IEC TS 60695-2-20

Edition 4.0 2024-11
REDLINE VERSION

TECHNICAL SPECIFICATION

colour inside

Fire hazard testing –
Part 2-20: Glowing/hot wire based test methods – Hot-wire ~~coil~~ ignition (HWI) test method test method – Apparatus, verification, test method and guidance

IEC TS 60695-2-20:2024-11 RLV(en)

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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TS 60695-2-20:2021. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TS 60695-2-20 has been prepared by IEC technical committee 89: Fire hazard testing. It is a Technical Specification.

This fourth edition cancels and replaces the third edition published in 2021. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Removed all text which was related to drip or dripping, since in this 4th edition only ignition is taken into consideration for determination of the classification level;
b) Title changed: "Hot wire coil test method" is now "Hot wire ignition (HWI) test method".

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

Draft	Report on voting
89/1583/DTS	89/1593/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.

Part 2 of IEC 60695 consists of the following parts:

Part 2-10: *Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

Part 2-11: *Glowing/hot-wire based test methods – Glow-wire flammability test method for end products*

Part 2-12: *Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

Part 2-13: *Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

Part 2-20: *Glowing/hot-wire based test methods – Hot-wire ignition test method – Apparatus, verification, test method and guidance*

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

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.

NOTE The following print types are used:

- Terms **in bold** in the text are defined in Clause 3.

Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

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
- revised.

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

In the design of any electrotechnical product, the risk of **abnormal heat** and the potential hazards associated with **abnormal heat** need to be considered. In this respect the objective of component, circuit, and product design, as well as the choice of materials, is to reduce to acceptable levels the potential risks during normal operating conditions, reasonably foreseeable abnormal use, malfunction and/or failure. IEC 60695-1-10 [1][1], together with its companion IEC 60695-1-11 [2], provides guidance on how this is to be accomplished.

The primary aims of IEC 60695-1-10 [1] and IEC 60695-1-11 [2] are to provide guidance on how:

a) to prevent **ignition** caused by an electrically energized component part, and
b) to confine any resulting fire within the bounds of the enclosure of the electrotechnical product in the event of **ignition**.

Secondary aims of IEC 60695-1-10 [1] and IEC 60695-1-11 [2] include the minimization of any flame spread beyond the product's enclosure and the minimization of the harmful effects of **fire effluents** such as heat, smoke, toxicity and/or corrosivity.

The test method provided in this document applies to solid electrical insulating materials which can provide test specimens. It applies to materials for which the test specimen does not deform during preparation, especially during the winding of the test specimen with the heater wire as described in 5.5.

Examples of deformation that render this test method inapplicable include:

a) bowing, in either a transverse or a longitudinal direction, or twisting of the test specimen during the winding of the test specimen with the heater wire, to a degree visible to the eye, or
b) visible indentation of the test specimen by the heater wire.

A~~n informative~~ classification system described in Annex B can be used for the **preselection** of materials.

1 Numbers in square brackets refer to the bibliography.

FIRE HAZARD TESTING –

Part 2-20: Glowing/hot wire based test methods – Hot-wire ~~coil~~ ignition (HWI) test method – Apparatus, verification, test method and guidance

1 Scope

This part of IEC 60695, which is a technical specification, describes a test method that applies to solid electrical insulating materials of which test specimens can be provided. The test measures the time required to ignite a test specimen when it is affected by heat from an electrically heated wire wound around the test specimen. ~~If the test specimen drips, the time at which this occurs is also recorded.~~

The test method can be used to provide classifications which can be used for quality assurance, the **preselection** of materials of products as described in IEC 60695-1-30, or to verify the required minimum classification of materials used in **end products**.

~~This basic safety publication is intended for use by technical committees in the preparation of standards in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.~~

~~One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications. The requirements, test methods or test conditions of this basic safety publication 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 60695-1-30, *Fire hazard testing - Part 1-30: Guidance for assessing the fire hazard of electrotechnical products - Preselection testing process - General guidelines*~~

~~IEC 60695-4:2012, *Fire hazard testing - Part 4: Terminology concerning fire tests for electrotechnical products*~~

~~IEC GUIDE 104:2019, *The preparation of safety publications and the use of basic safety publications and group safety publications*~~

~~ISO/IEC Guide 51:2014, *Safety aspects – Guidelines for their inclusion in standards*~~

ISO 291:2008, *Plastics – Standard atmospheres for conditioning and testing*

ISO 293, *Plastics – Compression moulding test specimens of thermoplastic materials*

ISO 294 (all parts), *Plastics – Injection moulding of test specimens of thermoplastic materials*

ISO 295, *Plastics – Compression moulding of test specimens of thermosetting materials*

