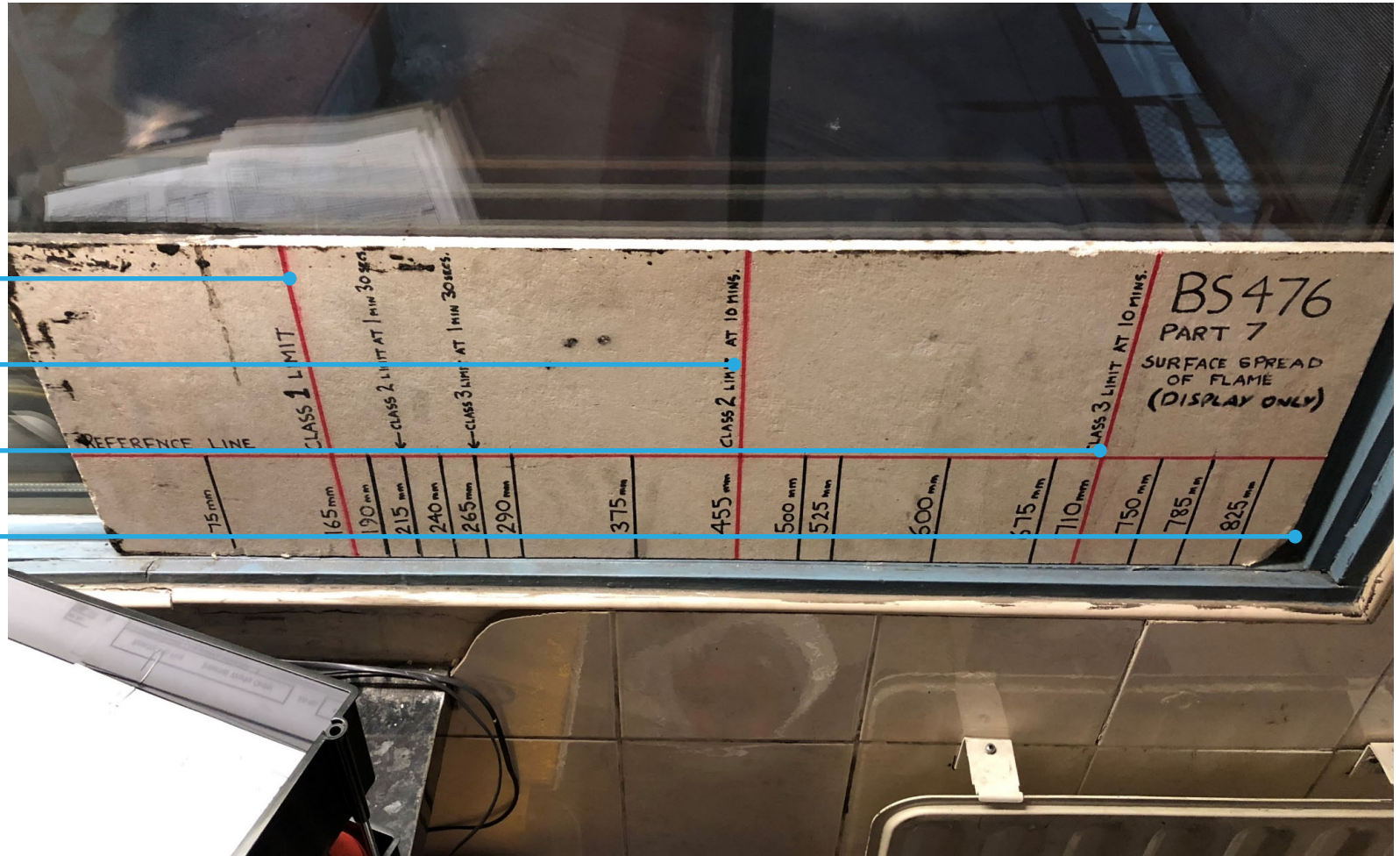


Class 1, Class 2, Class 3 and Class 4

BS 476-7

- Class 1
- Class 2
- Class 3
- Class 4



Class 1-4 – classification to BS 476-7

11.5 A suffix 'Y' shall be added to the classification if any of the following occur:

- a) the product distorts during testing, e.g. curls away at the hot end, so that areas of the test specimen are shielded from the irradiance from the radiation panel such that the test classification may be affected;
 - b) the test specimen does not remain in position for the duration of the test (see 9.2.3);
 - c) the test specimen delaminates, with the flaming portion of the specimen falling away, thus preventing further spread of flame;
 - d) there is delamination from the substrate over a substantial area of the specimen;
 - e) a thin product that softens or melts and coalesces so that areas of the substrate become exposed but without the product falling away;
- NOTE 1: Movement of the test specimen should not lead to the addition of a 'Y' suffix if this results in the specimen being subjected to increased irradiance from the radiation panel.
- NOTE 2: A material could have a classification of D3RY indicating:
- a) a modified surface has been used;
 - b) a class 3 result has been obtained;
 - c) additional specimens have been used to obtain six valid results; and
 - d) softening and/or other behaviour has occurred which is

12 Report

The test report shall include the following:

- a) the name and address of the testing laboratory;
- b) the name and address of the sponsor;
- c) the name and address of the manufacturer/supplier, if known;
- d) the date of test;
- e) a full description of the product (and face) tested including its component parts and method of construction, name and/or reference number if available, nominal thickness(s), colour(s) and, where appropriate, density(ies);
- NOTE: It may be helpful to provide a sketch of the product.
- f) the individual test results in accordance with clause 10;
- g) observations made during the test and comments on any difficulties encountered during the test (see 9.2.2 and 9.2.3);
- h) details of the form in which the specimens were tested (material, composite or assembly), together with details of any modification to the product (4.1.3), the specimen thickness and, where appropriate, air gap; orientation; substrate; whether the product incorporates a thin film; the face or faces subjected to the test; use of reduced size specimens (5.3.1) and the use of short pieces to make up a specimen (5.3.2);
- i) the derived classification according to clause 11, including any prefix and/or suffix as appropriate;
- j) where necessary, the statement that the prefix 'D' or suffix 'R' or 'Y' to the classification indicates that the results should be treated with caution, together with the reasons why this prefix or suffix has been applied;
- k) the statement: 'The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use'.

Classification	Spread of flame at 1.5 min		Final spread of flame	
	Limit	Limit for one specimen in sample	Limit	Limit for one specimen in sample
	mm	mm	mm	mm
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Classification	Spread of flame at 1.5 min		Final spread of flame	
	Limit	Limit for one specimen in sample	Limit	Limit for one specimen in sample
	mm	mm	mm	mm
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Class 0

B PERFORMANCE OF MATERIALS, PRODUCTS AND STRUCTURES

Method of test to determine the classification of the surface spread of flame of products under which materials or products are classified 1, 2, 3 or 4 with Class 1 being the highest.

Under the European classifications, lining systems are classified in accordance with BS EN 13501-1:2007, *Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests*. Materials or products are classified as A1, A2, B, C, D, E or F, with A1 being the highest. When a classification includes "s3, d2", it means that there is no limit set for smoke production and/or flaming droplets/particles.

12 To restrict the use of materials which ignite easily, which have a high rate of heat release and/or which reduce the time to flashover, maximum acceptable 'fire propagation' indices are specified, where the National test methods are being followed. These are determined by reference to the method specified in BS 476-6:1981 or 1989 *Method of test for fire propagation of products*. Index of performance (I) relates to the overall test performance, whereas sub-index (I1) is derived from the fire test performance of test.

13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

- a. composed throughout of materials of limited combustibility; or
- b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (I1) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test.

14 Composite products defined as materials of limited combustibility (see paragraph 9 above and Table A7) should in addition comply with the test requirement appropriate to any surface rating specified in the guidance on requirements B2, B3 and B4.

15 The notional performance ratings of certain widely used generic materials or products are listed in Table A8 in terms of their performance in the traditional lining tests BS 476 Parts 6 and 7 or in accordance with BS EN 13501-1:2007, *Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests*.

16 Results of tests on proprietary materials are frequently given in literature available from manufacturers and trade associations.

Any reference used to substantiate the surface spread of flame rating of a material or product should be carefully checked to ensure that it is suitable, adequate and applicable to the construction to be used. Small differences in detail, such as thickness, substrate, colour, form, fixings, adhesive etc, may significantly affect the rating.

To reduce the testing burden on manufacturers, BS EN 13238 Reaction to fire tests for building products – conditioning procedures and general rules for the selection of standard substrates, defines a number of standard substrates that produce test results representative of different end use applications. The standard substrate selected for testing should take account of the intended end use applications (field of application) of the product and represent end use substrates which have a density of at least 75% of its nominal density. The reaction to fire classification achieved during testing is only valid when the product is used within this field of application i.e. when the product is fixed to a substrate of that class in its end use.

Standard substrates include, Gypsum plasterboard (BS EN 520) with a density of 700+/-100 Kg/m³, Calcium silicate board (BS EN 14306) 870+/-50 Kg/m³ and Fibre cement board 1800+/-200 Kg/m³.

Note: Standard calcium silicate board is not representative of gypsum plasterboard end use (due to the paper layer), but would be representative of most gypsum plasters (with densities of more than 650 Kg/m³). Classifications based on tests using a plasterboard substrate would also be acceptable for products bonded to a gypsum plaster end use substrate.

Thermoplastic materials

17 A thermoplastic material means any synthetic polymeric material which has a softening point below 200°C if tested to BS EN ISO 306:2004 method A120 *Plastics – Thermoplastic materials – Determination of Vicat softening temperature*. Specimens for this test may be fabricated from the original polymer where the thickness of material of the end product is less than 2.5mm.

18 A thermoplastic material in isolation can not be assumed to protect a substrate, when used as a lining to a wall or ceiling. The surface rating of both products must therefore meet the required classification. If however, the thermoplastic material is fully bonded to a non-thermoplastic substrate, then only the surface rating of the composite will need to comply.

19 Concessions are made for thermoplastic materials used for window glazing, rooflights and lighting diffusers within suspended ceilings, which may not comply with the criteria specified in paragraphs 11 onwards. They are described in the guidance on requirements B2 and B4.

20 For the purposes of the requirements B2 and B4 thermoplastic materials should either be used according to their classification 0-3, under the BS 476: Parts 6 and 7 tests as described in paragraphs 11 onwards, (if they have such a rating), or they may be classified TP(a) rigid, TP(a) flexible, or TP(b) according to the following methods:

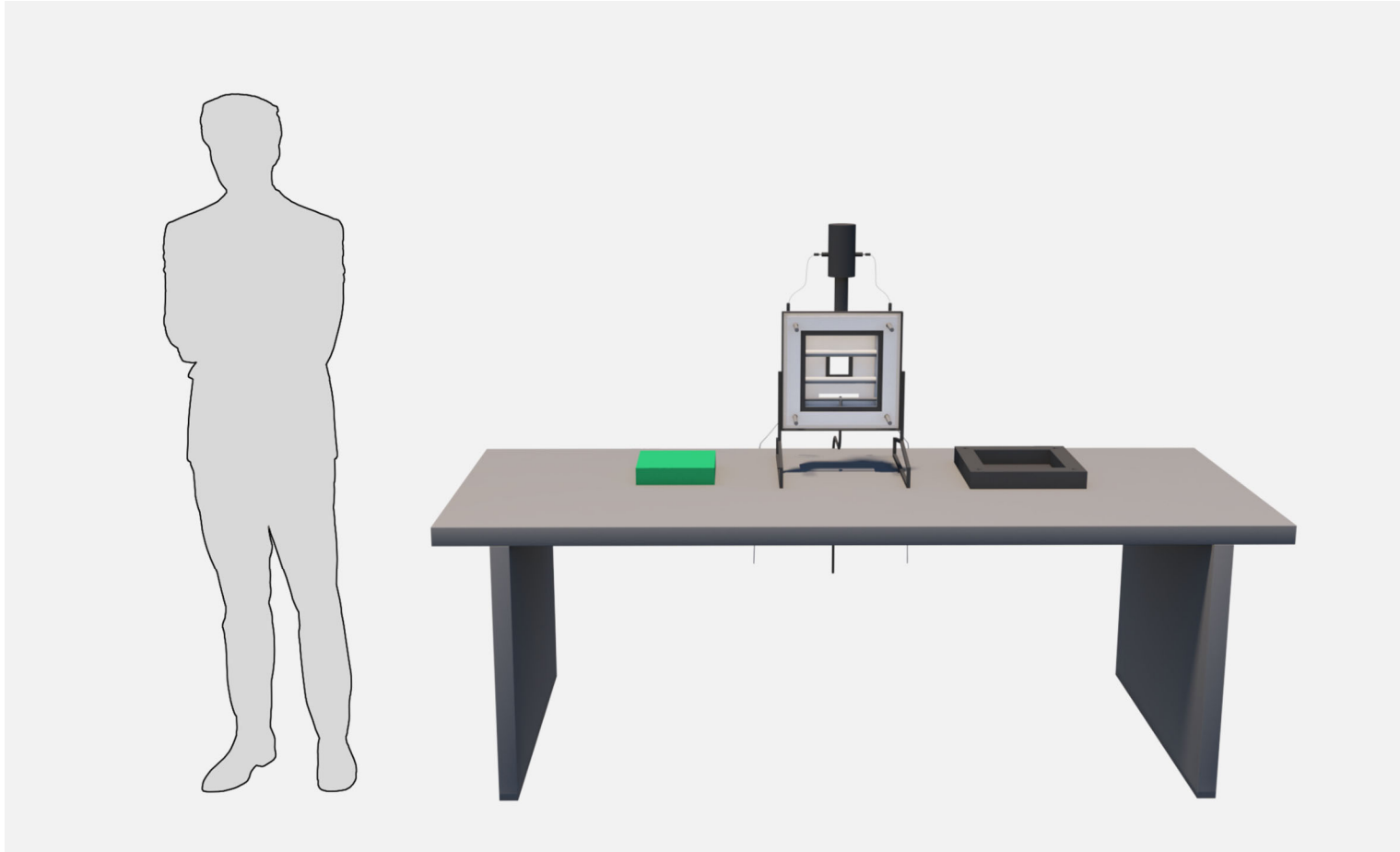
13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

- a. composed throughout of materials of limited combustibility; or
- b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (I1) of not more than 6.

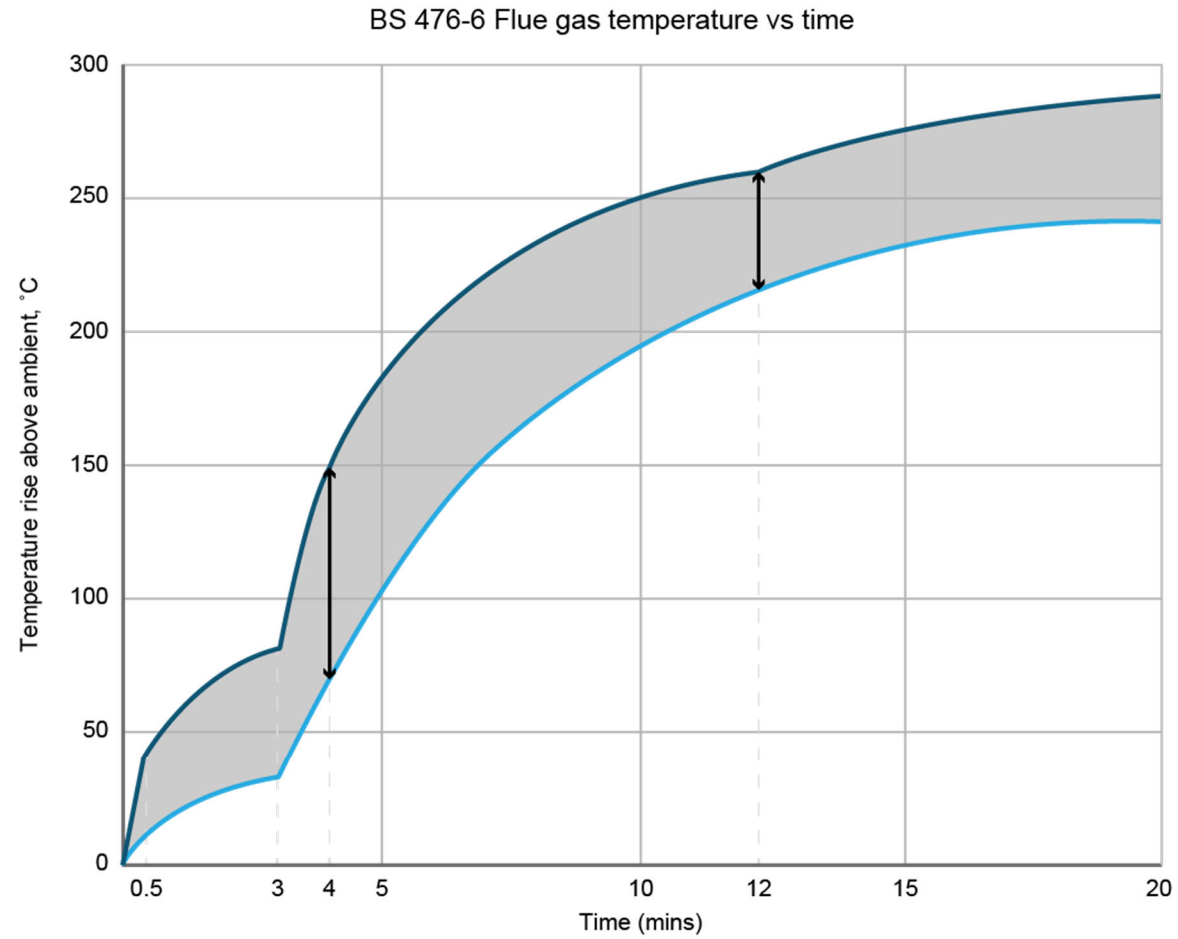
Note: Class 0 is not a classification identified in any British Standard test.

Fire propagation index (I); sub-index (i1); obtained from BS 476-6 – method of test for fire propagation for products

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Index I, i1, i2 and i3 – classification to BS 476-6



Index I, i1, i2 and i3 – classification to BS 476-6

10.2 Index of performance of specimens

The index of performance, S , for each of the specimens tested shall be calculated from the subindices, s_1 , s_2 and s_3 , according to the respective temperature ranges as follows:

$$S = s_1 + s_2 + s_3$$

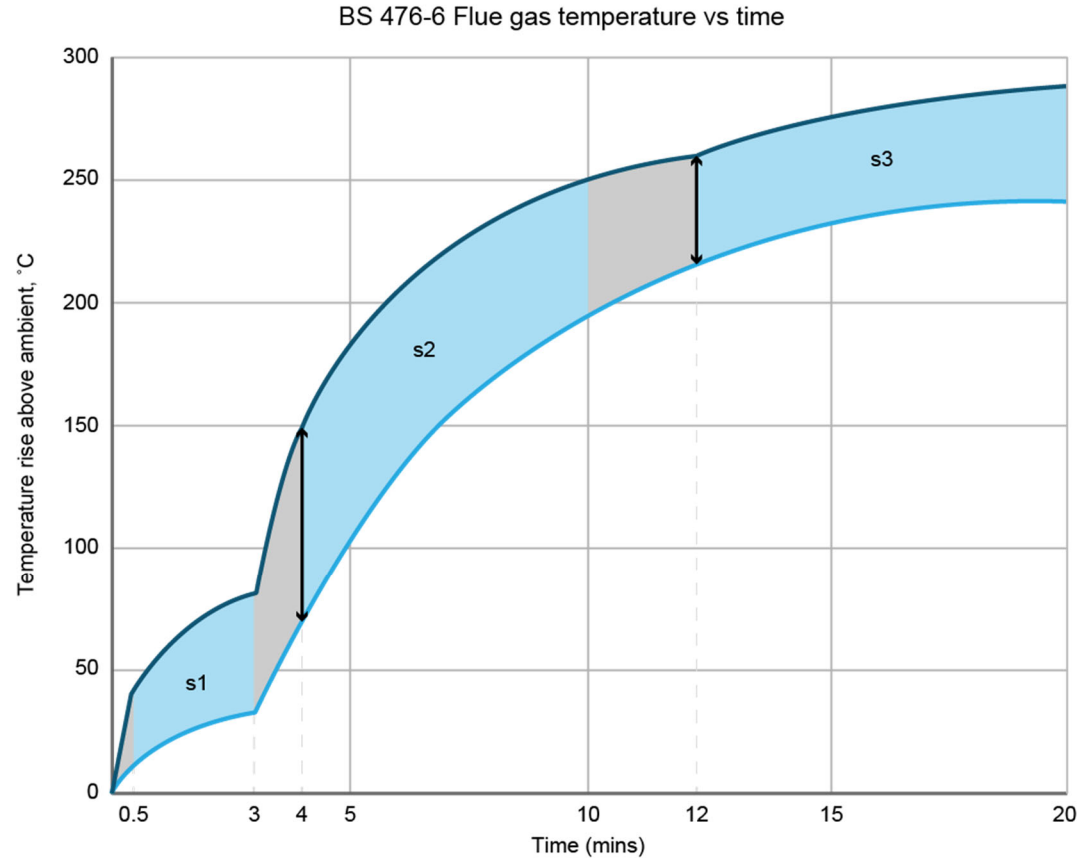
where

s_1 , s_2 and s_3 are given by the expressions

$$s_1 = \sum_{t=0.5}^{t=3} \frac{\theta_s - \theta_c}{10t}$$

$$s_2 = \sum_{t=4}^{t=10} \frac{\theta_s - \theta_c}{10t}$$

$$s_3 = \sum_{t=12}^{t=20} \frac{\theta_s - \theta_c}{10t}$$



Index I, i1, i2 and i3 – classification to BS 476-6

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10.3 Fire propagation index

The index of overall performance, l (fire propagation index), of the product shall be calculated from the individual results of each test as follows:

$$l = i_1 + i_2 + i_3$$

where i_1 , i_2 and i_3 are given by the expressions

$$i_1 = 1/3 [(s_1)_A + (s_1)_B + (s_1)_C]$$

$$i_2 = 1/3 [(s_2)_A + (s_2)_B + (s_2)_C]$$

$$i_3 = 1/3 [(s_3)_A + (s_3)_B + (s_3)_C]$$

The definition of Class 0 is only provided in the internal linings section of ADB

13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

- a. composed throughout of materials of limited combustibility; or
- b. a Class 1 material which has a fire propagation index (l) of not more than 12 and sub-index (i_1) of not more than 6.

Class 0- BS 476-7 requirement

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Class 1- flame
does not spread
beyond this line
at any point in
the test by 1.5
mins and 10
mins

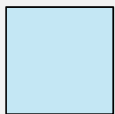


Class 0 – summary

13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

- a. composed throughout of materials of limited combustibility; or
- b. a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6.

Key



BS 476-7 Surface spread of flame



BS 476-6 Surface fire propagation

Approved Document B – Diagram 40

ONLINE VERSION B4

CONSTRUCTION OF EXTERNAL WALLS

Diagram 40 Provisions for external surfaces or walls

See paras 12.5 and 12.6

a. ANY BUILDING b. ANY BUILDING OTHER THAN c. c. ASSEMBLY OR RECREATION BUILDING OF MORE THAN ONE STOREY (see Table D1, Appendix D)

Building height less than 18m Up to 10m above a roof or any part of the building to which the public have access

Less than 1000mm 1000mm or more 1000mm or more 1000mm or more

Building height 18m or more Up to 18m above ground

Less than 1000mm 1000mm or more 1000mm or more

d. ANY BUILDING e. ANY BUILDING

Any dimension over 18m Relevant boundary

Up to 18m above ground No provision in respect of the boundaries indicated

Less than 1000mm 1000mm or more 1000mm or more

KEY TO EXTERNAL WALL SURFACE CLASSIFICATION

- No provision in respect of the boundaries indicated
- Class 0 (national class) or class B-s3, d2 or better (European class)
- Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable
- Index (I) not more than 20 (national class) or class C-s3, d2 or better (European class). Timber cladding at least 9mm thick is also acceptable. (The index I relates to tests specified in BS 476-6)

Notes

- 1 The national classifications do not automatically equal with the equivalent European classifications, therefore, products cannot typically assume a European class unless they have been tested accordingly.
- 2 When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

Approved Document B (Fire safety) Volume 2 – Buildings other than dwellings

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Building height 18m or more Any dimension over 18m

Less than 1000mm 1000mm or more 1000mm or more

Up to 18m above ground Relevant boundary

1000mm or more No provision in respect of the boundaries indicated

1000mm or more Class 0 (national class) or class B-s3, d2 or better (European class)

KEY TO EXTERNAL WALL SURFACE CLASSIFICATION

- No provision in respect of the boundaries indicated
- Class 0 (national class) or class B-s3, d2 or better (European class)
- Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable
- Index (I) not more than 20 (national class) or class C-s3, d2 or better (European class). Timber cladding at least 9mm thick is also acceptable. (The index I relates to tests specified in BS 476-6)

Reliance on the national Class 0 since 1965

The fire definitions relied upon in the National Classes since 1965

(5) Any part of an external wall which constitutes, or is situated less than 3 feet from any point on, the relevant boundary shall, if each side of the wall is separately exposed to test by fire, have fire resistance for not less than the minimum period required by regulation E5.

(6) Any part of an external wall which is situated 3 feet or more from the relevant boundary and which is required by the provisions of these regulations to have fire resistance, shall, if the inside of the wall is exposed to test by fire, have fire resistance for not less than the minimum period required by regulation E5 :

Provided that, for the purposes of this paragraph, the wall shall be capable of satisfying the requirements of clause 11c of section 3 of BS 476: Part 1: 1953 as to insulation for not less than 15 minutes.

(7) Any floor above the ground storey of a house falling within purpose group I shall, if the underside of such floor is exposed to test by fire in accordance with BS 476: Part 1: 1953, be capable of satisfying the requirements of that test as to freedom from collapse for a period of not less than half an hour and as to insulation and resistance to passage of flame for not less than 15 minutes.

(8) Any element of structure shall be deemed to have the requisite fire resistance if—

(a) it is constructed in accordance with one of the specifications given in Schedule 8, and the notional period of fire resistance given in that Schedule as being appropriate to that type of construction and other relevant factors is not less than the requisite fire resistance ; or

(b) a similar part made to the same specification as that element is proved to have the requisite fire resistance under the conditions of test prescribed in the foregoing paragraphs of this regulation.

External walls

E7.—(1) Any side of a building (other than a small garage which is a separate building and complies with the relevant requirements of regulation E16) shall comply with any relevant requirements relating to the permitted limits of unprotected areas specified in Schedule 9 unless the building is so situated that such side might in accordance with Schedule 9 consist entirely of an unprotected area.

(2) (a) Any external wall (other than an external wall of a building which is within the limits of size indicated by the letter "x" in Part 1 of Table A to regulation E5 or of a building not divided into compartments and within the limits of size indicated by the letter "x" in Part 2 of that Table) which constitutes, or is situated within a distance of 3 feet from any point on, the relevant boundary, and

(b) any external wall of a building exceeding 50 feet in height (other than an external wall of a part of that building which is less than 50 feet in height, and completely separated from all other parts as specified in regulation E5(3)(b) and which is situated 3 feet or more from the relevant boundary) shall be so constructed as—

(i) not to include any combustible material except any internal lining which complies with regulation E14, or any external cladding not required by paragraph (3) of this regulation to be non-combustible, and

(b) any external wall of a building exceeding 50 feet in height (other than an external wall of a part of that building which is less than 50 feet in height, and completely separated from all other parts as specified in regulation E5(3)(b) and which is situated 3 feet or more from the relevant boundary) shall be so constructed as—

(i) not to include any combustible material except any internal lining which complies with regulation E14, or any external cladding not required by paragraph (3) of this regulation to be non-combustible, and

The fire definitions relied upon in the National Classes since 1965

ARUP

(ii) to enable any required fire resistance to be attained by the non-com-

(3) (a) Any cladding on any external wall, if such cladding is situated within a distance of 3 feet from any point on the relevant boundary, shall be non-combustible.

(b) Any cladding on any external wall situated 3 feet or more from the relevant boundary shall, if the building is more than 50 feet in height, have a surface complying with the requirements specified for Class O in regulation E14, except that any part of such cladding below a height of 50 feet from the ground may consist of timber of not less than $\frac{3}{8}$ inch finished thickness.

(c) Any beam or column forming part of and any structure carrying an external wall which is required to be of non-combustible materials shall comply with the provisions of paragraph (2) as to non-combustibility.

(4) For the purposes of this regulation—

(a) any part of a roof shall be deemed to be part of an external wall or side of a building if it is pitched at an angle of 70 degrees or more to the horizontal and adjoins a space to which persons have access not limited to the purposes of maintenance or repair;

(b) any reference to Schedule 9 shall be construed as referring to the provisions of Part I of that Schedule, together with (at the option of the person intending to erect the building) either the provisions of Part II or those of Part III or, if the building is one to which Part IV applies, those of that Part or of Parts II or III.

(5) If—

(a) any building is to be erected on land occupied with any other building, or two or more detached buildings are to be erected on land in common occupation; and

(b) either of those buildings is of purpose groups I or III (other than a small garage which is a separate building and complies with regulation E16),

in the application of the provisions of this regulation to any external wall of any building to be so erected which faces an external wall of such other building—

(i) the relevant boundary shall be a notional boundary passing between those buildings and such boundary must be capable of being situated in such a position as to enable the external walls of those buildings to comply with the requirements of this regulation; and

(ii) if such other building is an existing building, it shall be deemed to be a building to be erected on the site which it occupies, being of the same purpose group and having the same unprotected areas and fire resistance as the existing building.

Separating walls

E8.—(1) Subject to the exception specified in paragraph (2), any separating wall shall be imperforate and shall form a complete vertical separation between any buildings separated (including any roof space therein).

41

(3) (a) Any cladding on any external wall, if such cladding is situated within a distance of 3 feet from any point on the relevant boundary, shall be non-combustible.

(b) Any cladding on any external wall situated 3 feet or more from the relevant boundary shall, if the building is more than 50 feet in height, have a surface complying with the requirements specified for Class O in regulation E14, except that any part of such cladding below a height of 50 feet from the ground may consist of timber of not less than $\frac{3}{8}$ inch finished thickness.

External wall fire performance requirements of high-rise buildings through time

Year	Regulation/Statutory guidance	Cladding performance requirement	External surface performance requirement	External wall requirement (except internal linings and cladding)	Insulation performance requirement
1965	Building Regulations	Class 0		Non- Combustible	
1972	Building Regulations	Class 0		Non- Combustible	
1976	Building Regulations	Class 0		Non- Combustible	
1985	Approved Document B	Class 0		Limited combustibility	
1992	Approved Document B		Class 0		*Limited combustibility
2000	Approved Document B		Class 0		Limited combustibility
2002	Approved Document B		Class 0/Class B-s3, d2		Limited combustibility
2006	Approved Document B		Class 0/Class B-s3, d2		Limited combustibility
2007	Approved Document B		Class 0/Class B-s3, d2		Limited combustibility
2010	Approved Document B		Class 0/Class B-s3, d2		Limited combustibility
2013	Approved Document B		Class 0/Class B-s3, d2		Limited combustibility

* First instance a specific performance requirement was set for insulation

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Building Regulations 1965	Any cladding on any external wall situated 3 feet [0.9144 m] or more from the relevant boundary shall, if the building is more than 50 feet [15.24m] in height, have a surface complying with the requirements specified for Class O in regulation E14, except that any part of such cladding below a height of 50 feet [15.24m] from the ground may consist of timber of not less than ¾ inch [9.525mm] finished thickness. (Regulation E7 3(b) pp. 41)		Any external wall of a building exceeding 50 feet [15.24m] in height” “and which is situated 3 feet [0.9144 m] or more from the relevant boundary shall be so constructed as: Not to include any combustible material except any internal lining which complies with regulation E14, or any external cladding not required by paragraph (3) of this regulation to be non-combustible (Regulation E7 2(b) pp. 40)	

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Building Regulations 1972	<p>Any Cladding on any external wall situated 1m or more from the relevant boundary shall, if the building is more than 15m in height, have a surface complying with the requirements specified for Class 0 in Regulation E15(1)(e)</p> <p>Except that any part of such cladding below a height of 15m from the ground may consist of timber not less than 9mm finished thickness or of a material having a surface which when tested in accordance with BS 476:Part 6:1968, has an index of performance (I) not exceeding 20 (Regulation E7 3(b) pp 1102)</p>		<p>Any external wall... which is a wall of a building which exceeds 15m in height shall be constructed wholly of non-combustible materials apart from any external cladding which complies with paragraph (3) of this regulation or any internal lining which complies with regulation E15 (Regulation E7 2(a)(i)) pp 1101)</p>	

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Building Regulations 1976	<p>Any Cladding on any external wall situated 1m or more from the relevant boundary shall, if the building is more than 15m in height, have a surface complying with the requirements specified for Class 0 in Regulation E15(1)(e)</p> <p>Except that any part of such cladding below a height of 15m from the ground may consist of timber not less than 9mm finished thickness or of a material having a surface which when tested in accordance with BS 476:Part 6:1968, has an index of performance (I) not exceeding 20 (Regulation E7 3(b) pp 1102)</p>		<p>Any external wall... which is a wall of a building which exceeds 15m in height shall be constructed wholly of non-combustible materials apart from any external cladding which complies with paragraph (3) of this regulation or any internal lining which complies with regulation E15 (Regulation E7 2(a)(i)) pp 1101)</p>	

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Approved Document B 1985	Any cladding 15m or more above the ground - Class 0 Any cladding less than 15m above ground- timber at least 9mm thick; or any material with an index of performance (I) not more than 20 (Table 2.2 pp. 13)		External walls should be constructed of materials of limited combustibility if the building or separated part is more than 15m in height (Paragraph 2.7 pp 13)	

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Approved Document B 1992		<p>External wall surface classification: Any dimension over 20m- Class 0 Up to 20m above ground- Index (I) not more than 20. Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 36 pp. 73)</p>		<p>“In a building with a storey at more than 20m above ground level, insulation material used in the external wall construction should be of limited combustibility” (Paragraph 12.7 pp.72)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Approved Document B 2000		<p>External wall surface classification: Any dimension over 18m- Class 0 Up to 18m above ground- Index (I) not more than 20. Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 91) “One alternative to meeting the provisions in Diagram 40 could be BRE Fire Note 9 Assessing the fire performance of external cladding systems: a test method” (Paragraph 13.5 pp 87)</p>		<p>“In a building with a storey 18m or more above ground level, insulation material used in ventilated cavities in the external wall construction should be of limited combustibility” (Paragraph 13.7 pp.90)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement (except internal linings and cladding)	Specific insulation performance requirement for fire
Approved Document B 2002		<p>External wall surface classification: Any dimension over 18m- Class 0 (national class) or Class B-s3, d2 or better (European Class) Up to 18m above ground- Index (I) not more than 20 or class C-s3,d2 or better (European Class). Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 91) “One alternative to meeting the provisions in Diagram 40 could be BRE Fire Note 9 Assessing the fire performance of external cladding systems: a test method” (Paragraph 13.5 pp 90)</p>		<p>“In a building with a storey 18m or more above ground level, insulation material used in ventilated cavities in the external wall construction should be of limited combustibility” (Paragraph 13.7 pp.90)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall requirement	Specific insulation performance requirement for fire
Approved Document B 2006		<p>External wall surface classification: Any dimension over 18m- Class 0 (national class) or Class B-s3, d2 or better (European Class)</p> <p>Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable</p> <p>Up to 18m above ground- Index (I) not more than 20 or class C-s3,d2 or better (European Class). Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 95)</p>	<p>“External walls should either meet the guidance given in paragraphs 12.6 to 12.9 or meet the performance criteria given in the BRE Report Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding systems using full scale test data from BS 8414-1:2002 or BS 8414- 2:2005.” (Paragraph 12.5 pp. 93)</p>	<p>“In a building with a storey 18m or more above ground level any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility” (Paragraph 12.7 pp.93)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall performance requirement for fire	Specific insulation performance requirement for fire
Approved Document B 2007		<p>External wall surface classification: Any dimension over 18m- Class 0 (national class) or Class B-s3, d2 or better (European Class)</p> <p>Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable</p> <p>Up to 18m above ground- Index (I) not more than 20 or class C-s3,d2 or better (European Class). Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 95)</p>	<p>“External walls should either meet the guidance given in paragraphs 12.6 to 12.9 or meet the performance criteria given in the BRE Report</p> <p>Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding systems using full scale test data from BS 8414-1:2002 or BS 8414-2:2005.”</p> <p>(Paragraph 12.5 pp. 93)</p>	<p>“In a building with a storey 18m or more above ground level any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility” (Paragraph 12.7 pp.93)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall performance requirement for fire	Specific insulation performance requirement for fire
Approved Document B 2010		<p>External wall surface classification: Any dimension over 18m- Class 0 (national class) or Class B-s3, d2 or better (European Class)</p> <p>Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable</p> <p>Up to 18m above ground- Index (I) not more than 20 or class C-s3,d2 or better (European Class). Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 95)</p>	<p>“External walls should either meet the guidance given in paragraphs 12.6 to 12.9 or meet the performance criteria given in the BRE Report</p> <p>Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding systems using full scale test data from BS 8414-1:2002 or BS 8414-2:2005.”</p> <p>(Paragraph 12.5 pp. 93)</p>	<p>“In a building with a storey 18m or more above ground level any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility” (Paragraph 12.7 pp.93)</p>

External wall fire performance requirements of high-rise buildings through time

Regulation/ Statutory guidance	Cladding performance requirement for fire	External surface performance requirement	External wall performance requirement for fire	Specific insulation performance requirement for fire
Approved Document B 2013		<p>External wall surface classification: Any dimension over 18m- Class 0 (national class) or Class B-s3, d2 or better (European Class)</p> <p>Profiled or flat steel sheet at least 0.5mm thick with an organic coating of no more than 0.2mm thickness is also acceptable</p> <p>Up to 18m above ground- Index (I) not more than 20 or class C-s3,d2 or better (European Class). Timber cladding at least 9mm thick is also acceptable (the index I relates to tests specified in BS 476 Part 6) (Diagram 40 pp. 95)</p>	<p>“External walls should either meet the guidance given in paragraphs 12.6 to 12.9 or meet the performance criteria given in the BRE Report</p> <p>Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding systems using full scale test data from BS 8414-1:2002 or BS 8414-2:2005.”</p> <p>(Paragraph 12.5 pp. 93)</p>	<p>“In a building with a storey 18m or more above ground level any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the external wall construction should be of limited combustibility” (Paragraph 12.7 pp.93)</p>

The primary changes to the definition of Class 0

Class 0 was originally Part 7 only

Regulation/ Statutory guidance	Definition of “Non- Combustible”	Definition of “limited combustibility”	Definition of “Class 0”
Building Regulations 1965	“Combustible” means capable of being classified as combustible if subjected to the test for combustibility prescribed in BS 476: Part I: 1953; and “non-combustible” shall be construed accordingly. (Regulation A2(1) pp.10)		Where the surface is required to be of Class 0 , the material shall- (i) be non-combustible throughout ; or (ii) comprise a base or background which is non-combustible with the addition of a surface not exceeding 1/32 inch (0.794 mm) thick so that the spread of flame rating of the combined product is not lower than Class I in clause 7 of BS 476: Part I:1953 ; or (iii) comprise a base or background which is combustible but with any exposed face finished with a layer not less than 1/8 inch (3.175 mm) of non-combustible material and the other face not exposed to air (Regulation E14 (1)(a) pp. 49)

Changes in national fire definitions

Regulation/ Statutory guidance	Definition of “Non- Combustible”	Definition of “limited combustibility”	Definition of “Class 0”
Building Regulations 1972	<p>“non-combustible” means capable of being classified as non-combustible if subjected to the test for non-combustibility prescribed in BS 476: Part 4: 1970; and “combustible” shall be construed accordingly. (Regulation A2(1) pp 1066)</p>		<p>Any reference to a surface being of Class 0 shall be construed as a requirement that-</p> <ul style="list-style-type: none"> (i) The material of which the wall or ceiling is constructed shall be non-combustible throughout; or (ii) The surface of the material (or if it is bonded throughout to a substrate the surface of the material in conjunction with the substrate) shall, when tested in accordance with BS 476-6: 1968 have an index of performance (I) not exceeding 12 and a sub-index (i1) not exceeding 6 (Regulation E15 (1)(e) pp 1111)

Changes in national fire definitions

Regulation/ Statutory guidance	Definition of “Non- Combustible”	Definition of “limited combustibility”	Definition of “Class 0”
<p>Building Regulations 1976</p>	<p>“non-combustible” means capable of being classified as non-combustible if subjected to the test for non-combustibility prescribed in BS 476: Part 4: 1970; and “combustible” shall be construed accordingly.</p> <p>(Regulation A4(1) pp 4230)</p>		<p>Any reference to a surface being of Class 0 shall be construed as a requirement that-</p> <ul style="list-style-type: none"> (i) The material of which the wall or ceiling is constructed shall be non-combustible throughout; or (ii) The surface of the material (or if it is bonded throughout to a substrate the surface of the material in conjunction with the substrate) shall, have a surface of Class 1 and, if tested in accordance with BS 476-6: 1968 have an index of performance (I) not exceeding 12 and a sub-index (i1) not exceeding <p>(Regulation E15 (1)(e) pp 4295)</p>

Changes in national fire definitions

Regulation/ Statutory guidance	Definition of “Non- Combustible”	Definition of “limited combustibility”	Definition of “Class 0”
Approved Document B 1985	<p>Any material which when tested to BS 476: Part 11 does not flame and there is no rise in temperature on either the centre (specimen) or furnace thermocouples.</p> <p>Products classified as non-combustible under BS 476: Part 4: 1970</p>	<p>Any non-combustible material listed in Table A6.</p> <p>Any material of density 300 kg/m³ or more, which when tested to BS 476: Part 11 does not flame and the rise in temperature on the furnace thermocouple is not more than 20° C.</p> <p>Any material of density less than 300 kg/m³, which when tested to BS 476: Part 11 does not flame for more than 10 seconds and the rise in temperature on the centre (specimen) thermocouple is not more than 35° C and on the furnace thermocouple is not more than 25° C.</p>	<p>A Class 0 material or the surface of a composite product is either:</p> <p>(a) composed throughout of materials of limited combustibility, or</p> <p>(b) a Class 1 material which has a fire propagation index (I) of not more than 12, and (i1) of not more than 6</p> <p>(Appendix A paragraph A8 pp. 46)</p>
	(Appendix A Table A6 pp. 48)	(Appendix A Table A7 pp. 48)	

Reference to National Classes on the Grenfell Refurbishment

Class 0 – relevance to Grenfell Tower



Issue 2, January 2012
C/S/56 | (2-3) | Rn7 | (M2)

Celotex FR5000

Introduction

Celotex FR5000 is our premium performance PIR solution. Through ongoing product innovation and breakthrough design, FR5000 represents pioneering progression within the PIR market offering an insulation board with enhanced thermal performance as well as an A+ rating when compared to the BRE Green Guide 2008, Class 0 fire performance and super low emissivity values with Celotex IQ.

With super low emissivity textured aluminium foil facings, FR5000 is manufactured from rigid polyisocyanurate (PIR) using a blowing agent that has low global warming potential (GWP) and zero ozone depletion potential (ODP).

With FR5000, you are specifying an insulation board that:

- Has a lower thermal conductivity value (0.021W/mK) compared with other typical PIR insulation boards providing enhanced thermal performance
- Has super low emissivity with Celotex IQ, delivering some of the highest rigid board insulation solutions
- Achieves an A+ rating when compared to the BRE Green Guide 2008
- **Has Class 0 fire performance throughout the entire product in accordance with BS 476**
- Is available in a broad range of thicknesses from 25mm-150mm and in a board size of 1200mm x 2400mm
- Is suitable for a range of applications

Applications

Celotex FR5000 can be specified in a variety of applications including:

- Pitched Roofs
- Walls
- Floors

Specification Clause

The insulation shall be Celotex FR5000 _____mm thick, comprising a polyisocyanurate rigid foam insulation core featuring Celotex IQ providing super low emissivity textured aluminium foil facings on both sides and **Class 0 fire performance throughout the product in accordance with BS 476**. FR5000 is A+ rated when compared to the BRE Green Guide 2008 and is CFC/HCFC free with low GWP and zero ODP. FR5000 is manufactured in accordance with quality management systems ISO 9001 and environmental management system ISO 14001. All products must be installed in accordance with instructions issued by Celotex Limited.



FR5000 PRODUCT OVERVIEW

- ✓ Premium PIR insulation
- ✓ 0.021 W/mK lambda
- ✓ BRE A+ rated
- ✓ **Class 0 fire performance**
- ✓ BBA validated
- ✓ Low global warming potential
- ✓ Zero ozone depletion potential

Sustainable Insulation

Celotex PIR insulation has been independently assessed by BRE Global and has been accredited with an A+ rating when compared to the BRE Green Guide 2008.

The results also show that Celotex offers a lower environmental impact than other typical PIR manufacturers.

For further information about Celotex' sustainable insulation solutions, visit the sustainability pages of the website at celotex.co.uk



Celotex RS5000

Premium Rainscreen Cladding Board
(suitable for buildings above 18 metres in height)

Introduction

Celotex RS5000 is our premium performance PIR solution for use in rainscreen cladding systems. Developed specifically to enhance the thermal performance of external facade constructions, RS5000 represents an ongoing commitment to product innovation and is the first PIR insulation board to meet the performance criteria in BR 135 for insulated rainscreen cladding systems and therefore is acceptable for use in buildings above 18 metres in height.

Featuring a premium lambda performance of 0.021 W/mK and textured aluminium foil facings, Celotex RS5000 offers enhanced thermal performance, an A+ rating when compared to the BRE Green Guide and Class 0 fire performance.

With Celotex RS5000 you are specifying an insulation board that:

- Features a super low lambda value of 0.021W/mK offering enhanced thermal performance
- Is the first PIR insulation board to successfully test to BS 8414-2:2005, meet the criteria set out in BR 135 and therefore is acceptable for use in buildings above 18 metres in height
- **Has Class 0 fire performance throughout the entire product in accordance with BS 476**
- Achieves an A+ rating when compared to the BRE Green Guide
- Is supported by LABC approval

Insulation

C/S/56 | (27-30) | Rn7 | M2
Ninth Issue | March 2011

Kooltherm® K15 Rainscreen Board

INSULATION FOR RAINSCREEN CLADDING SYSTEMS

- Premium performance rigid thermoset insulation – thermal conductivities as low as 0.020 W/m-K
- First insulation board for use in rainscreen cladding applications to achieve LABC System Approval
- Successfully tested to BS 8414: 2002, can meet the criteria within BR135 and is therefore acceptable for use above 18 metres
- **Class 0 fire rating**
- **Class 0 fire rated insulation core**
- Negligible smoke obscuration
- Unaffected by air infiltration
- Resistant to the passage of water vapour
- Easy to handle and install
- Ideal for new build and refurbishment
- Non-deleterious material
- Manufactured with a blowing agent that has zero ODP and low GWP



Low Energy –
Low Carbon Buildings

Limited combustibility under ADB

B PERFORMANCE OF MATERIALS, PRODUCTS AND STRUCTURES

Table A7 Use and definitions of materials of limited combustibility

References in AD B guidance to situations where such materials should be used	Definitions of materials of limited combustibility	
	National class	European class
1. stairs where there is provision in the guidance to B1 for them to be constructed of materials of limited combustibility (see 5.19).	a. Any non-combustible material listed in Table A6.	a. Any material listed in Table A6.
2. materials above a suspended ceiling meeting the provisions in the guidance to B3, paragraph 9.12.	b. Any material of density 300kg/m ³ or more, which when tested to BS 476-11:1982, does not flame and the rise in temperature on the furnace thermocouple is not more than 20°C.	b. Any material/product classified as Class A2-s3, d2 or better in accordance with BS EN 13501-1:2007 Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests.
3. reinforcement/support for fire-stopping referred to in the guidance to B3, see 10.16.	c. Any material with a non-combustible core at least 8mm thick having combustible facings (on one or both sides) not more than 0.5mm thick. (Where a flame spread rating is specified, these materials must also meet the appropriate test requirements).	
4. roof coverings meeting provisions:		
a. in the guidance to B3, paragraph 8.29; or		
b. in the guidance to B4, Table 16 or		
c. in the guidance to B4, Diagram 47.		
5. roof deck meeting the provisions of the guidance to B3, Diagram 30a.		
6. class 0 materials meeting the provisions in Appendix A, paragraph 13(a).		
7. ceiling tiles or panels of any fire protecting suspended ceiling (Type Z) in Table A3.		
8. insulation material in external wall construction referred to in paragraph 12.7.	Any of the materials (a), (b) or (c) above, or: d. Any material of density less than 300kg/m ³ , which when tested to BS 476-11:1982, does not flame for more than 10 seconds and the rise in temperature on the centre (specimen) thermocouple is not more than 35°C and on the furnace thermocouple is not more than 25°C.	Any of the materials/products (a) or (b) above.
9. insulation above any fire-protecting suspended ceiling (Type Z) in Table A3.		

Note:

- The National classifications do not automatically equate with the equivalent classifications in the European column; therefore, products cannot typically assume a European class unless they have been tested accordingly.
- When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

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Approved Document B (Fire safety)

8. insulation material in external wall construction referred to in paragraph 12.7.	Any of the materials (a), (b) or (c) above, or:
9. insulation above any fire-protecting suspended ceiling (Type Z) in Table A3.	d. Any material of density less than 300kg/m ³ , which when tested to BS 476-11:1982, does not flame for more than 10 seconds and the rise in temperature on the centre (specimen) thermocouple is not more than 35°C and on the furnace thermocouple is not more than 25°C.

Class 0 – relevance to Grenfell Tower

C/S/B

(21.9) Ry

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Agrément Certificate
No 08/4510

PRODUCT SHEET — REYNOBOND ARCHITECTURE WALL CLADDING PANELS

PRODUCT SCOPE AND SUMMARY OF CERTIFICATION

This Certificate of Confirmation relates to Reynobond Architecture Wall Cladding Panels, aluminium/polyethylene composite panels used to provide a decorative/protective façade over the external walls of buildings.

- AGRÉMENT CERTIFICATION INCLUDES:**
- factors relating to compliance with Building Regulations where applicable
 - factors relating to additional non-regulatory information where applicable
 - independently verified technical specification
 - assessment criteria and technical investigations
 - design considerations
 - installation guidance
 - regular surveillance of production
 - formal three-yearly review



KEY FACTORS ASSESSED

- Practicability of installation— the panels are suitable for installation by cladding contractors providing they have undergone suitable training (see section 4).
- Strength and stability— the panels can be incorporated in a cladding system designed to resist the wind loads normally encountered in the UK (see section 5).
- Behaviour in relation to fire— in relation to the Building Regulations for reaction to fire, the panels may be regarded as having a Class 0 surface in England and Wales, and a 'low risk' material in Scotland (see section 6).
- Air and water penetration— provided all joints between panels are adequately baffled, the cladding will minimise water entering the cavity. Any water collecting in the cavity will be removed by drainage and ventilation (see section 7).
- Maintenance— damaged panels may be replaced individually without disturbing adjacent ones (see section 8).
- Durability— in normal UK conditions, the panels should have a service life in excess of 30 years (see section 9).

The BBA has awarded this Agrément Certificate for Reynobond Architecture Wall Cladding Panels to Alcoa Architectural Products as fit for their intended use provided they are installed, used and maintained as set out in this Agrément Certificate.

On behalf of the British Board of Agrément

Greg Cooper: Chief Executive

Date of First issue: 14 January 2008

The BBA is a UKAS accredited certification body — Number 113. This schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA or contacting the BBA direct.

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e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk
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KEY FACTORS ASSESSED

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- Maintenance— damaged panels may be replaced individually without disturbing adjacent ones (see section 8).
- Durability — in normal UK conditions, the panels should have a service life in excess of 30 years (see section 9).

Class 0 – relevance to Grenfell Tower

- 5.3 The maximum allowable wind pressure/suction will be the lesser value obtained by considering the panels and fixings separately.
- 5.4 When calculating wind loads, higher pressure coefficients applicable to corners of the building should be used.
- 5.5 Design of the sub-frame should be such as to limit mid-span deflections to L/200 and cantilever deflections to L/150.
- 5.6 Design of the sub-frame attachment to the substrate wall should be such as to ensure adequate pull-out capacity due to wind suction.
- 5.7 A suitably qualified engineer must check the design and installation of the cladding system.
- 5.8 The supporting wall must be able to take the full wind, as well as any racking, loads on its own – any contribution from the cladding should be ignored.
- 5.9 Wind loads should be calculated in accordance with BS EN 1991-1-4 : 2005 and BS 6399-2 : 1997.
- Impact
- 5.10 As the products are susceptible to damage from hard body impacts, it is recommended that use is limited to locations where there is little possibility of such impacts, ie at ground level in private areas where there is some incentive to exercise care, and at higher levels in public areas, as described in categories C to F of BS 8200 :1985.

6 Behaviour in relation to fire

- 6.1 A standard sample of the product, with a grey/green Duragloss 5000 coating, when tested for reaction to fire, achieved a classification of B-s2,d0 in accordance with EN 13501-1 : 2002. A fire retardant sample of the product, with a gold-coloured Duragloss finish, when tested for reaction to fire, achieved a classification B-s1, d0 in accordance with EN 13501 : 2002.
- 6.2 A fire retardant sample of the product, with a metallic grey PVDF finish, when tested in accordance with BS476-6 : 1989, achieved a fire propagation index (I) of 0 and, when tested in accordance with BS 476-7 : 1997, achieved a Class 1 surface spread of flame.
- 6.3 As a consequence of sections 6.1 and 6.2, the products may be regarded as having a Class 0 surface in relation to the Approved Document B of The Building Regulations 2000 (as amended) (England and Wales) and Technical Booklet E of The Building Regulations (Northern Ireland) 2000 (as amended) and a 'low risk' material as defined in Annex 2C⁽¹⁾ and Annex 2E⁽²⁾ of The Building (Scotland) Regulations 2004 (as amended). The unexposed side of the products may also be regarded as having a class 0 surface.
- 6.4 These performances may not be achieved by other colours of the product and the designations of a particular colour should be confirmed by:
- England and Wales— Test or assessment in accordance with Approved Document B, Appendix A, Clause 1
- Scotland— Test to conform with the Table to Annex 2C or Annex 2E⁽²⁾ of Regulation 9
- (1) Technical Handbook (Domestic).
- (2) Technical Handbook (Non-Domestic).
- Northern Ireland— Test or assessment by a UKAS accredited laboratory or an independent consultant with appropriate experience.
- 6.5 For resistance to fire, the performance of a wall incorporating the product, can only be determined by tests from a suitably accredited laboratory, and is not covered by this Certificate.
- 6.6 Cavity barriers should be incorporated behind the cladding, as required by the national Building Regulations, but should not block essential ventilation pathways. Particular attention should be paid to preventing the spread of fire from within a building breaching the cladding system through window and door openings.

7 Air and water penetration

- 7.1 The products are suitable for use in back-ventilated and drained cladding systems.
- 7.2 The supporting wall must be watertight and reasonably airtight.
- 7.3 Providing all joints are adequately baffled, the amount of water entering the cavity by wind-driven rain will be minimal. Water collecting in the cavity due to rain or condensation will be removed by drainage and ventilation.
- 7.4 The air space between the back of the panels and the supporting wall or insulation should be as wide as possible and allow for conventional building tolerances. Guidance on recommended cavity widths is given in NHBC Standards 2007, Chapter 6.9.

8 Maintenance

- 8.1 The painted surface may be cleaned using hot and cold water with a mild cleaning agent using a non-abrasive pad or sponge. General household cleaners should not be used. After cleaning, the surface should be rinsed with clean water. For more difficult chemical soiling, the manufacturer's specialist advice must be sought.
- 8.2 Annual maintenance inspections should be carried out to ensure that rain-ware is complete and in good order and that such features as tiles, flashings and seals are in place and secure.

6 Behaviour in relation to fire



6.1 A standard sample of the product, with a grey/green Duragloss 5000 coating, when tested for reaction to fire, achieved a classification of B-s2,d0 in accordance with EN 13501-1 : 2002. A fire retardant sample of the product, with a gold-coloured Duragloss finish, when tested for reaction to fire, achieved a classification B-s1, d0 in accordance with EN 13501 : 2002.

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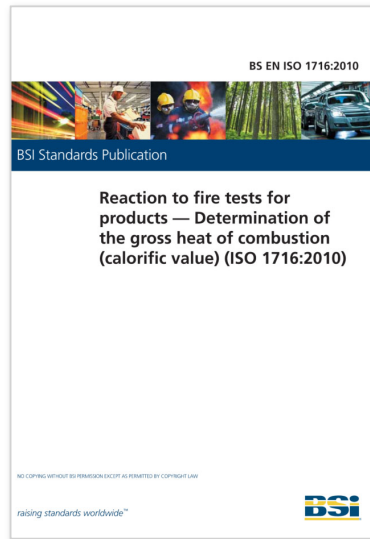
6.3 As a consequence of sections 6.1 and 6.2, the products may be regarded as having a Class 0 surface in relation to the Approved Document B of The Building Regulations 2000 (as amended) (England and Wales) and Technical Booklet E of The Building Regulations (Northern Ireland) 2000 (as amended) and a 'low risk' material as defined in Annex 2C⁽¹⁾ and Annex 2E⁽²⁾ of The Building (Scotland) Regulations 2004 (as amended). The unexposed side of the products may also be regarded as having a class 0 surface.

Section 2: European reaction to fire tests

Section 2: European reaction to fire testing and classification ^{ARUP}



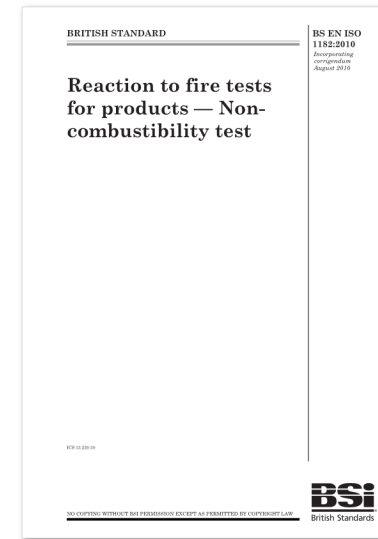
BS EN 13823
Building products
excluding floorings
exposed to the
thermal attack by a
single burning item



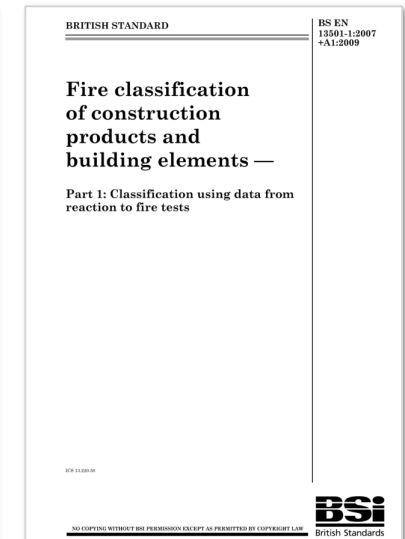
BS EN ISO 1716
Determination of
the gross heat of
combustion
(calorific value)



BS EN ISO 11925-2
Ignitability of
building products
subjected to direct
impingement of
flame. Single-flame
source test



BS EN ISO 1182
Non-combustibility
test



BS EN 13501-1
Fire classification of
construction
products and
building elements.
Classification using
data from reaction
to fire tests

CEN Committee

Committee	Role in committee	Named Person	Job title
CEN/TC 127 - Fire safety in buildings	Chairman	Dr Debbie Smith ¹	Managing director BRE ³
CEN/TC 127/WG 4 - Reaction to fire	Convenor	Mr Roy Weghorst ²	Head of regulatory affairs - Fire Kingspan ⁴

References:

- 1) https://standards.cen.eu/dyn/www/f?p=204:7:0:::FSP_ORG_ID:6109&cs=104D85C15BEEFAC5963909130D6A7EB7
- 2) https://standards.cen.eu/dyn/www/f?p=CENWEB:7:0:::FSP_ORG_ID:405215&cs=13A091026857E258739FF573C57427005
- 3) {BRE00005624}
- 4) <https://wfmmedia.com/writer/roy-weghorst/>

Limitations of the European classification system



“The use of the Euroclass system for facades has long been questioned. Considering that the reference scenario for the Euroclass system is fire in a room it is only right to question the use of this for externally applied products. The challenge is to define a new reference scenario and a large scale reference test for facades.

The commission services created a task group in 2005 consisting of fire regulators with the task of writing a mandate to CEN for “the evaluation of the functional reaction to fire performance characteristics of façade systems / facade cladding systems.

Unfortunately this mandate was never completed and the work with defining a test method for facades was transferred to EOTA.”

Birgitte Messerschmidt

Rockwool International A/S, Fire Seat Conference 2008, Denmark¹



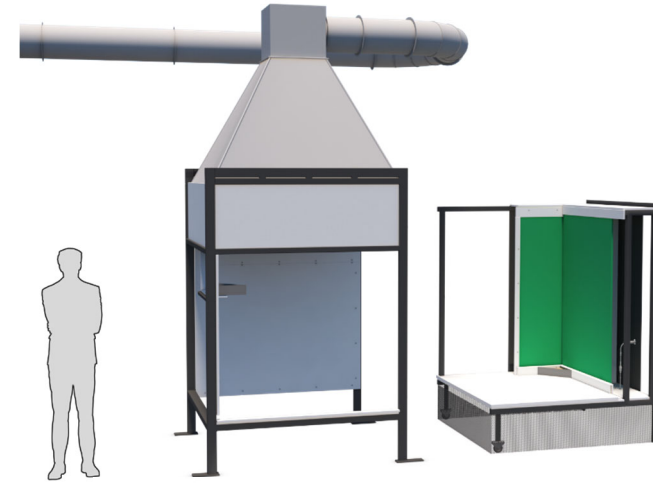
1. Available at: <https://www.fireseat.eng.ed.ac.uk/sites/fireseat.eng.ed.ac.uk/files/images/07-Messerschmidt.pdf>; Accessed: 09/11/2020

2. Available at: <https://www.eota.eu/en-GB/content/united-kingdom/34/178/28/>; Accessed: 09/11/2020

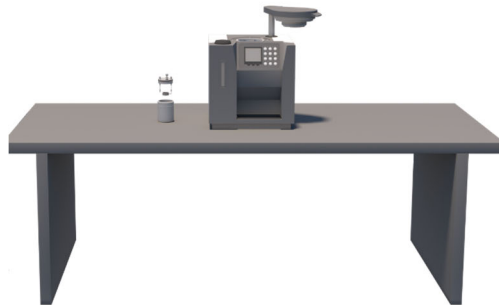
European reaction to fire test – summary



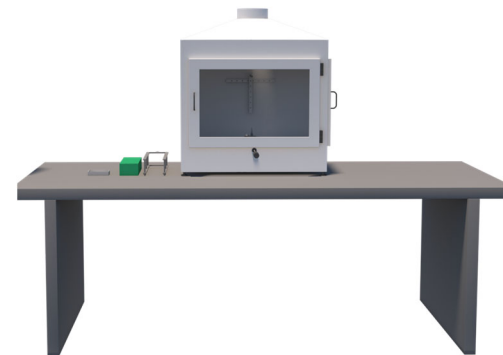
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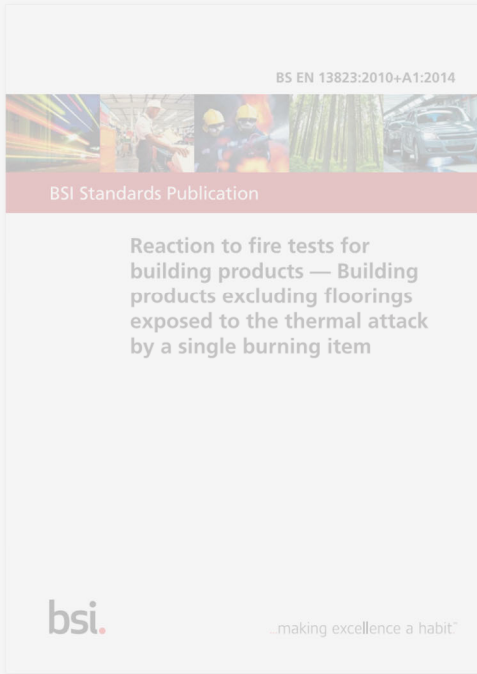
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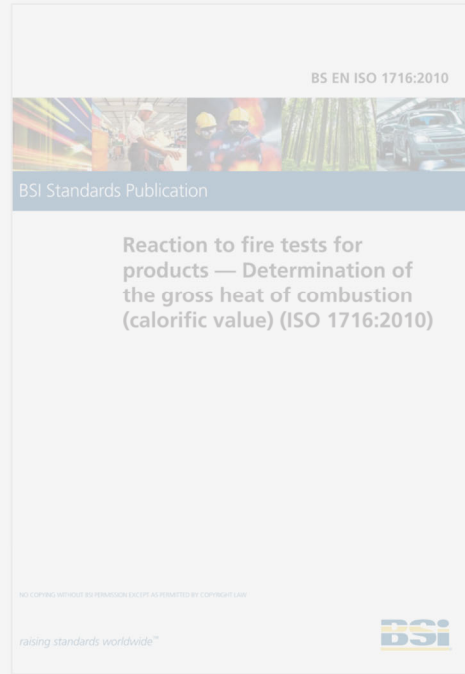
BS EN ISO 1716



BS EN ISO 11925-2



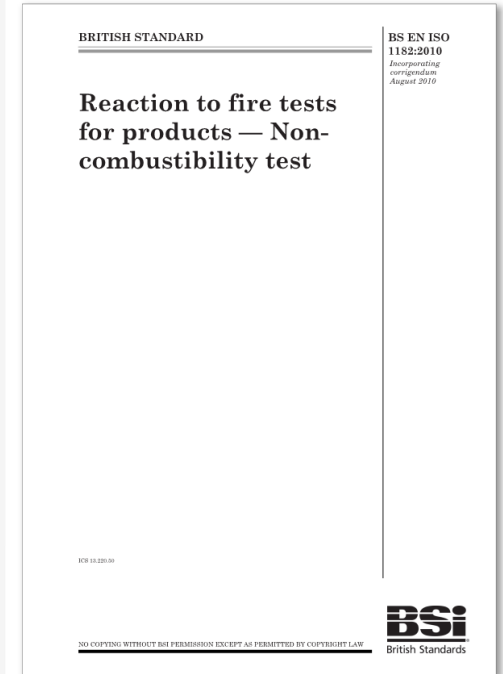
BS EN 13823
Building products excluding floorings exposed to the thermal attack by a single burning item



BS EN ISO 1716
Determination of the gross heat of combustion (calorific value)



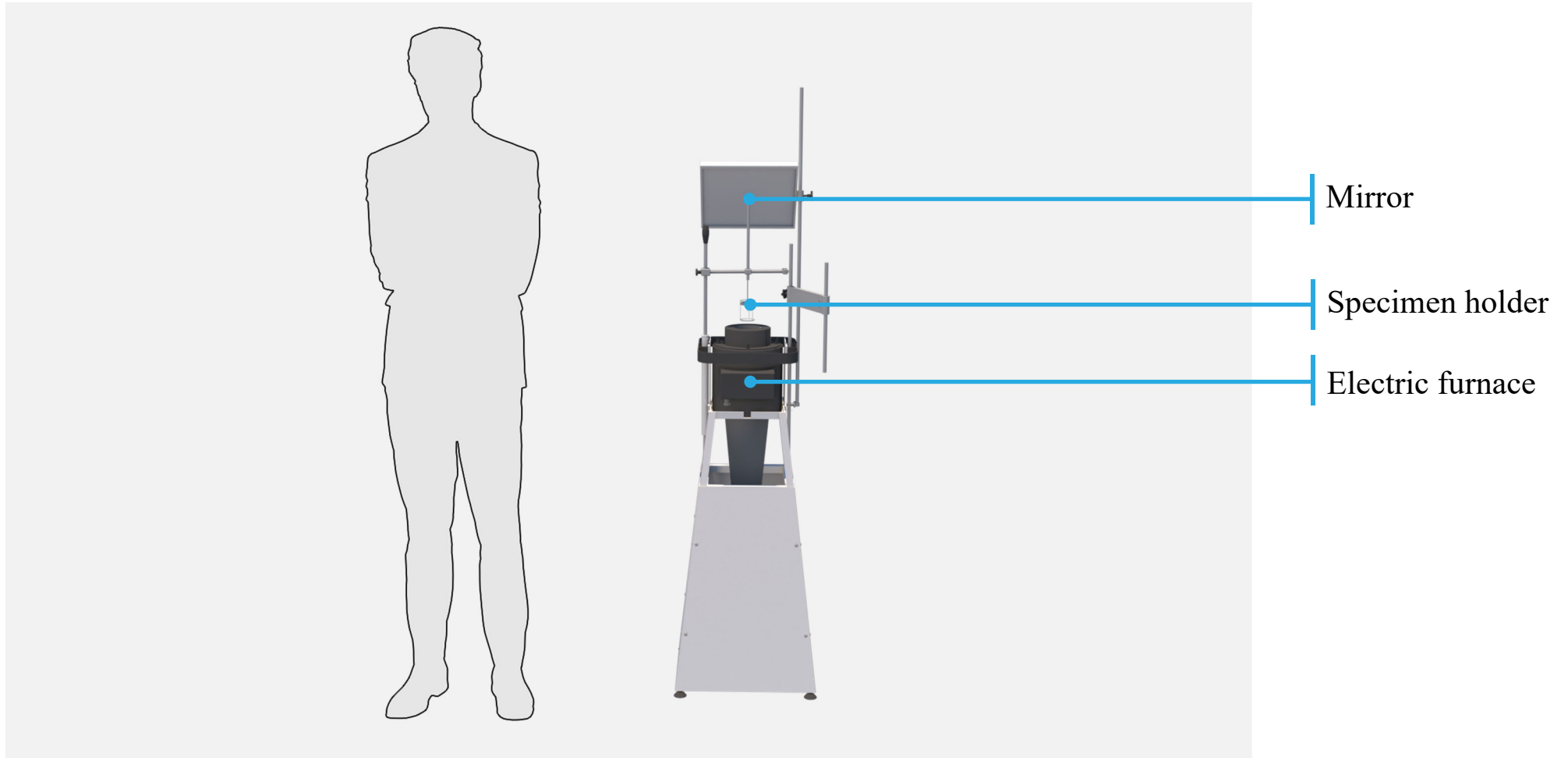
BS EN ISO 11925-2
Ignitability of building products subjected to direct impingement of flame. Single-flame source test



BS EN ISO 1182
Non-combustibility test

BS EN ISO 1182 – apparatus

ARUP



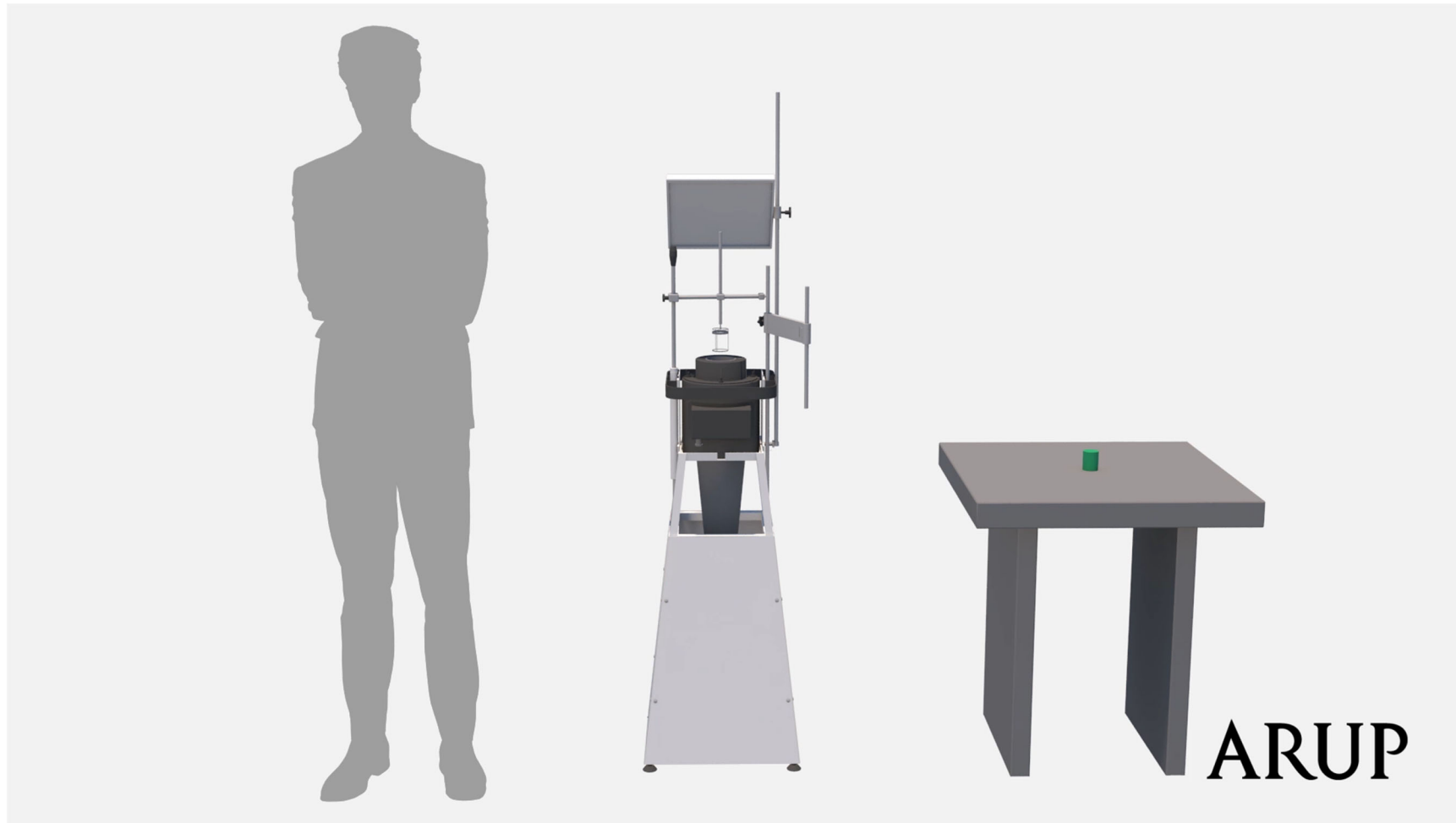
BS EN ISO 1182 – specimen

ARUP



BS EN ISO 1182 – apparatus

ARUP



BS EN ISO 1182 – measurements taken

ARUP



- Record the mass, in g, before and after the test for each specimen
- Record the occurrence of any sustained flaming and record the duration of such flaming in seconds.
- Record the following temperatures, in ° C, as measured by the furnace thermocouple:
 - a) the initial temperature, T_I which is the average temperature over the final 10 min of the stabilisation period;
 - b) the maximum temperature, T_m which is the discrete value at maximum temperature anywhere over the entire test period;
 - c) the final temperature, T_f which is the average temperature over the final 1 min of the test period.

BS EN ISO 1182 – Test report

BS EN ISO 1182:2010
EN ISO 1182:2010 (E)

8.3 Temperature rise

Calculate and record the temperature rise, $\Delta T = T_{\text{max}} - T_i$, in degrees Celsius, for each of the five specimens recorded by the thermocouple as specified in 7.5.3.

9 Test report

The test report shall include, at a minimum, the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

- a) reference to this International Standard, i.e. ISO 1182 [see b)];
- b) any deviation from the test method;
- c) name and address of the testing 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 details of the construction of the product;
- k) details of conditioning;
- l) date of test;
- m) calibration results, expressed in accordance with 7.3.1 and 7.3.2;
- n) test results, expressed in accordance with Clause 8, also C.5, if additional thermocouples are used;
- o) observations made during the test;
- p) 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 criteria for assessing the potential fire hazard of the product in use.

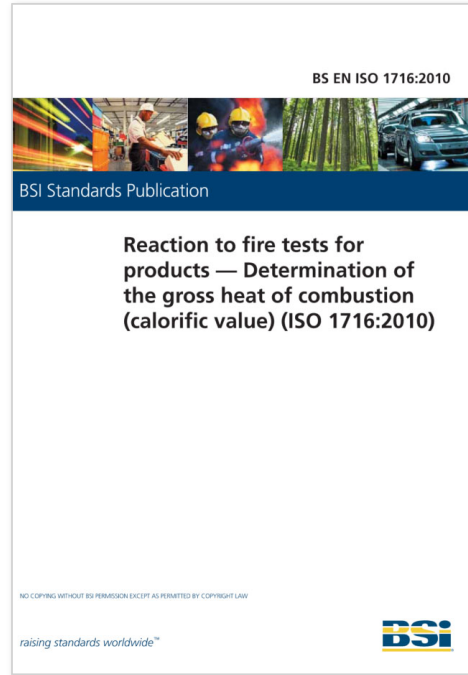
9 Test report

The test report shall include the following information as a minimum. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

- a) reference that the test was carried out in accordance with EN ISO 1182 (but see b));
- b) any deviations from the test method;
- c) name and address of the testing 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) a general description of the product tested including density, mass per unit area and thickness, together with details of the construction of the product;
- k) details of conditioning;
- l) date of test;
- m) calibration results expressed in accordance with 7.3.1 and 7.3.2;
- n) test results expressed in accordance with clause 8, and C.5 if additional thermocouples are used;
- o) observations made during the test;
- p) 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’.



BS EN 13823
Building products excluding floorings exposed to the thermal attack by a single burning item



BS EN ISO 1716
Determination of the gross heat of combustion (calorific value)



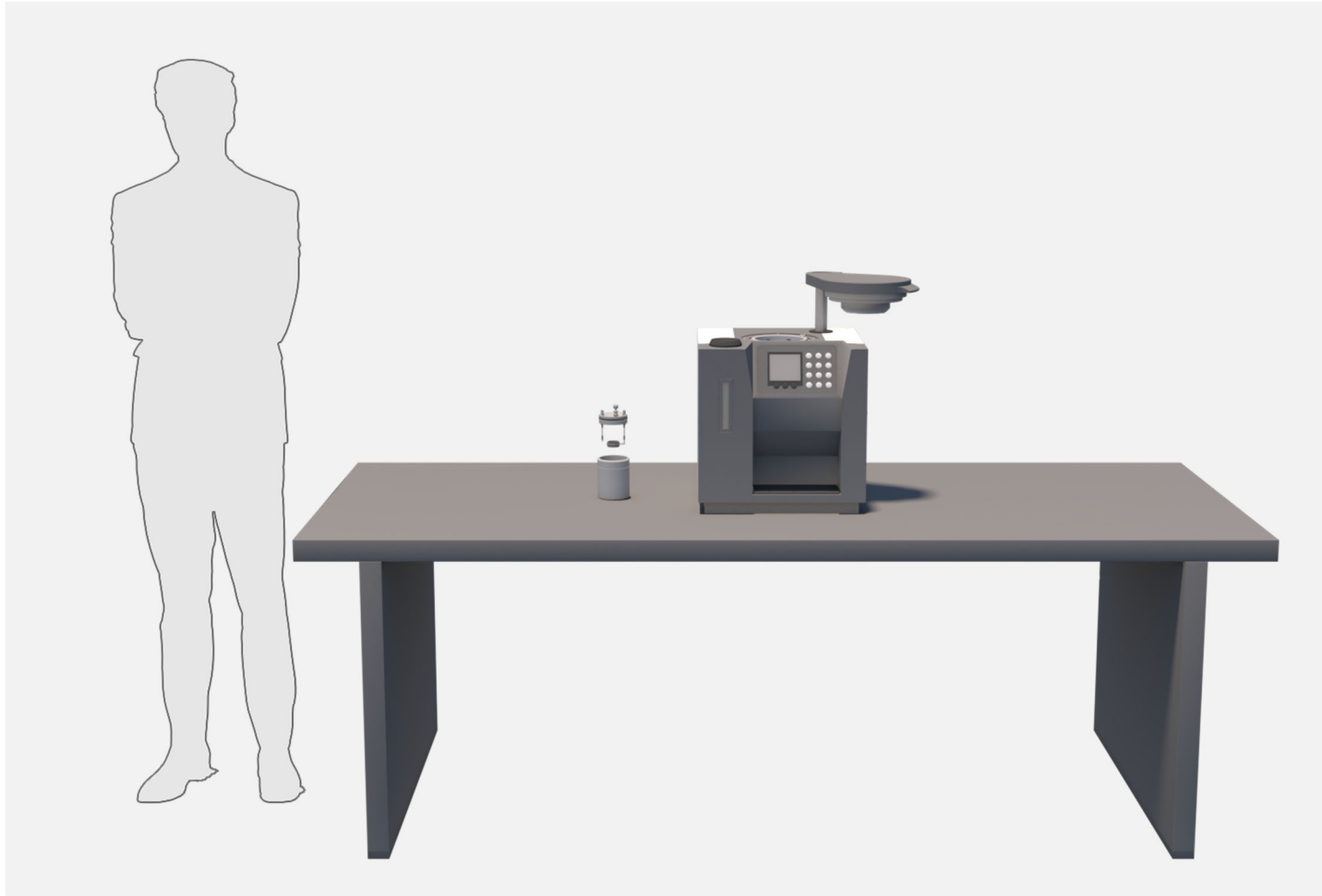
BS EN ISO 11925-2
Ignitability of building products subjected to direct impingement of flame. Single-flame source test



BS EN ISO 1182
Non-combustibility test

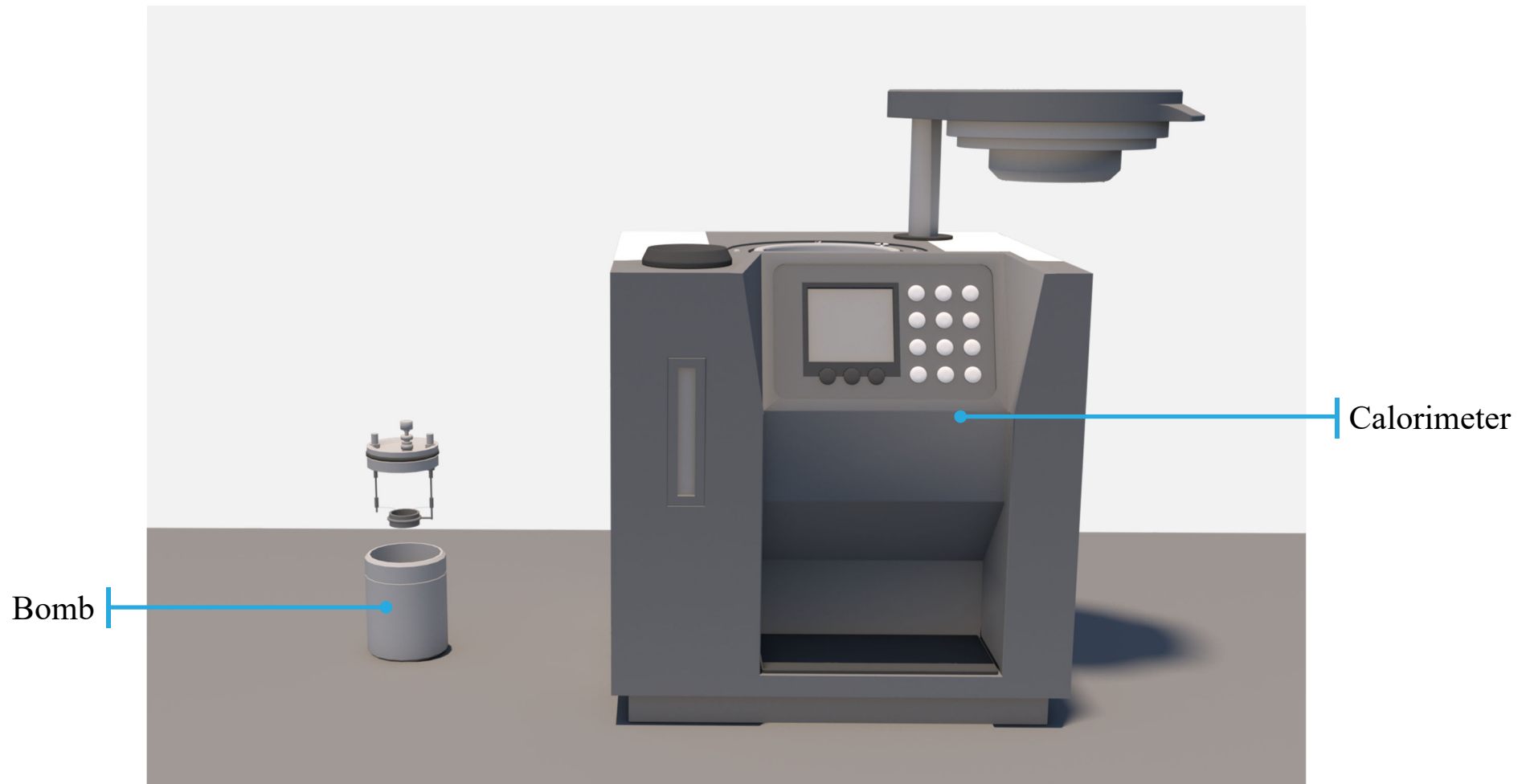
BS EN ISO 1716 – specimen

ARUP



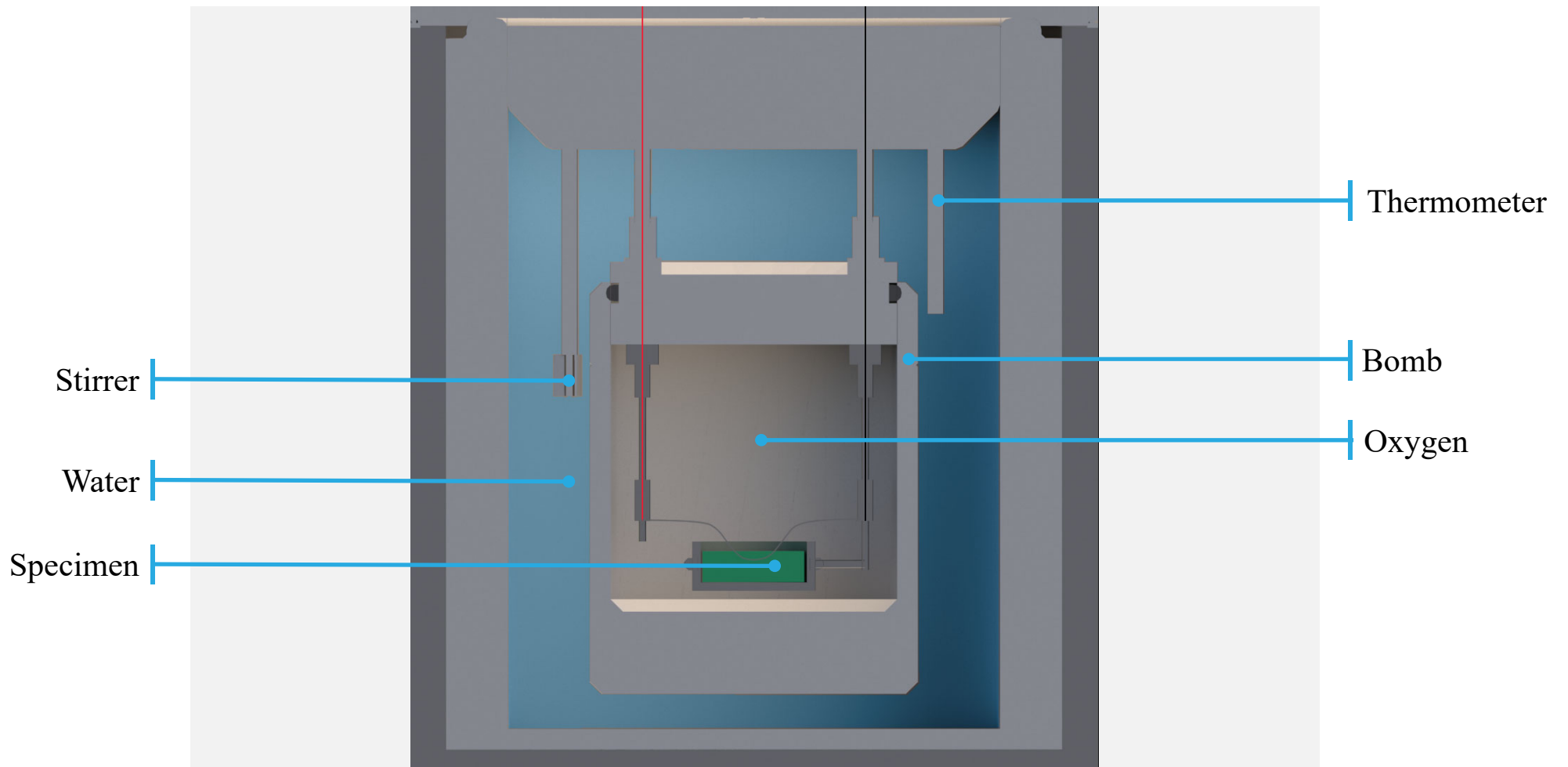
BS EN ISO 1716 – specimen

ARUP



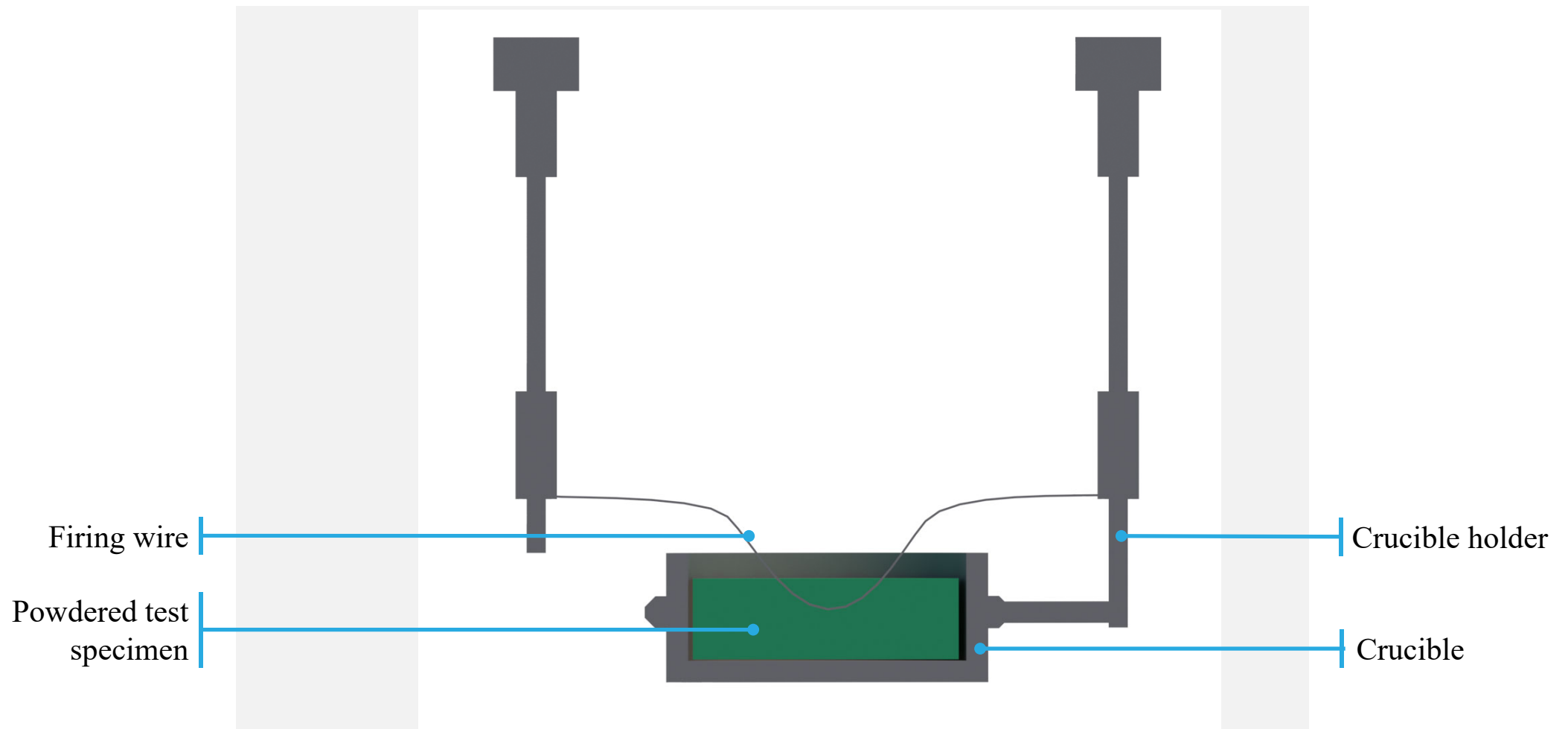
BS EN ISO 1716 – specimen

ARUP



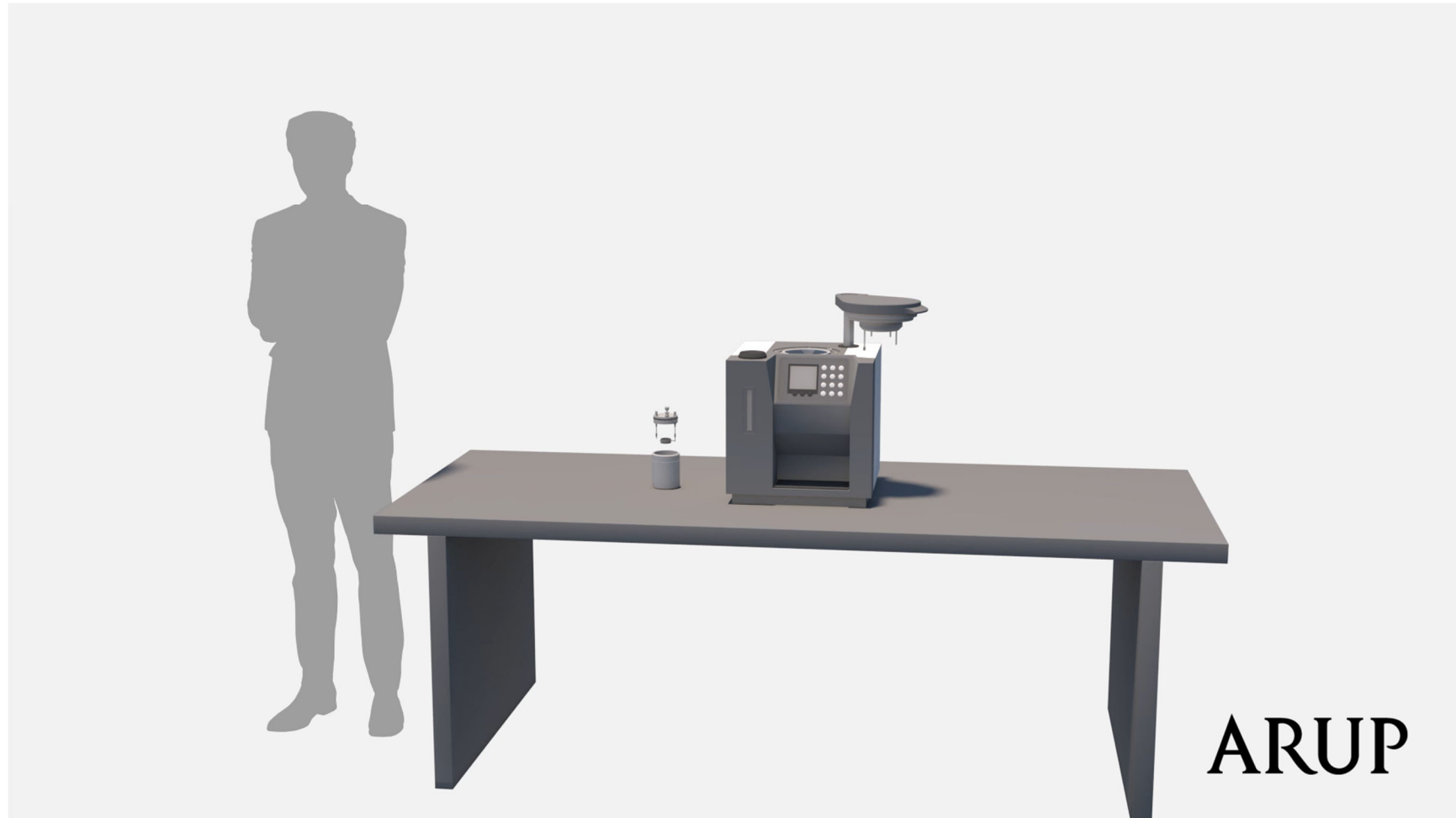
BS EN ISO 1716 – specimen

ARUP



BS EN ISO 1716 – Procedure

ARUP



BS EN ISO 1716 – measurements taken



- Three 0.5g specimens are tested
- Increase in water temperature is measured and converted into Joules (J) or megajoules (MJ)
- Final result is an average of the three values

11 Validity of test results

To be validated, test results shall comply with the criteria in the specified range of values given in Table 1.

Table 1 — Criteria for the validity of test results

Gross heat of combustion	Max. and min. of the three replicated tests	Range of validity
Q_{PCS} (MJ/kg)	$\leq 0,2$ MJ/kg Within 5 % Within 10 %	From 0 MJ/kg to 3,2 MJ/kg From 3,2 MJ/kg to 20,0 MJ/kg Greater than 20,0 MJ/kg
Q_{PCS} (MJ/m ²) ^a	$\leq 0,1$ MJ/m ² Within 5 % Within 10 %	From 0 MJ/m ² to 4,1 MJ/m ² From 4,1 MJ/m ² to 20 MJ/m ² Greater than 20 MJ/m ²

^a For non-substantial components only.

BS EN ISO 1716 – Test report

BS EN ISO 1716:2010
ISO 1716:2010(E)

9.4.2 Homogeneous product

9.4.2.1 For an individual sample (see 7.2.1), three test specimens are evaluated. If the spread of the individual values complies with the criteria given in Clause 11, the test is valid and the gross heat of combustion is the mean of these three individual values.

9.4.2.2 If the range of values determined on these three test specimens does not comply with the criteria given in Clause 11, then two further test specimens shall be taken from the same sample and evaluated. The maximum and minimum values of these five results are then discarded and the final three test results are evaluated as described in 9.4.2.1.

9.4.2.3 If the range of values obtained from 9.4.2.2 does not meet the requirements for the range of validity described in 9.4.2.1, then a new test sample shall be obtained and the whole procedure repeated.

9.4.2.4 If two further test specimens (after the initial three) are needed for the purpose of any classification procedure and two further test specimens are needed as described in 9.4.2.2, then the same two test specimens are used for both purposes, i.e. a maximum of five specimens are tested.

9.4.3 Non-homogeneous product

The gross heat of combustion of the non-homogeneous product shall be determined as follows.

- a) Determine the gross heat of combustion of each individual component in the same way as for a homogeneous product (see 9.4.2). The gross heat of combustion shall be expressed in both MJ/kg and MJ/m² using the mass per unit area of each individual component.
- b) Calculate the gross heat of combustion of the non-homogeneous product using the gross heat of combustion (see 9.4.2) and the mass per unit area of each individual component.

An example of the determination of the gross heat of combustion of a non-homogeneous product is given in Annex D.

10 Test report

The test report shall include at least the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

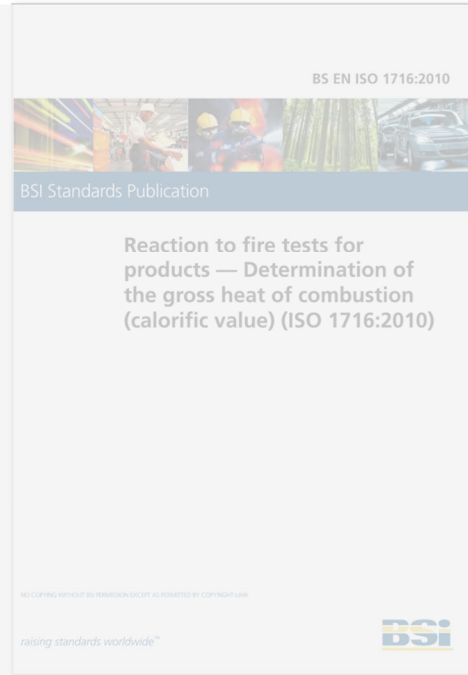
- a) a statement that the test was carried out in accordance with this International Standard (ISO 1716:2010);
- b) any deviations from the test method;
- c) name and address of the testing laboratory;
- d) date and identification number of the report;
- e) name and address of the sponsor;
- f) name 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) a general description of the product tested, including density, mass per unit area and thickness, together with details of the construction of the product;

The test report shall include at least the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test.

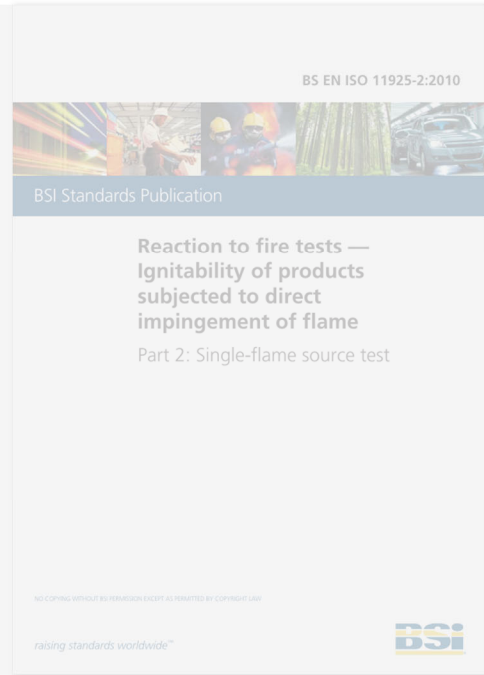
- a) a statement that the test was carried out in accordance with this International Standard (ISO 1716:2010);
- b) any deviations from the test method;
- c) name and address of the testing laboratory;
- d) date and identification number of the report;
- e) name and address of the sponsor;
- f) name 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) a general description of the product tested, including density, mass per unit area and thickness, together with details of the construction of the product;
- k) details of conditioning;
- l) description of method to cure material, where relevant;
- m) date of test;
- n) water equivalent, expressed in accordance with 8.2;
- o) test results, expressed in accordance with Clause 9;
- p) observations made during the test;
- q) 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.”



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Building products excluding floorings exposed to the thermal attack by a single burning item



BS EN ISO 1716
Determination of the gross heat of combustion (calorific value)



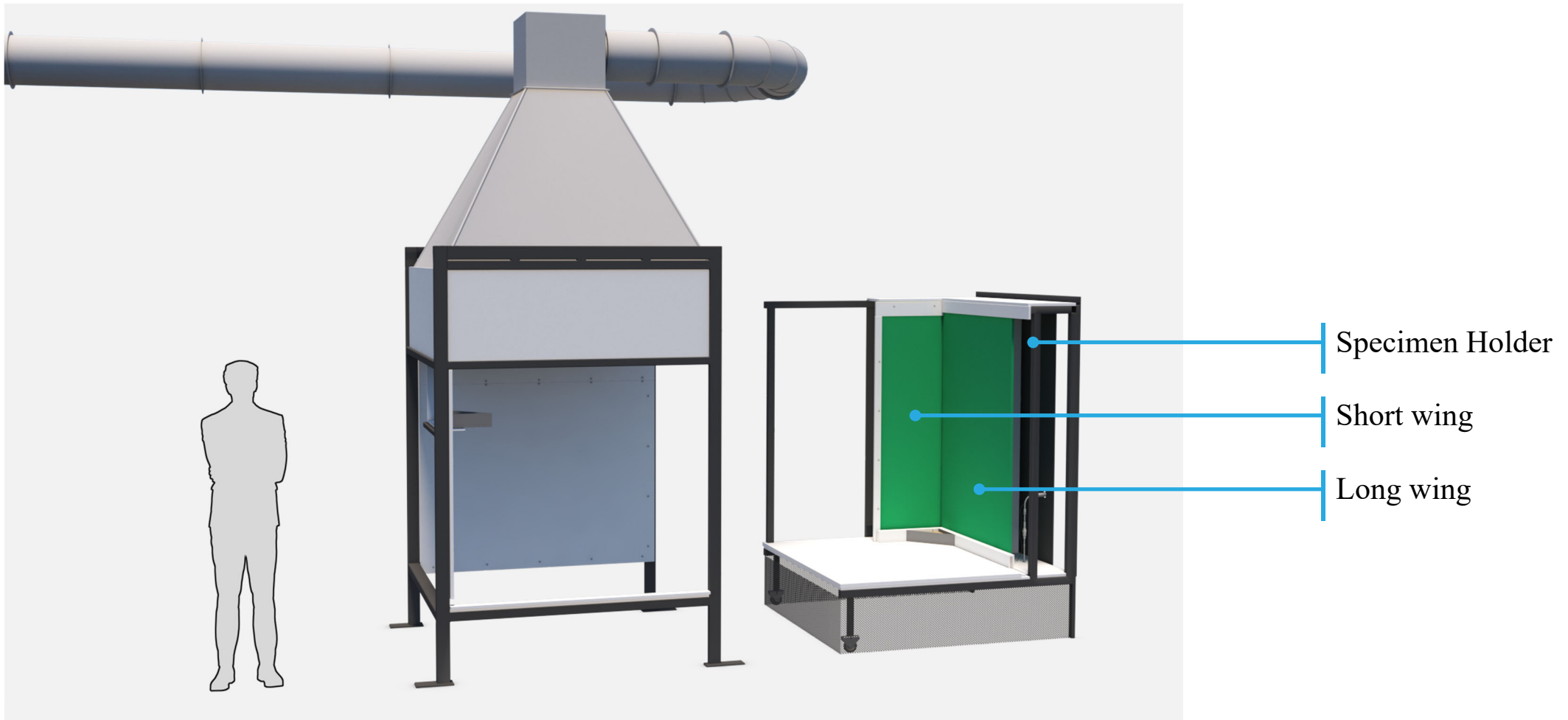
BS EN ISO 11925-2
Ignitability of building products subjected to direct impingement of flame. Single-flame source test



BS EN ISO 1182
Non-combustibility test

BS EN 13823 – specimen

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BS EN 13823 – Additional specimen requirements – mounting and substrates

ARUP

3.2

specimen

piece of a product, which is to be tested

NOTE This can include the mounting technique used in its end-use application. This also can include an air gap and/or a substrate where appropriate.

3.3

substrate

product which is used immediately beneath the product about which information is required

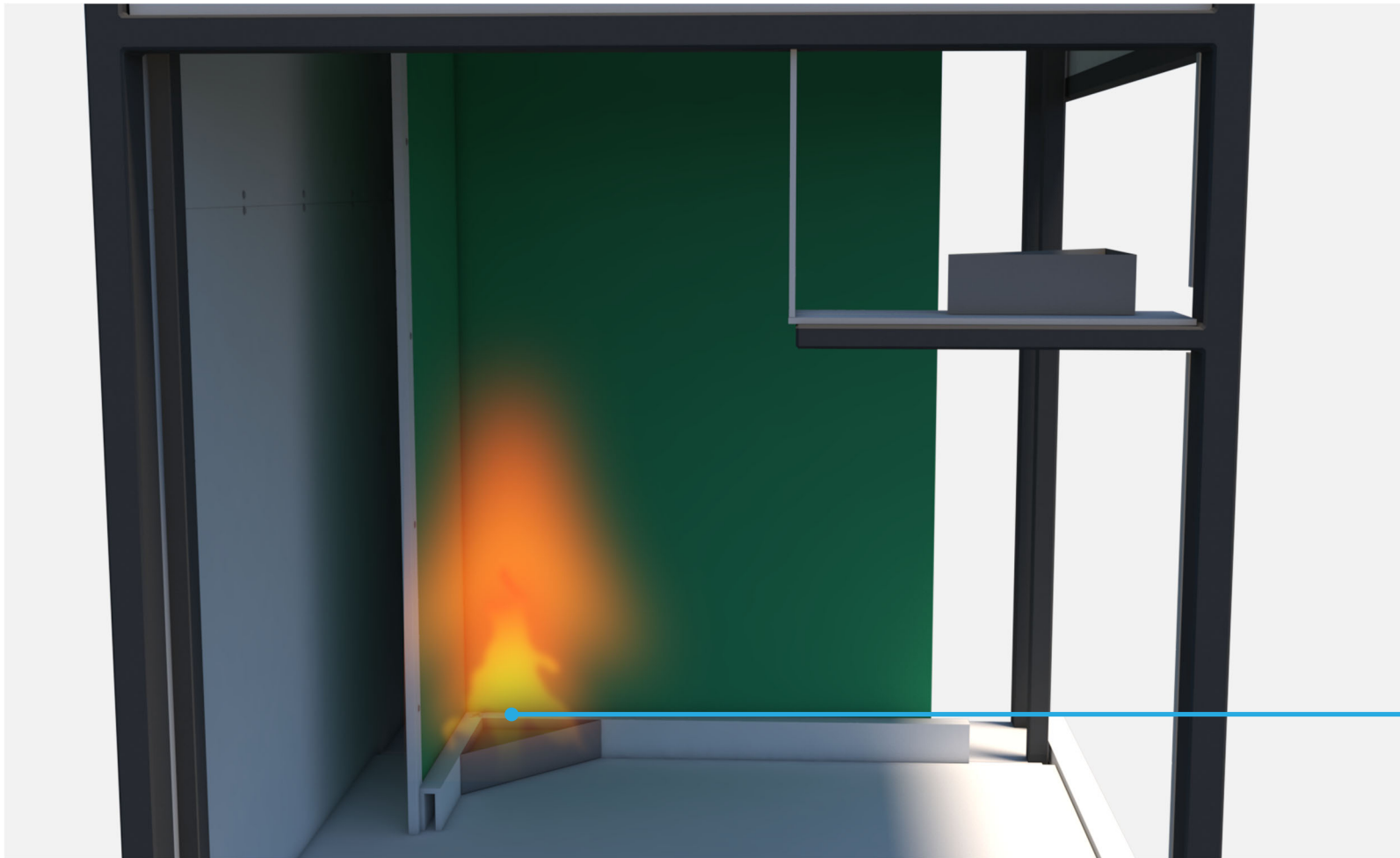
5.2.2 Standard mounting

When products are tested using a standard mounting, the test results are valid for that end use application and can be valid for a wider range of end use applications. The standard mounting used and its range of validity shall be in accordance with the relevant product specifications, and the following:

- a) Boards that are free standing in their end use application shall be tested free standing at a distance of at least 80 mm from the backing board. Boards that have in the end use application a ventilated cavity behind it shall be tested with a cavity of at least 40 mm width. For these two types of boards the sides of the cavity farthest away from the corner shall be open, the panels in accordance with 4.4.11 shall be removed and the cavities behind both specimen wings shall be in open connection. For other types of boards the sides of the cavity farthest away from the corner shall be closed, the panels in accordance with 4.4.11 shall be in place and the cavities behind both specimen wings shall not be in open connection.
- b) Boards that are fixed mechanically to a substrate in the end use application shall be tested fixed to a substrate using appropriate fixings. Fixings that stick out of the specimen surface shall be placed in such a way that the specimen wing can be placed against the U-profile at the bottom and against the other specimen wing at its side, over its full length.
- c) Boards that in their end use application are fixed mechanically to a substrate with a cavity behind it shall be tested with a cavity between substrate and backing board. The distance between the substrate and the backing board shall be at least 40 mm.
- d) Products that in their end use application are glued to a substrate shall be tested glued to a substrate.
- e) Products tested with a horizontal joint shall be tested with a horizontal joint in the long wing at a height of 500 mm from the bottom edge of the specimen. Products tested with a vertical joint shall be tested with a vertical joint in the long wing at a distance of 200 mm from the corner line, measured when the wings are mounted ready for testing.

