BS EN 60695-11-10:2013

BSI Standards Publication

Fire hazard testing

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

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 60695-11-10:2013. It is identical to IEC 60695-11-10:2013. It supersedes BS EN 60695-11-10:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/89, Fire hazard testing.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2013

ISBN 978 0 580 68473 9
ICS 13.220.40; 29.020

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2013.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60695-11-10

August 2013

ICS 13.220.40; 29.020

Supersedes EN 60695-11-10:1999 + A1:2003

English version

Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods

(IEC 60695-11-10:2013)

Essais relatifs aux risques du feu - Partie 11-10: Flammes d'essai - Méthodes d'essai horizontal et vertical à la flamme de 50 W (CEI 60695-11-10:2013)

Prüfungen zur Beurteilung der Brandgefahr - Teil 11-10: Prüfflammen - Prüfverfahren mit einer 50-W-Prüfflamme horizontal und vertikal (IEC 60695-11-10:2013)

This European Standard was approved by CENELEC on 2013-06-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 89/1161/FDIS, future edition 2 of IEC 60695-11-10, prepared by IEC/TC 89 "Fire hazard testing" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60695-11-10:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-03-25
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-06-25

This document supersedes EN 60695-11-10:1999 + A1:2003.

EN 60695-11-10:2013 includes the following significant technical changes with respect to EN 60695-11-10:1999 + A1:2003:

- editorial changes have been made throughout the document for the purpose of aligning EN 60695-11-10 with EN 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.

This standard shall be used in conjunction with EN 60695-11-4.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 60695-11-10:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60695-1-10:2009	NOTE	Harmonised as EN 60695-1-10:2010 (not modified).
IEC 60695-1-11:2010	NOTE	Harmonised as EN 60695-1-11:2010 (not modified).
IEC 60695-11-5:2004	NOTE	Harmonised as EN 60695-11-5:2005 (not modified).
IEC 60695-1-30:2008	NOTE	Harmonised as EN 60695-1-30:2008 (not modified).
IEC 60695-11-20	NOTE	Harmonised as EN 60695-11-20.
ISO 1043-1	NOTE	Harmonised as EN ISO 1043-1.
ISO 845	NOTE	Harmonised as EN ISO 845.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60695-4	-	Fire hazard testing - Part 4: Terminology concerning fire tests for electrotechnical products	EN 60695-4	-
IEC 60695-11-4	-	Fire hazard testing - Part 11-4: Test flames - 50 W flame - Apparatus and confirmational test method	EN 60695-11-4	-
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	EN ISO 291	2008
ISO 293	-	Plastics - Compression moulding of test specimens of thermoplastic materials	EN ISO 293	-
ISO 294	Series	Plastics - Injection moulding of test specimens of thermoplastic materials	EN ISO 294	Series
ISO 295	-	Plastics - Compression moulding of test specimens of thermosetting materials	EN ISO 295	-
ISO 307	-	Plastics - Polyamides - Determination of viscosity number	EN ISO 307	-
ISO 9773	-	Plastics - Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source	EN ISO 9773	-
ISO 16012	-	Plastics - Determination of linear dimensions of test specimens	-	-

CONTENTS

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.

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/m^3, 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/m^3 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*

3 Terms and definitions

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]

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 $m \times s^{-1}$ or 0,2 $m \times s^{-1}$ 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

[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 ($m \times s^{-1}$).

Note 2 to entry: In this standard, units of millimetres per minute ($mm \times min^{-1}$) 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 h ± 2 h at 70 °C ± 2 °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 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 °C ± 2 °C and a relative humidity of 50 % ± 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 °C ± 2 °C and a relative humidity not exceeding 20 %.

6.11 Air-circulating oven

The air-circulating oven shall provide a conditioning temperature of 70 °C ± 2 °C, unless otherwise stated in the relevant specification, whilst providing not less than five air changes per hour.

6.12 Cotton pads

The pads shall be made of absorbent cotton designated “100 % cotton” or “pure cotton”.

NOTE This is also referred to as “cotton wool”.

7 Test specimens

7.1 Test specimen preparation

Test specimens shall be fabricated by the appropriate ISO method, e.g. casting and injection moulding in accordance with ISO 294, 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 produced using the same fabrication process as would be normally used to mould a part of a product; and where this is not possible, specimens are to be cut from a representative sample of the moulded material taken from an end product.

NOTE If it is not possible to prepare test specimens by any of the methods outlined above, alternative fire test methods may be used (such as IEC 60695-11-5).

After any 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.

7.2 Test specimen dimensions

Bar test specimens shall measure 125 mm ± 5 mm long by 13,0 mm ± 0,5 mm wide, and shall be provided in at least the minimum and maximum thickness for which the flame classification is under consideration (see Figure 4). The preferred thickness values include 0,1 mm, 0,2 mm, 0,4 mm, 0,75 mm, 1,5 mm, 3,0 mm, 6,0 mm, and/or 12,0 mm.

NOTE 1 The gauges found in Figures 9 and 10 have been found useful for confirming proper specimen dimensions

The thickness shall not exceed 13,0 mm. In addition, other thicknesses may be used by agreement between the interested parties and, if so, shall be noted in the test report. Edges shall be smooth, and the radius on the corners shall not exceed 1,3 mm.

A minimum of 6 bar test specimens for Method A and 20 test specimens for Method B shall be prepared.

Thickness measurements shall be made using the measuring scale at the centre and at both ends of the test specimen using a micrometer. The arithmetic mean of the three measured values is taken as the value of the thickness of the test specimen.

For rigid specimens, thickness measurements shall be performed in accordance with ISO 16012 as follows. Using a ratchet micrometer, close the micrometer at such a rate that the change in reading on the scale or digital display can be easily followed. Continue the closing motion until the ratchet clicks three times, the friction thimble slips, or the two contact surfaces can be felt to be in full contact with the test specimen. Record the indicated reading.

For flexible, non-rigid, or elastic test specimens, a dial gauge micrometer may be used. The closing motion shall be stopped when the pressure foot just contacts the test specimen.

NOTE 2 Other measuring devices equivalent to a micrometer may be used to measure thickness if found to be satisfactory.

In order for test specimens to accurately represent a nominal thickness, each measurement and the overall average shall meet the tolerances given in Table 1.

Table 1 – Thickness tolerances

Thickness mm	**Tolerance** mm
< 0,02	± 10 %
≤ 0,02 to < 0,05	± 0,005
≤ 0,05 to < 0,1	± 0,010
≤ 0,1 to < 0,2	± 0,020
≤ 0,2 to < 0,3	± 0,030
≤ 0,3 to < 0,5	± 0,04
≤ 0,5 to < 0,6	± 0,05
≤ 0,6 to < 3,0	± 0,15
≤ 3,0 to < 6,0	± 0,25
≤ 6,0 to < 13,0	± 0,40

NOTE 3 For example, to represent a thickness of 1,5 mm, all tested specimens should measure between 1,35 mm and 1,65 mm.

7.3 Testing materials – ranges in formulations

7.3.1 General

The results of tests carried out on test specimens of different colour, thickness, density, molecular mass, anisotropic direction and type, or with different additives or fillers/reinforcements can vary.

7.3.2 Density, melt flows and filler/reinforcement

Test specimens with extremes of density, melt flows and filler/reinforcement content may be provided and considered representative of the range if the test results yield the same flame test classification. If the test results do not yield the same flame test classification for all test specimens representing the range, evaluation shall be limited to the materials with the extremes of density, melt flows and filler/reinforcement contents tested. In addition, test specimens with intermediate density, melt flows, and filler/reinforcement content shall be tested to determine the representative range for each flame classification.

