भारतीय मानक

Indian Standard

IS 18320 : 2023
IEC 61112 : 2009

खुले विद्युन्मय — विद्युत रोधी कम्बल

Live Working — Electrical Insulating Blankets

ICS 13.260; 29.240.20; 29.260.99

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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NATIONAL FOREWORD

This Indian Standard which is identical to IEC 61112 : 2009 'Live working — Electrical insulating blankets' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Tools And Equipment for Live Working Sectional Committee and approval of the Electrotechnical Division Council.

The text of the 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'; and
b) Comma (,) has been used as a decimal marker, 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 60060-1 High-voltage test techniques — Part 1: General definitions and test Requirements	IS 2071 (Part 1) : 2016/IEC 60060-1 : 2010 High-voltage test techniques: Part 1 General definitions and test requirements (*third revision*)	Identical
IEC 60060-2 High-voltage test techniques — Part 2: Measuring systems	IS/IEC 60060 (Part 2) : 2010 High-voltage test techniques: Part 2Measuring systems	Identical
IEC 60068-1 Environmental testing — Part 1: General and guidance	IS/IEC 60068-1 : 2013 Guidance for environmental testing: Part 1 General	Identical
IEC 60212 : 1971 Standard conditions for use prior to and during the testing of solid electrical insulating materials	IS 2260 : 1973 Preconditioning, conditioning and testing of solid electrical insulating materials (*first revision*)	Technically Equivalent
IEC 61318 Live working — Conformity assessment applicable totools, devices and equipment	IS 16155 : 2014/IEC 61318 : 2007 Live working — Conformity assessment applicable to tools, devices and equipment (*first revision*)	Identical
ISO 2592 Determination of flash and fire points — Cleveland open cup method	IS 1448 (Part 69) : 2019/ISO 2592 : 2017 Methods of test for petroleum and its products [P : 69] Determination of flash and fire points — Cleveland open cup method (*second revision*)	Identical

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INTRODUCTION

This International Standard has been prepared according to the requirements of IEC 61477 where applicable.

The product covered by this standard may have an impact on the environment during some or all stages of its life cycle. These impacts can range from slight to significant, be of short-term or long-term, and occur at the global, regional or local level.

Except for a disposal statement in the instructions for use, this standard does not include requirements and test provisions for the manufacturers of the product, or recommendations to the users of the product for environmental improvement. However, all parties intervening in its design, manufacture, packaging, distribution, use, maintenance, repair, reuse, recovery and disposal are invited to take account of environmental considerations.

Indian Standard

LIVE WORKING — ELECTRICAL INSULATING BLANKETS

1 Scope

This International Standard is applicable to electrical insulating blankets for the protection of workers from accidental contact with live or earthed electrical conductors, apparatus or circuits and avoidance of short circuits on electrical installations.

Electrical insulating blankets in rolls having a width lower than 50 mm are not covered by this standard.

NOTE 1 For a.c. electrical classification, as well as d.c. use, see 4.2.

NOTE 2 This standard gives a.c. test provisions. There is limited history for use in d.c. applications.

NOTE 3 See Annex A for suggested maximum voltage use.

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 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60212:1971, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60417, *Graphical symbols for use on equipment*

IEC 61318, *Live working – Conformity assessment applicable to tools, devices and equipment*

IEC 61477, *Live working – Minimum requirements for the utilization of tools, devices and equipment*

ISO 2592, *Determination of flash and fire points – Cleveland open cup method*

ISO 2977, *Petroleum products and hydrocarbon solvents – Determination of aniline point and mixed aniline point*

ISO 3104, *Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity*

ASTM D 3767:2003 (reapproved 2008): *Standard practice for rubber – Measurement of dimensions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61318 and the following apply.

3.1
disruptive discharge
passage of an arc following dielectric breakdown

NOTE 1 The term “sparkover” (in French “amorçage”) is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

NOTE 2 The term “flashover” (in French “contournement”) is used when a disruptive discharge occurs at least partly along the surface of a solid dielectric surrounded by a gaseous or liquid medium.

NOTE 3 The term “puncture” (in French “perforation”) is used when a disruptive discharge occurs through a solid dielectric producing permanent damage.

[IEV 651-01-18 and definition 2.7.7 of IEC 60743, modified]

3.2
elastomer
macromolecular material which returns rapidly to its initial dimensions and shape after substantial deformation by a weak stress and release of the stress

NOTE 1 The definition applies under room temperature test conditions.

NOTE 2 Elastomer is a generic term that includes rubber, latex and elastomeric compounds that may be natural or synthetic or a mixture or a combination of both. It also includes thermoplastic elastomer (TPE) material.

[ISO 472 modified]

3.3
electrical insulating blanket
flexible sheeting made of elastomer or plastic material, used to cover conductors or metallic parts which are either energized, dead or earthed

NOTE The sheeting is either of various definite shapes or in roll allowing the workers to custom-cut the material to fit the application.

[Definition 5.2.2 of IEC 60743 and IEV 651-04-06, modified]

3.4
nominal voltage (of a system)
suitable approximate value of voltage used to designate or identify a system

[IEV 601-01-21]

3.5
plastic
material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow

NOTE 1 Elastomeric materials, which also are shaped by flow, are not considered as plastics.

NOTE 2 In some countries, particularly in the United Kingdom, it is a permitted option to use the term “plastics” as the singular form as well as the plural form.

[Definition 2.4.4 of IEC 60743 and ISO 472]

3.6
proof test voltage
specified voltage that is applied to a device or test piece for the time defined under specified conditions to assure that the electrical strength of the insulation is above a specified value

3.7
withstand test voltage
voltage that a test piece is required to withstand without disruptive discharge or other electric failure when voltage is applied under specified conditions

4 Requirements

4.1 General

Electrical insulating blanket shall be designed and manufactured to contribute to the safety of the users provided they are used by skilled persons, in accordance with safe methods of work and the instructions for use.

4.2 Classification

The electrical insulating blankets covered by this standard shall be designated as follows:

– by electrical class, as class 00, class 0, class 1, class 2, class 3 and class 4;
– by adding suffix(s) to the class designation, in the case of a blanket with special category(s) as shown in Table 1.

Guidance for the selection of class (a.c. and d.c.) is given in Annex A.

Guidance as to the temperature range at which electrical insulating blankets can be used is given in Annex B.

Table 1 – Special properties

Category	Resistant to
A	Acid
H	Oil
Z	Ozone
M	Mechanical puncture
R	Acid, Oil and Ozone
C	Extremely low temperature
NOTE Any combination of categories may be used.	

4.3 Physical requirements

4.3.1 Composition

Electrical insulating blankets shall be manufactured of elastomer or plastic materials and produced by a seamless process. Where eyelets are provided in electrical insulating blankets they shall be non-conductive. Where other types of fastening systems are provided in electrical insulating blankets (for example hook and loop fastening) they shall also be non-conductive.

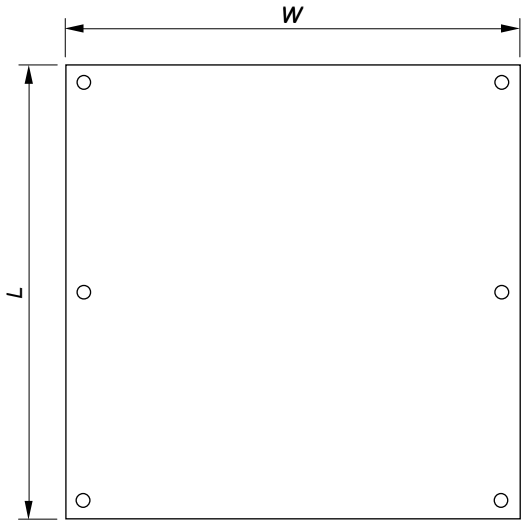
NOTE A standard number, size and type of eyelets is usually proposed by the manufacturers. Eyelets of ∅8 mm are the most common. For special needs, agreement could be reached between manufacturer and customer.

4.3.2 Shape and design

There is no requirement for the shape and design of the electrical insulating blankets.

Electrical insulating blankets may be either of various shapes or in rolls to be cut for individual applications.

The electrical insulating blankets of various shapes may be plain or of the slotted design (Figure 1 and Figure 2 provide examples of such design). They may include a grid of synthetic fiber for their reinforcement. In all cases electrical insulating blankets may have a strap(s) (Velcro®[1]) around their perimeter.

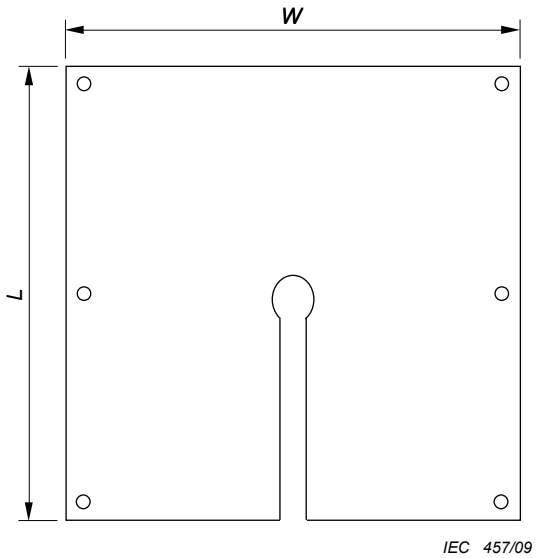


Key

L Length

W Width

Figure 1 – Example of plain design



Key

L Length

W Width

Figure 2 – Example of slotted design

[1] Velcro® is the trade name of a product supplied by Velcro Industries B.V. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

4.3.3 Dimensions and tolerances

4.3.3.1 Length and width

Manufacturers shall provide blanket length and width. These dimensions for each blanket shall be within a tolerance of ± 2 % of the stated dimensions.

Common lengths and widths for electrical insulating blankets are indicated in Table 2.

Table 2 – Common lengths and widths for electrical insulating blankets

Blankets of various shapes				Blankets in rolls
Plain design		Slotted design		
Length mm	Width mm	Length mm	Width mm	Width mm
560 660 900 910 910 910 910 1 160 1 200 2 000 2 128 2 280	560 360 500 305 457 690 910 1 160 800 1 300 910 910	560 900 - 910 1 160 2 000 	560 900 - 910 1 160 1 300 	60[a], 90[a] 360, 500, 800, 1 000, 1 300, 2 000

[a] To be produced in class 00 and class 0 only.

NOTE Blankets with dimensions of 90 mm or less require special considerations for electrical testing.

4.3.3.2 Thickness

4.3.3.2.1 Maximum thickness

The maximum thickness of an electrical insulating blanket shall be as given in Table 3 in order to obtain appropriate flexibility.

Blankets of categories A, H, M, R and Z may require additional thickness which shall not exceed 0,6 mm.

Table 3 – Maximum thickness for electrical insulating blankets

Class	Elastomer mm	Plastic mm
00	1,5	0,8
0	2,2	1,0
1	3,6	1,5
2	3,8	2,0
3	4,0	[a]
4	4,3	[a]

[a] Unavailable on the market

4.3.3.2.2 Minimum thickness

The minimum thickness shall be determined only by the ability to pass the tests defined in Clauses 5 and 6.

4.3.4 Workmanship and finish

Electrical insulating blankets shall be free from harmful physical irregularities on both surfaces that can be detected by thorough test and/or inspection.

Harmful physical irregularities defined as any feature that disrupts the uniform, smooth surface contour, such as pinholes, cracks, blisters, cuts, conductive embedded foreign matter, creases, pinch marks, voids (entrapped air), prominent ripples and prominent mould marks shall not be acceptable.

Non-harmful physical irregularities defined as surface irregularities present on either surface of the blanket due to imperfections on forms or moulds or other imperfections inherent to the manufacturing process shall be acceptable. These irregularities appear as mould marks that look like cuts even though they are actually a raised ridge of elastomer, indentations, or protuberances.

4.4 Mechanical, climatic and environmental requirements

Electrical insulating blankets shall support the mechanical, climatic and environmental stresses occurring during normal working conditions.

Electrical insulating blankets with one or more special categories shall support any relevant additional stresses.

4.5 Dielectric requirements

Electrical insulating blankets shall be capable of withstanding the corresponding electrical stresses according to their electrical class.

4.6 Marking

Electrical insulating blankets complying with the requirements of this standard shall be marked on the product with the following items of marking:

– name, trademark or identification of the manufacturer;
– symbol IEC 60417-5216 (2002-10) – Suitable for live working; double triangle (see Annex C);

  NOTE 1 The exact ratio of the height of the figure to the base of the triangle is 1,43. For the purpose of convenience, this ratio can be between the values of 1,4 and 1,5.

– number of the relevant IEC standard immediately adjacent to the symbol, (IEC 61112);
– month and year of manufacture;
– category if applicable;
– class designation.

For blankets in rolls, these items of marking shall appear at least every metre.

NOTE 2 Manufacturers are recommended to mark blankets in rolls of Class 00 and Class 0 at least every 30 cm to retain marking information in case it is later cut into smaller parts.

NOTE 3 Blankets in rolls of Class 00 and Class 0 may be considered as consumable products, intended for a single use.

Any additional item of marking shall be subject to agreement between the manufacturer and the customer.

The marking shall be clearly visible, durable and shall not impair the quality of the electrical insulating blanket.

When a colour code is used, the colour of the symbol (double triangle) shall correspond to the following code:

– Class 00 - beige;
– Class 0 - red;

– Class 1 - white;
– Class 2 - yellow;
– Class 3 - green;
– Class 4 - orange.

4.7 Packaging

Electrical insulating blankets shall be packaged in containers or packages of sufficient strength to properly protect the electrical insulating blankets from damage during delivery and normal storage and transportation before first use.

NOTE It is the responsibility of the user to provide protective packaging (ex: a specific bag) if cut portions are to be reused.

The outside of the container or package shall be marked with at least the following information:

– number of the relevant IEC standard immediately adjacent to the symbol with year of publication (4 digits), (IEC 61112:2009);
– name, trademark, or identification of the manufacturer.

4.8 Instructions for use

The manufacturer shall provide written instructions for use with each packaging of electrical insulating blankets covered by this standard.

These instructions shall be prepared in accordance with the general provisions of IEC 61477.

The instructions for use shall include, as a minimum, information such as storage, handling, disposal and periodic testing.

The instructions for use shall inform the users about critical hazards the manufacturer is aware of and offer relevant recommendations, but without intruding into the area of work procedures (for example, recommendation in case of overlapping blankets).

5 Tests

5.1 General

The present standard provides testing provisions to demonstrate compliance of the product to the requirements of Clause 4. These testing provisions are primarily intended to be used as type tests for validation of the design input. Where relevant, alternative means (calculation, examination, tests, etc.) are specified within the test subclauses for the purpose of electrical insulating blankets having completed the production phase.

The allocation of the electrical insulating blankets into various test groups, the quantity required and the order in which the type tests are carried out are given in Annex D.

The test location conditions shall be in accordance with IEC 60068-1:

– ambient temperature: 15 °C to 35 °C;
– relative humidity: 45 % to 75 %;
– atmospheric pressure: 86 kPa to 106 kPa.

For type tests, unless otherwise specified, electrical insulating blankets or test pieces shall be conditioned for a period of 2 h ± 0,5 h at a temperature of 23 °C ± 2 °C and relative humidity of 50 % ± 5 % according to IEC 60212 standard atmosphere B.

Unless otherwise specified, the tolerances for any measured value shall be ± 5 %.

5.2 Visual inspection and measurements

5.2.1 General

Visual inspection shall be carried out by a person with normal or corrected vision without additional magnification.

5.2.2 Classification

It shall be checked by visual inspection that the requirements of 4.2 are fulfilled.

5.2.3 Composition

It shall be checked by visual inspection that the requirements of 4.3.1 are fulfilled.

5.2.4 Dimensions, workmanship and finish

The product length and width as provided by the manufacturer shall be verified with electrical insulating blankets in a flattened condition. The dimensional requirements shall be considered as fulfilled if the dimensioning is within the tolerances outlined in 4.3.3.1.

The workmanship and finish shall be verified by visual inspection. In case of a roll, a length of 2 m shall be submitted to inspection.

The inspection shall be considered as passed if the requirements of 4.3.4 are satisfied. Non-harmful physical irregularities are defined as surface irregularities present on either surface of the blanket due to imperfections on forms or moulds or other imperfections inherent to the manufacturing process and are acceptable provided that:

a) the depression has rounded edges and no visible break in the surface, and cannot be seen on the opposite side when stretching over the thumb;
b) there are not more than five depressions as described in a) anywhere on the electrical insulating blanket or on the roll section under test and any two are separated by at least 15 mm;
c) the indentations, protuberances or mould marks tend to blend into a smooth surface upon stretching of the material;
d) the small projections or protuberances represent only a small amount of excess material that cannot be readily removed with the finger and these projections do not appreciably affect the stretching of the material.

5.2.5 Thickness

Thickness measurements shall be made at five or more points uniformly distributed over the total area of the electrical insulating blanket. In case of a roll, a length of 2 m shall be submitted to test.

Measurements shall be made with a commercial device designed for use on flexible materials and that measures the maximum thickness with an accuracy of 0,03 mm. Sufficient support shall be given to the blanket so that it will present an unstressed flat surface at the measurement point.

According to ASTM D3767, the pressure exerted by the presser foot of the measuring device shall be (22 ± 5) kPa for blanket material having a hardness equal to or greater than 35 IRHD, and (10 ± 2) kPa for blanket material having a hardness less than 35 IRHD.

The test shall be considered as passed if the requirements of 4.3.3.2.1 are fulfilled.

5.3 Marking

5.3.1 Visual inspection and measurement

The marking requirements of 4.6 shall be verified by visual inspection. In case of a roll, a length of 2 m shall be submitted to test.

5.3.2 Durability of marking

The durability of the items marked on the electrical insulating blanket shall be checked by rubbing vigorously for 15 s with a piece of lint-free cloth soaked in soapy water and then rubbing it for a further 15 s with a piece of lint-free cloth soaked in isopropanol (CH_3-CH(OH)-CH_3).

NOTE It is the employer's duty to ensure that any relevant legislation and any specific safety instructions regarding the use of this chemical are fully observed.

The test shall be considered as passed if the items of marking remain legible and the letters do not smear.

For marking produced by an engraving or moulding process, the test for durability is not needed.

5.4 Packaging and instructions for use

The packaging and complete supply of the information required in 4.7 and 4.8 shall be verified by visual inspection.

5.5 Mechanical tests

5.5.1 General

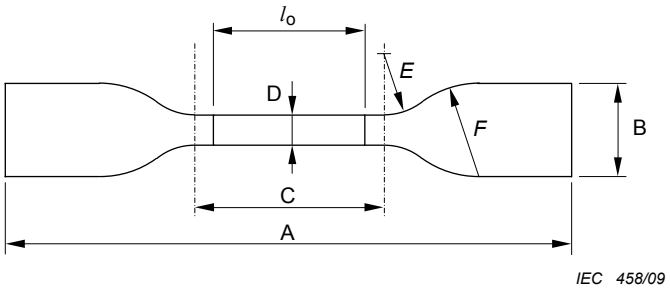
All mechanical tests shall be performed on test pieces which have been conditioned by storing each separately in a flat, horizontal position for at least 24 h at a temperature of 23 °C ± 2 °C and relative humidity of 50 % ± 5 % according to IEC 60212, standard atmosphere B. In the case of blankets in rolls, the material taken from the roll needed to prepare the test pieces shall be cut before conditioning.

NOTE The properties of vulcanized elastomeric material change continuously with time, these changes being particularly rapid in the period immediately following vulcanization.

5.5.2 Tensile strength and elongation at break

Dumb-bell test pieces shall have the outline shown in Figure 3 and four shall be cut from the corners of the electrical insulating blanket under test, one near each corner. Two test pieces shall be cut in length and two in width. The dumb-bell test pieces shall be cut longitudinally for roll material with width less than 75 mm.

Reference lines, 20 mm apart, shall be marked on these test pieces, symmetrically placed on the narrow part of the dumb-bell (see Figure 3).



Reference	Dimensions mm	Reference	Dimensions mm
A	75	E	8 ± 0,5
B	12,5 ± 1,0	F	12,5 ± 1
C	25 ± 1	l_o	20
D	4 ± 0,1		

Figure 3 – Plan view of the dumb-bell test piece

The test pieces shall be tested in a tensile testing machine which shall be power driven at a sufficient speed to maintain the rate of traverse of the driven grip substantially constant up to the maximum force capacity of the machine. The rate of traverse shall be 500 mm/min ± 50 mm/min.

The tensile strength shall be calculated by dividing the force at break by the initial area of the cross section under test.

The test shall be considered as passed if for each of the four test pieces the tensile strength is not less than 12 MPa.

The elongation at break shall be calculated by subtracting the initial distance between the reference lines on the test piece from the distance between the lines at breaking point and expressing the result as a percentage of the initial distance.

The elongation at break for blankets reinforced by synthetic fiber is not applicable

The test shall be considered as passed if for each of the four test pieces the elongation at break is not less than 300 % for elastomers and 150 % for plastics.

NOTE 1 The machine should be equipped to give a continuous indication of the force applied to the test piece and a graduated scale to measure the elongation.

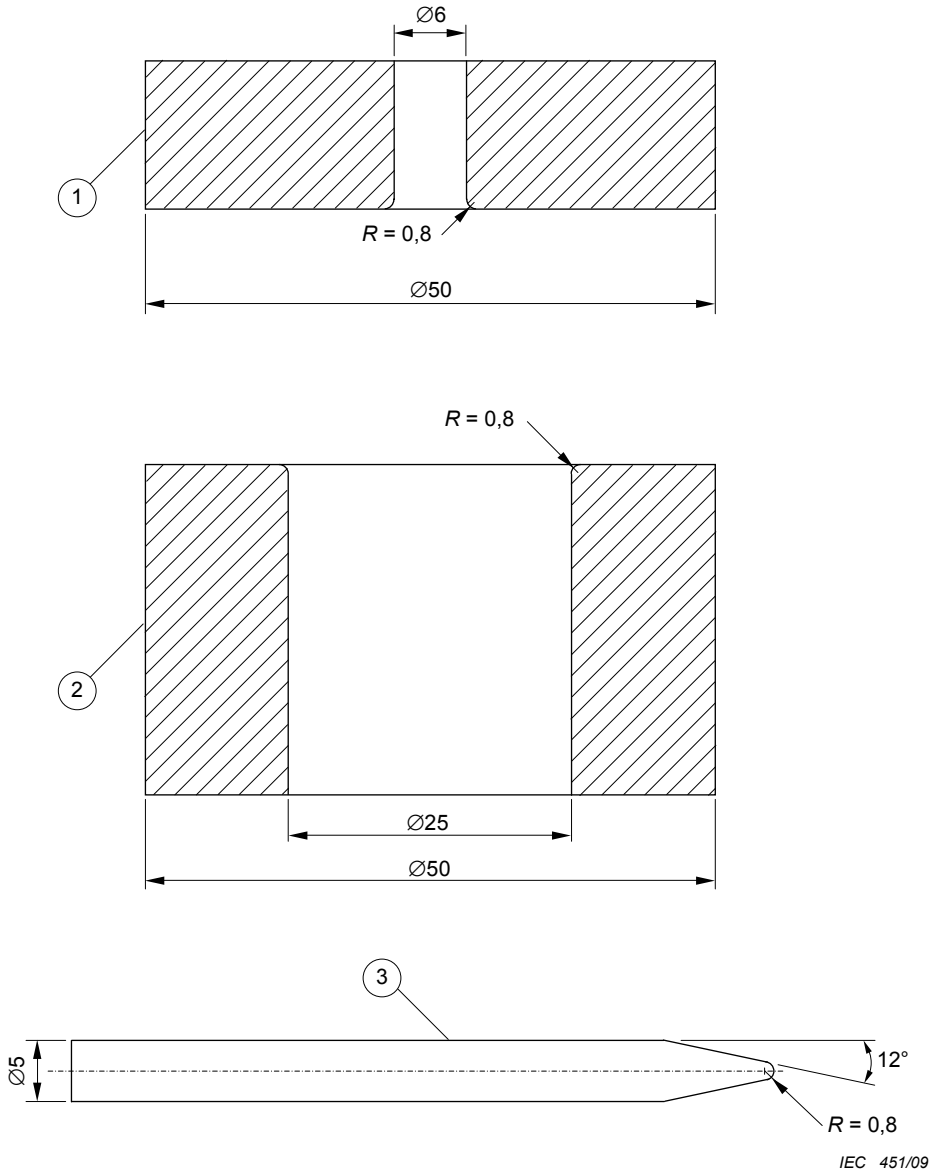
NOTE 2 After the test piece has been broken, the machine should give a permanent indication of the maximum force and where possible the maximum elongation.

5.5.3 Mechanical puncture resistance

Two circular test pieces 50 mm in diameter shall be cut from the electrical insulating blanket and each shall be clamped between two flat 50 mm diameter test plates. The top plate shall have a circular opening 6 mm in diameter and the bottom plate a 25 mm diameter circular opening. The edges of both openings shall be rounded to a radius of 0,8 mm (see Figure 4).

A needle shall be produced from a 5 mm diameter metallic rod and one end shall be machined to produce a taper with an included angle of 12° and with the tip rounded to a radius of 0,8 mm (see Figure 4). The needle shall be clean at the time of use.

Dimensions in millimetres except for angles



Key

1 Top plate

2 Bottom plate

3 Needle

Figure 4 – Test plates and needle for resistance to mechanical puncture

The needle shall be positioned perpendicularly above the test piece (clamped between the plates) and shall be driven into and through the specimen. The rate of traverse shall be 500 mm/min ± 50 mm/min. The force required to perform the puncture shall be measured.

The test shall be considered as passed if the puncture resistance is greater than 45 N except for class 0 electrical insulating blankets in which case it shall be greater than 30 N and for Class 00 it shall be greater than 25 N.

5.5.4 Tension set for elastomer material

Four test pieces, having the outline shown in Figure 3, shall be cut from the electrical insulating blanket. The test pieces shall be fitted in a straining device consisting of a metal rod or other suitable guide fitted with a pair of holders, one fixed and one movable, to hold the ends of the test piece.

The measurement of the unstrained reference length (shown as l_o in Figure 3) shall be checked to the nearest 0,1 mm and the test piece shall be placed in the holder. The test piece shall be extended at a speed of between 2 mm/s and 20 mm/s to a 200 % ± 10 % elongation and held for 10 min. After this time, the strain shall be released at a speed of between 2 mm/s and 10 mm/s, and then the test piece shall be removed from the holder and laid free on a flat surface. After a 10 min recovery time, the reference length shall be measured again.

The tension set is calculated as a percentage of the initial strain as follows:

$$\text{Tension set} = 100\frac{l_1 - l_o}{l_s - l_o}$$

where

l_o is the original unstrained reference length;

l_s is the strained reference length;

l_1 is the reference length after recovery.

The test shall be considered as passed if the tension set does not exceed 15 %.

5.5.5 Tear resistance test for plastic material

Four rectangular test pieces, having the outline shown in Figure 5, shall be cut from the electrical insulating blanket. They shall be pre-conditioned at a temperature of 23 °C ± 2 °C and relative humidity of 50 % ± 5% (see IEC 60212, standard atmosphere B).

A slit 25 mm ± 0,5 mm long shall be made in the middle of each test piece, beginning the incision at the centre of the test piece. Two lines shall then be drawn with a soft-lead pencil at the location shown in Figure 5. Angle shall be within ±1°.

The test pieces shall be tested in a tensile testing machine. Two holders larger than the test piece shall be set flush with the lines and tightened in order to avoid any slippage.

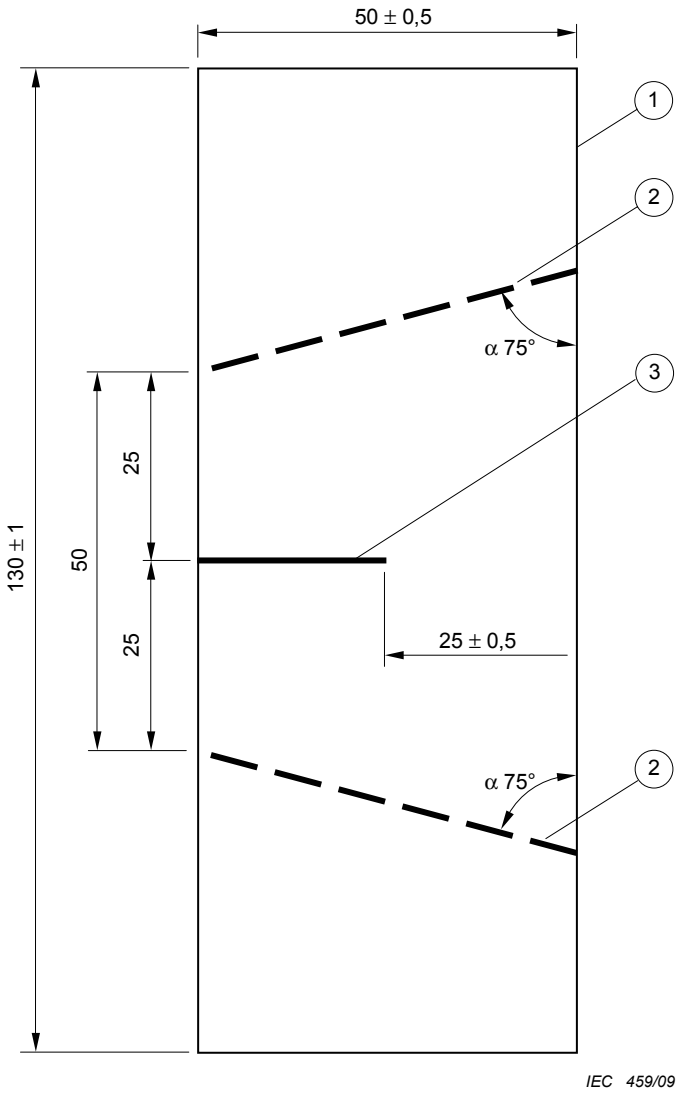
The testing machine shall be power driven at a constant speed of 100 mm/min ± 10 mm/min, and the tensile strength recorded as a function of time.

The tensile pressure shall be increased until the material tears, and the test continued until complete separation of the two halves.

The maximum tear resistance is taken from the strength/time curve and an average calculated for all the test pieces.

The test shall be considered as passed if the value is greater than 30 N.

Dimensions in millimetres except for angles



Key

1 Test piece

2 Heavy line mark with pencil

3 Slit line

Figure 5 – Tear resistance test

5.6 Dielectric tests

5.6.1 General

Dielectric testing shall be carried out using a. c. voltage. The peak (crest) or r.m.s. value of the a.c. voltage shall be measured with a maximum error according to IEC 60060-2.

The blankets, including test pieces from rolls, shall be conditioned for moisture absorption by total immersion in a bath of tap water with a resistivity of (100 ± 15) Ω·m at room temperature (as specified in 5.1) for a period of 16 h ± 0,5 h. After the conditioning they shall be wiped dry and immediately submitted to the dielectric test.

NOTE Insulating compounds used in the finishing process (e.g. paraffin and talcum powder) should be removed with suitable solvents before the test is commenced.

5.6.2 Electrodes

5.6.2.1 General

Electrodes shall be of such design so as to apply the electrical stress uniformly over the test area without producing corona at any point or mechanical strain in the material.

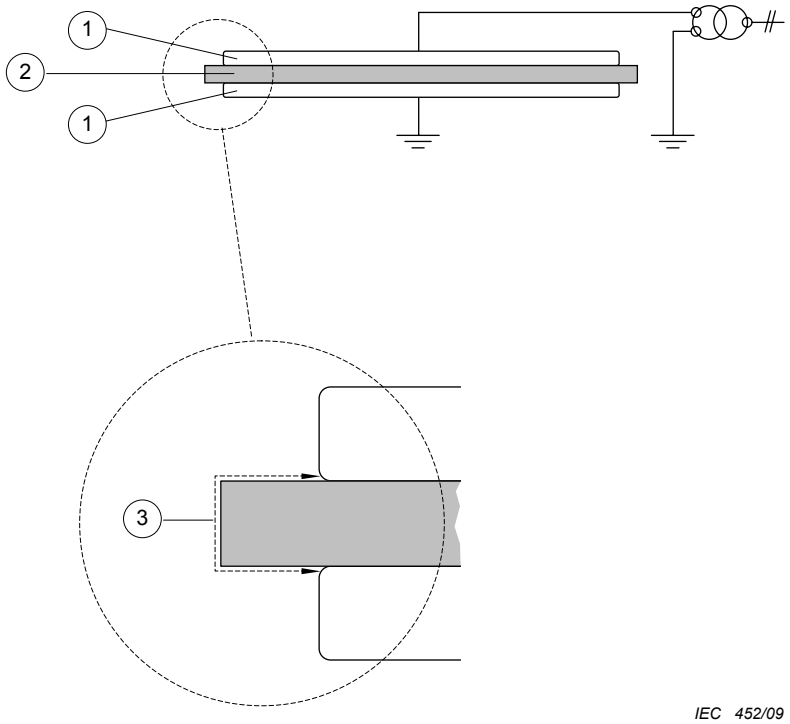
The different types of electrodes to be employed are described as follows.

5.6.2.2 For voltage proof test

5.6.2.2.1 Standard type of electrodes

Unless flashover happens during the conduct of the test, this type of electrodes shall be used for all classes of blankets.

The test electrodes shall be conductive plates, having smoothly rounded edges and corners, of a size that covers the maximum area of the electrical insulating blanket or test piece taking into account the maximum clearance given in Table 4 (see Figure 6).



Key

1 Conductive plate

2 Blanket or test piece

3 Electrode clearance

Figure 6 – Test set-up for voltage proof test of electrical insulating blankets with standard type of electrodes

In case of tests on rolls, the electrodes shall be able to contain at least a length of electrical insulating blanket equal to its width.

The electrodes shall be of such dimensions that the clearances specified in Table 4 are not exceeded.

Table 4 – Maximum electrode clearance for proof tests

Class of electrical insulating blankets	Clearance for tests mm
00	10
0	20
1	80
2	150
3	200
4	300

Clearance is defined as the distance between the upper electrode and the lower electrode around the edge of the blanket or test piece.

5.6.2.2.2 Alternative type of electrodes in case of flashover with the standard type

If flashover happens during the conduct of the test with the standard type of electrodes of 5.6.2.2.1, the following type of electrodes shall be used.

A 1 270 mm × 1 270 mm sheet of insulating material 3 mm to 5 mm thick which has a 762 mm × 762 mm opening in the centre, shall be placed on an earthed metal plate. This mask, which has a "picture frame" appearance, shall have the opening filled with a conductive material of such thickness as to bring the earth electrode to approximately the same level as the mask in order to maintain direct contact with the blanket or test piece.

The blanket or test piece shall be placed over the mask.

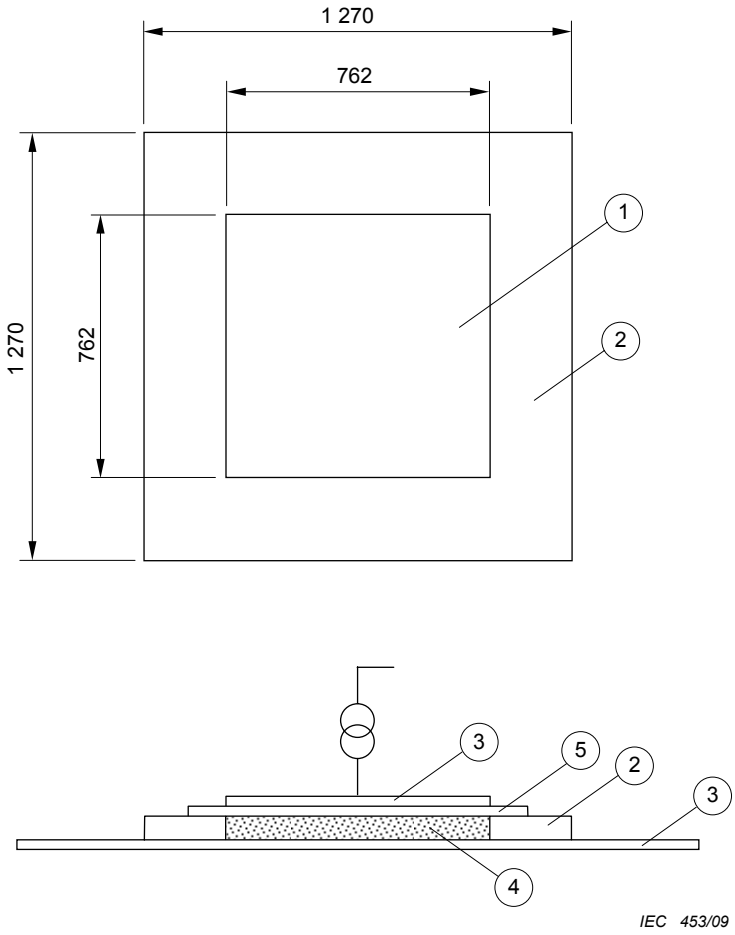
A rectangular metal plate, 762 mm × 762 mm and approximately 5 mm thick, having smoothly rounded edges and corners, shall be placed on top of the blanket or test piece. This top plate shall then be energized with the test voltage (see Figure 7).

NOTE 1 This arrangement will test a 762 mm × 762 mm area of a 914 mm × 914 mm blanket at 40 kV a.c. as the mask prevents flashover.

NOTE 2 Other mask dimensions may be used according to the dimensions of the blanket.

Other electrode designs may be used to achieve the same results.

Dimensions in millimetres



Key

1	Hole	4	Conductive material
2	Plexiglass mask (thickness 3 mm to 5 mm)	5	Blanket or test piece (1 000 mm × 1 000 mm)
3	Metal plate		

Figure 7 – Test set-up for voltage proof test of electrical insulating blankets with alternative type of electrodes

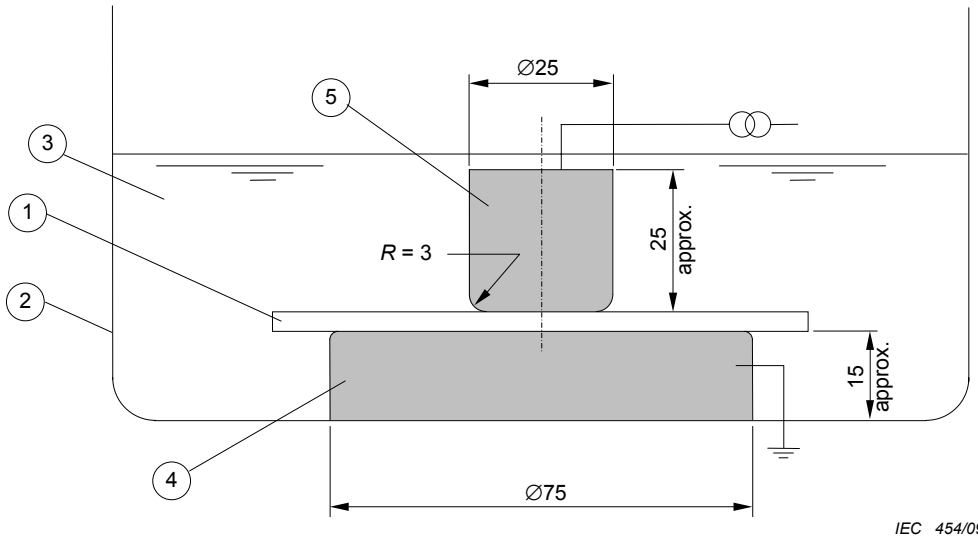
5.6.2.3 For voltage withstand test

The electrodes shall consist of two metal cylinders with the sharp edges removed to give a radius of 3 mm. One electrode shall be 25 mm in diameter and approximately 25 mm long. The other electrode shall be 75 mm in diameter and approximately 15 mm long. These electrodes shall be arranged coaxially as in Figure 8.

5.6.3 Test equipment

The test equipment used shall be capable of supplying an essentially stepless and continuously variable test voltage. Motor-driven regulating equipment is convenient and tends to provide uniform rate-of-rise to the test voltage. The test equipment shall be protected by an automatic circuit-breaking device designed to open promptly on the current produced by failure of the blanket or test piece.

Dimensions in millimetres



Key

1	Test piece	4	Metal base
2	Tank	5	Metal
3	Insulating liquid		

NOTE Suitable modification of the electrode dimensioning will be required in case of test pieces cut from rolls of small width.

Figure 8 – Test set-up for voltage withstand test

5.6.4 Electrical test procedure

5.6.4.1 Test equipment

The test voltage shall be applied according to IEC 60060-1 and the measuring equipment shall comply with IEC 60060-2.

5.6.4.2 Proof test procedure

5.6.4.2.1 Type test

Electrical insulating blankets in plane form shall be tested as received, without modification. In the case of electrical insulating blankets in rolls having a width equal to or larger than 1 000 mm, the minimum size of each test piece shall be 1 000 mm × 1 000 mm. For rolls having a width less than 1 000 mm, the test piece shall have the length equal to the width.

The electrical insulating blanket or test piece shall be given a voltage test as specified in Table 5 using electrodes as specified in 5.6.2.2. The voltage shall be initially applied at a low value and gradually increased at a constant rate-of-rise of approximately 1 000 V/s until the specified test voltage level is reached. The test period shall be considered to start at the instant the specified voltage is reached.

Table 5 – Test voltages

Class of electrical insulating blankets	Voltage kV r.m.s.	
	Proof test	Withstand test
00	2,5	5
0	5	10
1	10	20
2	20	30
3	30	40
4	40	50

The test shall be considered as passed if the specified test voltage is reached and maintained for 3 min without the occurrence of disruptive discharge or other electrical failure.

NOTE At the end of the test period, in order to prevent any temporary overvoltage, the applied voltage should be reduced at a constant rate to approximately half value before opening the test circuit, unless an electrical failure has already occurred.

5.6.4.2.2 Alternative test in case of electrical insulating blankets having completed the production phase

For conformity testing, the blanket has not to be submitted to a conditioning for moisture absorption. The time duration of the proof test, shall be 1 min.

In case of a blanket in a roll, an alternative test for testing the entire length of each roll is under consideration (for example, a test set-up made of a roller to hold the roll to be tested, a feed table at an appropriate speed with rollers energized at an appropriate test voltage, a take-up support table and take-up rollers).

5.6.4.3 Withstand test procedure

Three test pieces having dimensions of 150 mm × 150 mm shall be cut from an electrical insulating blanket.

In case of rolls having a width less than 150 mm, the test pieces shall have the length equal to the width.

The test pieces are placed between the metallic electrodes as specified in 5.6.2.3 and the whole arrangement is submerged in an insulating liquid (for instance, insulating oil). The test pieces shall not touch the wall of the tank.

Only one voltage rise is applied to each test piece. The voltage shall be applied to each test piece at a constant rate-of-rise of 1 000 V/s until the withstand voltage value given in Table 5 is reached.

NOTE At the end of the test period, in order to prevent any temporary overvoltage, the applied voltage should be reduced at a constant rate to approximately half value before opening the test circuit unless an electrical failure has already occurred.

The test shall be considered as passed if no electrical puncture occurs.

5.7 Ageing tests

For elastomer, eight dumb-bell test pieces shall be cut as according to Figure 3.

For plastics, four dumb-bell test pieces shall be cut according to Figure 3 and four more test pieces as shown in Figure 5.

These test pieces shall be placed in an air oven for 168 h at 70 °C ± 2°C and a relative humidity of less than 20 % (see IEC 60212 for standard atmosphere for dry heat).

The apparatus shall consist of an air oven in which there is a circulation of air providing between three and ten air changes per hour. The incoming air shall be at 70 °C ± 2 °C before coming in contact with the test pieces.

There shall be no copper or copper alloy parts inside the air oven. Provision shall be made for suspending the test pieces so that there is a minimum separation of 10 mm between the test pieces and 50 mm between the test pieces and the inner surfaces of the oven.

When the heating period is complete, the test pieces shall be removed from the oven and allowed to cool for not less than 16 h.

At the end of this period, tensile strength and elongation at break tests shall be carried out on the four elastomer and the four plastic test pieces in accordance with 5.5.2.

For elastomers only: tension set tests shall be carried out on the four test pieces in accordance with 5.5.4.

For plastic only: tear resistance shall be carried out on test pieces in accordance with 5.5.5.

The test shall be considered as passed if the results obtained are as follows:

– for both elastomer and plastic blankets: tensile strength and elongation at break is not less than 80 % of the values obtained for un-aged blankets. Elongation testing is not applicable for electrical insulating blankets reinforced by synthetic fibre;
– for elastomer only: tension set does not exceed 15 %;
– for plastic only: tear resistance is not less than 30 N.

5.8 Thermal tests

5.8.1 Flame retardance test

A test piece 150 mm × 150 mm shall be cut from the electrical insulating blanket and mounted horizontal and central, 40 mm above a gas burner and held by suitable clips.

In case of rolls having a width less than 150 mm, the test piece shall have the length of twice the width.

The test shall be carried out in a draught free room or chamber.

The gas supply shall be technical grade methane gas with a suitable regulator and meter to produce a uniform gas flow.

NOTE If natural gas is used as an alternative to methane, its heat content should be approximately 37 MJ/m^3, which has been found to provide similar results.

The nozzle of the burner shall have a diameter of 9,5 mm ± 0,5 mm to produce a 20 mm ± 2 mm high blue flame.

The burner is placed remote from the test piece, ignited and adjusted in the vertical position to produce a blue flame 20 mm ± 2 mm high. The flame is obtained by adjusting the gas supply and the air influx of the burner until a 20 mm ± 2 mm yellow tipped blue flame is produced and then the air supply is increased until the yellow tip disappears. The height of the flame is measured again and corrected if necessary.

The burner shall then be placed centrally below the test piece for 10 s and then withdrawn. It should be ensured that no air draught interferes with the test.

The propagation of the flame on the test piece shall be observed for 55 s after the withdrawal of the testing flame.

The test shall be considered as passed if the flame does not reach any point on a 50 mm diameter circle from the centre of the test piece, during the observation period.

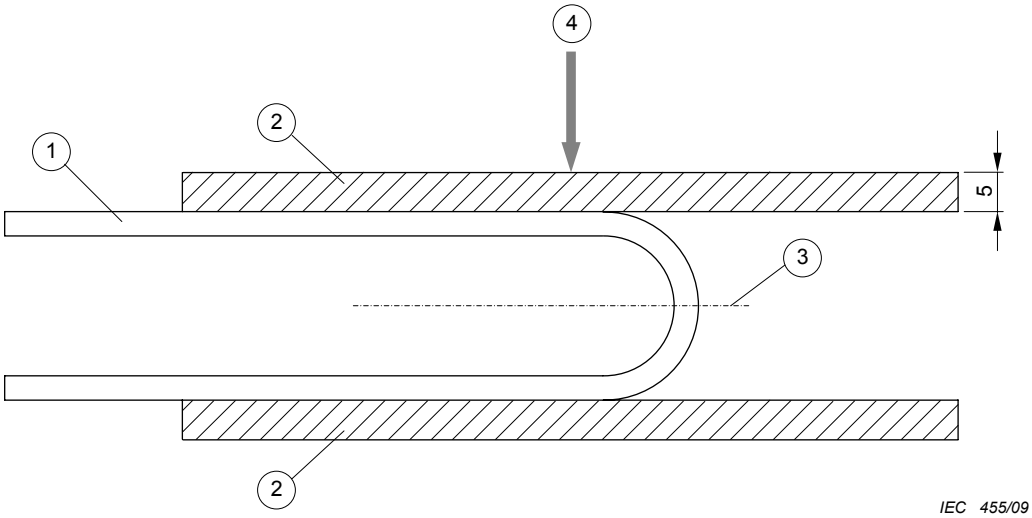
5.8.2 Low temperature folding test (except for category C blankets)

Three rectangular test pieces 200 mm × 500 mm shall be cut from an electrical insulating blanket. In case of rolls having a width less than 200 mm, the test pieces shall have the length double the width.

Each test piece shall be placed in a chamber for 4 h at a temperature of –25 °C ± 3 °C. Two polyethylene plates 200 mm × 200 mm × 5 mm thick shall be conditioned at the same temperature and for the same time.

Within 1 min after removal from the chamber, each test piece shall be folded at the mid-point, placed between the two polyethylene plates and subjected to a force of 100 N for 30 s as shown in Figure 9.

Dimensions in millimetres



Key

1	Test piece	3	Centre line of fold
2	Polyethylene plate	4	Force of 100 N

Figure 9 – Test set-up for low and extremely low temperature folding tests

The test shall be considered as passed if no tear, break or crack is visible. The test piece shall also pass the dielectric withstand test (see 5.6.4.3) but without conditioning for moisture absorption.

The three test pieces necessary for the dielectric withstand test shall be cut from the test piece submitted to folding, in such a way that the surface where folding occurs is found and centred on each test piece for withstand test.

6 Tests on electrical insulating blankets with special properties

6.1 General

Electrical insulating blankets with special properties (see Table 1) shall meet, in addition to the general tests of Clause 5, the following applicable tests. For blankets of Category C, the extremely low temperature folding test shall replace the test of 5.8.2.

6.2 Category A: Acid resistance

Four test pieces of 150 mm × 150 mm shall be cut from an electrical insulating blanket or from a roll having a width greater than 150 mm of category A material. In case of rolls having a width less than 150 mm, the length to be taken shall be sufficient to later allow the cut of the necessary four test pieces.

They shall be conditioned by immersing in 32 °Baumé sulphuric acid solution at a temperature of 23 °C ± 2 °C for 8 h ± 0,5 h. Following acid conditioning, the test pieces shall be rinsed in water and dried for 2 h ± 0,5 h at approximately 70 °C.

The time elapsed between the end of drying and the start of testing shall be 45 min ± 15 min. Tests shall then be carried out on three test pieces for withstand tests (see 5.6.4.3) but without conditioning for moisture absorption and on one test piece for tensile strength and elongation at breaking point (see 5.5.2).

The acid resistance test shall be considered as passed if the electrical withstand tests are fulfilled and the values obtained for the mechanical tests are not less than 75 % of values obtained in the tests carried out on a test piece from the same batch without acid conditioning.

6.3 Category H: Oil resistance

Four test pieces of 150 mm × 150 mm shall be cut from an electrical insulating blanket or from a roll having a width greater than 150 mm of category H material. In case of rolls having a width less than 150 mm, the length to be taken shall be sufficient to later allow the cut of the necessary four test pieces.

The test pieces shall be preconditioned in air for not less than 3 h ± 0,5 h at 23 °C ± 2 °C, and 50 % ± 5 % relative humidity, then they shall be conditioned by immersing in liquid 102 (see Annex E) at a temperature of 70 °C ± 2 °C for 24 h ± 0,5 h.

Following conditioning the test pieces shall be dried using a lint-free clean absorbent cloth.

Time elapsed between removal from oil and start of testing shall be 45 min ± 15 min. Tests shall then be carried out on three test pieces for withstand tests (see 5.6.4.3) but without conditioning for moisture absorption and on one test piece for tensile strength and elongation at breaking point (see 5.5.2).

The oil resistance test shall be considered as passed if the electrical withstand tests are fulfilled and the values obtained for the mechanical tests are not less than 75 % of values obtained in the tests carried out on a test piece from the same batch without oil conditioning.

6.4 Category Z: Ozone resistance

6.4.1 General

Two methods are presented to determine the compliance of electrical insulating blankets with the requirements needed for category Z. In case of dispute, method A shall be used.

6.4.2 Test methods

6.4.2.1 Method A

Three test pieces of 12 mm × 150 mm shall be cut from an electrical insulating blanket or from a roll of category Z material. They shall be conditioned at an extension of 20 % in an oven for 8 h ± 0,5 h at a temperature of 40 °C ± 2 °C, and an ozone concentration of 1 mg/m^3 ± 0,01 mg/m^3 (0,5 × 10^{-6} ± 0,05 × 10^{-6} by volume) at standard atmospheric pressure of 1 013 mbar (101,3 kPa).

The test pieces shall then be stored at a room temperature of 23 °C ± 2°C, and 50 % ± 5 % relative humidity for 48 h ± 0,5 h and then examined for ozone damage.

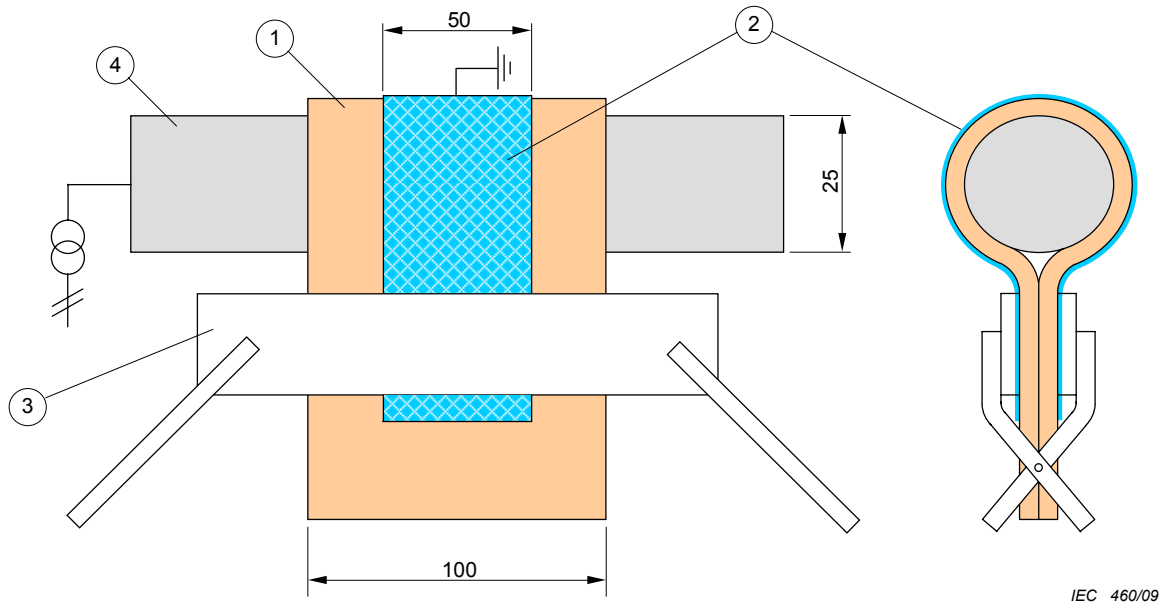
The test shall be considered as passed if, after completion, the test pieces exhibit no visible cracks under visual inspection.

6.4.2.2 Method B

The ozone resistance test shall be made on a 100 mm × 150 mm test piece cut from an electrical insulating blanket or from a roll of category Z material suitably conditioned by lying flat for 24 h.

The test piece shall be draped over a 25 mm diameter metal tube of sufficient length to completely underlie the test piece, while possessing additional length for the required mounting supports (see Figure 10).

Dimensions in millimetres



Key

1	Test piece	3	Polyethylene strip
2	Aluminium sheet	4	Metal tube

Figure 10 – Ozone resistance – Method B test set-up

The free ends of the test piece shall be clamped beneath the tube so that an intimate contact is established between the test piece and the tube along the upper half of the cylindrically-shaped electrode surface.

A piece of flat aluminium sheet foil approximately 50 mm × 100 mm shall be placed over the draped test piece so as to provide adequate separation distance to prevent flashover between the foil and the tube.

The aluminium foil shall be earthed. The inside electrode (tube) shall be energized for 1 h at a test voltage of 15 kV a.c. (r.m.s.).

The test shall be considered as passed if, after completion, the test pieces exhibit no visible cracks under visual inspection.

6.5 Category M: Mechanical puncture resistance

Electrical insulating blankets of category M shall be tested in accordance with the mechanical test of 5.5.3. However the results shall be as specified below:

– mechanical puncture resistance: the puncture resistance shall be greater than 70 N.

If the electrical insulating blanket is of non-uniform construction the test shall be performed on the weakest area.

6.6 Category C: Extremely low temperature folding test

Three rectangular test pieces 200 mm × 500 mm shall be cut from an electrical insulating blanket. In case of rolls having a width less than 200 mm the test pieces shall have the length double the width.

Each test piece shall be placed in a chamber for 24 h ± 0,5 h at a temperature of –40 °C ± 3 °C. Two polyethylene plates 200 mm × 200 mm × 5 mm thick shall be conditioned at the same temperature and for the same time.

Within 1 min after removal from the chamber, each test piece shall be folded at the mid-point, placed between the two polyethylene plates and subjected to a force of 100 N for 30 s as shown in Figure 9.

The test shall be considered as passed if no tear, break or crack is visible. The test piece shall also pass the dielectric withstand test (see 5.6.4.3) but without conditioning for moisture absorption.

The three test pieces necessary for the dielectric withstand test shall be cut from the test piece submitted to folding, in such a way that the surface where folding occurs is found and centred on each test piece for withstand test.

7 Conformity assessment of electrical insulating blankets having completed the production phase

For conducting the conformity assessment during the production phase, IEC 61318 shall be used in conjunction with the present standard.

Annex F issued of a risk analysis on the performance of the electrical insulating blanket provides the classification of defects and identifies the associated tests applicable in case of production follow-up.

8 Modifications

Any modification of the electrical insulating blanket shall require the type tests to be repeated, in whole or in part (if the degree of modification so justifies), as well as a change in blanket reference literature.

Annex A
(informative)

Guidelines for the selection of the class of electrical insulating blankets in relation to nominal voltage of a system

The maximum use voltage recommended for each class of electrical insulating blankets is designated in Table A.1.

Table A.1 – Designation maximum use voltage

Class	A.C. V r.m.s.	D.C. V
00	500	Not available
0	1 000	1 500
1	7 500	11 250
2	17 000	25 500
3	26 500	39 750
4	36 000	54 000

The maximum use voltage is the voltage rating of the protective equipment that designates the maximum nominal voltage of the energized system that may be safely worked.

On multiphase circuits, the nominal voltage is equal to the phase-to-phase voltage. If there is no multiphase exposure in a system area, and the voltage exposure is limited to the phase to earth potential, the phase to earth potential should be considered to be the nominal voltage.

If electrical equipment and devices are insulated, or isolated, or both, such that the multiphase exposure on an earthed neutral star circuit (grounded wye) is removed, the nominal voltage may be considered as the phase-to-earth voltage on that circuit.

The user may decide to use a different class of electrical insulating blanket than that recommended in Table A.1.

Caution should be exercised in the use of electrical insulating blanket on d.c. systems due to lack of data at the present time.

Annex B
(informative)

In-service care and testing

B.1 General

The following is for guidance only for the maintenance, inspection, retest and use of electrical insulating blankets after purchase.

When the blanket is used for non-live working applications or when the recommendations of this annex cannot be followed, the blanket product is no longer suitable for live working.

B.2 Storage

Electrical insulating blankets should be stored in a manner to prevent damage in accordance with the manufacturer's instructions (see 4.8), such as appropriate compartments or containers. The manufacturer will supply suitable packaging for shipping and initial storage of the electrical insulating blankets to provide protection until it is opened for use. The user should provide the necessary protection following the opening of the initial packaging for blankets or any unused portion of a roll and any cut portions that may be reused.

Care should be taken to ensure that the electrical insulating blanket is not compressed, folded or stored in proximity to steam pipes, radiators or other sources of artificial heat or exposed to direct sunlight, artificial light or other sources of ozone. It is desirable that the storage temperature be between 10 °C and 21 °C.

B.3 Marking on blankets of small dimensions cut from rolls

In the case of blankets in rolls, the manufacturer is required by 4.6 to have the items of marking appear at least every metre.

Blankets cut from rolls of Class 00 and Class 0 should be cut in such a manner to retain the marking information.

If the dimensions of a blanket are cut down by the user to a point that the marking is not complete, and this part is to be reused, the user should make sure the information is duplicated on the blanket in some durable manner that does not affect its performance.

B.4 Examination before use

Before each use, both sides of each electrical insulating blanket should be visually inspected. Examine the material closely for any damage that might affect the dielectric characteristics, such as cracks, tears or small pinholes.

If an electrical insulating blanket is thought to be unsafe, it has not to be used and should be returned for testing.

B.5 Temperature

Standard electrical insulating blankets should be used in areas having ambient temperatures between –25 °C and +55 °C and category C blankets in ambient temperatures between –40 °C and +55 °C.

Caution should be taken when using electrical insulating blankets on electrical parts having high temperatures. The normal use temperature of a blanket may be exceeded if it is placed over a current-carrying part with an elevated temperature.

B.6 Precautions in use

Electrical insulating blankets should not be exposed unnecessarily to heat or light or should not be exposed to chemicals, solvents or strong acid. If an electrical insulating blanket does come in contact with conductive grease, it should be cleaned as soon as possible with a suitable solvent.

When an electrical insulating blanket becomes soiled it should be washed with soap and water at a temperature not exceeding that recommended by the blanket manufacturer and thoroughly dried in accordance with manufacturer's instructions. If insulating compounds such as tar and paint continue to stick to the blankets, the affected parts should be wiped immediately with a suitable solvent, avoiding excessive solvent use, and then immediately washed and treated as prescribed. Petrol, paraffin or white spirit should not be used to remove such compounds.

Electrical insulating blankets which become wet in use or by washing should be dried thoroughly, but not in a manner that will cause the temperature of the blankets to exceed 65 °C.

If an electrical insulating blanket is used to cover energized conductors at voltages above 1 kV, it should be ozone resistant (for example, a blanket of category Z or a blanket with a combination of special properties like category R).

Electrical insulating blankets are not intended to be walked on.

B.7 Periodic inspection and testing

No electrical insulating blankets, even those held in storage, should be used unless they have been inspected and/or electrically tested within the previous 12 months.

The inspection and testing on an electrical insulating blanket consist of visual inspection, and then a proof dielectric test without moisture conditioning, except for class 00 and class 0 where visual inspection only is required.

The user should refer to subclauses within this document for test guidance to verify the suitability for the continuing use of a blanket.

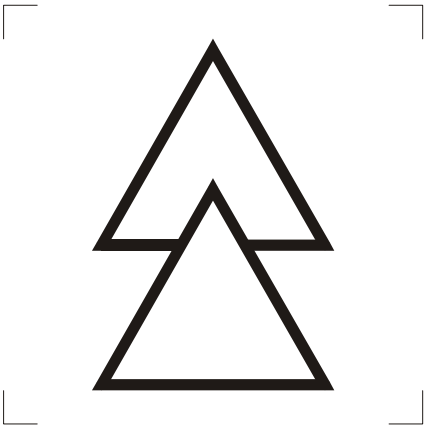
In case the blanket fails the visual inspection or dielectric test, the disposal should be done in a manner that will not harm the environment. Recycling should be considered, if available.

The user or the testing laboratory should mark the electrical insulating blanket with the date of current or next required inspection and test.

Such marking should be in a border area and should not affect the dielectric properties of the product.

Annex C
(normative)

Suitable for live working ; double triangle
(IEC 60417-5216 (2002-10))



Annex D
(normative)

General type test procedure

D.1 General

The numbers given in the different test groups of Table D.1 indicate the order in which the type tests shall be made. Within a group, tests with the same sequential number can be performed in the more convenient order.

Table D.1 indicates the sequential order for performing the general tests as well as the alternative test for category C or the additional tests for categories A, H and Z. For blankets of category R or of any other combination of categories, the requirements for tests and the sequential order are obtained by combining the relevant provisions. Electrical insulating blankets which have been subjected to type tests shall not be re-used.

Table D.1 – List and chronological order of type tests

Type of test	Subclause		Test groups						
	Test	Requirement	Group 1	Group 2	Group 3	Group 4	Group 5 A	Group 6 H	Group 7 Z
Visual and measurement									
Classification	5.2.2	4.2	1						
Composition	5.2.3	4.3.1	1						
Dimensions – Length and width	5.2.4	4.3.3.1	1						
Dimensions – Thickness	5.2.5	4.3.3.2	1						
Workmanship and finish	5.2.4	4.3.4	1	1	1	1	1	1	1
Marking	5.3	4.6	1						
Packaging	5.4	4.7	1						
Instructions for use	5.4	4.8	1						
Mechanical		4.4							
Tensile strength and elongation at break	5.5.2		2						
Puncture resistance	5.5.3		2 [b]						
Tension set	5.5.4		2 [a]						
Tear resistance	5.5.5		2 [a]						
Dielectric		4.5							
Proof test	5.6.4.2.1			2	2	2			
Withstand test	5.6.4.3			3	3	3			
Ageing	5.7	4.4		3					
Thermal		4.4							
Flame retardant test	5.8.1		2						
Low temperature	5.8.2					3 [c]			
Special properties		4.4							
Cat. A: Acid	6.2						2		
Cat. H: Oil	6.3							2	
Cat. Z: Ozone	6.4								2
Cat. M: Mechanical	6.5		2 [b]						
Cat. C: Extremely low temperature	6.6					3 [c]			
Size of each group (the unit is the blanket or roll)			1	1	1	1	1	1	1

[a] Depending on the material of which the electrical insulating blanket is made, either the tension set or the tear resistance shall be performed.

[b] Values specified are different in the case of electrical insulating blankets of category M.

[c] Values specified are different in the case of electrical insulating blankets of category C.

D.2 Group size requirements

D.2.1 Group 1

Group 1 requires one plane blanket or a sufficient length of blanket in a roll, from which the necessary test pieces will be cut for the mechanical tests and the thermal test, after the visual inspection and measurements have been performed.

– Tensile strength and elongation at break: four test pieces
– Mechanical puncture resistance: two test pieces
– Tension set (elastomer material only): four test pieces
– Tear resistance (plastic material only): four test pieces
– Flame retardancy: one test piece

D.2.2 Group 2

Group 2 requires one plane blanket or a sufficient length of blanket in a roll from which the necessary test piece will be cut for the dielectric proof test after the inspection for workmanship and finish has been performed.

The same blanket or test piece is then used to cut the three test pieces for the dielectric withstand test and the eight test pieces for the ageing test. In case of rolls of small width the test pieces may have to be cut from the original roll.

D.2.3 Group 3

Group 3 requires one plane blanket or a sufficient length of blanket in a roll from which the necessary test piece will be cut for the dielectric proof test after the inspection for workmanship and finish has been performed.

The same blanket or test piece is then used to cut the three test pieces for the dielectric withstand test. In case of rolls of small width the test pieces may have to be cut from the original roll.

D.2.4 Group 4

Group 4 requires one plane blanket or a sufficient length of blanket in a roll from which the necessary test piece will be cut for the dielectric proof test after the inspection for workmanship and finish has been performed.

The same blanket or test piece is then used to cut the three test pieces for the dielectric withstand test and the three test pieces for the test at low temperature or extremely low temperature. In case of rolls of small width the test pieces may have to be cut from the original roll.

D.2.5 Group 5 – Additional test for acid resistance

Group 5 (for category A) requires one plane blanket or a sufficient length of blanket in a roll, from which the necessary four test pieces will be cut after the visual inspection for workmanship and finish has been performed. The four test pieces will be submitted to the acid exposure as described in 6.2.

D.2.6 Group 6 – Additional test for oil resistance

Group 6 (for category H) requires one plane blanket or a sufficient length of blanket in a roll, from which the necessary four test pieces will be cut after the visual inspection for workmanship and finish has been performed. The four test pieces will be submitted to the oil exposure as described in 6.3.

D.2.7 Group 7 – Additional test for ozone resistance

Group 7 (for category Z) requires one plane blanket or a sufficient length of blanket in roll, from which the necessary three test pieces will be cut after the visual inspection for workmanship and finish has been performed. The three test pieces will be submitted to the ozone exposure as described in 6.4.

Annex E
(normative)

Liquid for tests on electrical insulating blankets of category H – Oil resistance

E.1 Particularities of liquid 102

Liquid 102 is intended to simulate certain high-pressure hydraulic oils.

It is a blend comprising 95 % (*m/m*) of oil no. 1 and 5 % (*m/m*) of a hydrocarbon-compound oil additive containing 29,5 % (*m/m*) to 33 % (*m/m*) of sulfur, 1,5 % to 2 % (*m/m*) of phosphorus and 0,7 % (*m/m*) of nitrogen. A suitable additive is commercially available.

E.2 Characteristics of oil no. 1

Oil no.1 shall have the characteristics shown in Table E.1. Generally it is of the mineral oil type, and a low volume increase oil.

To ensure uniformity, the source of this oil shall also be specified as a closely controlled blend of mineral oils consisting of a solvent-extracted, chemically treated, dewaxed, paraffinic residuum and natural oil. Oil no. 1 shall not contain any additive, except that a trace (approximately 0,1 %) of a pour-point depressant may be added.

Table E.1 – Characteristics of oil no. 1

Property	Oil no. 1
Aniline point (°C) [a]	124 ± 1
Kinematic viscosity (m^2/s) [b]	$(20 \pm 1) \times 10^{-6}$
Flash point (°C minimum) [c]	243
[a] See ISO 2977. [b] Measured at 98,89 °C (see ISO 3104). [c] Measured by Cleveland open cup method (see ISO 2592).	

See ISO 1817 for supplementary information.

Annex F
(normative)

Classification of defects and tests to be allocated

This annex was developed to address the level of defects of electrical insulating blankets having completed the production phase (critical, major or minor) in a consistent manner (see IEC 61318). For each requirement identified in Table F.1, both the type of defect and the associated test are specified.

Table F.1 – Classification of defects and associated requirements and tests

Requirements		Type of defect			Tests
		Critical	Major	Minor	
4.3.1	Diameter of eyelets			X	5.2.3
4.3.3.1	Availability of length and width and tolerances Tolerances not within the specified limits			 X X	5.2.4
4.3.3.2.1	Maximum thickness			X	5.2.5
4.3.4	Workmanship and finish (various shape)	X [a]	X [a]	X [a]	5.6.4.2.2
4.3.4	Workmanship and finish (in rolls)	X [a]	X [a]	X [a]	5.6.4.2.2
4.5	Dielectric	X			5.6.4.2.2
4.6	Marking		X		5.3
4.7	Packaging			X	5.4
4.8	Instructions for use			X	5.4
4.4	**Mechanical** Tensile strength and elongation at break Mechanical puncture Tension set or Tear resistance		 X X X		 5.5.2 5.5.3 5.5.4 or 5.5.5
4.4	Ageing			X	5.7
4.4	**Thermal** Flame retardance Low temperature			 X X	 5.8.1 5.8.2
4.4	**Special properties** Acid resistance Oil resistance Ozone resistant Mechanical puncture Extremely low temperature			 X X X X X	 6.2 6.3 6.4 6.5 6.6

[a] The classification of defect is related to the type of irregularities. The electrical proof test of 5.6.4.2.2 will cover all cases.

Bibliography

IEC 60050(601):1985, *International Electrotechnical Vocabulary – Chapter 601: Generation, transmission and distribution of electricity – General*

IEC 60050(651):1999, *International Electrotechnical Vocabulary (IEV) – Part 651: Live working*

IEC 60743:2001, *Live working – Terminology for tools, equipment and devices*
Amendment 1 (2008)[2)]

ISO 472:1999, *Plastics – Vocabulary*

ISO 1817, *Rubber, vulcanized – Determination of the effect of liquids*

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[2)] There exists a consolidated edition 2.1 (2008) that includes edition 2 of IEC 60743 and its Amendment 1.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 2977 Determination of flash and fire points — Cleveland open cup method	IS 1448 (Part 3) : 2007/ISO 2977 : 1997 Methods of test for petroleum and its products [P : 3] Petroleum products and hydrocarbon solvents — Determination of aniline point and mixed aniline point (*third revision*)	Identical
ISO 3104 Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity	IS 1448 (Part 25/Sec 1) : 2018/ ISO 3104 : 1994 Methods of test for petroleum and its products [P : 25] Transparent and opaque liquids, Section 1 Determination of kinematic viscosity and calculation of dynamic viscosity (*second revision*)	Identical

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

International Standard	*Title*
IEC 60417	Graphical symbols for use on equipment
IEC 61477	Live working — Minimum requirements for theutilization of tools, devices and equipment
ASTM D 3767 : 2003	Standard practice for rubber — Measurement of dimensions

Only the English language text has been retained while adopting it in this 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 : 2022 ‘Rules for rounding of numerical values (*second revision*)’. 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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Amendments Issued Since Publication

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