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TECHNICAL SPECIFICATION

colour inside

Fire hazard testing – Part 2-21: Glowing/hot-wire based test methods – Fire containment test on finished units

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CONTENTS

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FOREWORD

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IEC TS 60695-2-21 has been prepared by IEC technical committee 89: Fire hazard testing. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
89/1554/DTS	89/1561A/RVDTS

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 Technical Specification 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.

This publication has the status of a Technical Specification in accordance with IEC Guide 104 and ISO/IEC Guide 51.

NOTE The following print types are used:

- terms defined in Clause 3: in **bold** type.

A list of all parts in the IEC 60695 series, published under the general title *Fire hazard testing*, 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- withdrawn,
- replaced by a revised edition, or
- amended.

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

INTRODUCTION

Fires might create hazards to life and property as a result of the generation of heat (emission of heat on fire hazard), and also as a result of the production of toxic effluent, corrosive effluent and smoke (fire effluents on the fire hazard). Fires start with ignition and then can grow, leading in some cases to flash-over and a fully developed fire. Resistance to ignition is therefore one of the most important parameters of a material to be considered in the assessment of a fire hazard.

Most current fire hazard assessment techniques evaluate the resistance to ignition characteristics of a single material or component. These assessment techniques are able to drive the preselection and validation of materials and components but are not able to evaluate the possible interaction of materials or components in a complex environment such as in a finished unit, once a fire event is initiated.

In a fault condition, a finished unit might be subject to the overheating of electrical connections and contacts. Such overheating can be caused by corrosion, poor crimp connections, incorrect assembly, erosion of contact surfaces, or mechanical fatigue. Insulating materials that are overheated can ignite and cause fire.

It is difficult to simulate the actual conditions of potential faults in finished units; therefore all possible fire hazards should be taken into account at the design stage and subsequently during the preselection of materials and components.

This fire containment test has been developed to verify if a finished unit is able to contain an internal fire event, generated by combustible parts ignited by a simulated overheated electrical connection.

FIRE HAZARD TESTING –

Part 2-21: Glowing/hot-wire based test methods – Fire containment test on finished units

1 Scope

This part of IEC 60695, which is a Technical Specification, specifies a **fire** containment test method for **finished units**. It is intended to verify the capability of containing of a fire event generated by an **effective ignition source** inside a **finished unit**.

Unless otherwise specified by the relevant product standard, determination of the **fire** containment described in this document does not apply to any of the following:

- A single electrical component;
- A single electrical component when incorporated into a **finished unit**;
- Electrical installation products such as distribution boards, circuit protection devices, switchgear, controlgear, cable management system and electrical accessories (wiring devices).

The test method described in this document does not apply to the following electrical connections:

- Low-power electrical connections contained in **finished units**, where the maximum power through the connection does not exceed 15 W.
- Soldered and welded electrical connections are exempted from the evaluations of this document.

This document is intended to be used for evaluating the capability of **fire** containment of **finished units**, during the selection of **finished units** and in the design of **finished units**.

The requirements, test method or test conditions of this document will not apply unless specifically referred to or included in the relevant publications.

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 62368-1:2018, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ISO 13943:2017, *Fire safety – Vocabulary*

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
cheesecloth
bleached cotton cloth of approximately 40 g/m^2

[SOURCE: IEC 62368-1:2018, 3.3.6.2, modified – Deleted the Note to entry]

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

Note 1 to entry: A qualitative example is a space in which a wax candle **flame** remains essentially undisturbed. Quantitative examples are small-scale **fire** tests in which a maximum air speed of 0,1 m-s^{-1} or 0,2 m-s^{-1} is sometimes specified.

[SOURCE: ISO 13943:2017, 3.83]

3.3
effective ignition source
potential ignition source that has been proved to be able to initiate combustion of surrounding insulating material or combustible parts

Note 1 to entry: The proving methodology is defined by the test specified in 8.6.

3.4
enclosure
<electrotechnical> external casing protecting the electrical and mechanical parts of apparatus

Note 1 to entry: The term excludes cables.

[SOURCE: ISO 13943:2017, 3.93]

3.5
finished unit
complete unit which is designed to stand alone, usable by an end-user and having a direct function for the end-user

Note 1 to entry: It is intended to be placed on the market and/or taken into service as single unit.

Note 2 to entry: Electrical installation products such as distribution boards, circuit protection devices, switchgear, controlgear, cable management system and electrical accessories (wiring devices) are not considered to be finished units.

3.6
fire
process of combustion characterized by the emission of heat and fire effluent and usually accompanied by smoke, **flame** or glowing or a combination thereof

Note 1 to entry: In English language the term "**fire**" is used to designate three concepts, two of which relate to specific types of self-supporting combustion with different meanings. Of these three, two of them are designated using two different terms in both French and German.

[SOURCE: ISO 13943:2017, 3.114, modified – The domain <general> has been deleted.]

3.7
flame, noun
rapid, self-sustaining, sub-sonic propagation of combustion in a gaseous medium, usually with emission of light

[SOURCE: ISO 13943:2017, 3.159]

3.8
ignition
DEPRECATED: sustained **ignition**
initiation of sustained **flame**

[SOURCE: ISO 13943:2017, 3.218]

3.9
low-power point
electrical connection where the power dissipated at the connection does not exceed 15 W

Note 1 to entry: To dissipate more than 15 W at an electrical connection, the power delivered to a resistive load via the electrical connection must exceed 60 W. This is based on the maximum power transfer theorem that shows that an electrical connection can only dissipate one-fourth of the power delivered to a resistive load when the resistance of the connection is equal to the resistance of the load.

3.10
non-combustible material
not capable of undergoing combustion (see ISO 13943:2017, 3.55) under specified test conditions

EXAMPLE According to the test method described in this document, steel, glass, ceramic and concrete are considered examples of non-combustible materials.

[SOURCE: ISO 13943:2017, 3.282, modified – Added “test]

3.11
potential ignition source
electrical connection where electrical energy can cause **ignition**

[SOURCE: IEC 62368-1:2018, 3.3.9.1, modified – Deleted “PIS” and “location”]

4 Test specimen

4.1 General

The test specimen is a **finished unit**.

4.2 Verification of potential ignition sources

Before carrying out any tests on the test specimen, it is necessary to identify electrical connections and verify if these are **potential ignition sources** as described in 8.2 to 8.6.

4.3 Test conditions

The test conditions shall not be significantly different from those occurring when the **finished unit** is operated according to the intended use as specified by the manufacturer, taking into account 8.3. However, the test specimen shall be de-energized during the test with the factors identified in 8.3 supplied by an external power source. It is acceptable to have limited modifications to the test specimen and to the **potential ignition source** in order to allow access of the heating wire and the related supply wires. Such modifications should not be expected to have any significant effect on the test results.

5 Test apparatus

5.1 Nickel-Chromium wire (NiCr wire)

The heating wire shall be a Nickel/Chromium wire (NiCr wire), having a nominal composition of > 77 % Ni and 20 ± 1 % Cr, having a nominal diameter of 0,81 mm ± 0,05 mm (20 AWG), a minimum length of 100 mm and a resistance at ambient temperature between 15 °C and 35 °C of (0,22 ± 0,05) Ω per 100 mm length.

NOTE Nickel/Chromium wire is also known as NiCr8020.

5.2 Test circuit

The NiCr wire is heated by a constant current power supply having minimum output characteristic of 0 A to 15 A. The circuit shall contain a current measuring device which indicates a true RMS value having an accuracy of ± 2,5 % or more accurate.

5.3 Connections

Due to the high currents involved, it is essential that all electrical connections for the NiCr wire are capable of carrying the current without affecting the performance or long-term stability of the circuit. Connections between the NiCr wire and the supply wires shall be made using non-insulated straight butt splices, ceramic screw terminals or similar means provided that they are made of **non-combustible material**.

5.4 Cheesecloth

Cheesecloth is used to evaluate the possible spread of **fire** outside of the test specimen during the test in 8.7.

If not otherwise specified in the relevant product standard, **cheesecloth** shall be as specified in 3.1.

NOTE The Project Team is aware of the existence of several different types of ignition indicators on the market. Product committees are welcome to replace the currently described **cheesecloth** by other types. Product committees using different ignition indicators than the described are kindly invited to provide their feedback on the type of ignition indicator and its general behavior, when used according to this test method, to the Project Team, in order to be taken into account for the future revisions of this document.

5.5 Test chamber

The test chamber shall provide a **draught-free environment** and shall be provided with suitable means allowing the observation of specimen during the test of 8.6 and 8.7 and ensuring to meet the testing conditions defined in 7.3 at the start of the test. The volume of the test chamber shall be adequate to contain the test specimen and to ensure that oxygen depletion does not significantly affect the results.