7.3.3 Colour

Uncoloured bar test specimens and bar test specimens with the highest level of organic and inorganic pigment loading by weight are considered representative of the colour range, if the test results yield the same flame test classification. When certain pigments are known to affect flammability characteristics, the test specimens containing those pigments shall also be tested. Test specimens which shall be tested are those 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.

Otherwise, individual colours shall be evaluated and classified.

8 Test method A – Horizontal burning test

8.1 Conditioning and test conditions

8.1.1 General

Unless otherwise required by the relevant specification, the requirements listed below shall apply.

8.1.2 "As received" conditioned test specimens

Two sets of three bar test specimens shall be conditioned for a minimum of 48 h at 23 °C ± 2 °C and 50 % ± 10 % relative humidity (see ISO 291:2008, Clause 6, Table 2, Class 2). Once removed from the conditioning chamber (see 6.7), the test specimens shall be tested within 30 min.

8.1.3 Test conditions

All test specimens shall be tested in a laboratory atmosphere of 15 °C to 35 °C and 75 % or less relative humidity.

8.2 Test procedure

8.2.1 Test specimen marking

Three test specimens shall be tested. Each test specimen shall be marked with two lines perpendicular to the longitudinal axis of the bar, 25 mm ± 1 mm and 100 mm ± 1 mm from the end that is to be exposed to the test flame.

NOTE The gauge found in Figure 9 has been found useful for properly marking a set of 3 specimens at a time.

8.2.2 Test specimen setup

Clamp the test specimen at the end furthest from the 25 mm mark, with its longitudinal axis approximately horizontal and its transverse axis inclined at 45° ± 2°, as illustrated in Figure 1. Clamp the wire gauze (see 6.6) horizontally 10 mm ± 1 mm beneath the lower edge of the test specimen. The free end of the test specimen shall be vertically even with the edge of the gauze as shown in Figure 1. Any material remaining on the wire gauze from previous tests shall be burned off or a new wire gauze shall be used for each test.

If the test specimen sags at its free end and is not able to maintain the distance of 10 mm ± 1 mm, the support fixture (see 6.9) shown in Figure 2 shall be used. Place the support fixture on the gauze in such a manner that the test specimen is supported by the support fixture to maintain the distance of 10 mm ± 1 mm with the small extended portion of the support fixture approximately 10 mm from the free end of the test specimen. Provide enough clearance at the clamped end of the test specimen so that the support fixture can be moved freely sideways.

8.2.3 Flame setup

With the central axis of the burner tube vertical, place the burner remote from the test specimen and set the burner (see 6.2) to produce a standardized 50 W nominal test flame, conforming with IEC 60695-11-4. The flame shall be confirmed

a) when the gas supply is changed,

b) when any test apparatus and/or parameters are changed, or

c) in case of dispute,

but at least once per month. Wait for a minimum of 5 min to allow the burner conditions to reach equilibrium.

8.2.4 Application of flame and use of the HB support fixture

Maintaining the central axis of the burner tube at an angle of 45° ± 2° to the horizontal and inclined towards the free end of the test specimen, apply the flame to the lower edge of the test specimen's free end so that the central axis of the burner tube is in the same vertical plane as the longitudinal bottom edge of the test specimen (see Figure 1). Position the burner so that the flame impinges on the free end of the test specimen over a length of approximately 6 mm.

As the flame front (see 8.2.5) progresses along the test specimen, withdraw the support fixture (if used) at approximately the same rate, preventing the flame front from contacting the support fixture, so that there is no effect on the flame or on the burning of the test specimen.

The test flame shall either be applied without changing its position for 30 s ± 1 s or removed as soon as the flame front on the test specimen reaches the 25 mm mark if within less than 30 s. Restart the timing device (see 6.4) when the flame front reaches the 25 mm mark.

NOTE Withdrawing the burner a distance of 150 mm from the test specimen has been found to be satisfactory.

8.2.5 Method and observations

If the test specimen continues to burn with a flame after removal of the test flame, record the elapsed time *t*, in seconds to the nearest whole second, for the flame front to travel from the 25 mm mark past the 100 mm mark, and record the damaged length *L* as 75 mm. If the flame front passes the 25 mm mark but does not pass the 100 mm mark, record the elapsed time *t*, in seconds to the nearest whole second, and the damaged length *L*, in millimetres, between the 25 mm mark and the mark where the flame front stops.

Test two additional new test specimens. The contents of the laboratory fume/chamber hood shall be evacuated after each test specimen.

If only one test specimen from the first set of three test specimens (see 7.3) fails to conform to the criteria indicated in 8.4.1 and 8.4.2, another set of three test specimens shall be tested. All test specimens from the second set shall conform to all the specified criteria for the relevant classification.

8.3 Calculation

Calculate the linear burning rate *v*, in units of millimetres per minute, for each test specimen where the flame front passes the 100 mm mark, using the following equation:

$$v = \left(\frac{L}{t}\right) \times \left(\frac{60\,\mathrm{s}}{\mathrm{min}}\right)$$

where

v is the linear burning rate (see 3.22);

L is the damaged length (see 8.2.5); and

t is the time (see 8.2.5).

8.4 Classification

8.4.1 General

The materials shall be classified HB, HB40 or HB75 (HB = horizontal burning) in accordance with the criteria given below.

NOTE The preferred classifications are HB or HB40. The HB75 rating will be removed from the next edition of this standard.

8.4.2 HB classification

A material classified HB shall conform to one of the following criteria:

a) it does not burn with a flame after the ignition source is removed;

b) if the test specimens continue to burn with a flame after removal of the ignition source, the flame front does not pass the 100 mm mark;

c) if the flame front passes the 100 mm mark,

   1) it does not have a linear burning rate exceeding 40 mm/min for a thickness of 3,0 mm to 13,0 mm or

   2) a linear burning rate not exceeding 75 mm/min for a thickness of less than 3,0 mm;

If the linear burning rate does not exceed 40 mm/min for tests performed with specimens between 1,5 and 3,2 mm, the HB classification shall automatically be accepted down to a 1,5 mm minimum thickness.

8.4.3 HB40 classification

A material classified HB40 shall conform to one of the following criteria:

a) if it does not burn with a flame after the ignition source is removed;

b) if the test specimens continue to burn with a flame after removal of the ignition source, and the flame front does not pass the 100 mm mark;

c) if the flame front passes the 100 mm mark and it does not have a linear burning rate exceeding 40 mm/min;

8.4.4 HB75 classification

A material classified HB75 shall conform to one of the following criteria:

a) if it does not burn with a flame after the ignition source is removed;

b) if the test specimens continue to burn with a flame after removal of the ignition source, and the flame front does not pass the 100 mm mark;

c) if the flame front passes the 100 mm mark and it does not have a linear burning rate exceeding 75 mm/min.

8.5 Test report

The test report shall include the following:

a) a reference to this International Standard;

b) all the details necessary to identify the product tested, including the manufacturer's name, number or code, and colour;

c) the thickness of the test specimen:

   – for test specimens 1,0 mm or greater, to the nearest 0,01 mm,

   – for test specimens less than 1,0 mm, to the nearest 0,001 mm;

d) the nominal apparent density (rigid cellular materials only);

e) the direction of any anisotropy relative to the dimensions of the test specimen;

f) the conditioning treatment;

g) any treatment before testing, other than cutting, trimming and conditioning;

h) a note as to whether or not the test specimen continued to burn with a flame after application of the test flame;

i) a note as to whether or not the flame front passed the 25 mm and 100 mm marks;

j) for test specimens in which the flame front passed the 25 mm mark but not the 100 mm mark, the elapsed time *t* and the damaged length *L*;

k) for test specimens in which the flame front reached or passed the 100 mm mark, the average linear burning rate *v*;

l) a note as to whether the flexible test specimen support fixture was used;

m) the assigned classification in combination with the relevant thickness, for example,

"HB @ 3,0 mm" (see 8.4).

