BS EN 60695-11-4:2011

BSI Standards Publication

# Fire hazard testing

Part 11-4: Test flames — 50 W flame — Apparatus and confirmational test method

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## National foreword

This British Standard is the UK implementation of EN 60695-11-4:2011. It is identical to IEC 60695-11-4:2011. It supersedes DD IEC/TS 60695-11-4:2004, which is withdrawn.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.


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

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| Amd. No. | Date | Text affected |
|---|---|---|

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 60695-11-4

November 2011

ICS 13.220.40; 29.020

English version

# Fire hazard testing - Part 11-4: Test flames - 50 W flame - Apparatus and confirmational test method

(IEC 60695-11-4:2011)

Essais relatifs aux risques du feu - Partie 11-4: Flammes d'essai - Flamme de 50 W - Appareillage et méthodes d'essai de vérification
(CEI 60695-11-4:2011)

Prüfungen zur Beurteilung der Brandgefahr - Teil 11-4: Prüfflammen - 50 W Prüfflamme - Prüfeinrichtungen und Prüfverfahren zur Bestätigung
(IEC 60695-11-4:2011)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

The text of document 89/1060/FDIS, future edition 1 of IEC 60695-11-4, prepared by IEC/TC 89 "Fire hazard testing" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60695-11-4:2011.

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) | 2012-08-01 |
| • latest date by which the national standards conflicting with the document have to be withdrawn | (dow) | 2014-11-01 |

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.

## Endorsement notice

The text of the International Standard IEC 60695-11-4:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

| | |
|---|---|
| IEC 60695-11-2:2003 | NOTE Harmonized as EN 60695-11-2:2003 (not modified). |

# Annex ZA
(normative)

## Normative references to international publications with their corresponding European publications

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.

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 60584-1 | 1995 | Thermocouples - Part 1: Reference tables | EN 60584-1 | 1995 |
| IEC 60584-2 + A1 | 1982 1989 | Thermocouples - Part 2: Tolerances | EN 60584-2 | 1993 |
| 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 13943 | 2008 | Fire safety - Vocabulary | EN ISO 13943 | 2010 |
| ASTM B187 | - | Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes | - | - |

# CONTENTS

# INTRODUCTION

The best method for testing electrotechnical products with regard to fire hazard is to duplicate exactly the conditions occurring in practice. In most instances, this is not possible. Accordingly, for practical reasons, the testing of electrotechnical products with regard to fire hazard is best conducted by simulating as closely as possible the actual effects occurring in practice.

Work initiated by ACOS resulted in a series of standards that make available standardized test flames covering a range of powers for the use of all product committees needing such test flames. A needle flame is described in IEC 60695-11-5, two 500 W flames are described in IEC 60695-11-4, and a 1 kW flame is described in IEC 60695-11-2.

This international standard provides a description of the apparatus required to produce a 50 W test flame and a description of a calibration procedure to check that the test flame produced meets given requirements. Guidance on confirmatory tests for test flames is given in IEC 60695-11-40.

Three 50 W test flame methods (A, B and C) were originally specified in IEC/TS 60695-11-4:2000, with the intention that users would determine a ranking preference. This process has resulted in two of these flame methods being withdrawn, as shown below:

| **50 W test flame method** | **Flame type** | **Gas** | **Approximate flame height / mm** |
|---|---|---|---|
| A | Pre-mixed | Methane | 20 |
| B | Withdrawn | | |
| C | Withdrawn | | |

The method described in Clause 4 of this standard is the method that was originally designated as Method A. It produces a 50 W nominal test flame using a single gas supply tube, a needle valve to adjust the gas back pressure, a flowmeter to adjust the gas flow rate, and adjustable air ports on the burner tube.

The flame is produced by burning methane, and the method makes use of a more tightly specified version of a burner that was used in some countries for many years.

The method has been developed as a technical enhancement of previous technology.

# FIRE HAZARD TESTING –

# Part 11-4: Test flames – 50 W flame – Apparatus and confirmational test method

## 1 Scope

This part of IEC 60695 provides detailed requirements for the production of a 50 W nominal, pre-mixed type test flame. The approximate overall height of the flame is 20 mm. Details are given for confirmation of the test flame.

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 60584-1:1995, *Thermocouples – Part 1: Reference tables*

IEC 60584-2:1989, *Thermocouples – Part 2: Tolerances*
Amendment 1

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/IEC 13943:2008, *Fire safety – Vocabulary*

ASTM-B187/B187M-06, *Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 13943, some of which are reproduced below for the users' convenience, as well as the following apply..

**3.1**
**burn**, intransitive verb
undergo combustion

[ISO/IEC 13943, definition 4.28]

**3.2**
**burn**, transitive verb
cause combustion

[ISO/IEC 13943, definition 4.29]

**3.3**
**combustion**
exothermic reaction of a substance with an oxidizing agent

NOTE Combustion generally emits fire effluent accompanied by flames and/or glowing.

[ISO/IEC 13943, definition 4.46]

**3.4**
**draught-free environment**
space in which the results of experiments are not significantly affected by the local air speed

NOTE A qualitative example is a space in which a wax candle flame remains essentially undisturbed. Quantitative examples are small-scale fire tests in which a maximum air speed of 0,1 $m \cdot s^{-1}$ or 0,2 $m \cdot s^{-1}$ is sometimes specified.

