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Edition 3.0 2017-06
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

BASIC SAFETY PUBLICATION

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

IEC 60695-11-2:2017-06 RLV(en)

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Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60695-11-2 has been prepared by IEC technical committee 89: Fire hazard testing.

The text of this International Standard is based on the following documents:

CDV	Report on voting
89/1327/CDV	89/1354/RVC

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

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

This third edition of IEC 60695-11-2 cancels and replaces the second edition published in 2013. It constitutes a technical revision.

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

This edition includes the following significant technical changes with respect to the previous edition:

- addition of an alternative production of the test flame;
- deletion of Annex B.

In this standard, the following print types are used:

- **terms defined within Clause 3: in bold type**

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

Part 11 consists of the following parts:

Part 11-2: *Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

Part 11-3: *Test flames – 500 W flames – Apparatus and confirmational test methods*

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

Part 11-5: *Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

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

Part 11-20: *Test flames – 500 W flame test methods*

Part 11-30: *Test flames – History and development from 1979 to 1999*

Part 11-40: *Test flames – Confirmatory tests – Guidance*

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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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. The IEC has developed IEC 60695-1-10 [1][1], together with its companion, IEC 60695-1-11 [2], 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 risk assessment.

IEC 60695-11-2 provides a description of the apparatus required to produce a 1 kW test flame, and provides a description of the principle of a confirmation procedure to check that the effective power output of the flame is as intended. Guidance on confirmatory tests for test flames is given in IEC TS 60695-11-40 [3].

This part of IEC 60695 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.

1 Numbers in square brackets refer to the bibliography.

FIRE HAZARD TESTING –

Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance

1 Scope

This part of IEC 60695 gives the requirements for the production and confirmation of a nominal 1 kW propane/air **pre-mixed ~~test~~ flame** for use in fire hazard testing.

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 [4] and ISO/IEC Guide 51 [5].

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 are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60584-1~~:1995~~, *Thermocouples – Part 1: ~~Reference tables~~ EMF specifications and tolerances*

~~IEC 60584-2:1982, *Thermocouples – Part 2: Tolerances*~~
~~Amendment 1:1989~~

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

3 Terms and definitions

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

3.1
combustion
exothermic reaction of a substance with an oxidizing agent

Note 1 to entry **Combustion** generally emits fire effluent accompanied by **flames** and/or glowing.

[SOURCE: ISO~~/IEC~~ 13943:2008, definition 4.46]

3.2
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 × s^{-1} or 0,2 m × s^{-1} sometimes specified.

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

3.3
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]

3.4
pre-mixed flame
flame in which **combustion** occurs in an intimate mixture of fuel and oxidizing agent

[SOURCE: ISO~~/IEC~~ 13943:2008, definition 4.259]

3.5
standardized 1 kW test flame
test **flame** conforming to this international standard and meeting all of the requirements given in Clauses 4 to 6

4 Burner/supply arrangement

4.1 Requirements

A **standardized 1 kW test flame**, according to this method, is one that is produced

- using hardware according to Figure A.1 to Figure A.1,
- supplied with propane gas of purity not less than 95 %,
- supplied with air essentially free of oil and water.

The **flame** shall be symmetrical, stable and give a result of 46 s ± 6 s in the confirmatory test described in Clause 6.

The confirmatory test arrangement shown in Figure A.8 shall be used.

4.2 Apparatus and fuel

4.2.1 Burner

The burner shall be in accordance with Figure A.1 to Figure A.5 inclusive.

NOTE The gas injector and **flame** stabilizer are removable for cleaning purposes.

4.2.2 Flow control

Flow controllers shall be used and shall be capable of:

- the measurement and control of a propane gas flow rate of about 650 cm^3/min at 23 °C and 0,1 MPa, with an adequate accuracy ~~of ± 2 %~~ to measure within the tolerance specified in the relevant test method (see Clause 5),
- the measurement and control of an air flow rate of about 10 dm^3/min at 23 °C and 0,1 MPa, with an adequate accuracy ~~of ± 2 %~~ to measure within the tolerance specified in the relevant test method (see Clause 5).

NOTE Mass flow controllers ~~will probably~~ have been found to be ~~used in order~~ suitable to meet the requirements of Clause 5.

4.2.3 Copper block

A copper block 9 mm in diameter, with a mass of 10,00 g ± 0,05 g in the fully machined but undrilled state, as described in Figure A.7, shall be made from electrolytic tough pitch copper Cu-ETP USN C11000 [6].

4.2.4 Thermocouple

A ~~class 1, in accordance with IEC 60584-1,~~ mineral-insulated, metal-sheathed fine-wire thermocouple with an insulated junction, shall be used for measuring the temperature of the copper block. 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~~ 60584-1, class 1.

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

The preferred method of fastening the thermocouple to the copper block is by first ensuring that the thermocouple is inserted to the full depth of the hole and then by compressing the copper around the thermocouple as shown in Figure A.8.

4.2.5 Temperature/time indicating/recording devices

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

4.2.6 Laboratory fumehood/chamber

The laboratory fume hood/chamber shall have an inside volume of at least 1,0 m^3. The chamber shall provide a **draught-free environment**, whilst allowing normal thermal circulation of air around the test specimen. The chamber shall permit observation of tests in progress. Unless otherwise stated in the relevant specification, the inside surfaces 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 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~~ should be fitted with an extraction device, such as an exhaust fan, to remove products of **combustion** which ~~may~~ could 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 important for the conduct of this **flame** test. For tests conducted by this method when burning times are prolonged, chambers having an inside volume of 1,0 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 to be useful.

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2 ~~Inconel is the trademark of a product supplied by Special Metals Corporation.~~ 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.

5 Production of the test flame

5.1 Selection of the method

Unless otherwise specified in the relevant standard, method A shall be used.

5.2 Method A

Set up the burner supply arrangement according to Figure A.6 ensuring leak-free connections and place the burner in the laboratory fume hood/chamber.

Ignite the gas and adjust the gas and air flow rates to the following values.

The volume flow rate of propane gas shall be equivalent to 650 cm^3/min ± 10 cm^3/min when measured at 23 °C and 0,1 MPa.

The volume flow rate of air shall be equivalent to 10,0 dm^3/min ± 0,3 dm^3/min when measured at 23 °C and 0,1 MPa.

NOTE These volume flow rates correspond to mass flow rates of 1,184 g/min ± 0,018 g/min for propane gas (density at 23 °C and 0,1 MPa = 1,821 g/dm^3), and 11,64 g/min ± 0,35 g/min for air (density at 23 °C and 0,1 MPa = 1,1764 g/dm^3).

The **flame** shall appear stable and symmetrical on examination.

5.3 Method B (alternative)

Set up the burner supply arrangement according to Figure A.6 ensuring leak-free connections and place the burner in the laboratory fume hood/chamber.

Ignite the gas and adjust the gas and air flow rates to the following values.

The volume flow rate of propane gas shall be equivalent to 650 cm^3/min ± 30 cm^3/min when measured at 23 °C and 0,1 MPa.

The volume flow rate of air shall be equivalent to 10,0 dm^3/min ± 0,5 dm^3/min when measured at 23 °C and 0,1 MPa.

NOTE These volume flow rates correspond to mass flow rates of 1,184 g/min ± 0,054 g/min for propane gas (density at 23 °C and 0,1 MPa = 1,821 g/dm^3), and 11,64 g/min ± 0,58 g/min for air (density at 23 °C and 0,1 MPa = 1,1764 g/dm^3).

The **flame** shall appear stable and symmetrical on examination.

6 Confirmation of the test flame

6.1 Principle

The time for the temperature of the copper block, described in Figure A.6, to increase from 100 °C ± 5 °C to 700 °C ± 3 °C shall be 46 s ± 6 s when the **flame** test arrangement of Figure A.8 is used.

6.2 Frequency of confirmatory tests

The confirmatory test shall be done;

a) when the gas supply is changed, or test equipment is replaced, or when data are questioned;

and either

b) before use of the test **flame** if the period between use exceeds one month;

or

c) at least once a month if the period between use is less than or equal to one month.

6.3 Procedure

Set up the burner supply and confirmatory test arrangement according to Figure A.8 in the laboratory fume hood/chamber, ensuring leak-free gas connections.

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

Ignite the gas and adjust the gas and air flow rates to the values specified in Clause 5. Ensure that the **flame** is symmetrical. The approximate dimensions of the **flame** (see Figure 1), when measured in the laboratory fume hood/chamber and viewed in subdued light, are as follows:

- blue cone height: 46 mm to 78 mm;
- overall **flame** height: 148 mm to 208 mm.

Wait for a period of at least 5 min to allow the burner conditions to reach equilibrium.

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

Determine the time for the temperature of the block to increase from 100 °C ± 5 °C to 700 °C ± 3 °C. If the time is 46 s ± 6 s, record the gas and air flow rates and repeat the procedure two additional times until three successive determinations are each 46 s ± 6 s. Allow the block to cool naturally in air to below 50 °C between determinations. If the time of any determination is not 46 s ± 6 s, then all parts of the apparatus should be checked to ensure that they are in accordance with this international standard.

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 copper block surface. Discard the result.

7 Recommended arrangements for use of the test flame

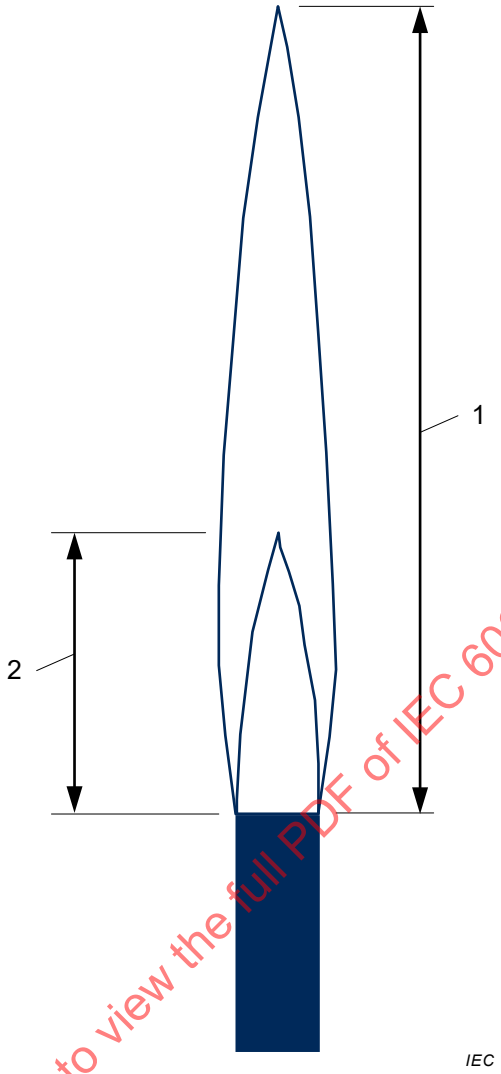
~~Examples of appropriate test arrangements are given in Annex B (see Figure B.1).~~

When used for testing equipment, unless otherwise stated in the relevant standard, the recommended distance from the top of the burner tube to the point on the surface of the test specimen to be tested is approximately 100 mm and the burner shall be fixed in position during the test.

