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English Version

Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2:2020)

Essais de réaction au feu - Allumabilité de produits soumis à l'incidence directe de la flamme - Partie 2: Essai à l'aide d'une source à flamme unique (ISO 11925-2:2020)

Prüfungen zum Brandverhalten - Entzündbarkeit von Produkten bei direkter Flammeneinwirkung - Teil 2: Einzelflammentest (ISO 11925-2:2020)

This European Standard was approved by CEN on 4 February 2020.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO 11925-2:2020) has been prepared by Technical Committee ISO/TC 92 "Fire safety" in collaboration with Technical Committee CEN/TC 127 “Fire safety in buildings” the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2020, and conflicting national standards shall be withdrawn at the latest by September 2020.

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

This document supersedes EN ISO 11925-2:2010.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 11925-2:2020 has been approved by CEN as EN ISO 11925-2:2020 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

This fourth edition cancels and replaces the third edition (ISO 11925-2:2010), which has been technically revised. It also incorporates the Technical Corrigendum ISO 11925-2:2010/Cor1:2011.

A list of all parts in the ISO 11925 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This fire test method has been developed to define reaction to fire performance of products. The method specifies a test for determining the ignitability of products by direct small-flame impingement under zero impressed irradiance using vertically oriented test specimens.

Although the method is designed to assess ignitability, this is addressed by measuring the spread of a small flame up the vertical surface of a specimen following application of a small (match-sized) flame to either the surface or edge of a specimen for either 15 s or 30 s. The determination of the production of flaming droplets/particles depends on whether or not the filter paper placed beneath the specimen ignites.

Reaction to fire tests — Ignitability of products subjected to direct impingement of flame —

Part 2: Single-flame source test

1 Scope

This document specifies a method of test for determining the ignitability of products by direct small flame impingement under zero impressed irradiance using vertically oriented test specimens.

Information on the precision of the test method is given in Annex A (informative).

Information on testing not essentially flat end-use products is given in Annex B (normative).

Information on testing perforated end-use products is given in Annex C (normative).

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.

EN 13238, *Reaction to fire tests for building products — Conditioning procedures and general rules for selection of substrates*

ISO 13943, *Fire safety — Vocabulary*

ISO 14697, *Reaction-to-fire tests — Guidance on the choice of substrates for building and transport products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
product
material, element or component about which information is required

3.2
essentially flat product
product having one of the following characteristics:

a) a planar exposed surface;

b) a planar exposed surface with a surface irregularity that is evenly distributed over the exposed surface, provided that

— at least 50 % of the surface of a representative square area of 250 mm × 250 mm lies within a depth of 6 mm from a plane taken across the highest points on the exposed surface, or

— for a surface containing cracks, fissures or holes, these do not exceed 6,5 mm in width or 10 mm in depth, and that the total area of such cracks, fissures or holes at the surface does not exceed 30 % of a representative square area of 250 mm × 250 mm of the exposed surface

3.3
flaming droplets/particles
material separating from the specimen during the fire test procedure and igniting the filter paper beneath the specimen

3.4
multi-layered products
product composed of two or more layers of different materials, which can be either substantial and/or non-substantial

[SOURCE: EN 13501-1:2018-12, 3.1.5 and 3.1.6]

3.5
sustained flaming
persistence of flame for a period greater than 3 s

3.6
ignition
presence of sustained flaming

4 Test apparatus

4.1 Test room, capable of providing an environment at (23 ± 5) °C and a relative humidity of (50 ± 20) %.

NOTE It has been found that a partially darkened room assists with the perception of small surface flames.

4.2 Combustion chamber, consisting of an enclosure constructed from stainless steel sheets, with heat-resistant, glazed doors provided for access and observation in at least the front and one lateral side (see Figure 1). Ventilation of the enclosure shall be free through the square box section base in the bottom of the chamber. This shall be made of stainless steel of 1,5 mm thickness, 50 mm in height, with the open square area being 25 mm × 25 mm. To make free ventilation possible, the chamber shall stand on 40 mm high supports which provide a gap on the lateral sides of the combustion chamber. The air velocity measured on the central axis in the chimney of the combustion chamber shall be (0,7 ± 0,1) m/s, measured with the burner only ignited and with the ventilation hood "on". The combustion chamber shall be situated under a suitably ventilated hood.

4.3 Ignition source, consisting of burner constructed as shown in Figure 2 and designed so that it can be used vertically or be tilted at 45° with respect to the vertical axis. The burner shall be mounted onto a horizontal plate so that it moves smoothly forwards and backwards in a horizontal plane along the centreline of the combustion chamber.

The burner shall be fitted with a fine adjustment valve to ensure accurate control of the flame height.

4.4 Fuel, consisting of commercial propane of 95 % minimum purity. In order to obtain flame stability with the burner tilted at 45°, the gas pressure shall be between 10 kPa and 50 kPa.

4.5 Specimen holder, consisting of two stainless steel U-shaped frames. The thickness of the frames shall be (5 ± 1) mm. The dimensions of the frame shall be as shown in Figure 3. The frame shall hang vertically from the support (see 4.6 and Figure 7) such that the underside of the specimen is exposed directly to the flame along its centreline and edges see Figure 8. The two halves of the specimen holder shall be held together by screws or clamps to prevent the specimen warping.

It is important that the technique of clamping used be capable of restraining the specimen for the total duration of the test.

NOTE Small pins of approximately 1 mm in length incorporated on the surface of the frame to which the specimen is attached have been found suitable.

For multi-layered products, a typical test frame as shown in Figure 4 shall be used when carrying out the prescribed additional set of tests on multi-layer test specimens of thickness greater than 10 mm according to 7.3.3.2.3.

For the mounting and fixing of loose fill material, the following applies.

a) A specimen holder as shown in Figure 5 shall be used.

b) When making the specimens for testing, the surface of the loose fill material specimen shall be as even as possible.

c) A wire lacing as shown in Figure 6 shall be used to retain the specimen if material falls from the specimen holder. A wire of 0,2 mm diameter shall be used to form 11 rows vertically in front of the opening to hold the loose fill material in place. The wire lacing will have the shape of a harp.

d) If the material is a mixture of various grain sizes, the release of smaller particles from the open central surface does not justify the use of the harp.

e) It is deemed sufficient to carry out the tests with a surface flame attack. Edge flame attack tests are not necessary.

4.6 Support, consisting of a vertical stand to which the specimen holder is attached such that it hangs vertically and exposes its open edge containing the specimen to the burner flame (see Figure 7).

The distance between the underside of the specimen and the top of horizontal plate above the metal grid shall be (125 ± 10) mm for edge flame impingement and (85 ± 10) mm for surface flame impingement.

4.7 Timing device, capable of recording elapsed time to the nearest second and which shall be accurate to within 5 s in 1 h.

4.8 Template, consisting of one metal plate $\left(250^{\ 0}_{-1}\right)$ mm long and $\left(90^{\ 0}_{-1}\right)$ mm wide.

4.9 Flame checking devices.

4.9.1 Flame-height measuring device, capable of indicating a flame height of 20 mm (see Figure 9) when located against a fixed point of the burner. The tolerance on the flame-height measuring device shall be ±0,1 mm.

The flame height shall be measured from the upper edge of the burner to the yellow tip of the flame. The outer blue halo of the flame may not be considered. This check shall be conducted before testing each specimen.

4.9.2 Burner spacer for edge flame impingement, removable, 16 mm long, which can be mounted at the burner orifice to check the distance from the pre-set flame contact point on the specimen (see Figure 10).