ISO 13943:~~2008~~2017, *Fire safety – Vocabulary*

ISO 16012~~:2004~~, *Plastics – Determination of linear dimensions of test specimens*

~~JIS C 2520:1999, *Wires and rolled wires for electrical heating*~~

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943:2017, some of which are reproduced below for the user's convenience, as well as the following 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
abnormal heat
<electrotechnical> heat that is additional to that resulting from use under normal conditions, up to and including that which causes a fire

[SOURCE: ISO 13943:2017, definition 3.1]

3.2
classification time
t_A, t_C
arithmetic mean of ~~relevant~~ **times to ignite,** ***IT*** ~~**and times to drip,** ***DT***~~, used for the purpose of classification

3.3
combustion
exothermic reaction of a substance with an oxidizing agent

Note 1 to entry: Combustion generally emits fire effluent accompanied by flames and/or glowing.

[SOURCE: ISO 13943:2017, definition 3.55]

3.4
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 $m \cdot s^{-1}$ or 0,2 $m \cdot s^{-1}$ is sometimes specified.

[SOURCE: ISO 13943:2017, definition 3.83]

3.5
end product
product which is ready for use

Note 1 to entry: An **end product** can be a component of another **end product**.

[SOURCE: IEC 60695-4:2012, definition 3.2.7]

3.6
fire effluent
all gases and aerosols, including suspended particles, created by **combustion** or pyrolysis and emitted to the environment

[SOURCE: ISO 13943:2017, definition 3.123]

3.7
fire hazard
potential for harm associated with fire

Note 1 to entry: Alternatively, **fire hazard** can be a physical object or condition with a potential for an undesirable consequence from fire.

[SOURCE: ISO 13943:2017, definition 3.131]

~~**3.8**~~
~~**ignitability**~~
~~**ease of ignition**~~
~~measure of the ease with which a test specimen can be ignited, under specified conditions~~

~~Note 1 to entry: Modified, notes to entry have been deleted~~

~~[SOURCE: ISO 13943:2017, definition 3.212]~~

3.8
ignition
sustained **ignition** (deprecated)
<general> initiation of **combustion**

[SOURCE: ISO 13943:2017, definition 3.217]

~~**3.10**~~
~~**molten drip**~~
~~falling droplet of material which has been softened or liquefied by heat~~

~~Note 1 to entry: The droplets can be flaming or not flaming.~~

~~[SOURCE: ISO 13943:2017, definition 3.275]~~

3.9
preselection
process of assessing and choosing candidate materials, components or sub-assemblies for making an **end product**

[SOURCE: IEC 60695-1-30, definition 3.5]

~~**3.12**~~
~~**time to drip, *DT***~~
~~time elapsed after the start of a test when **molten drips** are first observed to fall from the test specimen~~

3.10
time to ignite
IT
time elapsed after the start of a test when **ignition** of the test specimen is observed to occur

4 Principle

A rectangular bar-shaped test specimen is supported horizontally on a test fixture (an example of a test fixture is shown in Figure 1 and Figure 3). The centre portion is wound with a coil of heater wire as shown in Figure 2. A constant current is applied to the coil, which rapidly heats up and the behaviour of the test specimen is observed. The **time to ignite,** ***IT*** ~~and/or the **time to drip,** ***DT***~~ shall be recorded.