9 Test method B – Vertical burning test

9.1 Conditioning and test conditions

9.1.1 General

Unless otherwise required by the relevant specification, the requirements listed below shall apply.

9.1.2 "As received" conditioned test specimens

Two sets of five bar test specimens shall be conditioned for a minimum of 48 h at 23 °C ± 2 °C and 50 % ± 10 % relative humidity (ISO 291:2008, Table 2, Class 2). Once removed from the conditioning chamber (see 6.7), the test specimens shall be tested within 30 min.

9.1.3 Oven conditioned test specimens

Two sets of five bar test specimens shall be conditioned in an air-circulating oven (see 6.11) for 168 h ± 2 h at 70 °C ± 2 °C and then cooled in the desiccator (see 6.10) for at least 4 h. As an alternative to this conditioning, industrial laminates may be conditioned for 24 h at 125 °C ± 2 °C. Once removed from the desiccator chamber, the test specimens shall be tested within 30 min.

9.1.4 Conditioning of the cotton pads

The cotton pads shall be conditioned in a desiccator for at least 24 h prior to use. Once removed from the desiccator, the cotton pad shall be used within 30 min.

9.1.5 Test conditions

All test specimens shall be tested in a laboratory atmosphere of 15 °C to 35 °C and 40 % to 75 % relative humidity.

9.2 Test procedure

9.2.1 Test specimen setup

Clamp the test specimen using the upper 6 mm of its length with the longitudinal axis vertical. The lower end of the test specimen shall be 300 mm ± 10 mm above the horizontal cotton pad (see 6.12). The cotton pad shall be approximately 50 mm × 50 mm × 6 mm uncompressed thickness and shall have a maximum mass of 0,08 g (see Figure 3).

9.2.2 Flame setup

With the central axis of the burner tube vertical, place the burner remote from the test specimen and set the burner (see 6.2) to produce a standardized 50 W nominal test flame, conforming with IEC 60695-11-4. The flame shall be confirmed

a) when the gas supply is changed,

b) when any test apparatus and/or parameters are changed, or

c) in case of dispute,

but at least once per month.

Wait for a minimum of 5 min to allow the burner conditions to reach equilibrium.

9.2.3 Flame application and observations

Maintaining the central axis of the burner tube in the vertical position, approach the test specimen horizontally towards the wide face (see Figure 7). Apply the flame centrally to the middle point of the bottom edge of the test specimen so that the top of the burner is 10 mm ± 1 mm below that point. Maintain the burner at that distance for 10 s ± 0,5 s (starting when the flame is fully positioned under the test specimen), moving the burner in the vertical plane in response to any changes in the length or position of the test specimen.

NOTE 1 For test specimens which move under the influence of the burner flame, the use of a clearance gauge attached to the burner (see Figure 5), as described in IEC 60695-11-4, has been found to be satisfactory in maintaining the 10 mm distance between the top of the burner and the major portion of the test specimen.

If the test specimen produces molten drips during the flame application, tilt the burner at an angle of up to 45° perpendicular to the wide side of the test specimen (see Figures 6 and 8). Withdraw it just sufficiently from beneath the test specimen to prevent material from dropping into the barrel of the burner while maintaining the 10 mm ± 1 mm spacing between the centre of the outlet of the burner and the remaining major portion of the test specimen ignoring any strings of molten material. After the application of the flame to the test specimen for 10 s ± 0,5 s , immediately withdraw the burner sufficiently so that there is no effect on the test specimen, and simultaneously use the timing device to commence measurement of the afterflame time t_1, in seconds. Note and record t_1, and whether there were any particles or molten drips, and if so, whether they ignited the layer of cotton.

NOTE 2 Withdrawing the burner a distance of 150 mm from the test specimen while measuring t_1 has been found to be satisfactory.

When flaming of the test specimen ceases, immediately replace the test flame under the test specimen, maintaining the central axis of the burner tube in the vertical position and the top of the burner at a distance of 10 mm ± 1 mm below the remaining lower edge of the test specimen for 10 s ± 0,5 s. If necessary, move the burner clear of any molten drips, as described above. After this second application of the flame to the test specimen for 10 s ± 0,5 s, immediately extinguish the burner or remove it sufficiently from the test specimen so that there is no effect on the test specimen and simultaneously, using the timing device, begin measurement, to the nearest second, of the afterflame time t_2, and the afterglow time t_3 of the test specimen. Note and record t_2, t_3, and t_2 plus t_3. Also note and record

a) whether any particles or molten drips fall from the test specimen and, if so, whether they ignite the cotton pad (see 6.12); and

b) whether test specimens burned to the holding clamp (See 9.2.4).

NOTE 3 Measuring and recording the afterflame time t_2 and then continuing the measurement of the sum of the afterflame time t_2 and the afterglow time t_3 (without resetting the timing device) has been found to be satisfactory in the recording of t_3.

NOTE 4 Withdrawing the burner to a distance of 150 mm from the test specimen while measuring t_2 and t_3 has been found to be satisfactory.

Repeat the procedure until five test specimens, conditioned in accordance with 9.1.2, as well as five test specimens conditioned in accordance with 9.1.3, have been tested. The contents of the laboratory fume hood/chamber shall be evacuated after each test.

9.2.4 Evaluation of “burned to the holding clamp”

The condition designated “burned to the holding clamp” shall be evaluated as follows. Allow the sample to cool. Using a soft, dry cloth wipe away soot and effluent residue and examine the sample 2 mm below the clamp line for signs of combustion or pyrolysis. Any thermal damage such as melting or distortion on the sample below the clamp shall be neglected. If the damage to the test specimen (2 mm below the clamp) is caused by the visible test flame during its application, this is not to be considered being burned to the holding clamp. A material is to be considered burned to the holding clamp if the damage to the test specimen is a result of the burning flame front on the test specimen. A material is also to be considered burned to the holding clamp if the test specimen is totally consumed (see Figures 11 and 12).

9.2.5 Criteria for retest

If only one test specimen from a set of five test specimens for a given conditioning treatment does not conform to all the criteria for a classification, another set of five test specimens subjected to the same conditioning shall be tested. For the criterion concerning the total number of seconds of afterflame time t_f, an additional set of five test specimens shall be tested if the afterflame time totals are in the range of 51 s to 55 s for V-0, or 251 s to 255 s for V-1 and V-2 (See 9.4). All test specimens from the second set shall conform to all the specified criteria for the classification.

9.3 Calculation of the total afterflame time, t_f

For each set of five test specimens from the two conditioning treatments, calculate the total afterflame time for the set t_f, in seconds, using the following equation:

$$t_f = \sum_{i=1}^{5} \left(t_{1,i} + t_{2,i} \right)$$

where

t_f is the total afterflame time, in seconds;

$t_{1,i}$ is the first afterflame, in seconds, of the i^{th} test specimen;

$t_{2,i}$ is the second afterflame time, in seconds, of the i^{th} test specimen.

9.4 Classification

The material shall be classified either V-0, V-1 or V-2 (V = vertical burning), in accordance with the criteria indicated in Table 2. If the test results are not in accordance with the specified criteria, the material cannot be classified by this test method.