4.9.3 Burner spacer for surface flame impingement, removable, cone-shaped, which can be mounted at the burner orifice to check the fixed distance of 5 mm between the burner edge and specimen surface (see Figure 11).

4.10 Anemometer, thermal anemometer with an accuracy of ±0,1 m/s, for measuring the airflow velocity in the upper outlet of the combustion chamber (see 4.2 and Figure 1).

4.11 Filter paper and tray. The paper shall be new undyed filter paper with a mass/unit area of (75 ± 15) g/m^2 and an ash content of less than 0,1 %. The tray shall be 100 mm × 50 mm and 10 mm deep and made of aluminium foil. The tray is placed beneath the specimen holder and is replaced between tests.

4.12 Apparatus to allow observation of the reverse face of the specimen. For some materials, it is sometimes necessary to observe the flame on the reverse face of the specimen as well as the exposed face.

Provision shall therefore be made to enable the operator to view both sides of the specimen at the same time. One method by which this may be achieved is to place a mirror such that the backside of the specimen can be monitored. The mirror shall not be placed above the specimen, in order to avoid disturbance of the airflow. The design and location of the mirror shall be appropriate for the construction of the equipment and the available ambient lighting. The result observed on the reverse face shall be treated as if it occurred on the front side.

5 Test specimen

5.1 Preparation

The test specimen shall be cut from a sample which is representative of the product to be tested using the templates specified in 4.8.

5.2 Dimensions

The dimensions of the test specimens shall be $\left(250^{+2}_{-2}\right)$ mm long by $\left(90^{+2}_{-2}\right)$ mm wide.

Specimens normally having a thickness of 60 mm or less shall be tested using their full thickness. Specimens normally having a thickness greater than 60 mm shall be reduced to a thickness of 60 mm by cutting away the unexposed surface. If it is necessary to reduce the specimen size in this manner, the cut surface shall not be exposed to the flame.

For products which are normally manufactured in sizes less than the test specimen, a test sample of appropriate size shall be specifically produced for the test.

5.3 Products which are not essentially flat

When the product is not an essentially flat product, the specimens may be tested in the form of their end use (e.g. pipe insulation). The product shall be supplied in its entirety or as specimens of lengths of 250 mm.

5.4 Number of specimens

5.4.1 For each exposure condition, a minimum of six representative specimens of the product shall be tested. Three specimens shall be cut lengthwise and three crosswise.

5.4.2 If a product under test is asymmetric through its thickness and in practice either face may be exposed to a source of ignition, test two specimens on each face to find the critical point of impingement. For the critical impingement point a full test series shall be conducted.

5.4.3 Where a product has areas of its surface which are distinctly different, but each of these separate areas can satisfy the surface characteristics for essentially flat products, two tests shall be conducted at each point of flame impingement. The critical impingement point shall be found. For the critical impingement point a full test series shall be conducted.

5.4.4 If a product is installed with covered edges, but can also be used with unprotected edges, tests shall be performed on both covered and uncovered specimens.

5.5 Substrates

Where a substrate is used, it shall be selected in accordance with ISO 14697 or EN 13238.

Care is needed when preparing test specimens for bottom-edge exposure of materials applied to substrates, since in practice the substrate may extend beyond the bottom of the material to be tested and not itself be subject to edge exposure. The configuration of the test specimen should reflect the practical aspects such as type of substrate and fixing to substrate.

NOTE Additional advice on the use of substrates can be found in any relevant product standard.

6 Conditioning

Test specimens and filter paper shall be conditioned in accordance with EN 13238.

7 Test procedure

7.1 General

Two flame application times are available, 15 s or 30 s, as required by the sponsor. The start time of the test is on application of the flame.

7.2 Preliminary operations

7.2.1 Check the required airflow velocity in the chimney of the combustion chamber (see 4.2).

7.2.2 Remove the set of six test specimens and the filter paper from the conditioning environment and test them within 30 min. If necessary, the test specimen can be transferred from the conditioning room to the test apparatus in a sealed container.

7.2.3 Clamp the test specimen in the specimen holder so that one end and both sides are covered by the holder frames and the exposed end is 30 mm from the end of the frame (see Figures 3 to 6).

NOTE The operator can find it useful to mark the specimen holder such that the bottom edge of the test specimen is always placed at this distance.

7.2.4 Check the distances of the burner from the specimen by means of the relevant spacer specified in 4.9.2 or 4.9.3 with the burner tilted at 45° (see Figures 7 and 8, as appropriate).

7.2.5 Position two pieces of filter paper in the aluminium foil tray beneath the specimen, not more than 3 min before the start of the test.

7.3 Testing operations

WARNING — The attention of all persons concerned with managing and carrying out this test is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/

or harmful smoke and gases can be evolved during the test. Operational hazards can also arise during the testing of specimens and the disposal of test residues.

WARNING — An assessment of all potential hazards and risks to health should be made and safety precautions identified and provided. Written safety instructions should be issued. Appropriate training should be given to relevant personnel. Laboratory personnel should ensure that they follow written safety instructions at all times.

WARNING — Adequate means of extinguishing the specimen should be provided, bearing in mind that some specimens can produce severe flaming during the test. A hand water spray or an inert gas suppression system, e.g. compressed nitrogen, which can be directed to the burning area, should be available together with other means, such as fire extinguishers.

WARNING — In some cases, smouldering can be difficult to extinguish completely and immersion in water may be necessary.

7.3.1 Light the burner in the vertical position and allow the flame to stabilize. Adjust the burner valve to give a flame height of 20 mm using the device specified in 4.9.1. This operation is carried out away from the pre-set operating position to prevent accidental impingement of the flame on the test specimen. The flame height shall be checked prior to each flame application.

NOTE It has been found useful to measure the flame height against a black background.

7.3.2 Tilt the burner at 45° with respect to its vertical axis and advance it horizontally until the flame reaches the pre-set contact point with the test specimen.

Start the timing device at the moment the flame is brought into contact with the test specimen. Apply the flame for 15 s or 30 s as required by the sponsor and then retract the burner in a smooth continuous manner.

Parallax errors shall be avoided when determining the maximum flame height.

7.3.3 Exposure conditions

Tests may need to be conducted to either surface exposure or edge exposure, or both.

NOTE Advice on exposure conditions can be given in the relevant product standards.

7.3.3.1 Surface exposure

For all essentially flat products, the flame shall be applied on the centreline of the specimen, 40 mm above the bottom edge (see Figure 11). Each different surface that could be exposed in practice shall be tested (see 5.4.2).

7.3.3.2 Edge exposure

7.3.3.2.1 For single-layer or multi-layer, essentially flat products having a total thickness ≤3 mm, the flame shall be applied to the mid-point on the bottom of the test specimen see Figure 8 a).

Products with edges that are not exposed to fire in end use applications should not be subjected to edge exposure testing.

NOTE As the flame width is estimated at 5 mm then the flame will be impinging on the entire thickness of the specimen.

7.3.3.2.2 For single-layer or multi-layer, essentially flat products having a total thickness greater than 3 mm, the flame shall be applied to the centre of the width of the bottom edge of the test specimen 1,5 mm behind the surface see Figure 8 b).

7.3.3.2.3 For all multi-layer products greater than 10 mm total thickness, an additional set of tests shall be carried out with the specimen turned at 90° from its vertical axis and the flame impinging at the bottom edge of the centreline of the underside of each different layer see Figure 8 c).

If it is known and stated by the manufacturer that two or more layers in a product are identical then only one of the layers needs to be tested. If these layers are less than 10 mm thick, they may only be considered identical if the layers adjacent to them are also identical.

The flame application point which gives the worst result shall be determined by performing at least two tests for each possible flame application point. The results should be compared and a complete test of six specimens shall be conducted using the flame application point which gives the worst result.

Very thin layers like thin layers of adhesive shall be included in the testing. Each layer shall be impinged by the burner flame.

If a thin layer less than 1 mm is an external layer of a product this does not need to be tested at 90°. For thin layers or a combination of layers adjacent to layers that are larger than 1 mm then this layer shall be tested.

7.3.4 For products that are not essentially flat products and which are to be tested in their end-use form, the flame shall be applied as specified in 7.3.3.1 and 7.3.3.2. A full description of the method of retention shall be given in the test report.

The flame application point which gives the worst result should be determined by performing at least two tests for each possible flame application point. The results should be compared and a complete test of six specimens shall be conducted using the flame application point which gave the worst result.

The product may be free-standing or may be held in its end-use orientation in a retaining frame which can be as simple as a laboratory clamp stand or could require a more substantial, specially constructed framework.

NOTE A modification to the apparatus and/or procedure can be necessary, but many non-planar products normally only require a change in the specimen support frame. In some instances, however, the burner mounting can also be inappropriate and the ignition source can need to be held and applied manually.

7.4 Duration of test

7.4.1 If the flame application time is 15 s, the total test duration shall be 20 s from the time at which the flame is first applied.

7.4.2 If the flame application time is 30 s, the total test duration shall be 60 s from the time at which the flame is first applied.

8 Expression of results

8.1 Record the position of flame application.

8.2 For each of the test specimens, record the following:

a) whether ignition occurs;

b) whether the flame front exceeds 150 mm above the flame application point, and the time at which this occurs;

c) presence of flaming droplets/particles which cause ignition of the filter paper;

d) observations of physical behaviour of the test specimen.

9 Test report

The test report shall include at least the following information.

a) reference that the test was carried out in accordance with this document, i.e. ISO 11925-2: 2020;

b) any deviations from the test method;

c) name and address of the test laboratory;

d) date and identification number of the report;

e) name and address of the sponsor;

f) name and address of the manufacturer/supplier, if known;

g) date of sample arrival;

h) identification of the product;

i) description of the sampling procedure, where relevant;

j) general description of the product tested, including density, mass per unit area and thickness, together with the details of construction of the test specimen;

k) details of conditioning;

l) details of any substrates used and method of fixing;

m) date of test;

n) test results expressed in accordance with Clause 8;

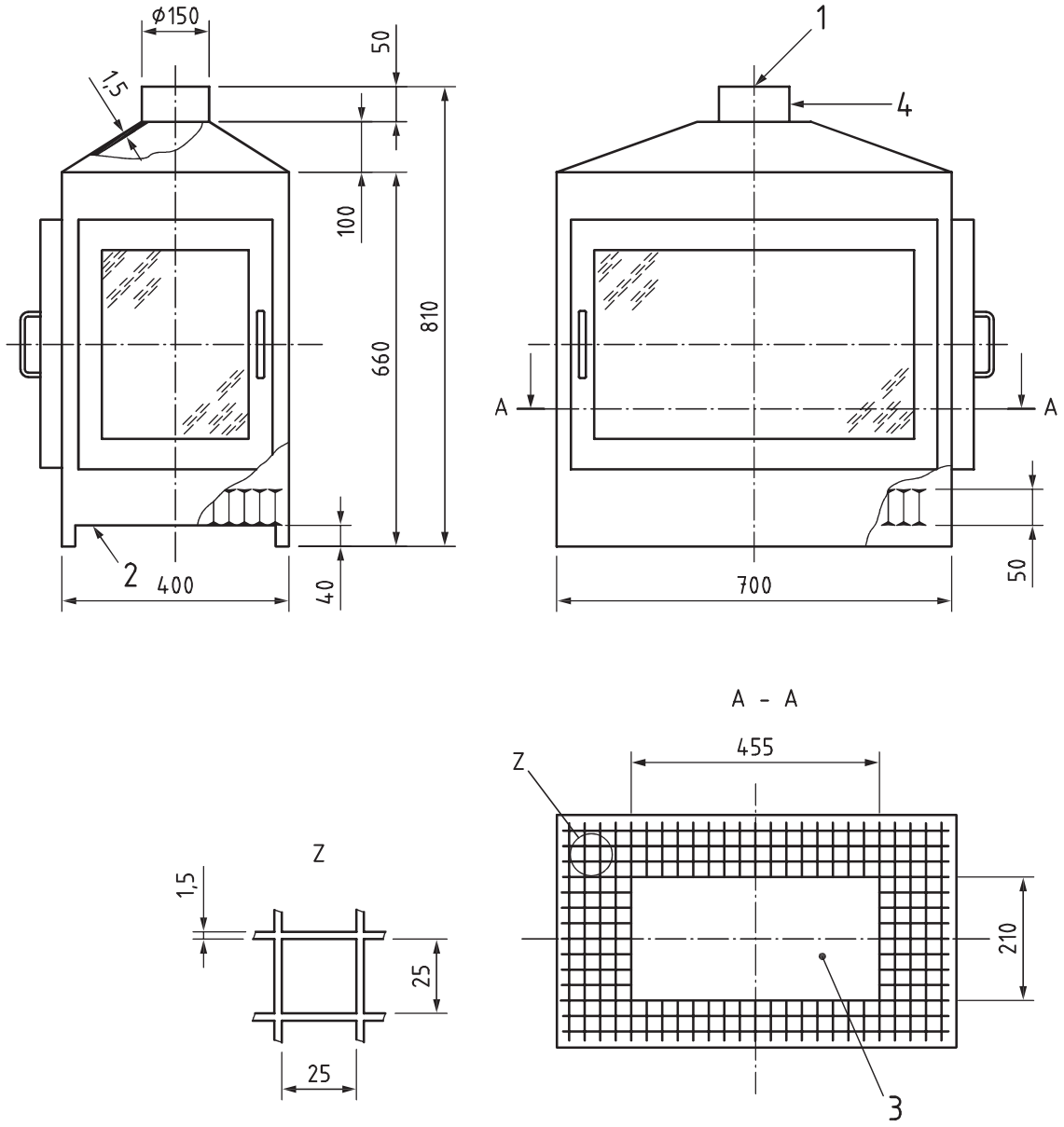
o) flame application time;

p) observations made during the test;

q) information on the intended application of the product, if known;

r) the statement, “The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.”

A clear distinction shall be made between the data provided by the sponsor and the data determined by the test.



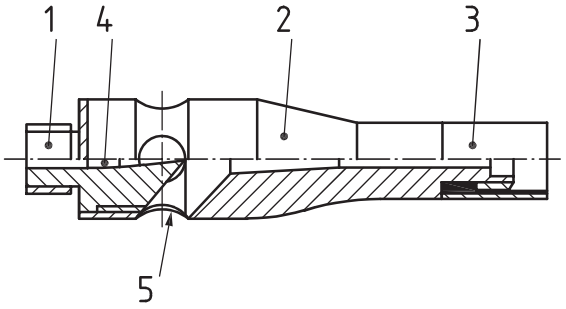
Key

1 measuring point for air velocity
2 metal grid mesh
3 horizontal plate
4 chimney

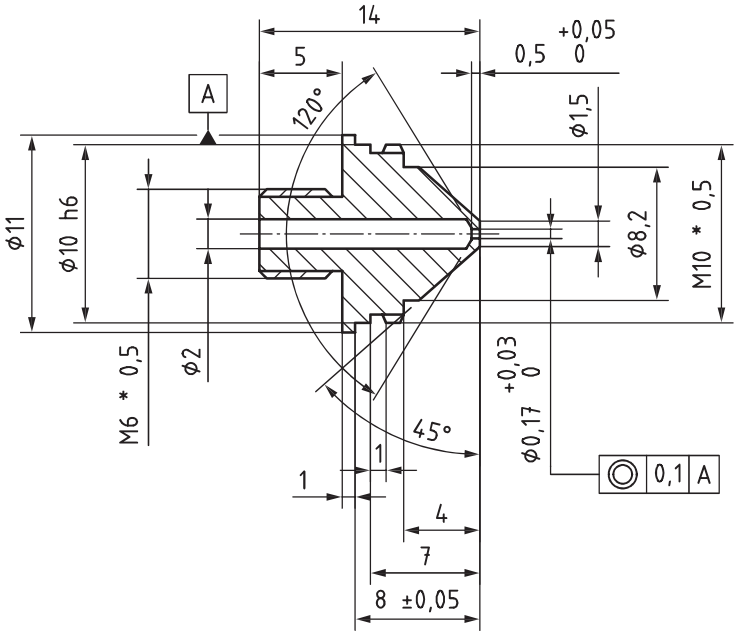
NOTE All dimensions are nominal values in millimetres unless tolerances are given.

