

INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**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 Standard
Document Preview

IEC 60331-1:2018

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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	2
1 Scope.....	7
2 Normative references	8
3 Terms and definitions	8
4 Test conditions — Test environment	8
5 Test apparatus	9
5.1 Test equipment.....	9
5.2 Test ladder and mounting	12
5.3 Source of heat	13
5.3.1 Burner	13
5.3.2 Flow meters and flow rates	14
5.3.3 Verification	15
5.4 Shock producing device	15
5.5 Positioning of source of heat.....	16
5.6 Continuity checking arrangements for electric power and control cables with rated voltage up to and including 600 V/1 000 V	16
5.7 Fuses.....	16
6 Test specimen (electric power and control cables with rated voltage up to and including 600 V/1 000 V).....	16
6.1 Test specimen preparation.....	16
6.2 Test specimen mounting	17
6.2.1 Single core cables with concentric metal layer and multicore cables	17
6.2.2 Single core cables without concentric metal layer	19
7 Test procedure (electric power and control cables with rated voltage up to and including 600 V/1 000 V).....	20
7.1 Test equipment and arrangement.....	20
7.2 Electrical connections	20
7.3 Flame and shock application.....	22
7.4 Electrification	22
8 Performance requirements (electric power and control cables with rated voltage up to and including 600/1 000 V)	23
8.1 Flame application time	23
8.2 Acceptance criteria	23
9 Retest procedure.....	23
10 Test report (electric power and control cables with rated voltage up to and including 600 V/1 000 V).....	23
11 Cable marking	23
Annex A (normative) Verification procedure for the source of heat	24
A.1 Measuring equipment.....	24
A.2 Procedure	24
A.3 Evaluation.....	25
A.4 Further verification.....	25
A.5 Verification report	25
Annex B (informative) Guidance on the choice of recommended test apparatus (burner and venturi)	26

Influence of draughts in the test chamber	
Guidance on provision of a suitable test chamber	
Bibliography.....	27
Figure 1 – Schematic diagram of test configuration.....	10
Figure 2 – Plan view of fire test equipment.....	11
Figure 3 – End elevation of fire test equipment (not to scale).....	12
Figure 4 – Typical rubber bush for supporting the test ladder.....	13
Figure 5 – Burner face.....	14
Figure 6 – Schematic diagram of an example of a burner control system using rotameters	15
Figure 7 – Example of method of mounting a larger diameter test specimen for test (with a bending radius between approximately 200 and 400 mm).....	17
Figure 8 – Detailed section of adjustable position of vertical ladder elements for mounting a smaller diameter test specimen for test (with a maximum bending radius of approximately 200 mm).....	18
Figure 9 – Example of method of mounting test specimen with a bending radius in normal use larger than approximately 400 mm.....	19
Figure 10 – Method of mounting test specimen of a single core cable without concentric metal layer.....	20
Figure 11 – Basic circuit diagram – Electric power and control cables with rated voltage up to and including 600 V/1 000 V.....	22
Figure A.1 – Temperature measuring arrangement.....	24

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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**

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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This second edition cancels and replaces the first edition published in 2009. It constitutes a technical revision.

The significant technical changes with respect to the previous edition are as follows:

- extension of the scope to include metallic data and telecom cables and optical fibre cables, although details for the specific point of failure, continuity checking arrangement, test sample, test procedure and test report relevant to metallic data and telecom cables and optical fibre cables are not given by IEC 60331-1;
- improved description of the test environment;
- modified steel test ladder with two extra vertical elements to accommodate the modified testing of single core cables without concentric metal layer and the testing of cables with a bending radius in normal use larger than approximately 400 mm;
- mandatory use of mass flow meters/controllers as the means of controlling accurately the input flow rates of fuel and air to the burner;
- improved description of the information to be included in the test report.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
20/1781A/FDIS	20/1792/RVD

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

This document 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 parts of the IEC 60331 series, published under the 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.

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

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

NOTE 2 Parts 11, 21, 23 and 25 are no longer subject to maintenance. IEC 60331 Parts 1 and 2 are the recommended test procedures

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.~~

This part of IEC 60331 specifies the test method for cables which are required to maintain circuit integrity when subject to fire and mechanical shock under specified conditions.

This document is applicable to cables of rated voltage not exceeding 600 V/1 000 V, including those of rated voltage below 80 V, metallic data and telecom cables and optical fibre cables.

It is intended for use when testing cables of greater than 20 mm overall diameter.

NOTE Cables of smaller diameter ~~should~~ are intended to 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.~~

This document includes details for the specific point of failure, continuity checking arrangement, test sample, test procedure and test report relevant to electric power and control cables with rated voltage up to and including 600 V/1 000 V. Details for the specific point of failure, continuity checking arrangement, test sample, test procedure and test report relevant to metallic data and telecom cables and optical fibre cables are not given by IEC 60331-1.

NOTE Although the scope is restricted to cables with rated voltage up to and including 0,6/1,0 kV, the procedure ~~may~~ can be used, with the agreement of the manufacturer and the purchaser, for cables with rated voltage up to and including 1,8/3 (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 document.

CAUTION – 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.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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~~ EMF specifications and tolerances*

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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

circuits 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

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draught-free environment

space in which the results of tests are not significantly affected by the local air speed

4 ~~Test conditions~~ – Test environment

The test shall be carried out in a draught-free environment within a suitable chamber, of minimum volume ~~10~~ 20 m³, with facilities for disposing of any noxious gases resulting from the burning. Sufficient ventilation shall be available to sustain the flame for the duration of the test. Air inlets and the exhaust chimney should be located in such a way that the burner flame remains stable during the verification procedure and test. If necessary, the burner shall be shielded from any draughts by the use of draught shields. 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 achieved by means of natural draught through a chimney located at least 1 m from the burner. A damper may be used for adjustment of ventilation conditions.

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

NOTE Experience has shown a chamber similar to the "3 m cube" specified in IEC 61034-1 to be suitable.

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 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.

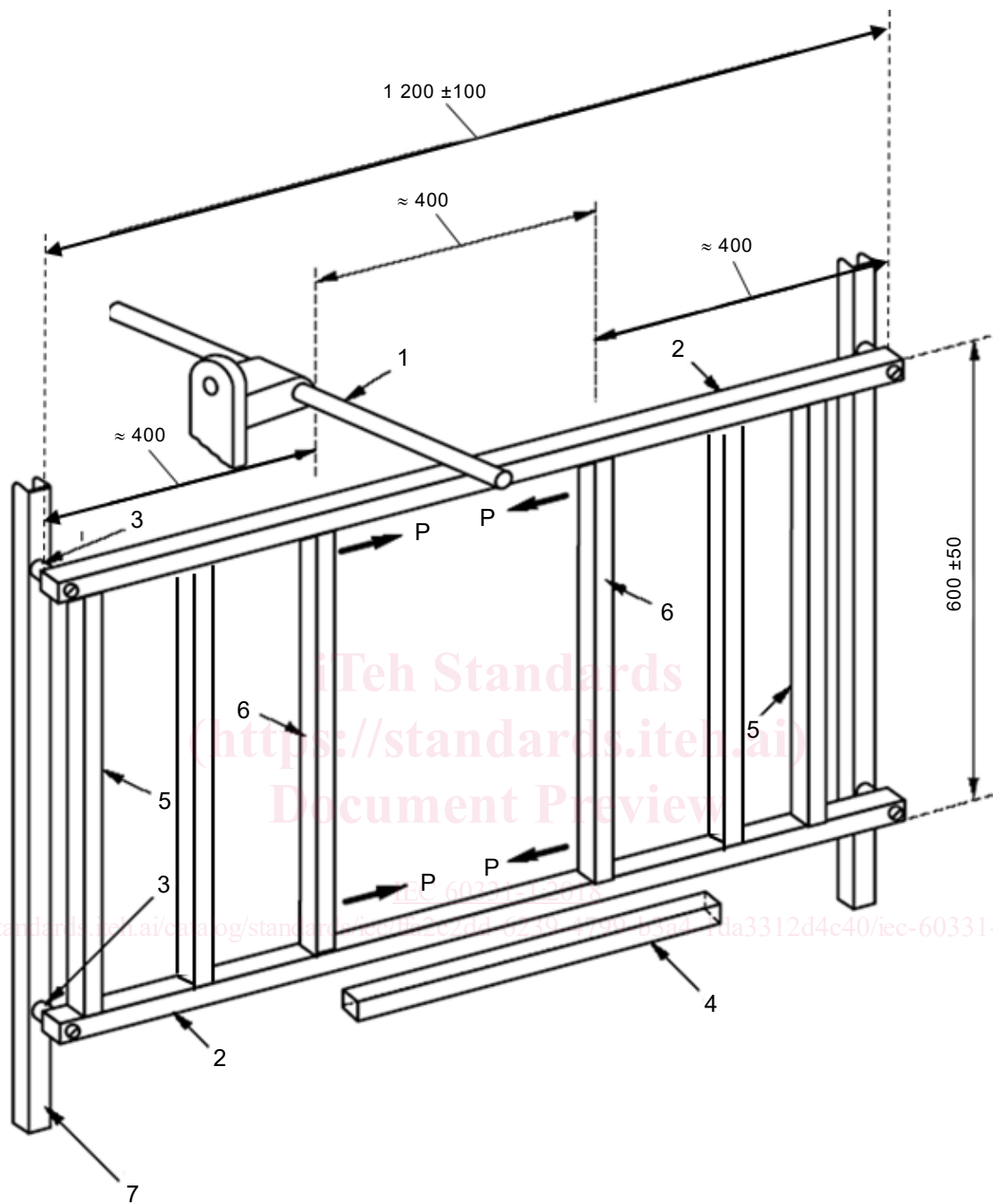
A general arrangement of the test equipment is shown in Figure 1, Figure 2 and Figure 3.

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Dimensions in millimetres

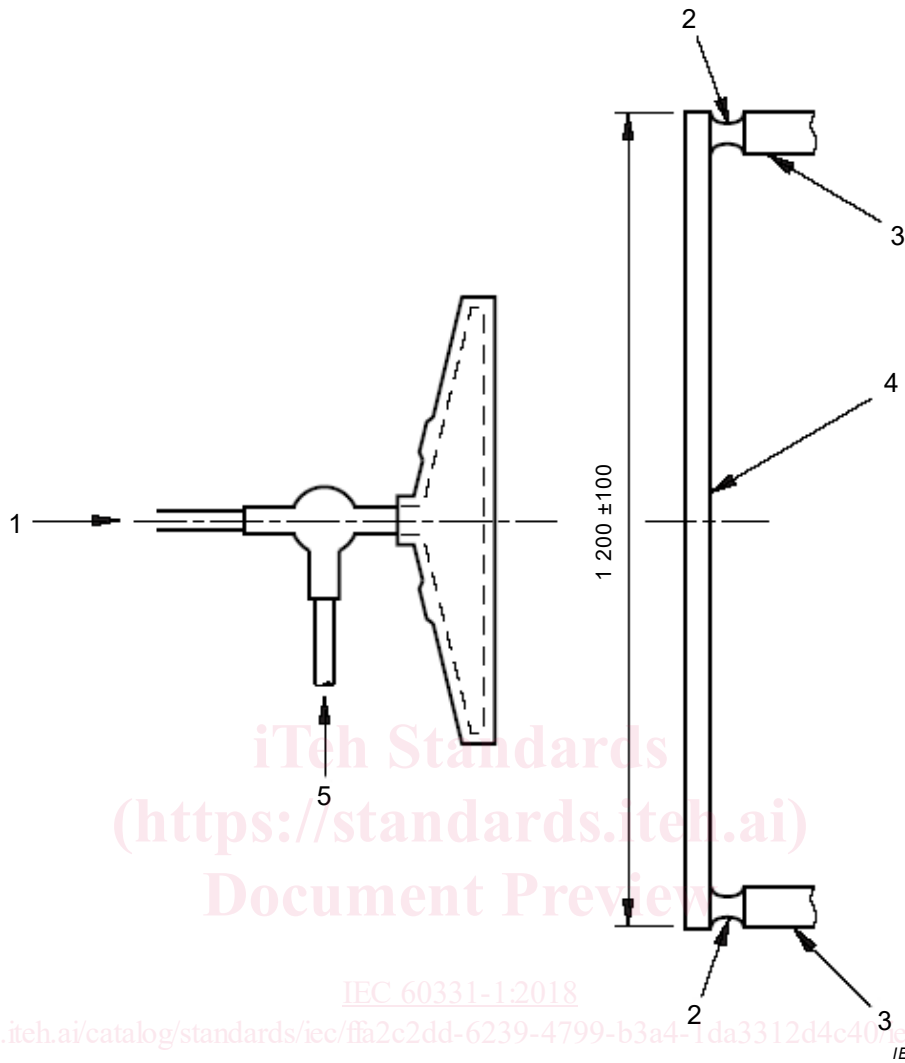


Key

- | | | | |
|---|------------------------|---|---|
| 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



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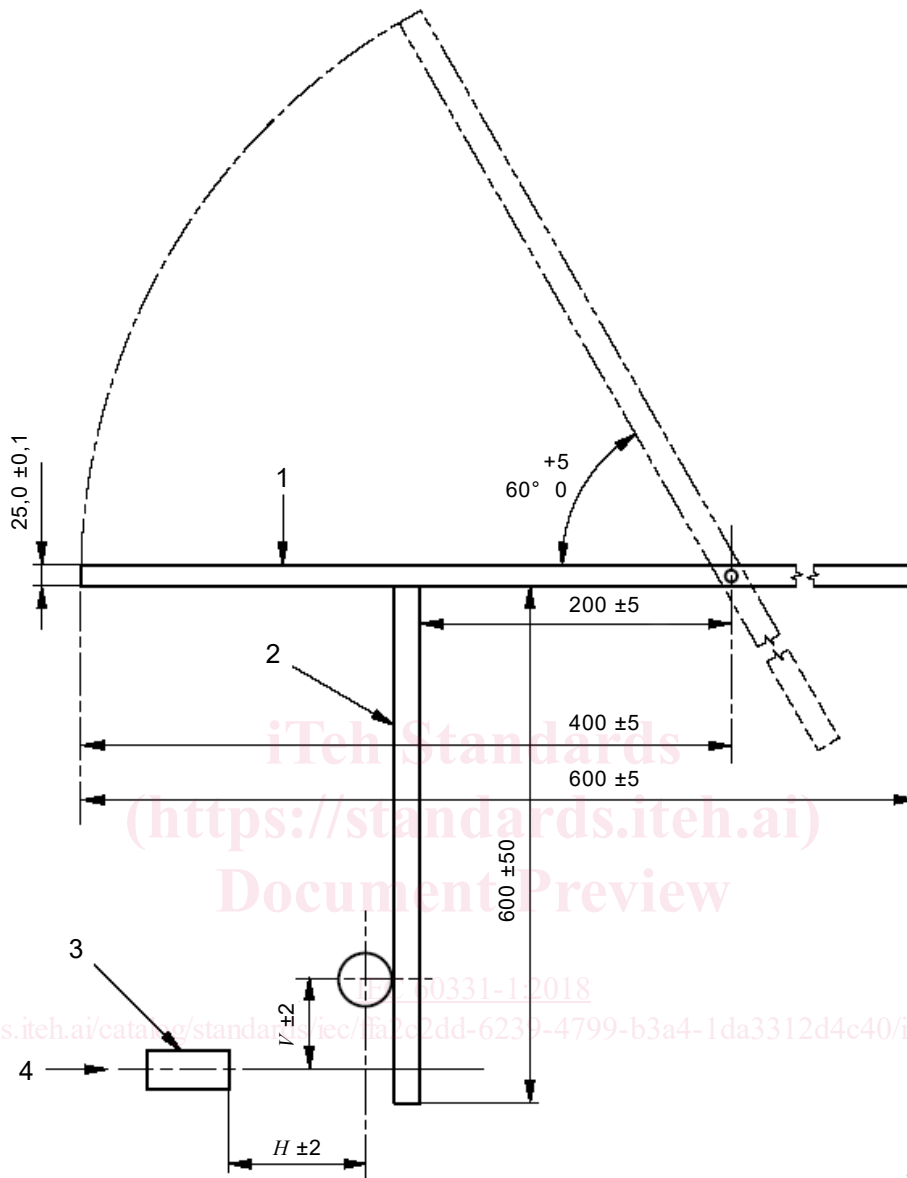
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Key

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

Figure 2 – Plan view of fire test equipment

Dimensions in millimetres



IEC

Key

- | | | | |
|---|----------------------------|-----|--|
| 1 | shock producing device | H | horizontal distance of metal enclosure centre line from burner face to the centre of the test specimen |
| 2 | steel test ladder | V | vertical distance of metal enclosure centre line from centre line of burner to the centre of the test specimen |
| 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~~ four central vertical elements of the ladder shall be adjustable in order to accommodate different sizes of cable under test. The test ladder shall be $(1\ 200 \pm 100)$ mm long and (600 ± 50) mm high, and the total mass of the test ladder shall be $(18\ 24 \pm 1)$ 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.