[ISO/IEC 13943, definition 4.70]

**3.5**
**fire hazard**
physical object or condition with a potential for an undesirable consequence from fire

[ISO/IEC 13943, definition 4.112]

**3.6**
**flame**, noun
rapid, self-sustaining, sub-sonic propagation of combustion in a gaseous medium, usually with emission of light

[ISO/IEC 13943, definition 4.133]

**3.7**
**pre-mixed flame**
flame in which combustion occurs in an intimate mixture of fuel and oxidizing agent

[ISO/IEC 13943, definition 4.259]

**3.8**
**standardized 50 W nominal test flame**
test flame that conforms to this international standard and meets all of the requirements given in Clause 4

## 4 Production of a standardized 50 W nominal test flame

### 4.1 Requirements

A standardized 50 W nominal test flame, according to this method, is one that is

- produced using hardware according to Figures A.1 and A.2,
- supplied with methane gas of purity not less than 98 % at a flow rate equivalent to 105 ml/min ± 5 ml/min at 23 °C, 0,1 MPa[1], using the arrangement of Figure A.3.

---

1 When corrected from measurements taken under actual conditions of use.

NOTE The expected back pressure is less than 10 mm of water.

The flame shall be symmetrical, stable and give a result of 44 s ± 2 s in the confirmatory test described in 4.4.

The confirmatory test arrangement shown in Figure A.4 shall be used.

The overall height of the flame should be typically within the range 18 mm to 22 mm, but targeted towards 20 mm when measured using the flame height gauge as described in Figure 2, in the laboratory fumehood/chamber (see 4.2.9).

### 4.2 Apparatus and fuel

#### 4.2.1 Burner

The burner shall be in accordance with Figures A.1 and A.2.

NOTE The burner tube, gas injector and needle valve are removable for cleaning purposes. Care should be taken on re-assembly that the needle valve tip is not damaged and that the needle valve and valve seat (gas injector) are correctly aligned.

#### 4.2.2 Flowmeter

The flowmeter shall be appropriate for the measurement of a gas flow rate of 105 ml/min at 23 °C, 0,1 MPa [1] to a tolerance of ± 2 %.

NOTE A mass flowmeter is the preferred means of controlling accurately the input flow rate of fuel to the burner. Other methods may be used if they can show equivalent accuracy.

#### 4.2.3 Manometer

The manometer shall be appropriate for the measurement of pressure in the range of 0 kPa to 7,5 kPa. Water manometers may be used for this purpose. They should be adapted to read 0 kPa to 7,5 kPa.

NOTE A manometer is required in conjunction with a mass flowmeter in order to maintain the required back pressure.

#### 4.2.4 Control valve

A control valve is required to set the gas flow rate.

#### 4.2.5 Copper block

The copper block shall be 5,50 mm in diameter, of mass 1,76 g ± 0,01 g in the fully machined but undrilled state as shown in Figure 1.

There is no verification method for the copper block. Laboratories are encouraged to maintain a standard reference unit, a secondary standard reference unit and a working unit, cross-comparing them as appropriate to verify the working system.

#### 4.2.6 Thermocouple

A mineral insulated, metal sheathed fine-wire thermocouple with an insulated junction, is used for measuring the temperature of the copper block. The thermocouple shall be Class 1 in accordance with IEC60584-2. It shall have an overall nominal diameter of 0,5 mm and wires of, for example, NiCr and NiAl (type K in accordance with IEC 60584-1) with the welded point located inside the sheath. The sheath shall consist of a metal resistant to continuous operation at a temperature of at least 1 050 °C. Thermocouple tolerances shall be in accordance with IEC 60584-2, Class 1.

NOTE A sheath made from a nickel-based, heat-resistant alloy (such as Inconel 600 [2]) will satisfy the above requirement.

The preferred method of fastening the thermocouple to the block, after first ensuring that the thermocouple is inserted to the full depth of the hole, is by compressing the copper around the thermocouple to retain it without damage, as shown in Figure A.4.

#### 4.2.7 Temperature/time indicating/recording devices

The temperature/time indicating/recording devices shall be appropriate for the measurement of the time for the block to heat up from 100 °C ± 2 °C to 700 °C ± 3 °C with a tolerance on the measured time of ± 0,5 s.

#### 4.2.8 Fuel gas

The fuel gas shall be methane with a purity of not less than 98 %.

#### 4.2.9 Laboratory fumehood/chamber

The laboratory fumehood/chamber shall have an inside volume of at least 0,5 $m^3$, which has been shown to be satisfactory, unless otherwise stated in the test method for burning behaviour. 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 walls of the chamber shall be of a dark colour. When a lux meter facing towards the rear of the chamber is positioned in place of the test flame, 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. If fitted, the extraction device 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 1 The amount of oxygen available to support combustion of the test specimen is naturally important for the conduct of flame tests. For tests conducted by these methods when burning times are prolonged, chambers having an inside volume of 0,5 $m^3$ may not be sufficient to produce accurate results.

NOTE 2 Placing a mirror in the chamber, to provide a rear view of the test specimen, has been found useful.

### 4.3 Production of the test flame

Set up the burner supply arrangement according to Figure A.3 ensuring leak-free connections and place the burner in the laboratory fumehood/chamber.

Ignite the gas and adjust the gas flow rate to the required value. The needle valve shall be adjusted to set the gas flow rate. The air inlet shall be adjusted until the flame is completely blue in colour with no inner cone.

The overall height of the flame shall be as described in 4.1. The flame shall appear stable and symmetrical on examination.

### 4.4 Confirmation of the test flame

#### 4.4.1 Principle

The time taken for the temperature of the copper block, described in Figure 1, to increase from 100 °C ± 2 °C to 700 °C ± 3 °C shall be 44 s ± 2 s, when the flame confirmatory test arrangement of Figure A.4 is used.