Figure 1 — Combustion chamber

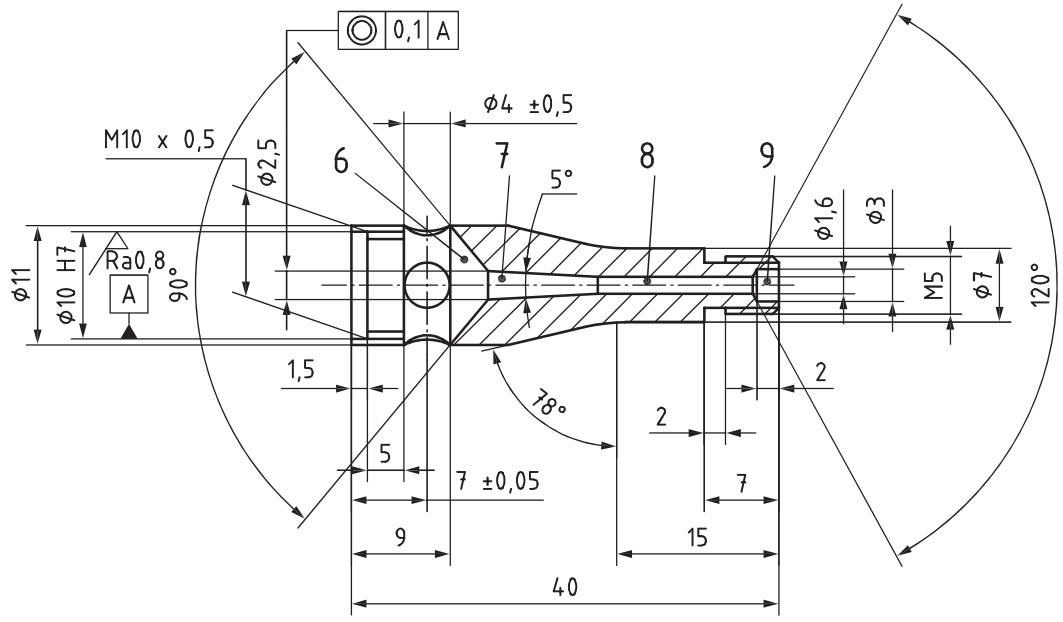
Dimensions in millimetres



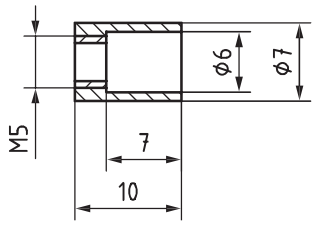
a) Burner assembly



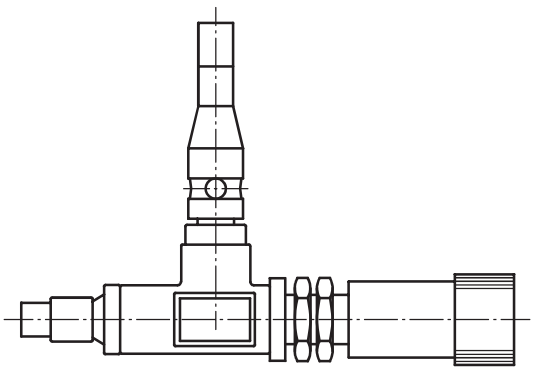
b) Gas jet



c) Burner tube



d) Flame stabilizer



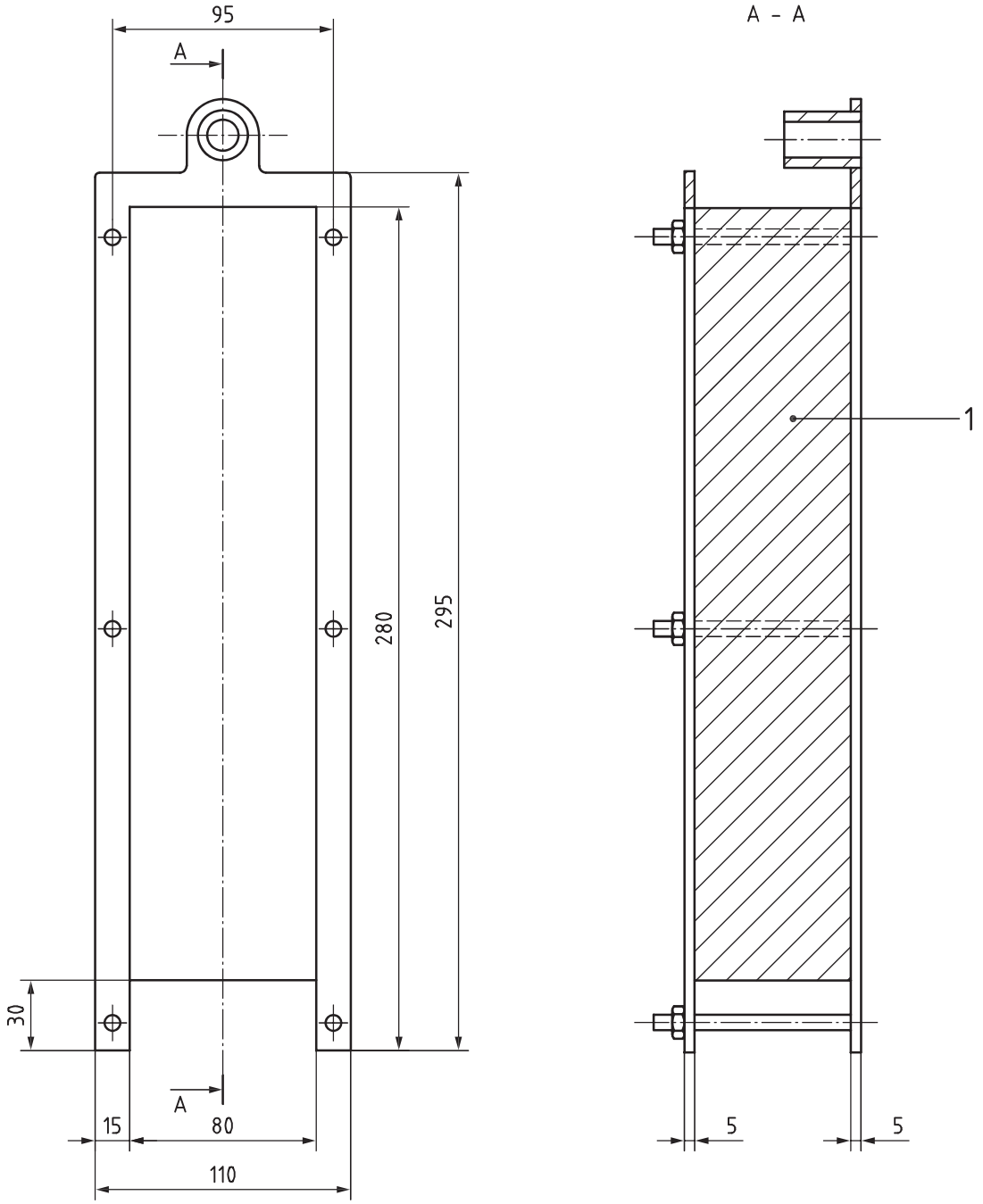
e) Burner and adjustment valve

Key

1	gas jet	6	gas mixing zone
2	burner tube	7	acceleration section
3	flame stabilizer	8	conduction section
4	choke tube	9	outlet
5	notch fitted during assembly		

Figure 2 — Gas burner

Dimensions in millimetres

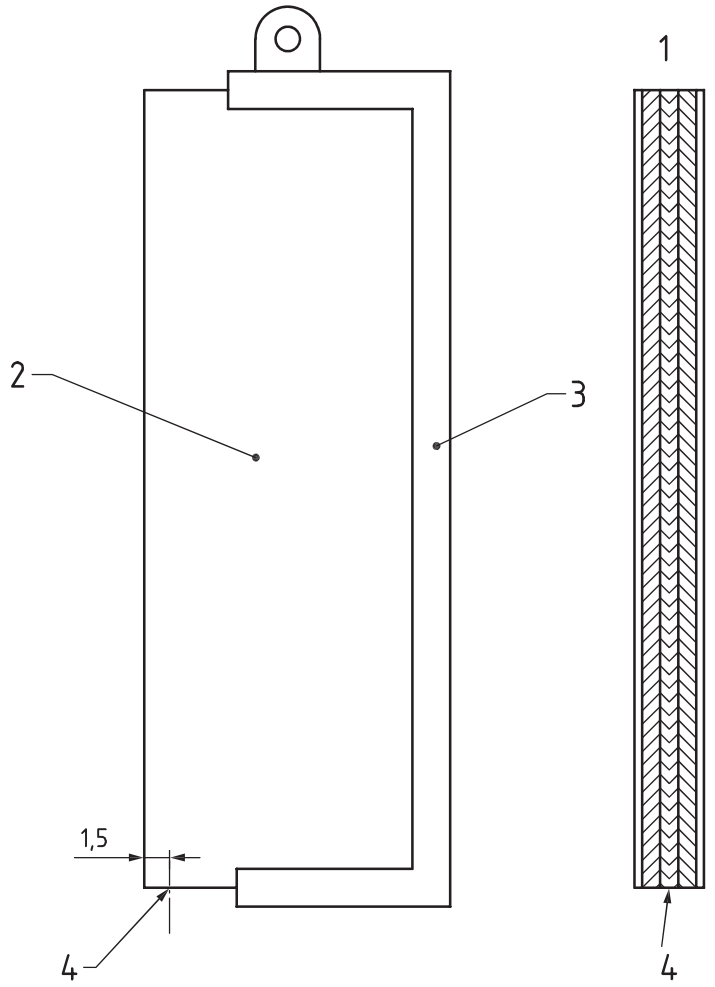


Key

1 test specimen with thickness approximately 60 mm

Figure 3 — Typical specimen holder with test specimen mounted

Dimensions in millimetres

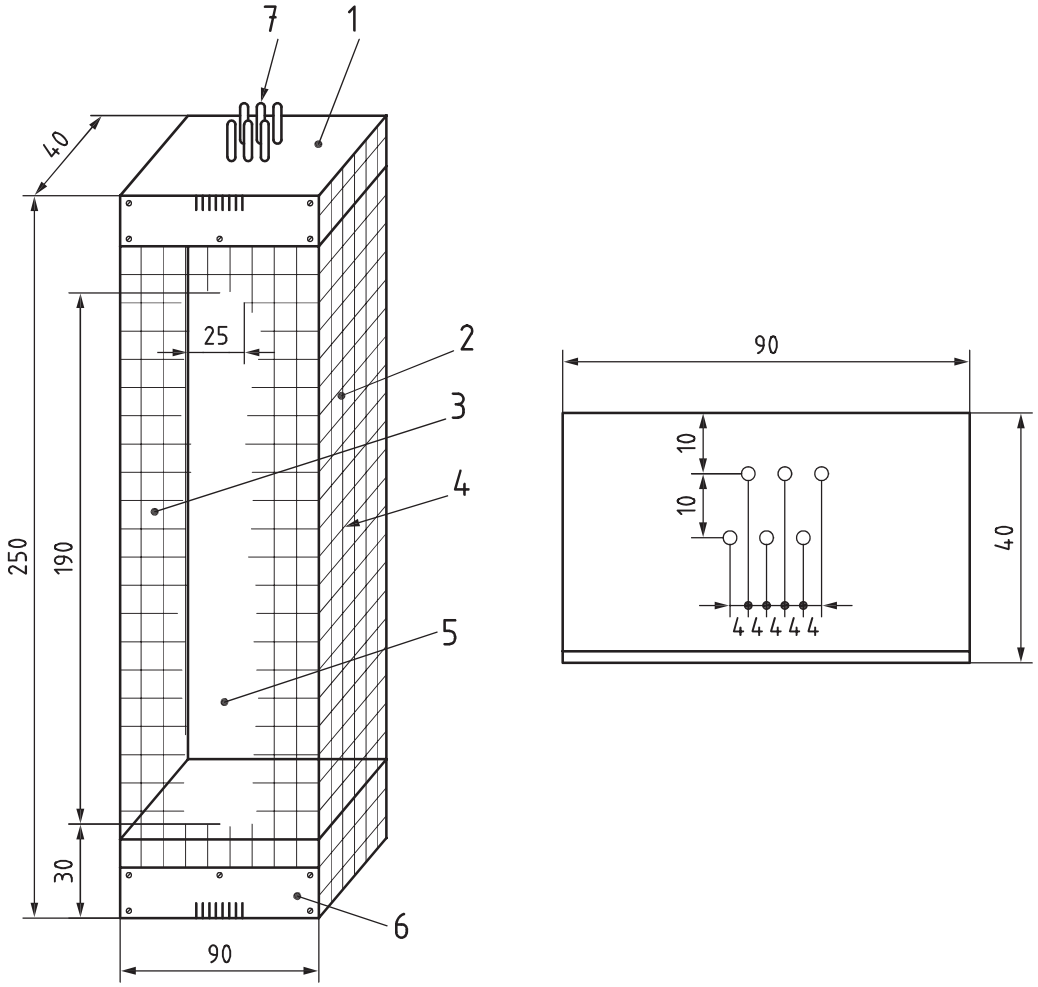


Key

1 side view of specimen
2 test specimen
3 specimen holder
4 flame impingement point

Figure 4 — Typical specimen holder for testing vertical edge of multi-layered specimens over 10 mm thick

