

CONSOLIDATED VERSION

VERSION CONSOLIDÉE



BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

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

**Essais relatifs aux risques du feu –
Partie 2-13: Essais au fil incandescent/chauffant – Méthode d'essai de
température d'allumabilité au fil incandescent (GWIT) pour matériaux**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIRE HAZARD TESTING –

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

FOREWORD

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This Consolidated version of IEC 60695-2-13 bears the edition number 2.1. It consists of the second edition (2010-10) [documents 89/1018/FDIS and 89/1035/RVD] and its amendment 1 (2014-02) [documents 89/1199/FDIS and 89/1208/RVD]. The technical content is identical to the base edition and its amendment.

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

This publication has been prepared for user convenience.

International Standard IEC 60695-2-13 has been prepared by technical committee 89: Fire hazard testing.

It has the status of a basic safety publication in accordance with IEC Guide 104 and ISO/IEC Guide 51. This standard is to be used in conjunction with IEC 60695-2-10.

The main changes with respect to the previous edition are listed below:

- modified title;
- addition of an Introduction;
- clarification of Scope;
- expansion of Clause 2: Normative references;
- expansion of Clause 3;
- revision of Clause 4 to alignment with the IEC 60695-11 series to introduce guidance on test programs for material variations;
- clarification of Clause 8: Conditioning (now Clause 7);
- deletion of Clause 9: Initial measurement;
- expansion of Clause 10: Test procedures (now Clause 8);
- expansion of Clause 11: Observation and measurement (now Clause 9);
- clarification of Clause 12: Evaluation of test results (now Clause 10);
- expansion of Clause 13: Test report (now Clause 11).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60695 series, under the general title *Fire hazard testing* can be found on the IEC web site.

Part 2 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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability 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.

The contents of the corrigendum of February 2012 have been included in this copy.

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

In electrotechnical equipment, overheated metal parts can act as ignition sources. In glow-wire tests an electrically heated wire is used to simulate such an ignition source.

IEC 60695-2-10 describes a glow-wire test apparatus and common test procedure, IEC 60695-2-11 describes a glow-wire flammability test for end products, and IEC 60695-2-12 describes a glow-wire flammability index test method for materials.

In the design of any electrotechnical product, the risk of fire and the potential hazards associated with fire 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 of fire during normal operating conditions, reasonable foreseeable abnormal use, malfunction and/or failure. IEC/TC 89 has developed IEC 60695-1-10, together with its companion, IEC 60695-1-11, to provide guidance on how this is to be accomplished.

The primary aims of IEC 60695-1-10 and IEC 60695-1-11 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 and IEC 60695-1-11 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.

Fires involving electrotechnical products can also be initiated from external non-electrical sources. Considerations of this nature should be dealt with in the overall fire ~~risk~~ hazard assessment.

This part of IEC 60695 describes a glow-wire ignition temperature test method for materials. It should be used to measure, describe, and rank the properties of materials in response to heat caused by contact with an electrically heated wire under controlled laboratory conditions. This may be useful for the evaluation of materials for use in products that may be exposed to excess thermal stress such as a fault current flowing through a wire, overloading of components, and/or bad connections. It should not be used to solely describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire ~~risk~~ hazard assessment which takes into account all of the factors which are pertinent to ~~a fire hazard assessment of~~ a particular end use.

This International Standard may involve hazardous materials, operations, and equipment. It does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

FIRE HAZARD TESTING –

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

1 Scope

This part of IEC 60695 specifies the details of the glow-wire test to be applied to test specimens of solid electrical insulating materials or other solid materials for ignitability testing to determine the glow-wire ignition temperature (GWIT).

The GWIT is the temperature which is 25 K (or 30 K) higher than the maximum test temperature, determined during this standardized procedure, at which the tested material

- a) does not ignite, or
- b) ~~if sustained and continuous~~ flaming combustion does not occur for a time longer than 5 s for any single flame event and the specimen is not totally consumed.

This test is a materials test carried out on a series of standard test specimens. The data obtained, along with data from the glow-wire flammability index (GWFI) test method for materials, IEC 60695-2-12, can then be used in a preselection process in accordance with IEC 60695-1-30 to judge the ability of materials to meet the requirements of IEC 60695-2-11.

NOTE As an outcome of conducting a fire hazard assessment, an appropriate series of preselection flammability and ignition tests may allow a reduction of end product testing.

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 referenced documents are indispensable for the application 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 60695-1-30:2008, *Fire hazard testing – Part 1.30: Guidance for assessing the fire hazard of electrotechnical products – Preselection testing process – General guidelines*

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

~~IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*~~

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC Guide 104:1997, *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 terms and definitions given in ISO/IEC 13943, some of which are reproduced below for the user's convenience, as well as the following apply.

3.1 combustion

exothermic reaction of a substance with an oxidizing agent

NOTE Combustion generally emits fire effluent accompanied by flames and/or glowing.