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2 This information is given for the convenience of users of this international standard and does not constitute an endorsement by the IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

#### 4.4.2 Procedure

Set up the burner supply and confirmatory test arrangements according to Figures A.3 and A.4 in the laboratory fumehood/chamber as described in 4.2.9, ensuring leak-free gas connections.

Temporarily remove the burner away from the block to ensure that there is no influence of the flame on the copper block during the preliminary adjustment of the gas and air flow rates.

Ignite the gas and adjust the gas flow rate to the required value. Adjust the air inlet by turning the burner tube until the moment the yellow tip of the flame disappears. Ensure that the overall height of the flame, when measured using the gauge described in Figure 2, is within the required limits, and that the flame is symmetrical. Wait for a period of at least 5 min to allow the burner conditions to reach equilibrium. Measure the gas flow rate and determine that they are within the required limits.

With the temperature/time indicating/recording devices operational, re-position the burner under the copper block.

Determine the time for the temperature of the copper block to increase from 100 °C ± 2 °C to 700 °C ± 3 °C. If the time is 44 s ± 2 s, repeat the procedure two additional times until three successive determinations are within specification. Allow the copper block to cool naturally in air to below 50 °C between determinations. If the time of any determination is not 44 s ± 2 s, adjust the flame accordingly, allow the flame to reach equilibrium, and restart the procedure.

NOTE At temperatures above 700 °C, the thermocouple can easily be damaged, therefore it is advisable to remove the burner immediately after reaching 700 °C.

If the copper block has not been used before, make a preliminary run to condition the block surface. Discard the result.

#### 4.4.3 Verification

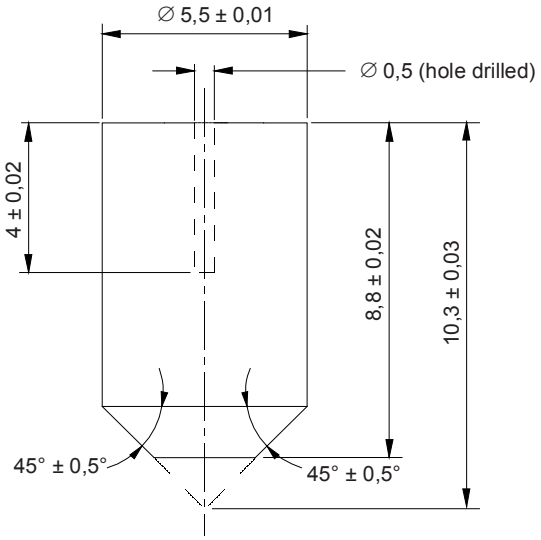
The flame is confirmed and may be used for test purposes if the results of three successive determinations are within the range 44 s ± 2 s.

## 5 Classification and designation

Apparatus that conforms with the requirements of this international standard and produces the 50 W nominal test flame may be labelled:

"50 W nominal test flame apparatus, conforming to IEC 60695-11-4".