Dimensions in millimetres



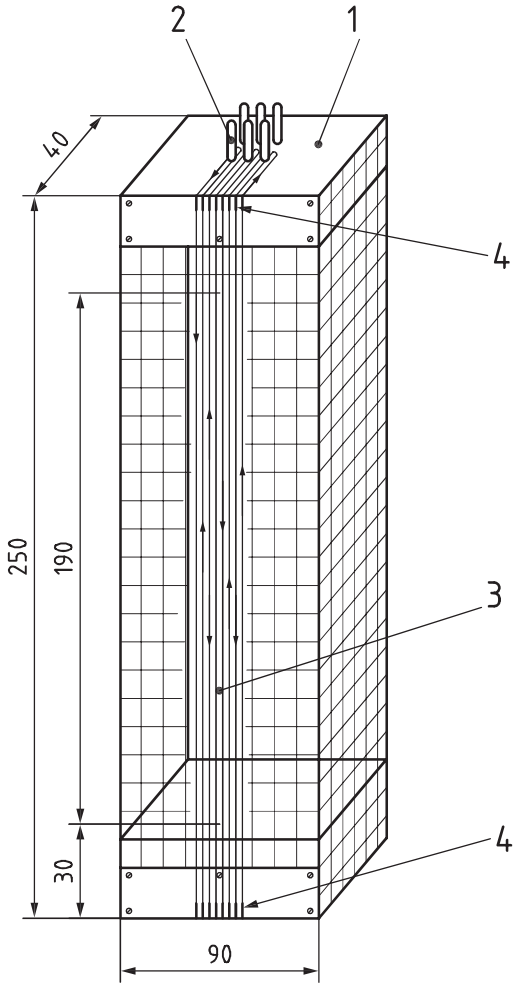
Key

1 small hardwood blocks, 90 mm × 40 mm × 25 mm (beech or oak)
2 back panel identical to side panel shown
3 side panel identical to side panel shown
4 wire mesh, zinc-coated, width of mesh 9 ± 1 mm, wire size 1 ± 0,2 mm
5 flame attack opening 190 mm × 25 mm
6 screwed on sheet metal, 16 mm × 1,4 mm, with 11 guide notches at top and bottom, spaced at intervals of 2 mm
7 metal pins to which wire lacing is attached

NOTE Plan view showing metal pins (7).

Figure 5 — Typical specimen holder for loose fill materials

Dimensions in millimetres

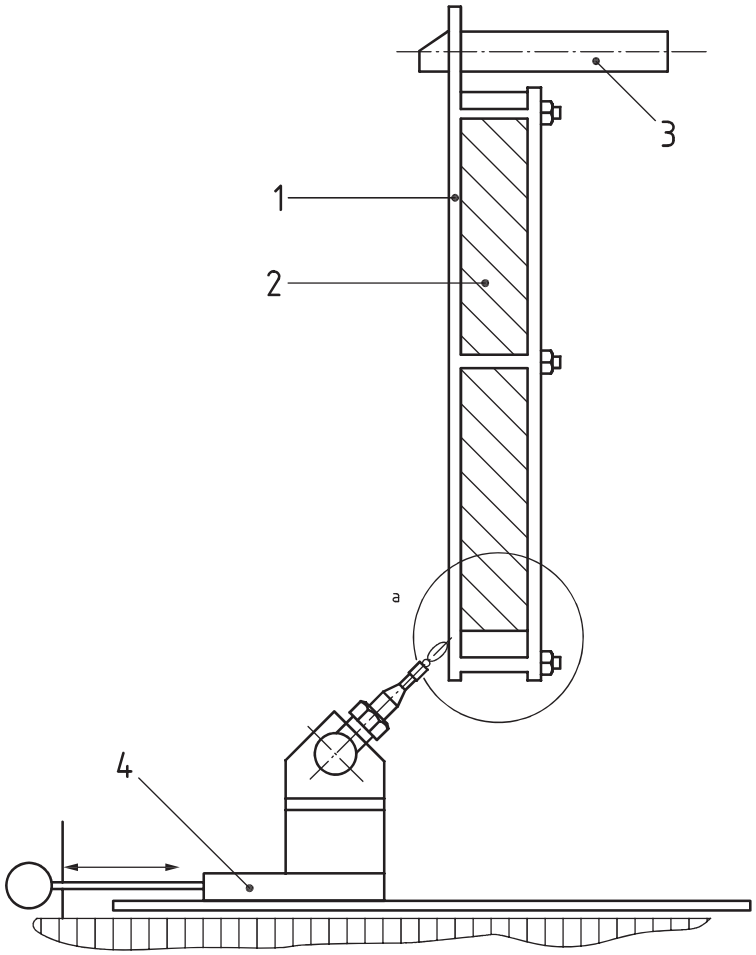


Key

1 hardwood block
2 metal pins
3 wire lacing (resistance wire is used as bracing wire), diameter 0,2 mm, 15,6 Ω/m
4 comb

Figure 6 — Typical lacing to close specimen holder for loose fill materials

Dimensions in millimetres



Key

1 specimen holder

2 specimen

3 support

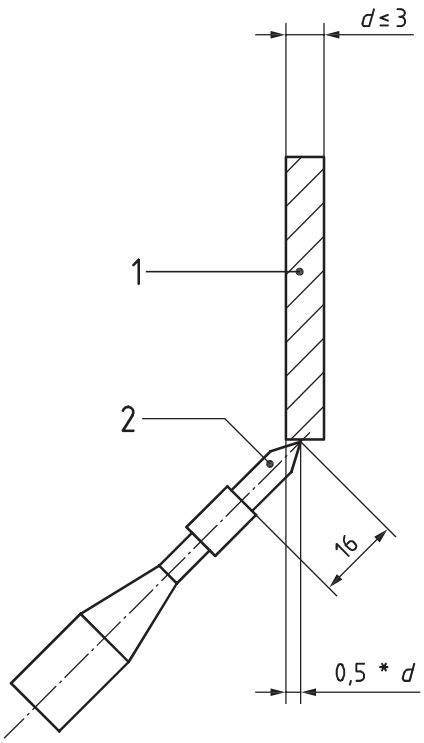
4 burner base

[a] See Figure 8 a) and Figure 8 b).

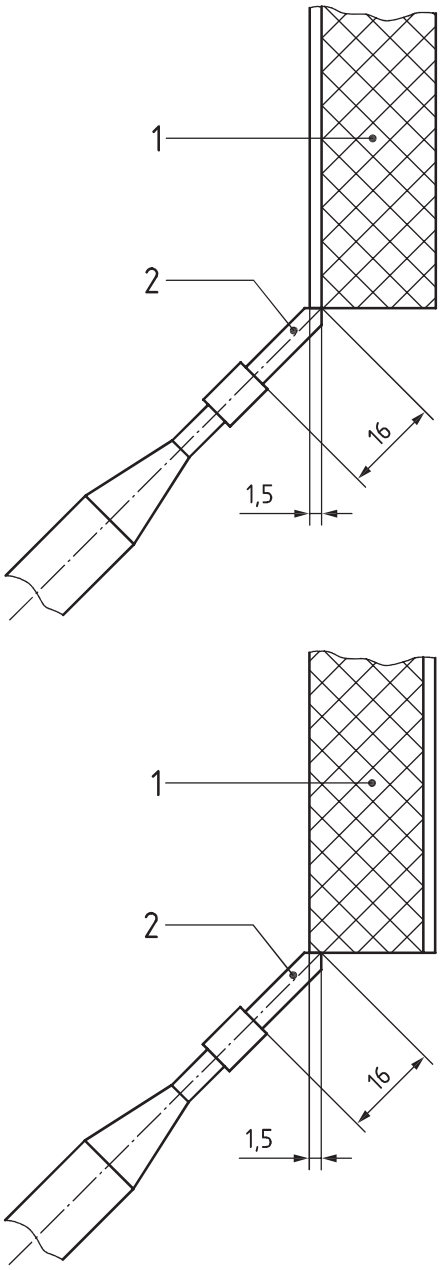
NOTE Shows the standard specimen in the support with a specimen mounted in the holder of maximum thickness.

Figure 7 — Typical support and burner positioning (side view)

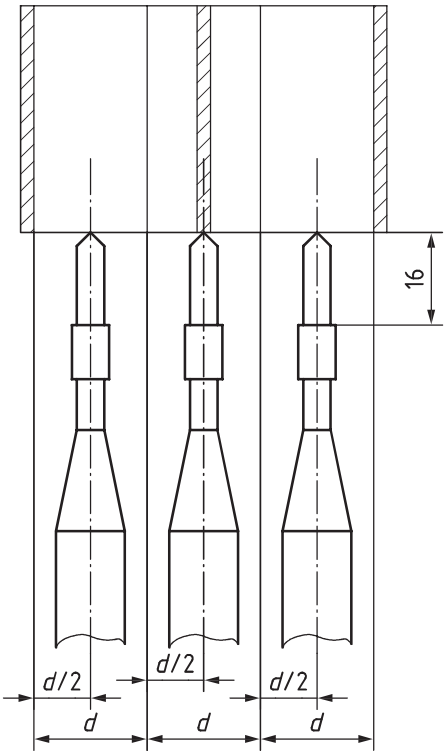
Dimensions in millimetres



a) Flame impingement point for products less than or equal to 3 mm thick



b) Typical flame impingement points for products with thickness greater than 3 mm



c) Flame impingement points for additional set of tests for multi-layer specimens greater than 10 mm thick with single layers greater than 3 mm thick

Key

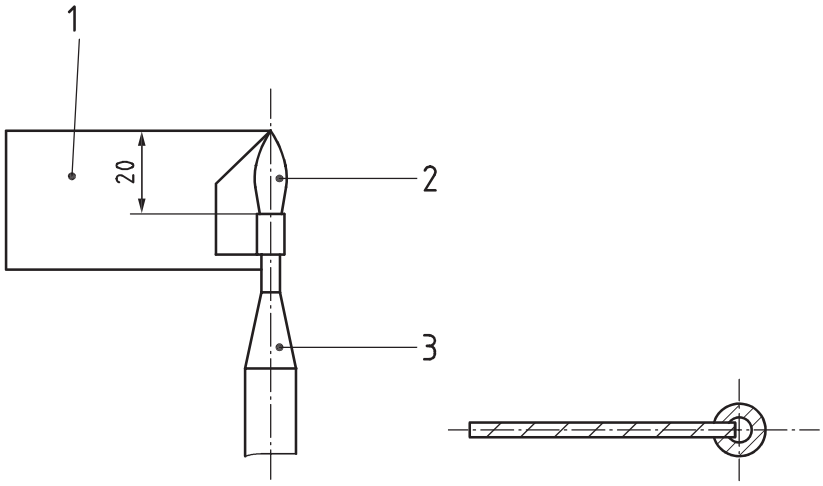
1 test specimen

2 burner spacer

d thickness

Figure 8 — Flame impingement points

Dimensions in millimetres

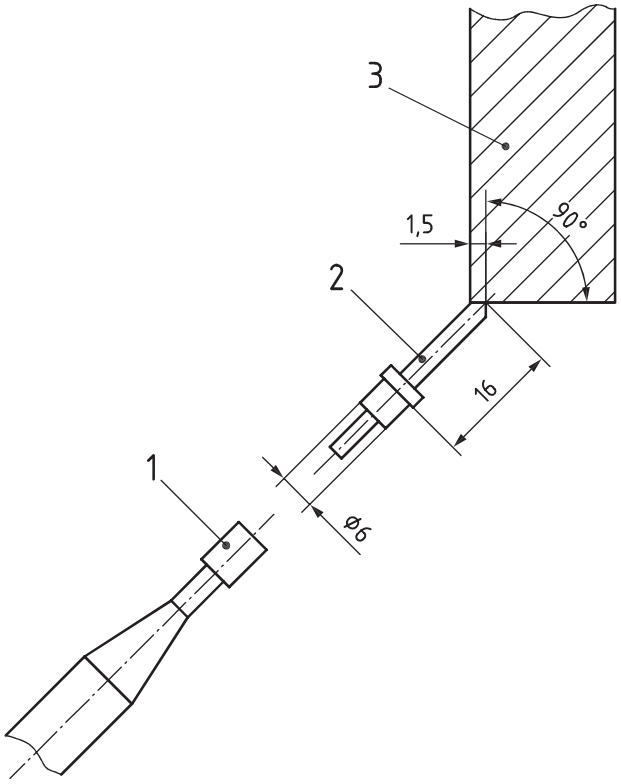


Key

1 metal plate
2 flame
3 burner

Figure 9 — Typical flame height measuring device

Dimensions in millimetres

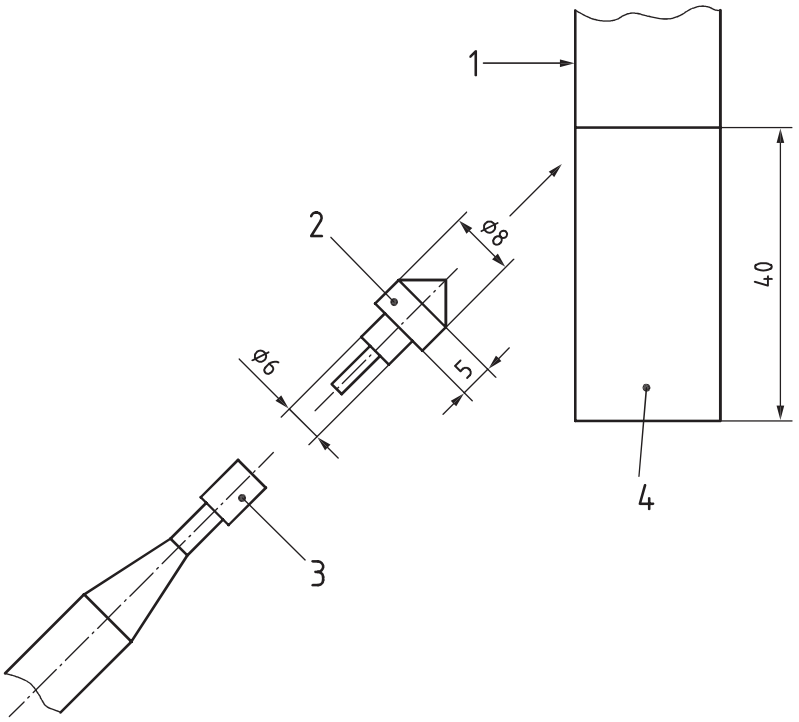


Key

1 burner
2 spacer
3 test specimen

Figure 10 — Burner spacer — Edge flame impingement

Dimensions in millimetres



Key

1 specimen surface
2 spacer
3 burner
4 test specimen

Figure 11 — Burner spacer — Surface flame impingement

Annex A
(informative)

Precision of test method

A.1 General

An inter-laboratory trial of the test method described in this document was conducted, involving 10 laboratories and 12 building products. Statistical analysis of the results of the trials on the ignitability test was carried out according to the principles of ISO 5725-2 in order to determine the repeatability and reproducibility of the method.