Table 2 – Criteria for vertical burning classification

Criteria	Materials Classification		
	V-0	V-1	V-2
Individual test specimen afterflame times (t_1, t_2)	≤ 10 s	≤ 30 s	≤ 30 s
Total afterflame time t_f for any conditioned set of five specimens	≤ 50 s	≤ 250 s	≤ 250 s
Individual test specimen afterflame time plus afterglow time after the second flame application ($t_2 + t_3$)	≤ 30 s	≤ 60 s	≤ 60 s
Afterflame and/or afterglow of any specimen burned to the holding clamp	No	No	No
Cotton indicator pad ignited by flaming particles or drops	No	No	Yes

For polyamide (type 66) materials classed as V-2, a solution of the supplied form shall have a relative viscosity of less than 225 ml/g (as determined using the 96 % sulphuric acid preparation method) or 210 ml/g (as determined using the 90 % formic acid preparation method) according to ISO 307. Alternatively, if the relative viscosity is greater than 225 ml/g

or 210 ml/g respectively, the relative viscosity of a solution of the moulded test specimen material shall not be less than 70 % of the relative viscosity of a solution of the supplied material.

9.5 Test report

The test report shall include the following:

a) a reference to this International Standard;

b) all details necessary to identify the product tested, including the, number or code, the colour, and the manufacturer's name;

c) the thickness of the test specimen:
   – for test specimens 1,0 mm or greater, to the nearest 0,01 mm,
   – for test specimens less than 1,0 mm, to the nearest 0,001 mm;

d) the nominal apparent density (rigid cellular materials only);

e) the direction of any anisotropy relative to the dimensions for each test specimen;

f) the conditioning treatment;

g) any treatment before testing, other than cutting, trimming and conditioning;

h) the individual values of t_1, t_2, t_3, and t_2 plus t_3 for each test specimen;

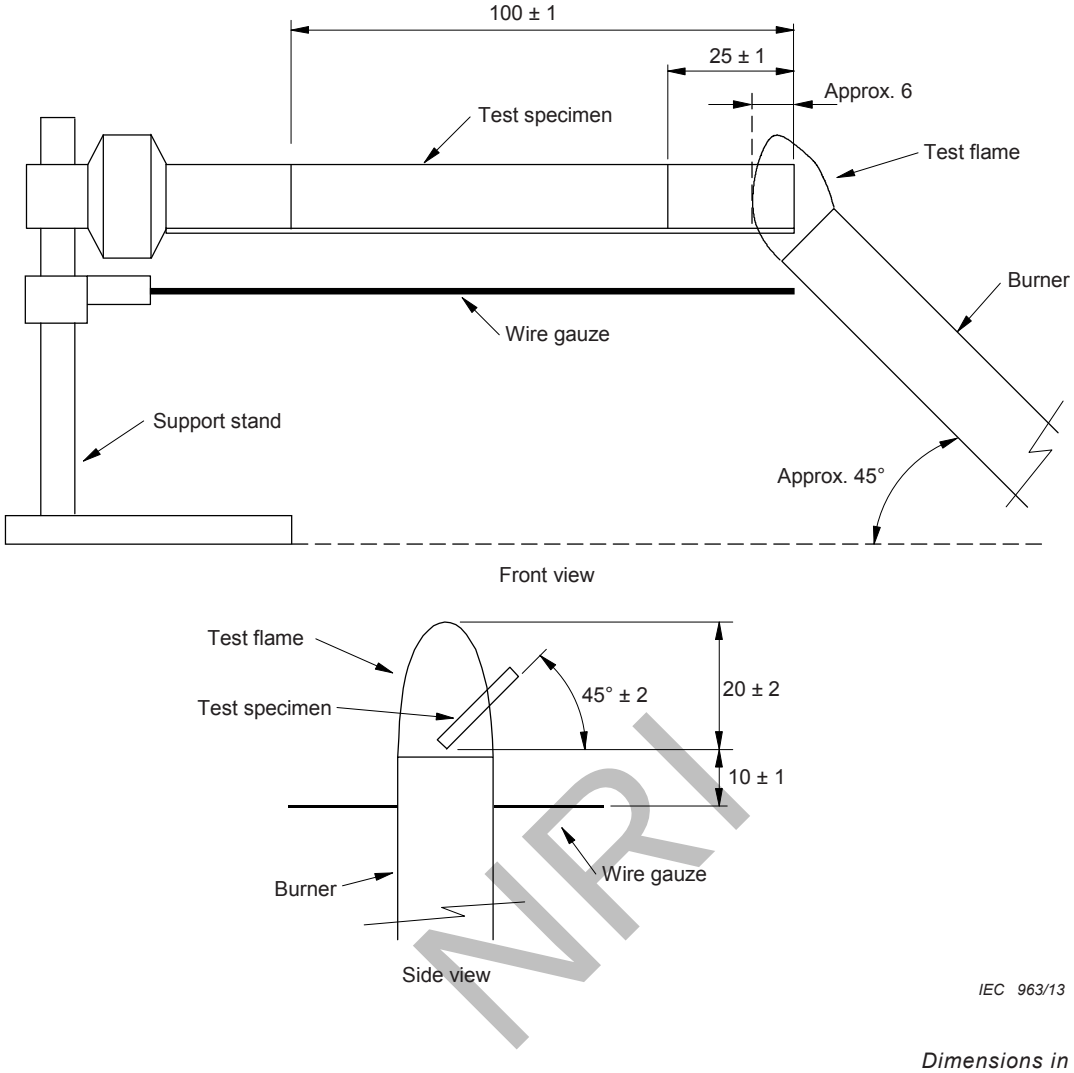
i) the total afterflame time t_f for each set of five test specimens from the two conditioning treatments (see 9.1.1 and 9.1.2);

j) a note as to whether any particles or molten drips fell from the test specimens and whether they ignited the cotton;

k) a note as to whether any of the test specimens burned to the holding clamp;

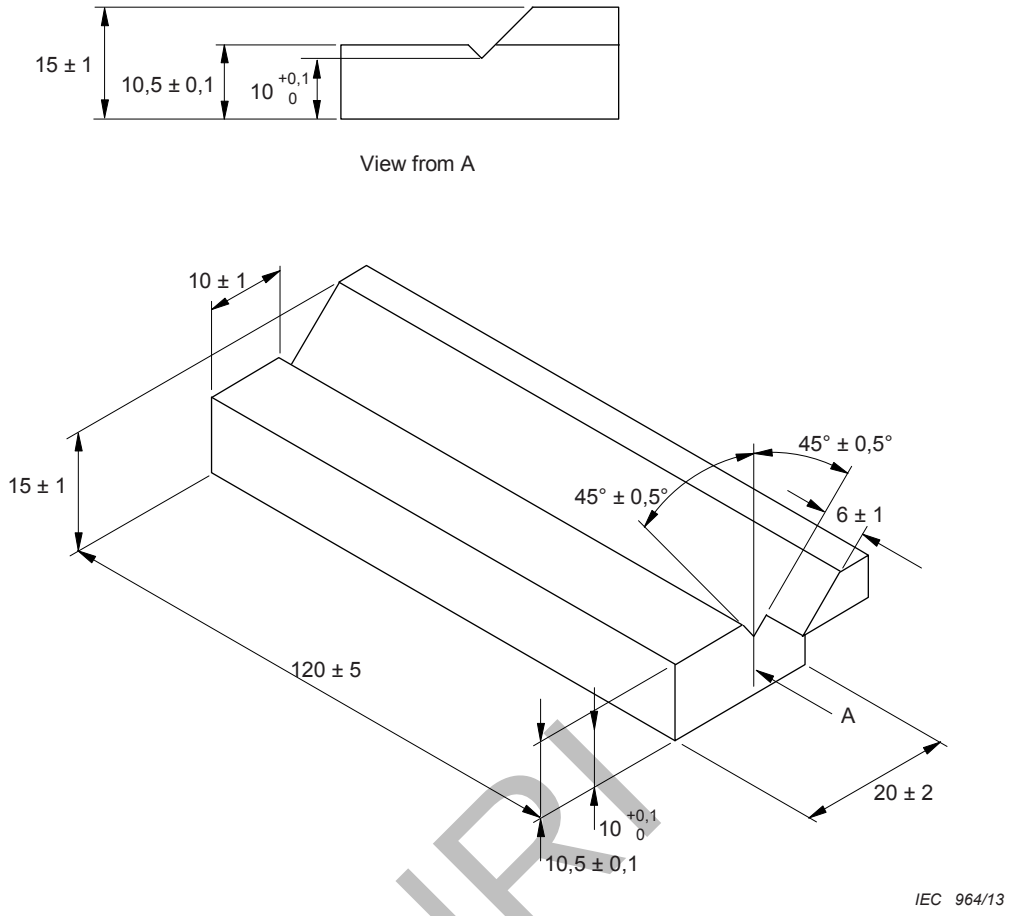
l) the assigned classification in combination with the relevant thickness, for example

"V-0 @ 1,5 mm" (see 9.4).