*Dimensions in millimetres*



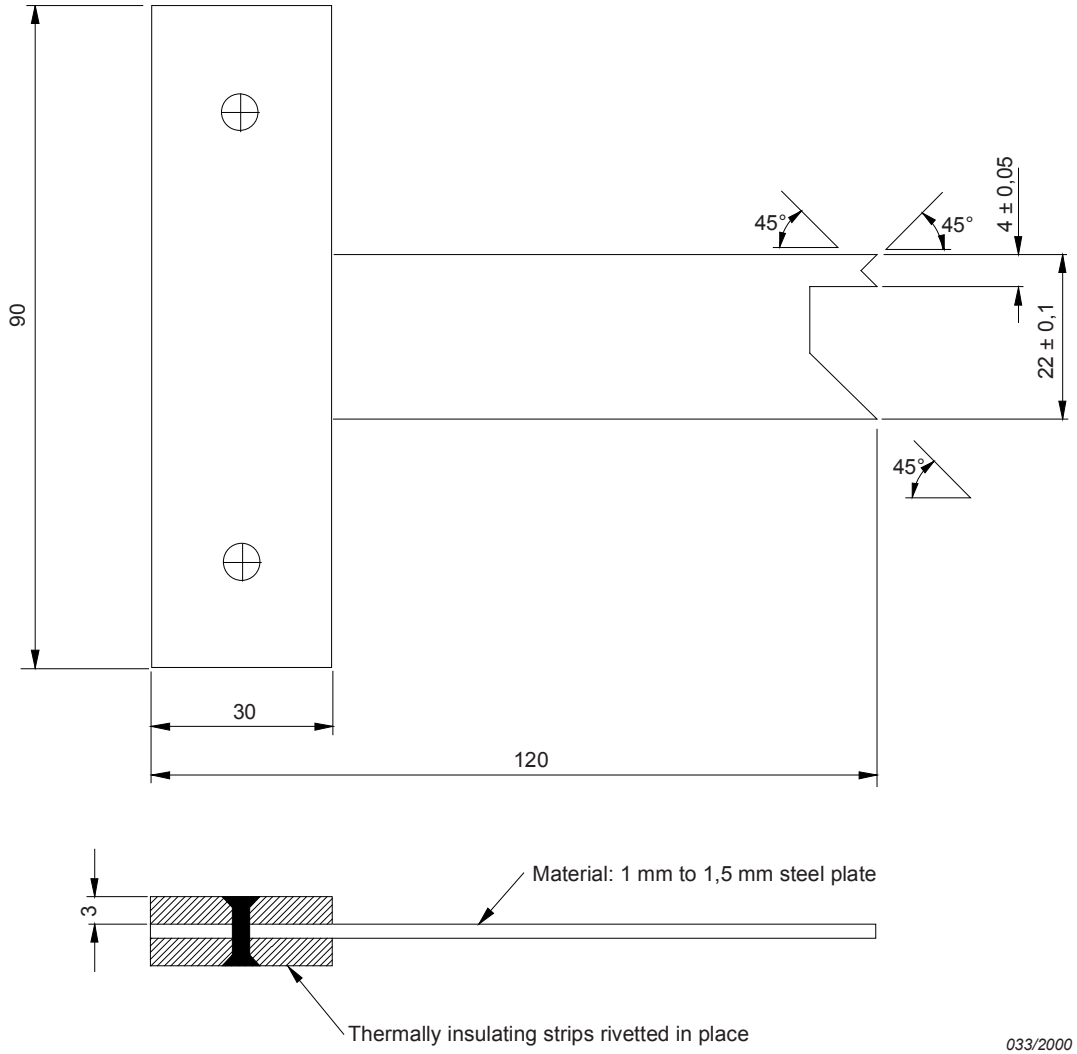

Material: high conductivity electrolytic copper Cu-ETP UNS C 11000 (see ASTM-B187/B187M-06)

Weight: 1,76 g ± 0,01 g before drilling

Tolerances: ± 0,1, ± 30 min (angular) unless otherwise stated

**Figure 1 – Copper block**

*Dimensions in millimetres*




Tolerances: ± 0,1, ± 30 min (angular) unless otherwise stated

**Figure 2 – Flame height gauge**

# Annex A
(normative)

## Test arrangements

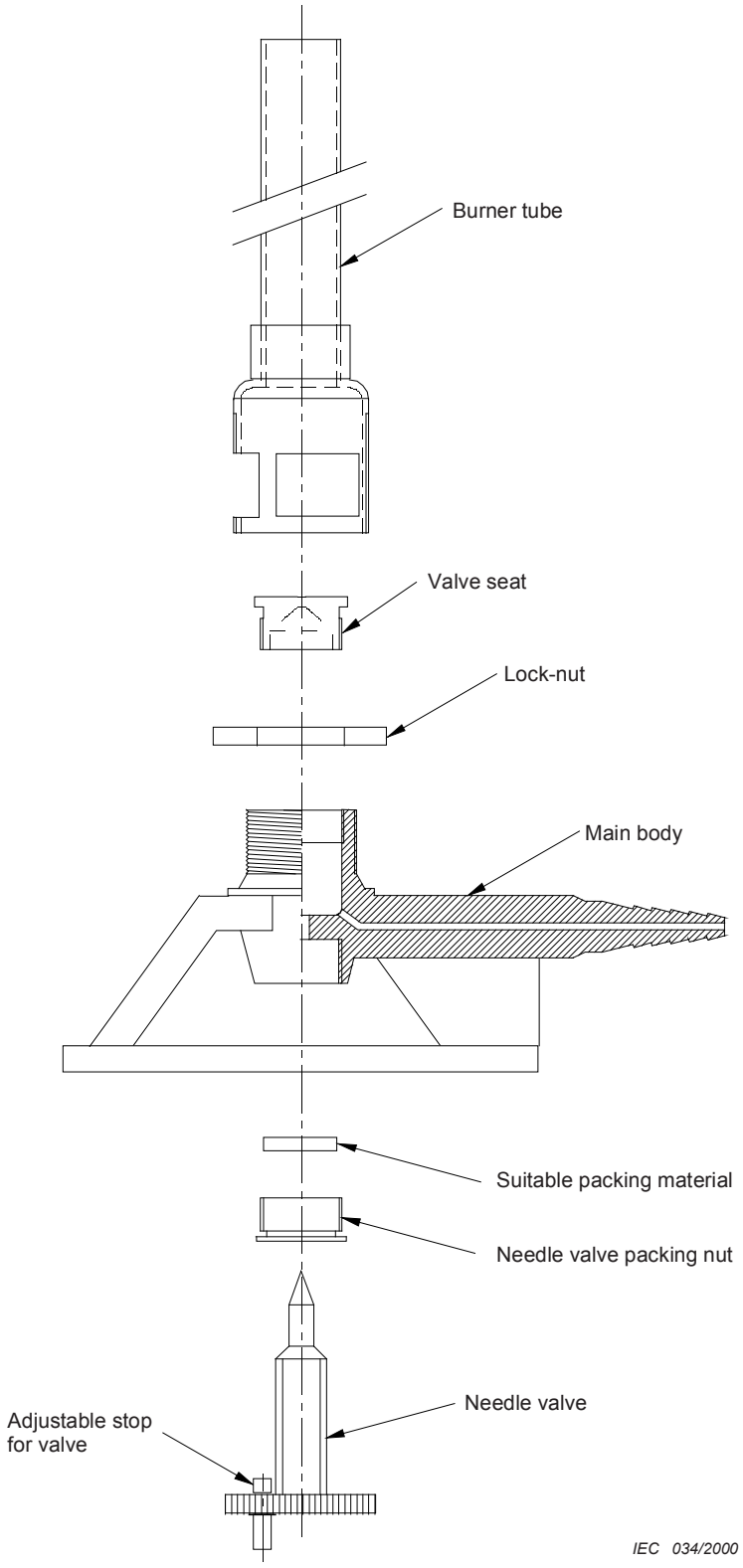
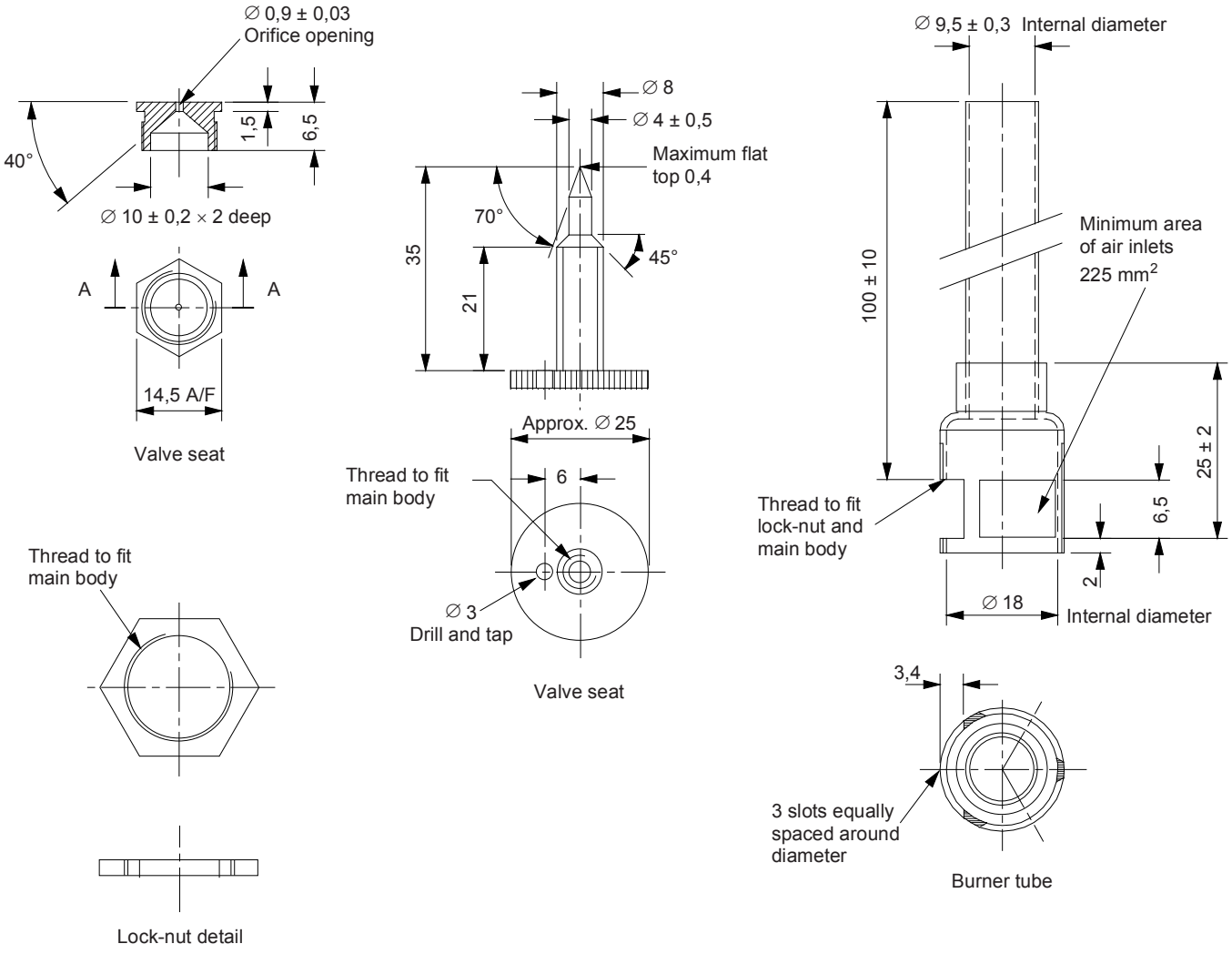



