IEC 60695-2-10

Edition 3.0 2021-10
REDLINE VERSION

INTERNATIONAL STANDARD

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HORIZONTAL PUBLICATION

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

IEC 60695-2-10:2021-10 RLV(en)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 13.220.40; 29.020

ISBN 978-2-8322-4414-2

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 8
4 Description of the test apparatus 10
4.1 Glow-wire 10
4.2 ~~Test circuit and connections~~ Electrical circuit of the glow-wire apparatus 12
4.3 Temperature measuring system 14
4.4 Specified layer 15
4.5 Test chamber 19
4.6 Timing device 19
5 Verification of the apparatus 20
5.1 Verification of the glow-wire tip 20
5.2 Verification of the temperature measuring system 20
6 Conditioning 20
7 Common test procedure 20
7.1 Test specimen support 20
7.2 Glow-wire temperature 21
7.3 Application of the glow-wire 21
8 General test observations and evaluations of test results 21
~~Annex A (informative) Equipment manufacturers and suppliers ....~~
Annex ~~B~~ A (~~informative~~ normative) ~~Guidance on~~ Requirements for "ignition" and "flaming" observations 23
A.1 General 23
A.2 Examples of ignition and non-ignition 23
Annex ~~C~~ B (informative) Guidance on the verification procedure of the glow-wire temperature measuring system by the heating current 25
B.1 Objective 25
B.2 Preparation 25
B.3 Verification procedure 25
B.3.1 Observation and measurement 25
B.3.2 Correlation chart 25
B.3.3 Frequency of revising the correlation chart 26
Annex C (informative) Supplement – Times and durations, and examples of evaluations 27
C.1 Times and durations (in accordance with Clause 3) 27
C.2 Examples of evaluations 27
Bibliography 29

Figure 1 – Glow-wire and position of thermocouple 12
Figure 2 – ~~Test circuit~~ Electrical circuit of the glow-wire apparatus 14
Figure 3 – Test apparatus examples 19
Figure A.1 – Example of a brightly shining flame 23
Figure A.2 – Example of a blue corona at the glow-wire tip 24

Figure A.3 – Example of ionized gases in the form of a ~~blue corona~~ tail near the glow wire tip 24
Figure B.1 – Correlation curve between the heating current and the glow-wire temperature (example) 26
Figure C.1 – Times and durations (in accordance with Clause 3) 27
Figure C.2 – Evaluation scheme with examples 28

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FIRE HAZARD TESTING –

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

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.
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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 60603-7:2013. 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 60695-2-10 has been prepared by IEC technical committee 89: Fire hazard testing. It is an International Standard.

This third edition cancels and replaces the second edition published in 2013. This edition constitutes a technical revision.

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

a) New terms and definitions with regards to times and durations have been added to Clause 3.
b) Previous Annex A of Equipment manufacturers and suppliers has been deleted.
c) Annex A (previous Annex B) for ignition and flaming observations has been changed from informative to normative.
d) New Annex C has been added, which visualizes times and durations, and gives examples for the behaviour of specimens, and how to evaluate them.

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

FDIS	Report on voting
89/1535/FDIS	89/1547/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/standardsdev/publications.

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

This standard is to be used in conjunction with IEC 60695-2-11, IEC 60695-2-12, and IEC 60695-2-13.

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 publication 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.

The contents of the corrigendum 1 (2024-01) have been included in this copy.

INTRODUCTION

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, reasonably foreseeable abnormal use, malfunction, and/or failure. IEC 60695-1-10 [1][1] was developed, together with its companion, IEC 60695-1-11 [2], 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 these documents include the minimization of any flame spread beyond the product's enclosure and the minimization of 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 assessment.

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

This part of IEC 60695 gives recommendations with regard to the glow-wire test apparatus and describes a common test procedure for tests applicable to end products and materials to be used with IEC 60695-2-11 which describes a glow-wire flammability test for end products (GWEPT), IEC 60695-2-12 which describes a glow-wire flammability index test for materials (GWFI), and IEC 60695-2-13 which describes a glow-wire ignition temperature test method for materials (GWIT).

