IEC 60331-2

Edition 2.0 2018-03

INTERNATIONAL STANDARD

GROUP SAFETY PUBLICATION

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

IEC 60331-2:2018-03(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC 60331-2

Edition 2.0 2018-03

INTERNATIONAL STANDARD

GROUP SAFETY PUBLICATION

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 13.220.40; 29.020; 29.060.20

ISBN 978-2-8322-5490-5

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60331-2 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 with 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 metallicdata and telecom cables and optical fibre cables are not given by IEC 60331-2;
– improved description of the test environment;

– 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 figure illustrating method of mounting of the sample regarding bending radius;
– 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
20/1783A/FDIS	20/1793/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.

A bilingual version of this publication may be issued at a later date.

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 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 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 not greater than 20 mm overall diameter.

Cables of larger diameter are intended to be tested using the apparatus, procedure and requirements of IEC 60331-1.

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/1000 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 60331-2.

Although the scope is restricted to cables with rated voltage up to and including 0,6/1,0 kV, the procedure 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 standard.

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: 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*

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
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

3.2
draught-free environment
space in which the results of tests are not significantly affected by the local air speed

4 Test environment

The test shall be carried out in a draught-free environment within a suitable chamber, of minimum volume 20 m^3, 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 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.

5 Test apparatus

5.1 Test equipment

The test equipment shall consist of the following:

a) a test wall onto which the cable is mounted, comprising a board manufactured from heat-resistant, non-combustible material suitable for the temperatures involved fastened to steel supports and mounted on 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;

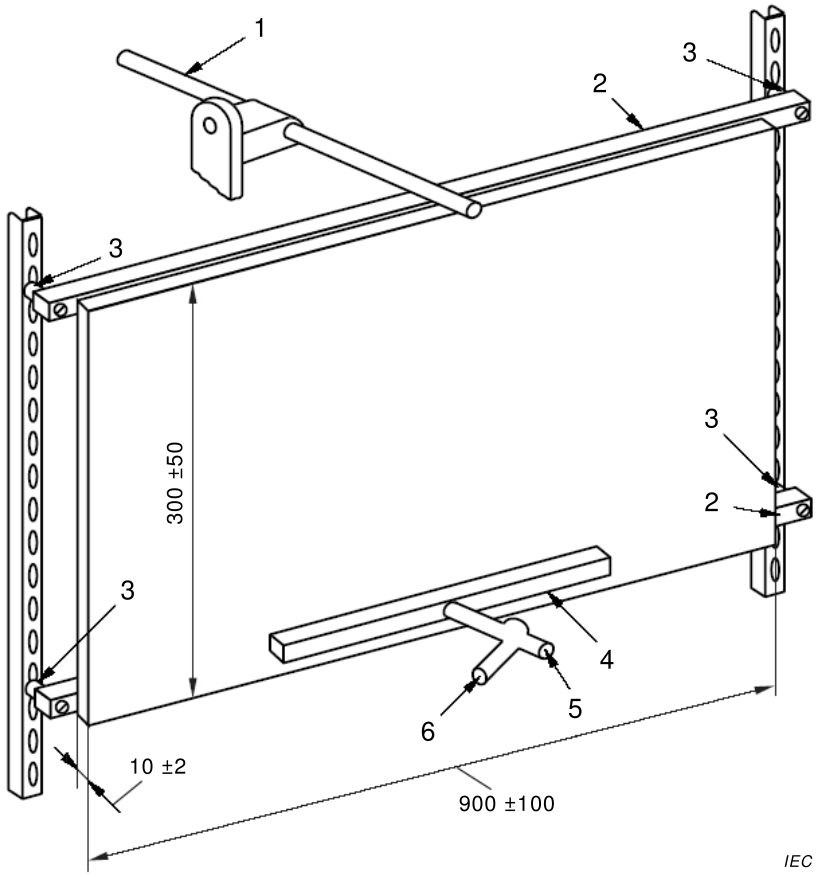
d) a test wall equipped with thermocouples for verification of the source of heat as described in Annex A;

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.