Two methods of analysis were utilized.

The data expressed in terms of numbers were analysed using the statistical procedures specified in ISO 5725-2, i.e. mean values, m, and the standard deviations calculated related to repeatability, s_r, and reproducibility, s_R, at the 95 % confidence level. Prior to the statistical evaluations, the results were checked for values differing significantly from the others, outliers (with 1 % probability of occurrence) and stragglers (with 5 % probability); only outliers were rejected.

Of the results expressed in terms of Yes/No answers, the numbers of the Yes and No answers, as well as their relative proportions, were evaluated. Also included was an additional non-standard parameter called *degree of uncertainty*, which attempts to combine the proportions of Yes and No answers into a single number. This quantity is calculated as 2× min (Yes %, No %), hence it equals zero if all the answers are Yes or No and 100 % if half of the answers are Yes and half No.

The parameters analysed and other relevant details are given in Tables A.1 and A.4.

Table A.1 — Parameters analysed for all materials

Parameter	Type	Notation
Occurrence of ignition	Yes/No	—
Whether flame exceeds 150 mm	Yes/No	—
Time to exceed 150 mm	Number	t_{150}
Ignition of the filter paper	Yes/No	—

The results are categorized according to the ignition method (surface, bottom edge and vertical edge). In the case of surface and bottom-edge ignition methods, data were reported on all the products, whereas in the case of the vertical-edge ignition method, only materials E, I, K, and L were analysed.

The essential repeatability and reproducibility values as a function of the time to 150 mm (t_{150}) are reported in Table A.2 as a range for each of the products assessed for surface, bottom edge and vertical edge, respectively, for 15 s application. Table A.3 gives the same data for the 30 s application.

Table A.2 — Summary of precision results for time to reach 150 mm t_{150} for 15 s application times

Flame application area	Range of standard deviations	Average standard deviation	Range of relative repeatability	Average relative repeatability	Range of relative reproducibility	Average relative reproducibility
	%	%	r/m (%)	r/m (%)	R/m (%)	R/m (%)
Surface	s_r/m 0 to 28,4	s_r/m 16,3 s_R/m 43,6	21,2 to 80,4	46,0	65,8 to 204,7	123,2
Bottom edge	s_r/m 0 to 12,8	s_r/m 8,0 s_R/m 18,5	0 to 36,2	22,7	0 to 72,4	52,4
Vertical edge	s_r/m 0 to 16,0	s_r/m 5,3 s_R/m 16,1	0 to 45,3	15,1	0 to 137,0	45,7

Table A.3 — Summary of precision results for time to reach 150 mm t_{150} for 30 s application times

Flame application area	Range of standard deviations	Average standard deviation	Range of relative repeatability	Average relative repeatability	Range of relative reproducibility	Average relative reproducibility
	%	%	r/m (%)	r/m (%)	R/m (%)	R/m (%)
Surface	s_r/m 0 to 28,1	s_r/m 29,3 s_R/m 35,0	0 to 74,4	49,1	0 to 211,4	99,1
Bottom edge	s_r/m 0 to 11,6	s_r/m 8,1 s_R/m 19,7	0 to 32,9	23,0	0 to 81,5	55,7
Vertical edge	s_r/m 0 to 18,8	s_r/m 6,3 s_R/m 6,3	0 to 53,3	17,8	0 to 53,3	17,8

Tables A.4 and A.5 show the results of the yes/no analysis for each of the application times and application areas. The results are consistent for some products and slightly variable for others, which have been shown to be more a function of material/product variation than test method variability.

Table A.4 — Surface ignition — Degree of uncertainty values for yes/no answers

Material	15 s ignition	Ignition of paper	30 s ignition	Ignition of paper
	%	%	%	%
A	87	0	91	0
B	32	0	24	0
C	52	67	30	86
D	20	0	60	46
E	20	0	20	0
F	52	17	53	0
G	60	0	93	0
H	80	0	93	0
I	40	0	60	0
J	0	46	0	0
K	40	7	27	0
L	82	0	44	0

Table A.5 — Bottom-edge ignition — Degree of uncertainty values for yes/no answers

Material	15 s ignition %	Ignition of paper %	30 s ignition %	Ignition of paper %
A	82	0	82	0
B	24	0	48	0
C	25	86	7	57
D	0	22	0	22
E	44	0	44	0
F	91	27	95	0
G	67	0	60	0
H	22	0	0	0
I	7	0	7	0
J	0	0	0	0
K	0	0	0	0
L	0	0	15	30

A.2 Conclusions

The conclusions are the following.

a) The variability of the Yes/No response for each product is generally a function of the product itself rather than the method. However, some of the lack of reproducibility could be attributed to the positioning of the ignition source; different areas of impingement may have led to different ignition results.

b) The values of s_r/m and s_R/m for t_{150} are within acceptable limits for the 15 s and 30 s flame applications, the mean of the standard deviations for all products being comparable with the same parameter achieved in other round robins on fire test methods.

c) The relative repeatability is also acceptable for this method of test. However, the relative reproducibility values for some products and parameters are quite high.

d) The absolute repeatability/reproducibility was good, i.e. within 3 s to 5 s for all times measured. Therefore, if the value is low, the r/R values were high and *vice versa*. For times greater than 10 s, the r/R values were therefore good.

Annex B
(normative)

Testing not essentially flat end-use products

The ignition source described in this document may also be used to determine the ignitability of end-use products which are not essentially flat. This may, however, require a modification of the normative procedure.

The product may be held in its end-use orientation using any of the specimen holders mentioned in the standard. If needed, use thin wire for fixing in a non-obstructive manner. Alternatively, laboratory clamps mounted to the support (Figure 4, item 3) can be used.

In particular, specifically constructed framework or laboratory clamp stands shall not be used, as changes in airflow pattern could be expected.

A full description of the method of mounting and fixing should be given in the test report preferably documented with photographs.

The product to be tested shall be supplied in its entirety or as a specimen of minimum dimensions as described in (5.2 and 5.3).

The specimen shall be mounted with a straight section giving the maximum planar width directly opposite the burner so that the flame is applied directly onto this area.

Additional support for the specimen may be necessary and where this is used this shall be detailed in the test report.

The specimen used may be less than 90 mm wide, i.e. end-use and this deviation shall also be recorded in the test report. If the specimen is less than 30 mm wide, additional pieces shall be used to each side of the central specimen to provide a specimen width of at least 50 mm. If the product is not available in a length of 250 mm, the maximum length shall be used and a joint incorporated at the maximum dimension available provided this does not fall between a height of 120 mm to 160 mm above the flame impingement point.

Where the specimen needs to be fabricated from pieces then they shall be held together with non-obstructive mechanical fixings.

Details of the fabrication of the specimen shall be reported.

Annex C
(normative)

Testing perforated end-use products

The size of the perforations in a product can affect the performance of underlying substrates used in the finished product.

Perforations greater than 1,5 mm in any one direction can result in the passage of flame to any underlying layers or to the reverse face of the product.

For products with perforations greater than 1,5 mm the test shall be conducted on a product incorporating any end use substrates, e.g. fleeces, fabric, insulation.

The product shall be tested twice, once with the maximum and once with the minimum number of perforations in the vertical run above the flame application point using both edge and surface application of the flame.

The full test shall be completed on the worst case in both flame application positions.

Bibliography

[1] 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*

[2] EN 13501-1:2018, *Fire classification of construction products and building elements. Classification using test data from reaction to fire tests*