[1] Numbers in square brackets refer to the Bibliography.

FIRE HAZARD TESTING –

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

1 Scope

This part of IEC 60695 specifies the glow-wire apparatus and common test procedure to simulate the effects of thermal stresses which may be produced by heat sources such as glowing elements or overloaded resistors, for short periods, in order to assess the fire hazard by a simulation technique.

The test procedure described in this document is a common test procedure intended for the small-scale tests in which a standardized electrically heated wire is used as a source of ignition.

It is a common part of the test procedures applied to end products and to solid electrical insulating materials or other solid combustible materials.

A detailed description of each particular test procedure is given in IEC 60695-2-11, IEC 60695-2-12 and IEC 60695-2-13.

This basic safety publication focusing on safety test method(s) is primarily intended for use by technical committees in the preparation of ~~standards~~ safety publications 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 60584-1, *Thermocouples – Part 1: Reference tables*~~

~~IEC 60584-2, *Thermocouples – Part 2: Tolerances*~~

IEC 60584-1, *Thermocouples – Part 1: EMF specifications and tolerances*

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

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 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

~~IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*~~

~~ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*~~

ISO 4046-4:~~2002~~2016, *Paper, board, pulps and related terms – Vocabulary – Part 4: Paper and board grades and converted products*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943:~~2008~~2017, some of which are reproduced below for the user's convenience, and 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
combustible, adjective
capable of being ignited and burned

[SOURCE: ~~ISO 13943:2008, definition 4.43~~ ISO 13943:2017, 3.52]

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

[SOURCE: ~~ISO 13943:2008, definition 4.70~~ ISO 13943:2017, 3.83]

3.3
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 13943:2008, definition 4.112~~ ISO 13943:2017, 3.131]

3.4
fire test
test that measures fire behaviour ~~of a fire~~ or exposes an item to the effects of a fire

Note 1 to entry: The results of a fire test can be used to quantify fire severity or determine the fire resistance or reaction to fire of the test specimen.

[SOURCE: ~~ISO 13943:2008, definition 4.132~~ ISO 13943:2017, 3.157]

3.5
flame, noun
rapid, self-sustaining, sub-sonic propagation of combustion in a gaseous medium, usually with emission of light

[SOURCE: ~~ISO 13943:2008, definition 4.133~~ ISO 13943:2017, 3.159]

3.6
flame event
sustained flaming and/or glowing combustion

3.7
flammability
ability of a material or product to burn with a flame under specified conditions

[SOURCE: ~~ISO 13943:2008, definition 4.151~~ ISO 13943:2017, 3.178]

3.8
ignition
DEPRECATED: sustained ignition
<general> initiation of combustion

[SOURCE: ~~ISO 13943:2008, definition 4.187~~ ISO 13943:2017, 3.217]

3.9
test temperature
temperature to which the tip of the glow-wire is heated and stabilized prior to any contact with the test specimen

3.10
time of application
t_{APP}
application time of the glow-wire

Note 1 to entry: Time of application constitutes the first 30 s of the test.

Note 2 to entry: t_{APP} was originally designated as t_A in Editions 1 and 2 of IEC 60695-2.

Note 3 to entry: See Annex C.

3.11
time of observation
t_{OBS}
observation time of the specimen and/or specified layer, starting immediately after t_{APP}

Note 1 to entry: Time of observation constitutes the second 30 s of the test.

Note 2 to entry: See Annex C.

3.12
time of ignition
t_I
time (to the nearest 0,5 s), from the start of test, at which the longest persisting flame event starts

Note 1 to entry: This is a measured value.

Note 2 to entry: See Annex C.

3.13
time of extinguishing
t_E
time (to the nearest 0,5 s), from the start of the test, at which the longest persisting flame event ends

Note 1 to entry: This is a measured value.

Note 2 to entry: See Annex C.

3.14
total flame event time
t_T
duration of the longest persisting flame event

$t_T = t_E - t_I$

Note 1 to entry: This is a calculated value.

Note 2 to entry: See Annex C.

3.15
flame time after removal
t_R
time elapsed after the removal of the glow-wire tip from the test specimen to the end of the longest persisting flame event

$t_R = t_E - 30$ s

Note 1 to entry: If t_E is less than 30 s then t_R is zero.

Note 2 to entry: This is a calculated value.

Note 3 to entry: See Annex C.

3.16
flame time during application
t_B
duration of the longest persisting flame event whilst the glow-wire tip is in contact with the test specimen

$t_B = t_T - t_R$

Note 1 to entry: This is a calculated value.

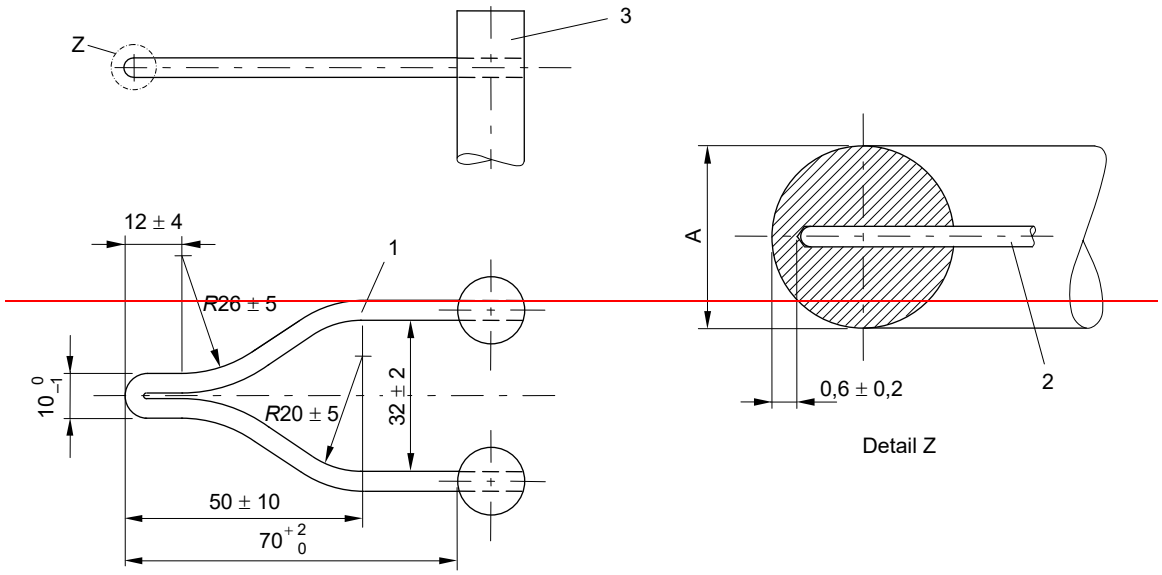
Note 2 to entry: See Annex C.

4 Description of the test apparatus

4.1 Glow-wire

The glow-wire is formed from nickel/chromium (> 77 % Ni/20 ± 1 % Cr) wire, having an overall diameter of 4,00 mm ± 0,07 mm (before bending). The dimensions of the glow-wire loop are as detailed in Figure 1. When forming the glow-wire, ensure that fine cracking at the tip is avoided.

NOTE Annealing is a suitable process for prevention of fine cracking at the tip.