Dimensions in millimetres

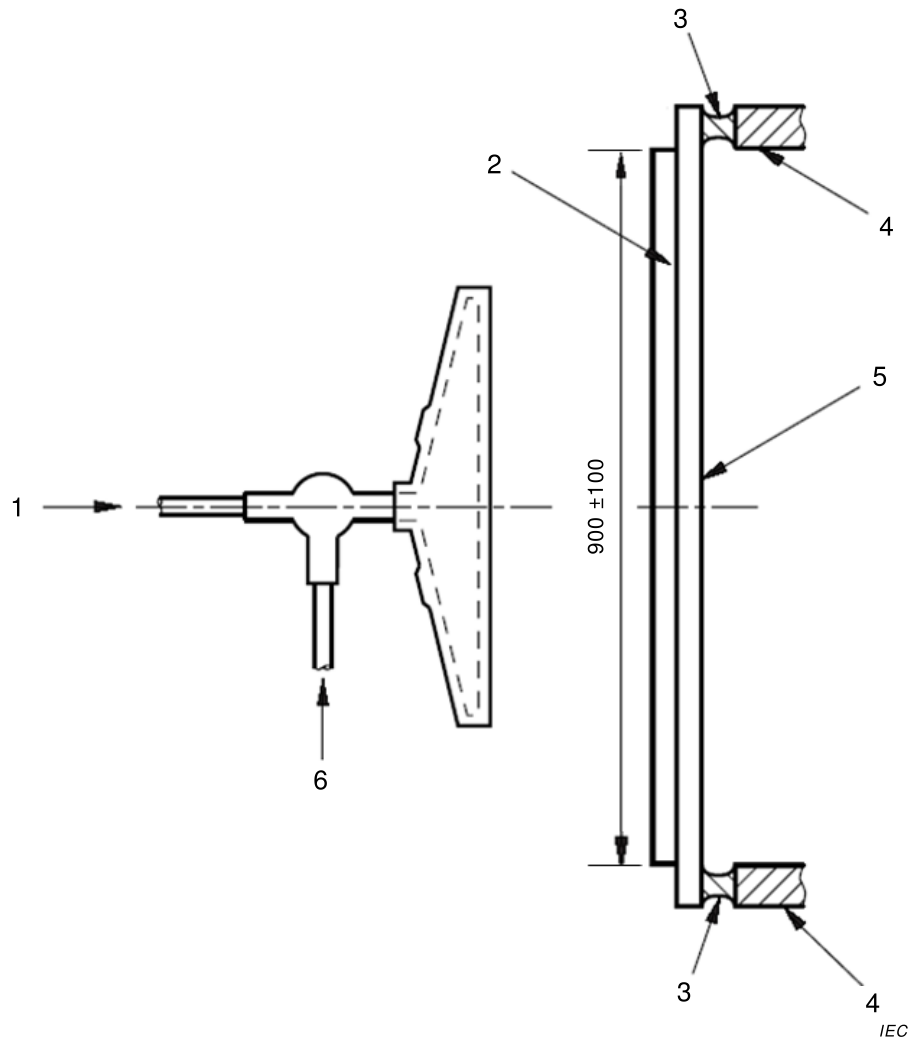


Key

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

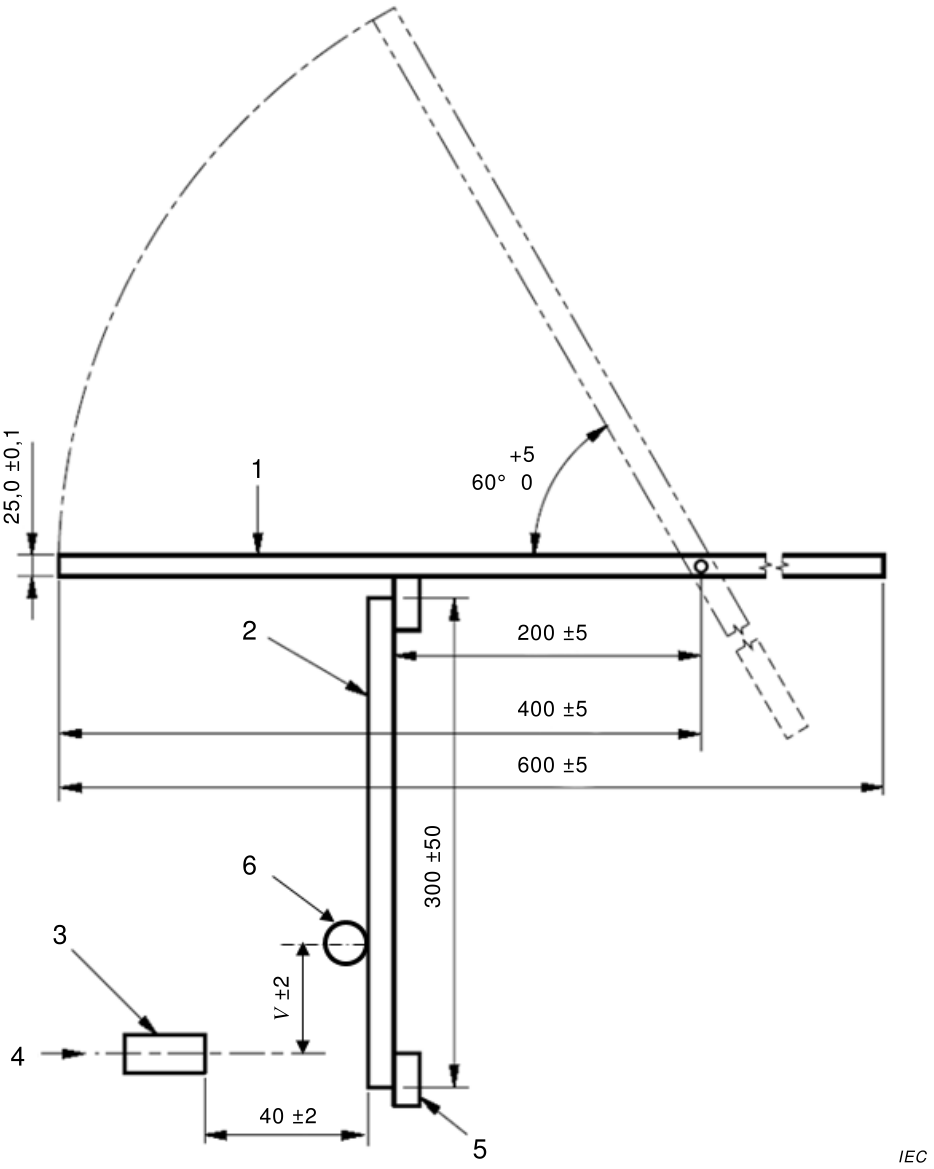


Key

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	6	test sample
V	Vertical distance from centre line of burner to the centre of the test specimen		

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, (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.

In case of dispute, a new board should be used for each test.

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.

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 Figure 1 and Figure 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.