**Figure A.1 – Burner – General assembly**

*Dimensions in millimetres*

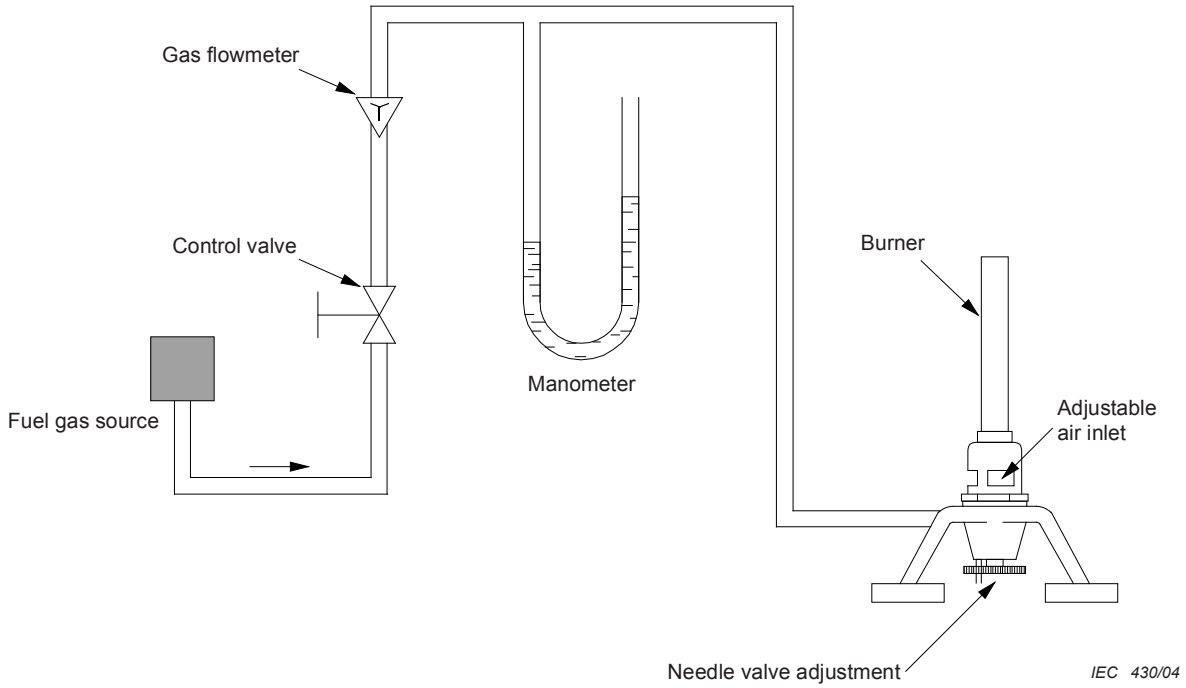



Material: brass or any other suitable material

Tolerances on linear dimensions:
xx (e.g. 20) means ± 0,5 mm
xx,x (e.g. 20,0) means ± 0,1 mm
unless otherwise stated.

Tolerances on angular dimensions:
x (e.g. 45) means ± 30 min
unless otherwise stated.

**Figure A.2 – Burner details**

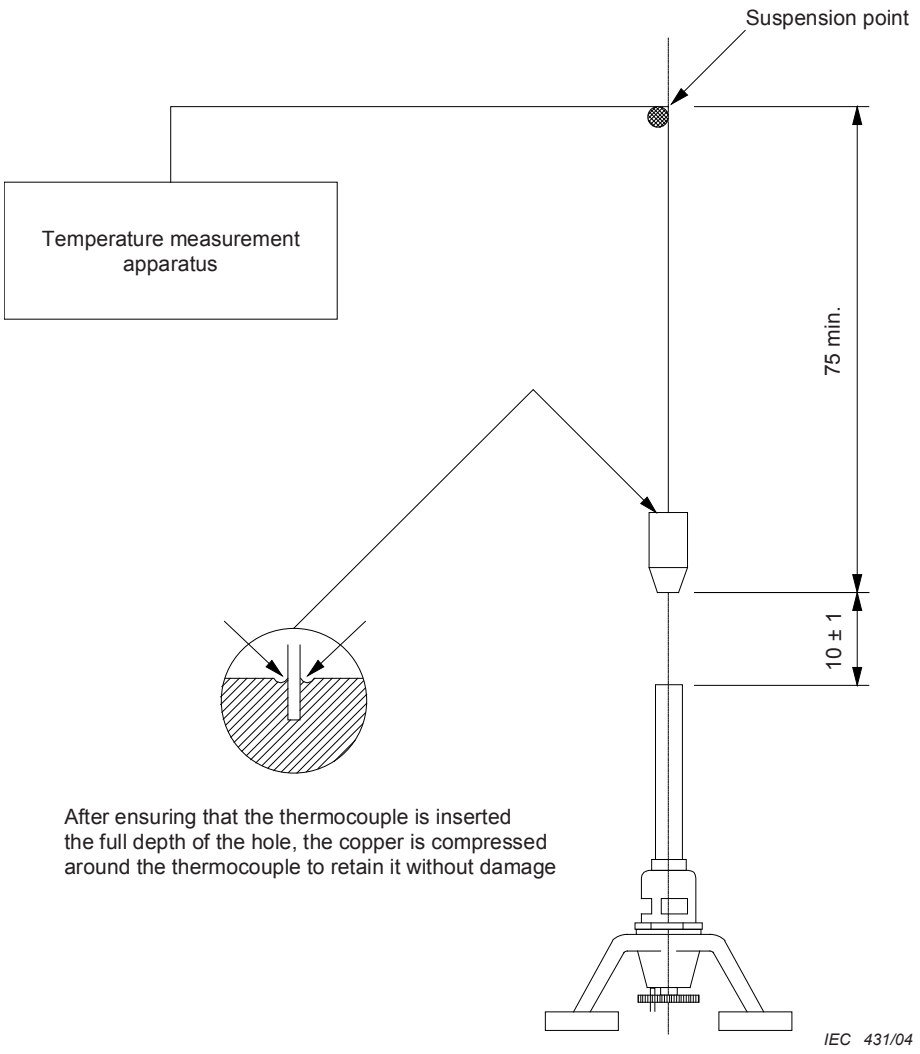



NOTE A manometer is required in conjunction with a mass flowmeter in order to maintain the required back pressure.

The inner diameter of the tubes connecting the flowmeters to the burner must be of adequate size to minimize pressure drop.

**Figure A.3 – Supply arrangement for burner (example)**

*Dimensions in millimetres*




The mode of suspension of the copper block shall be such that the block remains essentially stationary during the test.

**Figure A.4 – Confirmatory test arrangement**

# Annex B
(informative)

## Recommended arrangements for the use of the test flame

The criteria to be used for the selection of the appropriate test arrangements are given in Annexes D and E. Examples of test arrangements are shown in Figures D.1 and E.1.

When used for testing equipment, the recommended distance from the top of the burner tube to the point on the surface of the test specimen to be tested is 20 mm and the burner may be tilted to an angle of 45 ° or less and fixed in position during the test, unless otherwise stated in the relevant specification.

When used for testing bar test specimens of materials, the operator may move the flame during the test to follow the distorting or burning test specimen, and the recommended distance from the top of the burner tube to the point on the surface of the test specimen to be tested is 10 mm, unless otherwise stated in the relevant specification.

NOTE The distance of 10 mm was chosen to give better reproducibility than that obtained in the position where the tip of the flame is in contact with the bar test specimen.