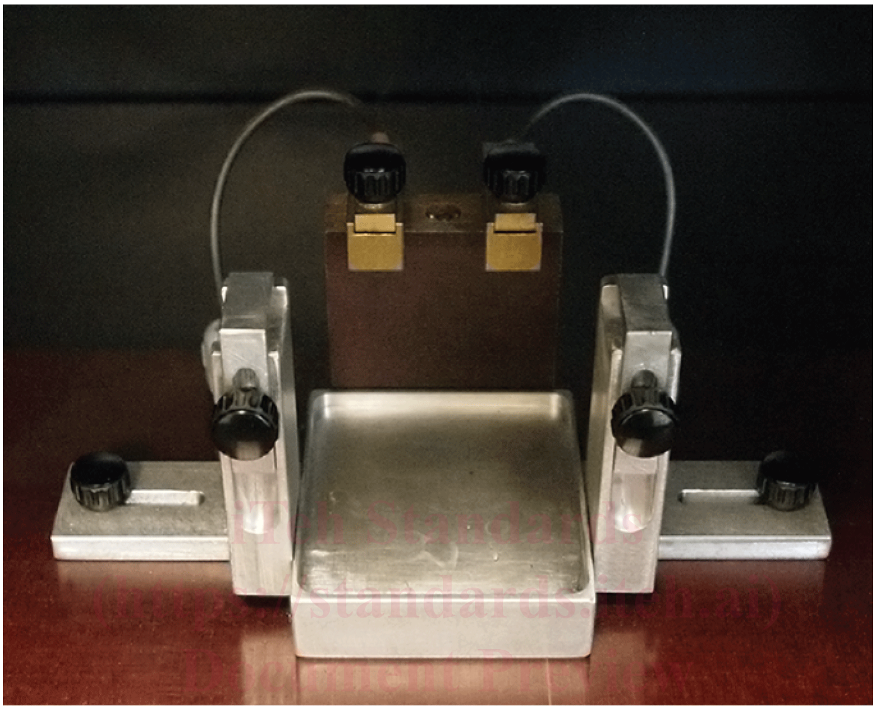

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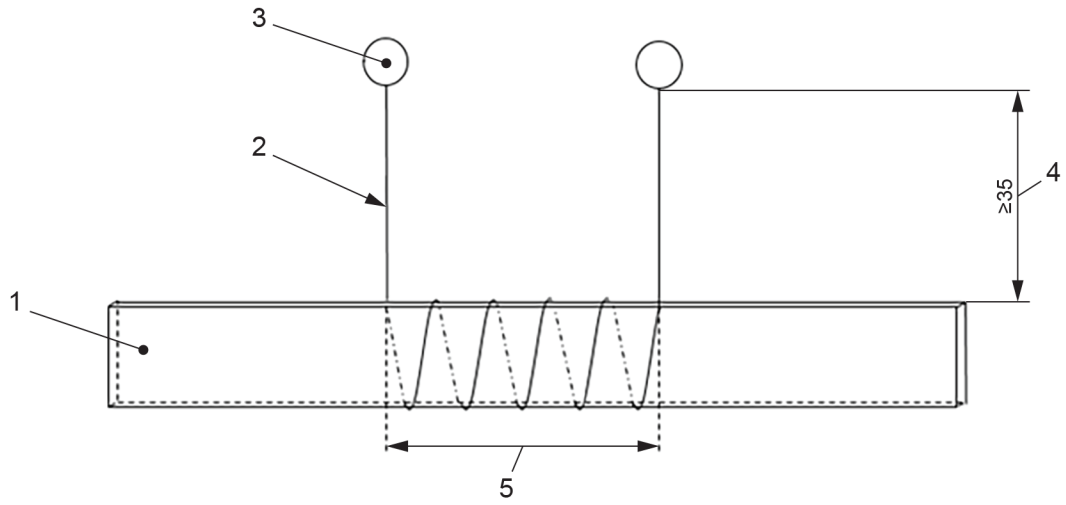
Figure 1 – Test fixture arrangement (example)

Dimension in millimetres



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Key

1 Test specimen
2 Heater wire
3 Electrical connection point
4 Distance to electrical connection points (≥ 35 mm)
5 Distance between all 5 windings (~~31,5 to 32,0~~ 30,5 to 32,5 mm)

Figure 2 – Test specimen winding pattern

5 Apparatus

5.1 Test chamber

The test chamber consists of a laboratory fume hood/chamber ~~shall have~~ having an inside volume of at least 0,5 m^3. The test chamber shall provide a **draught-free environment** ~~whilst allowing normal thermal circulation of air past the test specimen~~. The test chamber shall permit observation of the test in progress. The inside surfaces of the walls shall be a dark colour. The test chamber shall have an ambient light level not exceeding 20 lux. For safety and convenience, it is desirable that this ~~enclosure~~ test chamber (which can be completely closed) is fitted with an extraction device, such as an exhaust fan, to remove the **fire effluent** which may be toxic. The extraction device, if fitted, shall be turned off during the test and turned on immediately after the test. A positive closing damper may be needed.

5.2 Heater wire

The heater wire shall be a Nickel/Chromium wire ~~(NCHW1 according to JIS C 2520)~~, having a nominal composition of > 77 % Ni and (20 ± 1 % Cr), having a nominal diameter of (0,5 ± 0,016) mm and a length of 260 mm (+ 10 mm, – 0 mm).

NOTE 1 NiCr (> 77 % Ni / 20 ± 1 % Cr) heater wire has a nominal cold resistivity of (1,08 ± 0,05) × 10^{-6} Ω·m.

NOTE 2 The Nickel/Chromium wire is also known as NCHW1 according to JIS C 2520 ~~is also known as~~ and NiCr8020 according to DIN 17470 Werkstoffnummer 2.4869, or as specified in ASTM D3874.

NOTE 3 The length of wire may need to be adapted as follows: 280 mm (+ 10 mm, − 0 mm) for specimens with thicknesses between > 3 mm and ≤ 8 mm; and 350 mm (+10 mm, −0 mm) for specimens with thicknesses between > 8 mm and ≤ 13 mm.