

INTERNATIONAL STANDARD

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BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Fire hazard testing – **STANDARD PREVIEW**
Part 11-10: Test flames – 50 W horizontal and vertical flame test methods
(standards.iteh.ai)

Essais relatifs aux risques du feu –
Partie 11-10: Flamme d'essai – Méthodes d'essai horizontal et vertical à la
flamme de 50 W





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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIRE HAZARD TESTING –

**Part 11-10: Test flames –
50 W horizontal and vertical flame test methods**

FOREWORD

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International Standard IEC 60695-11-10 has been prepared by IEC technical committee 89: Fire hazard testing.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|--------------|------------------|
| 89/1161/FDIS | 89/1165/RVD |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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

This second edition cancels and replaces the consolidated version of IEC 60695-11-10 published in 2003 and constitutes a technical revision.

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

- Editorial changes have been made throughout the document for the purpose of aligning IEC 60695-11-10 with IEC 60695-11-20.
- Details on test specimen dimensions have been added to Clause 7.
- New Subclause 9.1.4 Conditioning of the cotton pad has been added.
- New Subclause 9.2.4 Evaluation of “burned to the holding clamp” has been added.
- The Bibliography has been updated and references added.

It has the status of a basic safety publication in accordance with IEC Guide 104 and ISO/IEC Guide 51.

This International Standard is to be used in conjunction with IEC 60695-11-4.

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

Part 11 consists of the following parts:

- Part 11-2: *Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*
- Part 11-3: *Test flames – 500 W flames – Apparatus and confirmational test methods*
- Part 11-4: *Test flames – 50 W flame – Apparatus and confirmational test method*
- Part 11-5: *Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*
- Part 11-10: *Test flames – 50 W horizontal and vertical flame test methods*
- Part 11-11: *Test flames – Determination of the characteristic heat flux for ignition from a non-contacting flame source*
- Part 11-20: *Test flames – 500 W flame test methods*
- Part 11-30: *Test flames – History and development from 1979 to 1999*
- Part 11-40: *Test flames – Confirmatory tests – Guidance*

The committee has decided that the contents of this publication 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 September 2014 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 document using a colour printer.

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, reasonable foreseeable abnormal use, malfunction, and/or failure. IEC Technical Committee 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 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 hazard assessment.

This part of IEC 60695 describes the test procedures for small scale tests to be carried out on materials used in electrotechnical equipment. A 50-W test flame is used as an ignition source. The test methods described provide classifications which may be used for quality assurance, the pre-selection of component materials of products, or to verify the required minimum flammability classification of materials used in end products.

[https://standards.iteh.ai/catalog/standards/sist/1954c7d5-e030-43df-9330-](https://standards.iteh.ai/catalog/standards/sist/1954c7d5-e030-43df-9330-265a3738131e/iec-60695-11-10-2013)

These test methods should not be used solely to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of these test methods may be used as elements of a fire hazard assessment which takes into account all of the factors which are pertinent to 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 international standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

FIRE HAZARD TESTING –

Part 11-10: Test flames – 50 W horizontal and vertical flame test methods

1 Scope

This part of IEC 60695 specifies small-scale laboratory test procedures intended to compare the burning behaviour of different materials used in electrotechnical products when vertically or horizontally oriented test bar specimens are exposed to a small flame ignition source with a nominal thermal power of 50 W. These test methods determine either the linear burning rate or the self-extinguishing properties of materials.

These test methods are applicable to solid and cellular materials that have an apparent density of more than 250 kg/m³, determined in accordance with ISO 845.

Two test methods are described. Method A is a horizontal burning test and is intended to determine the linear burning rate of materials under specific test conditions. Method B is a vertical burning test and is intended to determine whether materials self-extinguish under specific test conditions.

NOTE 1 ISO 9772 [8]¹ describes a test method for the determination of the burning characteristics to be used for materials with an apparent density of 250 kg/m³ or less. ISO 9773 describes a test method for the determination of the burning behaviour to be used for materials that due to their thinness, either distort and/or are burned up to the holding clamp using Method B of this standard.

The test methods described provide classifications (see 8.4 and 9.4), which may be used for quality assurance, the pre-selection of component materials of products, or to verify the required minimum flammability classification of materials used in end products.

NOTE 2 Guidance on pre-selection is given in IEC 60695-1-30.

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, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

¹ Figures in square brackets refer to the bibliography.

IEC 60695-11-4, *Fire hazard testing – Part 11-4: Test flames – 50 W flames – Apparatus and confirmational test method*

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

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

ISO/IEC 13943:2008, *Fire Safety – Vocabulary*

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

ISO 293, *Plastics – Compression moulding of 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 307, *Plastics – Polyamides – Determination of viscosity number*

ISO 9773, *Plastics – Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source*

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

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3 Terms and definitions

[IEC 60695-11-10:2013](#)

For the purposes of this document, the terms and definitions given in ISO/IEC 13943:2008 and IEC 60695-4, some of which are reproduced below for the user's convenience, as well as the following apply.

3.1

afterflame

flame that persists after the ignition source has been removed

[SOURCE: ISO/IEC 13943:2008, definition 4.6]

3.2

afterflame time

length of time for which an afterflame persists under specified test conditions

Note 1 to entry: Designated in Method B of this standard by the parameters t_1 and t_2 .

[SOURCE: ISO/IEC 13943:2008, definition 4.7]

3.3

afterglow

persistence of glowing combustion after both removal of the ignition source and the cessation of any flaming combustion

[SOURCE: ISO/IEC 13943:2008, definition 4.8]

3.4

afterglow time

length of time which an afterglow persists under specified test conditions

Note 1 to entry: Designated in Method B of this standard by the parameter t_3 .

[SOURCE: ISO/IEC 13943:2008, definition 4.9]

3.5

“as received”

state of test specimens after a specified period of preconditioning at laboratory ambient conditions

3.6

burn, intransitive verb

undergo combustion

[SOURCE: ISO/IEC 13943:2008, definition 4.28]

3.7

burning behaviour

⟨fire tests⟩ response of a test specimen, when it burns under specified conditions, to examination of reaction to fire or fire resistance

[SOURCE: ISO/IEC 13943:2008, definition 4.32]

3.8

combustion

exothermic reaction of a substance with an oxidizing agent

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

[SOURCE: ISO/IEC 13943:2008, definition 4.46]1-10:2013

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3.9

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

[SOURCE: ISO/IEC 13943:2008, definition 4.70]

3.10

enclosure

⟨electrotechnical⟩ external casing protecting the electrical and mechanical parts of apparatus

Note 1 to entry: The term excludes cables.

[SOURCE: ISO/IEC 13943:2008, definition 4.78]

3.11

fire hazard

physical object or condition with a potential for an undesirable consequence from fire

[SOURCE: ISO/IEC 13943:2008, definition 4.112]

3.12

fire hazard assessment

evaluation of the possible causes of fire, the possibility and nature of subsequent fire growth, and the possible consequences of fire

[SOURCE: IEC 60695-4, definition 3.2.10]²

3.13

fire retardant

substance added, or a treatment applied, to a material in order to delay ignition or to reduce the rate of combustion

Note 1 to entry: The use of a fire retardant does not necessarily suppress fire or terminate combustion.

[SOURCE: ISO/IEC 13943:2008, definition 4.123]

3.14

fire risk

probability of a fire combined with a quantified measure of its consequence

Note 1 to entry: It is often calculated as the product of probability and consequence.

[SOURCE: ISO/IEC 13943:2008, definition 4.124]

3.15

fire test

test that measures 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/IEC 13943:2008, definition 4.132]

3.16

flame, verb

produce flame

[IEC 60695-11-10:2013](https://standards.iteh.ai/catalog/standards/sist/1954c7d5-e030-43df-9330-26a5a2738c2c/iec-60695-11-10-2013)

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[SOURCE: ISO/IEC 13943:2008, definition 4.134]

3.17

flame, noun

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

[SOURCE: ISO/IEC 13943:2008, definition 4.133]

3.18

flame front

boundary of flaming combustion at the surface of a material or propagating through a gaseous mixture

[SOURCE: ISO/IEC 13943:2008, definition 4.136]

3.19

flame spread

propagation of a flame front

[SOURCE: ISO/IEC 13943:2008, definition 4.142]

² Proposed.

3.20**flammability**

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

[SOURCE: ISO/IEC 13943:2008, definition 4.151]

3.21**ignition**

DEPRECATED: sustained ignition
(general) initiation of combustion

[SOURCE: ISO/IEC 13943:2008, definition 4.187]

3.22**ignition**

DEPRECATED: sustained ignition
(flaming combustion) initiation of sustained flame

[SOURCE: ISO/IEC 13943:2008, definition 4.188]

3.23**linear burning rate**

DEPRECATED: burning rate
DEPRECATED: rate of burning
length of material burned per unit time under specified conditions

Note 1 to entry: The typical units are metres per second ($\text{m} \times \text{s}^{-1}$).

Note 2 to entry: In this standard, units of millimetres per minute ($\text{mm} \times \text{min}^{-1}$) are used.

[SOURCE: ISO/IEC 13943:2008, definition 4.214]

3.24**molten drip, noun**

falling droplet of material that has been softened or liquefied by heat

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

[SOURCE: ISO/IEC 13943:2008, definition 4.232]

3.25**self-extinguish, verb**

DEPRECATED: self-extinguishing
cease combustion without being affected by an external agent

[SOURCE: ISO/IEC 13943:2008, definition 4.284]

4 Principle

A rectangular bar-shaped test specimen is supported horizontally or vertically by one end and the free end is exposed to a specified test flame. The burning behaviour of the horizontally supported bar under specific test conditions is assessed by measuring the linear burning rate. The burning behaviour of the vertically supported bar under specific test conditions is assessed by measuring the afterflame and afterglow times (observing whether the materials self-extinguish), the extent of burning and the dripping of flaming particles.

5 Significance of the fire tests

5.1 Vertical and horizontal testing

Fire tests made on a material under the conditions specified can be of considerable value when comparing the relative burning behaviour of different materials, controlling manufacturing processes or assessing any change in burning characteristics. The results obtained from these fire test methods are dependent on the shape and orientation of the test specimen, on the environment surrounding the test specimen, and on the conditions of ignition.

The significant feature of these fire test methods is the arrangement of the test specimens in either a horizontal or a vertical position. These testing arrangements make it possible to distinguish between different classes of material flammability.

NOTE 1 The results obtained by the horizontal burning (HB) and vertical burning (V) methods are not equivalent.

NOTE 2 The results obtained by these methods (HB and V) are not equivalent to the 5VA and 5VB burning tests specified in IEC 60695-11-20 [5] because the thermal power of the test flame in this method is 50 W whereas the test flame in IEC 60695-11-20 [5] is 500 W.

5.2 Limitations on the use of test results

Results obtained in accordance with this standard shall not be used solely to describe or appraise the fire hazard presented by a particular material under actual fire conditions. Assessment of fire hazard also requires consideration of other such factors as fuel contribution, intensity of burning (rate of heat release), products of combustion and environmental factors, including the nature of the ignition source, the orientation of exposed material and ventilation conditions.

5.3 Physical properties that can affect burning behaviour

Burning behaviour, as measured by these test methods, is affected by such factors as density, any anisotropy of the material and the thickness of the test specimen.

5.4 Shrinkage and distortion

Certain test specimens may shrink from or be distorted by the applied flame without igniting. In this event, additional test specimens at the same thickness will be required to obtain valid results. If valid results at that thickness cannot be obtained, these materials at that specific tested thickness are not suitable for evaluation by these test methods.

NOTE To be able to determine a flammability classification for thin flexible test specimens, and in cases where more than one test specimen shrinks from the applied flame without igniting, ISO 9773 provides a suitable test method.

5.5 Effects of test specimen conditioning

The burning behaviour of some plastic materials may change with time. It is accordingly advisable to make tests before and after conditioning using an appropriate procedure. The preferred oven conditioning is $168 \text{ h} \pm 2 \text{ h}$ at $70 \text{ °C} \pm 2 \text{ °C}$. However, other conditioning times and temperatures may be used by agreement between the interested parties, and, if used, shall be noted in the test report.

6 Apparatus

6.1 Laboratory fume hood/chamber

The laboratory fume hood/chamber shall have an inside volume of at least $0,5 \text{ m}^3$. The chamber shall permit observation of tests in progress and shall provide a draught-free environment, whilst allowing normal thermal circulation of air past the test specimen during

burning. The inside surfaces of the chamber shall be of a dark colour. When a light meter, facing towards the rear of the chamber, is positioned in place of the test specimen, the recorded light level shall be less than 20 lx. For safety and convenience, it is desirable that this enclosure (which can be completely closed) is fitted with an extraction device, such as an exhaust fan, to remove products of combustion which may be toxic. The extraction device, if fitted, shall be turned off during the test and turned on immediately after the test to remove the fire effluents. A positive closing damper may be needed.

NOTE Placing a mirror in the chamber to provide a rear view of the test specimen has been found to be useful.

6.2 Laboratory burner

The laboratory burner shall conform to IEC 60695-11-4.

6.3 Support stand

The support stand shall have clamps or the equivalent, adjustable for the positioning of the test specimen (see Figures 1 and 3).

6.4 Timing device

The timing device shall have a resolution of 0,5 s or less.

NOTE Some laboratories have found it useful to utilize a sound activated timer as a means of counting the flame application time.

6.5 Measuring scale

The measuring scale shall be graduated in millimetres.

6.6 Wire gauze

The wire gauze shall be 20 mesh (approximately 20 openings per 25 mm), made from steel wire 0,40 mm to 0,45 mm in diameter and cut into approximately 125 mm squares.

6.7 Conditioning chamber

The conditioning chamber shall be maintained at $23\text{ °C} \pm 2\text{ °C}$ and a relative humidity of $50\% \pm 10\%$.

NOTE Standard atmospheres for the conditioning and testing of plastic materials are described in ISO 291:2008.

6.8 Micrometer

The micrometer shall have a resolution of

- a) 0,01 mm or less for test specimens with a thickness of 0,25 mm or greater, and
- b) 0,001 mm or less for test specimens with a thickness less than 0,250 mm.

6.9 HB support fixture

The HB support fixture shall be used for testing specimens that are not self-supporting (see Figure 2).

6.10 Desiccator

The desiccator shall contain anhydrous calcium chloride or other drying agent, which can be maintained at $23\text{ °C} \pm 2\text{ °C}$ and a relative humidity not exceeding 20 %.