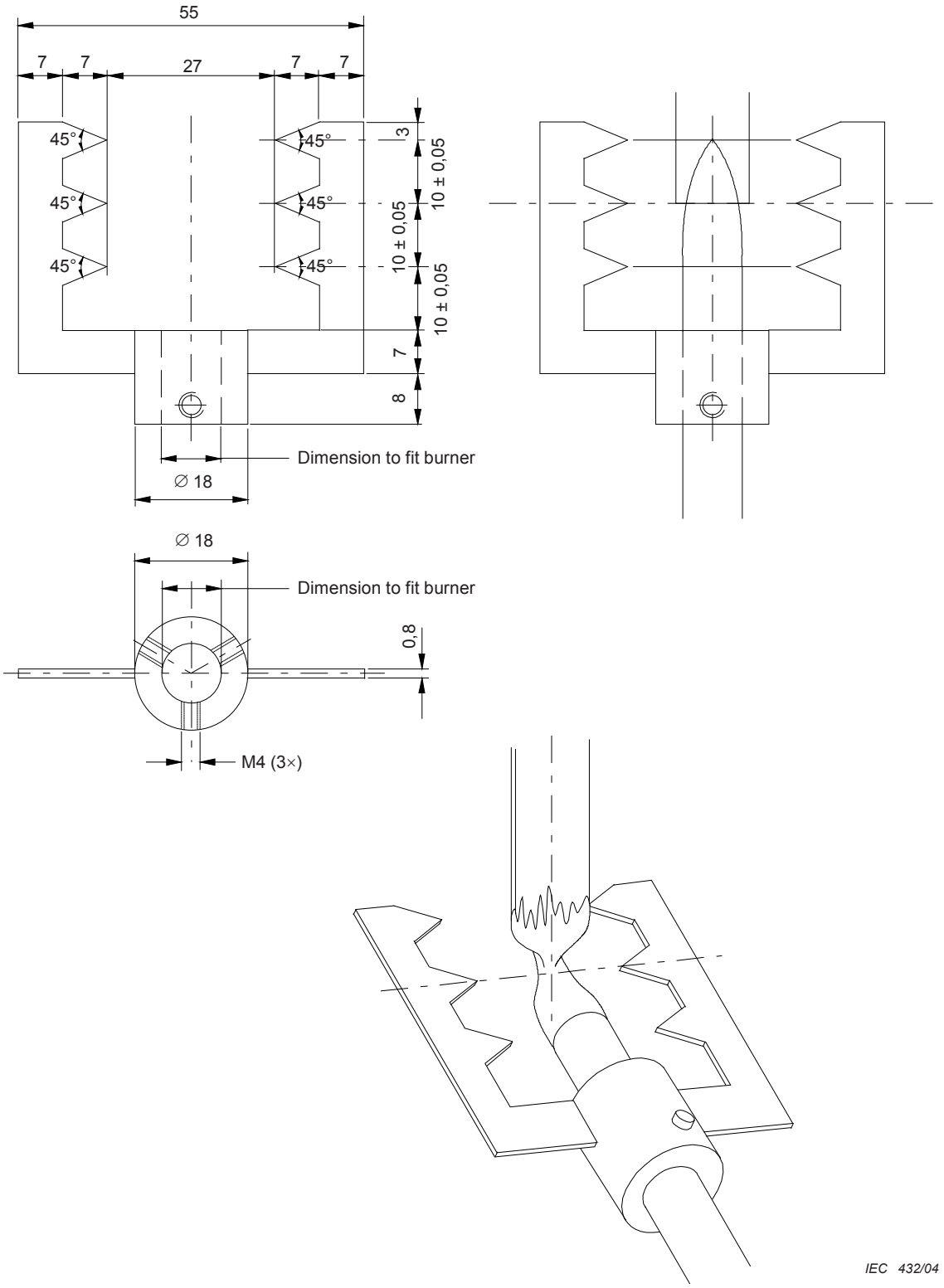
If necessary, the burner may be tilted in such a way that debris falling from the test specimen under test does not fall into the burner.

The clearance gauge shown in Figure C.1 may be secured to the top of the burner tube to assist the operator in maintaining the specified spacing between the top of the burner tube and the test specimen.