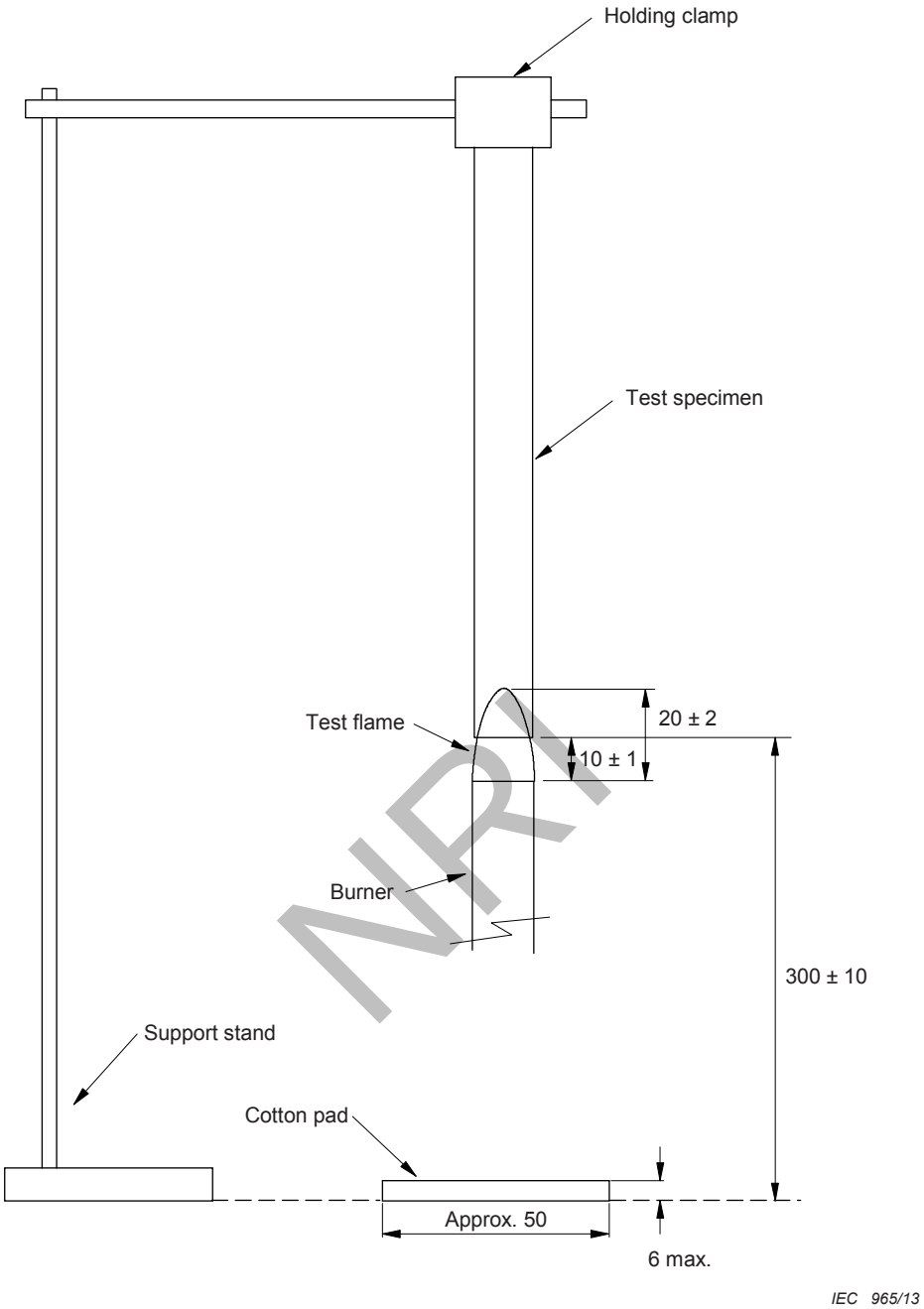
Dimensions in millimetres

Figure 1 – Horizontal burning test apparatus



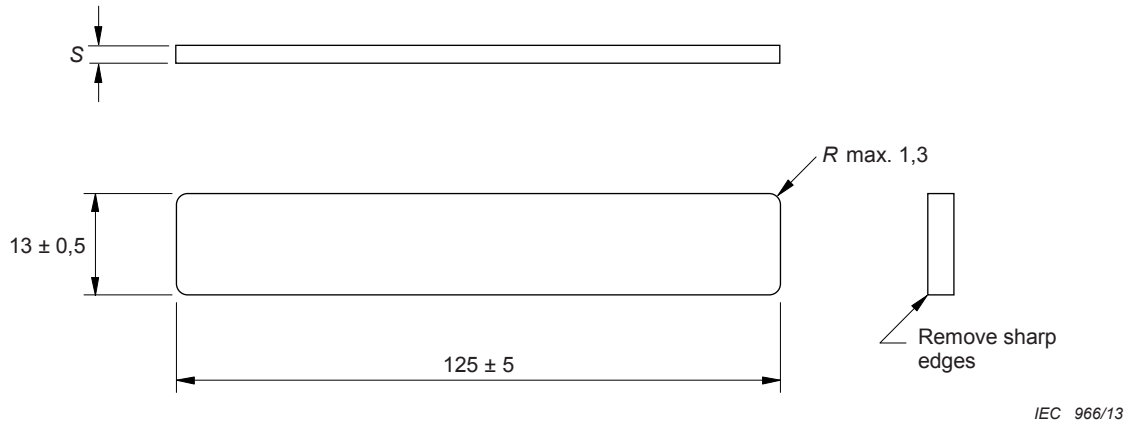
Dimensions in millimetres

Figure 2 – Flexible test specimen support fixture – method A



Dimensions in millimetres

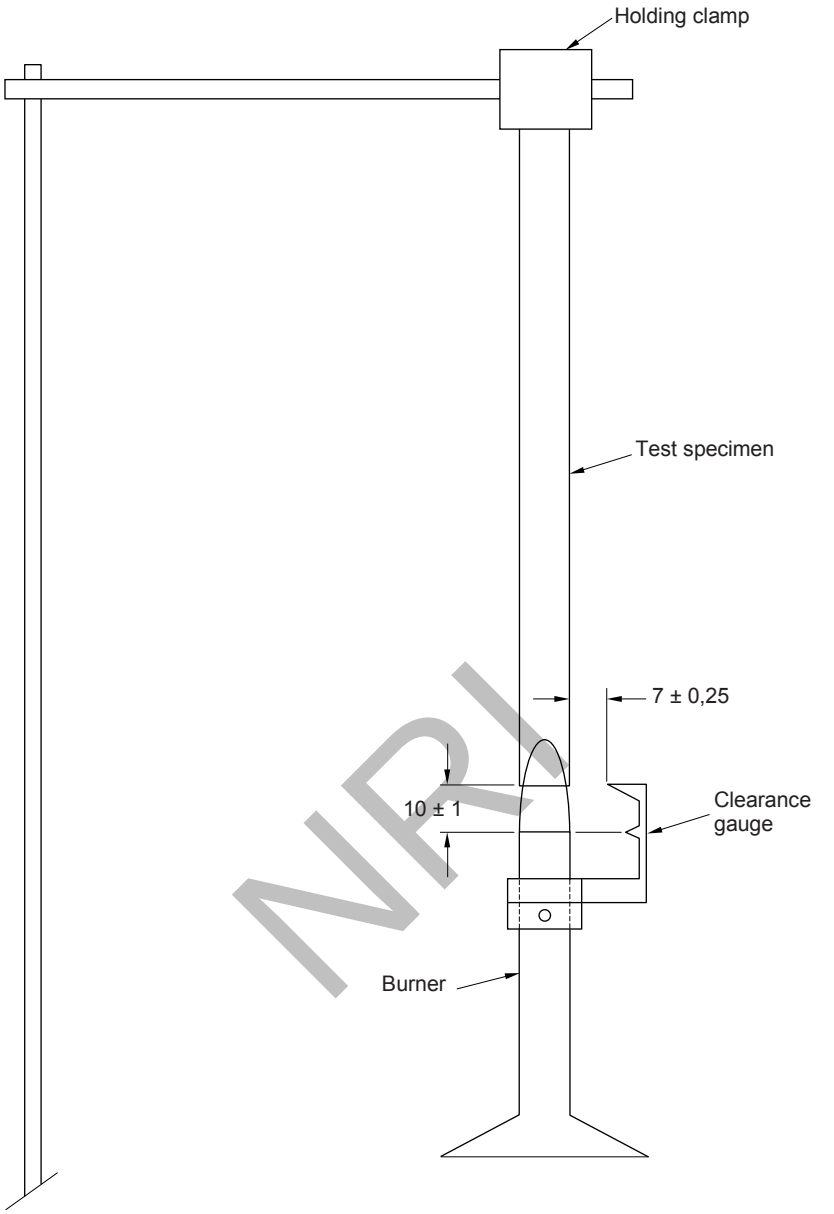
Figure 3 – Vertical burning test apparatus – method B