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

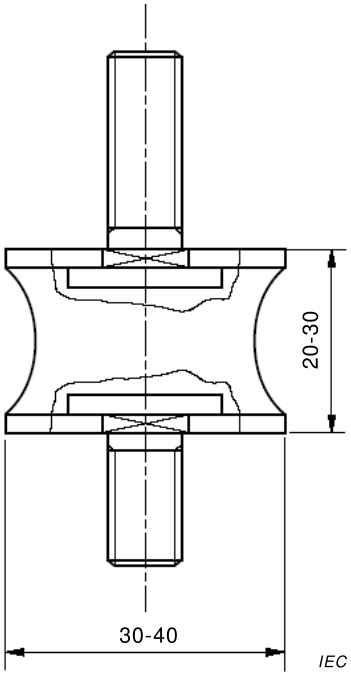


Figure 4 – Typical rubber bush (hardness: 50-60 shore A) for fastening wall

5.3 Source of heat

5.3.1 Burner

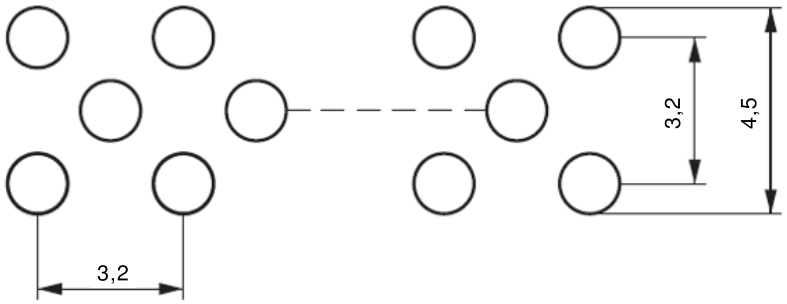
The source of heat shall be a ribbon type propane gas burner with a nominal burner face length of 500 mm (outer distance between outer holes) with a venturi mixer. The nominal burner face width shall be 10 mm. The face of the burner shall have three staggered rows of drilled holes, nominally 1,32 mm in diameter and drilled at centres 3,2 mm from one another, as shown in Figure 5.

A centre-feed burner is recommended.

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
(Dimensions are approximate)



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 shall be used as the means of controlling accurately the input flow rates of fuel and air to the burner.

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

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

Propane: (160 ± 6) mg/s

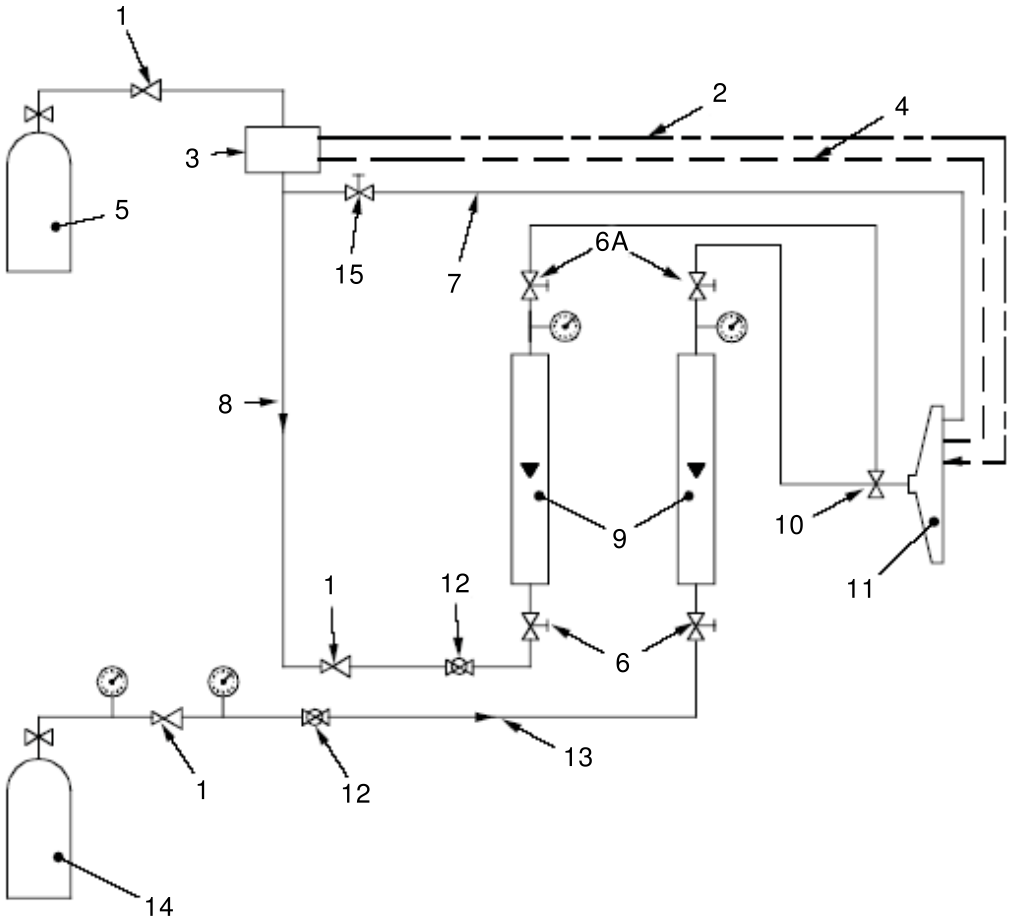
NOTE 1 This is approximately equivalent to a volume flow rate of (5,0 ± 0,2) litres/min at reference conditions (1 bar and 20 °C).

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

Air: (1 600 ± 80) mg/s

NOTE 2 This is approximately equivalent to a volume flow rate of (80 ± 4) litres/min at reference conditions (1 bar and 20 °C).

A schematic diagram of an example of a burner control system is given in Figure 6.



Key

1	regulator	9	mass flow meters
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

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 Figure 1 and Figure 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.

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

5.6 Continuity checking arrangements for electric power and control cables with rated voltage up to and including 600 V/1 000 V

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 Note 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 comply with IEC 60269-3 Fuse System A-D Type DII, 2A. 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 (electric power and control cables with rated voltage up to and including 600 V/1 000 V)

6.1 Test specimen preparation

A cable sample at least 3,6 m 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 covering removed at each end.

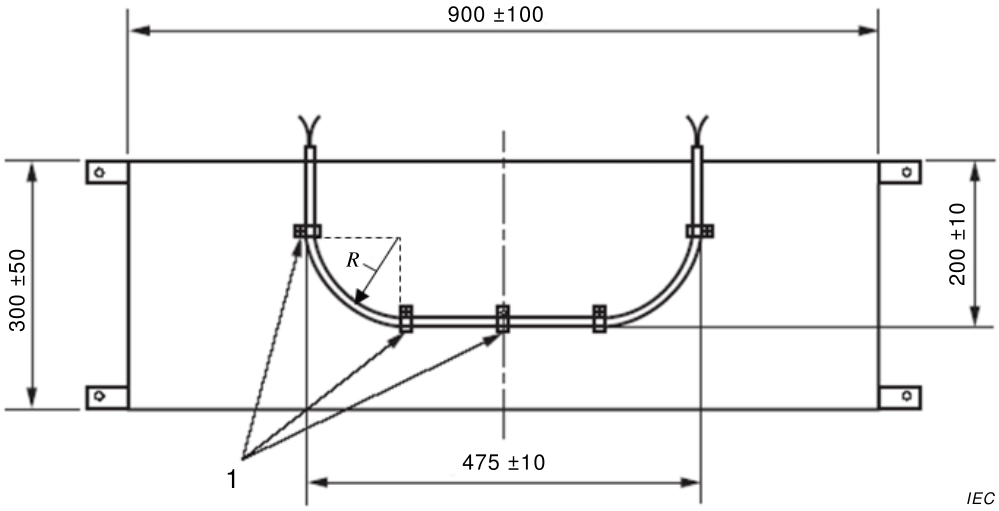
At each end of the test specimen, each conductor shall be suitably prepared for electrical connections, and, if there is more than one conductor, the exposed conductors shall be spread apart to avoid contact with each other.

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 in normal use 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 both ends 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 in normal use

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

7 Test procedure (electric power and control cables with rated voltage up to and including 600 V/1 000 V)

7.1 Test equipment and arrangement

The test procedure defined in this clause 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, if present, and any protective conductors. Any metal screens, drain wire or metal 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 metal 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.

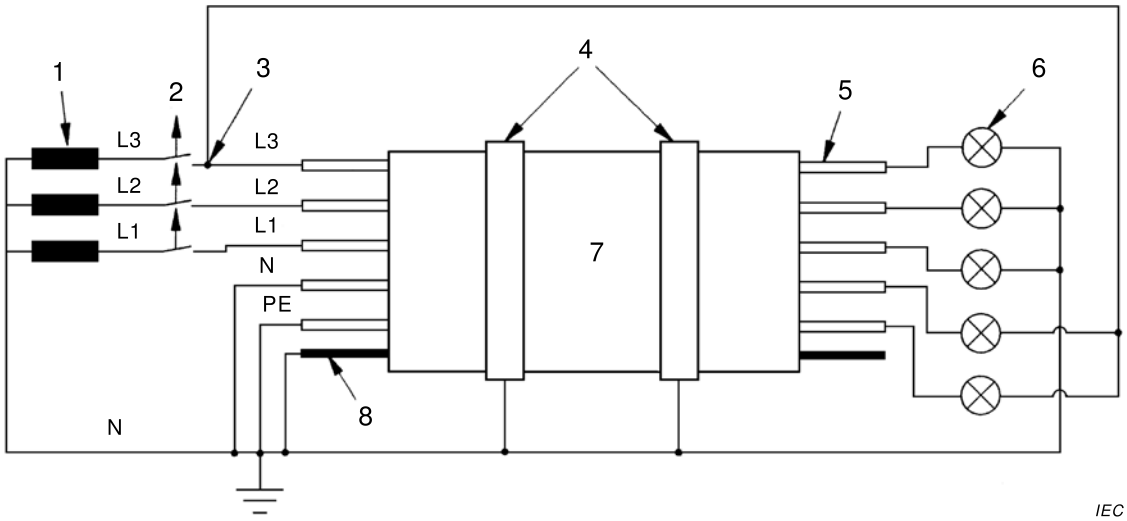
The above test procedure connects the neutral conductor to earth. This may not be appropriate if the cable is designed for use on a system where neutral is not earthed. If required by the cable standard it is permissible for the neutral conductor to be tested as if it were a phase conductor. Where a metal 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.

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.

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 V/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 AC), 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 (electric power and control cables with rated voltage up to and including 600 V/1 000 V)

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.

Failure by either one of the criteria listed shall be sufficient to show a failure for that cable.

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 (electric power and control cables with rated voltage up to and including 600 V/1 000 V)

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 and actual applied electrical connections, in accordance with Paragraphs 7 to 9 of 7.2;

e) any option used in the test procedure (i.e. type of test wall, failure detection method);

f) the type and disposition of clips supporting cable sample;

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

h) the method used for temperature monitoring during the verification procedure;

i) the point of failure mechanism (i.e. voltage not maintained or conductor rupture);

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

k) the flame application time;

l) 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.

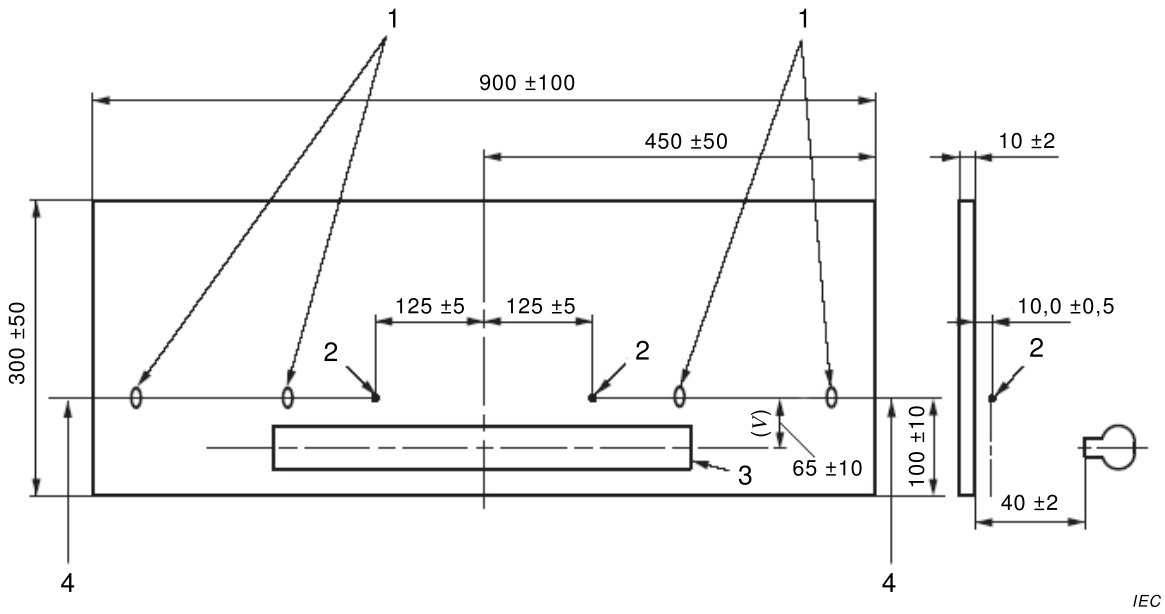
Annex A
(normative)

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 conforming to 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.

Dimensions in millimetres



Key

1	thermocouple supports	3	burner
2	thermocouple tip	4	1,5 mm type K sheathed thermocouples
V	vertical distance of thermocouple tip from centre line of burner		

Figure A.1 – Temperature measuring arrangement

A.2 Procedure

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.

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 arithmetic 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.

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.2) 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 (of V) and flow rates used shall be recorded.

Annex B
(informative)

Guidance on the choice of recommended test apparatus[1]

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. A recommended venturi mixer is the AGF 14-18.

The recommended burner and venturi are available from:

AGF Burner, Inc.
www.agfburner.com
1955 Swarthmore Ave
Lakewood, NJ 08703-8060

B.2 Test wall material

Examples of materials 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

---

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

_____

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch