IEC TS 60695-2-20

Edition 4.0 2024-11

TECHNICAL SPECIFICATION

colour inside

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 13.220.40; 29.020

ISBN 978-2-8322-9976-0

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
4 Principle 9
5 Apparatus 10
5.1 Test chamber 10
5.2 Heater wire 10
5.3 Power supply and test circuit 11
5.4 Test specimen fixture 11
5.5 Test specimen winding and pressing 11
5.6 Conditioning chamber 13
5.7 Timing device 13
5.8 Micrometer 13
5.9 Measuring scale 13
6 Test specimens 13
6.1 Test specimen preparation 13
6.2 Test specimen dimensions 13
7 Conditioning 14
7.1 Requirements 14
7.2 Test specimen conditioning 14
7.3 Heater wire conditioning 15
7.4 Test conditions 15
8 Test procedure 15
8.1 Verification of the heater wire 15
8.1.1 General 15
8.1.2 Test circuit for the verification 15
8.1.3 Determination of the test current, I_C 15
8.1.4 Calculation of test current, I_C 16
8.2 Determination of time to ignite, IT 17
9 Observations and measurement 19
10 Evaluation of test results – Assigning an HWI PLC classification 19
11 Test report 19
Annex A (informative) Guidance on how to effectively wind the heater wire on to the test specimen 20
Annex B (normative) Hot Wire Ignition test (HWI) – Performance level category (PLC) classes 21
B.1 General 21
B.2 Reporting a classification 21
Annex C (informative) Calibration curve to determine test current (I_C) in a spreadsheet program 22
Bibliography 23

Figure 1 – Test fixture arrangement (example) 9

Figure 2 – Test specimen winding pattern 10
Figure 3 – Test specimen fixture (example) 11
Figure 4 – Heater wire winding device (Example) 12
Figure 5 – Test circuit for the heater wire verification 15
Figure 6 – Heater wire marking and connection 16
Figure 7 – Calibration curve 17
Figure 8 – Decision tree 18
Figure A.1 – Illustration of type a) behaviour 20
Figure A.2 – Illustration of type b) behaviour 20
Figure C.1 – Calibration curve in a spreadsheet program used to determine I_C 22

Table 1 – Nominal thickness tolerances 14
Table 2 – Heater wire verification lengths 16
Table B.1 – Hot Wire Ignition test (HWI) – Performance level category (PLC) classes 21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FIRE HAZARD TESTING –

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

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

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:

c) 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

d) visible indentation of the test specimen by the heater wire.

A 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 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.

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**.

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.

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 13943:2017, *Fire safety – Vocabulary*

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