ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๔๙๙๓ (พ.ศ. ๒๕๖๐)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

วิธีทดสอบสายไฟฟ้าในภาวะที่เกิดการลุกไหม้ – ความสมบูรณ์ของวงจรไฟฟ้า

เล่ม ๒ วิธีทดสอบการไหม้ไฟกับแรงกระแทกที่อุณหภูมิอย่างน้อย 830°C สำหรับสายไฟฟ้า

ที่มีแรงดันไฟฟ้าที่กำหนดไม่เกิน 0.6/1.0 kV และมีเส้นผ่านศูนย์กลางรวมไม่เกิน 20 mm

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อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ ซึ่งแก้ไขเพิ่มเติมโดยพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม (ฉบับที่ ๗) พ.ศ. ๒๕๕๘ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม วิธีทดสอบสายไฟฟ้าในภาวะที่เกิดการลุกไหม้ – ความสมบูรณ์ของวงจรไฟฟ้า เล่ม ๒ วิธีทดสอบการไหม้ไฟกับแรงกระแทกที่อุณหภูมิอย่างน้อย 830°C สำหรับสายไฟฟ้าที่มีแรงดันไฟฟ้าที่กำหนดไม่เกิน 0.6/1.0 kV และมีเส้นผ่านศูนย์กลางรวมไม่เกิน 20 mm มาตรฐานเลขที่ มอก. 2755 เล่ม 2 – 2559 ไว้ดังมีรายละเอียดต่อท้ายประกาศนี้

ทั้งนี้ ให้มีผลตั้งแต่วันที่ประกาศในราชกิจจานุเบกษาเป็นต้นไป

ประกาศ ณ วันที่ ๗ มีนาคม พ.ศ. ๒๕๖๐

อุตตม สาวนายน

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

มาตรฐานผลิตภัณฑ์อุตสาหกรรม
วิธีทดสอบสายไฟฟ้าในภาวะที่เกิดการลุกไหม้ - ความสมบูรณ์ของวงจรไฟฟ้า
เล่ม 2 วิธีทดสอบการไหม้ไฟกับแรงกระแทกที่อุณหภูมิอย่างน้อย 830 °C สำหรับสายไฟฟ้าที่มีแรงดันไฟฟ้าที่กำหนดไม่เกิน 0.6/1.0 kV และมีเส้นผ่านศูนย์กลางรวมไม่เกิน 20 mm

1. ขอบข่าย

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ระบุเครื่องทดสอบ วิธีทดสอบ และคุณลักษณะที่ต้องการด้านสมรรถนะ รวมถึงเวลาการใช้เปลวไฟที่แนะนำ สำหรับสายไฟฟ้ากำลังแรงดันต่ำที่มีแรงดันไฟฟ้าที่กำหนดไม่เกิน 0.6/1.0 kV และสายไฟฟ้าควบคุมที่มีแรงดันไฟฟ้าที่กำหนดซึ่งจำเป็นต้องรักษาความสมบูรณ์ของวงจรไฟฟ้าเมื่อไหม้ไฟและมีแรงกระแทกทางกลภายใต้เงื่อนไขที่กำหนด มีเจตนาสำหรับการใช้งานเมื่อทดสอบสายไฟฟ้าที่มีเส้นผ่านศูนย์กลางรวมไม่เกิน 20 mm

หมายเหตุ สายไฟฟ้าที่มีเส้นผ่านศูนย์กลางใหญ่กว่าควรทดสอบโดยใช้เครื่องทดสอบ วิธีทดสอบ และคุณลักษณะที่ต้องการตาม มอก.2755 เล่ม 1

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้อธิบายวิธีการเตรียมตัวอย่างทดสอบ การตรวจสอบความต่อเนื่อง วิธีดำเนินการทดสอบทางไฟฟ้า วิธีการเผาไหม้สายไฟฟ้า วิธีการสร้างแรงกระแทก และข้อกำหนดสำหรับการประเมินผลการทดสอบ

Annex A กำหนดวิธีการทวนสอบหัวเผาและระบบควบคุมที่ใช้ในการทดสอบ

คุณลักษณะที่ต้องการที่ระบุไว้สำหรับการชี้บ่ง เป็นทางเลือกที่อาจระบุข้อความบนสายไฟฟ้าเพื่อแสดงความสอดคล้องกับมาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS – CIRCUIT INTEGRITY –

Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60331-2 has been prepared by IEC technical committee 20: Electric cables.

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

FDIS	Report on voting
20/1050/FDIS	20/1054/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

It has the status of a group safety publication in accordance with IEC Guide 104.

A list of all the parts in the IEC 60331 series, under the general title *Tests for electric cables under fire conditions – circuit integrity*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 60331 consists of the following parts under the general title: *Tests for electric cables under fire conditions – Circuit integrity:*

Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm

Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm

Part 3: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV tested in a metal enclosure

Part 11: Apparatus – Fire alone at a flame temperature of at least 750 °C

Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV

Part 23: Procedures and requirements – Electric data cables

Part 25: Procedures and requirements – Optical fibre cables

NOTE Parts 21, 23 and 25 relate to fire-only conditions at a flame temperature of at least 750 °C.

Since its first edition (1970), IEC 60331 has been extended and has introduced a range of test apparatus in order that a test may be carried out on large and small power, control, data and optical fibre cables.

Successful tests carried out in accordance with this standard will enable an identification to be marked on the product.

TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS – CIRCUIT INTEGRITY –

Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm

1 Scope

This part of IEC 60331 specifies the test apparatus and procedure and gives the performance requirements, including recommended flame application times, for low-voltage power cables of rated voltage up to and including 0,6/1,0 kV and control cables with a rated voltage which are required to maintain circuit integrity when subject to fire and mechanical shock under specified conditions. It is intended for use when testing cables not greater than 20 mm overall diameter.

NOTE Cables of larger diameter should be tested using the apparatus, procedure and requirements of IEC 60331–1.

This standard describes the means of test specimen preparation, the continuity checking arrangements, the electrical testing procedure, the method of burning the cables and the method of shock production, and gives requirements for evaluating test results

Annex A provides the method of verification of the burner and control system used for the test.

Requirements are stated for an identification that may optionally be marked on the cable to signify compliance with 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 60584-1, *Thermocouples – Part 1: Reference tables*

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
circuit integrity
ability of an electric cable to continue to operate in the designated manner whilst subjected to a specified flame source for a specified period of time under specified conditions.

4 Test conditions – Test environment

The test shall be carried out in a suitable chamber, of minimum volume 10 m^3, with facilities for disposing of any noxious gases resulting from burning. Sufficient ventilation shall be available to sustain the flame for the duration of the test.

NOTE 1 Guidance on the choice of suitable chambers is given in Annex B.

The chamber and test apparatus shall be at a temperature of between 10 °C and 40 °C at the start of each test.

The same ventilation and shielding conditions shall be used in the chamber during both the verification and cable test procedures.

NOTE 2 The test given in this standard may involve the use of dangerous voltages and temperatures. Suitable precautions should be taken against the risk of shock, burning, fire and explosion that may be involved, and against any noxious fumes that may be produced.

5 Test apparatus

5.1 Test equipment

The test equipment shall consist of the following:

a) a test wall on to which the cable is mounted, comprising a board manufactured from heat-resistant, non-combustible material with steel supports fastened to a rigid support as described in 5.2;

b) a source of heat comprising a horizontally mounted ribbon burner as described in 5.3;

c) a shock-producing device as described in 5.4;

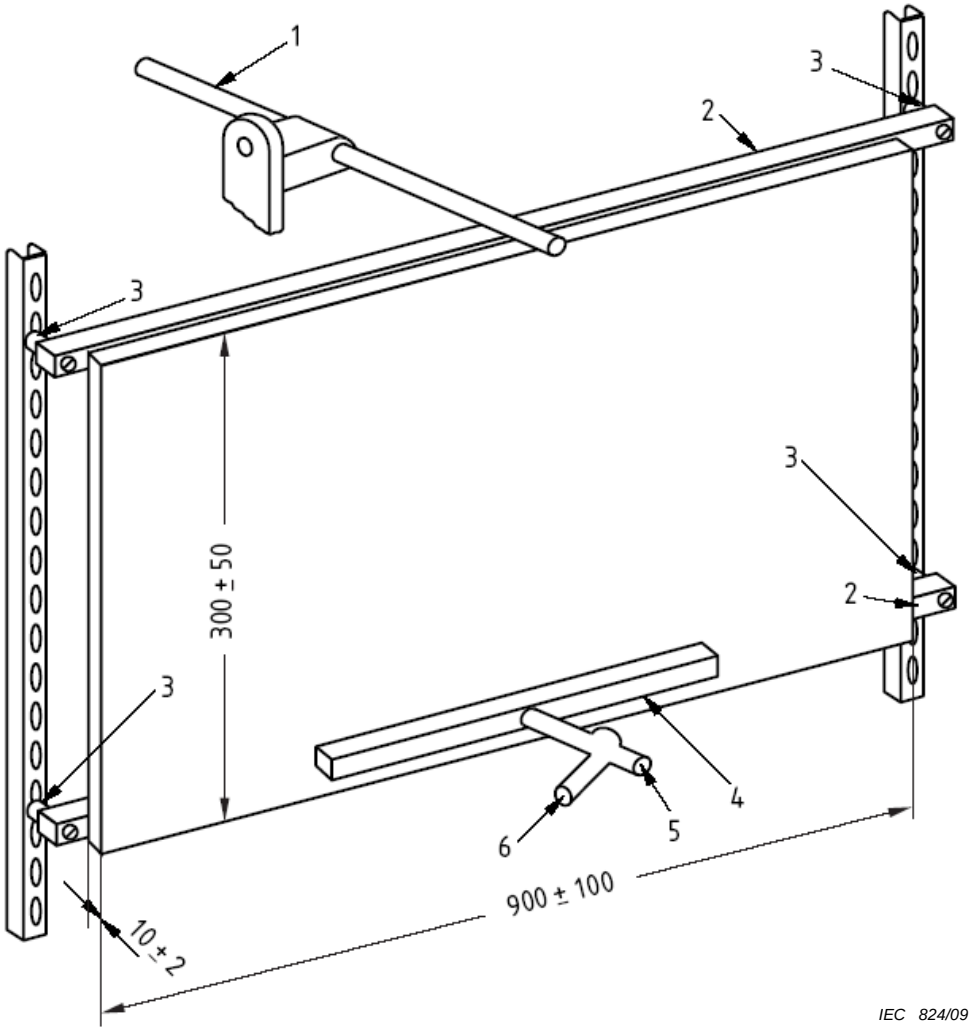
d) a test wall equipped with thermocouples for verification of the source of heat as described in Annex A.

e) a continuity checking arrangement as described in 5.6;

f) fuses as described in 5.7

A general arrangement of the test equipment is shown in Figures 1, 2 and 3.

Dimensions in millimetres

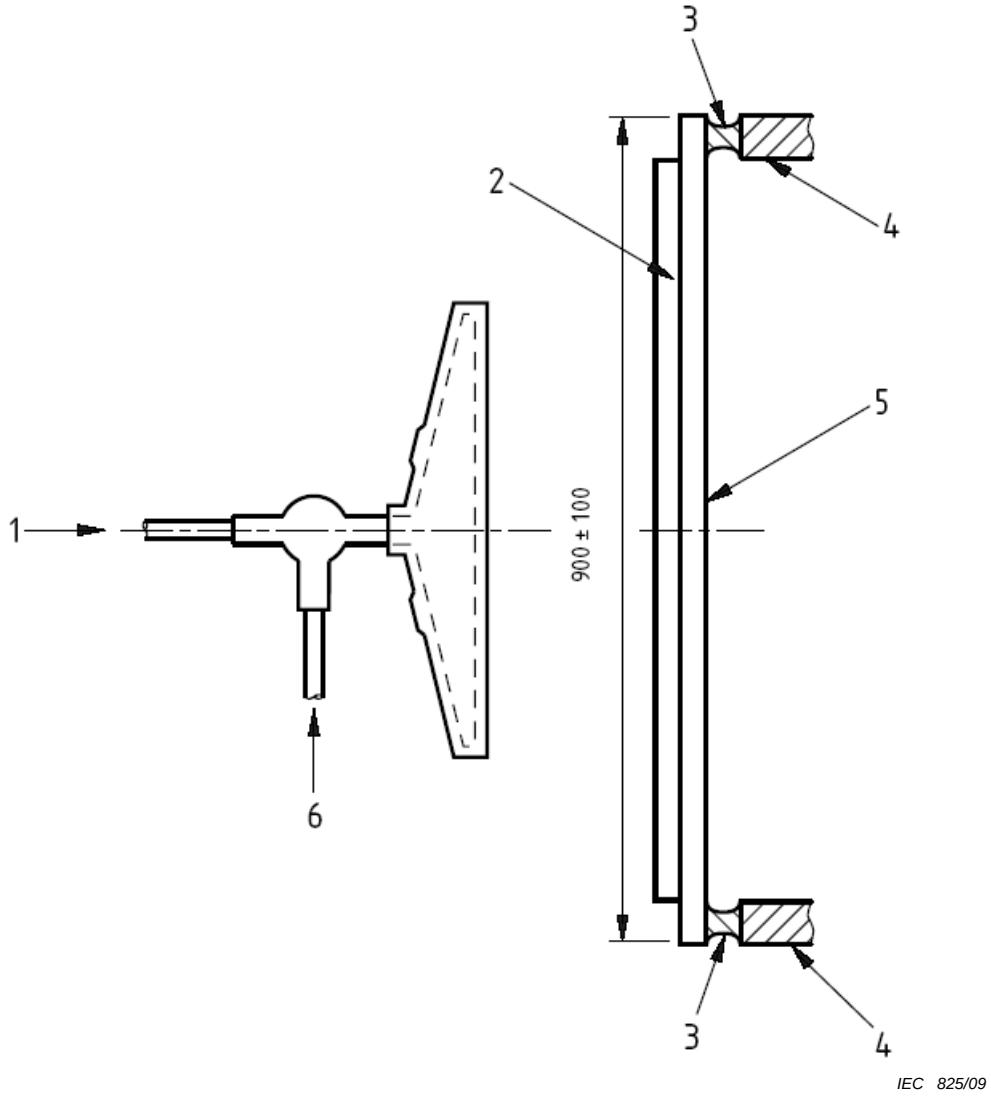


Key

1	shock-producing device	4	ribbon gas burner
2	steel support	5	air inlet pipe
3	rubber bush	6	propane inlet pipe

Figure 1 – Schematic diagram of test configuration

Dimensions in millimetres

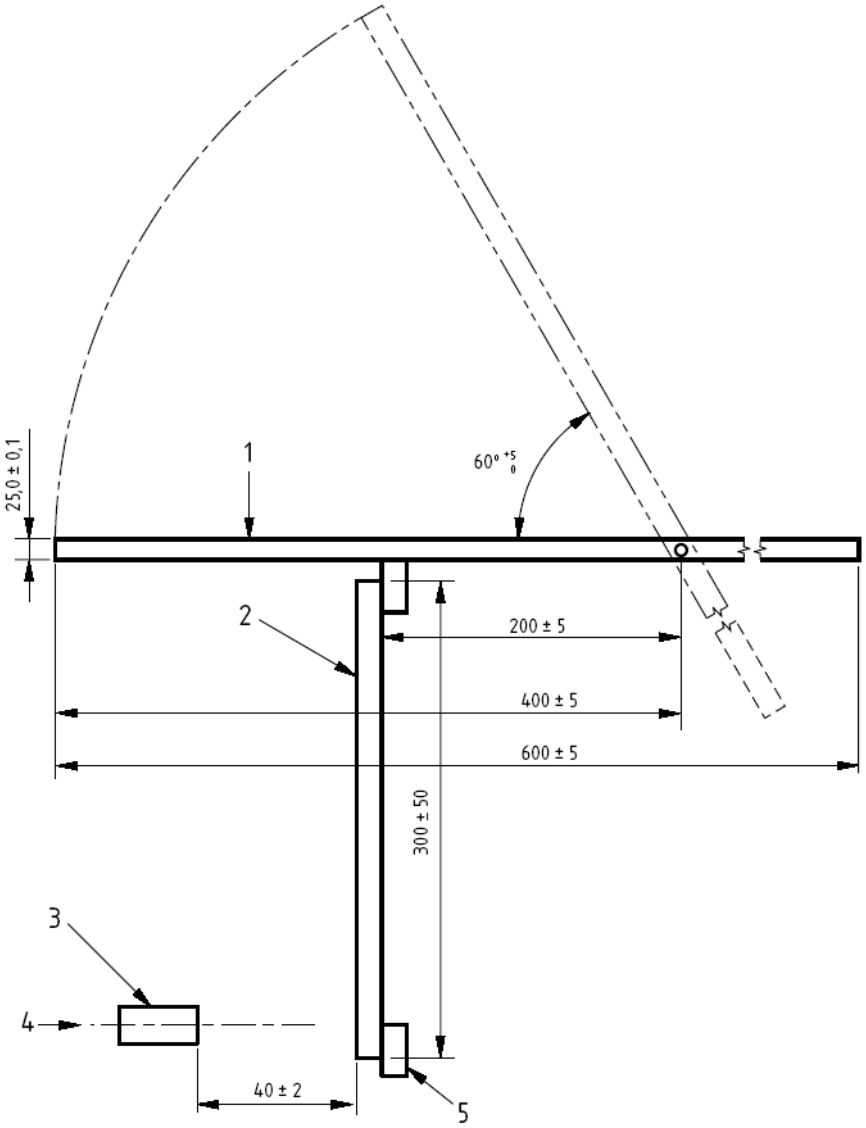


Key

1	entry for air	4	support framework
2	board	5	horizontal steel support for board
3	rubber bush	6	entry for propane gas

Figure 2 – Plan view of fire test equipment

Dimensions in millimetres



Key

1	shock producing device	4	centre line of burner face
2	board	5	support framework
3	gas burner		

Figure 3 – End elevation of fire test equipment (not to scale)

5.2 Test wall and mounting

The test wall shall consist of a board of heat-resistant, non-combustible and non-metallic material fastened rigidly to two horizontal steel supports, one at the top of the board and the other at the bottom, as shown in Figure 1. Vertical supports may also be used. The board shall be (900 ± 100) mm long and (300 ± 50) mm high and (10 ± 2) mm thick and the total mass of the test wall (i.e. board and steel supports) shall be (10,0 ± 0,5) kg. Ballast, if required, shall be placed on the steel supports.

NOTE 1 Supports made from square section steel tube approximately 25 mm x 25 mm and approximately 1 m long have been found to be suitable.

NOTE 2 The top support should be fastened to the board so that its upper face is slightly above the upper edge of the board, so that the shock-producing device impacts on the support and not the board.

Each horizontal support shall have a mounting hole at each end, not more than 100 mm from the edge of the board, the exact position and diameter being determined by the particular supporting bush and supporting framework used. The test wall shall be fastened to a rigid support by four bonded rubber bushes of hardness 50–60 Shore A fitted between the horizontal steel supports of the wall and the support framework, as shown in Figures 1 and 2 so as to allow movement under impact.

NOTE 3 A typical rubber bush, which has been found to be suitable, is shown in Figure 4.

In order to check the mounting of the wall, the static deflection following application of a mass to the centre of the upper support of the wall shall periodically be measured.

The values of mass and deflection shall comply with the following:

Mass kg	**Deflection** mm
25,0 ± 0,2	1,5 ± 0,3

Dimensions in millimetres

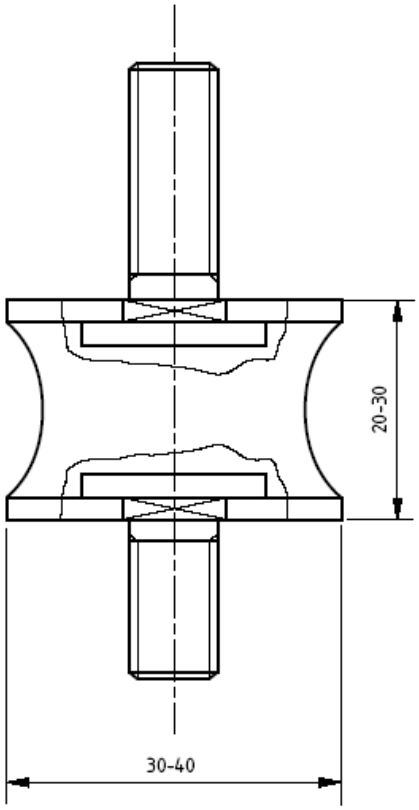


Figure 4 – Typical rubber bush (hardness: 50-60 shore A) for fastening wall

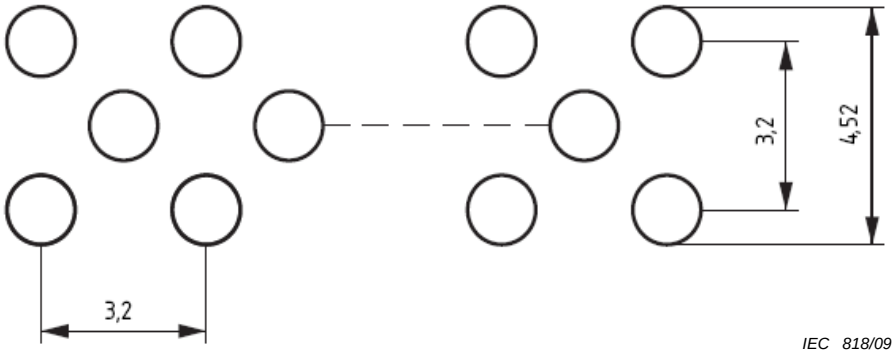
5.3 Source of heat

5.3.1 Burner

The source of heat shall be a ribbon type propane gas burner with a nominal burner face length of 500 mm with a Venturi mixer. A centre-feed burner is recommended. The nominal burner face width shall be 10 mm. The face of the burner shall have three staggered rows of drilled holes, nominally 1,32 mm in diameter and drilled at centres 3,2 mm from one another, as shown in Figure 5. Additionally, a row of small holes milled on each side of the burner plate, to serve as pilot holes for keeping the flame burning, is permitted.

Guidance on the choice of a recommended burner system is given in Annex B.

Dimensions in millimetres



NOTE Round holes, 1,32 mm in diameter, on centres 3,2 mm from one another, staggered in three rows and centred on the face of the burner. Nominal burner face length 500 mm.

Figure 5 – Burner face

5.3.2 Flow meters and flow rates

Mass flow meters/controllers should be used as the means of controlling accurately the input flow rates of fuel and air to the burner.

NOTE 1 Rotameter type flow meters may be used as an alternative, but are not recommended. Guidance on their use, and the application of appropriate correction factors is given in IEC 60331-11:1999, Annex C.

NOTE 2 Figure 6 shows an example of a rotameter type system.

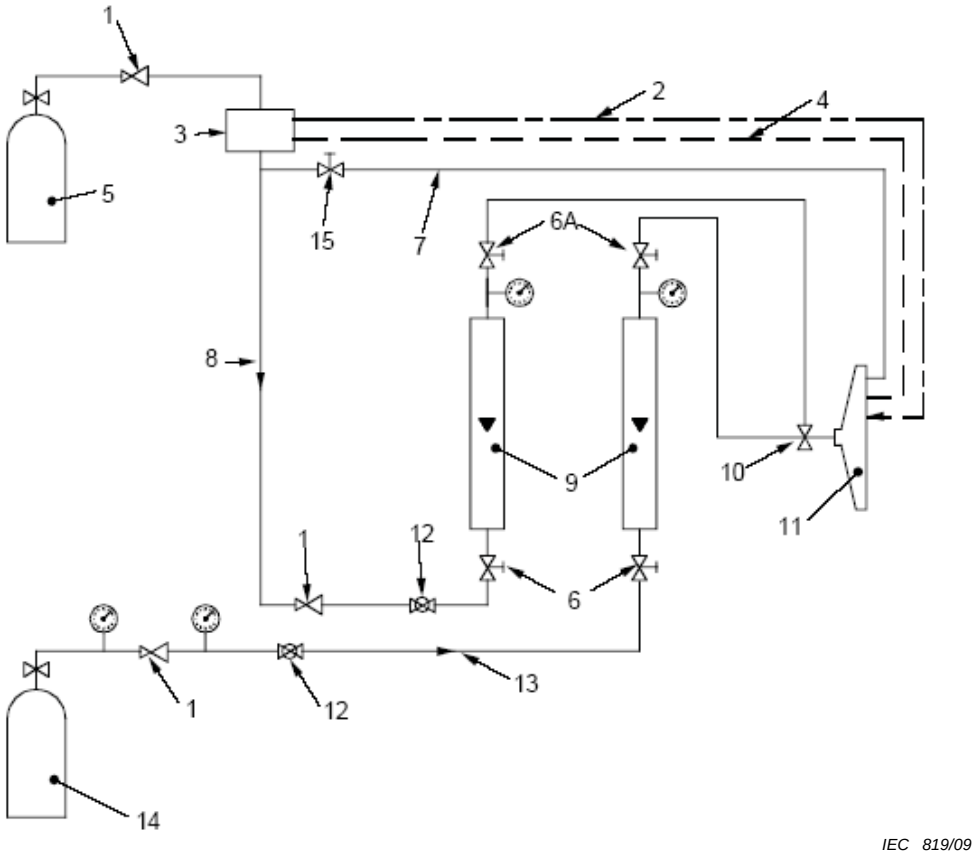
For the purpose of this test, the air shall have a dew point not higher than 0 °C.

The flow rates used for the test shall be as follows:

– air: (80 ± 4) l/min at reference conditions (1 bar and 20 °C) or (1600 ± 80) mg/s;

– propane: (5,0 ± 0,2) l/min at reference conditions (1 bar and 20 °C) or (160 ± 6) mg/s.

NOTE 3 The purity of the propane is not defined. Industrial grades that contain impurities are allowed provided that the calibration requirements are achieved.



Key

1	regulator	9	flowmeters
2	piezoelectric igniter	10	Venturi mixer
3	flame failure device	11	burner
4	control thermocouples	12	ball valve
5	propane cylinder	13	air flow
6	screw valve (6A = alternative position)	14	compressed air cylinder
7	pilot feed	15	screw valve on pilot feed
8	gas flow		

Figure 6 – Schematic diagram of an example of a burner control system using rotameters

5.3.3 Verification

The burner and control system shall be subject to verification following the procedure given in Annex A.

5.4 Shock-producing device

The shock producing device shall be a mild steel round bar (25,0 ± 0,1) mm in diameter and (600 ± 5) mm long. The bar shall be freely pivoted about an axis parallel to the test wall, which shall be in the same horizontal plane as, and (200 ± 5) mm away from, the upper edge of the wall. The axis shall divide the bar into two unequal lengths, the longer length being (400 ± 5) mm which shall impact the wall. The bar shall drop under its own weight from an angle of $(60^{+5}_{0})°$ to the horizontal to strike the upper steel support of the wall at its midpoint as shown in Figures 1 and 3.

5.5 Positioning of source of heat

The burner face shall be positioned in the test chamber so that it is at least 200 mm above the floor of the chamber, or any solid mounting block, and at least 500 mm from any chamber wall.

By reference to the centre point of the cable to be tested, the burner shall be positioned centrally at a horizontal distance of (40 ± 2) mm from the burner face to the test wall and at a vertical distance of (V ± 2) mm from the burner horizontal central plane to the central horizontal plane of the test specimen, as shown in Figure 3 and Figure A.1.

The exact burner location to be used during cable testing shall be determined using the verification procedure given in Annex A, where the value of V to be used shall be determined.

NOTE The burner should be rigidly fixed to the framework during testing so as to prevent movement relative to the test sample.

5.6 Continuity checking arrangements

During the test, a current for continuity checking shall be passed through all conductors of the test specimen. This shall be provided by a three-phase star connected or single-phase transformer(s) of sufficient capacity to maintain the test voltage up to the maximum leakage current allowable.

NOTE 1 Due note should be taken of the fuse characteristics when determining the power rating of the transformer.

This current shall be achieved by connecting, at the other end of the test specimen, a suitable load and an indicating device (e.g. lamp) to each conductor, or group of conductors.

NOTE 2 A current of 0,25 A at the test voltage, through each conductor or group of conductors, has been found to be suitable.

5.7 Fuses

Fuses used in the test procedure in Clause 7 shall be of type DII, complying with IEC 60269-3. Alternatively, a circuit-breaker with equivalent characteristics may be used.

Where a circuit-breaker is used, its equivalent characteristics shall be demonstrated by reference to the characteristic curve shown in IEC 60269-3.

The test method using fuses shall be the reference method in the case of dispute.

6 Test specimen

6.1 Test specimen preparation

A cable sample at least 4,5m long shall be available from the cable length for test. Each individual test specimen to be tested shall be a piece of cable, taken from the cable sample, not less than 1 200 mm long with approximately 100 mm of sheath or outer coverings removed at each end.

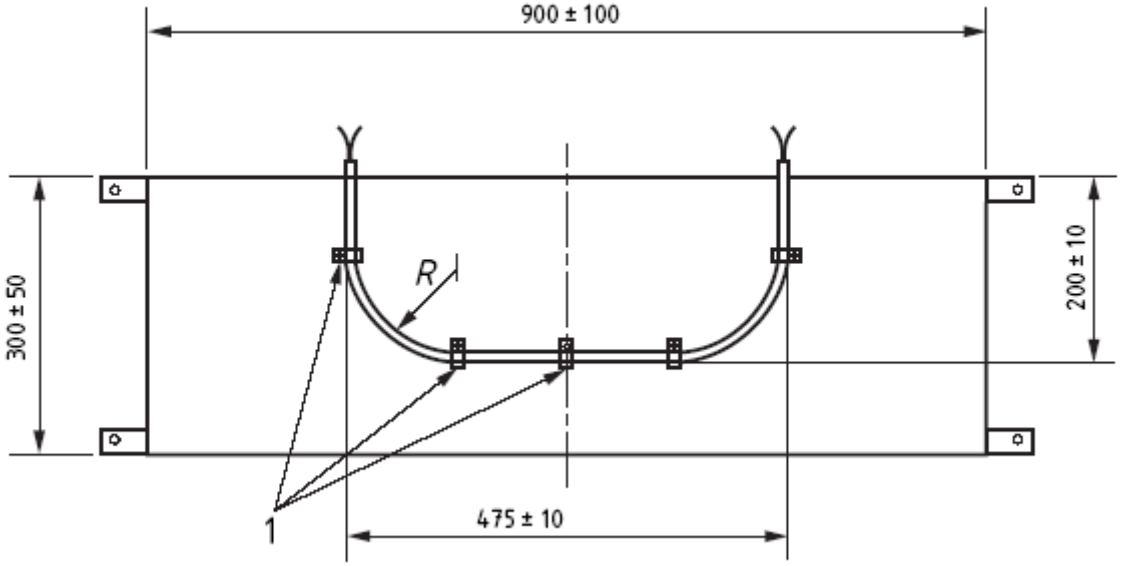
At each end of the test specimen each conductor shall be suitably prepared for electrical connections, and the exposed conductors shall be spread apart to avoid contact with each other.

6.2 Test specimen mounting

The test specimen shall be bent to form an approximate “U” shape. The internal radius of each bend shall be the manufacturer’s declared minimum bending radius and the overall distance between the vertical portions of the cable shall be (475 ± 10) mm as shown in Figure 7.

The test specimen shall be mounted centrally on the wall using metal clips which shall be earthed. The lower edge of the cable shall be (200 ± 10) mm below the top of the test wall. P-clips made of metal strip (10 ± 1) mm wide shall support the test specimen at either end of the radiused section and in the centre as shown in Figure 7. The P-clips shall be formed so as to have approximately the same diameter as the cable under test.

Dimensions in millimetres



Key

1 metal clips

R minimum bending radius of cables

Figure 7 – Example of method of mounting a sample for test

7 Test procedure

7.1 Test equipment and arrangement

The test procedure shall be carried out using the apparatus detailed in Clause 5.

Mount the test specimen on the test wall and adjust the burner to the correct position relative to the specimen in accordance with 5.5**.**

7.2 Electrical connections

At the transformer end of the test specimen, earth the neutral conductor and any protective conductors. Any metal screens, drain wire or metallic layer shall be interconnected and earthed. Connect the transformer(s) to the conductors, excluding any conductor which is specifically identified as intended for use as a neutral or a protective conductor, as shown in the circuit diagram in Figure 8. Where a metallic sheath, armour or screen acts as a neutral or protective conductor, it shall be connected, as shown in the circuit diagram in Figure 8, as for a neutral or protective conductor.

For single-, twin- or three-phase conductor cables, connect each phase conductor to a separate phase of the transformer(s) output with a 2 A fuse or circuit-breaker with equivalent characteristics in each phase.

For multicore cables that have four or more conductors (excluding any neutral or protective conductors), the conductors shall be divided into three roughly equal groups, ensuring that adjacent conductors are, as far as possible, in different groups.

For multipair cables, the conductors shall be divided into two equal groups, ensuring that the a-core of each pair is connected to one phase and the b-core of each pair is connected to another phase (L1 and L2 in Figure 8). Quads shall be treated as two pairs.

For multi-triple cables, the conductors shall be divided into three equal groups, ensuring that the a-core of each triple is connected to one phase, the b-core of each triple to another phase and the c-core of each triple to the third phase of the transformer (L1, L2 and L3 in Figure 8.).

Connect the conductors of each group in series and connect each group to a separate phase of the transformer output with a 2 A fuse or circuit-breaker with equivalent characteristics in each phase.

NOTE 1 The above test procedure connects the neutral conductor to earth. This may not be appropriate if the cable is designed for use on a system where neutral is not earthed. If required by the cable standard it is permissible for the neutral conductor to be tested as if it were a phase conductor. Where a metallic sheath, armour or screen acts as a neutral conductor it shall always be connected to earth. Any such variations in methodology should be included in the test report.

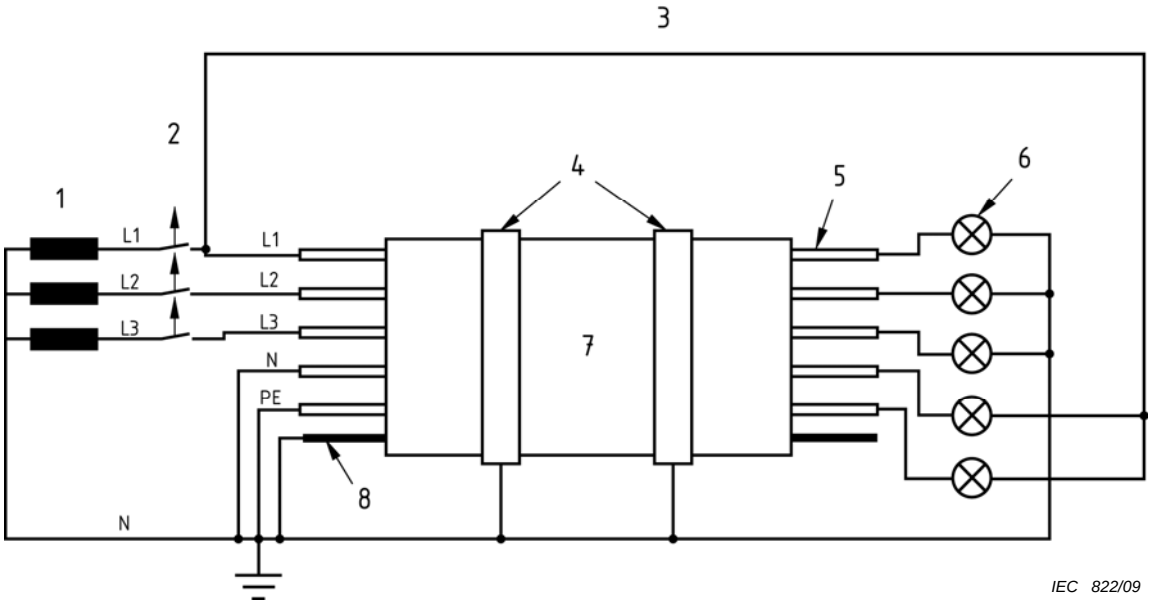
NOTE 2 For cable constructions not specifically identified above, the test voltage should be applied, as far as is practicable, to ensure that adjacent conductors are connected to different phases.

NOTE 3 In certain cases, for example when testing a control cable using a three-phase transformer, it may not be possible to apply a test voltage between conductors and from conductor to earth equal to the rated voltage simultaneously. In such cases, either the test voltage between conductors, or the test voltage from conductor to earth shall be equal to the rated voltage, such that both the test voltage between conductors and the test voltage from conductor to earth is equal to or higher than the rated voltage.

At the end of the test specimen remote from the transformer:

– connect each phase conductor, or group of conductors, to one terminal of the load and indicating device (as described in 5.6), the other terminal being earthed;

– connect the neutral conductor and any protective conductor to one terminal of the load and indicating device (as described in 5.6), the other terminal being connected to L1 (or L2 or L3) at the transformer end (see Figure 8).



Key

L1, L2, L3	phase conductors (L2, L3 if present)		
N	neutral conductor (if present)		
PE	protective earth (if present)		
1	transformer	5	test conductor or group
2	fuse (2 A)	6	load and indicating device (e.g. Lamp)
3	connection to phase L1 (or L2 or L3)	7	test specimen
4	metal clips	8	metal screen (if present)

Figure 8 – Basic circuit diagram – Electric power and control cables with rated voltage up to 600/1 000 V

7.3 Flame and shock application

Ignite the burner and adjust the propane and air flow rates to those obtained during the verification procedure (see Annex A).

Immediately after igniting the burner, activate the shock-producing device and start the test duration timer. The shock-producing device shall impact the wall after 5 min ± 10 s from activation and subsequently at 5 min ± 10 s intervals. After each impact, the impacting bar shall be raised from the test wall no more than 20 s after the impact.

7.4 Electrification

Immediately after starting the test duration timer, switch on the electricity supply and adjust the voltage to the rated voltage of the cable (subject to a minimum voltage of 100 V a.c.), i.e. the test voltage between conductors shall equal the rated voltage between conductors, and the test voltage from conductor to earth shall equal the rated voltage from conductor to earth.

The test shall continue for the flame application time given in 8.1, after which the flame shall be extinguished.

8 Performance requirements

8.1 Flame application time

The flame application time shall be as specified in the relevant cable standard. In the absence of such a standard, a flame and impact application of 30 min, 60 min, 90 min or 120 min shall be chosen.

8.2 Acceptance criteria

With reference to the test procedure given in Clause 7, the cable possesses the characteristics for providing circuit integrity so long as during the course of the test

– the voltage is maintained, i.e. no fuse fails or circuit-breaker is interrupted,

– a conductor does not rupture, i.e. the lamp is not extinguished.

9 Retest procedure

In the event of a failure, as judged by the requirements of the relevant standard, two further test specimens, taken from the same cable sample, shall be tested. If both comply, the test shall be deemed successful.

10 Test report

The test report shall include the following information:

a) the number of this standard;

b) a full description of the cable tested;

c) the manufacturer of the cable tested;

d) the test voltage;

e) the actual cable bending radius used for the test;

f) the actual performance requirement applied (by reference to Clause 8);

g) the flame application time;

h) the chamber volume and temperature at the start of the test.

11 Cable marking

If a cable is required to be marked to signify compliance with this standard, it shall be marked with the number of this standard and the duration of flame application, as follows: “IEC 60331-2 (XX)” where XX shall be the duration in minutes. The marking shall be in addition to any requirement of the cable standard.

Annex A
(normative)

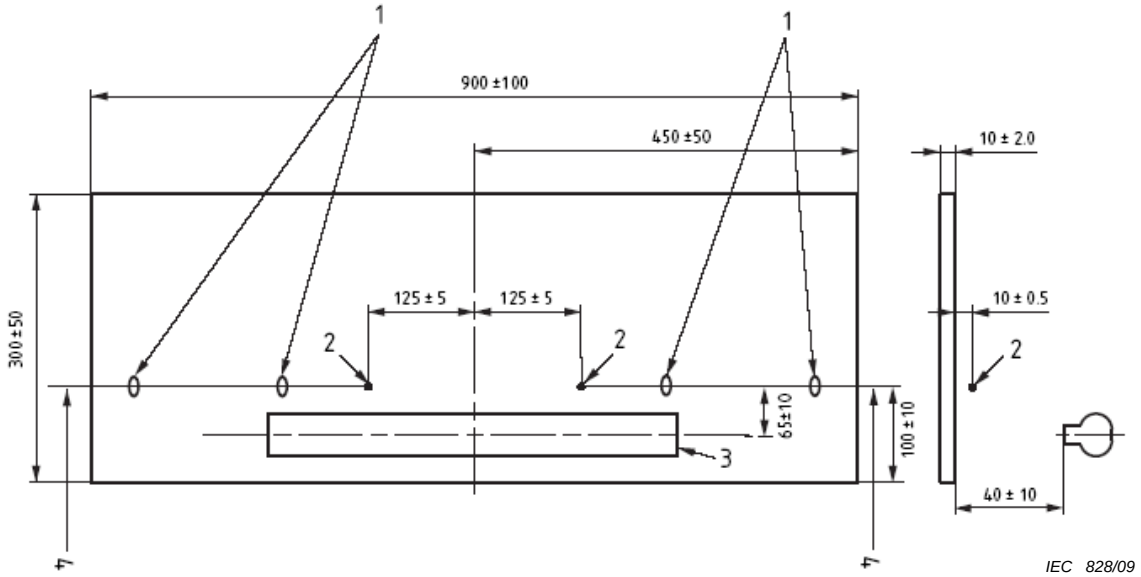
Verification procedure for the source of heat

A.1 Measuring equipment

The flame temperature shall be measured using two 1,5 mm mineral-insulated, stainless steel sheathed thermocouples, type K (see IEC 60584-1), mounted on the test wall as shown in Figure A.1. The thermocouple tips shall be (10,0 ± 0,5) mm in front of the test wall. The horizontal line of the thermocouples shall be (100 ± 10) mm above the bottom of the wall. The wall shall consist of a board of heat-resistant, non-combustible and non-metallic material (900 ± 100) mm long, (300 ± 50) mm high and (10 ± 2) mm thick.

Position the burner (40 ± 2) mm horizontally from the wall and (65 ± 10) mm vertically below the centre line of the thermocouples (*V*) as shown in Figure A.1.

Dimensions in millimetres



Key

1	thermocouple supports	3	burner
2	thermocouple tip	4	1,5 mm type K sheathed thermocouples

Figure A.1 – Temperature measuring arrangement

A.2 Procedure

Ignite the burner and adjust the gas and air supplies to those given in 5.3**.**

Monitor the temperature as recorded by the thermocouples over a period of 10 min to ensure conditions are stable.

A.3 Evaluation

The verification procedure shall be considered satisfactory if:

a) the mean of the averaged readings for each of the two thermocouples over the 10 min falls within the requirement of $(830\ ^{+40}_{0})$ °C; and

b) the difference of the averaged readings for each of the two thermocouples over the 10 min period does not exceed 40 °C.

At least one measurement shall be made every 30 s in order to obtain the average.

NOTE The actual method of obtaining the average thermocouple reading over the period is not specified, but it is recommended that a recorder with averaging facilities is used in order to damp the variability caused by point measurement.

If the verification is not successful, the flow rates shall be altered within the tolerances given in 5.3 and a further verification carried out.

A.4 Further verification

If the verification of Clause A.3 is not successful, the vertical distance (*V*) between burner and thermocouples shall be altered (within the tolerance given in Clause A.1) and a further verification carried out.

If no successful verification can be achieved within the tolerances given, then the burner system shall be considered as incapable of providing the source of heat required by this standard.

A.5 Verification report

The position established for successful verification (*V*) and flow rates used shall be recorded.

Annex B
(informative)

Guidance on the choice of recommended test apparatus

B.1 Burner and Venturi

A commercially available burner face meeting the recommendations of this standard is the AGF burner insert 11-55, and a suitable 500 mm burner, including the specified burner face, is the AGF, reference 1857B[1]. A recommended Venturi mixer is the AGF 14-18[1].

Pemfab
30 Indel Avenue
PO Box 227
Rancocas
NJ 08073-0227
USA

www.amgasfur.com or www.pemfab.com

B.2 Test wall material

Examples of materials[1] which have been found to be suitable for the wall are:

i) Tenmat Limited, UK - Sindanyo H61

ii) Frenzelit-Werke, Germany - Isoplan 1100

iii) Skamol, Denmark - Skamolex V-1100 Mk.2

iv) Elit, France - Monolax 500

B.3 Influence of draughts in the test chamber

Experience has shown that the flame geometry is influenced by any draughts in the test chamber and it is recommended that the burner be shielded from any draughts by the use of draught shields.

B.4 Guidance on provision of a suitable test chamber

The chamber must have a sufficient volume such that fire effluents released during combustion do not alter the test conditions. Experience has shown a chamber similar to the “3 m cube” specified in IEC 61034-1 to be suitable, although other chambers of suitable volume may be used. Windows may be installed in the walls of the chamber in order to observe the behaviour of the cable during the test. Fume exhaust should be by means of a chimney located at least 1 m from the burner. A damper may be used for adjustment of ventilation conditions.

Air inlet to the chamber should be made through orifices located near the base of the chamber. Air inlets and an exhaust chimney should be located in such a way that the burner flame remains stable during the verification procedure and test.

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1 This information is given for the convenience of users of this International Standard 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.

Bibliography

IEC 60331-1, *Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm*

IEC 60331-11:1999, *Tests for electric cables under fire conditions – Circuit integrity – Part 11: Apparatus – Fire alone at a flame temperature of at least 750 °C*

IEC 61034-1, *Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus*

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