NOTE The distance of 100 mm was chosen to give better reproducibility than the position where the tip of the blue cone is in contact with the test specimen.

When used for testing strips of materials, where the operator may move the **flame** during the test to follow the distorting or burning test specimen, the tip of the blue cone should be as close as possible without touching the test specimen.

The burner shall be tilted in such a way that debris falling from the test specimen under test does not fall into the burner.



Key

1 Overall flame height (148 mm to 208 mm)

2 Blue cone height (46 mm to 78 mm)

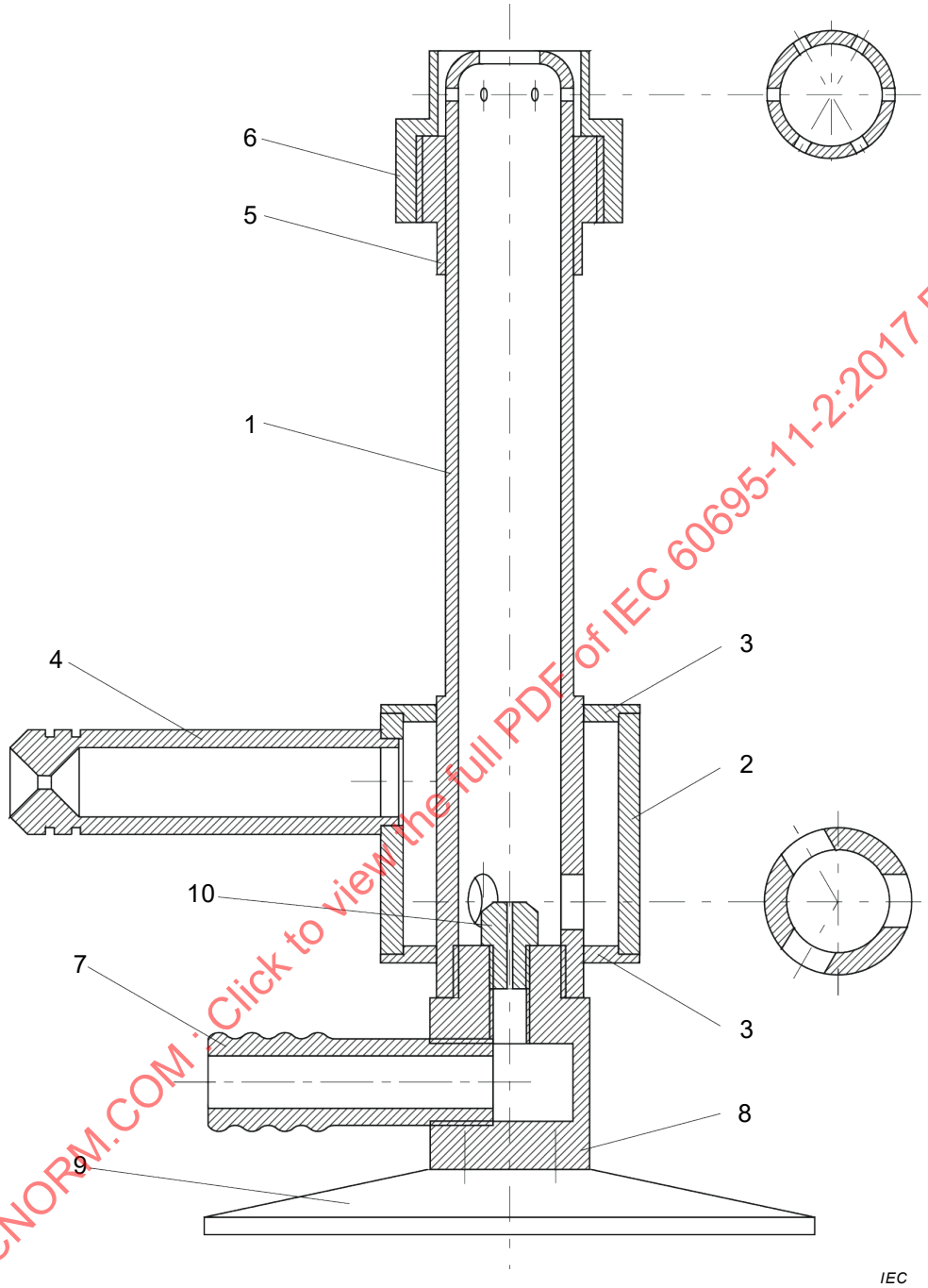
Figure 1 – Flame dimensions

Annex A
(normative)

Burner details, arrangements and confirmatory test

A.1 Burner construction

~~Burner construction is demonstrated in~~ Figure A.1 through Figure A.8 illustrate the burner assembly.



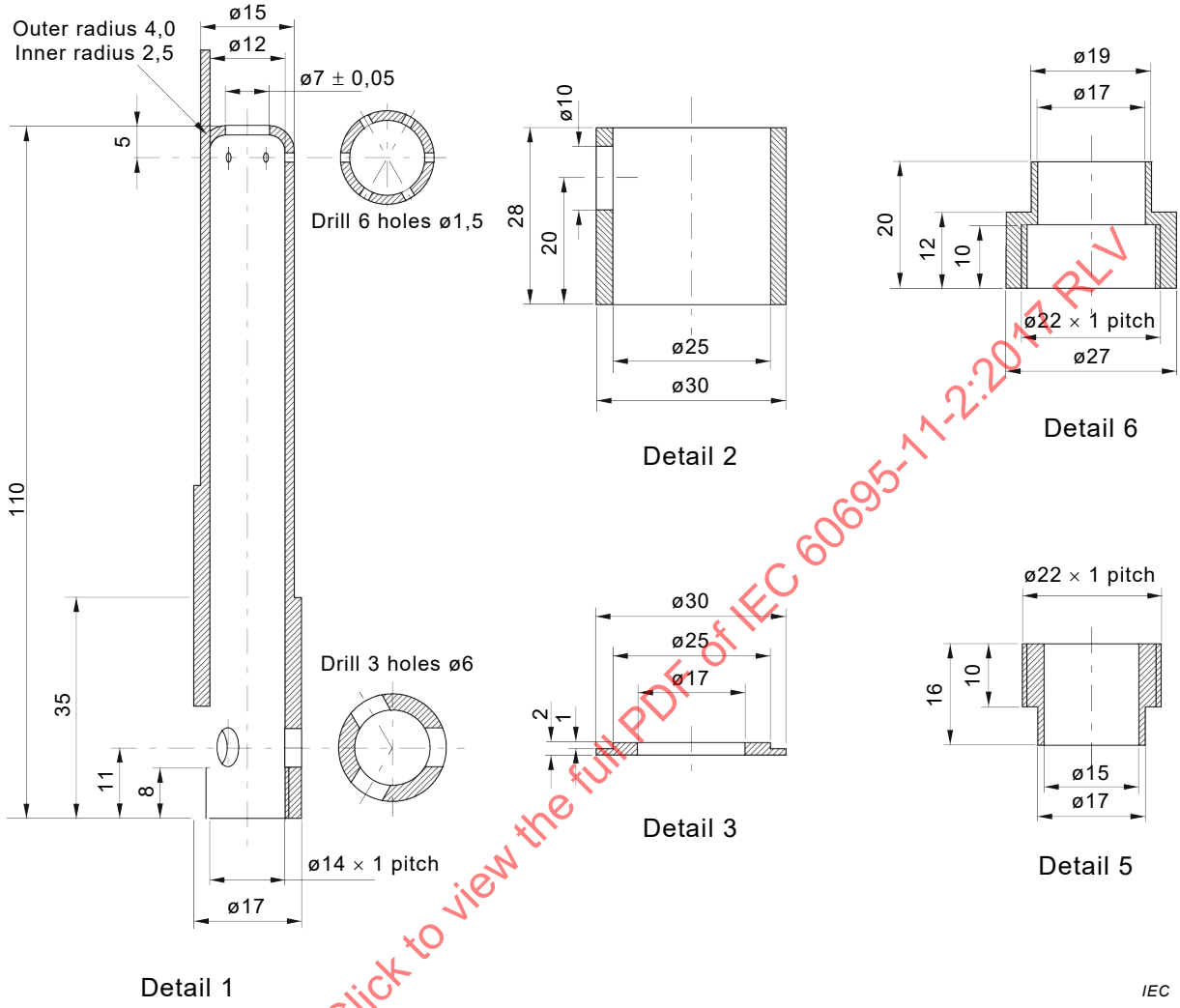
Key

1	Burner barrel	Parts 1, 2, 3, 4, and 5 are hard soldered on assembly.
2, 3	Air manifold	Parts 7 and 8 may be hard soldered together, if necessary, to prevent gas leakage.
4	Air supply tube	Parts 8 and 9 may be fabricated in one piece, or otherwise fastened together, to prevent gas leakage.
5, 6	Flame stabilizer	Parts 1, 2, 3, 5 and 6 are detailed in Figure A.2.
7	Gas supply tube	Parts 8 and 9 are detailed in Figure A.3.
8	Elbow block	Parts 7 and 10 are detailed in Figure A.4.
9	Burner base	Part 4 is detailed in Figure A.5.
10	Gas jet	

Figure A.1 – General assembly

Dimensions in millimetres

Tolerances ± 0,1 unless otherwise stated

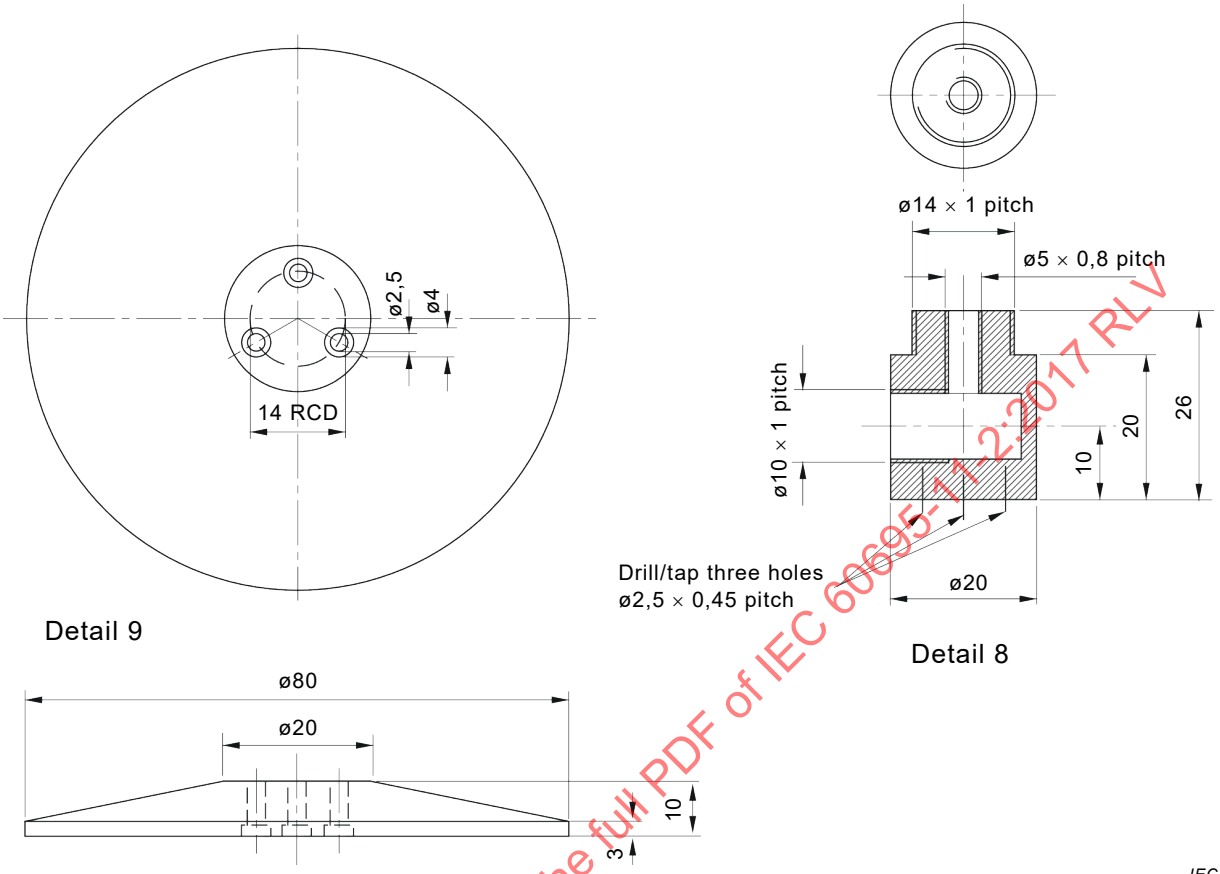


Material: brass

Figure A.2 – ~~Pre-mixed~~ Burner details (1)

Dimensions in millimetres

Tolerances ± 0,1 unless otherwise stated



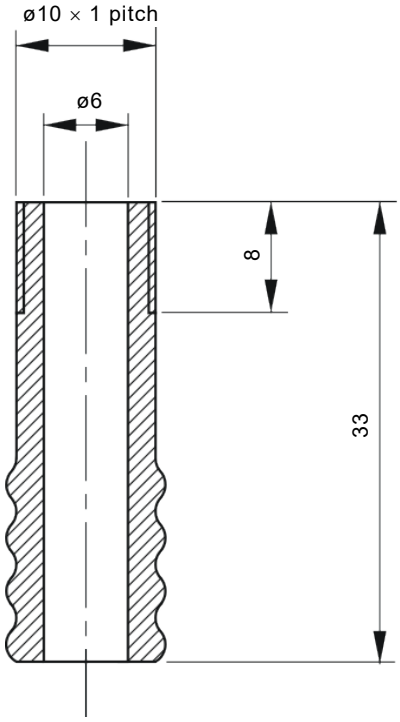
NOTE The shape of part 9 is given as an example.

Material: brass or any other suitable material.

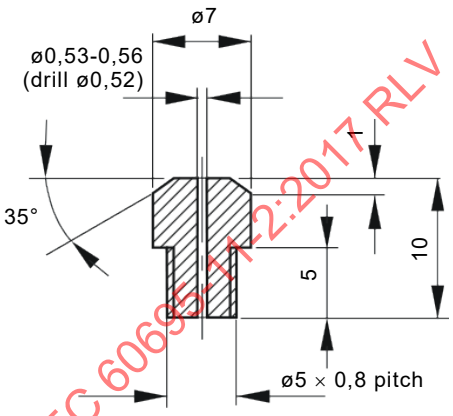
Figure A.3 – ~~Pre-mixed~~ Burner details (2)

Dimensions in millimetres

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



Detail 7



Detail 10

Gas injector

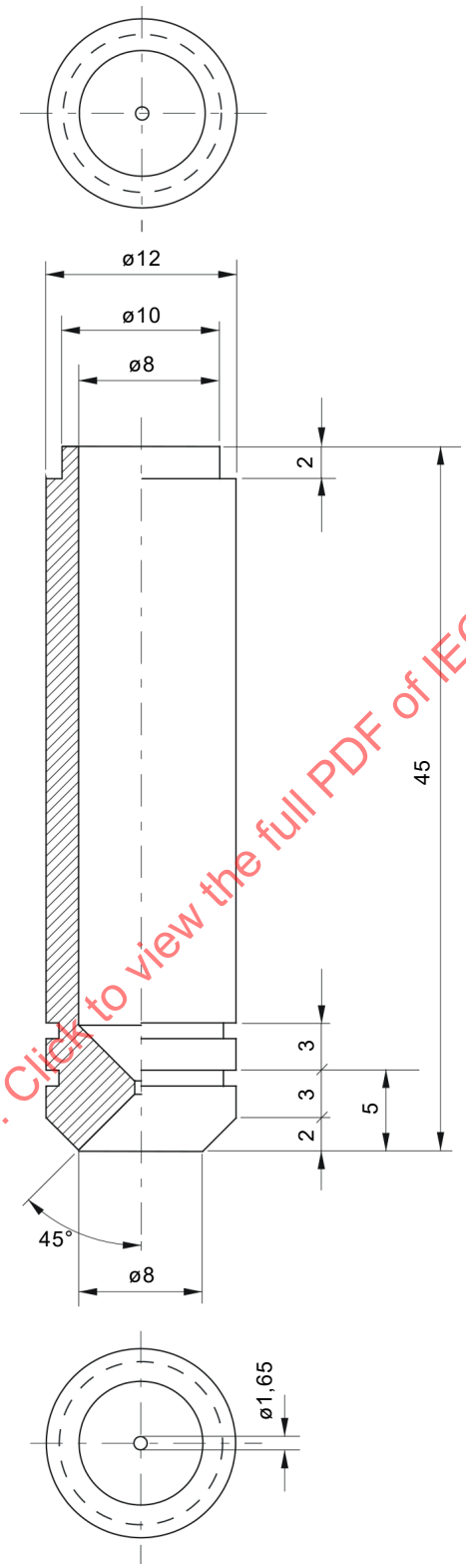
IEC

Material: brass

Figure A.4 – ~~Pre-mixed~~ Burner details (3)

Dimensions in millimetres

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



Detail 4

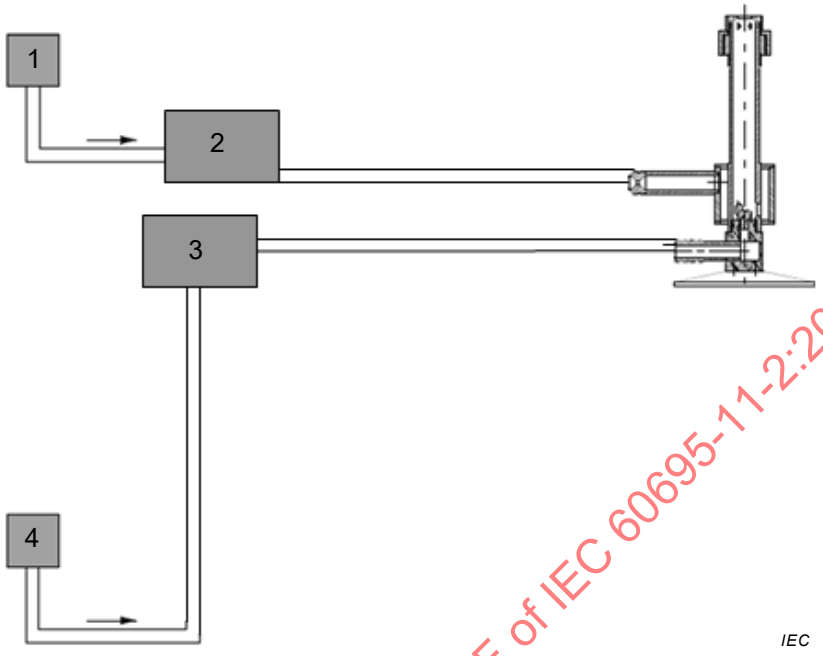
IEC

Material: brass

Figure A.5 – ~~Pre-mixed~~ Burner details (4)

A.2 Gas supply arrangement

Figure A.1 illustrates the gas supply arrangement to the burner.



Key

1 Compressed air supply
2 Air flow control and measurement
3 Gas flow control and measurement
4 Gas supply

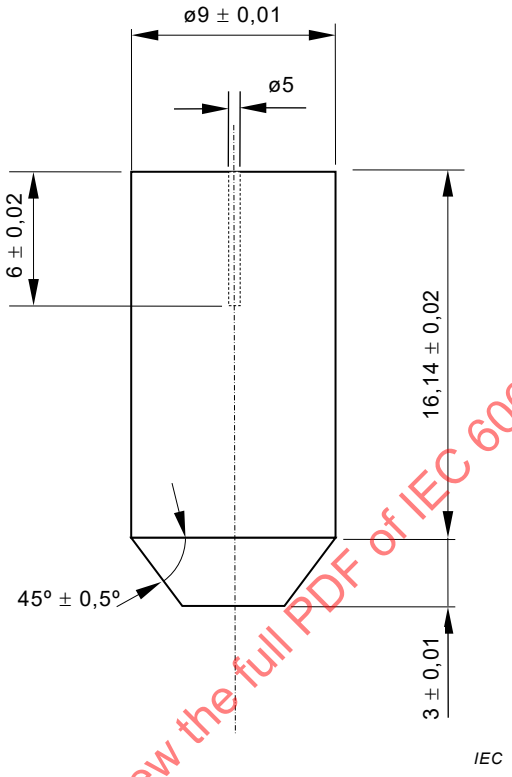
Figure A.6 – Example of supply arrangement for burner

A.3 The copper block

Figure A.1 gives the dimensions of the copper block

Dimensions in millimetres

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



The copper block shall be polished on all external surfaces.