IEC 632/13

~~*Dimensions in millimetres*~~

~~Glow-wire material: Nickel/Chromium (>77 %Ni/20 ± 1 %Cr)~~

~~Diameter: 4,0 mm ± 0,07 mm (before bending)~~

~~Dimension A: (after bending) see 5.1~~

~~When forming the glow-wire, care shall be taken to avoid fine cracking at the tip.~~

~~NOTE Annealing is a suitable process for prevention of fine cracking at the tip.~~

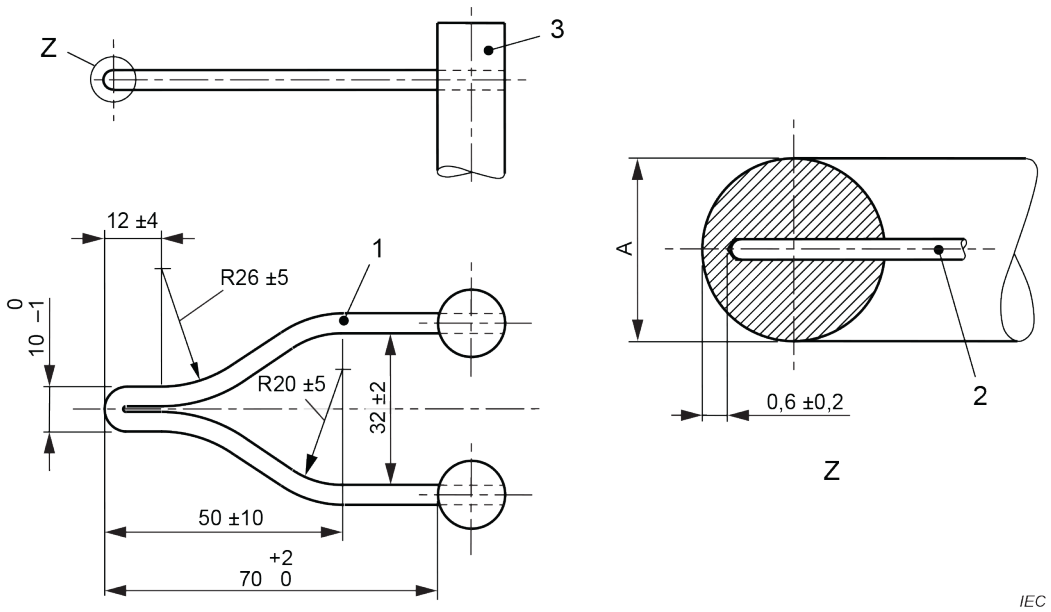
~~**Key**~~

~~1 Glow-wire~~

~~2 Thermocouple~~

~~3 Stud~~

Dimensions in millimetres



Key

1 Glow-wire

2 Thermocouple

3 Stud

Dimension A (after bending): see 5.1.

Figure 1 – Glow-wire and position of thermocouple

A new glow-wire shall be annealed for a total of at least 10 h by being subjected to a current of at least 120 A before being used for a test run. The total annealing time may be achieved cumulatively. To avoid damage, the thermocouple shall not be installed during annealing. At the end of annealing, the depth of the thermocouple pocket hole shall be verified.

NOTE 1 The temperature of a new glow-wire which has not been annealed gradually lowers during the first few hours when subjected to a flow of current. After a period of time the temperature then reaches equilibrium.

The test apparatus shall be designed so that the glow-wire is kept in a horizontal plane and applies a force of 0,95 N ± 0,10 N to the test specimen during the application of the glow-wire. The force shall be maintained at this value when the glow-wire or the test specimen is moved horizontally one towards the other. The penetration of the tip of the glow-wire into and through the test specimen shall be limited to 7 mm ± 0,5 mm.

The test apparatus shall be designed in such a way that burning or glowing particles falling from the test specimen are able to fall without obstruction onto the layer as specified in 4.4.

Two typical examples of the test apparatus are shown in Figure 3a) and Figure 3b).

NOTE 2 The apparatus shown in Figure 3b) has been found useful when testing heavy and/or awkwardly shaped test specimens.

4.2 ~~Test circuit and connections~~ Electrical circuit of the glow-wire apparatus

~~The glow-wire is heated by a simple electric circuit as shown in Figure 2. There shall be no feedback mechanism or circuit to maintain the temperature. The power supply for the glow-wire test apparatus shall be a stabilized voltage source (± 2 % rms). The test circuit shall contain a current measuring device which indicates a true rms value with a maximum error of 1,0 %.~~