

INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**Tests for electric cables under fire conditions – Circuit integrity –
Part 4: Test method for fire with shock at a temperature of at least 830 °C for
cables of rated voltage higher than 1kV up to and including 30 kV**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS –
CIRCUIT INTEGRITY –**
**Part 4 – Test method for fire with shock at a temperature of at least 830 °C
for cables of rated voltage higher than 1 kV up to and including 30 kV**

FOREWORD

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IEC 60331-4 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

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

Draft	Report on voting
20/2194/FDIS	20/2215/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

A list of all parts in the IEC 60331 series, published 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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
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INTRODUCTION

The IEC 60331 series consists of the following parts:

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, *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 60331-3, *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*

IEC 60331-4, *Tests for electric cables under fire conditions – Circuit integrity – Part 4: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage higher than 1 kV up to and including 30 kV*

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

IEC 60331-21, *Tests for electric cables under fire conditions – Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV*

IEC 60331-23, *Tests for electric cables under fire conditions – Circuit integrity – Part 23: Procedures and requirements – Electric data cables*

IEC 60331-25, *Tests for electric cables under fire conditions – Circuit integrity – Part 25: Procedures and requirements – Optical fibre cables*

NOTE 1 IEC 60331-21, IEC 60331-23 and IEC 60331-25 relate to fire-only conditions at a flame temperature of at least 750 °C.

NOTE 2 IEC 60331-11, IEC 60331-21, IEC 60331-23 and IEC 60331-25 are no longer subject to maintenance. The relevant test procedures are given in IEC 60331-1 and IEC 60331-2.

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

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

TESTS FOR ELECTRIC CABLES UNDER FIRE CONDITIONS – CIRCUIT INTEGRITY –

Part 4 – Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage higher than 1 kV up to and including 30 kV

1 Scope

This part of the IEC 60331 series specifies the test apparatus and procedure, and gives the performance requirements, including recommended flame application times and flame temperatures, for power cables of rated voltage higher than 0,6/1,0 kV up to and including 18/30 kV for maintaining circuit integrity when subject to fire and mechanical shock under specified conditions.

The test method in this document is restricted to conductor sizes up to and including 120 mm². The test results for 120 mm² size conductors constructions qualify larger cross-sections of the same cable construction.

In the case of preassembled three-core cables, then the complete cable is considered as tested when a complete single-core of the cable has been tested.

This document includes details for the specific point of failure, continuity checking arrangement, test sample, test procedure and test report relevant to electric power cables with a rated voltage higher than 0,6/1,0 kV up to and including 18/30 kV.

Annex A provides the method of verification of the burner and control system used for the test. Annex B provides a choice of the recommended test apparatus.

Annex C provides, as an option, guidance for using either water spray or water jet protocols.

Annex D provides, as an option, the flame temperature of 1 000 °C, which is applicable for special applications.

Requirements are stated for an identification that can optionally be marked on the cable to signify compliance with this document.

This group safety publication focusing on the test method for circuit integrity safety for power cables of rated voltage higher than 1 kV up to and including 30 kV under fire conditions, is primarily intended to be used as a product safety standard for the products mentioned in the scope, but is also intended to be used by TCs in the preparation of publications for products similar to those mentioned in the scope of this group safety publication, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a TC is, wherever applicable, to make use of either BSPs or GSPs, or both, in the preparation of its publications.

WARNING – The test given in this document can involve the use of dangerous voltages and temperatures. Suitable precautions should be taken against the risk of shock, burning, fire and explosion that can arise, and against any noxious fumes that can 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*

3 Terms and definitions

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

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

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

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

3.2

draught-free environment

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

4 Test conditions

The test shall be carried out in a draught-free environment within a suitable chamber, of minimum volume 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 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 can be used.

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 ladder, onto 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 voltage supply arrangement as described in 5.6;
- f) and optionally: a water spray or water jet as described in Annex C.

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

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