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GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

Tests for electric cables under fire conditions – Circuit integrity – 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

Essais pour câbles électriques soumis au feu – Intégrité des circuits – Partie 3: Méthode d'essai au feu pour les câbles de tension assignée au plus égale à 0,6/1,0 kV, essayés sous conduit métallique avec chocs, à une température d'au moins 830 °C

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CONTENTS

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TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS – CIRCUIT INTEGRITY –

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

FOREWORD

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International Standard IEC 60331-3 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
20/1051/FDIS	20/1055/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- withdrawn,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.

IEC 60331-3 introduces apparatus and a procedure to allow cables to be tested in a metal enclosure under conditions of mechanical shock as well as fire at temperature of at least 830 °C.

TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS – CIRCUIT INTEGRITY –

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

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 tested in a metal enclosure and when subject to fire and mechanical shock under specified conditions.

This standard describes the means of sample 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 All cables assessed by this method should first have been assessed against the test of IEC 60331-1 or IEC 60331-2. Such performance may be recognized by the marking according to Clause 11 of IEC 60331-1 or Clause 11 of IEC 60331-2.

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

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 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 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 60331-2, *Test 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*

IEC 60584-1, *Thermocouples – Part 1: Reference tables*

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 and the need for shielding 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 metal enclosure, through which the test specimen(s) are drawn, constructed from a straight stainless steel tube of circular cross-section as described in 5.2;

b) a test ladder, onto which the metal enclosure is mounted, comprising a steel framework fastened to a rigid support as described in 5.3;

c) a source of heat comprising a horizontally mounted ribbon burner as described in 5.4;

d) a shock-producing device as described in 5.5;

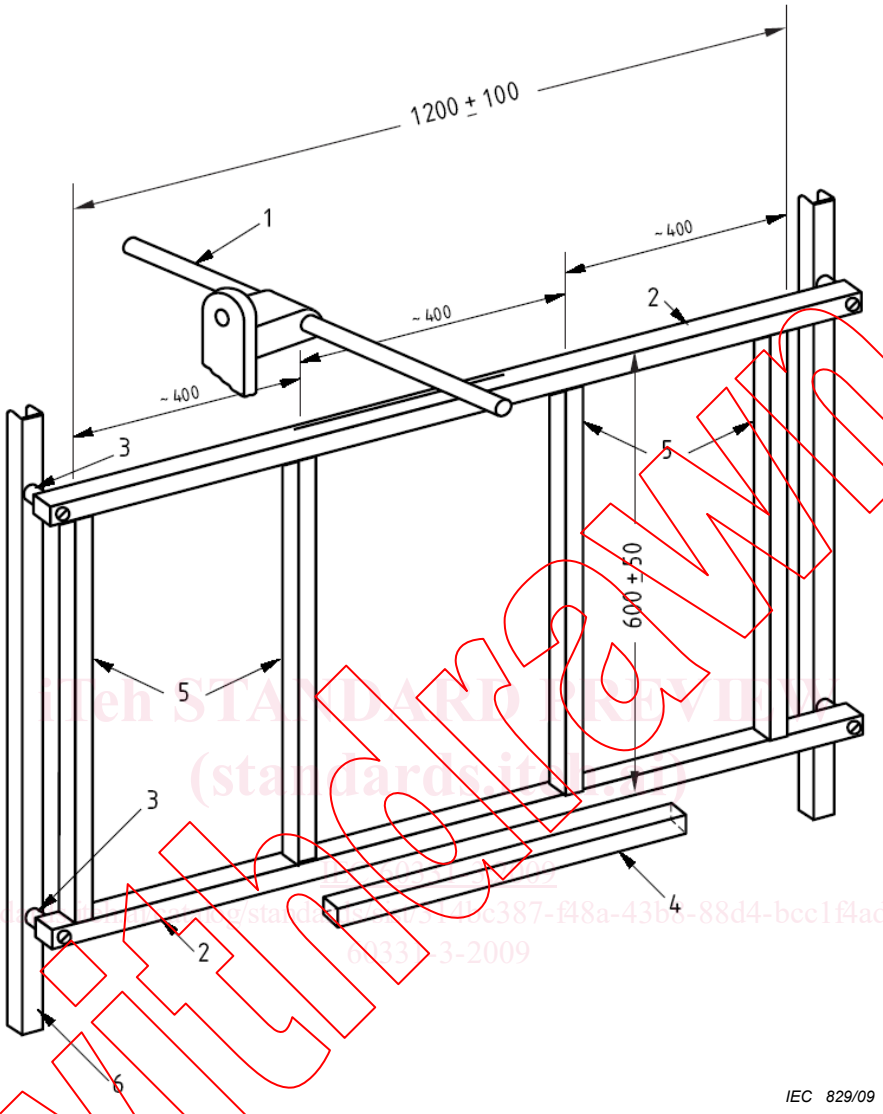
e) a test wall equipped with thermocouples for verification of the source of heat as described in Annex A;

f) a continuity checking arrangement as described in 5.7;

g) fuses as described in 5.8.

A general arrangement of the test equipment is shown in Figures 1, 2, 3 and 4.

Dimensions in millimetres

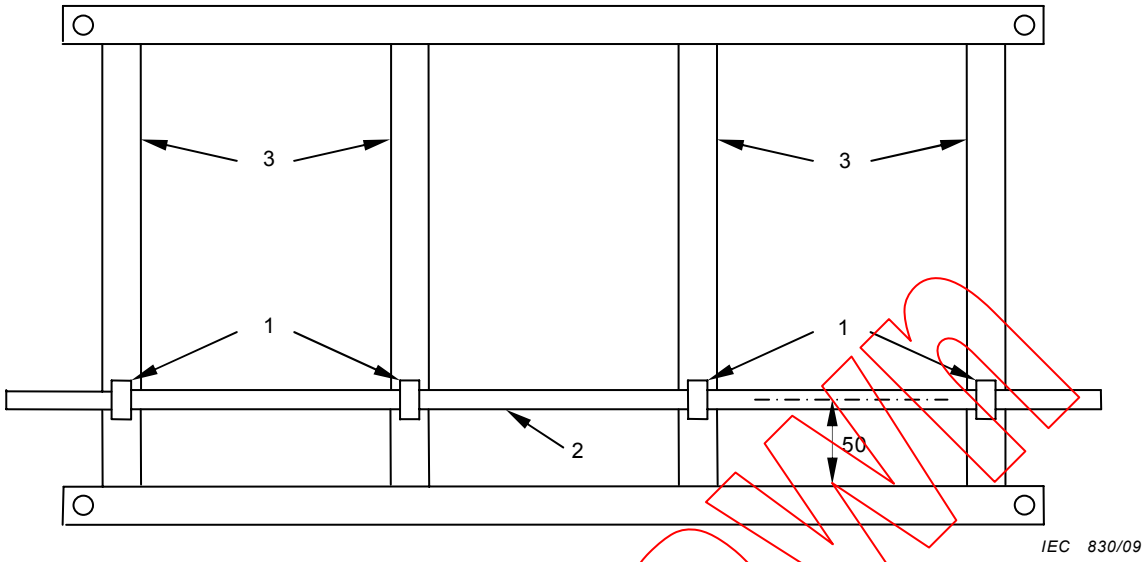


Key

1	shock producing device	4	ribbon gas burner
2	steel ladder	5	fixed vertical element
3	rubber bush	6	ladder support

Figure 1 – Schematic diagram of test configuration

Dimensions in millimetres
(dimensions are approximate)



Key

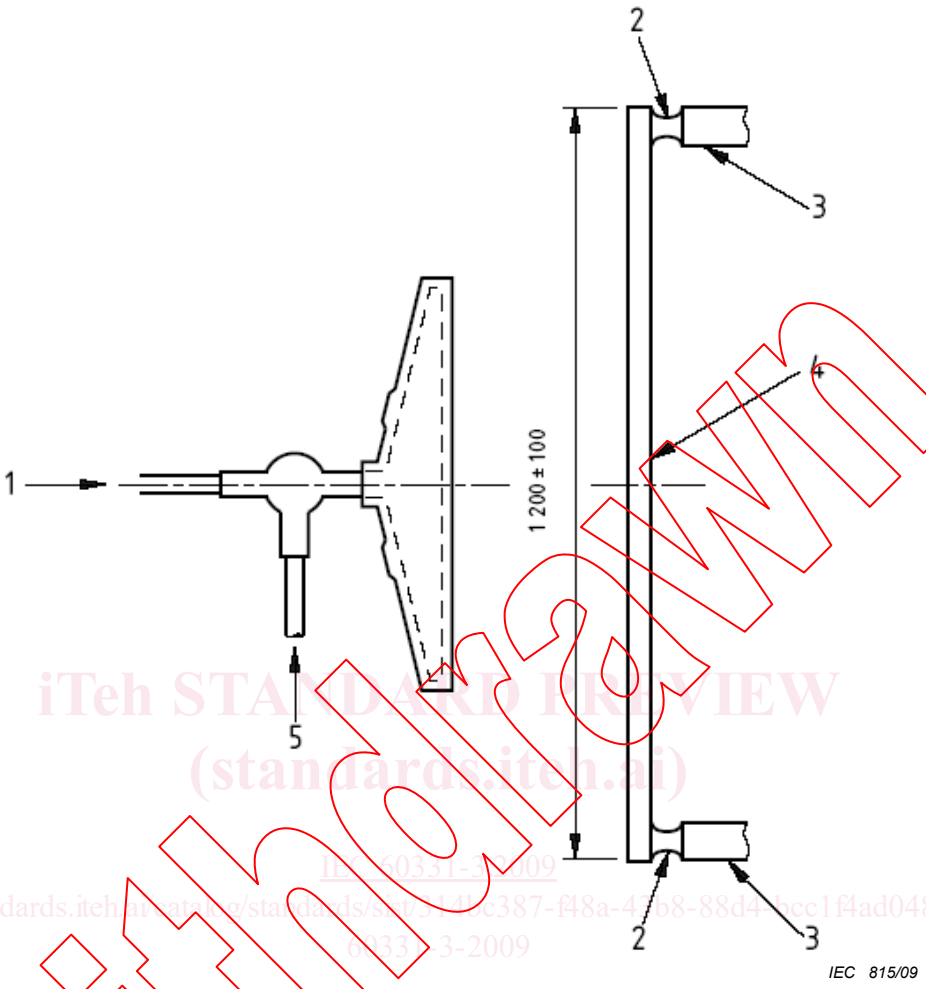
1 U-bolt

2 metal enclosure

3 fixed vertical elements

Figure 2 – Recommended method of mounting the metal enclosure to the test ladder

Dimensions in millimetres

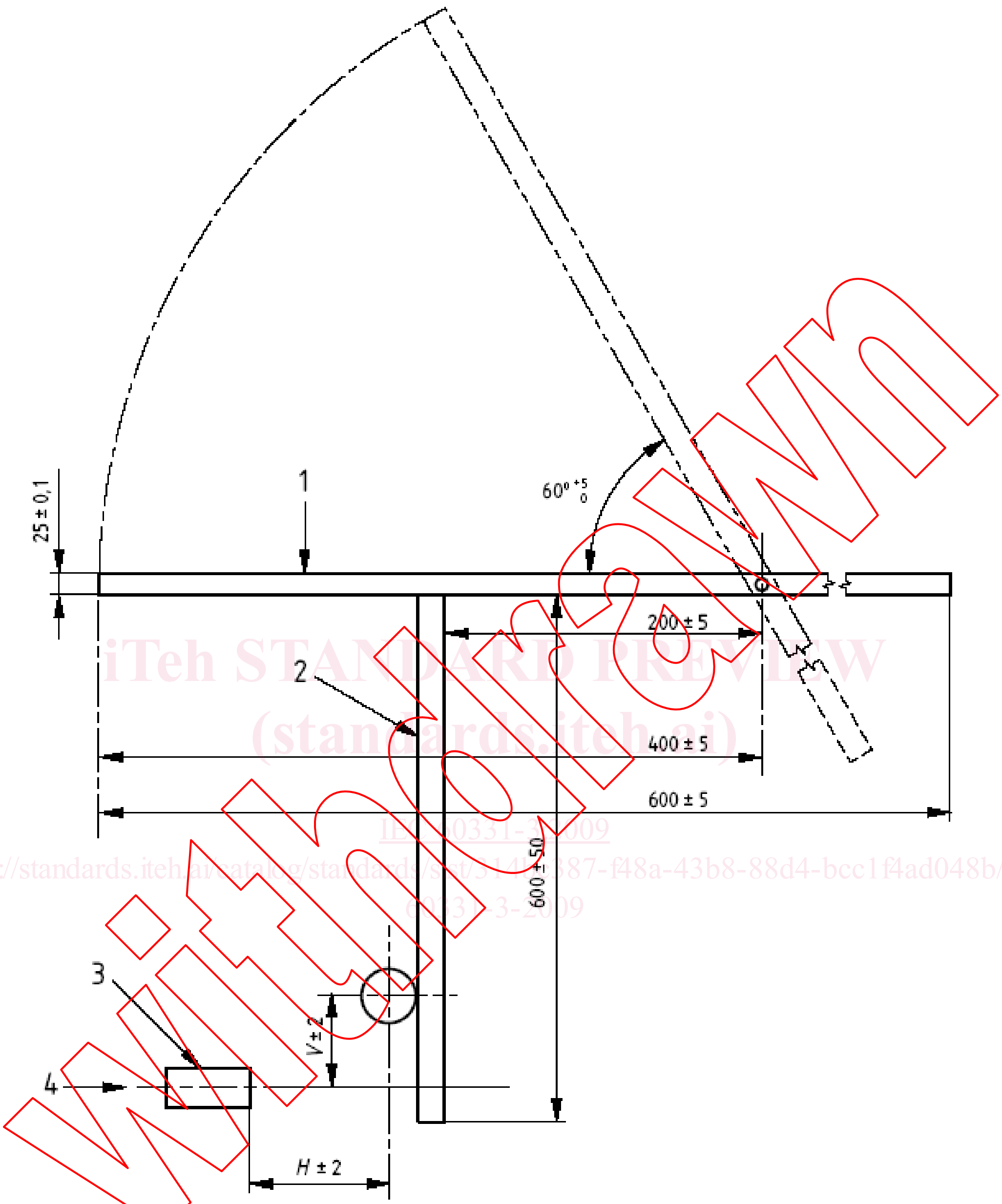


Key

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

Figure 3 – 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 4 – End elevation of fire test equipment (not to scale)

5.2 Metal enclosure

5.2.1 Material and dimensions

The enclosure shall comprise a straight stainless steel tube of circular cross-section, manufactured free from surface irregularities. The metal enclosure shall be (1 300 ± 50) mm long and shall conform to dimensions as detailed in Table 1.

NOTE AISI grades 304 and 316 have been found to be suitable materials for the enclosure.

Table 1 – Enclosure dimensions

Outer diameter mm	**Wall thickness** mm
20	1,6 ± 0,15
40	1,6 ± 0,15

5.2.2 Metal enclosure selection

The particular metal enclosure shall be selected using the criteria given in 6.2.

5.3 Test ladder and mounting

The test ladder shall consist of a steel framework as shown in Figure 1. The vertical elements of the ladder shall be fixed at (400 ± 20) mm spacing. 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.

The metal enclosure shall be rigidly mounted centrally on the test ladder, as shown in Figure 2. Suitably sized saddles or U-bolts are recommended for fixing on the vertical elements.

NOTE 2 It is important that the fixings are tight enough to prevent vertical movement of the metal enclosure whilst allowing longitudinal expansion of the metal enclosure.

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 3 so as to allow movement under impact.

NOTE 3 A typical rubber bush, which has been found to be suitable, is shown in Figure 5.