Material: electrolytic copper Cu-ETP USN C11000 [6]

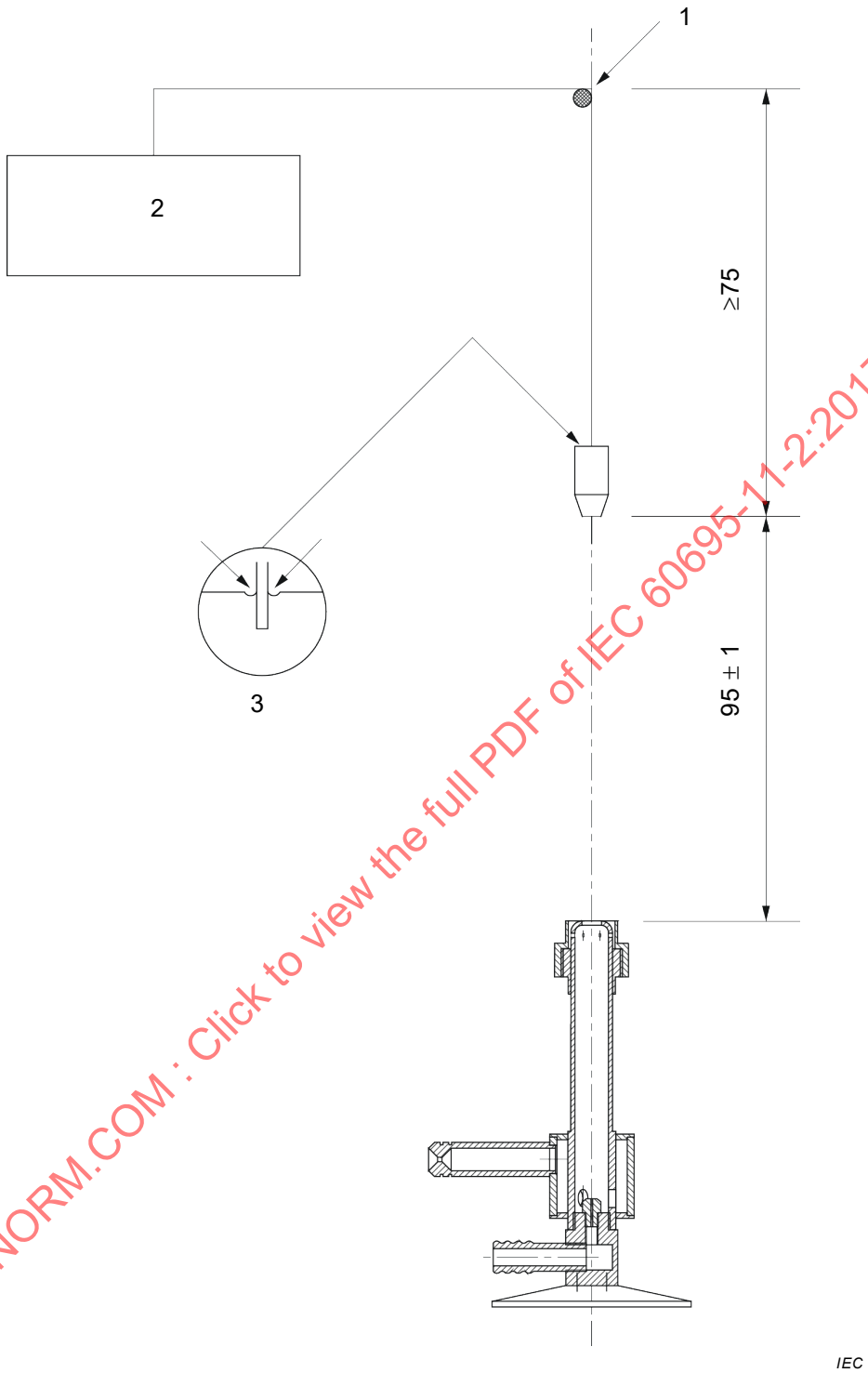
Mass: 10,00 g ± 0,05 g before drilling

Figure A.7 – Copper block

A.4 Confirmatory test

Figure A.1 shows the arrangement of the apparatus for a confirmatory test.

Dimensions in millimetres



Key

1 Suspension point

2 Temperature indicating/recording device(s) and Time indicating/recording device(s)

3 After first ensuring that the thermocouple is inserted to the full depth of the hole, the copper is compressed around the thermocouple to retain it without damage.

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

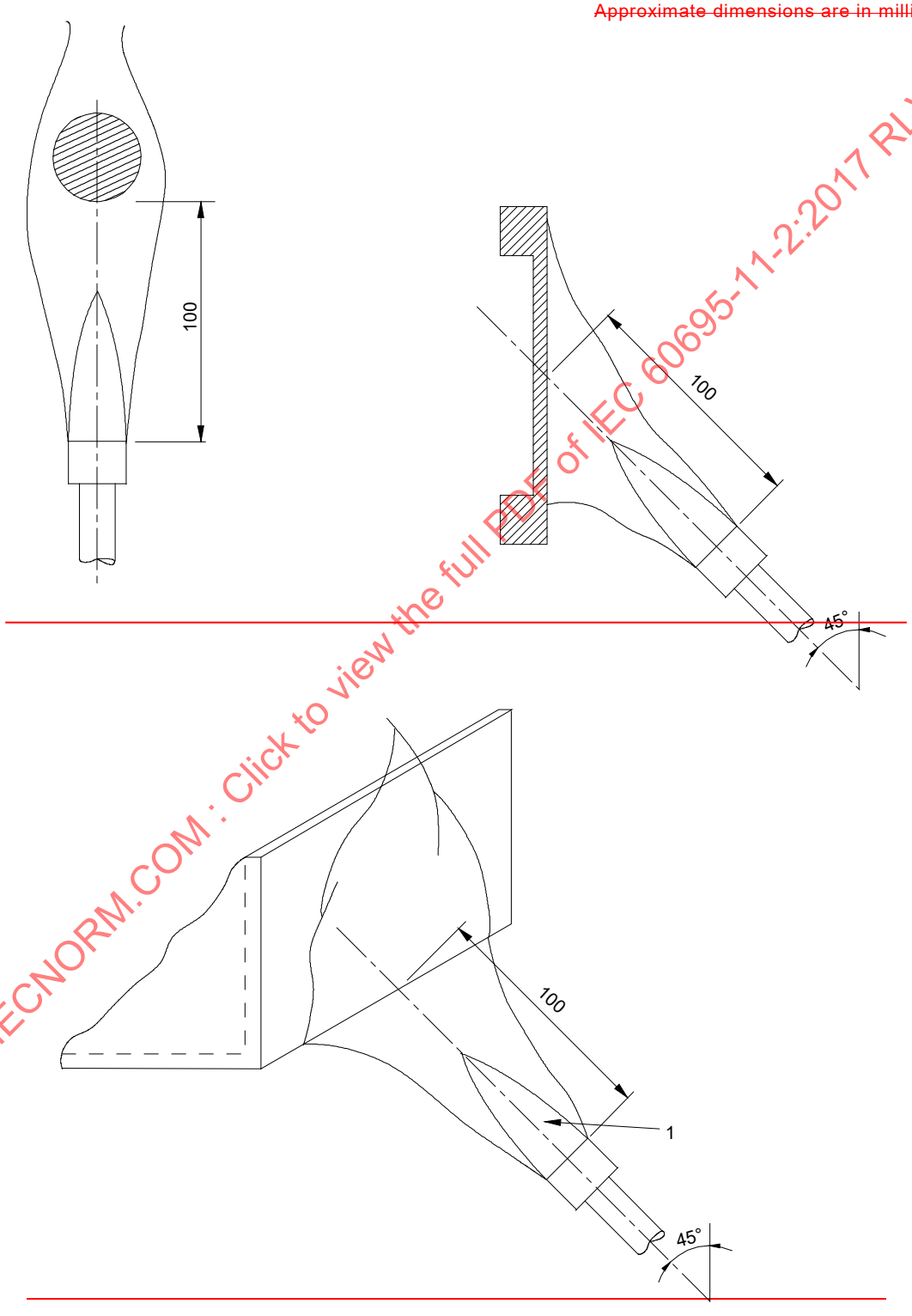
Figure A.8 – Confirmatory test arrangement

Annex B
(informative)

Examples of test arrangements

Examples of appropriate test arrangements are demonstrated in Figure B.1.

Approximate dimensions are in millimetres



Key

1 Blue cone

Figure B.1 – Examples of test arrangements

Bibliography

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

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

[3] IEC TS 60695-11-40, *Fire hazard testing – Part 11-40: Test flames – Confirmatory tests – Guidance*

[4] IEC GUIDE 104~~:2010~~, *The preparation of safety publications and the use of basic safety publications and group safety publications*

[5] ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

[6] ISO 1337:1980, *Wrought coppers (having minimum copper contents of 99,85 %) – Chemical composition and forms of wrought products*

NOTE This publication was withdrawn without replacement in 2000-03 by ISO/TC 26. The replacement call out for electrolytic tough pitch copper is: Cu-ETP USN C11000 [6].

IEC 60695-11-2

Edition 3.0 2017-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

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

Essais relatifs aux risques du feu – Partie 11-2: Flammes d'essai – Flamme à prémélange de 1 kW nominal – Appareillage, configuration pour l'essai de vérification et préconisations

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIRE HAZARD TESTING –

Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60695-11-2 has been prepared by IEC technical committee 89: Fire hazard testing.

The text of this International Standard is based on the following documents:

CDV	Report on voting
89/1327/CDV	89/1354/RVC

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

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

This third edition of IEC 60695-11-2 cancels and replaces the second edition published in 2013. It constitutes a technical revision.

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

This edition includes the following significant technical changes with respect to the previous edition:

- addition of an alternative production of the test flame;
- deletion of Annex B.

In this standard, the following print types are used:

- **terms defined within Clause 3: in bold type**

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

Part 11 consists of the following parts:

Part 11-2: *Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance*

Part 11-3: *Test flames – 500 W flames – Apparatus and confirmational test methods*

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

Part 11-5: *Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

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

Part 11-20: *Test flames – 500 W flame test methods*

Part 11-30: *Test flames – History and development from 1979 to 1999*

Part 11-40: *Test flames – Confirmatory tests – Guidance*

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

In the design of any electrotechnical product, the risk of fire and the potential hazards associated with fire need to be considered. In this respect the objective of component, circuit, and product design, as well as the choice of materials, is to reduce to acceptable levels the potential risks of fire during normal operating conditions, reasonable foreseeable abnormal use, malfunction, and/or failure. The IEC has developed IEC 60695-1-10 [1][1], together with its companion, IEC 60695-1-11 [2], 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 risk assessment.

IEC 60695-11-2 provides a description of the apparatus required to produce a 1 kW test flame, and provides a description of the principle of a confirmation procedure to check that the effective power output of the flame is as intended. Guidance on confirmatory tests for test flames is given in IEC TS 60695-11-40 [3].

This part of IEC 60695 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.

[1] Numbers in square brackets refer to the bibliography.

FIRE HAZARD TESTING –

Part 11-2: Test flames – 1 kW nominal pre-mixed flame – Apparatus, confirmatory test arrangement and guidance

1 Scope

This part of IEC 60695 gives the requirements for the production and confirmation of a nominal 1 kW propane/air **pre-mixed flame** for use in fire hazard testing.

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 [4] and ISO/IEC Guide 51 [5].

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 are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60584-1, *Thermocouples - Part 1: EMF specifications and tolerances*

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

3 Terms and definitions

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

3.1
combustion
exothermic reaction of a substance with an oxidizing agent

Note 1 to entry **Combustion** generally emits fire effluent accompanied by **flames** and/or glowing.

[SOURCE: ISO 13943:2008, definition 4.46]

3.2
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 × s^{-1} or 0,2 m × s^{-1} sometimes specified.

[SOURCE: ISO 13943:2008, definition 4.70]

3.3
flame, noun
rapid, self-sustaining, sub-sonic propagation of **combustion** in a gaseous medium, usually with emission of light

[SOURCE: ISO 13943:2008, definition 4.133]

3.4
pre-mixed flame
flame in which **combustion** occurs in an intimate mixture of fuel and oxidizing agent

[SOURCE: ISO 13943:2008, definition 4.259]

3.5
standardized 1 kW test flame
test **flame** conforming to this international standard and meeting all of the requirements given in Clauses 4 to 6

4 Burner/supply arrangement

4.1 Requirements

A **standardized 1 kW test flame**, according to this method, is one that is produced

- using hardware according to Figure A.1 to Figure A.1,
- supplied with propane gas of purity not less than 95 %,
- supplied with air essentially free of oil and water.

The **flame** shall be symmetrical, stable and give a result of 46 s ± 6 s in the confirmatory test described in Clause 6.

The confirmatory test arrangement shown in Figure A.8 shall be used.

4.2 Apparatus and fuel

4.2.1 Burner

The burner shall be in accordance with Figure A.1 to Figure A.5 inclusive.

NOTE The gas injector and **flame** stabilizer are removable for cleaning purposes.

4.2.2 Flow control

Flow controllers shall be used and shall be capable of:

- the measurement and control of a propane gas flow rate of about 650 cm^3/min at 23 °C and 0,1 MPa, with an adequate accuracy to measure within the tolerance specified in the relevant test method (see Clause 5),
- the measurement and control of an air flow rate of about 10 dm^3/min at 23 °C and 0,1 MPa, with an adequate accuracy to measure within the tolerance specified in the relevant test method (see Clause 5).

NOTE Mass flow controllers have been found to be suitable to meet the requirements of Clause 5.

4.2.3 Copper block

A copper block 9 mm in diameter, with a mass of 10,00 g ± 0,05 g in the fully machined but undrilled state, as described in Figure A.7, shall be made from electrolytic tough pitch copper Cu-ETP USN C11000 [6].

4.2.4 Thermocouple

A mineral-insulated, metal-sheathed fine-wire thermocouple with an insulated junction, shall be used for measuring the temperature of the copper block. 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 60584-1, class 1.

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

The preferred method of fastening the thermocouple to the copper block is by first ensuring that the thermocouple is inserted to the full depth of the hole and then by compressing the copper around the thermocouple as shown in Figure A.8.

4.2.5 Temperature/time indicating/recording devices

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

4.2.6 Laboratory fumehood/chamber

The laboratory fume hood/chamber shall have an inside volume of at least 1,0 m^3. The chamber shall provide a **draught-free environment**, whilst allowing normal thermal circulation of air around the test specimen. The chamber shall permit observation of tests in progress. Unless otherwise stated in the relevant specification, the inside surfaces 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 specimen, the recorded light level shall be less than 20 lx.

For safety and convenience, this enclosure (which can be completely closed) should be fitted with an extraction device, such as an exhaust fan, to remove products of **combustion** which could 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 important for the conduct of this **flame** test. For tests conducted by this method when burning times are prolonged, chambers having an inside volume of 1,0 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 to be useful.

5 Production of the test flame

5.1 Selection of the method

Unless otherwise specified in the relevant standard, method A shall be 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.

5.2 Method A

Set up the burner supply arrangement according to Figure A.6 ensuring leak-free connections and place the burner in the laboratory fume hood/chamber.

Ignite the gas and adjust the gas and air flow rates to the following values.

The volume flow rate of propane gas shall be equivalent to 650 cm^3/min ± 10 cm^3/min when measured at 23 °C and 0,1 MPa.

The volume flow rate of air shall be equivalent to 10,0 dm^3/min ± 0,3 dm^3/min when measured at 23 °C and 0,1 MPa.

NOTE These volume flow rates correspond to mass flow rates of 1,184 g/min ± 0,018 g/min for propane gas (density at 23 °C and 0,1 MPa = 1,821 g/dm^3), and 11,64 g/min ± 0,35 g/min for air (density at 23 °C and 0,1 MPa = 1,1764 g/dm^3).

The **flame** shall appear stable and symmetrical on examination.

5.3 Method B (alternative)

Set up the burner supply arrangement according to Figure A.6 ensuring leak-free connections and place the burner in the laboratory fume hood/chamber.

Ignite the gas and adjust the gas and air flow rates to the following values.

The volume flow rate of propane gas shall be equivalent to 650 cm^3/min ± 30 cm^3/min when measured at 23 °C and 0,1 MPa.

The volume flow rate of air shall be equivalent to 10,0 dm^3/min ± 0,5 dm^3/min when measured at 23 °C and 0,1 MPa.

NOTE These volume flow rates correspond to mass flow rates of 1,184 g/min ± 0,054 g/min for propane gas (density at 23 °C and 0,1 MPa = 1,821 g/dm^3), and 11,64 g/min ± 0,58 g/min for air (density at 23 °C and 0,1 MPa = 1,1764 g/dm^3).

The **flame** shall appear stable and symmetrical on examination.

6 Confirmation of the test flame

6.1 Principle

The time for the temperature of the copper block, described in Figure A.6, to increase from 100 °C ± 5 °C to 700 °C ± 3 °C shall be 46 s ± 6 s when the **flame** test arrangement of Figure A.8 is used.

6.2 Frequency of confirmatory tests

The confirmatory test shall be done;

a) when the gas supply is changed, or test equipment is replaced, or when data are questioned;

and either

b) before use of the test **flame** if the period between use exceeds one month;

or

c) at least once a month if the period between use is less than or equal to one month.

6.3 Procedure

Set up the burner supply and confirmatory test arrangement according to Figure A.8 in the laboratory fume hood/chamber, ensuring leak-free gas connections.

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

Ignite the gas and adjust the gas and air flow rates to the values specified in Clause 5. Ensure that the **flame** is symmetrical. The approximate dimensions of the **flame** (see Figure 1), when measured in the laboratory fume hood/chamber and viewed in subdued light, are as follows:

- blue cone height: 46 mm to 78 mm;
- overall **flame** height: 148 mm to 208 mm.

Wait for a period of at least 5 min to allow the burner conditions to reach equilibrium.

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

Determine the time for the temperature of the block to increase from 100 °C ± 5 °C to 700 °C ± 3 °C. If the time is 46 s ± 6 s, record the gas and air flow rates and repeat the procedure two additional times until three successive determinations are each 46 s ± 6 s. Allow the block to cool naturally in air to below 50 °C between determinations. If the time of any determination is not 46 s ± 6 s, then all parts of the apparatus should be checked to ensure that they are in accordance with this international standard.

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 copper block surface. Discard the result.

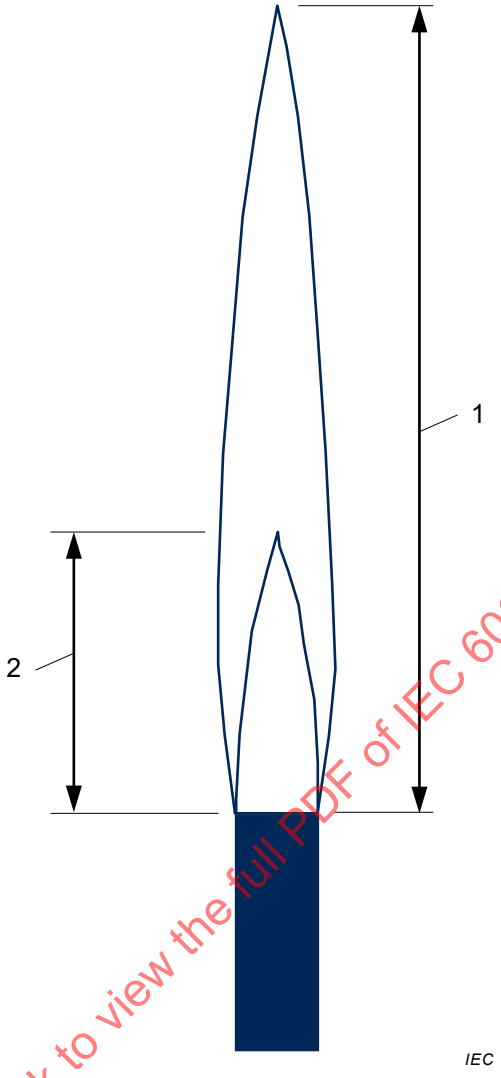
7 Recommended arrangements for use of the test flame

When used for testing equipment, unless otherwise stated in the relevant standard, the recommended distance from the top of the burner tube to the point on the surface of the test specimen to be tested is approximately 100 mm and the burner shall be fixed in position during the test.

NOTE The distance of 100 mm was chosen to give better reproducibility than the position where the tip of the blue cone is in contact with the test specimen.

When used for testing strips of materials, where the operator may move the **flame** during the test to follow the distorting or burning test specimen, the tip of the blue cone should be as close as possible without touching the test specimen.

The burner shall be tilted in such a way that debris falling from the test specimen under test does not fall into the burner.



Key

1 Overall flame height (148 mm to 208 mm)

2 Blue cone height (46 mm to 78 mm)

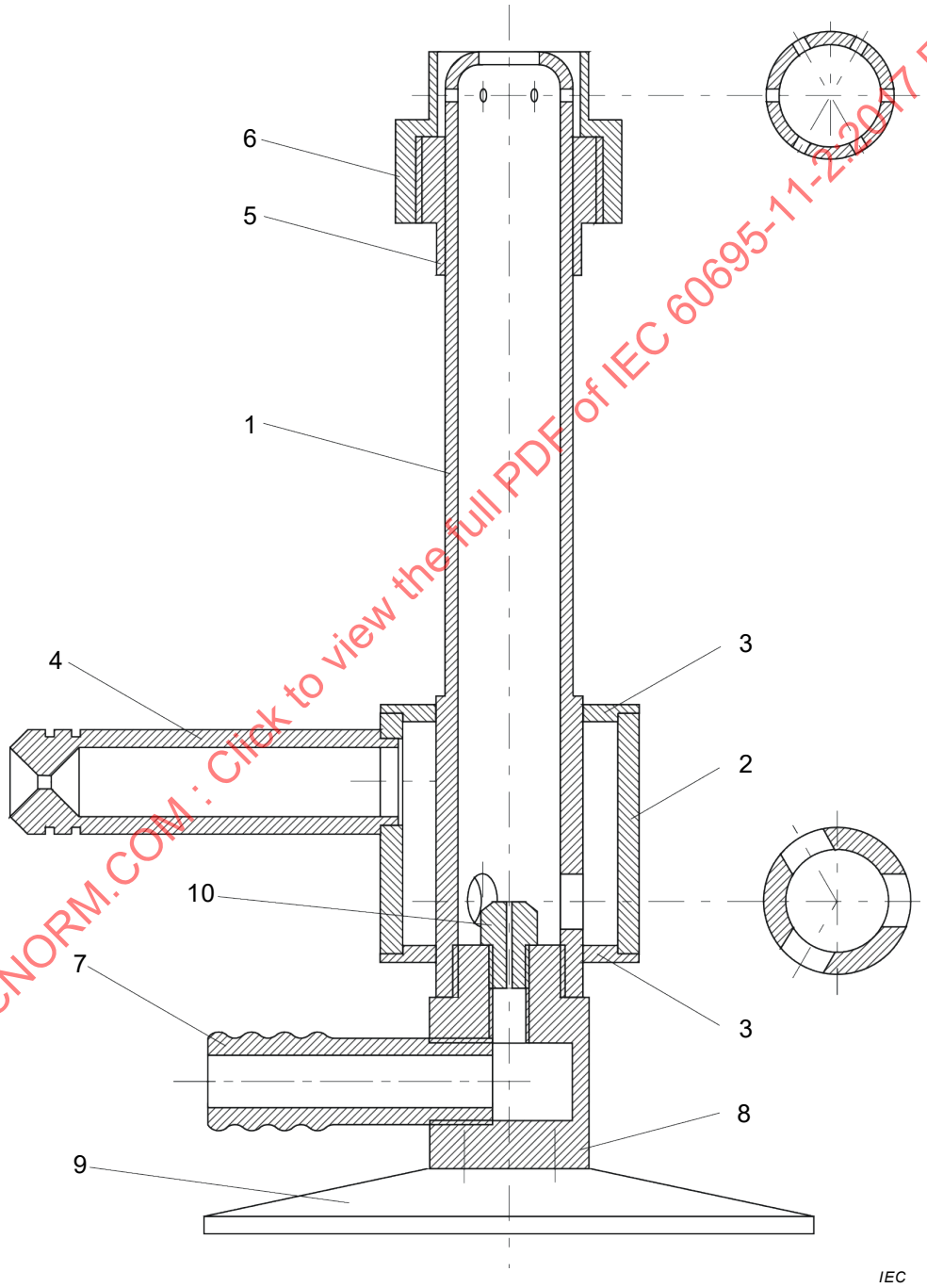
Figure 1 – Flame dimensions

Annex A
(normative)

Burner details, arrangements and confirmatory test

A.1 Burner construction

Figure A.1 through Figure A.8 illustrate the burner assembly.



Key

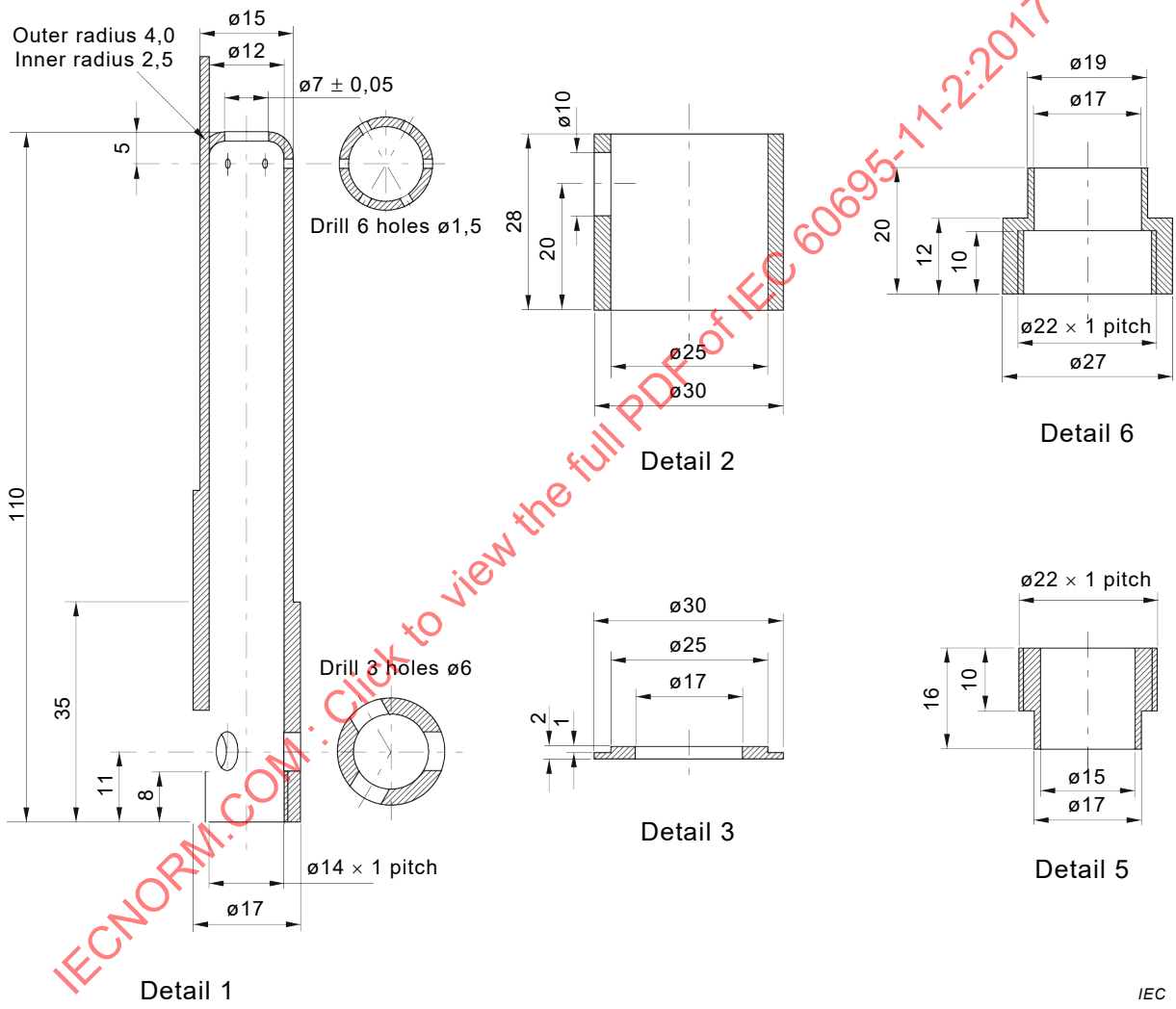
1	Burner barrel	Parts 1, 2, 3, 4, and 5 are hard soldered on assembly.
2, 3	Air manifold	Parts 7 and 8 may be hard soldered together, if necessary, to prevent gas leakage.

4	Air supply tube	Parts 8 and 9 may be fabricated in one piece, or otherwise fastened together, to prevent gas leakage.
5, 6	Flame stabilizer	Parts 1, 2, 3, 5 and 6 are detailed in Figure A.2.
7	Gas supply tube	Parts 8 and 9 are detailed in Figure A.3.
8	Elbow block	Parts 7 and 10 are detailed in Figure A.4.
9	Burner base	Part 4 is detailed in Figure A.5.
10	Gas jet	

Figure A.1 – General assembly

Dimensions in millimetres

Tolerances ± 0,1 unless otherwise stated

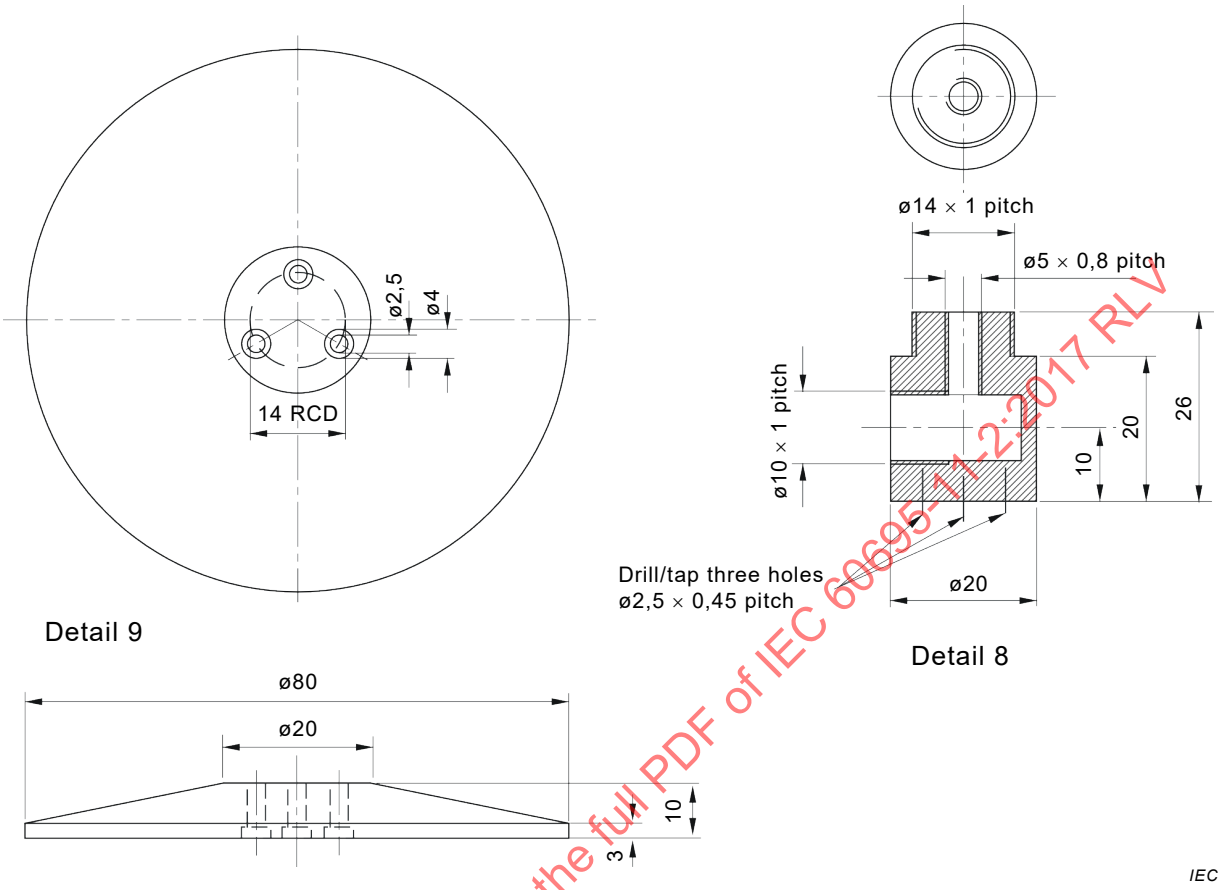


Material: brass

Figure A.2 – Burner details (1)

Dimensions in millimetres

Tolerances ± 0,1 unless otherwise stated



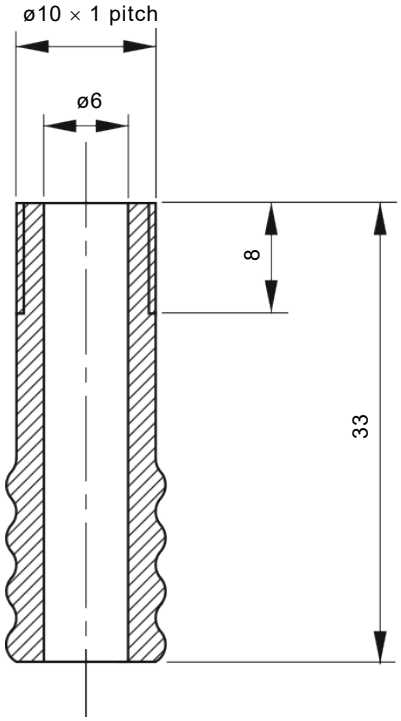
NOTE The shape of part 9 is given as an example.

Material: brass or any other suitable material.

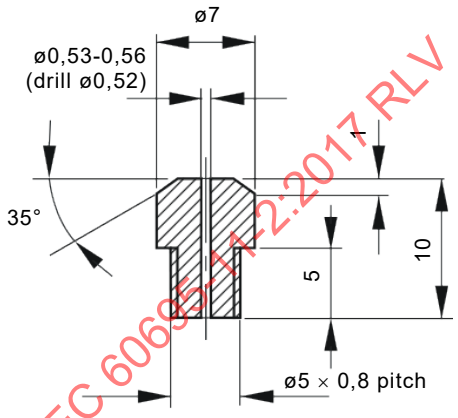
Figure A.3 – Burner details (2)

Dimensions in millimetres

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



Detail 7



Detail 10

Gas injector

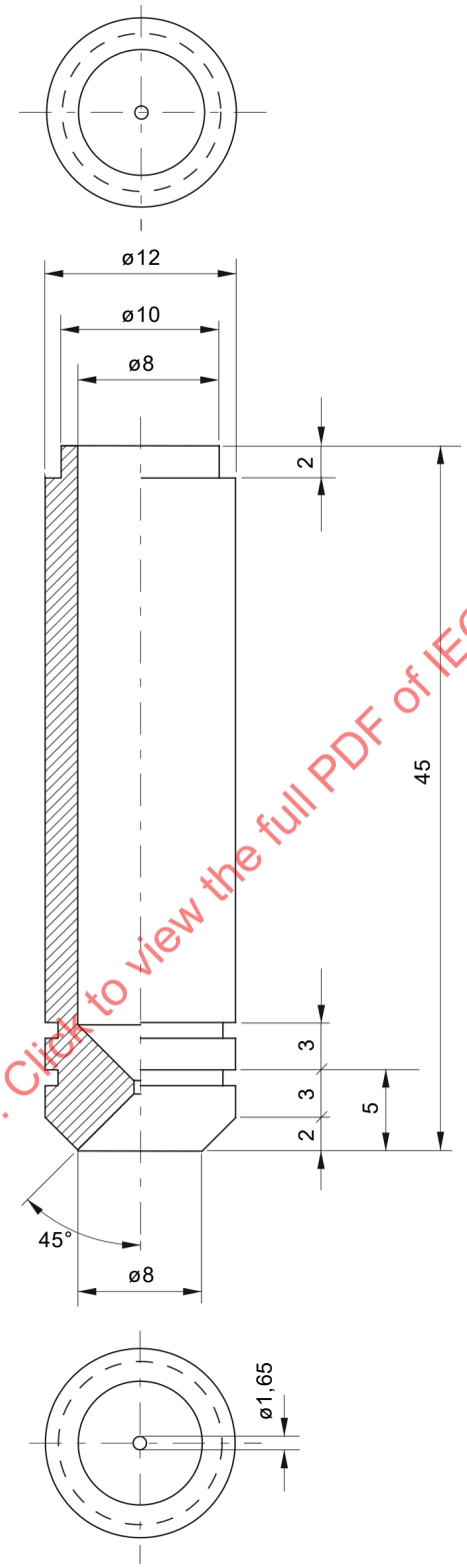
IEC

Material: brass

Figure A.4 – Burner details (3)

Dimensions in millimetres

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



Detail 4

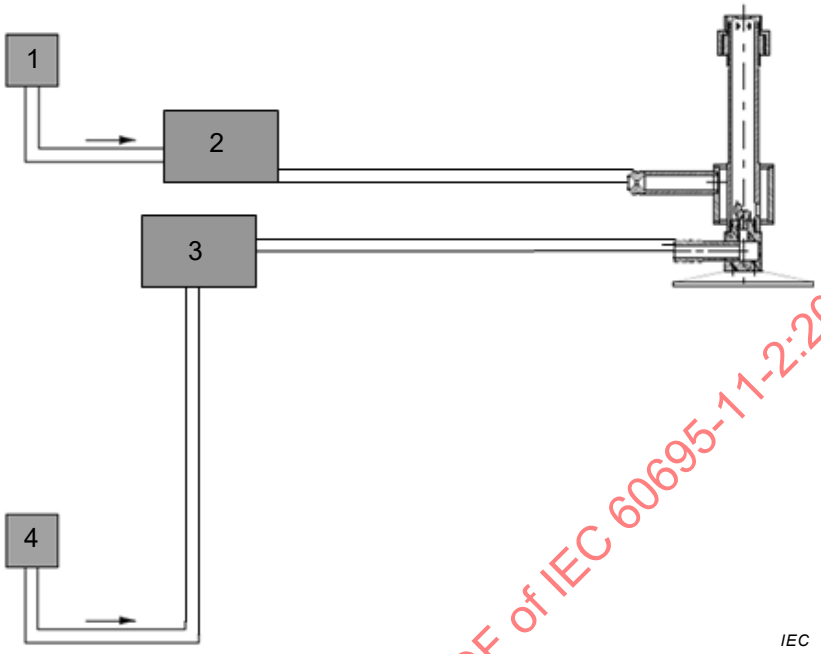
IEC

Material: brass

Figure A.5 – Burner details (4)

A.2 Gas supply arrangement

Figure A.1 illustrates the gas supply arrangement to the burner.



Key

1 Compressed air supply
2 Air flow control and measurement
3 Gas flow control and measurement
4 Gas supply

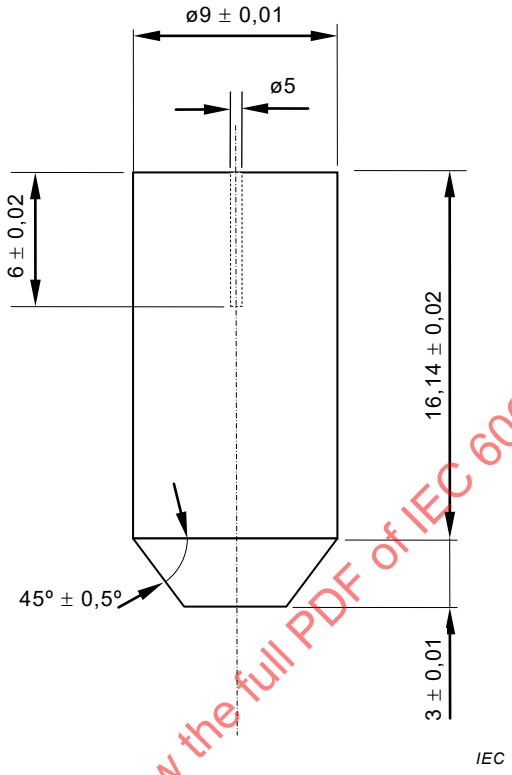
Figure A.6 – Example of supply arrangement for burner

A.3 The copper block

Figure A.1 gives the dimensions of the copper block

Dimensions in millimetres

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



The copper block shall be polished on all external surfaces.

Material: electrolytic copper Cu-ETP USN C11000 [6]

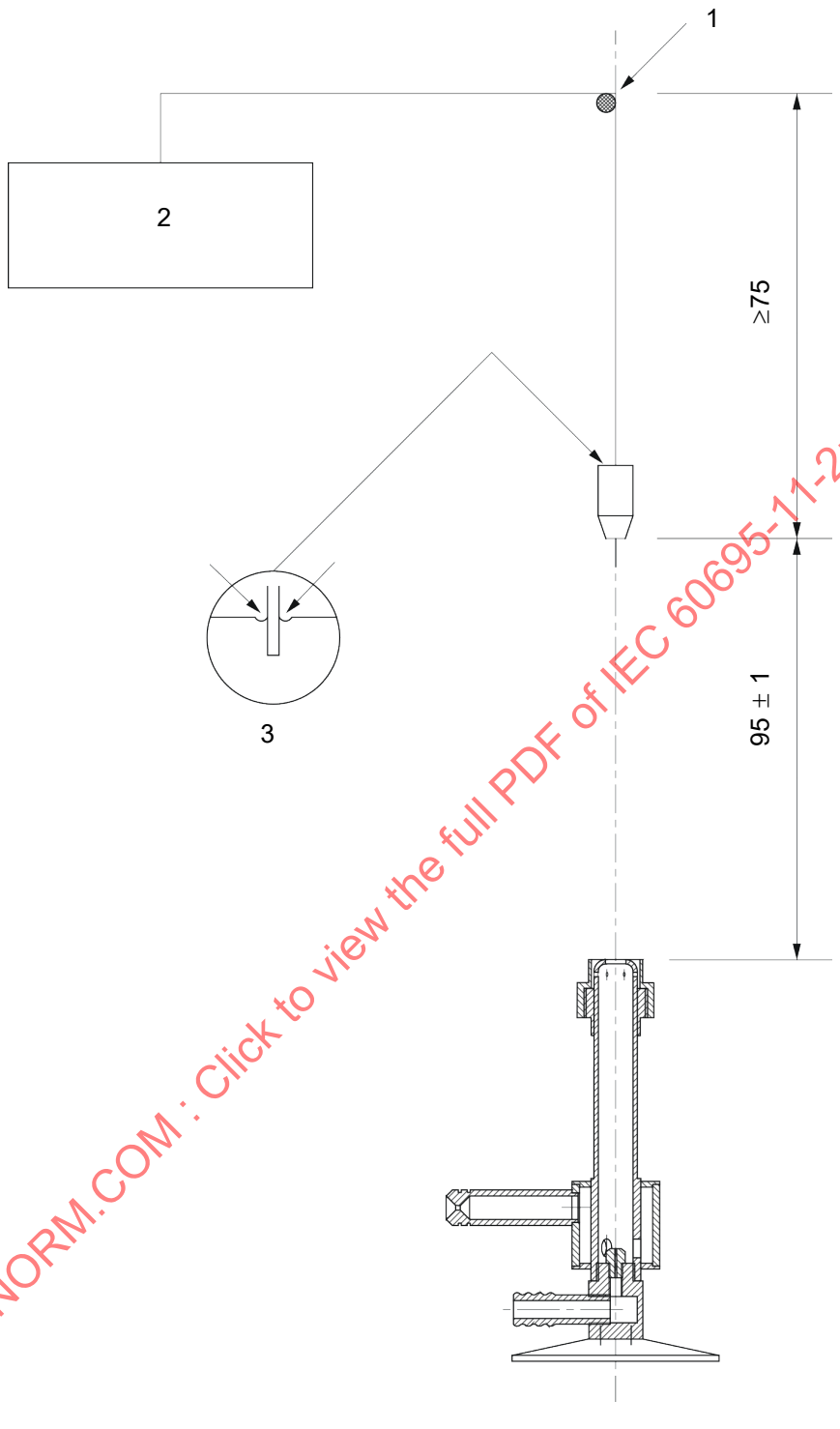
Mass: 10,00 g ± 0,05 g before drilling

Figure A.7 – Copper block

A.4 Confirmatory test

Figure A.1 shows the arrangement of the apparatus for a confirmatory test.

Dimensions in millimetres



Key

1 Suspension point

2 Temperature indicating/recording device(s) and Time indicating/recording device(s)

3 After first ensuring that the thermocouple is inserted to the full depth of the hole, the copper is compressed around the thermocouple to retain it without damage.

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

Figure A.8 – Confirmatory test arrangement

Bibliography

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

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

[3] IEC TS 60695-11-40, *Fire hazard testing – Part 11-40: Test flames – Confirmatory tests – Guidance*

[4] IEC GUIDE 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

[5] ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ESSAIS RELATIFS AUX RISQUES DU FEU –

Partie 11-2: Flammes d'essai – Flamme à prémélange de 1 kW nominal – Appareillage, configuration pour l'essai de vérification et préconisations

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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La Norme internationale IEC 60695-11-2 a été établie par le comité d'études 89 de l'IEC: Essais relatifs aux risques du feu.

