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GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

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

Essais pour câbles électriques soumis au feu – Intégrité des circuits – Partie 1: Méthode d'essai au feu avec chocs pour les câbles de tension assignée au plus égale à 0,6/1,0 kV et de diamètre externe supérieur à 20 mm, à une température d'au moins 830 °C

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60331-1 has been prepared by IEC technical committee 20: Electric cables.

This first edition of IEC 60331-1 cancels and replaces IEC 60331-12 (2002) and IEC 60331-31 (2002) to form one single standard.

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

FDIS	Report on voting
20/1049/FDIS	20/1053/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- withdrawn,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 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

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 of greater than 20 mm overall diameter.

NOTE 1 Cables of smaller diameter should be tested using the apparatus, procedure and requirements of IEC 60331-2.

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.

NOTE 2 Although the scope is restricted to cables with rated voltage up to and including 0,6/1,0 kV, the procedure may be used, with the agreement of the manufacturer and the purchaser, for cables with rated voltage up to and including 3,3 kV, provided that suitable fuses are used.

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 a 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 ladder, on to which the test specimen is mounted, comprising a steel framework 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;

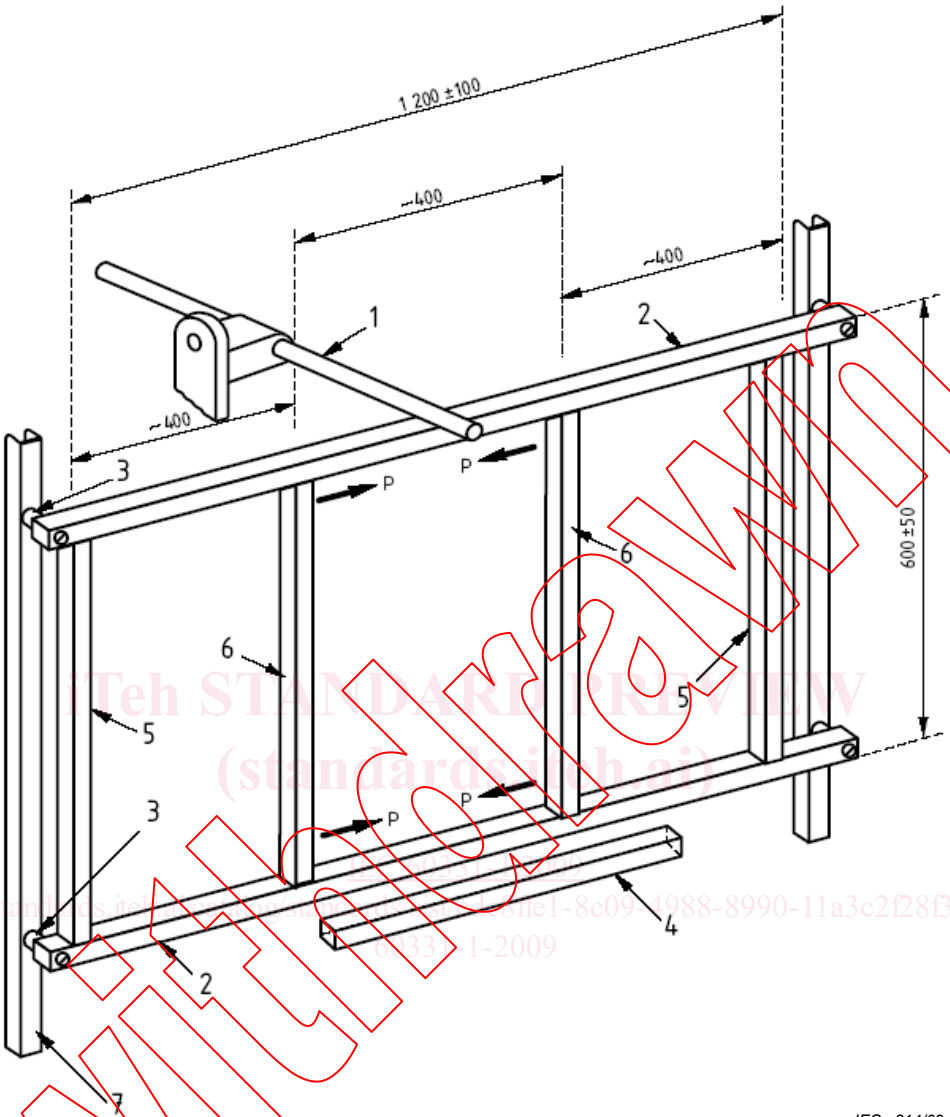
d) a test wall equipped with thermocouples for verification of the source of heat as described in Annex A.

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

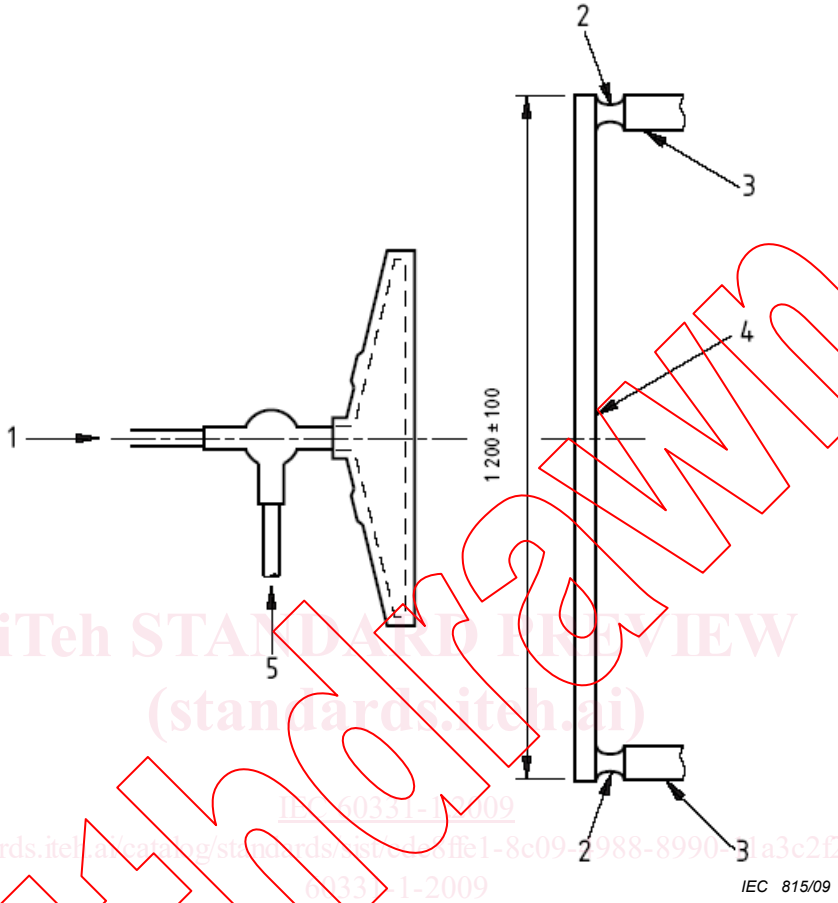


Key

1	shock producing device	5	fixed vertical elements of test ladder
2	steel test ladder	6	adjustable vertical elements of test ladder
3	rubber bush	7	RIGID support framework
4	ribbon gas burner	P	plane of adjustment

Figure 1 – Schematic diagram of test configuration

Dimensions in millimetres

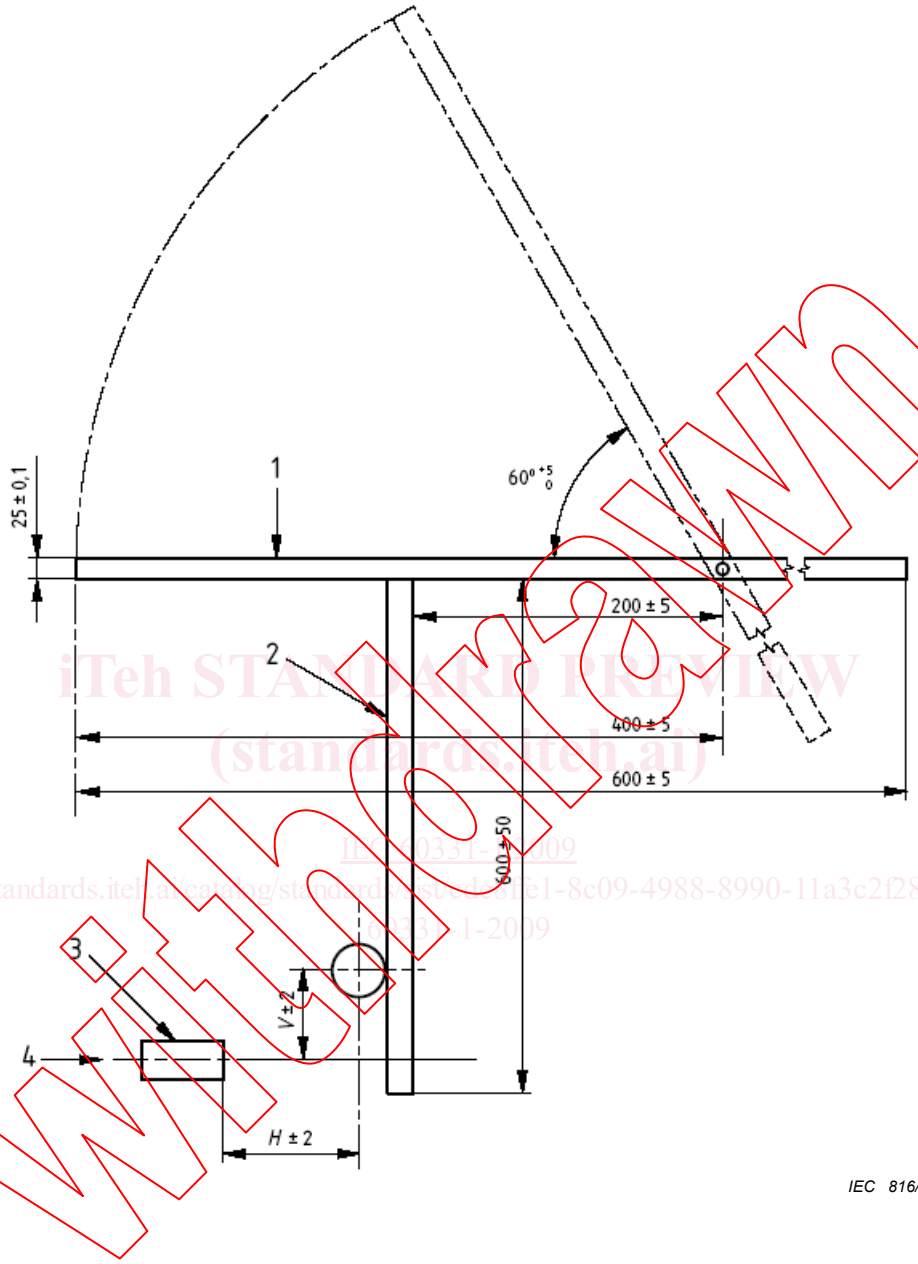


Key

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

Figure 2 – Plan view of fire test equipment

Dimensions in millimetres



Key

1	shock producing device	*H*	horizontal distance of metal enclosure centre line from burner face
2	steel test ladder	*V*	vertical distance of metal enclosure centre line from centre line of burner
3	gas burner		
4	centre line of burner face		

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

5.2 Test ladder and mounting

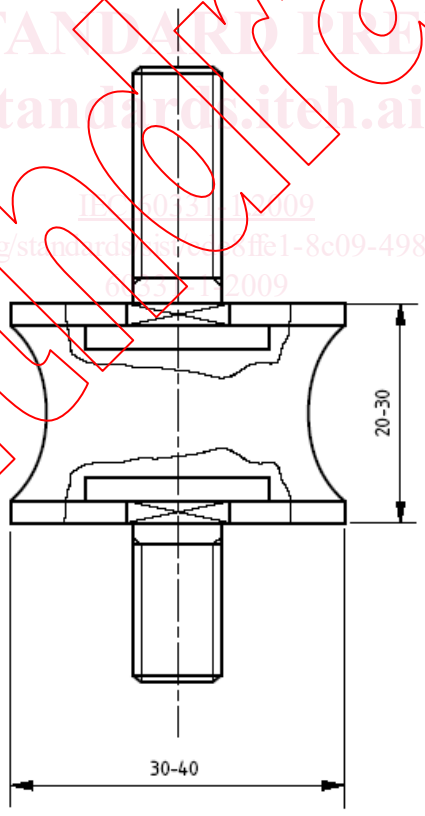
The test ladder shall consist of a steel framework as shown in Figure 1. The two central vertical elements of the ladder shall be adjustable in order to accommodate different sizes of cable under test. The test ladder shall be (1 200 ± 100) mm long and (600 ± 50) mm high, and the total mass of the test ladder shall be (18 ± 1) kg. Ballast, if required, shall be placed on the steel supports.

NOTE 1 Angle iron approximately 45 mm wide and 6 mm thick, with suitable slots cut to allow for fixing of the bolts or saddles, has been found to be a suitable material for construction of the ladder.

Each horizontal element shall have a mounting hole not more than 200 mm from each end, the exact position and diameter being determined by the particular supporting bush and supporting framework used. The test ladder shall be fastened to a rigid support by four bonded rubber bushes of hardness 50–60 Shore A fitted between the horizontal steel elements of the ladder and the support framework, as shown in Figures 1 and 2 so as to allow movement under impact.

NOTE 2 A typical rubber bush, which has been found to be suitable, is shown in Figure 4.

Dimensions in millimetres
(dimensions without tolerances are approximate)



IEC 817/09

Figure 4 – Typical rubber bush for supporting the test ladder

5.3 Source of heat

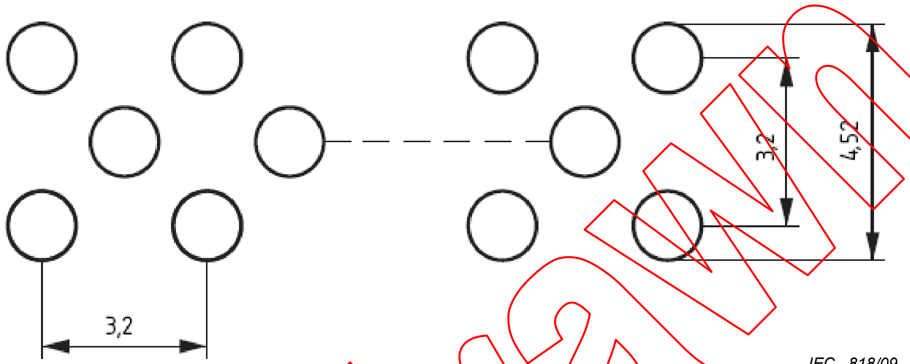
5.3.1 Burner

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 purposes 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: (160 ± 8) l/min at reference conditions (1 bar and 20 °C) or (3 267 ± 163) mg/s ;

– propane: (10 ± 0,4) l/min at reference conditions (1 bar and 20 °C) or (319 ± 13) 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.