[ISO/IEC 13943: 2008, definition 4.46]

3.2 flame, noun

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

[ISO/IEC 13943: 2008, definition 4.133]

3.3 flammability

ability of a material or product to burn with a flame under specified conditions

[ISO/IEC 13943: 2008, definition 4.151]

3.4 glowing, noun

luminosity caused by heat

[ISO/IEC 13943:2008, definition 4.168]

3.5 glowing combustion

combustion of a material in the solid phase without flame but with emission of light from the combustion zone

[ISO/IEC 13943:2008, definition 4.169]

3.6 ignitability ease of ignition

measure of the ease with which a test specimen can be ignited under specified conditions

[ISO/IEC 13943:2008, definition 4.182]

3.7

ignition

sustained ignition (deprecated)
<general> initiation of combustion

[ISO/IEC 13943:2008, definition 4.187]

3.8

ignition

sustained ignition (deprecated)
<flaming combustion> initiation of sustained flame

[ISO/IEC 13943:2008, definition 4.188]

3.9

preselection

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

[IEC 60695-1-30:2008, definition 3.2]

4 Test specimens

4.1 Test specimen preparation

Test specimens shall be fabricated using the appropriate ISO method, e.g. casting and injection moulding in accordance with the ISO 294 series, compression moulding in accordance with ISO 293 or ISO 295, or transfer moulding to the necessary shape. Where this is not possible, the test specimen shall be cut and/or sliced from a representative sample of the material (for example, produced using the same fabrication process as would be used to mould a part of a product).

After any fabrication or cutting operation, care shall be taken to remove all dust and any particles from the surface; cut edges shall be fine sanded to a smooth finish.

4.2 Test specimen dimensions

The dimensions of the planar sections of the test specimens shall be at least 60 mm in length and 60 mm in width (measured inside the clamping areas) and shall be provided in all thicknesses under consideration. The preferred values include 0,1 mm ± 0,02 mm, 0,2 mm ± 0,02 mm, 0,4 mm ± 0,05 mm, 0,75 mm ± 0,1 mm, 1,5 mm ± 0,15 mm, 3,0 mm ± 0,2 mm, or 6,0 mm ± 0,4 mm.

NOTE A set of ~~15~~ 30 test specimens per thickness will, in general, be adequate to concurrently establish the GWIT and the glow-wire flammability index, GWFI (See IEC 60695-2-12).

4.3 Testing ranges in formulations

4.3.1 General

The results of tests carried out on test specimen sets of different colour, thickness, density, molecular mass, anisotropic type/direction, additives, fillers, and/or reinforcements can vary. When agreed between involved parties, the test programs outlined in 4.3.2 and 4.3.3 may be employed in order to evaluate these variations.

4.3.2 Density, melt flow, and filler/reinforcement

Test specimens covering all combinations of minimum and maximum levels of density, melt flows and filler/reinforcement content may be provided and considered representative of the range if the test results yield the same GWIT. If the test results do not yield the same GWIT for all test specimens representing the range, evaluation shall be limited to the materials with the

specific levels of density, melt flows and filler/reinforcement tested. In addition, test specimens with intermediate density, melt flows, and filler/reinforcement content shall be tested to determine the representative range for each GWIT determination. However, as an alternative, the least favourable performance of the specific levels of density, melt flows and filler/reinforcement tested may be considered representative of intermediate levels without additional testing.

4.3.3 Colour

When evaluating a range of colours, test specimens that

- a) contain no colouring,
- b) contain the highest level of organic pigments/colorants/dyes and/or carbon black,
- c) contain the highest level of inorganic pigments, and
- d) contain pigments/colorants/dyes which are known to adversely affect flammability characteristics

are considered representative of the colour range if the test results yield the same GWIT.

5 Apparatus

The description of the test apparatus is specified in Clause 5 of IEC 60695-2-10. The reference to a specified layer does not apply.

6 Temperature measuring system verification

The method of verification of the temperature measuring system is specified in 6.2 of IEC 60695-2-10.

7 Conditioning and test conditions

7.1 Conditioning of test specimens

The test specimens shall be conditioned for a minimum of 48 h at $23\text{ °C} \pm 2\text{ °C}$ and at a relative humidity between 40 % and 60 %. Once removed from the conditioning atmosphere, the test specimens shall be tested within 4 h (see ISO 291, Clause 6, Table 2, Class 2).

7.2 Testing conditions

The test specimens shall be tested in a laboratory atmosphere having a temperature ~~of $25\text{ °C} \pm 40\text{ °C}$ between 15 °C and 35 °C and at a relative humidity between 45 % and less than or equal 75 %.~~

8 Test procedure

8.1 General

The test specimens shall be identified and examined visually.

The general test procedure shall be as specified in Clause 8 of IEC 60695-2-10.

8.2 Initial test temperatures

The glow-wire is heated to one of the initial test temperatures specified in Table 1, which is considered to be just high enough to cause ignition. If unknown, the initial test temperature shall not exceed 650 °C .

Table 1 – Initial test temperatures

Initial test temperature °C	Tolerances K
500	±10
550	±10
600	±10
650	±10
700	±10
750	±10
800	±15
850	±15
900	±15
960	±15

8.3 Test temperatures

A set of three test specimens shall be prepared for testing at a chosen test temperature.

If one of the three test specimens fails to withstand the test criteria as defined in 10.1, the test shall be repeated with three new test specimens at a test temperature preferably 50 K (60 K for 960 °C) lower.

If the three test specimens withstand the test criteria as defined in 10.1, the test shall be repeated with three new test specimens at a test temperature preferably 50 K (60 K for 900 °C) higher.

Repeat the tests with three new test specimens each time and reduce the interval of test temperatures to 25 K (30 K for 960 °C) in the final approach to determine the maximum test temperature at which all three test specimen withstand the test criteria as defined in 10.1.

However, there is no need to go to the higher temperature if it has already been determined that at least one of the three test specimen will not withstand the test criteria as defined in 10.1.

NOTE 1 The minimum test temperature is 500 °C and the maximum test temperature is 960 °C.

NOTE 2 It is recommended to start with a temperature of 650 °C.

9 Observations and measurements

9.1 General

The following observations and measurements shall be recorded.

9.2 Initial observations

After identifying and visually inspecting the test specimens, the following items shall be recorded: