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SPÉCIFICATION TECHNIQUE

BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Fire hazard testing – Part 11-11:Test flames – Determination of the characteristic heat flux for ignition from a non-contacting flame source

Essais relatifs aux risques du feu – Partie 11-11: Flammes d'essai – Détermination du flux de chaleur caractéristique pour l'allumage à partir d'une flamme source sans contact

IEC/TS 60695-11-11:2008

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FIRE HAZARD TESTING –

Part 11-11:Test flames – Determination of the characteristic heat flux for ignition from a non-contacting flame source

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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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard but there may be in the future.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 60695-11-11, which is a technical specification, has been prepared by IEC 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.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
89/866/DTS	89/883/RVC

Full information on the voting for the approval of this technical specification 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 technical specification 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 11-21: Test flames – 500 W vertical flame test method for tubular polymeric materials

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 maintenance result 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

- transformed into an International standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition; or
- amended.

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 equipment design as well as the choice of materials is to reduce to acceptable levels the potential risks of fire even in the event of foreseeable abnormal use, malfunction or failure. IEC 60695-1-10[1], together with its companion IEC 60695-1-11[1], provide guidance on how this is to be accomplished.

The primary aims are:

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

Secondary aims include the minimization of any flame spread beyond the product's enclosure and the minimization of harmful effects of fire effluents including heat, smoke, and toxic or corrosive combustion products.

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

This technical specification should be used to measure and describe the properties of materials used for electrotechnical products and sub-assemblies in response to heat from a non-contacting flame source under controlled laboratory conditions and should not be used to 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 assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use. A test specimen cut from end-product or sub-assembly can be tested by this test method.

This technical specification 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 to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Test methods to determine flammability by contact of flame have been developed and standardized already, such as IEC 60695-11-10 [1][2] and IEC 60695-11-20 [2] and ISO 4589-2 [3].

This is the first test method to determine the characteristic heat flux for ignition (CHFI) of materials used for electrotechnical products and sub-assemblies from a non-contacting flame source. CHFI characterizes ignition behaviour in terms of incident heat flux. This test method simulates the fire behaviour of materials used for electrotechnical products where a flame source exists close to, but does not contact with these items. An example is a candle flame near an electrotechnical product.

1 To be published.

2 Figures in square brackets refer to the bibliography.

FIRE HAZARD TESTING –

Part 11-11:Test flames –
Determination of the characteristic heat flux for ignition from a non-contacting flame source

1 Scope

This technical specification describes a test method used to determine the characteristic heat flux for ignition (CHFI) from a non-contacting flame source for materials used in electrotechnical products and sub-assemblies. It provides a relationship between ignition time and incident heat flux. A test specimen cut from an end-product or sub-assembly can be tested by this test method.

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 60695-1-10[3], *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines* (under development)

IEC 60695-1-11[3], *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment* (under development)

IEC 60695-11-4:2004, *Fire hazard testing – Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method*

IEC Guide 104:1997, *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 291:2008, *Plastics – Standard atmospheres for conditioning and testing*

ISO 293:2004, *Plastics – Compression moulding of test specimens of thermoplastic materials*

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

[3] To be published.

ISO 295:2004, *Plastics – Compression moulding of test specimens of thermosetting materials*

ISO/IEC 13943:2000, *Fire safety – Vocabulary*

ISO/TS 14934-4:2007, *Fire tests – Calibration of heat flux meters – Part 4: Guidance on the use of heat flux meters in fire tests*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
average ignition time, $\bar{t}_{ig}$
arithmetic mean of three ignition times measured at a given heat flux

3.2
characteristic heat flux for ignition (CHFI)
maximum incident heat flux which is a multiple of 5 kW × m^{-2} and at which $\bar{t}_{ig}$ is greater than 120 s

3.3
draught-free environment
environment in which the results of experiments are not significantly affected by local air speed

NOTE For example, for small scale tests a maximum air speed of 0,2 m/s is sometimes specified.

[ISO/IEC 13943:2000, definition 31]

3.4
heat flux
amount of thermal energy emitted, transmitted or received per unit area and per unit time

NOTE It is expressed in watts per square metre.

[ISO/IEC 13943:2000, definition 85]

3.5
ignition
initiation of combustion which results in a sustained and continuous flaming combustion for at least 5 s

NOTE The term “ignition” in French has a very different meaning [state of body combustion].

3.6
incident heat flux
heat flux received by the surface of a test specimen

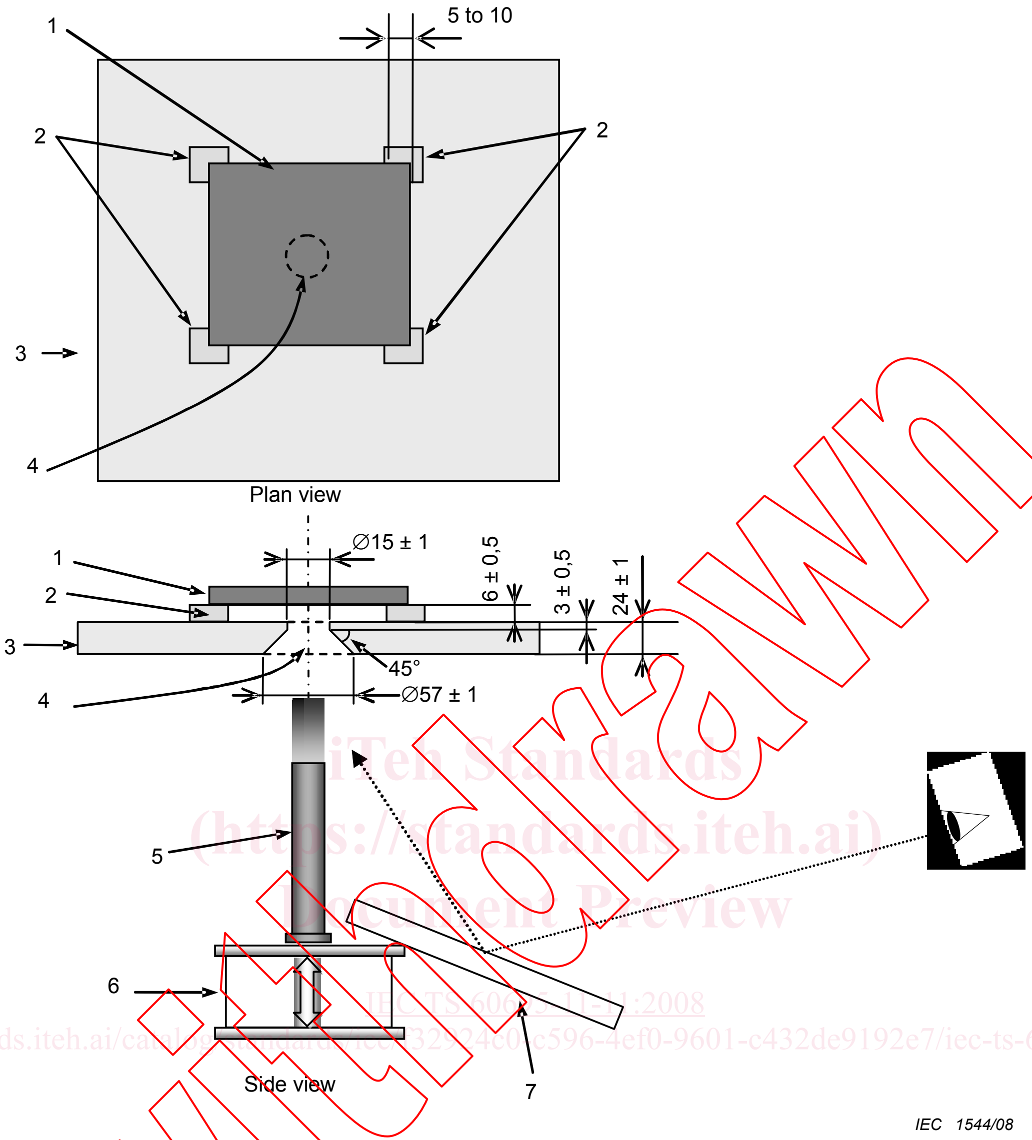
4 Principle of the test

The incident heat flux is measured using the apparatus described in 5.3 and 5.4. At a specific incident heat flux, the time to ignite the test specimen depends on properties of the tested material. The incident heat flux value is controlled by changing the distance between the top of the burner tube and the lower surface of the test specimen and by changing the flow rate of gas to the burner (see Annex A). The time required to ignite the test specimen is measured as a function of the incident heat flux. The tests are performed at different incident heat flux values until the maximum heat flux, at which $\bar{t}_{ig}$ is greater than 120 s, is determined. This incident heat flux is defined as the characteristic heat flux for ignition (CHFI). The incident heat flux values at which the tests are carried out are chosen within the range of 30 kW × m^{-2} to 75 kW × m^{-2} and shall be multiples of 5 kW × m^{-2}.

5 Apparatus

5.1 Test arrangement

The arrangement and position of the test specimen and burner are shown in Figure 1. The test specimen and masking board shall be mounted horizontally. The burner tube shall be mounted vertically. The centre line of the test specimen, the burner tube, the sensor of the heat flux meter and the conical hole in the masking board shall all be aligned vertically. The sensor of the heat flux meter shall be placed horizontally 6 mm above the upper surface of the masking board with its sensing surface facing down.



Key

1 test specimen

2 test specimen support

3 masking board

4 conical hole (diameter at the top side 15 mm)

5 burner tube and test flame (inner diameter 9,5 mm)

6 burner support (adjustable vertically)

7 mirror

Dimensions in milimetres

Figure 1 – Arrangement and position of test specimen and burner

5.2 Burner and test flame

The laboratory burner apparatus shall conform to IEC 60695-11-4. The flame size and the gas flow rate will differ from that specified in IEC 60695-11-4 in order to obtain the heat flux value necessary for the test. The flame used for each test shall be maintained throughout the test.

NOTE ISO 10093 [4] describes the burner as ignition source P/PF2 (50 W).

5.3 Heat flux meter

The heat flux meter shall be of a water-cooled thermopile type (see ISO/TS 14934-4) which determines the incident heat flux applied to the test specimen. The heat flux meter is placed in the centre of a dummy test specimen board.

When incident heat flux measurements are made, the heat flux meter shall not have any optical filter in-line with the sensor.

NOTE 1 The incident heat flux measurement is of critical importance to the test results. ISO 14934-3 [5] provides the calibration method for heat flux meter.

NOTE 2 A thermopile of the Schmidt-Boelter type, with a designed range up to 100 kW × m^{-2} and a target diameter of approximately 12,5 mm, has been found to be suitable.

5.4 Data acquisition system

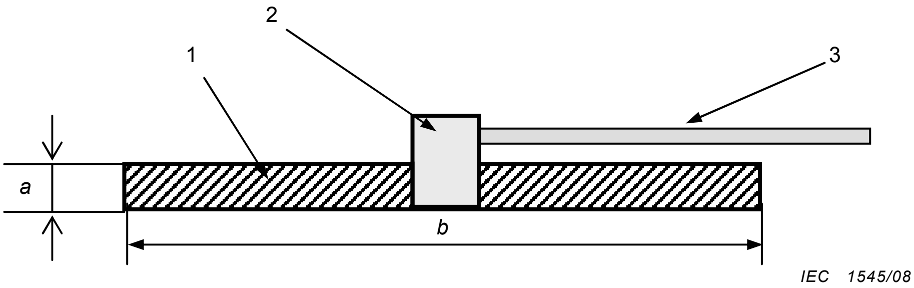
The voltmeter for measuring the output of the heat flux meter shall have a resolution of 0,01 % or better for the maximum output range.

NOTE It may consist of any commercial digital measuring unit designed for the purpose.

5.5 Dummy test specimen board

The dummy test specimen board shall be approximately 100 mm × 100 mm with a centrally located hole whose diameter is slightly larger than the outside diameter of the heat flux meter. The board shall be made from a heat-resistant non-combustible rigid board. The dummy specimen board is used, together with the heat flux meter (see Figure 2), for the determination of incident heat flux (see 8.1).

NOTE A calcium silicate board of approximately 12 mm thickness has been found suitable for the dummy test specimen board.



Key

1 dummy test specimen board

2 heat flux meter

3 cooling water pipe

a approximately 12 mm

b approximately 100 mm

Figure 2 – Dummy test specimen board

5.6 Masking board

The masking board shall be made of three heat-resistant non-combustible rigid boards, each having a density of 850 kg × m^{-3} ± 50 kg × m^{-3} and a thickness of 8 mm ± 0,5 mm and the total thickness of the three non-combustible board shall be 24 mm ± 1,5 mm. One board is inserted between the upper and lower boards and is made moveable. This moveable board is the radiant heat shield which protects the test specimen from the heat source before the test is started. At the centre of the masking board there shall be a conically shaped opening. The diameter of the opening on the upper surface shall be 15 mm ± 1 mm and 57 mm ± 1 mm on the lower surface. An illustration of the masking board and its operation is shown in Figure 3.

NOTE A calcium silicate board of the required density has a thermal conductivity of 0,14 W × m^{-1} × K^{-1} at 200 °C, 0,15 W × m^{-1} × K^{-1} at 400 °C, and 0,17 W × m^{-1} × K^{-1} at 600 °C.