimens because of greater heat transmission to the glass support through thinner test specimens. For this reason, stacked specimens are allowed.

Test specimens shall have nominally smooth and untextured surfaces which are free from surface imperfections such as scratches, blemishes, impurities, etc, unless otherwise stated in the product standard. If this is impossible, the results shall be reported together with a statement describing the surface of the specimen because certain characteristics on the surface of the specimen could add to the dispersion of the results.

For tests on parts of products, where it is impossible to cut a suitable test specimen from a part of a product, specimens cut from moulded plaques of the same insulating material may be used. In these cases care should be taken to ensure that both the part and the plaque are produced by the same fabrication process wherever possible. Where the details of the final fabrication process are unknown, methods given in ISO 293, ISO 294-1 and ISO 294-3 and ISO 295 may be appropriate.

NOTE 4 The use of different fabrication conditions/processes may lead to different levels of performance in the PTI and CTI test.

NOTE 5 Parts moulded using different flow directions may also exhibit different levels of performance in the PTI and CTI test.

In special cases, the test specimen may be ground to obtain a flat surface.

Where the direction of the electrodes relative to any feature of the material is significant, measurements shall be made in the direction of the feature and orthogonal to it. The direction giving the lower CTI shall be reported, unless otherwise specified.

6 Test specimen conditioning

6.1 Environmental conditioning

Unless otherwise specified, the test specimens shall be conditioned for a minimum of 24 h at 23 °C ± 5 K, with (50 ± 10) % RH.

6.2 Test specimen surface state

Unless otherwise specified,

a) tests shall be made on clean surfaces;

b) any cleaning procedure used shall be reported. Wherever possible, the details shall be agreed between supplier and customer.

NOTE Dust, dirt, fingerprints, grease, oil, mould release or other contaminants may influence the results. Care should be taken when cleaning the test specimen to avoid swelling, softening, abrasion or other damage to the material.

7 Test apparatus

7.1 Electrodes

Two electrodes of platinum with a minimum purity of 99 % shall be used (see Annex B). The two electrodes shall have a rectangular cross-section of (5 ± 0,1) mm × (2 ± 0,1) mm, with one end chisel-edged with an angle of 30° ± 2° (see Figure 1). The sharp edge shall be removed to produce an approximately flat surface, 0,01 mm to 0,1 mm wide.

NOTE 1 A microscope with a calibrated eyepiece has been found suitable for checking the size of the end surface.

NOTE 2 It is recommended that mechanical means are used to re-furbish the electrode shape after a test to ensure that the electrodes maintain the required tolerances, especially with respect to the edges and corners.

At the start of the test, the electrodes shall be symmetrically arranged in a vertical plane, the total angle between them being 60° ± 5° and with opposing electrode faces approximately vertical on a flat horizontal surface of the test specimen (see Figure 2). Their separation along the surface of the test specimen at the start of the test shall be 4,0 mm ± 0,1 mm.

A thin metal rectangular slip gauge shall be used to check the electrode separation. The electrodes shall move freely and the force exerted by each electrode on the surface of the test specimen at the start of the test shall be 1,00 N ± 0,05 N. The design shall be such that the force can be expected to remain at the initial level during the test.

One typical type of arrangement for applying the electrodes to the test specimen is shown in Figure 3. The force shall be verified at appropriate intervals.

Where tests are made solely on those materials where the degree of electrode penetration is small, the electrode force may be generated by the use of springs. However, gravity should be used to generate the force on general purpose equipment (see Figure 3).

NOTE 3 With most, but not all designs of apparatus, if the electrodes move during a test due to softening or erosion of the specimen, their tips will prescribe an arc and the electrode gap will change. The magnitude and direction of the gap change will depend on the relative positions of the electrode pivots and the electrode/specimen contact points. The significance of these changes will probably be material dependent and has not been determined. Differences in design could give rise to differences in inter-apparatus results.

7.2 Test circuit

The electrodes shall be supplied with a substantially sinusoidal voltage, variable between 100 V and 600 V at a frequency of 48 Hz to 62 Hz. The voltage measuring device shall indicate a true r.m.s. value and shall have a maximum error of 1,5 %. The power of the source shall be not less than 0,6 kVA. An example of a suitable test circuit is shown in Figure 4.

A variable resistor shall be capable of adjusting the current between the short-circuited electrodes to (1,0 ± 0,1) A and the voltage indicated by the voltmeter shall not decrease by more than 10 % when this current flows (see Figure 4). The instrument used to measure the value of the short-circuit current shall have a maximum error of ±3 %.

The input supply voltage to the apparatus shall be adequately stable.

The over-current device shall operate when a current with an r.m.s. value of 0,50 A with a relative tolerance of ±10 %, has persisted for 2,00 s with a relative tolerance of ±10 %.

7.3 Test solutions

Solution A:

Dissolve approximately 0,1 % by mass of analytical reagent grade anhydrous ammonium chioride (NH_4Cl), of a purity of not less than 99,8 %, in de-ionized water, having a conductivity of not greater than 1 mS/m to give a resistivity of (3,95 ± 0,05) Ωm at (23 ± 1) °C.

NOTE 1 Select the quantity of ammonium chloride to give a solution in the required range of resistivity.

Solution B:

Dissolve approximately 0,1 % by mass of analytical reagent grade anhydrous ammonium chloride, of a purity of not less than 99,8 %, and 0,5 % ± 0,002 % by mass of sodium-di-butyl naphthalene sulfonate in de-ionized water, having a conductivity of not greater than 1 mS/m, to give a resistivity of (1,98 ± 0,05) Ωm at (23 ± 1) °C.

NOTE 2 Select the quantity of ammonium chloride to give a solution in the required range of resistivity.

Solution A is normally used, but where a more aggressive contaminant is required, Solution B is recommended. To indicate that Solution B was used, the CTI or PTI value shall be followed by the letter "M".

The conductivity of the solutions shall be measured with alternating voltage at a frequency in the range 1 kHz to 2 kHz. The procedure is described in IEC 60589.

7.4 Dropping device

Drops of the test solution shall fall on to the specimen surface at intervals of 30 s ± 5 s. The drops shall fall more or less centrally between the electrodes from a height of 35 mm ± 5 mm.

The time for 50 drops to fall on to the specimen shall be (24,5 ± 2) min.

The mass of a sequence of 50 drops shall lie between 0,997 g and 1,147 g. The mass of a sequence of 20 drops shall lie between 0,380 g and 0,480 g.

NOTE 1 The mass of the drops may be determined by weighing with the appropriate laboratory balance.

The mass of the drops shall be checked at appropriate time intervals.

NOTE 2 For Solution A, a length of thin walled stainless steel tubing (e.g. hypodermic needle tubing), having an outer diameter of between 0,9 mm and 1,2 mm, dependent upon the dropping system, has been found to be suitable for the tip of the dropping device. For Solution B, tubes having outer diameters over the range 0,9 mm to 3,45 mm have been found to be necessary with the different dropping systems in use.

NOTE 3 The use of a drop detector/counter is recommended to ascertain whether there are any double drops or whether drops are missing.

7.5 Test specimen support platform

A glass plate or plates, having a total thickness of not less than 4 mm and of a suitable size shall be used to support the test specimen during the test.

NOTE 1 In order to avoid the problem of cleaning the specimen support table, it is recommended that a disposable glass microscope slide be placed on the specimen support table immediately under the test specimen.

NOTE 2 The use of thin metal foil conductors around the edge of the glass plate to detect electrolyte loss has been found useful.

7.6 Electrode assembly installation

The specimen and its immediate electrodes shall be mounted in an essentially draught-free space in an enclosure.

NOTE To keep the chamber reasonably free of fumes, it may be necessary, for certain classes of materials, to have a small air flow across the surface of the test specimen and between the electrodes. An air velocity of the order of 0,2 m/s before the start of the test and as far as possible during the test has been found suitable. The air velocity in other areas of the enclosure may be substantially higher to assist in fume removal. The air velocity may be measured with an appropriately scaled hot wire anemometer.

A suitable fume extraction system shall be provided to allow safe venting of the enclosure after the test.

8 Basic test procedure

8.1 General

Where the material is substantially anisotropic, tests shall be made in the direction of the features and orthogonal to them. Results from the direction giving the lower values shall be used, unless otherwise specified.

Test shall be made at an ambient temperature of (23 ± 5) °C.

Tests shall be made on uncontaminated test specimens, unless otherwise specified.

The result of a test where a hole is formed is considered to be valid, irrespective of the test specimen thickness, but the formation of the hole shall be reported together with the depth of the hole (the thickness of the test specimen or stack).

8.2 Preparation

After each test, clean the electrodes with an appropriate solvent and then rinse them with de-ionized water. If necessary, restore their shape and give a final rinse before the next test.

Immediately before the test ensure, if necessary by cooling the electrodes, that their temperature is sufficiently low so that they have no adverse effect on the specimen properties.

Ensure freedom from visual contamination and ensure that the solution to be used conforms to the conductivity requirements either by regular testing, or by measurement immediately before the test.

NOTE 1 Residues on the dropping device from an earlier test will probably contaminate the solution and evaporation of the solution will increase its concentration – both of which may result in lower than true values. In such cases it may be advisable to clean the outside of the dropping device mechanically and/or with a solvent and the inside by flushing through with conforming solution before each test. Flushing through some 10 to 20 drops depending upon the delay between tests will normally remove any non-conforming liquid.

In case of dispute, the cleaning procedures used for the electrodes and dropper tube shall be agreed between purchaser and supplier.

Place the test specimen, with the test surface uppermost and horizontal on the specimen support table. Adjust the relative height of the test specimen and electrode mounting assembly, such that on lowering the electrodes on to the specimen, the correct orientation is achieved with a separation of 4,0 mm ± 0,1 mm. Ensure that the chisel edges make contact with the surface of the specimen with the required force and over their full width.

NOTE 2 It may be helpful to place a light behind the electrodes when making this check visually.

Set the test voltage to the required value which shall be an integer multiple of 25 V, and adjust the circuit parameters so that the short-circuit current is within the permitted tolerance.

8.3 Test procedure

Start the dropping system so that drops fall on to the test surface and continue the test until one of the following occurs:

a) the over-current device operates;

b) a persistent flame occurs;

c) at least 25 s have elapsed after the fiftieth (hundredth) drop has fallen without a) or b) occuring.

NOTE If there is no requirement for the determination of erosion, the 100 drop tests may be made ahead of any 50 drop tests.

After completion of the test, vent the chamber of noxious fumes and remove the test specimen.

9 Determination of erosion

When required, specimens which have not failed at the 50 drop point shall be cleaned of any debris or loosely attached degradation products and placed on the platform of a depth gauge. The maximum depth of erosion of each specimen shall be measured in millimetres to an accuracy of 0,1 mm, using a 1,0 mm nominal diameter probe having a hemispherical end. The result is the maximum of the five measured values.

Erosion depths of less than 1 mm are reported as <1 mm.

In the case of tests according to Clause 10, when required the erosion shall be measured on the specimens which withstood 50 drops at the specified voltage.

In the case of tests according to Clause 11, when required the erosion shall be measured on the five specimens tested at the maximum 50 drop voltage.

10 Determination of proof tracking index (PTI)

10.1 Procedure

Where, in IEC standards for material or for electrical equipment specifications, or in other standards, a proof test only is required, 50 drop tests shall be made in accordance with Clause 8 but at the single voltage specified. The required number of specimens shall withstand the test period up to at least 25 s after the fiftieth drop has fallen without tracking failure, and without a persistent flame occurring.

Operation of the over-current device by air arcs does not constitute a tracking failure.

NOTE The recommended number of specimens is five.

The proof voltage shall be an integer multiple of 25 V.

10.2 Report

The report shall include the following information:

1. Identification of the material tested and details of any conditioning.
2. Thickness of the specimens and the number of layers used to achieve this thickness.
3. Nature of the test specimen surface where the original surface was not tested:
   - 3.1 details of any cleaning process,
   - 3.2 details of any machining processes, e.g. grinding,
   - 3.3 details of any coating on the tested surface.
4. State of the surface before testing, with regard to surface imperfections, e.g. surface scratches, blemishes, impurities, etc.
5. The cleaning procedure used for the electrodes and dropper.
6. Where the measurements were not made in an essentially draught free space, report on the approximate air flow rate.
7. Orientation of the electrodes in relation to any known characteristics of the material.
8. Report on the result of the proof tracking index test where there is no requirement for the determination of the degree of erosion as follows:

   Pass or fail at the specified voltage with an indication of the type of solution if Type B.

   EXAMPLE 'Pass PTI 175' or 'Fail PTI 175 M'.

   Where there is an erosion requirement the result shall be reported as follows:

   Pass or fail at the specified voltage with an indication of the type of solution if Type B, and the maximum depth of erosion.

   EXAMPLE 'Fail PTI 250 - 3', or 'Pass PTI 250 M - 3'.

   Where the erosion cannot be reported because the specimen flamed, this shall be reported.

   Where a hole developed through the specimen, its formation shall be reported together with an indication of its depth (specimen thickness).

   Where the tests were invalid due to air arcs, this shall be reported.

11 Determination of comparative tracking index (CTI)

11.1 General

Determination of the comparative tracking index requires the determination of the maximum voltage at which five specimens withstand the test period for 50 drops without failure and whether, at a voltage of 25 V lower than the maximum 50 drop figure, the specimen withstands 100 drops. If this is not the case, the maximum 100 drop withstand voltage has to be determined.

NOTE 1 The wording of the previous edition of this standard implied that determinations of the maximum 50 drop withstand voltage had to be made before any 100 drop determinations.

NOTE 2 It is recognized that the cost of testing may be reduced by firstly determining the maximum 100 drop withstand voltage and therefore this procedure is recommended in this standard.

11.2 Determination of the 100 drop point

Using the basic procedure described in Clause 8, set the voltage at a selected level and make the test until at least 25 s have elapsed after the one hundredth drop has fallen or until previous failure occurs.

If the behaviour of the material is unknown, it is recommended that the starting voltage be 350 V.

If the over-current device operated due to the occurrence of an air arc above the test specimen, the test was invalid. Repeat the test procedure at the same voltage using a new test specimen or site after cleaning the apparatus and following the procedure in Clause 8. If the same event occurs, repeat the test at progressively lower and lower voltages until a valid failure or pass occurs. Report the details of the tests (see 11.4).

NOTE 1 It may be impossible to determine the CTI of some materials because a valid failure cannot be achieved, the characteristic behaviour moving directly from withstanding the test period at one voltage to exhibiting air arcs at the next highest test voltage.

If the over-current device operated due to the passage of an excessive current across the surface of the test specimen, or if a persistent flame occurred, the specimen failed the test at that voltage. Repeat the test on a new site/specimen using a lower test voltage after cleaning the apparatus, etc. as described in Clause 8.

If none of the above occurred and at least 25 s elapsed after the one hundredth drop had fallen without the over-current device operating, the test is valid and the test specimen is considered to have passed. Repeat the test on new sites/specimens at progressively higher and higher voltages until the maximum voltage is established at which no failure occurred during the test period of up to at least 25 s after the one hundredth drop has fallen in the first five tests at that voltage. Five separate specimens or five sites on one plaque may be used for the tests after cleaning the apparatus and following the procedure described in Clause 8.

If a hole appeared through the test specimen, record the result noting both that a hole was formed and the depth of the hole (the thickness of the test specimen or stack), and then continue the tests as described above.

NOTE 2 Where a hole is generated during a test, the further tests may be made on thicker specimens (up to a maximum thickness of 10 mm) to gain additional information after cleaning the apparatus, etc., as described in Clause 8.

Where the properties of the test specimen are unknown, increases in test voltage at voltages above 400 V shall be limited to 50 V per test.

Record, as the 100 drop result, the maximum voltage at which five specimens withstood the 100 drop period without failure.

Continue by determining the maximum 50 drop withstand voltage

11.3 Determination of the maximum 50 drop withstand voltage

By inference from the 100 drop data, repeat the test procedure at an appropriate test voltage, using a new site/specimen and determine whether the specimen withstands the test for the period up to at least 25 s after the fiftieth drop has fallen.

If the over-current device operated due to the occurrence of an air arc above the test specimen, the test was invalid. Repeat the test procedure at the same voltage using a new site/test specimen after cleaning the apparatus and following the procedure as described in Clause 8. If the same event occurs, repeat the test at progressively lower and lower voltages until a valid failure or pass occurs. Report the details of the tests (see 11.4).

NOTE 1 It may be impossible to determine the CTI of some materials because a valid failure cannot be achieved, the characteristic behaviour moving directly from withstanding the test period at one voltage to exhibiting air arcs at the next highest test voltage.

If the over-current device operated due to the passage of an excessive current across the surface of the test specimen, or if a persistent flame occurred, the specimen failed the test at that voltage. Repeat the test on a new site/specimen using a lower test voltage after cleaning the apparatus, etc. as described in Clause 8.

If none of the above occurred and at least 25 s elapsed after the fiftieth drop had fallen without the over-current device operating, the test was valid and the test specimen is considered to have passed.

If a hole has not formed through the test specimen during the test, repeat the test on new sites/specimens, at progressively higher and higher voltages until the maximum voltage is established at which no failure occurred during the test period of up to at least 25 s after the fiftieth drop has fallen in the first five tests at that voltage. Five specimens or five sites on one plaque may be used for the tests after cleaning the apparatus and following the procedure described in Clause 8.

If a hole appeared through the test specimen, record the result noting both that a hole was formed, and the depth of the hole (the thickness of the test specimen or stack), and then continue the tests as described above.

NOTE 2 Where a hole is generated during a test, the further tests may be made on thicker specimens (up to a maximum thickness of 10 mm) to gain additional information after cleaning the apparatus, etc., as described in Clause 8.

The result of tests where a hole formed, irrespective of the test specimen thickness, are considered to be valid, but the formation of the hole shall be reported together with the depth of the hole (the thickness of the test specimen stack).

Record, as the 50 drop result, the maximum voltage at which five specimens withstood the 50 drop period without failure.

11.4 Report

The report shall include the following information:

1. Identification of the material tested and details of any conditioning.
2. Thickness of the specimens and number of layers used to achieve this thickness.
3. Nature of the test specimen surface where the original surface was not tested:
   - 3.1 details of any cleaning process,
   - 3.2 details of any machining processes, e.g. grinding,
   - 3.3 details of any coating on the tested surface;
4. State of the surface before testing, with regard to surface imperfections, e.g. scratches, blemishes, impurities, etc.;
5. Cleaning procedure used for the electrodes and dropper;
6. Where the measurements were not made in an essentially draught free space, report on the approximate air flow rate.
7. Orientation of the electrodes in relation to any known characteristics of the material.
8. Report on the result of the comparative tracking index test where there is no requirement for the determination of the degree of erosion as follows:

   - CTI the numerical value of the maximum 50 drop voltage, obtained in five consecutive tests (the numerical value of the highest 100 drop voltage determined in five consecutive tests, if more than 25 V below the maximum 50 drop figure), when appropriate followed by the letter "M" to indicate that Solution B was used.

EXAMPLE 'CTI 175', 'CTI 175 M', or 'CTI 400(350) M'

Where there is an erosion requirement the result shall be reported as follows:

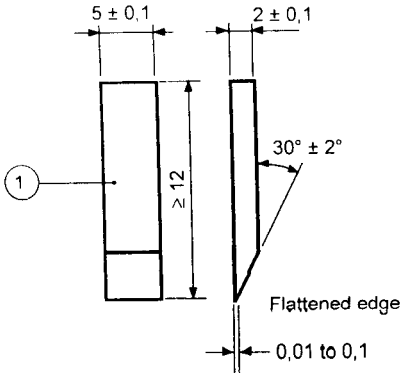
- CTI the numerical value of the maximum 50 drop voltage, obtained in five consecutive tests, (the numerical value of the highest 100 drop voltage determined in five consecutive tests, if more than 25 V below the maximum 50 drop figure), when appropriate followed by the letter "M" to indicate that Solution B was used – the maximum depth of erosion being in millimetres.

  EXAMPLE 'CTI 275 - 1,2', 'CTI 375 M - 2,4,' or 'CTI 400(350) M - 3,4'

If, for some reason (such as extensive flaming) the erosion cannot be measured, this shall be reported.

Where a hole developed through the specimen, its formation shall be reported together with an indication of its depth (specimen or stack thickness).

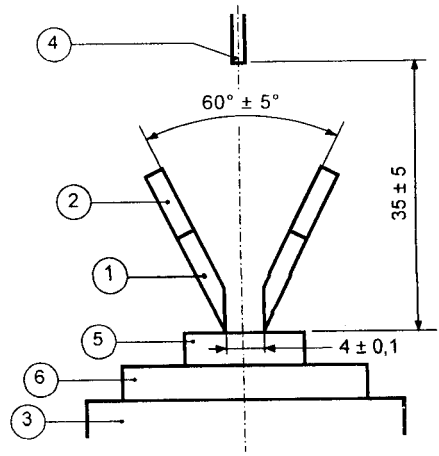
Where the tests were invalid due to air arcs, this shall be reported.



Key
1 Platinum electrode
3 Table
5 Specimen

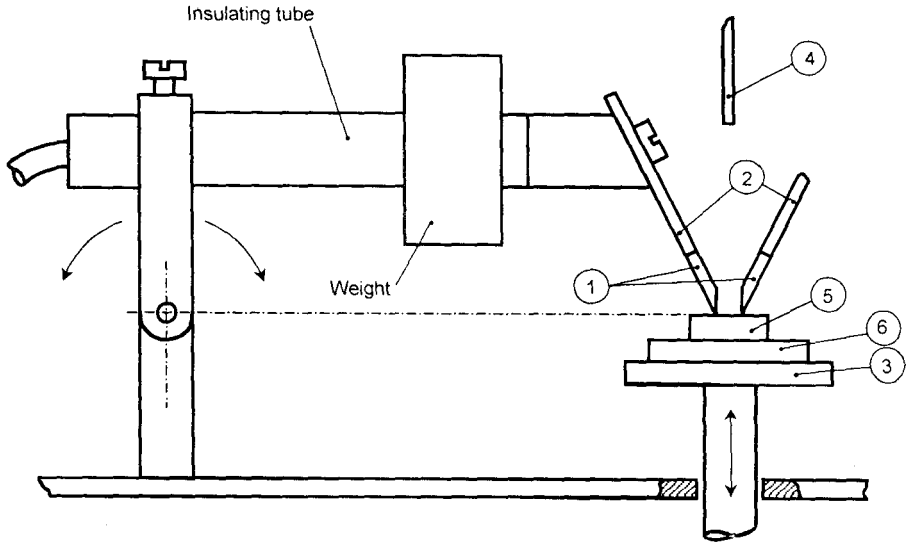
Figure 1 – Electrode

All dimensions are in millimetres



2 Brass extension (optional)
4 Tip of dropping device
6 Glass specimen support

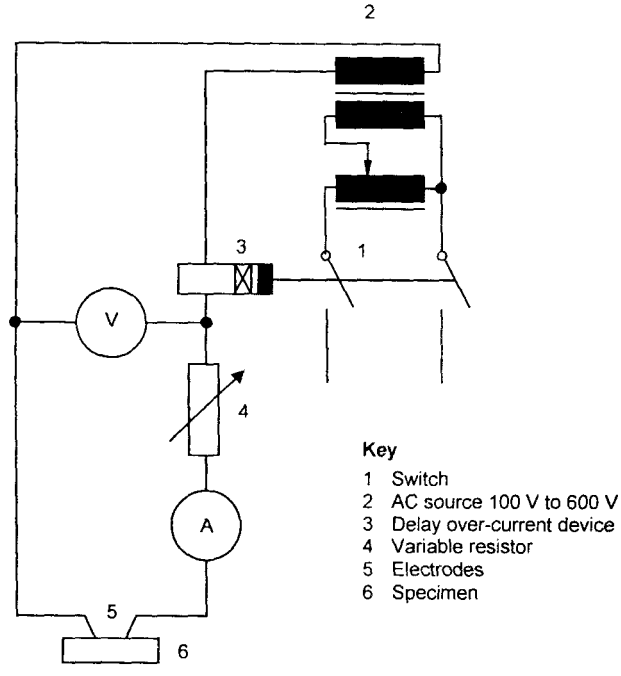
Figure 2 – Electrode / specimen arrangement



Key

1 Platinum electrode
2 Brass extension (optional)
3 Table
4 Tip of dropping device
5 Specimen
6 Glass specimen support

Figure 3 – Example of typical electrode mounting and specimen support



Key

1 Switch
2 AC source 100 V to 600 V
3 Delay over-current device
4 Variable resistor
5 Electrodes
6 Specimen

Figure 4 – Example of test circuit

Annex A
(informative)

List of factors that should be considered by product committees

The method may be used as published but there are several areas where product committees may wish to exercise their options:

1. Whether the surface of specimens with rough surfaces may be smoothed by machining, e.g. grinding (Clause 5).

2. Specimen surface state (6.2): clean(ed) or otherwise.

3. Nature of any allowed cleaning processes (6.2).

4. Type of electrolyte to be used (Solution A or B, 7.3).

5. Whether any special instructions need to be given concerning the method of cleaning the apparatus between tests (Clause 8).

6. Where the material is anisotropic, results from the direction giving the lower values are usually reported unless otherwise specified (8.1).

7. Number of specimens to be used in proof tests: usually five but a different number may be preferred (10.2).

8. Required proof test voltage (10.2).

9. Whether the proof test should include a requirement for a minimum 100 drop test voltage.

10. Whether determination of erosion depth is required, and if so, the limits to be specified (Clause 9).

11. Whether because of specific needs, the criteria for allowable flaming are not suitable for the application in mind. In those cases, alternative test methods should be developed/used.

Annex B
(informative)

Electrode material selection

B.1 Platinum electrodes have been selected for determining the comparative and proof tracking indices because platinum is the most inert material commonly available. It interacts least with the electrolyte and insulating materials used, allowing the characteristics of the insulating material under test to become the main determining factor in arriving at the tracking index

B.2 In order to simulate the hardware and insulating systems used in electrical devices and to reduce the electrode cost, materials such as copper, brass, stainless steel, gold and silver are sometimes used instead of platinum for appraising the tracking characteristics of the particular electrode metal and insulating material combinations. These electrode materials interact to varying degrees both with the electrolytes used and the insulating materials, and thereby influence the test results. The results of tests made with alternatives to platinum electrodes do not qualify as either comparative or proof tracking indices.

Bibliography

IEC 60587:1984, *Test methods for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions*

IEC/TR 62062:2002, *Results of the Round Robin series of tests to evaluate proposed amendments to IEC 60112*

ISO 3167:2002, *Plastics – Multipurpose test specimens*

(*Continued from second cover*)

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC Guide 104 : 1997	The preparation of safety publications and the use of basic safety publications and group safety publications
ISO 295 : 1991	Plastics — Compression moulding of test specimens of thermosetting materials

Only the English text of the International Standard has been retained while adopting it as an Indian Standard, and as such the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Review of Indian Standards

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This Indian Standard has been developed from Doc: No. ETD 02 (5734).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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