Dimensions in millimetres

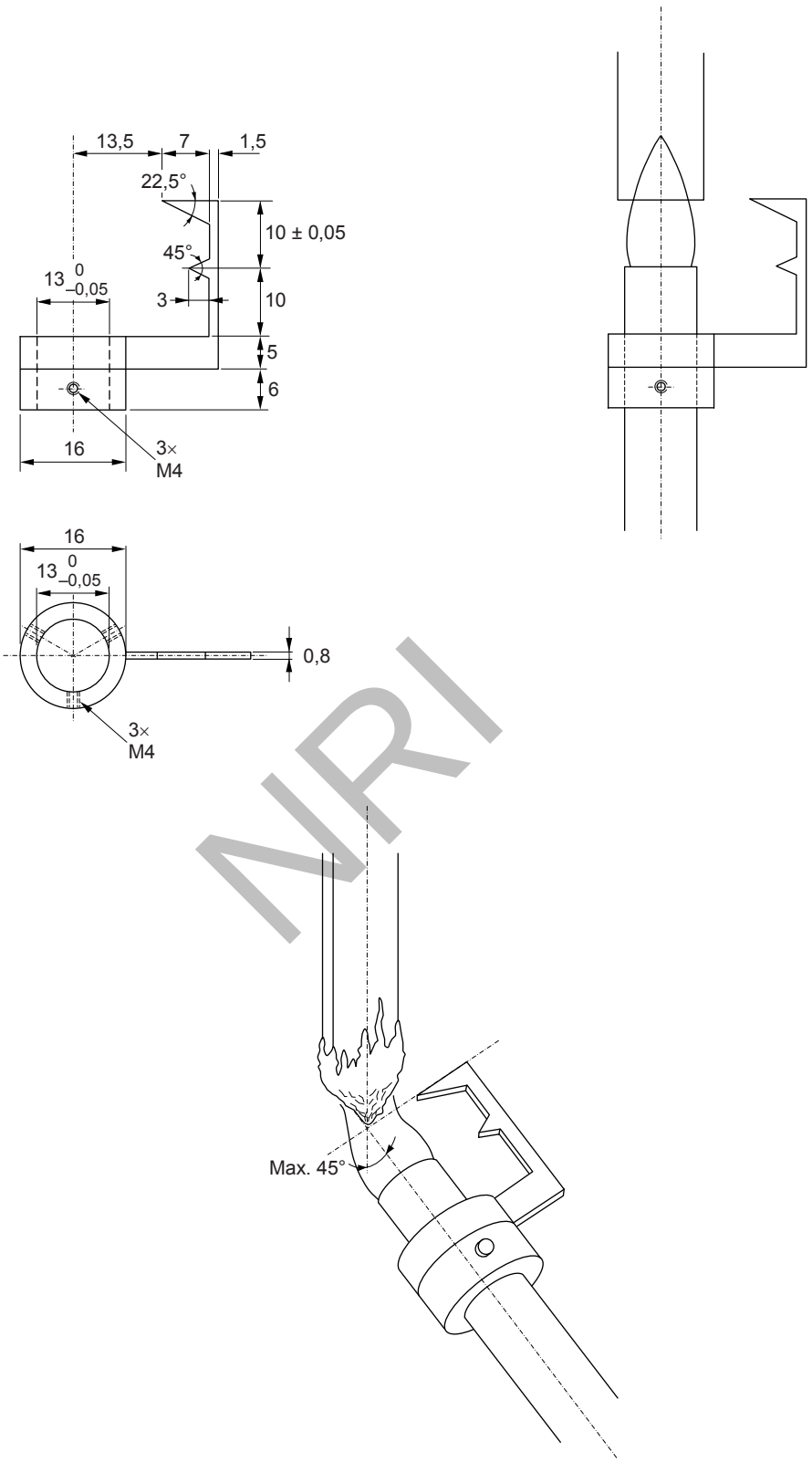
S = Thickness of test specimen

Figure 4 – Bar test specimen



Dimensions in millimetres

Figure 5 – Optional clearance gauge



Dimensions in millimetres

Figure 6 – Clearance gauge

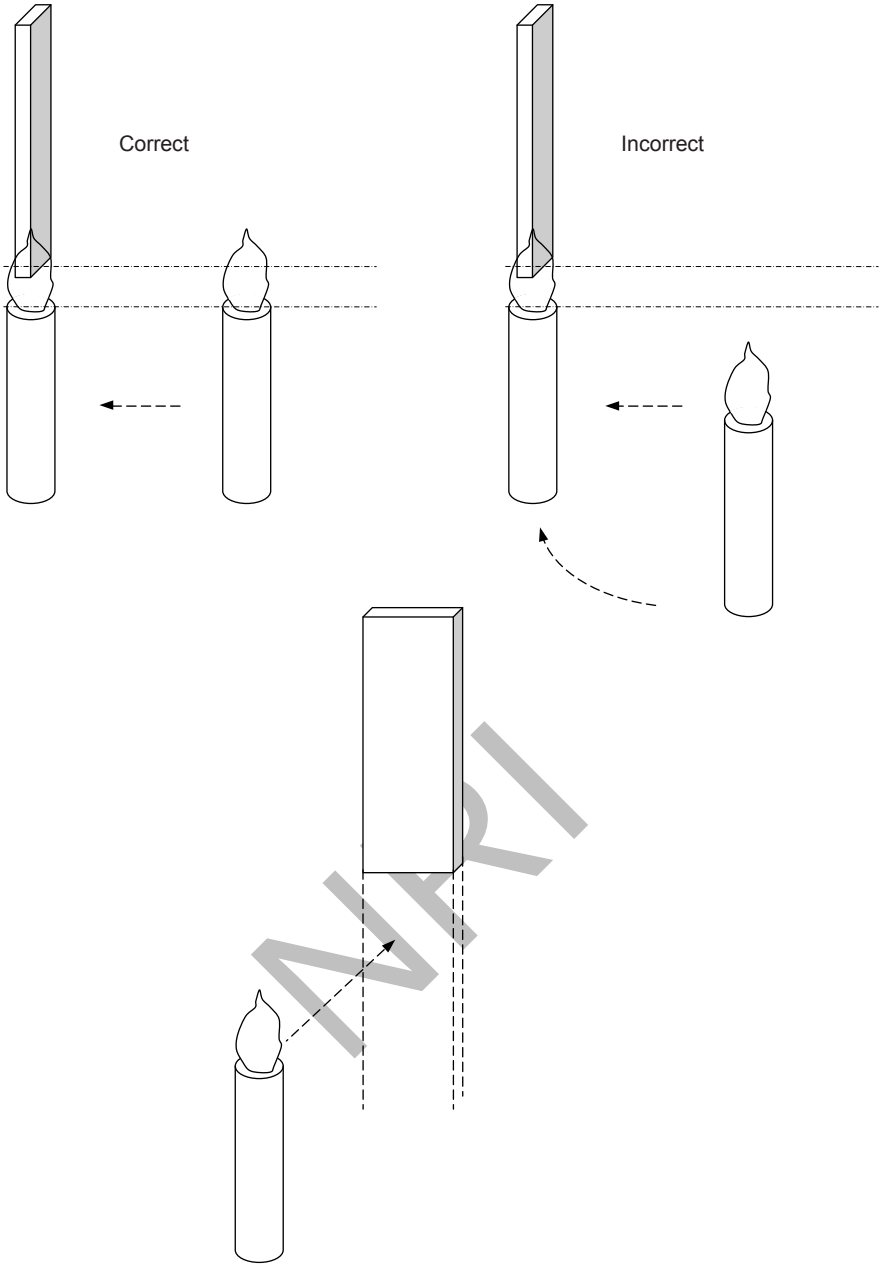


Figure 7 – Flame application

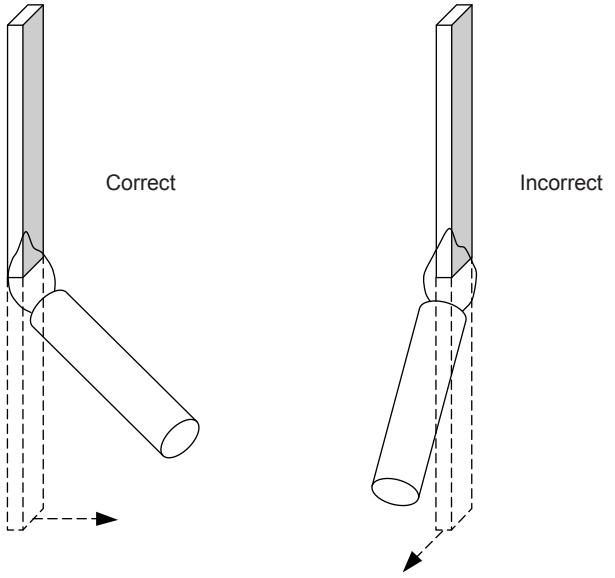
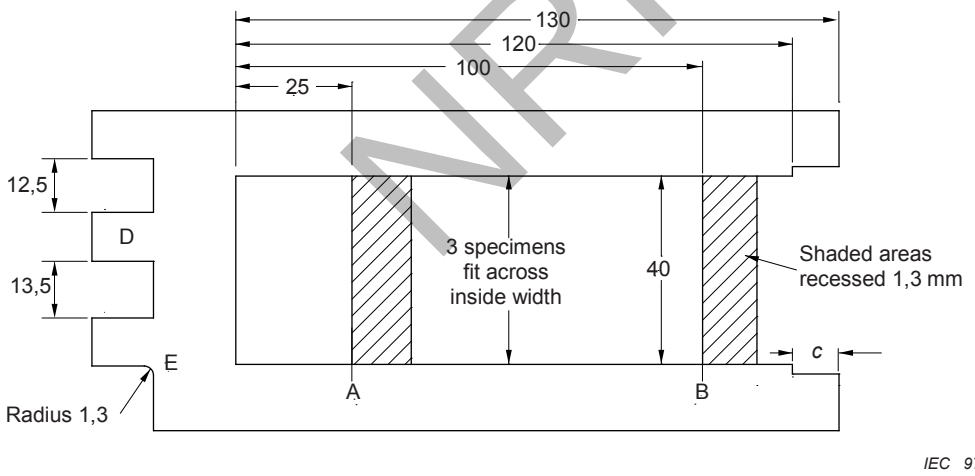


Figure 8 – Flame application when there are molten drips



Dimensions in millimetres

Key:

A: 25 mm mark

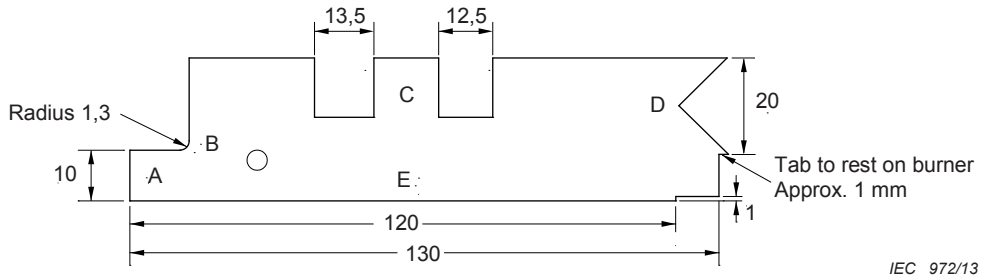
B: 100 mm mark

C: Specimen length

D: Specimen width

E: Specimen corner radius

Figure 9 – HB Specimen Gauge (Example)



Dimensions in millimetres

Key:

A: Copper Block height (IEC 60695-11-4)

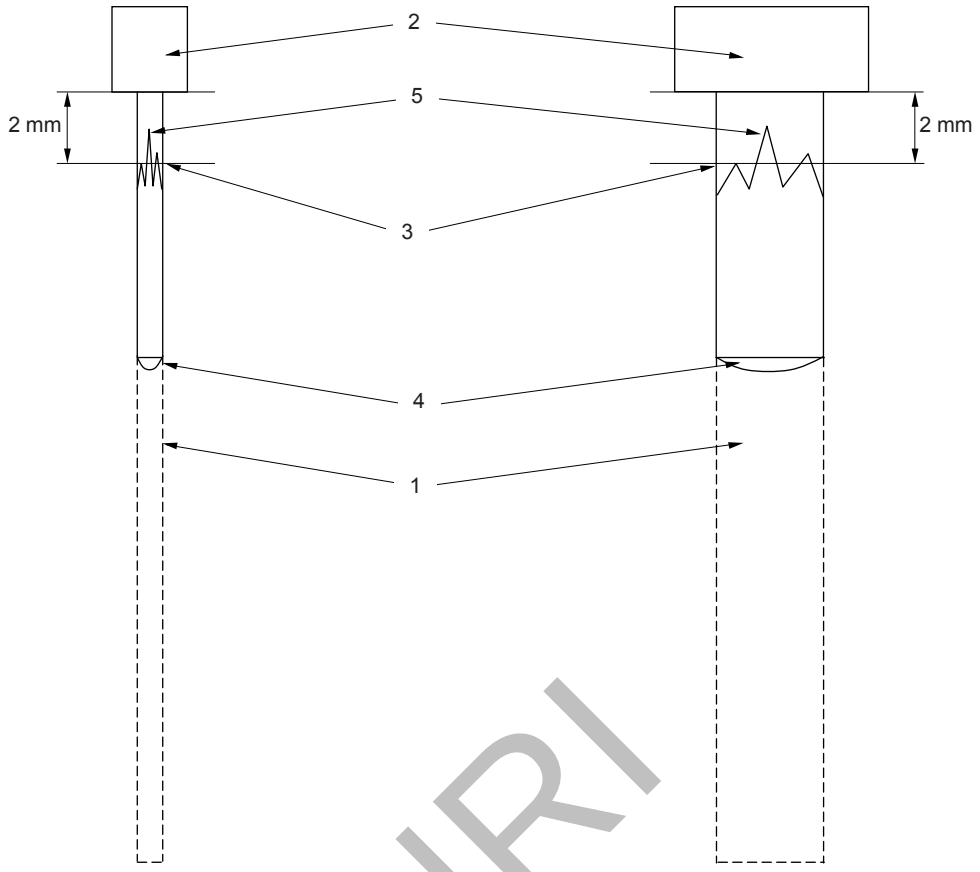
B: Specimen corner radius

C: Specimen width

D: 50W flame height

E: Specimen length

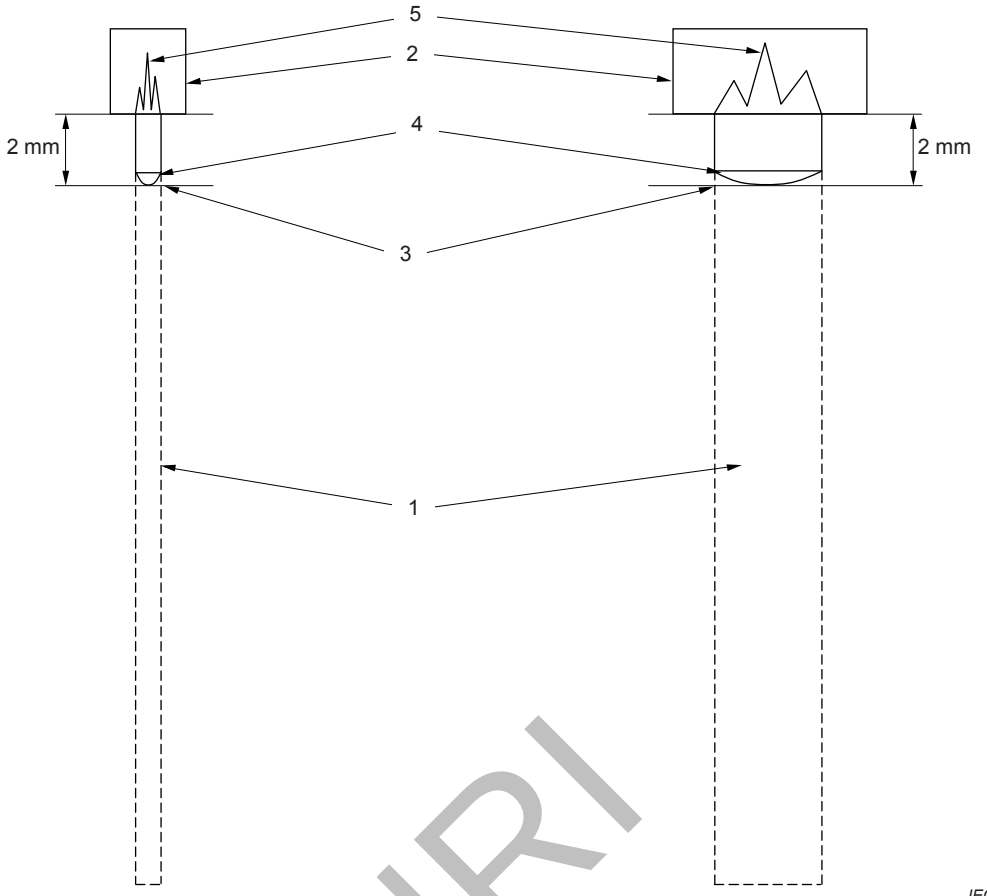
Figure 10 – V Specimen Gauge (Example)



Key:

1 Specimen – the amount of specimen that last is not relevant, only the burning front matters
2 Holding clamp
3 Examination line (2mm below the clamp line) of combustion or pyrolysis
4 Burning Flame front
5 Tip of the burning flame

Figure 11 – Flame front position not classified as “burned to the holding clamp”



Key:

1 Specimen – the amount of specimen that last is not relevant, only the burning front matters
2 Holding clamp
3 Examination line (2mm below the clamp line) of combustion or pyrolysis
4 Burning Flame front
5 Tip of the burning flame

Figure 12 – Flame front position classified as "burned to the holding clamp"

Annex A
(informative)

Precision of test method A

The precision data were determined from an interlaboratory experiment conducted in 1988 involving ten laboratories, three materials and three replicates, each material using the average of three data points. All tests were conducted on 3,0 mm thick test specimens. The results were analyzed in accordance with ISO 5725-2 [7] and are summarized in Table A.1.

Table A.1 – Linear burning rate

Parameter	PE	ABS	Acrylic
Average	15,1	27,6	29,7
Repeatability	0,9	2,0	1,9
Reproducibility	1,3	4,1	2,3
All values are in millimetres per minute.			

NOTE Material symbols are defined in ISO 1043-1 [6].

Table A.1 is only intended to present a meaningful way of considering the approximate precision of this test method for a small range of materials. These data should not be rigorously applied as criteria for acceptance or rejection of a material, as the data are specific to the interlaboratory test and may not be representative of other lots, conditions, thicknesses, materials or laboratories.

Annex B
(informative)

Precision of test method B

The precision data were determined from an interlaboratory experiment conducted in 1978 involving four laboratories, four materials and two replicates, each using the average of five data points. The results were analyzed in accordance with ISO 5725-2 [7], and are summarized in Table B.1. Nominal 3,0 mm thick test specimens were subjected to the interlaboratory trials.

Table B.1 – Afterflame time and afterflame plus afterglow times

Stage	Time measured	Parameter	Material			
			PC	PPE+PS	ABS	PF
After first flame application	Afterflame time t_1	Average	1,7	10,1	0,4	0,8
		Repeatability	0,4	3,9	0,3	0,3
		Reproducibility	0,6	4,4	0,5	0,6
After second flame application	Afterflame time plus afterglow $t_2 + t_3$	Average	3,6	16,0	1,1	49,3
		Repeatability	0,5	5,2	0,8	16,3
		Reproducibility	0,9	4,7	0,7	18,1
Values are in seconds.						

NOTE Symbols for plastics material are defined in ISO 1043-1.

Table B.1 is only intended to present a meaningful way of considering the approximate precision of this test method for a small range of materials. These data should not be rigorously applied as criteria for acceptance or rejection of a material, as the data are specific to the interlaboratory test and may not be representative of other lots, conditions, thicknesses, materials or laboratories.

Bibliography

[1] IEC 60695-1-10:2009, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

[2] IEC 60695-1-11:2010, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

[3] IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test methods – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

[4] 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*

[5] IEC 60695-11-20, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods*

[6] ISO 1043-1, *Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics*

[7] ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results – Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

[8] ISO 9772, *Cellular plastics – Determination of horizontal burning characteristics of small specimens subjected to a small flame*

[9] ISO 845, *Cellular plastics and rubbers – Determination of apparent (bulk) density*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™