# Annex C
(informative)

## Clearance gauge

*Dimensions in millimetres*



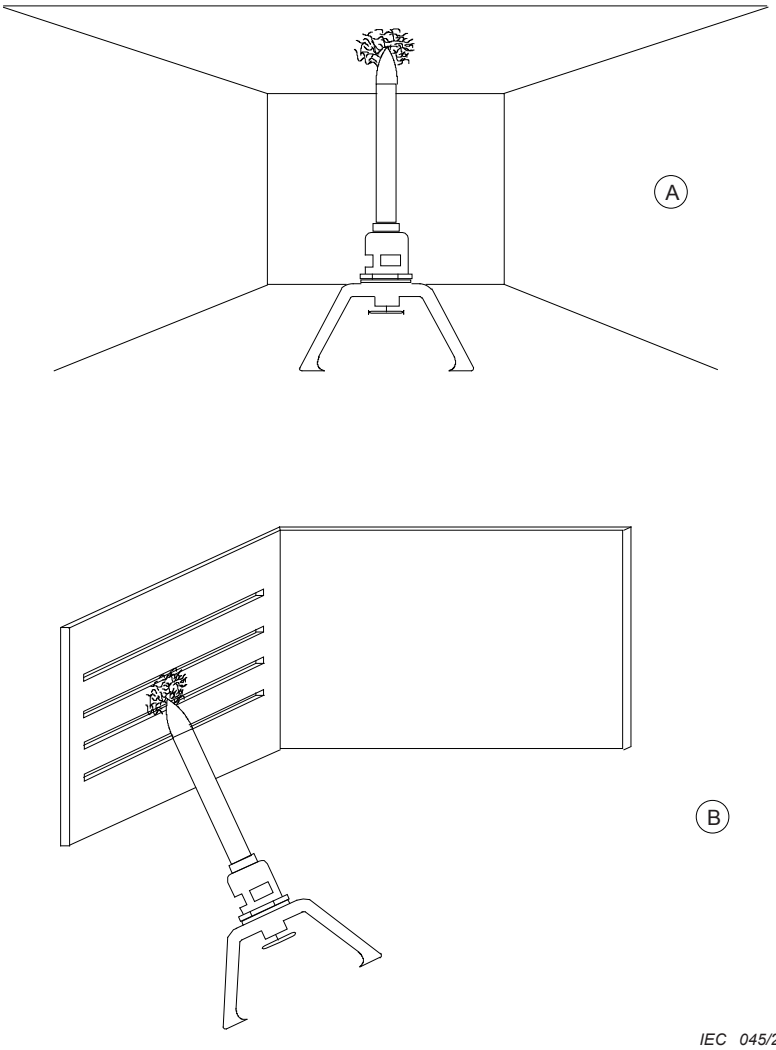

Material: stainless steel

Tolerances: ± 0,1, ± 30 min (angular) unless otherwise stated

**Figure C.1 – Clearance gauge**

# Annex D
(informative)

## Test arrangements for tests on equipment




NOTE The test flame is applied to an inside surface of the test specimen at a point judged likely to become ignited because of its proximity to a source of ignition. If ventilation openings are involved, the flame is applied to an opening, otherwise to a solid surface. In all cases, the tip of the flame should just touch the test specimen. If a vertical part is involved, the test flame is applied at any convenient angle from the vertical.

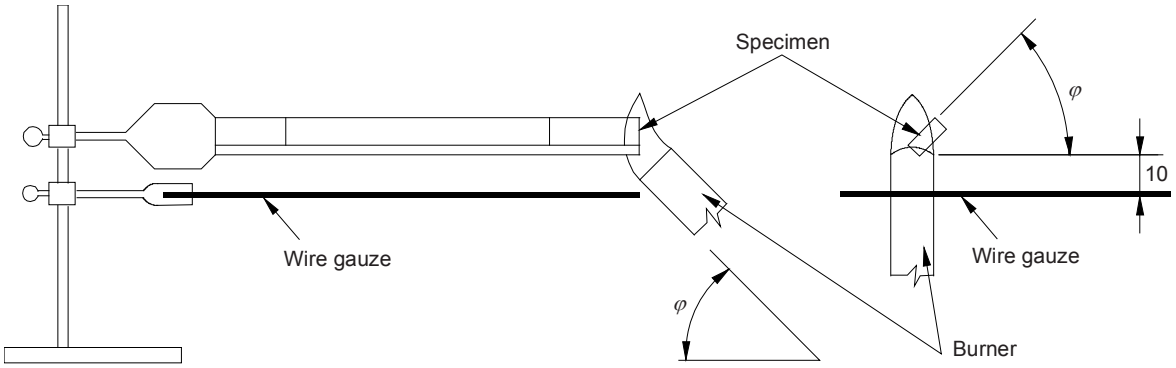
**Figure D.1 – Examples of test arrangements**

For the evaluation of materials located within a fire enclosure, namely that part of the equipment intended to minimize the spread of fire or flames from within, it is permitted to apply the test flame to an external surface of the test specimen if its size limits application internally.

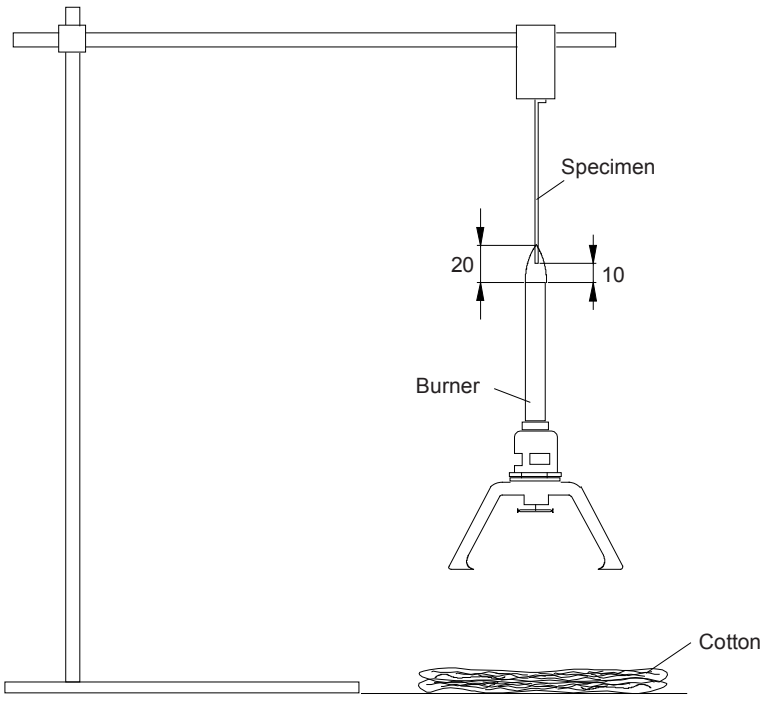
# Annex E
(informative)

## Test arrangements for tests on bar test specimens

*Dimensions in millimetres*




Horizontal burning test




Vertical burning test

IEC 046/2000

**Figure E.1 – Examples of test arrangements**

## Bibliography

IEC 60695-11-2:2003, *Fire hazard testing – Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

IEC 60695-11-3:2011, *Fire hazard testing – Part 11-3: Test flames – 500 W flames – Apparatus and confirmational test methods*

IEC/TS 60695-11-40:2002, *Fire hazard testing – Part 11-40: Test flames – Confirmatory tests – Guidance*

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