BS EN 13823 – test methodology

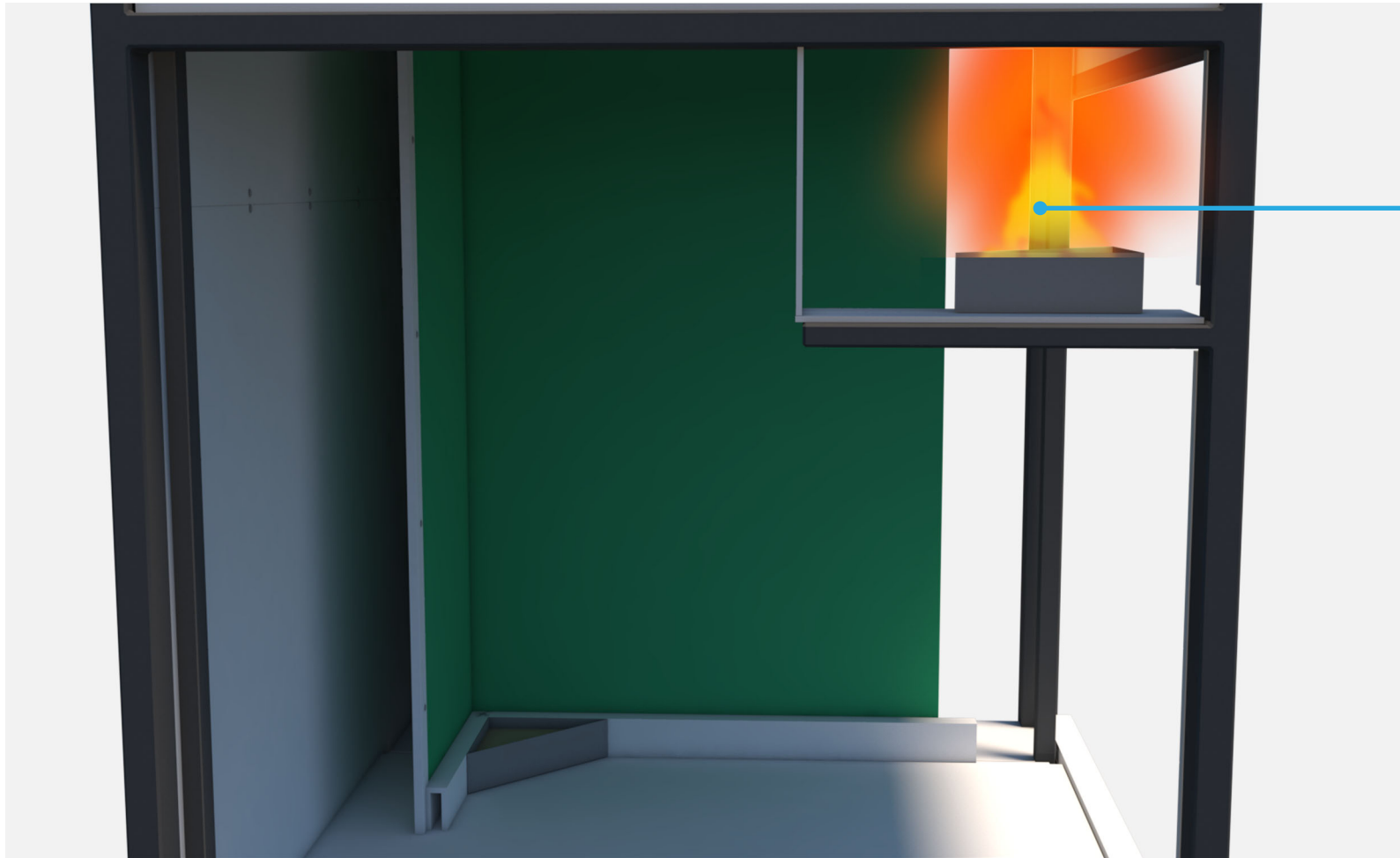
ARUP



Primary burner

BS EN 13823 – test methodology

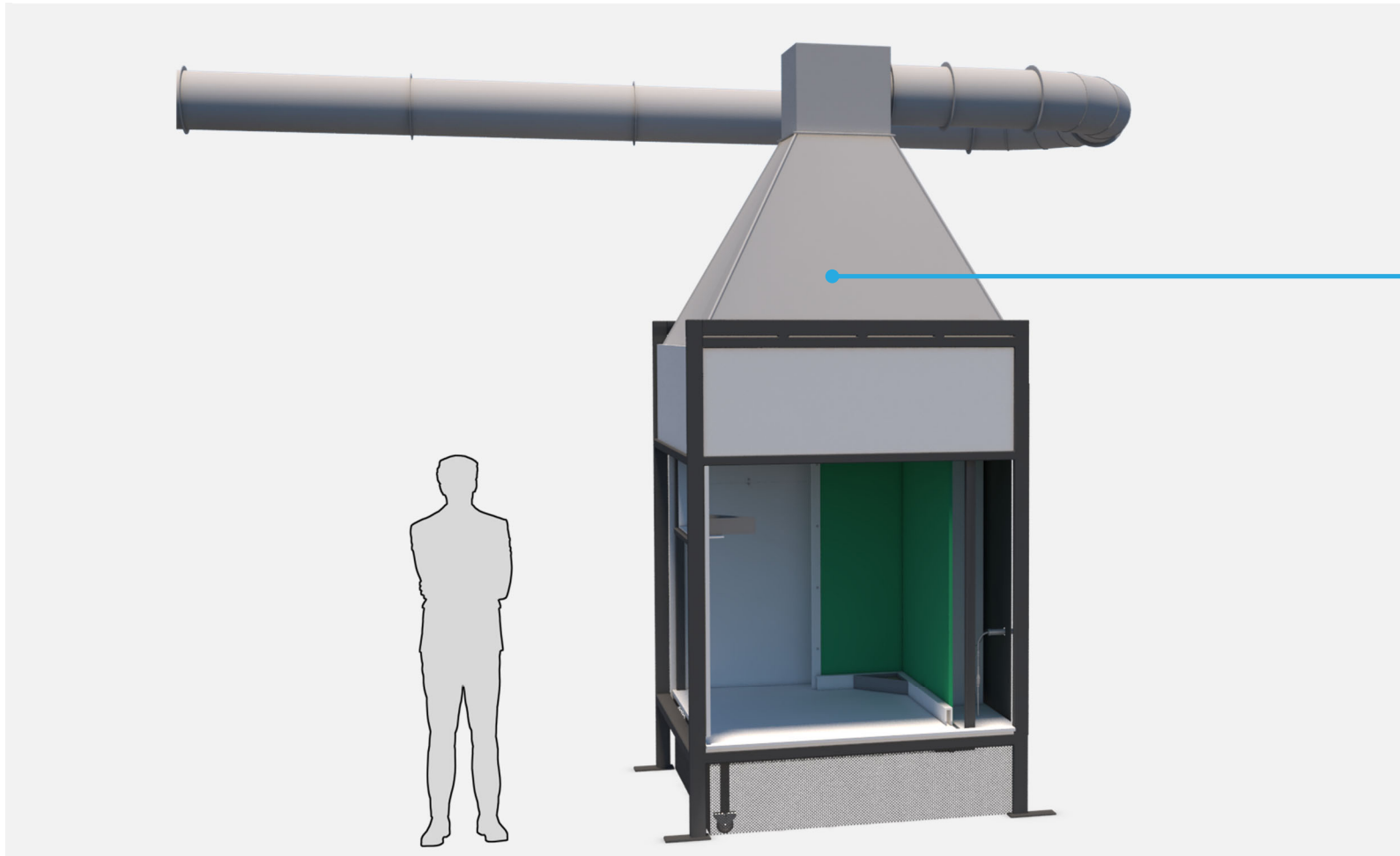
ARUP



Auxiliary burner

BS EN 13823 – test methodology

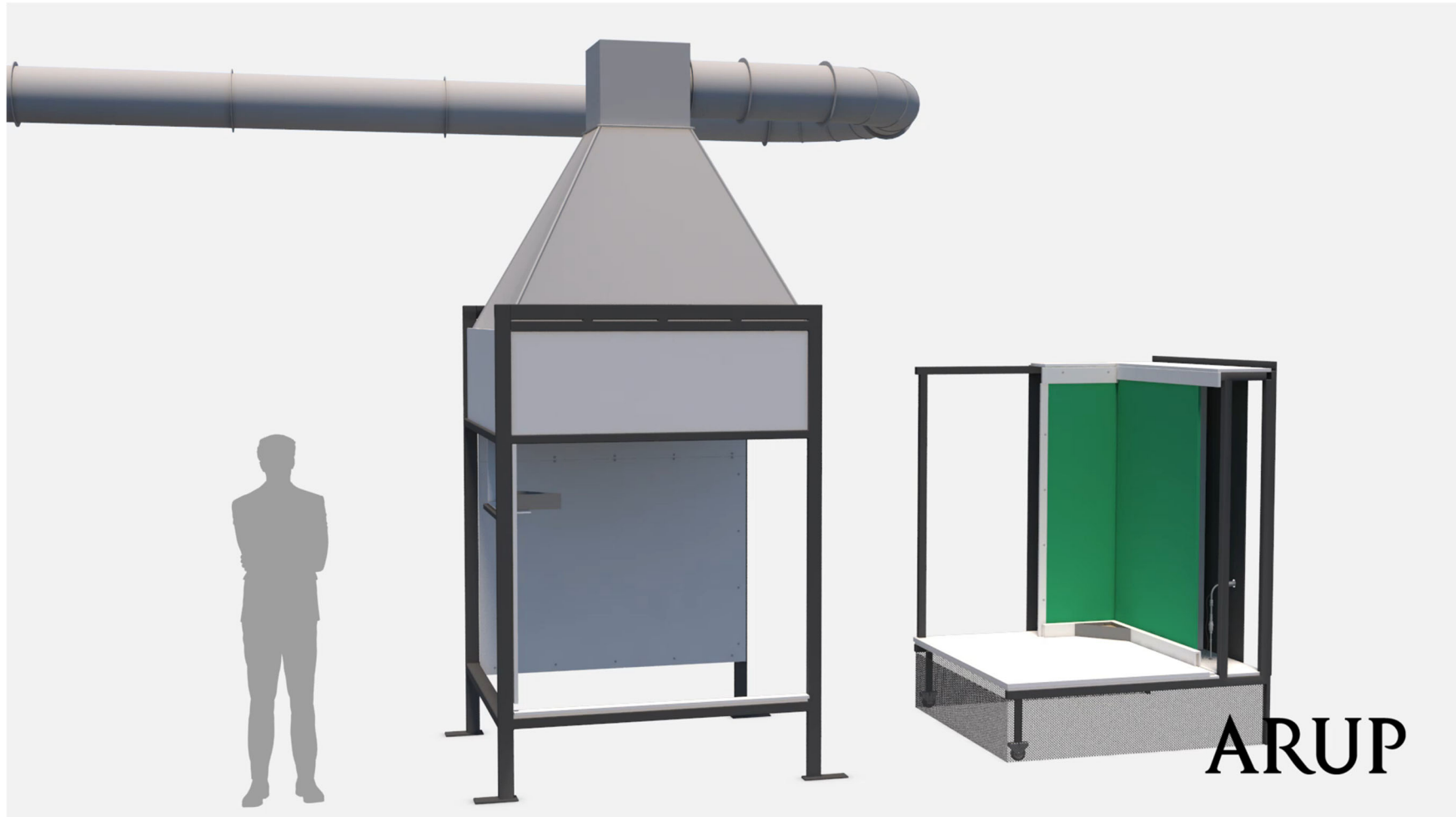
ARUP



Exhaust system

BS EN 13823 – test methodology

ARUP



BS EN 13823 – measurements taken

ARUP



- The lateral (horizontal) flame spread shall be recorded as the occurrence of sustained flames reaching the far edge of the long wing specimen at any height between 500 mm and 1 000 mm at any time during the test.
- The fall of flaming droplets or particles shall be recorded only within the first 600 s of the exposure period and only when the droplets/particles reach the floor level of the trolley (the level of the lower edge of the specimen) outside the burner zone.
- The exhaust duct is equipped with sensors to measure the temperature, light attenuation, oxygen and carbon dioxide content of the extracted gases and a flow induced pressure difference in the duct during the test.

BS EN 13823– Expression of results

BS EN 13823:2010+A1:2014
EN 13823:2010+A1:2014 (E)

NOTE 1 An early termination of the test can be prevented by the use of a grid in accordance with 4.4.6.

NOTE 2 The following occurrences may damage the test apparatus:

- a) a heat release rate of the specimen exceeding 350 kW at any instant, or exceeding 280 kW over a period of 30 s, or
- b) an exhaust duct temperature exceeding 400 °C at any instant, or exceeding a mean value of 300 °C over a period of 30 s.

If the above limits are exceeded the operator may consider an early termination of the test. Measured values for the temperature and the heat release rate will contain a certain amount of noise. It is therefore advised not to stop the test on the basis of only one or two successive measurement values from the instruments exceeding the given maximums.

9 Expression of results

9.1 For each test, the burning behaviour of the product shall be represented by graphs of average heat release rate $HRR_{av}(t)$, total heat release $THR(t)$, and $1\,000 \times HRR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; the values for the fire growth rate indices $FIGRA_{0,2\,MJ}$ and $FIGRA_{0,4\,MJ}$, and the total heat release within 600 s THR_{600s} , calculated in accordance with A.5, and the occurrence or not of lateral flame spread up to the edge of the specimen in accordance with 8.3.3.

9.2 For each test, the smoke production behaviour of the product shall be given as the graphs of $SPR_{av}(t)$, total smoke production $TSP(t)$ and $10\,000 \times SPR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; and the values for the smoke growth rate index $SMOGRA$ and the total smoke production within 600 s TSP_{600s} , calculated in accordance with A.6.

9.3 For each test, the behaviour of the product regarding the production of flaming droplets and particles shall be given as the occurrence, or not, of one or both categories of fallen flaming droplets and particles, in accordance with 8.3.4, a) or b) respectively.

10 Test report

The test report shall include the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

- a) a reference that the test was carried out in accordance with this standard;
- b) any deviations from the test method;
- c) name and address of the testing 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;

9 Expression of results

9.1 For each test, the burning behaviour of the product shall be represented by graphs of average heat release rate $HRR_{av}(t)$, total heat release $THR(t)$, and $1\,000 \times HRR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; the values for the fire growth rate indices $FIGRA_{0,2\,MJ}$ and $FIGRA_{0,4\,MJ}$, and the total heat release within 600 s THR_{600s} , calculated in accordance with A.5, and the occurrence or not of lateral flame spread up to the edge of the specimen in accordance with 8.3.3.

9.2 For each test, the smoke production behaviour of the product shall be given as the graphs of $SPR_{av}(t)$, total smoke production $TSP(t)$ and $10\,000 \times SPR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; and the values for the smoke growth rate index $SMOGRA$ and the total smoke production within 600 s TSP_{600s} , calculated in accordance with A.6.

9.3 For each test, the behaviour of the product regarding the production of flaming droplets and particles shall be given as the occurrence, or not, of one or both categories of fallen flaming droplets and particles, in accordance with 8.3.4, a) or b) respectively.

BS EN 13823– Test report

10 Test report

The test report shall include the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

- a) a reference that the test was carried out in accordance with this standard;
- b) any deviations from the test method;
- c) name and address of the testing 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;

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BS EN 13823:2010+A1:2014
EN 13823:2010+A1:2014 (E)

- j) a general description of the product tested including the density, mass per unit area and thickness, together with the form of construction of the test specimen;
- k) description of substrate and fixing to the substrate (if used);
- l) details of conditioning;
- m) date of test;
- n) test results expressed in accordance with Clause 9 including method of smoke calculation (A.6.1.2);
- o) photographs in accordance with 5.3.3;
- p) observations made during the test;
- q) the following 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".

10 Test report

The test report shall include the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

- a) a reference that the test was carried out in accordance with this standard;
- b) any deviations from the test method;
- c) name and address of the testing 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) a general description of the product tested including the density, mass per unit area and thickness, together with the form of construction of the test specimen;
- k) description of substrate and fixing to the substrate (if used);
- l) details of conditioning;
- m) date of test;
- n) test results expressed in accordance with Clause 9 including method of smoke calculation (A.6.1.2); photographs in accordance with 5.3.3;
- p) observations made during the test;
- q) the following 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".

BS EN 13823– Calculations to be performed on the test data ARUP

BS EN 13823:2010+A1:2014
EN 13823:2010+A1:2014 (E)

A.1.2 Calculations to be performed on the test data

After a test, a series of parameters shall be calculated to evaluate the performance of the product. All calculations in this annex, excluding the calculations in A.2, shall be performed on data shifted in time in accordance with A.2. The following calculations shall be carried out:

- synchronization of data;
- calculation of equipment response;
- calculation of exposure period;
- calculation of $HRR(t)$;
- calculation of time-averaged $HRR(t)$: $HRR_{30s}(t)$;
- calculation of $THR(t)$ and THR_{600s} ;
- calculation of $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$;
- calculation of $SPR(t)$;
- calculation of time-averaged $SPR(t)$: $SPR_{60s}(t)$;
- calculation of $TSP(t)$ and TSP_{600s} ;
- calculation of $SMOGRA$.

The results of a test are valid only when the requirements of A.2 and A.3 have been met. The calculations are specified in A.2 to A.6.

A.1.3 Calculations to be performed on calibration data

The calibration procedures are specified in Annex C. The quantities to be calculated are specified in A.7 if not already specified in A.2 to A.6 as part of the analysis of standard test data.

A.1.4 Standard data set

As the calculation methods are complex a standard data set can be used to verify the calculation steps and benchmark software.

A.2 Synchronization of data

A.2.1 O₂ and CO₂ synchronization with T_{ms}

Due to the switch from auxiliary to main (primary) burner, the major quantities measured show a short peak or dip at the same moment in time. These peaks and dips are used to synchronize the data. It is assumed that this automatic synchronization procedure and/or the measured delay times are erroneous if the shift calculated by this automatic synchronization procedure differs by more than 6 s from the delay times of the analysers determined in the calibration procedure according to C.2.1.

- a) Shift the O₂ and CO₂ data for the delay times found during calibration in accordance with C.2.1.

After a test, a series of parameters shall be calculated to evaluate the performance of the product. All calculations in this annex, excluding the calculations in A.2, shall be performed on data shifted in time in accordance with A.2. The following calculations shall be carried out:

- synchronization of data;
- calculation of equipment response;
- calculation of exposure period;
- calculation of $HRR(t)$;
- calculation of time-averaged $HRR(t)$: $HRR_{30s}(t)$;
- calculation of $THR(t)$ and THR_{600s} ;
- calculation of $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$;
- calculation of $SPR(t)$;
- calculation of time-averaged $SPR(t)$: $SPR_{60s}(t)$;
- calculation of $TSP(t)$ and TSP_{600s} ;
- calculation of $SMOGRA$.

The results of a test are valid only when the requirements of A.2 and A.3 have been met. The calculations are specified in A.2 to A.6.

BS EN 13823– Calculation of THR(600s)

BS EN 13823:2010+A1:2014
EN 13823:2010+A1:2014 (E)

$$HRR(t) = \max\{0 \text{ kW}, HRR_{\text{spec}}(t) - HRR_{\text{burner}}\} \quad (\text{A.19})$$

where

$HRR(t)$ is the heat release rate of the specimen, in kilowatts;
 $HRR_{\text{total}}(t)$ is the total heat release rate of specimen and burner, in kilowatts;
 HRR_{burner} is the average heat release rate of the burner, in kilowatts;
 $\max\{a, b\}$ is the maximum of two values a and b .

A.5.1.4 Calculation of HRR_{30s}

$HRR_{30s}(t)$ is the 30 s average of $HRR(t)$:

$$HRR_{30s}(t) = \frac{0,5HRR(t-15) + HRR(t-12) + \dots + HRR(t+12) + 0,5HRR(t+15)}{10} \quad (\text{A.20})$$

where

$HRR_{30s}(t)$ is the average of $HRR(t)$ over 30 s, in kilowatts;
 $HRR(t)$ is the heat release rate at time t , in kilowatts.

A.5.2 Calculation of $THR(t)$ and THR_{600s}

The total heat release of the specimen $THR(t)$ and the total heat release of the specimen in the first 600 s of the exposure period ($300 \text{ s} \leq t \leq 900 \text{ s}$), THR_{600s} , are calculated as follows:

$$THR(t_a) = \frac{3}{1\,000} \sum_{300 \text{ s}}^{t_a} (\max\{HRR(t), 0\}) \quad (\text{A.21})$$

$$THR_{600s} = \frac{3}{1\,000} \sum_{300 \text{ s}}^{900 \text{ s}} (\max\{HRR(t), 0\}) \quad (\text{A.22})$$

where

$THR(t_a)$ is the total heat release of the specimen during the period $300 \text{ s} \leq t \leq t_a$, in megajoules;
 $HRR(t)$ is the heat release rate of the specimen, in kilowatts;
 THR_{600s} is the total heat release of the specimen during the period $300 \text{ s} \leq t \leq 900 \text{ s}$, in megajoules;
 $\max\{a, b\}$ is the maximum of two values a and b .

NOTE The factor 3 is introduced since only one data point is available every three seconds.

A.5.3 Calculation of $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$ (fire growth rate indices)

The $FIGRA$ indices are defined as the maximum of the quotient $HRR_{av}(t)/(t - 300)$, multiplied by 1 000. The quotient is calculated only for that part of the exposure period in which the threshold levels for HRR_{av} and THR have been exceeded. If one or both threshold values of a $FIGRA$ index are not exceeded during the exposure period, that $FIGRA$ index is equal to zero. Two different THR -threshold values are used, resulting in $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$.

A.5.2 Calculation of $THR(t)$ and THR_{600s}

The total heat release of the specimen $THR(t)$ and the total heat release of the specimen in the first 600 s of the exposure period ($300 \text{ s} \leq t \leq 900 \text{ s}$), THR_{600s} , are calculated as follows:

$$THR(t_a) = \frac{3}{1\,000} \sum_{300 \text{ s}}^{t_a} (\max\{HRR(t), 0\}) \quad (\text{A.21})$$

$$THR_{600s} = \frac{3}{1\,000} \sum_{300 \text{ s}}^{900 \text{ s}} (\max\{HRR(t), 0\}) \quad (\text{A.22})$$

where

$THR(t_a)$ is the total heat release of the specimen during the period $300 \text{ s} \leq t \leq t_a$, in megajoules;

$HRR(t)$ is the heat release rate of the specimen, in kilowatts;

THR_{600s} is the total heat release of the specimen during the period $300 \text{ s} \leq t \leq 900 \text{ s}$, in megajoules;

$\max\{a, b\}$ is the maximum of two values a and b .

NOTE The factor 3 is introduced since only one data point is available every three seconds.

A.5.3 Calculation of $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$ (fire growth rate indices)

The $FIGRA$ indices are defined as the maximum of the quotient $HRR_{av}(t)/(t - 300)$, multiplied by 1 000. The quotient is calculated only for that part of the exposure period in which the threshold levels for HRR_{av} and THR have been exceeded. If one or both threshold values of a $FIGRA$ index are not exceeded during the exposure period, that $FIGRA$ index is equal to zero. Two different THR -threshold values are used, resulting in $FIGRA_{0,2MJ}$ and $FIGRA_{0,4MJ}$.

BS EN 13823– Calculation of FIGRA

3.4

THR600s

total heat release from the specimen in the first 600 s of exposure to the main (primary) burner flames

3.7

FIGRA_{0,2 MJ}

maximum of the quotient of heat release rate from the specimen and the time of its occurrence using a THR-threshold of 0,2 MJ

3.8

FIGRA_{0,4 MJ}

maximum of the quotient of heat release rate from the specimen and the time of its occurrence using a THR threshold of 0,4 MJ

FIGRA is calculated using the heat release rate measured during the test

And the calculations are presented in detail in the test standard reproduced on the right

a) The average of HRR , HRR_{av} , used to calculate the $FIGRA$ is equal to HRR_{30s} according to A.5.1.4, with the exception of the first 12 s of the exposure period. For data points in the first 12 s, the average is taken only over the widest possible symmetrical range of data points within the exposure period:

1) For $t = 300$ s: $HRR_{av}(300 \text{ s}) = 0$;

2) For $t = 303$ s: $HRR_{av}(303 \text{ s}) = \overline{HRR(300 \text{ s} \dots 306 \text{ s})}$;

3) For $t = 306$ s: $HRR_{av}(306 \text{ s}) = \overline{HRR(300 \text{ s} \dots 312 \text{ s})}$;

4) For $t = 309$ s: $HRR_{av}(309 \text{ s}) = \overline{HRR(300 \text{ s} \dots 318 \text{ s})}$;

5) For $t = 312$ s: $HRR_{av}(312 \text{ s}) = \overline{HRR(300 \text{ s} \dots 324 \text{ s})}$;

6) For $t \geq 315$ s: $HRR_{av}(t) = HRR_{30s}(t)$. (A.23)

b) Calculate $FIGRA_{0,2MJ}$ for all t where:

$(HRR_{av}(t) > 3 \text{ kW})$ and $(THR(t) > 0,2 \text{ MJ})$ and $(300 \text{ s} < t \leq 1\,500 \text{ s})$;

and calculate $FIGRA_{0,4MJ}$ for all t where:

$(HRR_{av}(t) > 3 \text{ kW})$ and $(THR(t) > 0,4 \text{ MJ})$ and $(300 \text{ s} < t \leq 1\,500 \text{ s})$;

both using:

$$FIGRA = 1\,000 \times \max \left(\frac{HRR_{av}(t)}{t - 300} \right) \quad (A.24)$$

where

$FIGRA$ is the fire growth rate index, in watts per second;

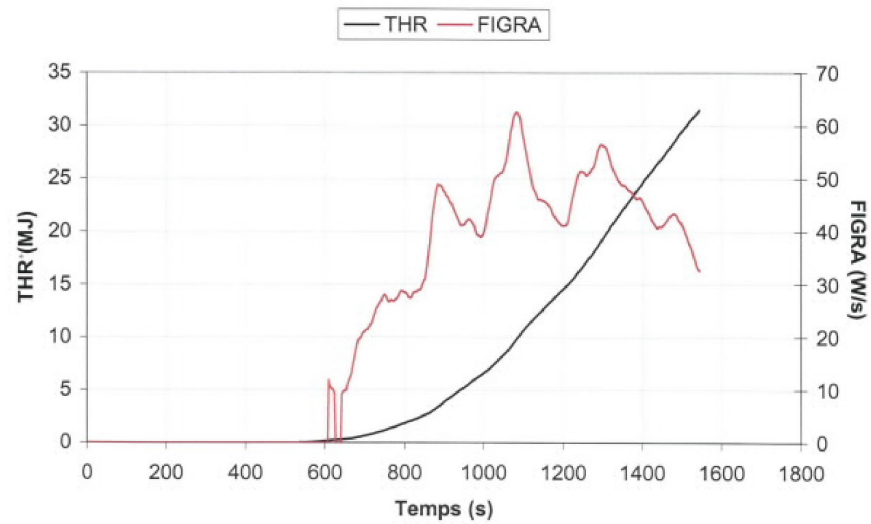
$HRR_{av}(t)$ is the average of $HRR(t)$ as specified in a), in kilowatts;

$\max. [a(t)]$ is the maximum of $a(t)$ within the given time period.