Le texte de cette Norme internationale est issu des documents suivants:

CDV	Rapport de vote
89/1327/CDV	89/1354/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Cette troisième édition de l'IEC 60695-11-2 annule et remplace la deuxième édition parue en 2013. Cette édition constitue une révision technique.

Elle a le statut d'une publication fondamentale de sécurité conformément au Guide IEC 104 et au Guide ISO/IEC 51.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- ajout d'une variante pour la production de la flamme d'essai;
- suppression de l'Annexe B.

Dans cette norme, les caractères suivants sont utilisés:

- **termes définis à l'Article 3: en gras**

Une liste de toutes les parties de la série IEC 60695, publiées sous le titre général *Essais relatifs aux risques du feu*, peut être consultée sur le site web de l'IEC.

La Partie 11 comprend les parties suivantes:

Partie 11-2: *Flammes d'essai – Flamme à prémélange de 1 kW nominal – Appareillage, configuration pour l'essai de vérification et préconisations*

Partie 11-3: *Flammes d'essai – Flamme de 500 W – Appareillage et méthodes d'essai de vérification*

Partie 11-4: *Flammes d'essai – Flamme de 50 W – Appareillage et méthodes d'essai de vérification*

Partie 11-5: *Flammes d'essai – Méthode d'essai au brûleur-aiguille – Appareillage, dispositif d'essai de vérification et lignes directrices*

Partie 11-10: *Flammes d'essai – Méthodes d'essai horizontal et vertical à la flamme de 50 W*

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

Partie 11-20: *Flammes d'essai – Méthode d'essai à la flamme de 500 W*

Partie 11-30: *Flammes d'essai – Historique et développement de 1979 à 1999*

Partie 11-40: *Flammes d'essai – Essais de confirmation – Guide*

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo *"colour inside"* qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

Il est nécessaire de prendre en considération le risque d'incendie et les dangers potentiels associés au feu dans la conception de tout produit électrotechnique. A cet égard, la conception des composants, des circuits et des produits ainsi que le choix des matériaux ont pour objectif de réduire à des niveaux acceptables les risques potentiels d'incendie dans les conditions de fonctionnement normal, d'utilisation anormale raisonnablement prévisible, de dysfonctionnement et/ou de défaillance. L'IEC a établi l'IEC 60695-1-10 [1][1], avec sa norme associée, l'IEC 60695-1-11 [2], afin de fournir des préconisations sur les méthodes de réalisation correspondantes.

L'IEC 60695-1-10 et l'IEC 60695-1-11 ont pour principaux objectifs de fournir des préconisations sur les éléments suivants:

a) éviter l'allumage provoqué par un composant alimenté électriquement, et

b) limiter la propagation du feu à l'enveloppe du produit électrotechnique lui-même en cas d'allumage.

Les objectifs secondaires de ces documents comprennent la limitation de toute propagation de la flamme au-delà de l'enveloppe du produit et la réduction le plus possible des effets préjudiciables des effluents du feu tels que la chaleur, la fumée et les produits de combustion toxiques ou corrosifs.

Les feux impliquant des produits électrotechniques peuvent également être déclenchés par des sources externes non électriques. Il convient de tenir compte de ces éléments dans le cadre de l'évaluation globale des risques d'incendie.

L'IEC 60695-11-2 fournit une description de l'appareillage exigé pour produire une flamme d'essai de 1 kW, et une description du principe d'une procédure de confirmation pour vérifier que la flamme produite satisfait aux exigences. Des préconisations relatives aux essais de vérification des flammes d'essai sont données dans l'IEC TS 60695-11-40 [3].

La présente partie de l'IEC 60695 peut impliquer des matériaux, opérations et matériels dangereux. Elle n'a pas pour objet de traiter tous les problèmes de sécurité associés à son utilisation. Il incombe à l'utilisateur de la présente norme internationale d'établir des bonnes pratiques appropriées en ce qui concerne la sécurité et la santé et de déterminer l'applicabilité des limitations réglementaires avant usage.

[1] Les chiffres entre crochets font référence à la bibliographie.

ESSAIS RELATIFS AUX RISQUES DU FEU –

Partie 11-2: Flammes d'essai – Flamme à prémélange de 1 kW nominal – Appareillage, configuration pour l'essai de vérification et préconisations

1 Domaine d'application

La présente partie de l'IEC 60695 spécifie les exigences pour la production et la validation d'une **flamme de type à prémélange** à base de propane/air de 1 kW nominal pour utilisation dans les essais relatifs aux risques du feu.

La présente publication fondamentale de sécurité est destinée à être utilisée par les comités d'études dans le cadre de l'élaboration de normes conformément aux principes établis dans le Guide IEC 104 [4] et le Guide ISO/IEC 51 [5].

L'une des responsabilités d'un comité d'études consiste, le cas échéant, à utiliser les publications fondamentales de sécurité dans le cadre de l'élaboration de ses publications.

Les exigences, les méthodes ou les conditions d'essai de la présente publication fondamentale de sécurité s'appliqueront seulement si elles servent spécifiquement de référence ou sont intégrées dans les publications correspondantes.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60584-1, *Couples thermoélectriques - Partie 1: Spécifications et tolérances en matière de FEM*

ISO/IEC 13943:2008, *Sécurité au feu – Vocabulaire*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions donnés dans l'ISO/IEC 13943:2008, dont certains sont repris ci-dessous pour aider l'utilisateur, ainsi que les suivants s'appliquent.

3.1
combustion
réaction exothermique d'une substance avec un comburant

Note 1 à l'article Cette **combustion** émet généralement des effluents du feu accompagnés de **flammes** et/ou d'incandescence.

[SOURCE: ISO 13943:2008, définition 4.46]

3.2
environnement en air calme
environnement dans lequel les résultats des expériences ne sont pas affectés de manière significative par la vitesse locale de l'air

Note 1 à l'article Un exemple qualitatif en est l'environnement dans lequel une **flamme** de bougie de cire demeure fondamentalement stable. Les exemples quantitatifs sont illustrés par des essais au feu à petite échelle dans lesquels une vitesse maximale de l'air de 0,1 m × s^{-1} ou de 0,2 m × s^{-1} est parfois spécifiée.

[SOURCE: ISO 13943:2008, définition 4.70]

3.3
flamme, nom
propagation subsonique, auto-entretenue et rapide de la **combustion** dans un milieu gazeux, généralement accompagnée d'une émission de lumière

[SOURCE: ISO 13943:2008, définition 4.133]

3.4
flamme de prémélange
flamme dans laquelle la **combustion** se produit dans un mélange intime de combustible et de comburant

[SOURCE: ISO 13943:2008, définition 4.259]

3.5
flamme d'essai normalisée de 1 kW
flamme d'essai conforme à la présente norme internationale et satisfaisant à toutes les exigences données dans les Articles 4 à 6

4 Configuration d'alimentation du brûleur

4.1 Exigences

Une **flamme d'essai normalisée de 1 kW**, selon la présente méthode, est une **flamme** produite

- par l'utilisation d'un matériel conforme aux indications de la Figure A.1 à la Figure A.1,
- avec une alimentation en gaz propane d'une pureté au moins égale à 95 %,
- avec une alimentation en air essentiellement exempt d'huile et d'eau.

La **flamme** doit être symétrique, stable et donner un résultat de 46 s ± 6 s au cours de l'essai de vérification décrit à l'Article 6.

La configuration pour l'essai de vérification représentée à la Figure A.8 doit être utilisée.

4.2 Appareillage et combustible

4.2.1 Brûleur

Le brûleur doit être conforme aux indications de la Figure A.1 à la Figure A.5 comprise.

NOTE L'injecteur de gaz et le stabilisateur de **flamme** sont amovibles pour en permettre le nettoyage.

4.2.2 Régulation de débit

Les régulateurs de débits doivent être utilisés et doivent être:

– adaptés au mesurage et à la régulation d'un débit de gaz propane d'environ 650 cm^3/min à 23 °C et 0,1 MPa avec une exactitude adéquate pour mesurer dans les limites de tolérance spécifiées dans la méthode d'essai concernée (voir Article 5),

– adaptés au mesurage et à la régulation d'un débit d'air d'environ 10 dm^3/min à 23 °C et 0,1 MPa avec une exactitude adéquate pour mesurer dans les limites de tolérance spécifiées dans la méthode d'essai concernée (voir Article 5).

NOTE Les régulateurs de débits massiques se sont avérés appropriés pour satisfaire aux exigences de l'Article 5.

4.2.3 Bloc de cuivre

Un bloc de cuivre de 9 mm de diamètre, d'une masse de 10,00 g ± 0,05 g en l'état d'usinage complet mais sans perçage, comme décrit à la Figure A.7, doit être réalisé à partir d'un cuivre électrolytique non désoxydé Cu-ETP USN C11000 [6].

4.2.4 Couple thermoélectrique

Un couple thermoélectrique en fil fin à gaine métallique et à isolation minérale avec jonction isolée doit être utilisé pour mesurer la température du bloc de cuivre. Il doit avoir un diamètre extérieur nominal de 0,5 mm et être constitué, par exemple, de fils de NiCr et de NiAl (type K), conformément à l'IEC 60584-1, avec le point soudé situé à l'intérieur de la gaine. La gaine doit être dans un métal résistant au service continu à une température d'au moins 1 050 °C. Les tolérances des couples thermoélectriques doivent être conformes à l'IEC 60584-1, classe 1.

NOTE Une gaine dans un alliage à base de nickel résistant à la chaleur (comme l'Inconel 600[2]) satisfait aux exigences indiquées ci-dessus.

La méthode préférentielle de fixation du couple thermoélectrique au bloc de cuivre consiste à s'assurer tout d'abord que le couple thermoélectrique est inséré à pleine profondeur du trou, et ensuite à comprimer le cuivre autour du couple thermoélectrique comme représenté à la Figure A.8.

4.2.5 Dispositifs d'indication et/ou d'enregistrement de température et de temps

Les dispositifs d'indication et/ou d'enregistrement de température et de temps doivent être adaptés au mesurage du temps qui est nécessaire pour que le bloc de cuivre passe d'une température de 100 °C ± 5 °C à 700 °C ± 3 °C avec une tolérance de ± 0,5 s pour le temps mesuré.

4.2.6 Hotte de laboratoire

La hotte de laboratoire doit avoir un volume intérieur d'au moins 1,0 m^3. La hotte doit fournir un **environnement en air calme** tout en permettant une circulation thermique normale de l'air autour de l'éprouvette d'essai. La hotte doit permettre l'observation des essais en cours. Sauf indication contraire dans la spécification correspondante, les surfaces intérieures de la hotte doivent être de couleur sombre. Lorsqu'un photomètre est positionné à la place de l'éprouvette d'essai, en faisant face à l'arrière de la hotte, le niveau de lumière enregistré doit être inférieur à 20 lx.

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2 Cette information est donnée à l'intention des utilisateurs de la présente norme internationale et ne signifie nullement que l'IEC approuve ou recommande l'emploi exclusif du produit ainsi désigné. Des produits équivalents peuvent être utilisés s'il est démontré qu'ils conduisent aux mêmes résultats.