NOTE As a consequence, specimens with an HRR_{av} value of not more than 3 kW during the total test period or a THR value of not more than 0,2 MJ over the total test period, have a $FIGRA_{0,2MJ}$ equal to zero. Specimens with an HRR_{av} value of not more than 3 kW during the total test period or a THR value of not more than 0,4 MJ over the total test period, have a $FIGRA_{0,4MJ}$ equal to zero.

BS EN 13283 – measurements taken

Eprouvette n° 1 REYNOBOND® 55 PE système riveté :



BS EN 13823– Expression of results

BS EN 13823:2010+A1:2014
EN 13823:2010+A1:2014 (E)

NOTE 1 An early termination of the test can be prevented by the use of a grid in accordance with 4.4.6.

NOTE 2 The following occurrences may damage the test apparatus:

- a heat release rate of the specimen exceeding 350 kW at any instant, or exceeding 280 kW over a period of 30 s, or
- an exhaust duct temperature exceeding 400 °C at any instant, or exceeding a mean value of 300 °C over a period of 30 s.

If the above limits are exceeded the operator may consider an early termination of the test. Measured values for the temperature and the heat release rate will contain a certain amount of noise. It is therefore advised not to stop the test on the basis of only one or two successive measurement values from the instruments exceeding the given maximums.

9 Expression of results

9.1 For each test, the burning behaviour of the product shall be represented by graphs of average heat release rate $HRR_{av}(t)$, total heat release $THR(t)$, and $1\,000 \times HRR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; the values for the fire growth rate indices $FIGRA_{0,2\,MJ}$ and $FIGRA_{0,4\,MJ}$, and the total heat release within 600 s THR_{600s} , calculated in accordance with A.5, and the occurrence or not of lateral flame spread up to the edge of the specimen in accordance with 8.3.3.

9.2 For each test, the smoke production behaviour of the product shall be given as the graphs of $SPR_{av}(t)$, total smoke production $TSP(t)$ and $10\,000 \times SPR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; and the values for the smoke growth rate index $SMOGRA$ and the total smoke production within 600 s TSP_{600s} , calculated in accordance with A.6.

9.3 For each test, the behaviour of the product regarding the production of flaming droplets and particles shall be given as the occurrence, or not, of one or both categories of fallen flaming droplets and particles, in accordance with 8.3.4, a) or b) respectively.

10 Test report

The test report shall include the following information. A clear distinction shall be made between the data provided by the sponsor and data determined by the test:

- a reference that the test was carried out in accordance with this standard;
- any deviations from the test method;
- name and address of the testing laboratory;
- date and identification number of the report;
- name and address of the sponsor;
- name and address of the manufacturer/supplier, if known;
- date of sample arrival;
- identification of the product;
- description of the sampling procedure, where relevant;

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9 Expression of results

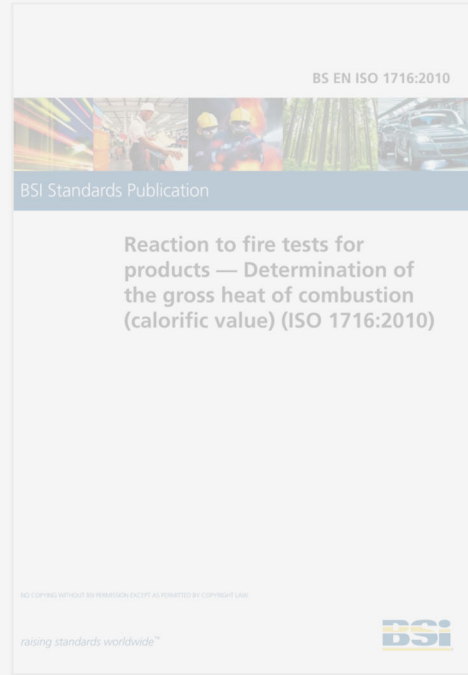
9.1 For each test, the burning behaviour of the product shall be represented by graphs of average heat release rate $HRR_{av}(t)$, total heat release $THR(t)$, and $1\,000 \times HRR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; the values for the fire growth rate indices $FIGRA_{0,2\,MJ}$ and $FIGRA_{0,4\,MJ}$, and the total heat release within 600 s THR_{600s} , calculated in accordance with A.5, and the occurrence or not of lateral flame spread up to the edge of the specimen in accordance with 8.3.3.

9.2 For each test, the smoke production behaviour of the product shall be given as the graphs of $SPR_{av}(t)$, total smoke production $TSP(t)$ and $10\,000 \times SPR_{av}(t)/(t - 300)$, for the time interval $0 \leq t \leq 1\,500$ s; and the values for the smoke growth rate index $SMOGRA$ and the total smoke production within 600 s TSP_{600s} , calculated in accordance with A.6.

9.3 For each test, the behaviour of the product regarding the production of flaming droplets and particles shall be given as the occurrence, or not, of one or both categories of fallen flaming droplets and particles, in accordance with 8.3.4, a) or b) respectively.



BS EN 13823
Building products excluding floorings exposed to the thermal attack by a single burning item



BS EN ISO 1716
Determination of the gross heat of combustion (calorific value)



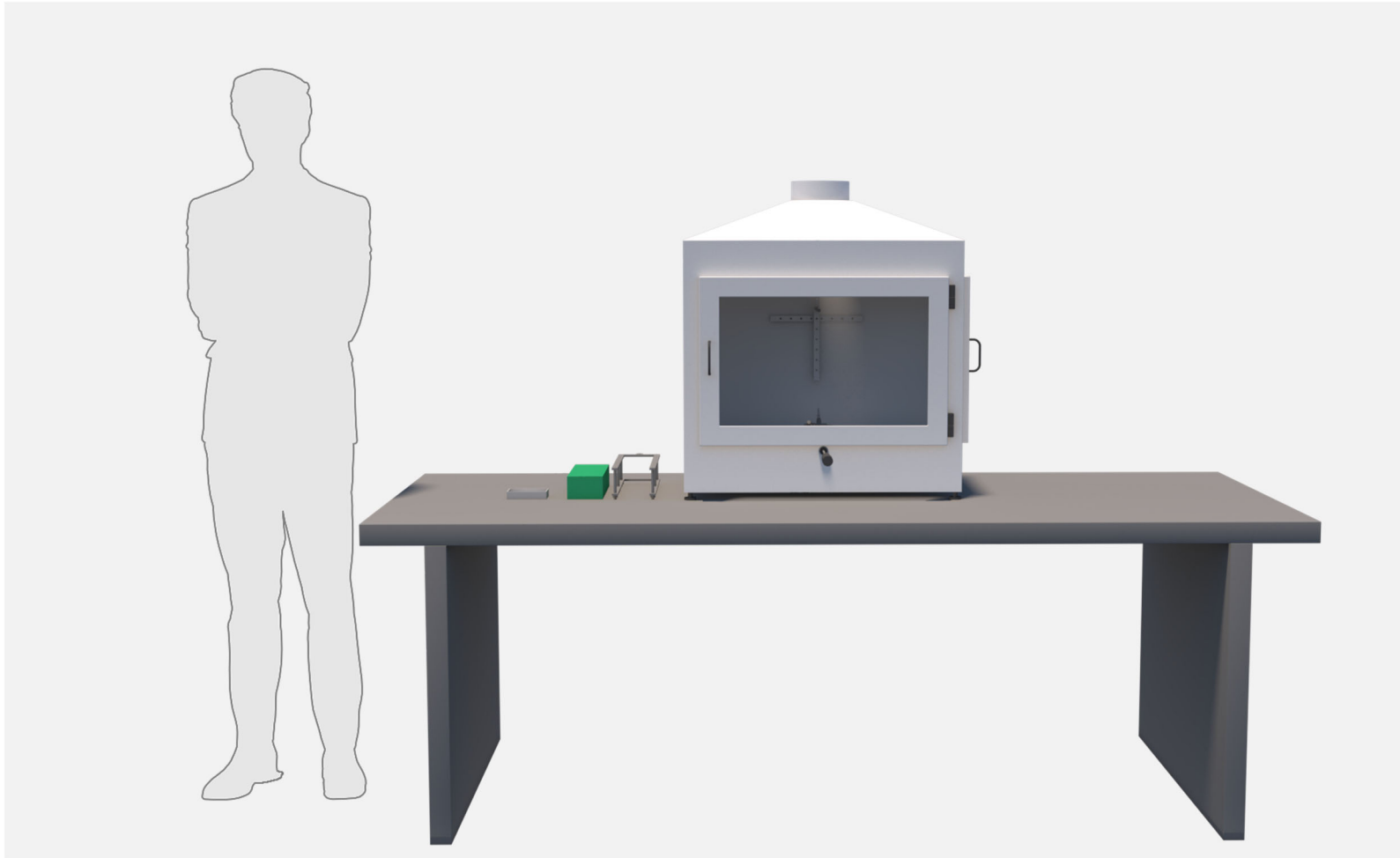
BS EN ISO 11925-2
Ignitability of building products subjected to direct impingement of flame. Single-flame source test



BS EN ISO 1182
Non-combustibility test

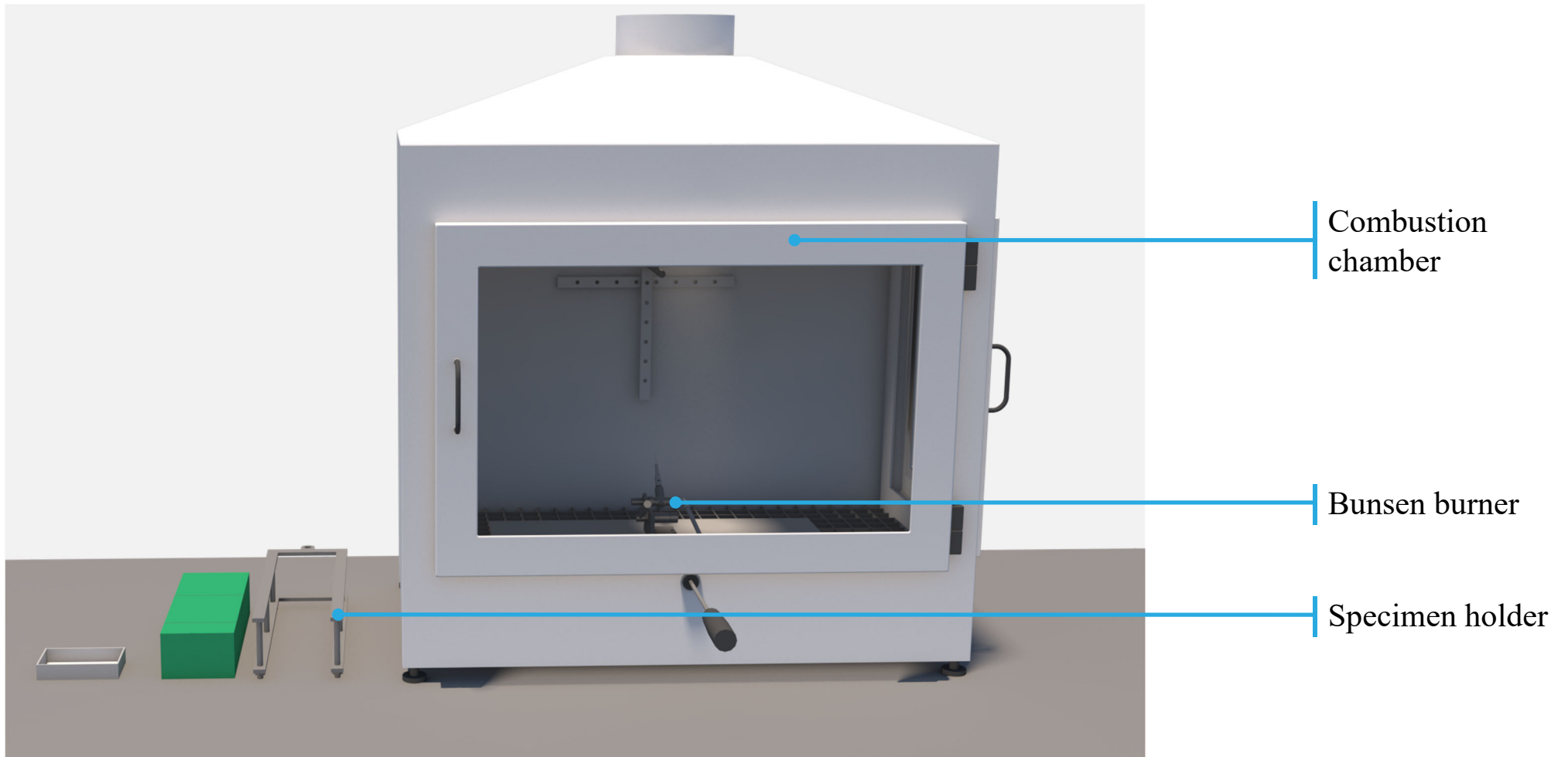
BS EN ISO 11925-2 – apparatus

ARUP



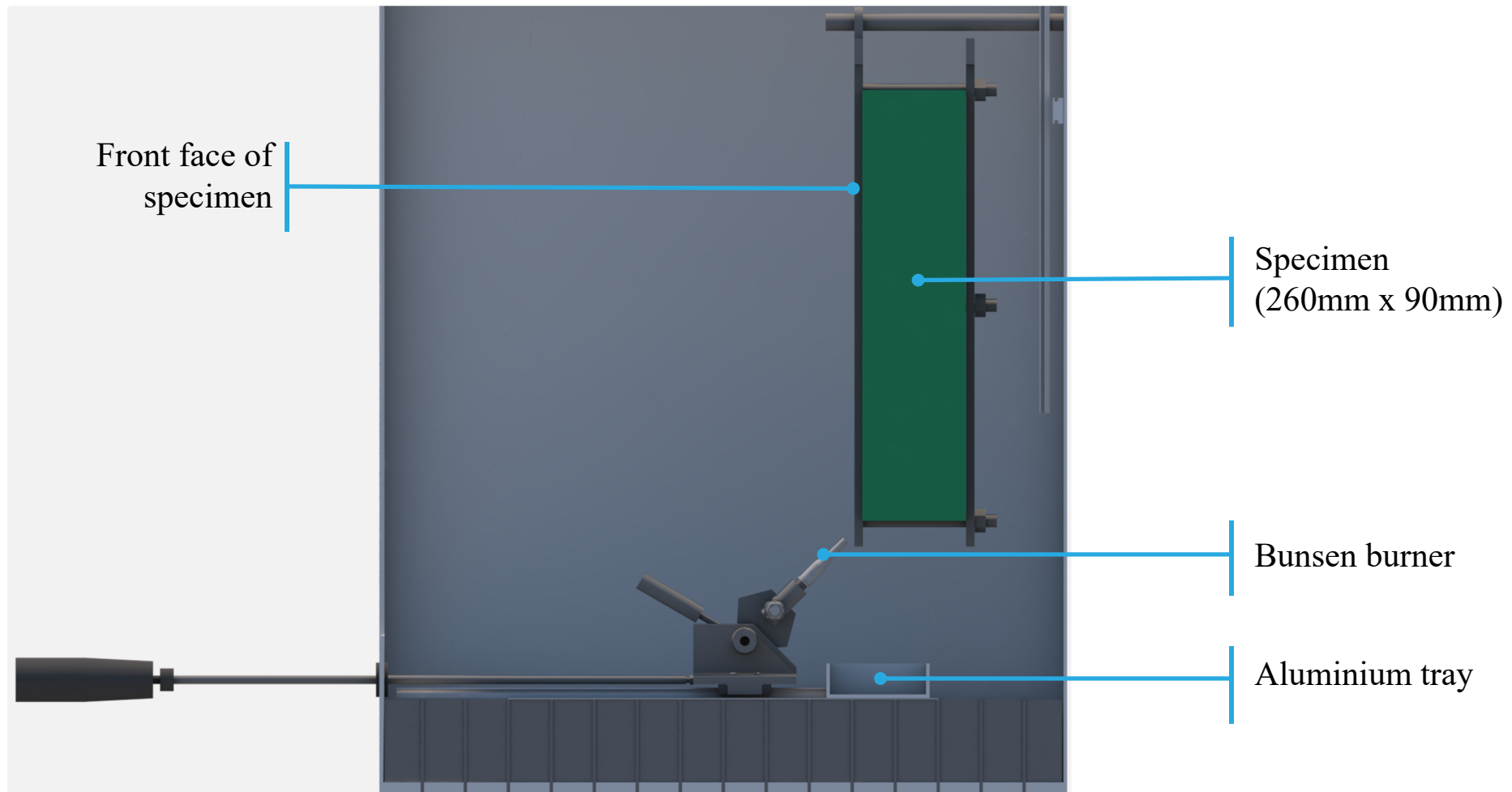
BS EN ISO 11925-2 – apparatus

ARUP



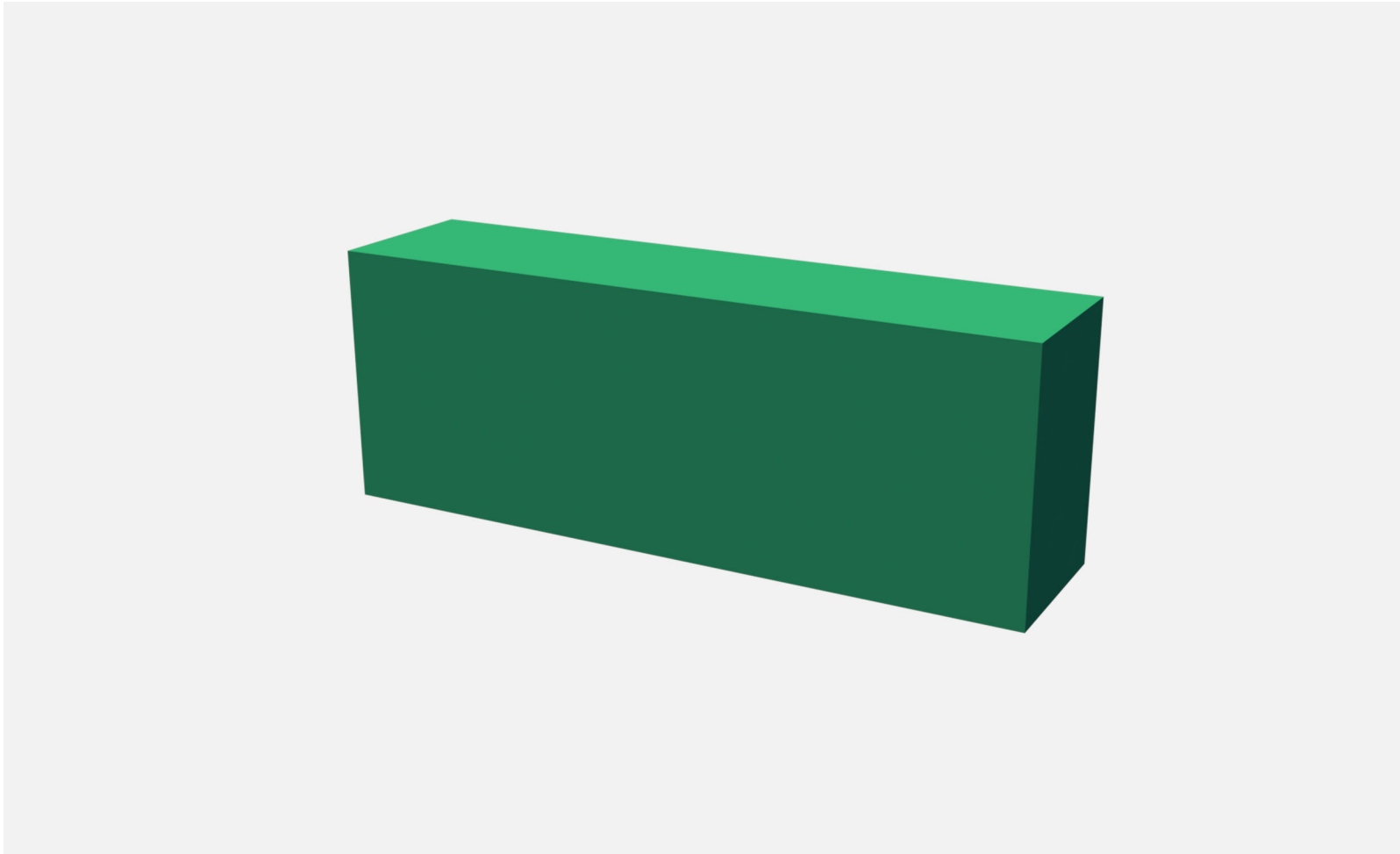
BS EN ISO 11925-2 – apparatus

ARUP



BS EN ISO 11925-2 – specimen

ARUP



BS EN ISO 11925-2 – specimen additional requirements

ARUP

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 a separate series of specimens on each face.

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, then more than one test set shall be conducted to evaluate the product.

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.

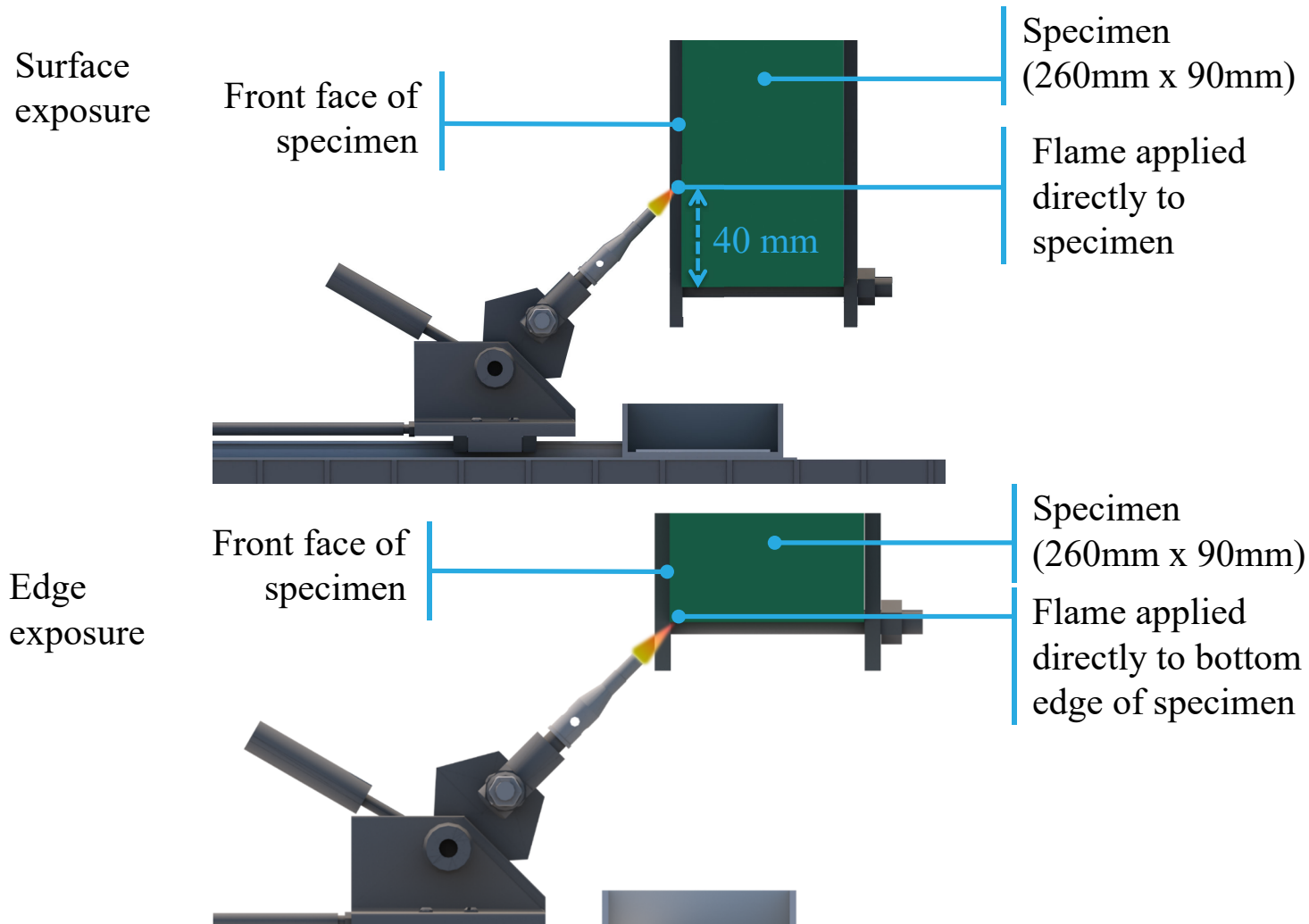
5.5 Substrates

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

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.

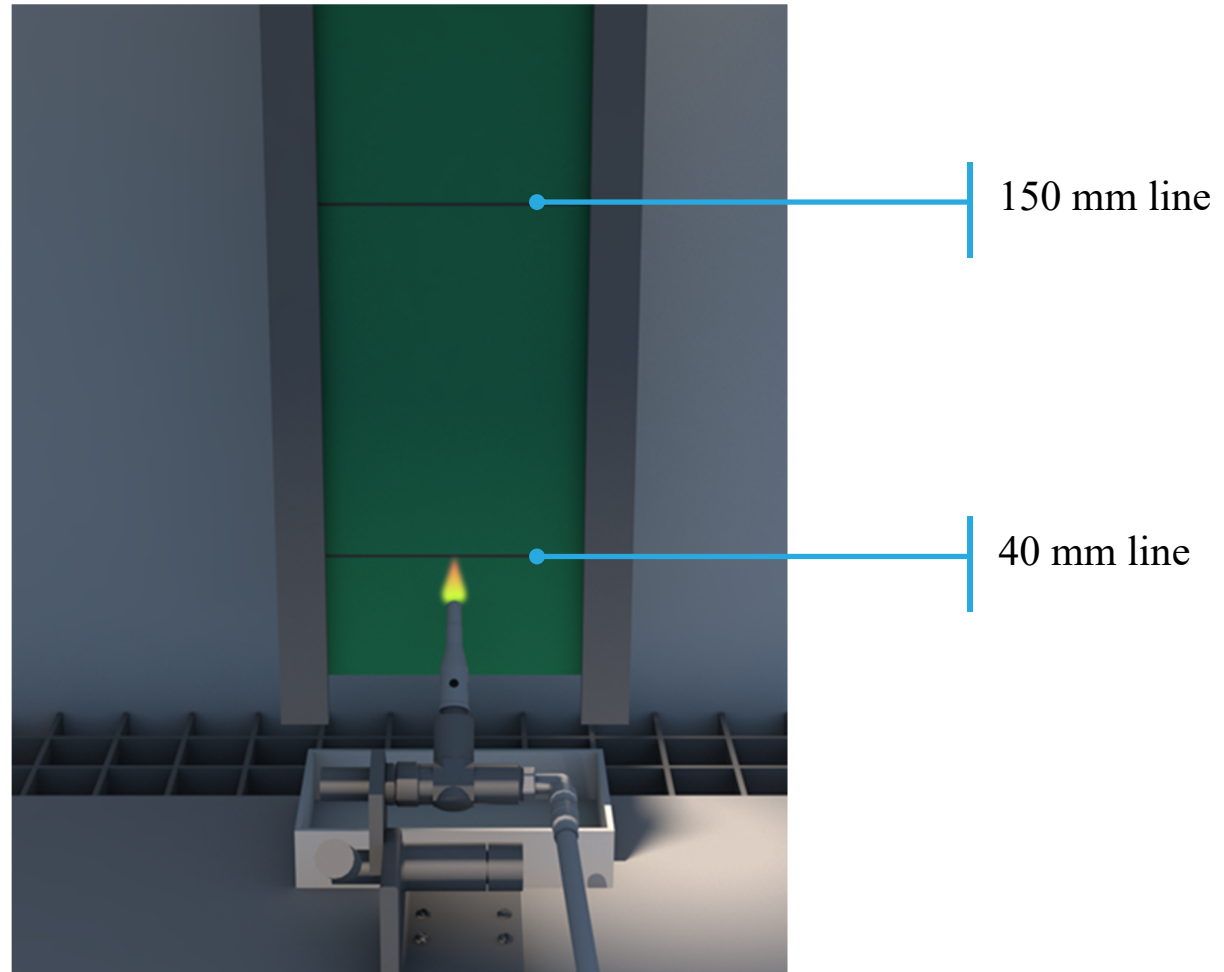
NOTE Additional advice on the use of substrates can be found in any relevant product standard.

BS EN ISO 11925-2 – apparatus



BS EN ISO 11925-2 – test methodology

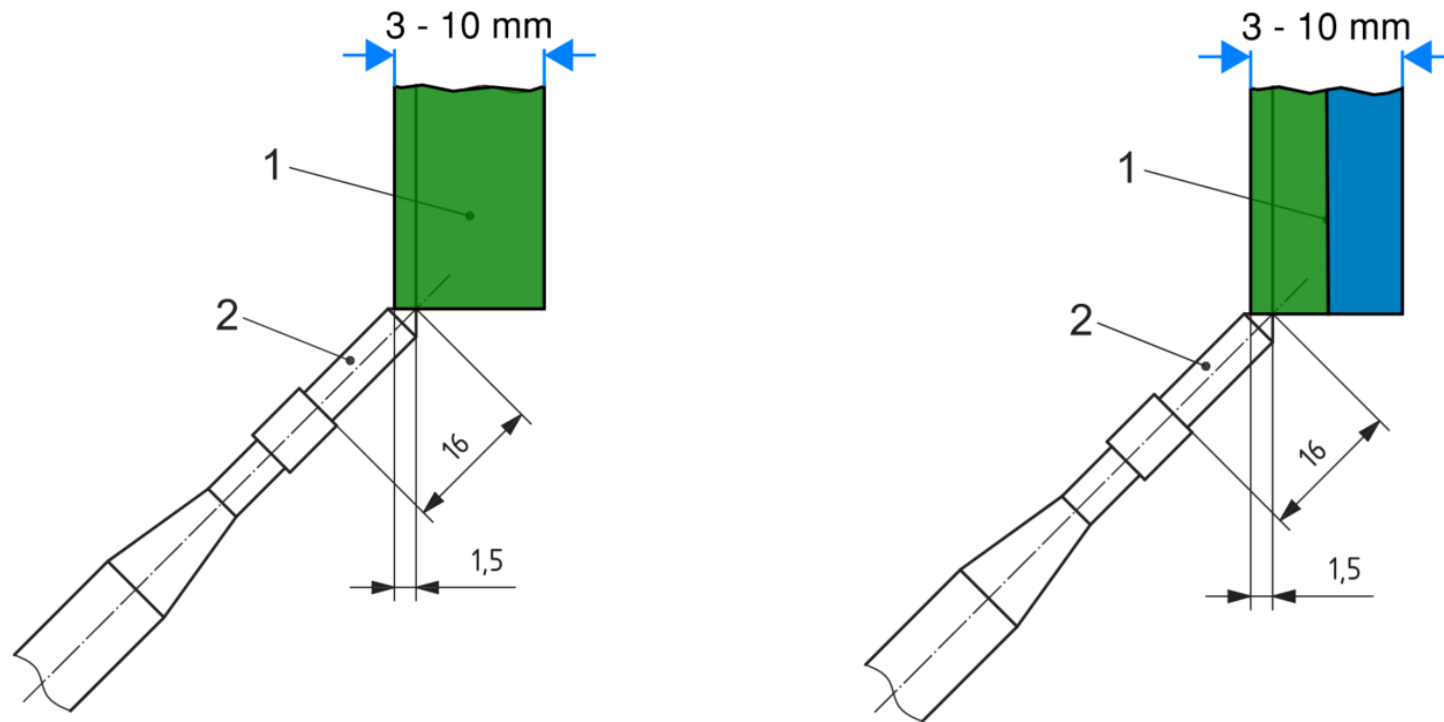
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BS EN ISO 11925-2 – edge exposure materials

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Dimensions in millimetres



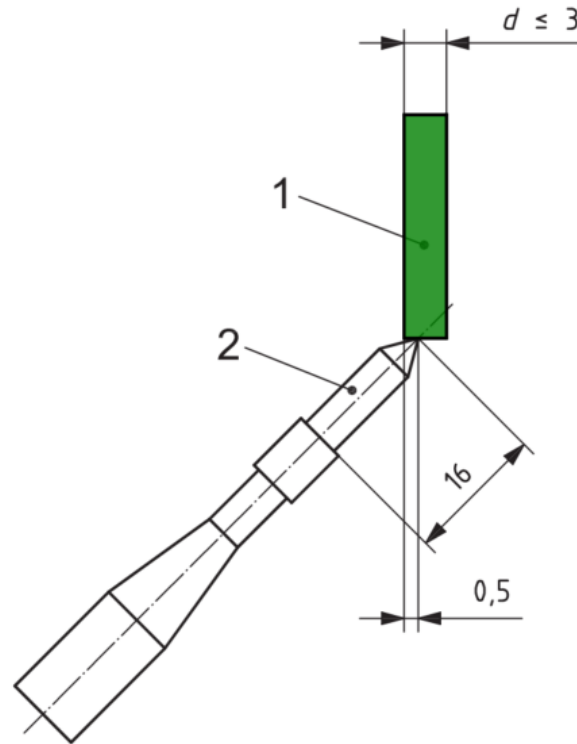
Key

- 1 test specimen
- 2 burner spacer

BS EN ISO 11925-2 – edge exposure materials

ARUP

Dimensions in millimetres

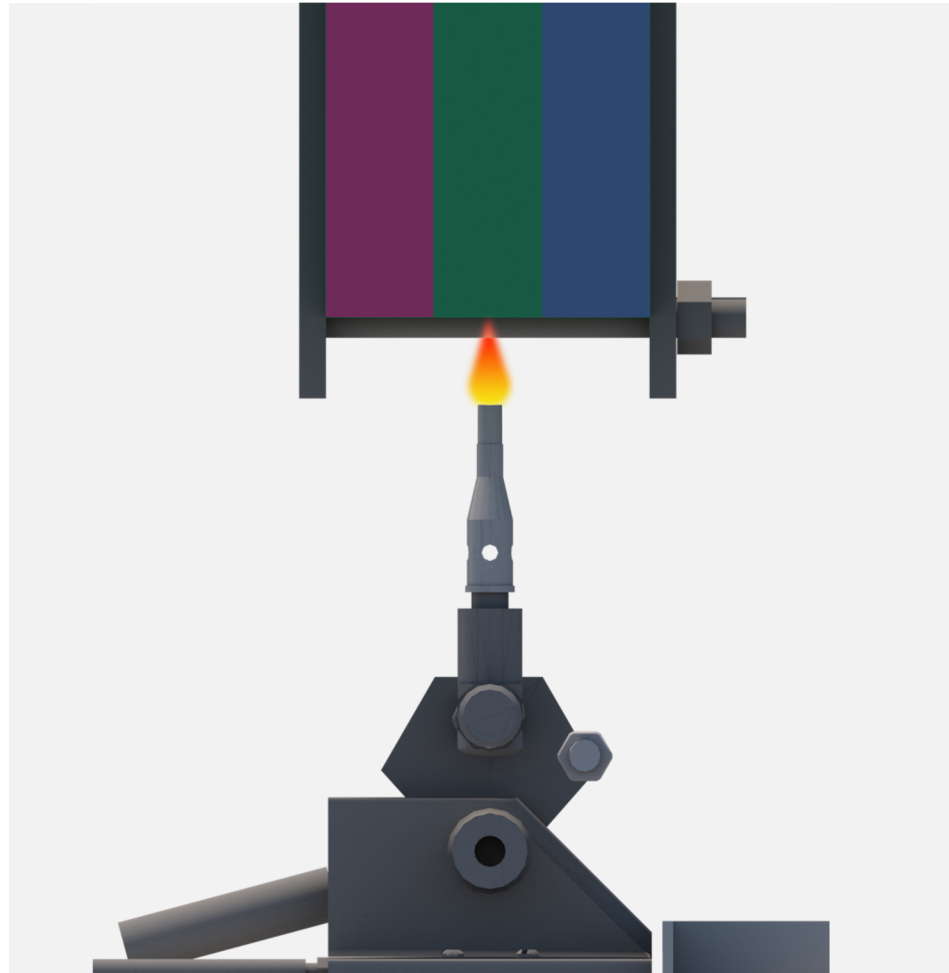


Key

- 1 test specimen
- 2 burner spacer
- d thickness

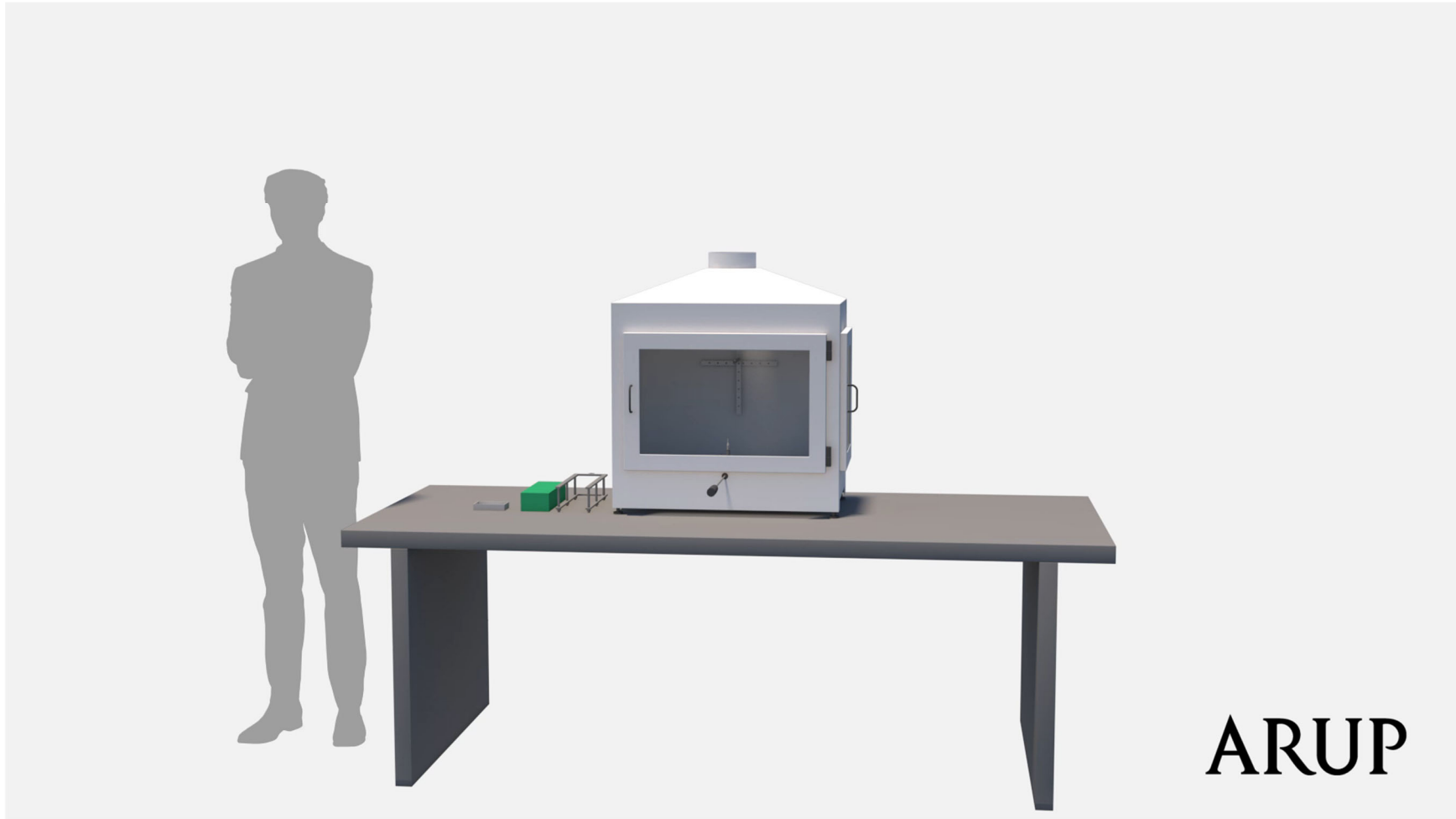
BS EN ISO 11925-2 – edge exposure materials

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BS EN ISO 11925-2

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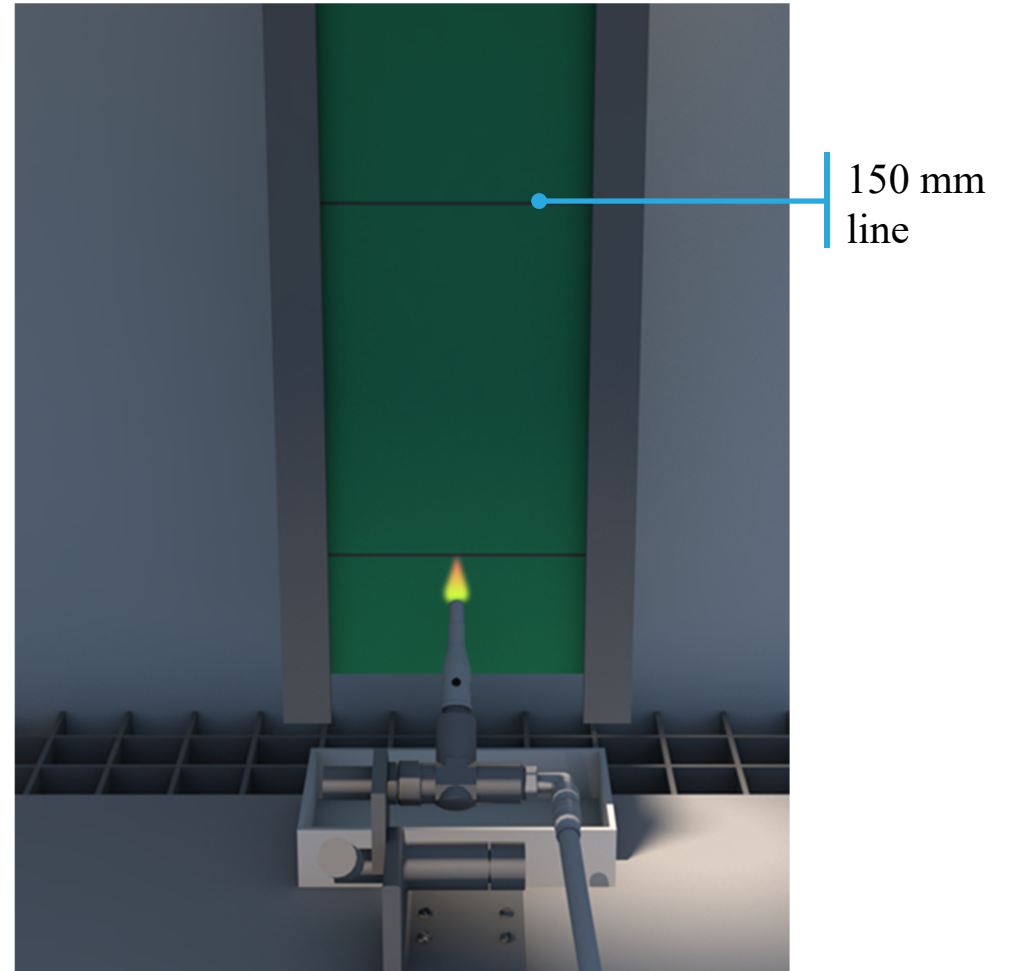


BS EN ISO 11925-2 – measurements taken

ARUP



- Did the flame reach the 150mm reference line?
- Was the filter paper ignited by any flaming droplets or particles?
- Did flaming occur once the pilot flame was removed?



BS EN ISO 11925-2– Test report

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 part of ISO 11925, i.e. ISO 11925-2;
- 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;

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BS EN ISO 11925-2:2010
EN ISO 11925-2:2010(E)

- 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.

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 part of ISO 11925, i.e. ISO 11925-2;
- 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;
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- 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;
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- l) details of any substrates used and method of fixing;
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- q) information on the intended application of the product, if known;
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A clear distinction shall be made between the data provided by the sponsor and the data determined by the test.

Smoke production and flaming droplets/ particles limits

ARUP

For homogeneous products and substantial components of non-homogeneous products

^b **s1** = SMOGRA $\leq 30 \text{ m}^2/\text{s}^2$ and TSP_{600s} $\leq 50 \text{ m}^2$ in EN 13823

s2 = SMOGRA $\leq 180 \text{ m}^2/\text{s}^2$ and TSP_{600s} $\leq 200 \text{ m}^2/\text{s}^2$ in EN 13823

s3 = not s1 or s2

^c **d0** = No flaming droplets / particles persisting longer than 10 s in EN 13823 within 600 s

d1 = No flaming droplets / particles persisting longer than 10 s in EN 13823 within 600 s

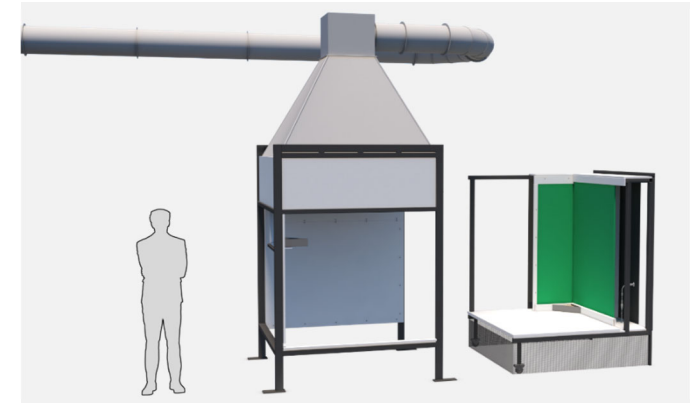
d2 = If no performance declared, or if the product does not comply with d0 or d1 or ignite the paper in ignitability test (EN ISO 11925-2)

Ignition of the paper in EN ISO 11925-2 results in a d2 classification.

Pass = no ignition of the paper (no classification);

Fail = ignition of the paper (d2 classification).

BS EN 13823:



BS EN ISO 11925-2:

