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Section 2:
European reaction to fire test classification system

BS EN 13501-1:2007+A1:2009 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

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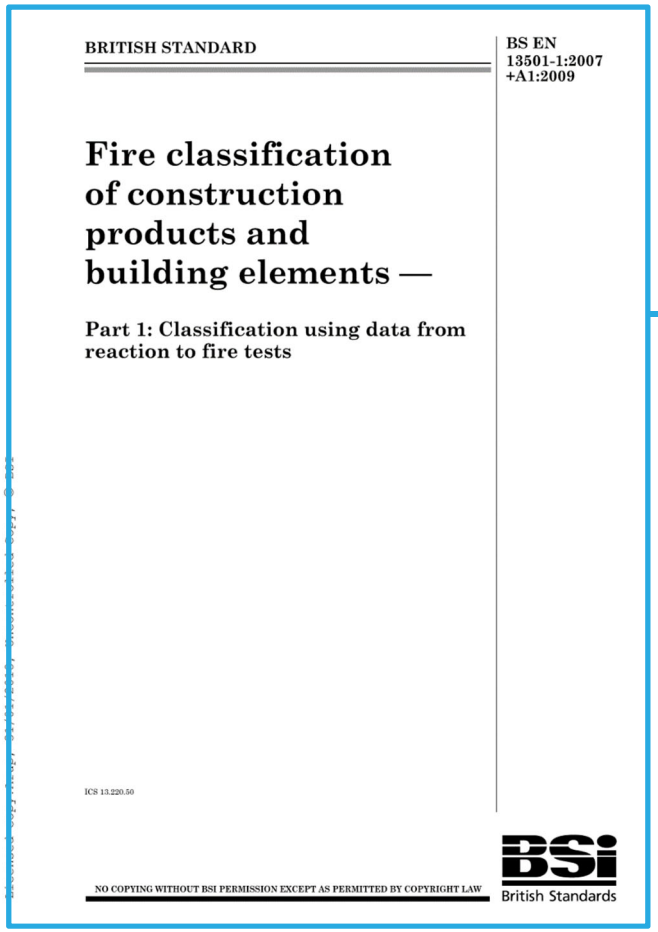
BRITISH STANDARD

BS EN 13501-1:2007 +A1:2009

Fire classification of construction products and building elements —

Part 1: Classification using data from reaction to fire tests

ICS 13.220.50

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BSI British Standards

"Scope

This European Standard provides the reaction to fire classification procedure for all construction products,

including products incorporated within building elements.

Products are considered in relation to their end use application.

This document applies to three categories, which are treated separately in this European Standard:

- construction products, excluding floorings and linear pipe thermal insulation products;
- floorings;
- linear pipe thermal insulation products.

BS EN 13501-1:2007+A1:2009 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests

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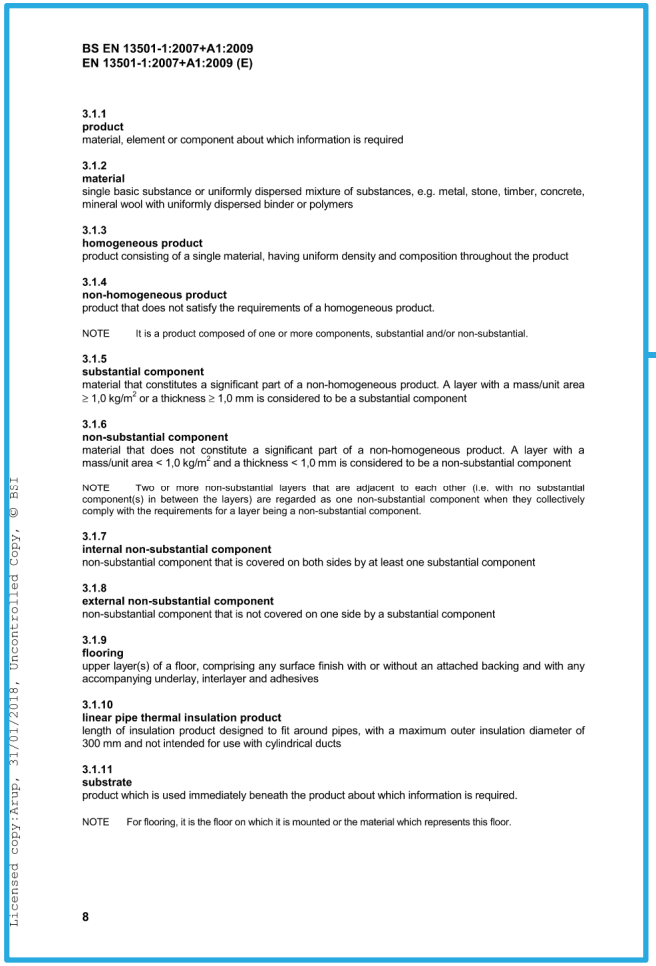

BS EN 13501-1:2007+A1:2009
EN 13501-1:2007+A1:2009 (E)

3.1.1
product
material, element or component about which information is required

3.1.2
material
single basic substance or uniformly dispersed mixture of substances, e.g. metal, stone, timber, concrete, mineral wool with uniformly dispersed binder or polymers

3.1.3
homogeneous product
product consisting of a single material, having uniform density and composition throughout the product

3.1.4
non-homogeneous product
product that does not satisfy the requirements of a homogeneous product.

NOTE It is a product composed of one or more components, substantial and/or non-substantial.

3.1.5
substantial component
material that constitutes a significant part of a non-homogeneous product. A layer with a mass/unit area ≥ 1,0 kg/m^2 or a thickness ≥ 1,0 mm is considered to be a substantial component

3.1.6
non-substantial component
material that does not constitute a significant part of a non-homogeneous product. A layer with a mass/unit area < 1,0 kg/m^2 and a thickness < 1,0 mm is considered to be a non-substantial component

NOTE Two or more non-substantial layers that are adjacent to each other (i.e. with no substantial component(s) in between the layers) are regarded as one non-substantial component when they collectively comply with the requirements for a layer being a non-substantial component.

3.1.7
internal non-substantial component
non-substantial component that is covered on both sides by at least one substantial component

3.1.8
external non-substantial component
non-substantial component that is not covered on one side by a substantial component

3.1.9
flooring
upper layer(s) of a floor, comprising any surface finish with or without an attached backing and with any accompanying underlay, interlayer and adhesives

3.1.10
linear pipe thermal insulation product
length of insulation product designed to fit around pipes, with a maximum outer insulation diameter of 300 mm and not intended for use with cylindrical ducts

3.1.11
substrate
product which is used immediately beneath the product about which information is required.

NOTE For flooring, it is the floor on which it is mounted or the material which represents this floor.

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"3.1.11
substrate
product which is used immediately beneath the product about which information is required.
NOTE For flooring, it is the floor on which it is mounted or the material which represents this floor.
3.1.12
standard substrate
product which is representative of the substrate used in end-use applications
3.1.13
end use application
real application of a product, in relation to all aspects that influence the behaviour of that product under different fire situations.
NOTE It covers aspects such as its quantity, orientation, position in relation to other adjacent products, and its method of fixing."

European reaction to fire classifications

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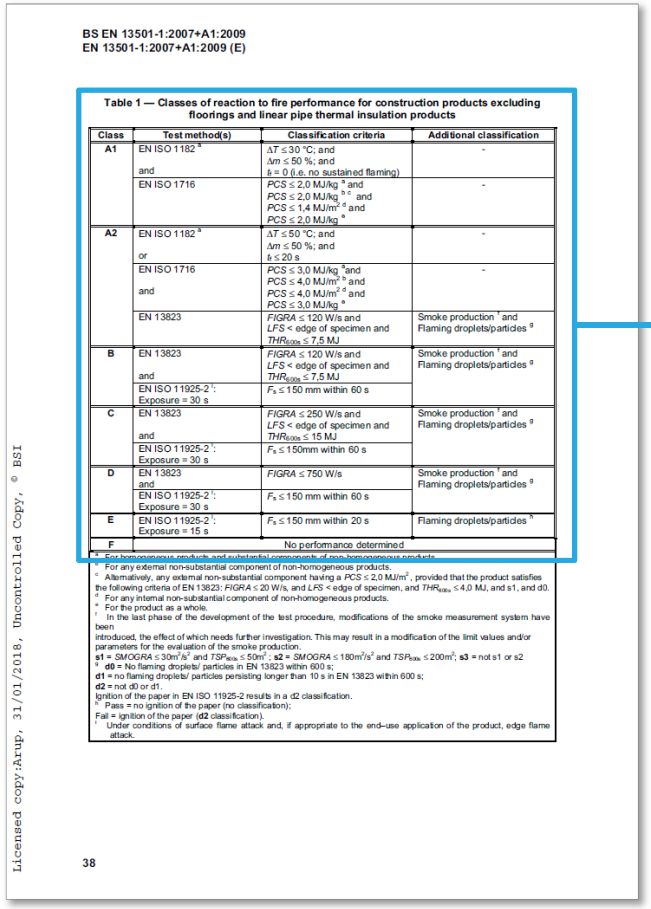

BS EN 13501-1:2007+A1:2009
EN 13501-1:2007+A1:2009 (E)

Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 [a]	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f = 0$ (i.e. no sustained flaming)	-
	and EN ISO 1716	$PCS \leq 2,0$ MJ/kg [a] and $PCS \leq 2,0$ MJ/kg [b c] and $PCS \leq 1,4$ MJ/m^2 [d] and $PCS \leq 2,0$ MJ/kg [e]	-
A2	EN ISO 1182 [a]	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	or EN ISO 1716	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m^2 [b] and $PCS \leq 4,0$ MJ/m^2 [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	and EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
B	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
C	EN 13823	$FIGRA \leq 250$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 15$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$mm within 60 s	
D	EN 13823	$FIGRA \leq 750$ W/s	Smoke production [f] and Flaming droplets/particles [g]
	and EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
E	EN ISO 11925-2 [i]: Exposure = 15 s	$F_s \leq 150$ mm within 20 s	Flaming droplets/particles [h]
F	No performance determined		

[a] For homogeneous products and substantial components of non-homogeneous products.
[b] For any external non-substantial component of non-homogeneous products.
[c] Alternatively, any external non-substantial component having a $PCS \leq 2,0$ MJ/m^2, provided that the product satisfies the following criteria of EN 13823: $FIGRA \leq 20$ W/s, and $LFS <$ edge of specimen, and $THR_{600s} \leq 4,0$ MJ, and s1, and d0.
[d] For any internal non-substantial component of non-homogeneous products.
[e] For the product as a whole.
[f] In the last phase of the development of the test procedure, modifications of the smoke measurement system have been introduced, the effect of which needs further investigation. This may result in a modification of the limit values and/or parameters for the evaluation of the smoke production.
s1 = $SMOGRA \leq 30$ m^2/s^2 and $TSP_{600s} \leq 50$ m^2; **s2** = $SMOGRA \leq 180$ m^2/s^2 and $TSP_{600s} \leq 200$ m^2; **s3** = not s1 or s2
[g] **d0** = No flaming droplets/ particles in EN 13823 within 600 s;
d1 = no flaming droplets/ particles persisting longer than 10 s in EN 13823 within 600 s;
d2 = not d0 or d1.
[h] Ignition of the paper in EN ISO 11925-2 results in a d2 classification.
[i] Pass = no ignition of the paper (no classification);
Fail = ignition of the paper (**d2** classification).
[j] Under conditions of surface flame attack and, if appropriate to the end–use application of the product, edge flame attack.

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Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 [a]	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f = 0$ (i.e. no sustained flaming)	-
	and EN ISO 1716	$PCS \leq 2,0$ MJ/kg [a] and $PCS \leq 2,0$ MJ/kg [b c] and $PCS \leq 1,4$ MJ/m^2 [d] and $PCS \leq 2,0$ MJ/kg [e]	-
A2	EN ISO 1182 [a]	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	or EN ISO 1716	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m^2 [b] and $PCS \leq 4,0$ MJ/m^2 [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	and EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
B	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
C	EN 13823	$FIGRA \leq 250$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 15$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$mm within 60 s	
D	EN 13823 and	$FIGRA \leq 750$ W/s	Smoke production [f] and Flaming droplets/particles [g]
	EN ISO 11925-2 [i]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
E	EN ISO 11925-2 [i]: Exposure = 15 s	$F_s \leq 150$ mm within 20 s	Flaming droplets/particles [h]
F	No performance determined		

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European classification limits

European classification – Class A1 & A2

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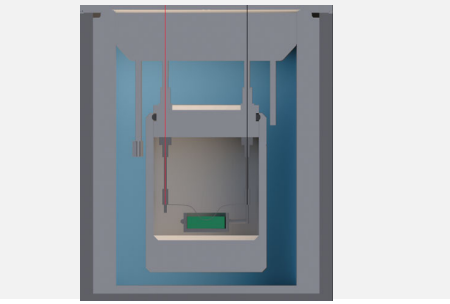
Class A1		
Test method (s)	Classification Criteria	Additional classification
BS EN ISO 1182[a] (Non-combustibility test)	$\Delta T \leq 30°C$; and	-
	$\Delta m \leq 50\%$; and	
	$t_f = 0$ (i.e. no sustained flaming)	
AND		
BS EN ISO 1716 (Determination of the gross heat of combustion)	PCS $\leq$ 2.0 MJ/kg [a] and	-



European classification – Class A2

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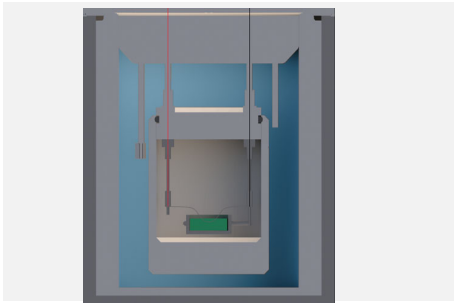
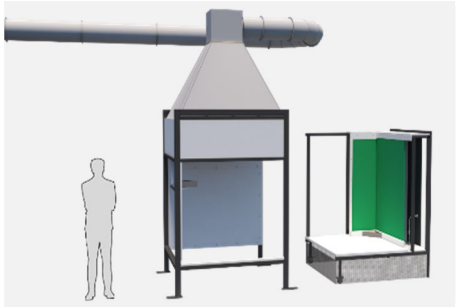
Class A2		
Test method (s)	Classification Criteria	Additional classification
BS EN ISO 1182[a] (Non-combustibility test)	$\Delta T \leq 50°C$; and $\Delta m \leq 50\%$; and $t_f = 20$ s	-
OR		
BS EN ISO 1716 (Determination of the gross heat of combustion)	PCS ≤ 3.0 MJ/kg [a] and	-
AND		
BS EN 13823 (Single burning item test)	FIGRA ≤ 120 W/s and LFS < edge of specimen and $THR_{600s} \leq 7.5$ MJ	Smoke production [b] and flaming droplets/ particles [c]

Note: A Class A2 material would be considered a material of limited combustibility under Approved Document B, and so would apply to an insulation material in an external wall or else can also be used to demonstrate that a material achieves Class 0 by virtue of paragraph 13a of Appendix A of ADB.





European classification – Class B

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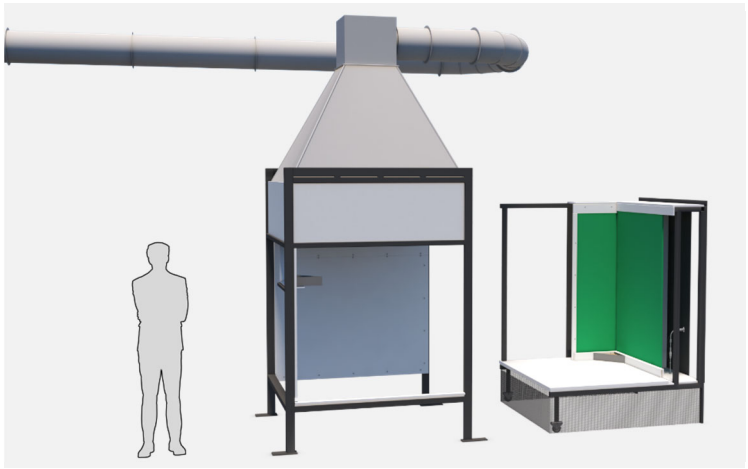
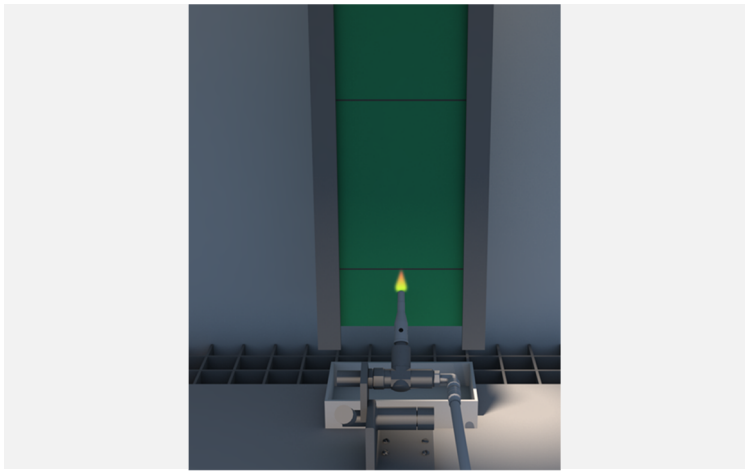
Class B		
Test method (s)	Classification Criteria	Additional classification
BS EN 13823 (Single burning item test)	FIGRA ≤ 120 W/s and	Smoke production [b] and flaming droplets/ particles [c]
	LFS < edge of specimen and	
	THR_{600s} ≤ 7.5 MJ	
	AND	
BS EN ISO 11925-2 (Exposure = 30 s) (single flame source test)	F_S ≤ 150 mm within 60 s	





European classification – Class C

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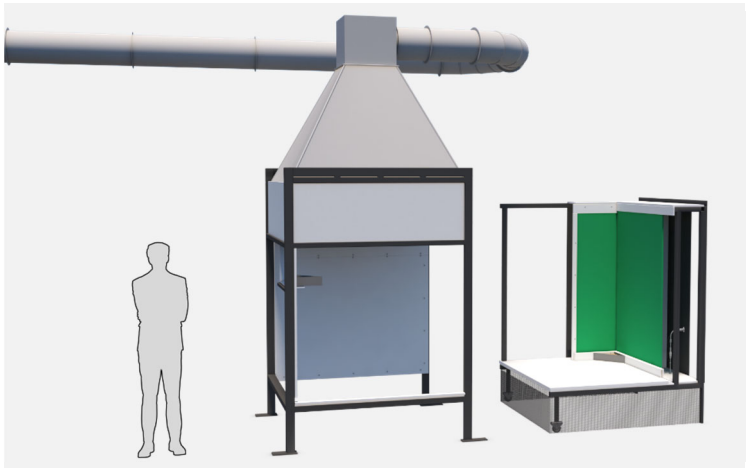
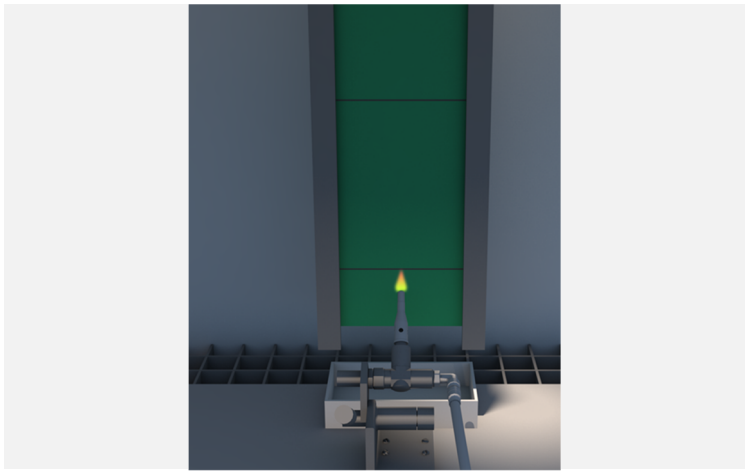
Class C		
Test method (s)	Classification Criteria	Additional classification
BS EN 13823 (Single burning item test)	FIGRA ≤ 250 W/s and	Smoke production [b] and flaming droplets/ particles [c]
	LFS < edge of specimen and	
	THR_{600s} ≤ 15 MJ	
	AND	
BS EN ISO 11925-2 (Exposure = 30 s) (single flame source test)	F_S ≤ 150 mm within 60 s	





European classification – Class D

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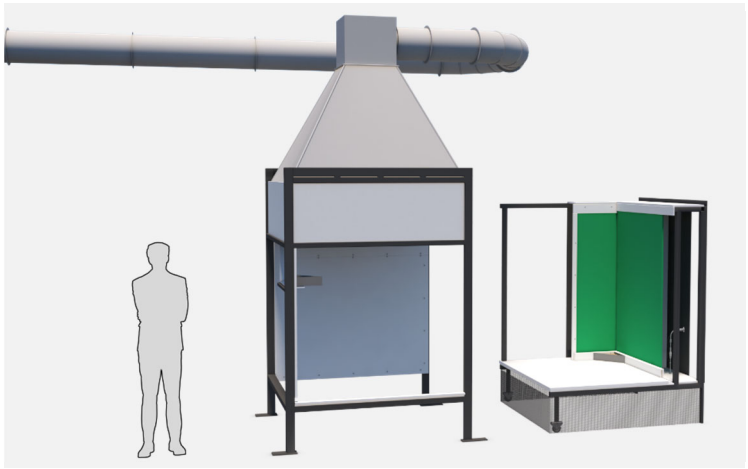
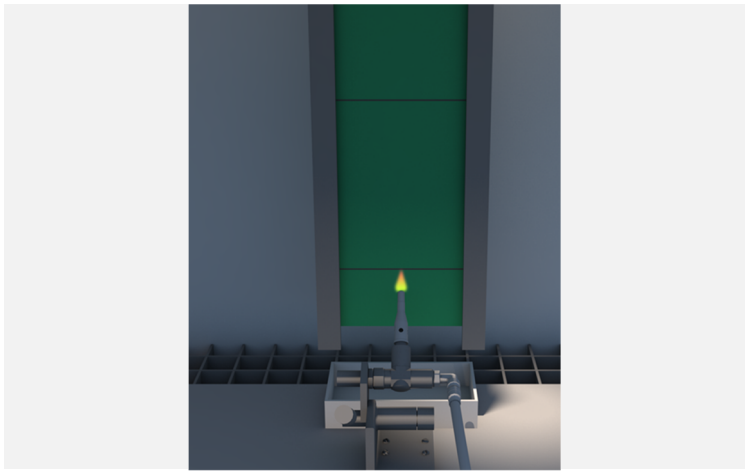
Class D		
Test method (s)	Classification Criteria	Additional classification
BS EN 13823 (Single burning item test)	FIGRA ≤ 750 W/s	Smoke production [b] and flaming droplets/ particles [c]
AND		
BS EN ISO 11925-2 (Exposure = 15 s) (single flame source test)	$F_S \leq 150$ mm within 20 s	





European classification – Class E

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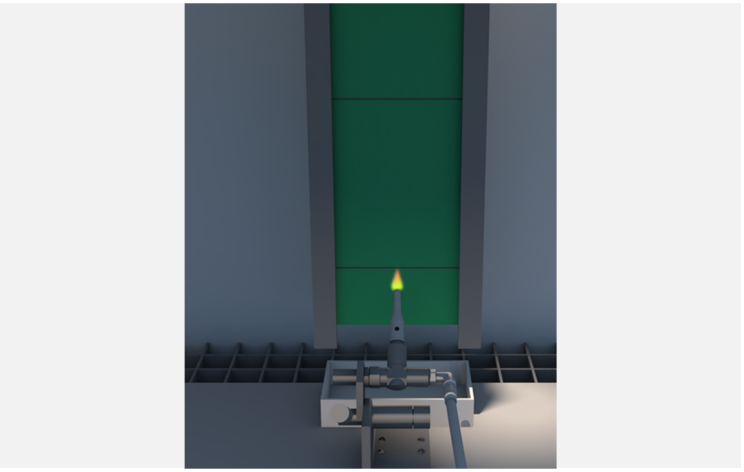
Class E		
Test method (s)	Classification Criteria	Additional classification
BS EN ISO 11925-2 (Exposure = 15 s) (single flame source test)	$F_S \leq 150$ mm within 20 s	Flaming droplets/ particles[1]



[1] Pass = no ignition of the paper (no classification)
Fail = ignition of the paper (**d2** classification)

European classification – Class F

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Class F		
Test method (s)	Classification Criteria	Additional classification
No performance determined [1]		

[1] Class F also applies if a product fails to obtain class E when tested to EN ISO 11926-2

Summary of classifications and the relevant tests to obtain them

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European Classification	Relevant tests
A1	BS EN ISO 1716 and BS EN ISO 1182
A2 (combination 1)	BS EN ISO 1182 and BS EN 13823
A2 (combination 2)	BS EN ISO 1716 and BS EN 13823
B	BS EN 13823 and BS EN ISO 11925-2
C	BS EN 13823 and BS EN ISO 11925-2
D	BS EN 13823 and BS EN ISO 11925-2
E	BS EN ISO 11925-2
F	No performance criteria OR fails to achieve Class E requirement to BS EN ISO 11925-2

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European classification limits for smoke production and flaming droplets

Summary of All European Classification

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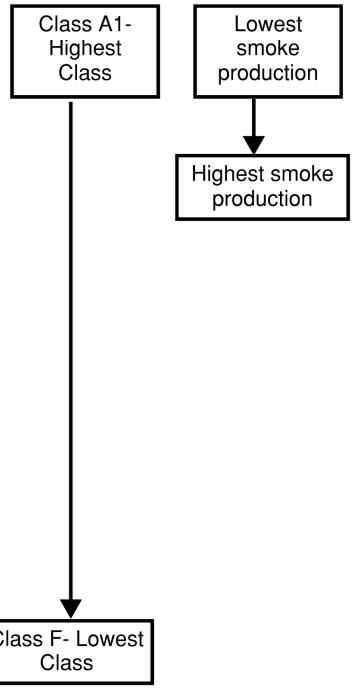
14 Presentation of classification

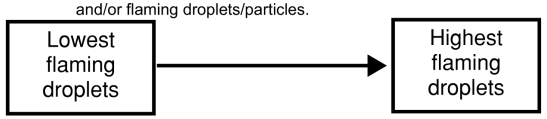
14.1 Construction products, excluding floorings and linear pipe thermal insulation products

The following classes for construction products, excluding floorings and linear pipe thermal insulation products are covered by this European Standard:

A1		
A2-s1, d0	A2-s1, d1	A2-s1, d2
A2-s2, d0	A2-s2, d1	A2-s2, d2
A2-s3, d0	A2-s3, d1	A2-s3, d2
B-s1, d0	B-s1, d1	B-s1, d2
B-s2, d0	B-s2, d1	B-s2, d2
B-s3, d0	B-s3, d1	B-s3, d2
C-s1, d0	C-s1, d1	C-s1, d2
C-s2, d0	C-s2, d1	C-s2, d2
C-s3, d0	C-s3, d1	C-s3, d2
D-s1, d0	D-s1, d1	D-s1, d2
D-s2, d0	D-s2, d1	D-s2, d2
D-s3, d0	D-s3, d1	D-s3, d2
E		
E-d2		
F		



NOTE When a classification includes s3 and/or d2, this means that there is no limit set for smoke production and/or flaming droplets/particles.



Smoke production and flaming droplets/ particles limits

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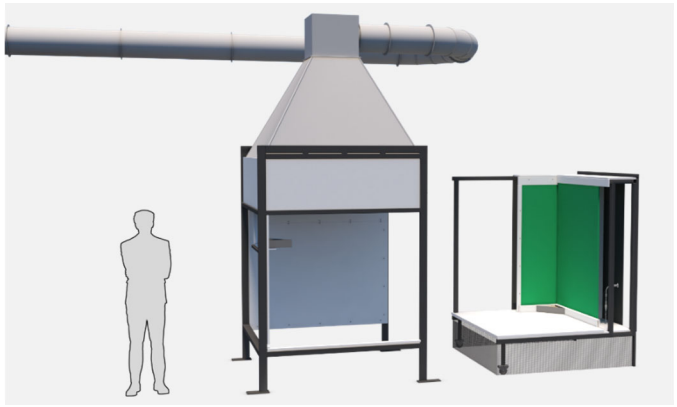
For homogeneous products and substantial components of non-homogeneous products

[b] **s1** = SMOGRA ≤ 30 m^2/s^2 and TSP_{600s} ≤ 50 m^2 in EN 13823
s2 = SMOGRA ≤ 180 m^2/s^2 and TSP_{600s} ≤ 200 m^2/s^2 in EN 13823
s3 = not s1 or s2

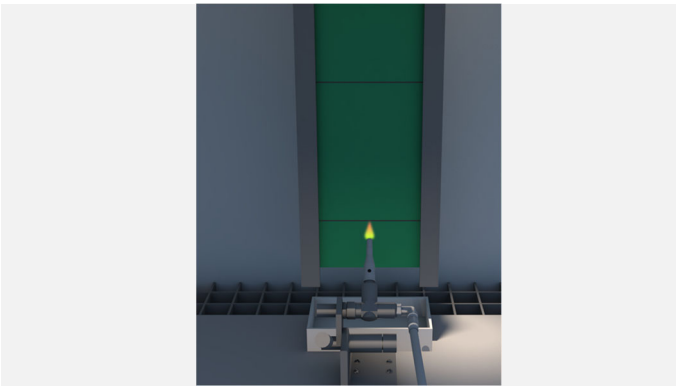
[c] **d0** = No flaming droplets / particles persisting longer than 10 s in EN 13823 within 600 s
d1 = No flaming droplets / particles persisting longer than 10 s in EN 13823 within 600 s
d2 = If no performance declared, or if the product does not comply with d0 or d1 or ignite the paper in ignitability 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:



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European classification – Field of application

European Classification - Field of application of classification

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15 Field of application of the classification

[A1] The field of application of the classification is identical to the field of application resulting from the test(s) and/or from the extended application process. [A1] If different end use applications are envisaged for a particular product, this may result in different classifications.

In considering substrates and backings which can be applied in practice, EN 13238 specifies standard substrates for use in tests and also gives rules for the field of application of test results obtained using these standard substrates. Use of these substrates is not mandatory. The product may also be applied in end use condition or with a non-standard substrate representative of end use.

The applicability of test results using standard substrates given in EN 13238 is included in that standard.

Where non-standard substrates are used, the test result is limited to that same substrate in its end use application.

The applicability of test results obtained for products attached to a substrate is limited to the method of attachment used in the test. If generic adhesives are used, the results apply for all adhesives of the same type, applied in similar quantities. 'Generic' refers to adhesives giving the same or higher reaction to fire classification to the product in question, as that tested. Subject to the above, 'generic' may also apply to adhesives of a defined type (e.g. polyvinylpyrolidone, polyvinylacetate). If specific adhesives are used, the results apply only for the specific adhesives.

The reaction to fire classification may be valid for products within the same family, where family is defined as a range of products within defined limits of variability of its parameters, e.g. thickness, density, end use application, [A1] for which the reaction to fire classification is proven to be unchanged , or for which the field of application is extended in an extended application report [A1].

NOTE Rules for direct and extended application are given in CEN/TS 15117.

European Classification – Field of application

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Riveted Reynobond PE

Cassette Reynobond PE

European Classification – Field of application

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Classification : B – s2, d0

4.3 Field of application

This classification is valid for the following product parameters :

- For a thickness of 4 mm.
- Only for the system riveted on any metallic substructure.

This classification is valid for the following end use conditions :

- On any A1 or A2 substrate with a density ≥ 700 kg/m^3.
- With a minimum air gap of 50 mm.

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The European Classes as cited in Approved Document B

Non-combustible European Class

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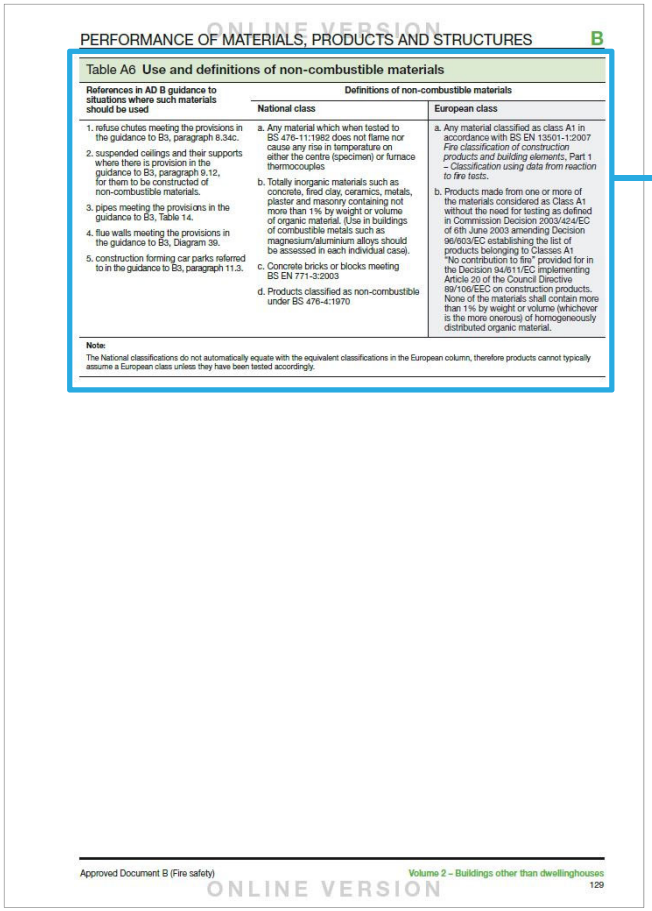

Table A6 **Use and definitions of non-combustible materials**

References in AD B guidance to situations where such materials should be used	Definitions of non-combustible materials	
	National class	European class
1. refuse chutes meeting the provisions in the guidance to B3, paragraph 8.34c.	a. Any material which when tested to BS 476-11:1982 does not flame nor cause any rise in temperature on either the centre (specimen) or furnace thermocouples	a. Any material classified as class A1 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*.
2. suspended ceilings and their supports where there is provision in the guidance to B3, paragraph 9.12, for them to be constructed of non-combustible materials.	b. Totally inorganic materials such as concrete, fired clay, ceramics, metals, plaster and masonry containing not more than 1% by weight or volume of organic material. (Use in buildings of combustible metals such as magnesium/aluminium alloys should be assessed in each individual case).	b. Products made from one or more of the materials considered as Class A1 without the need for testing as defined in Commission Decision 2003/424/EC of 6th June 2003 amending Decision 96/603/EC establishing the list of products belonging to Classes A1 "No contribution to fire" provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on construction products. None of the materials shall contain more than 1% by weight or volume (whichever is the more onerous) of homogeneously distributed organic material.
3. pipes meeting the provisions in the guidance to B3, Table 14.		
4. flue walls meeting the provisions in the guidance to B3, Diagram 39.		
5. construction forming car parks referred to in the guidance to B3, paragraph 11.3.	c. Concrete bricks or blocks meeting BS EN 771-3:2003	
	d. Products classified as non-combustible under BS 476-4:1970	

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.

Table A6 **Use and definitions of non-combustible materials**

References in AD B guidance to situations where such materials should be used	Definitions of non-combustible materials	
	National class	European class
1. refuse chutes meeting the provisions in the guidance to B3, paragraph 8.34c.	a. Any material which when tested to BS 476-11:1982 does not flame nor cause any rise in temperature on either the centre (specimen) or furnace thermocouples	a. Any material classified as class A1 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*.
2. suspended ceilings and their supports where there is provision in the guidance to B3, paragraph 9.12, for them to be constructed of non-combustible materials.	b. Totally inorganic materials such as concrete, fired clay, ceramics, metals, plaster and masonry containing not more than 1% by weight or volume of organic material. (Use in buildings of combustible metals such as magnesium/aluminium alloys should be assessed in each individual case).	b. Products made from one or more of the materials considered as Class A1 without the need for testing as defined in Commission Decision 2003/424/EC of 6th June 2003 amending Decision 96/603/EC establishing the list of products belonging to Classes A1 "No contribution to fire" provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on construction products. None of the materials shall contain more than 1% by weight or volume (whichever is the more onerous) of homogeneously distributed organic material.
3. pipes meeting the provisions in the guidance to B3, Table 14.		
4. flue walls meeting the provisions in the guidance to B3, Diagram 39.		
5. construction forming car parks referred to in the guidance to B3, paragraph 11.3.	c. Concrete bricks or blocks meeting BS EN 771-3:2003	
	d. Products classified as non-combustible under BS 476-4:1970	

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.

Limited combustibility European Class

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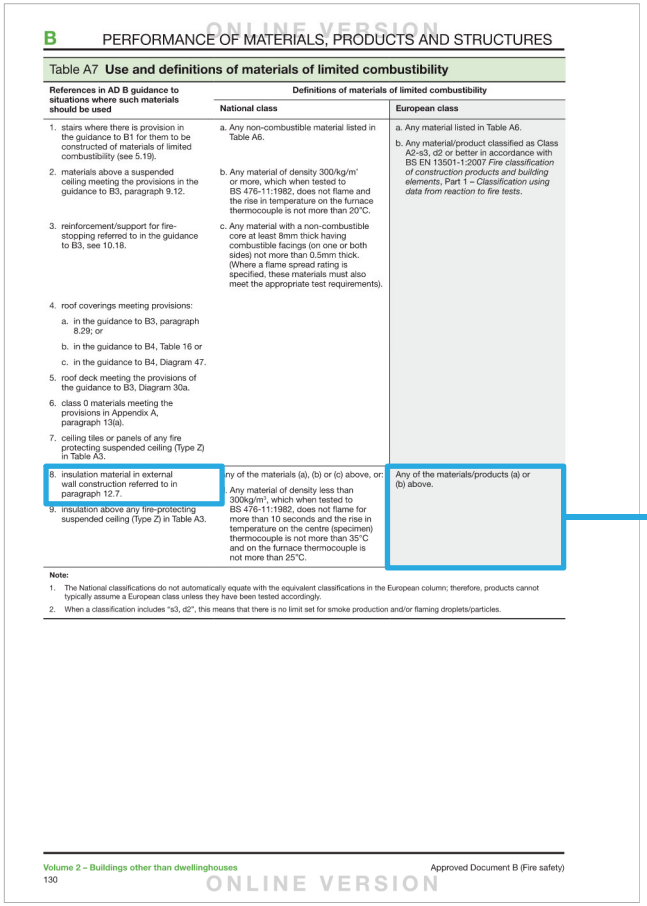

Table A7 **Use and definitions of materials of limited combustibility**

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 300/kg/m³ 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 10.18.	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.	ny of the materials (a), (b) or (c) above, or:	Any of the materials/products (a) or (b) above.
9. insulation above any fire-protecting suspended ceiling (Type Z) in Table A3.	. Any material of density less than 300kg/m³, 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.	

Note:

1. 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.
2. When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

Any of the materials/products (a) or (b) above.

European class

a. Any material listed in Table A6.

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*.

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Understanding Class 0 in the context of European reaction to fire testing

Limited combustibility as a method of demonstrating Class 0

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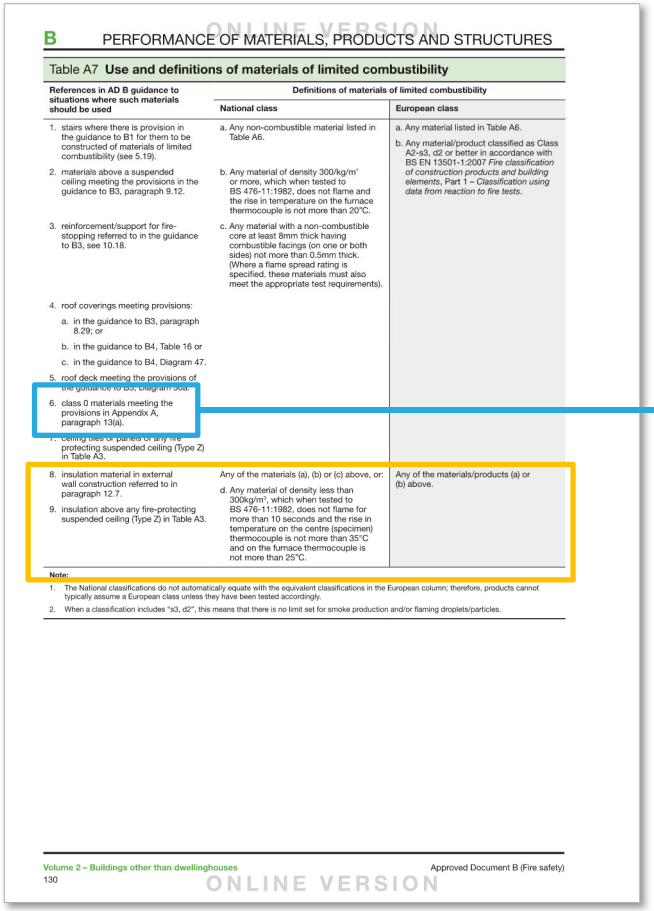

B PERFORMANCE OF MATERIALS, PRODUCTS AND STRUCTURES

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 300/kg/m³ 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 10.18.	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 50a.		
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:	Any of the materials/products (a) or (b) above.
9. insulation above any fire-protecting suspended ceiling (Type Z) in Table A3.	d. Any material of density less than 300kg/m³, 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.	

Note:
1. 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.
2. 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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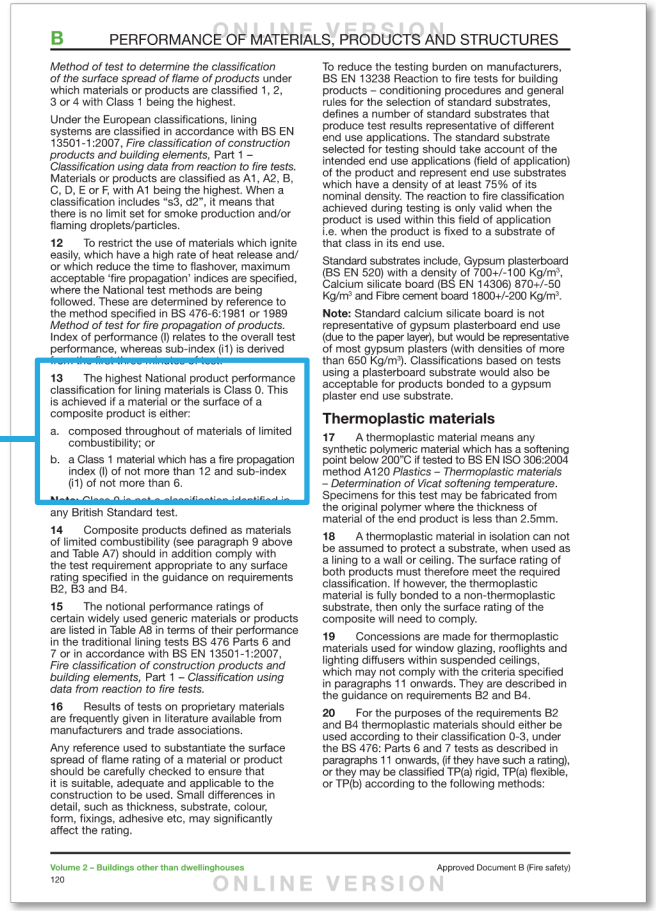
6. class 0 materials meeting the provisions in Appendix A, paragraph 13(a).

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.



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 first three minutes 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:

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Using the European Classes when reading Diagram 40 the Provisions for external surfaces or walls

Approved Document B – Diagram 40

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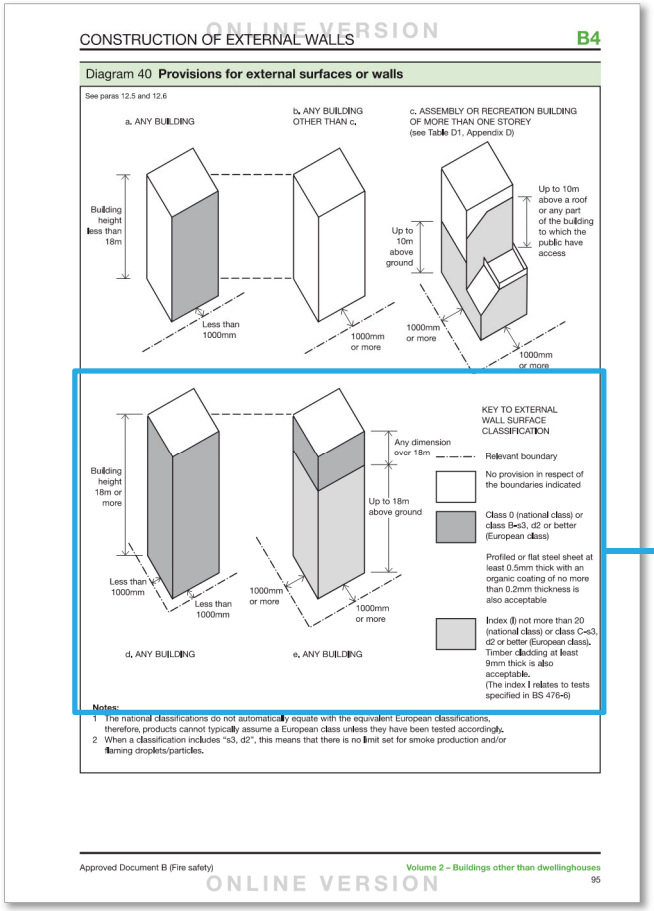

CONSTRUCTION OF EXTERNAL WALLS B4

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

Less than 1000mm

1000mm or more

Up to 10m above ground

Up to 10m above a roof or any part of the building to which the public have access

1000mm or more

1000mm or more

Building height 18m or more

Less than 1000mm

Less than 1000mm

1000mm or more

1000mm or more

Any dimension over 18m

Up to 18m above ground

KEY TO EXTERNAL WALL SURFACE CLASSIFICATION

Relevant boundary

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)

d. ANY BUILDING

e. ANY BUILDING

Notes:

1 The national classifications do not automatically equate 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.

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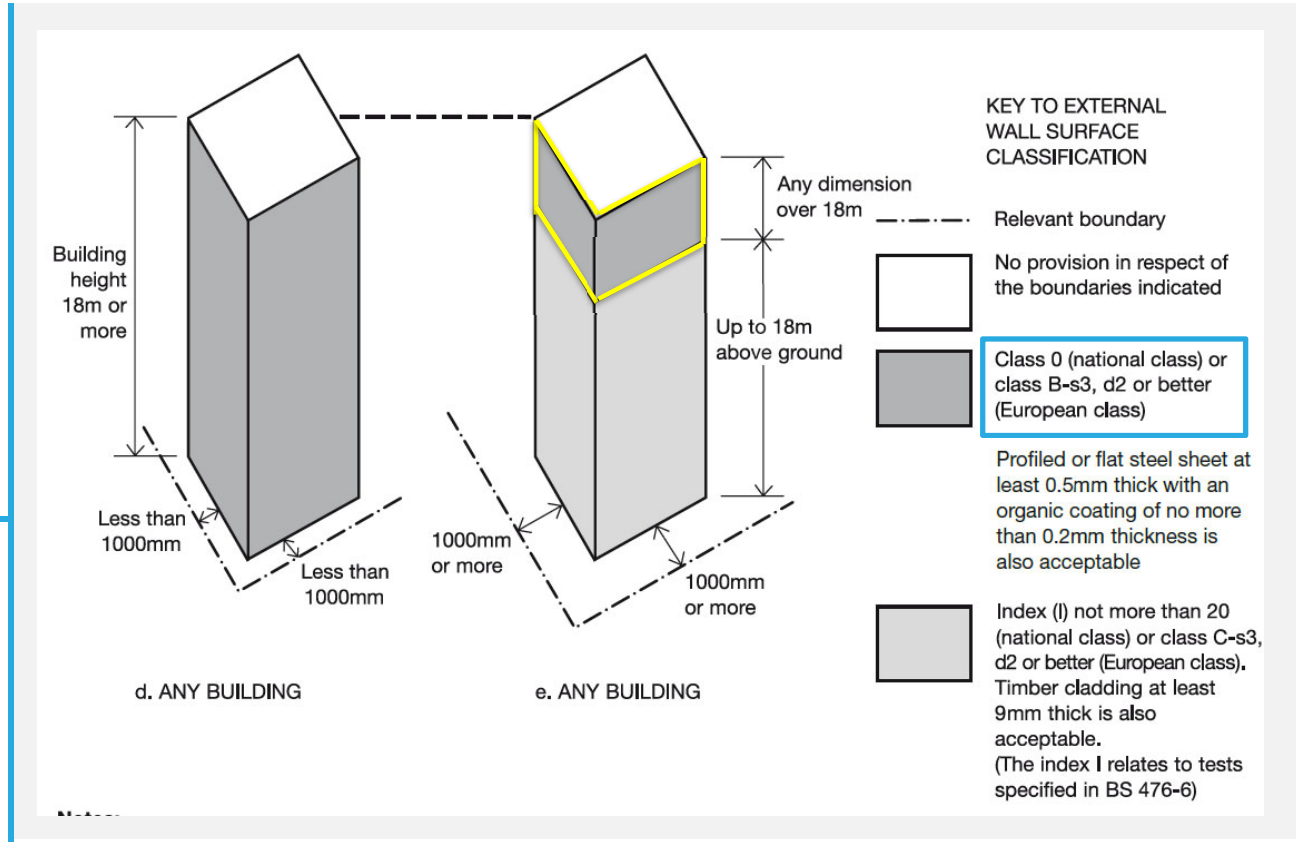

Comparison of National and European Classes for external surfaces

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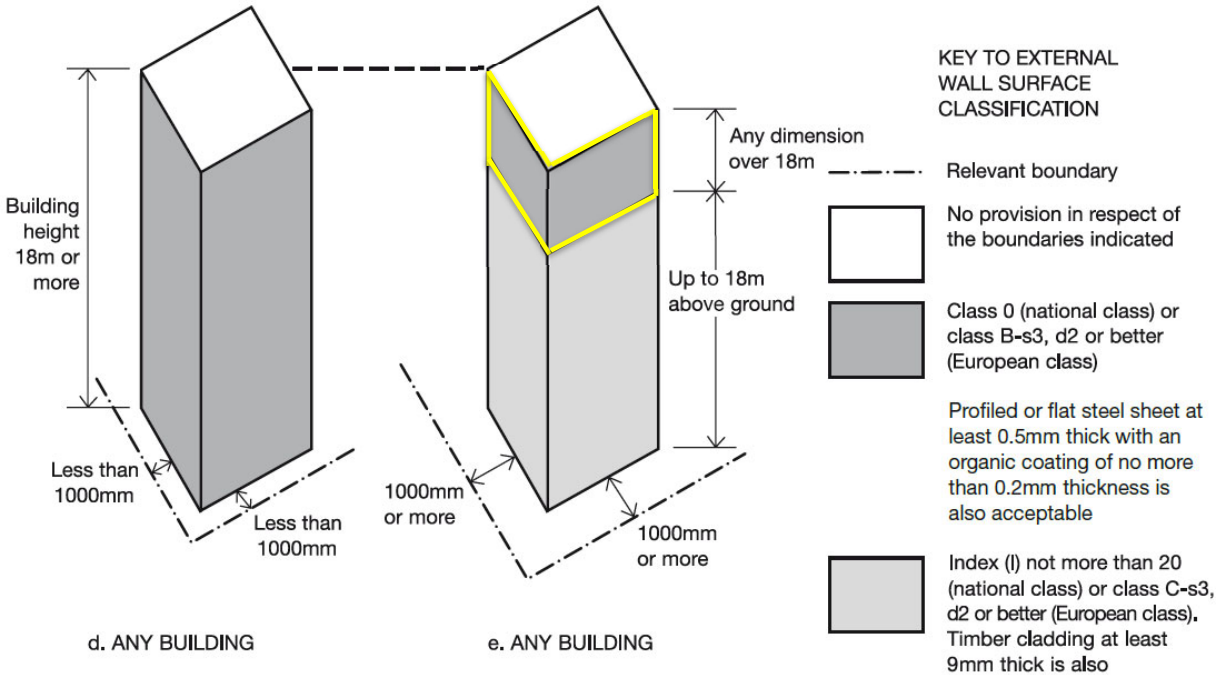

13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

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.

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Classification limits for European classifications referenced by ADB

European classification – A2

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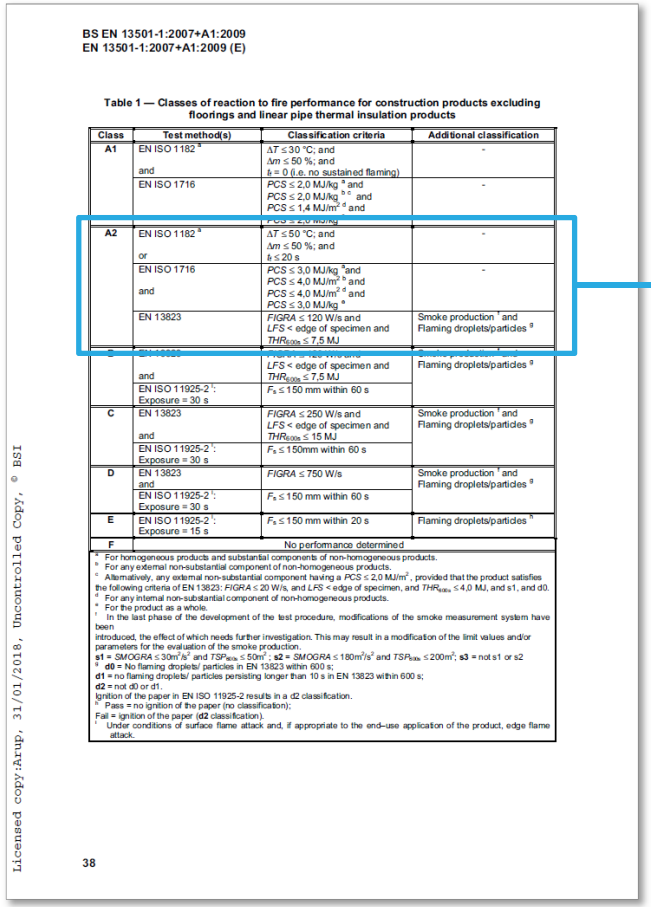

BS EN 13501-1:2007+A1:2009
EN 13501-1:2007+A1:2009 (E)

Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 [a] and EN ISO 1716	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f = 0$ (i.e. no sustained flaming) / $PCS \leq 2,0$ MJ/kg [a] and $PCS \leq 2,0$ MJ/kg [b, c] and $PCS \leq 1,4$ MJ/m² [c, d] and $PCS \leq 2,0$ MJ/kg	-
A2	EN ISO 1182 [a] or EN ISO 1716 and	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s / $PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m² [b] and $PCS \leq 4,0$ MJ/m² [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
B	EN ISO 1182 [a] or EN ISO 1716 and	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s / $PCS \leq 4,0$ MJ/kg [a] and $PCS \leq 5,0$ MJ/m² [b] and $PCS \leq 4,0$ MJ/m² [d] and $PCS \leq 4,0$ MJ/kg [e]	-
	EN 13823 and EN ISO 11925-2 [f]: Exposure = 30 s	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ / $F_s \leq 150$ mm within 60 s	Smoke production [f] and Flaming droplets/particles [g]
C	EN 13823 and EN ISO 11925-2 [f]: Exposure = 30 s	$FIGRA \leq 250$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 15$ MJ / $F_s \leq 150$mm within 60 s	Smoke production [f] and Flaming droplets/particles [g]
D	EN 13823 and EN ISO 11925-2 [f]: Exposure = 30 s	$FIGRA \leq 750$ W/s / $F_s \leq 150$ mm within 60 s	Smoke production [f] and Flaming droplets/particles [g]
E	EN ISO 11925-2 [f]: Exposure = 15 s	$F_s \leq 150$ mm within 20 s	Flaming droplets/particles [h]
F	No performance determined		

[a] For homogeneous products and substantial components of non-homogeneous products.
[b] For any external non-substantial component of non-homogeneous products.
[c] Alternatively, any external non-substantial component having a $PCS \leq 2,0$ MJ/m², provided that the product satisfies the following criteria of EN 13823: $FIGRA \leq 20$ W/s, and $LFS <$ edge of specimen, and $THR_{600s} \leq 4,0$ MJ, and s1, and d0.
[d] For any internal non-substantial component of non-homogeneous products.
[e] For the product as a whole.
[f] In the last phase of the development of the test procedure, modifications of the smoke measurement system have been introduced, the effect of which needs further investigation. This may result in a modification of the limit values and/or parameters for the evaluation of the smoke production.
s1 = $SMOGRA \leq 30$ m²/s² and $TSP_{600s} \leq 50$ m²; **s2** = $SMOGRA \leq 180$ m²/s² and $TSP_{600s} \leq 200$ m²; **s3** = not s1 or s2
[g] **d0** = No flaming droplets/ particles in EN 13823 within 600 s;
d1 = no flaming droplets/ particles persisting longer than 10 s in EN 13823 within 600 s;
d2 = not d0 or d1.
Ignition of the paper in EN ISO 11925-2 results in a d2 classification.
[h] Pass = no ignition of the paper (no classification);
Fail = ignition of the paper (**d2** classification).
[i] Under conditions of surface flame attack and, if appropriate to the end–use application of the product, edge flame attack.

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A2	EN ISO 1182 [a] or	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	EN ISO 1716 and	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m² [b] and $PCS \leq 4,0$ MJ/m² [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]

European classification – A2

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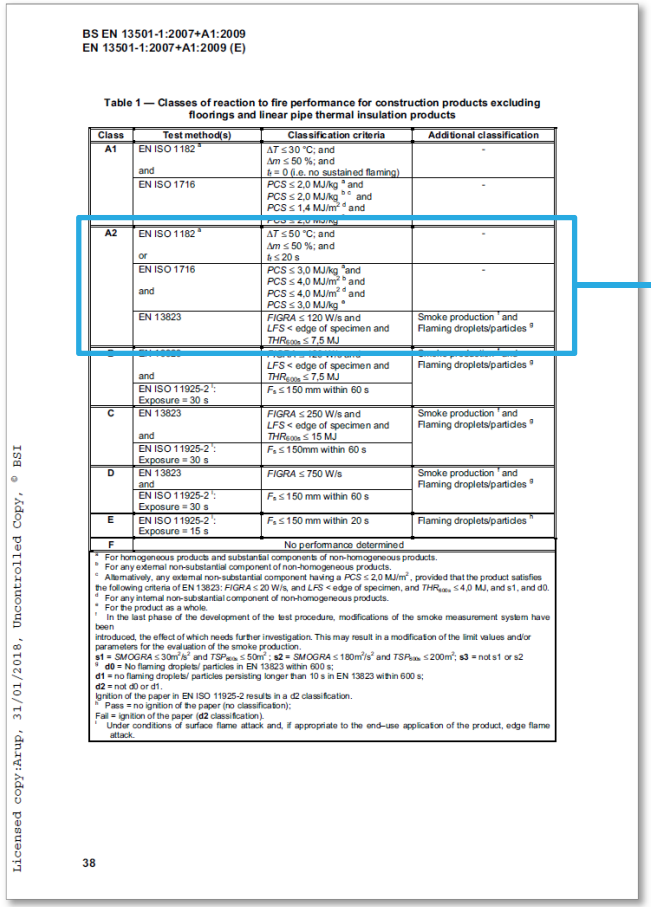

BS EN 13501-1:2007+A1:2009
EN 13501-1:2007+A1:2009 (E)

Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 [a]	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f = 0$ (i.e. no sustained flaming)	-
	and		
	EN ISO 1716	$PCS \leq 2,0$ MJ/kg [a] and $PCS \leq 2,0$ MJ/kg [b c] and $PCS \leq 1,4$ MJ/m^2 [c d] and $PCS \leq 2,0$ MJ/kg	-
A2	EN ISO 1182 [a]	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	or		
	EN ISO 1716	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m^2 [b] and $PCS \leq 4,0$ MJ/m^2 [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	and		
	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
B	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [f]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
C	EN 13823	$FIGRA \leq 250$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 15$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [f]: Exposure = 30 s	$F_s \leq 150$mm within 60 s	
D	EN 13823	$FIGRA \leq 750$ W/s	Smoke production [f] and Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [f]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
E	EN ISO 11925-2 [f]: Exposure = 15 s	$F_s \leq 150$ mm within 20 s	Flaming droplets/particles [g]
F	No performance determined		

[a] For homogeneous products and substantial components of non-homogeneous products.
[b] For any external non-substantial component of non-homogeneous products.
[c] Alternatively, any external non-substantial component having a $PCS \leq 2,0$ MJ/m^2, provided that the product satisfies the following criteria of EN 13823: $FIGRA \leq 20$ W/s, and $LFS <$ edge of specimen, and $THR_{600s} \leq 4,0$ MJ, and s1, and d0.
[d] For any internal non-substantial component of non-homogeneous products.
[e] For the product as a whole.
[f] In the last phase of the development of the test procedure, modifications of the smoke measurement system have been introduced, the effect of which needs further investigation. This may result in a modification of the limit values and/or parameters for the evaluation of the smoke production.
[g] **s1** = $SMOGRA \leq 30$ m^2/s^2 and $TSP_{600s} \leq 50$ m^2; **s2** = $SMOGRA \leq 180$ m^2/s^2 and $TSP_{600s} \leq 200$ m^2; **s3** = not s1 or s2
d0 = No flaming droplets/ particles in EN 13823 within 600 s;
d1 = no flaming droplets/ particles persisting longer than 10 s in EN 13823 within 600 s;
d2 = not d0 or d1.
Ignition of the paper in EN ISO 11925-2 results in a d2 classification.
[h] Pass = no ignition of the paper (no classification);
Fail = ignition of the paper (**d2** classification).
[i] Under conditions of surface flame attack and, if appropriate to the end–use application of the product, edge flame attack.

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A2	EN ISO 1182 [a]	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	or		
	EN ISO 1716	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m^2 [b] and $PCS \leq 4,0$ MJ/m^2 [d] and $PCS \leq 3,0$ MJ/kg [e]	-
	and		
	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]

European classification – B

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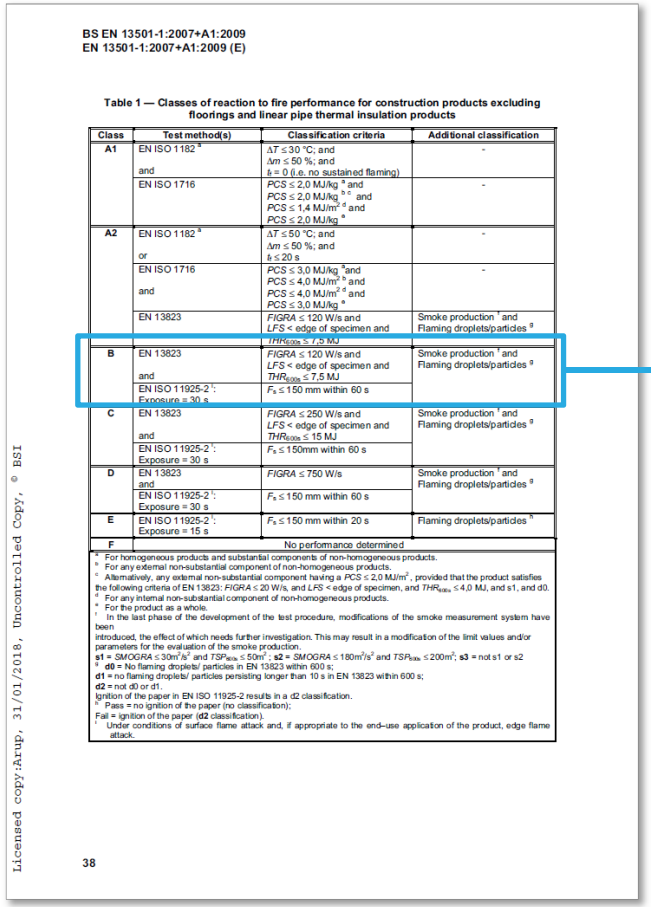

BS EN 13501-1:2007+A1:2009
EN 13501-1:2007+A1:2009 (E)

Table 1 — Classes of reaction to fire performance for construction products excluding floorings and linear pipe thermal insulation products

Class	Test method(s)	Classification criteria	Additional classification
A1	EN ISO 1182 [a]	$\Delta T \leq 30$ °C; and $\Delta m \leq 50$ %; and $t_f = 0$ (i.e. no sustained flaming)	-
	and		
	EN ISO 1716	$PCS \leq 2,0$ MJ/kg [a] and $PCS \leq 2,0$ MJ/kg [b c] and $PCS \leq 1,4$ MJ/m^2 [c d] and $PCS \leq 2,0$ MJ/kg [a]	-
A2	EN ISO 1182 [a]	$\Delta T \leq 50$ °C; and $\Delta m \leq 50$ %; and $t_f \leq 20$ s	-
	or		
	EN ISO 1716	$PCS \leq 3,0$ MJ/kg [a] and $PCS \leq 4,0$ MJ/m^2 [b] and $PCS \leq 4,0$ MJ/m^2 [c d] and $PCS \leq 3,0$ MJ/kg [a]	-
	and		
	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
B	EN 13823	$FIGRA \leq 120$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [l]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
C	EN 13823	$FIGRA \leq 250$ W/s and $LFS <$ edge of specimen and $THR_{600s} \leq 15$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [l]: Exposure = 30 s	$F_s \leq 150$mm within 60 s	
D	EN 13823	$FIGRA \leq 750$ W/s	Smoke production [f] and Flaming droplets/particles [g]
	and		
	EN ISO 11925-2 [l]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	
E	EN ISO 11925-2 [l]: Exposure = 15 s	$F_s \leq 150$ mm within 20 s	Flaming droplets/particles [h]
F	No performance determined		

[a] For homogeneous products and substantial components of non-homogeneous products.
[b] For any external non-substantial component of non-homogeneous products.
[c] Alternatively, any external non-substantial component having a $PCS \leq 2,0$ MJ/m^2, provided that the product satisfies the following criteria of EN 13823: $FIGRA \leq 20$ W/s, and $LFS <$ edge of specimen, and $THR_{600s} \leq 4,0$ MJ, and s1, and d0.
[d] For any internal non-substantial component of non-homogeneous products.
[e] For the product as a whole.
[f] In the last phase of the development of the test procedure, modifications of the smoke measurement system have been introduced, the effect of which needs further investigation. This may result in a modification of the limit values and/or parameters for the evaluation of the smoke production.
s1 = $SMOGRA \leq 30$ m^2/s^2 and $TSP_{600s} \leq 50$ m^2; **s2** = $SMOGRA \leq 180$ m^2/s^2 and $TSP_{600s} \leq 200$ m^2; **s3** = not s1 or s2
[g] **d0** = No flaming droplets/ particles in EN 13823 within 600 s;
d1 = no flaming droplets/ particles persisting longer than 10 s in EN 13823 within 600 s;
d2 = not d0 or d1.
Ignition of the paper in EN ISO 11925-2 results in a d2 classification.
[h] Pass = no ignition of the paper (no classification);
Fail = ignition of the paper (**d2** classification).
[i] Under conditions of surface flame attack and, if appropriate to the end–use application of the product, edge flame attack.

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B	EN 13823 and	*FIGRA* ≤ 120 W/s and *LFS* < edge of specimen and $THR_{600s} \leq 7,5$ MJ	Smoke production [f] and Flaming droplets/particles [g]
	EN ISO 11925-2 [l]: Exposure = 30 s	$F_s \leq 150$ mm within 60 s	

Summary of All European Classification

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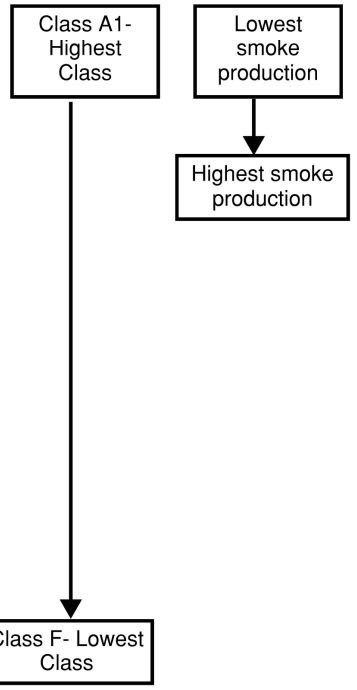
14 Presentation of classification

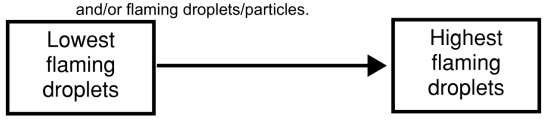
14.1 Construction products, excluding floorings and linear pipe thermal insulation products

The following classes for construction products, excluding floorings and linear pipe thermal insulation products are covered by this European Standard:

A1		
A2-s1, d0	A2-s1, d1	A2-s1, d2
A2-s2, d0	A2-s2, d1	A2-s2, d2
A2-s3, d0	A2-s3, d1	A2-s3, d2
B-s1, d0	B-s1, d1	B-s1, d2
B-s2, d0	B-s2, d1	B-s2, d2
B-s3, d0	B-s3, d1	B-s3, d2
C-s1, d0	C-s1, d1	C-s1, d2
C-s2, d0	C-s2, d1	C-s2, d2
C-s3, d0	C-s3, d1	C-s3, d2
D-s1, d0	D-s1, d1	D-s1, d2
D-s2, d0	D-s2, d1	D-s2, d2
D-s3, d0	D-s3, d1	D-s3, d2
E		
E-d2		
F		



NOTE When a classification includes s3 and/or d2, this means that there is no limit set for smoke production and/or flaming droplets/particles.



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Studies on equivalence of European and National classifications

RADAR report 2000

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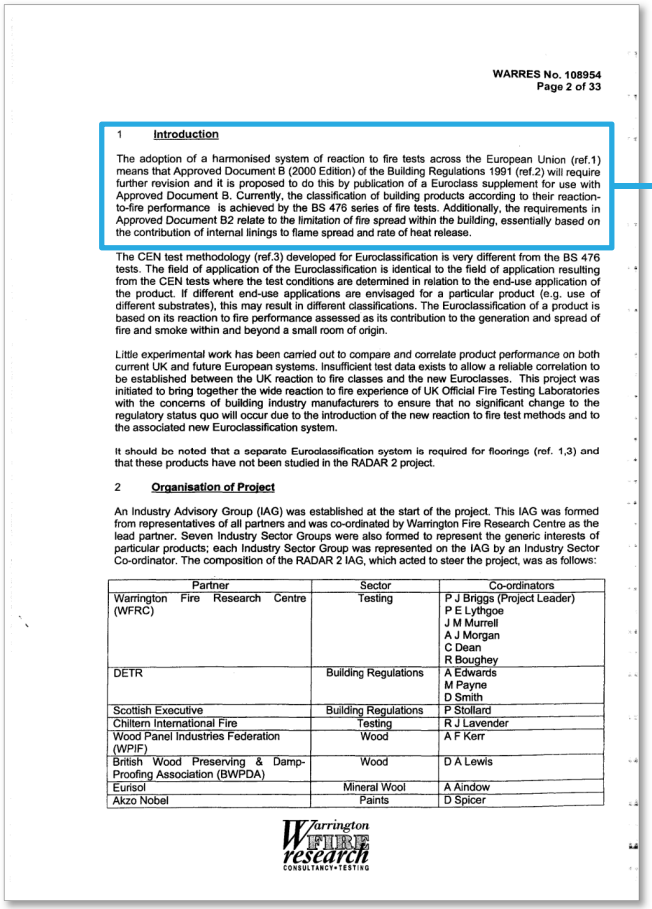

1 **Introduction**

The adoption of a harmonised system of reaction to fire tests across the European Union (ref.1) means that Approved Document B (2000 Edition) of the Building Regulations 1991 (ref.2) will require further revision and it is proposed to do this by publication of a Euroclass supplement for use with Approved Document B. Currently, the classification of building products according to their reaction-to-fire performance is achieved by the BS 476 series of fire tests. Additionally, the requirements in Approved Document B2 relate to the limitation of fire spread within the building, essentially based on the contribution of internal linings to flame spread and rate of heat release.

The CEN test methodology (ref.3) developed for Euroclassification is very different from the BS 476 tests. The field of application of the Euroclassification is identical to the field of application resulting from the CEN tests where the test conditions are determined in relation to the end-use application of the product. If different end-use applications are envisaged for a particular product (e.g. use of different substrates), this may result in different classifications. The Euroclassification of a product is based on its reaction to fire performance assessed as its contribution to the generation and spread of fire and smoke within and beyond a small room of origin.

Little experimental work has been carried out to compare and correlate product performance on both current UK and future European systems. Insufficient test data exists to allow a reliable correlation to be established between the UK reaction to fire classes and the new Euroclasses. This project was initiated to bring together the wide reaction to fire experience of UK Official Fire Testing Laboratories with the concerns of building industry manufacturers to ensure that no significant change to the regulatory status quo will occur due to the introduction of the new reaction to fire test methods and to the associated new Euroclassification system.

It should be noted that a separate Euroclassification system is required for floorings (ref. 1,3) and that these products have not been studied in the RADAR 2 project.

2 **Organisation of Project**

An Industry Advisory Group (IAG) was established at the start of the project. This IAG was formed from representatives of all partners and was co-ordinated by Warrington Fire Research Centre as the lead partner. Seven Industry Sector Groups were also formed to represent the generic interests of particular products; each Industry Sector Group was represented on the IAG by an Industry Sector Co-ordinator. The composition of the RADAR 2 IAG, which acted to steer the project, was as follows:

Partner	Sector	Co-ordinators
Warrington Fire Research Centre (WFRC)	Testing	P J Briggs (Project Leader) P E Lythgoe J M Murrell A J Morgan C Dean R Boughey
DETR	Building Regulations	A Edwards M Payne D Smith
Scottish Executive	Building Regulations	P Stollard
Chiltern International Fire	Testing	R J Lavender
Wood Panel Industries Federation (WPIF)	Wood	A F Kerr
British Wood Preserving & Damp-Proofing Association (BWPDA)	Wood	D A Lewis
Eurisol	Mineral Wool	A Aindow
Akzo Nobel	Paints	D Spicer

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Class 0 Equivalence– RADAR report 2000

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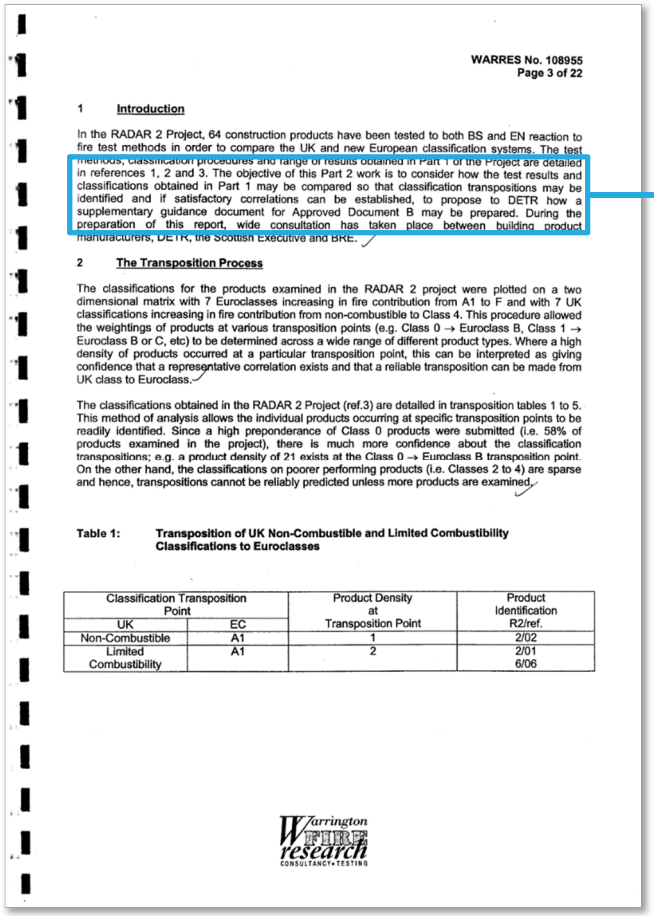

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1 Introduction

In the RADAR 2 Project, 64 construction products have been tested to both BS and EN reaction to fire test methods in order to compare the UK and new European classification systems. The test methods, classification procedures and range of results obtained in Part 1 of the Project are detailed in references 1, 2 and 3. The objective of this Part 2 work is to consider how the test results and classifications obtained in Part 1 may be compared so that classification transpositions may be identified and if satisfactory correlations can be established, to propose to DETR how a supplementary guidance document for Approved Document B may be prepared. During the preparation of this report, wide consultation has taken place between building product manufacturers, DETR, the Scottish Executive and BRE.

2 The Transposition Process

The classifications for the products examined in the RADAR 2 project were plotted on a two dimensional matrix with 7 Euroclasses increasing in fire contribution from A1 to F and with 7 UK classifications increasing in fire contribution from non-combustible to Class 4. This procedure allowed the weightings of products at various transposition points (e.g. Class 0 → Euroclass B, Class 1 → Euroclass B or C, etc) to be determined across a wide range of different product types. Where a high density of products occurred at a particular transposition point, this can be interpreted as giving confidence that a representative correlation exists and that a reliable transposition can be made from UK class to Euroclass.

The classifications obtained in the RADAR 2 Project (ref.3) are detailed in transposition tables 1 to 5. This method of analysis allows the individual products occurring at specific transposition points to be readily identified. Since a high preponderance of Class 0 products were submitted (i.e. 58% of products examined in the project), there is much more confidence about the classification transpositions; e.g. a product density of 21 exists at the Class 0 → Euroclass B transposition point. On the other hand, the classifications on poorer performing products (i.e. Classes 2 to 4) are sparse and hence, transpositions cannot be reliably predicted unless more products are examined.

Table 1: Transposition of UK Non-Combustible and Limited Combustibility Classifications to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
Non-Combustible	A1	1	2/02
Limited Combustibility	A1	2	2/01 6/06

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"The objective of this Part 2 work is to consider how the test results and classifications obtained in Part 1 may be compared so that classification transpositions may be identified and if satisfactory correlations can be established, to propose to DETR how a supplementary guidance document for Approved Document B may be prepared. "

Class 0 Equivalence– RADAR report 2000

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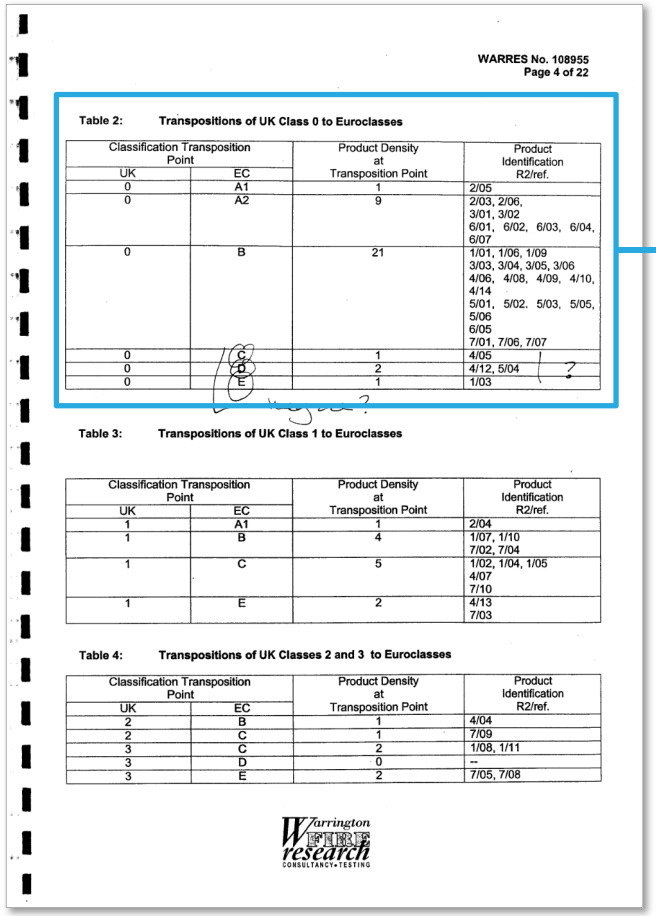

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Table 2: Transpositions of UK Class 0 to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
0	A1	1	2/05
0	A2	9	2/03, 2/06, 3/01, 3/02 6/01, 6/02, 6/03, 6/04, 6/07
0	B	21	1/01, 1/06, 1/09 3/03, 3/04, 3/05, 3/06 4/06, 4/08, 4/09, 4/10, 4/14 5/01, 5/02. 5/03, 5/05, 5/06 6/05 7/01, 7/06, 7/07
0	C	1	4/05
0	D	2	4/12, 5/04
0	E	1	1/03

Table 3: Transpositions of UK Class 1 to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
1	A1	1	2/04
1	B	4	1/07, 1/10 7/02, 7/04
1	C	5	1/02, 1/04, 1/05 4/07 7/10
1	E	2	4/13 7/03

Table 4: Transpositions of UK Classes 2 and 3 to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
2	B	1	4/04
2	C	1	7/09
3	C	2	1/08, 1/11
3	D	0	--
3	E	2	7/05, 7/08

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Table 2: Transpositions of UK Class 0 to Euroclasses

Classification Transposition Point		Product Density at Transposition Point	Product Identification R2/ref.
UK	EC		
0	A1	1	2/05
0	A2	9	2/03, 2/06, 3/01, 3/02 6/01, 6/02, 6/03, 6/04, 6/07
0	B	21	1/01, 1/06, 1/09 3/03, 3/04, 3/05, 3/06 4/06, 4/08, 4/09, 4/10, 4/14 5/01, 5/02. 5/03, 5/05, 5/06 6/05 7/01, 7/06, 7/07
0	C	1	4/05
0	D	2	4/12, 5/04
0	E	1	1/03

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Class 0 Equivalence– RADAR report 2000

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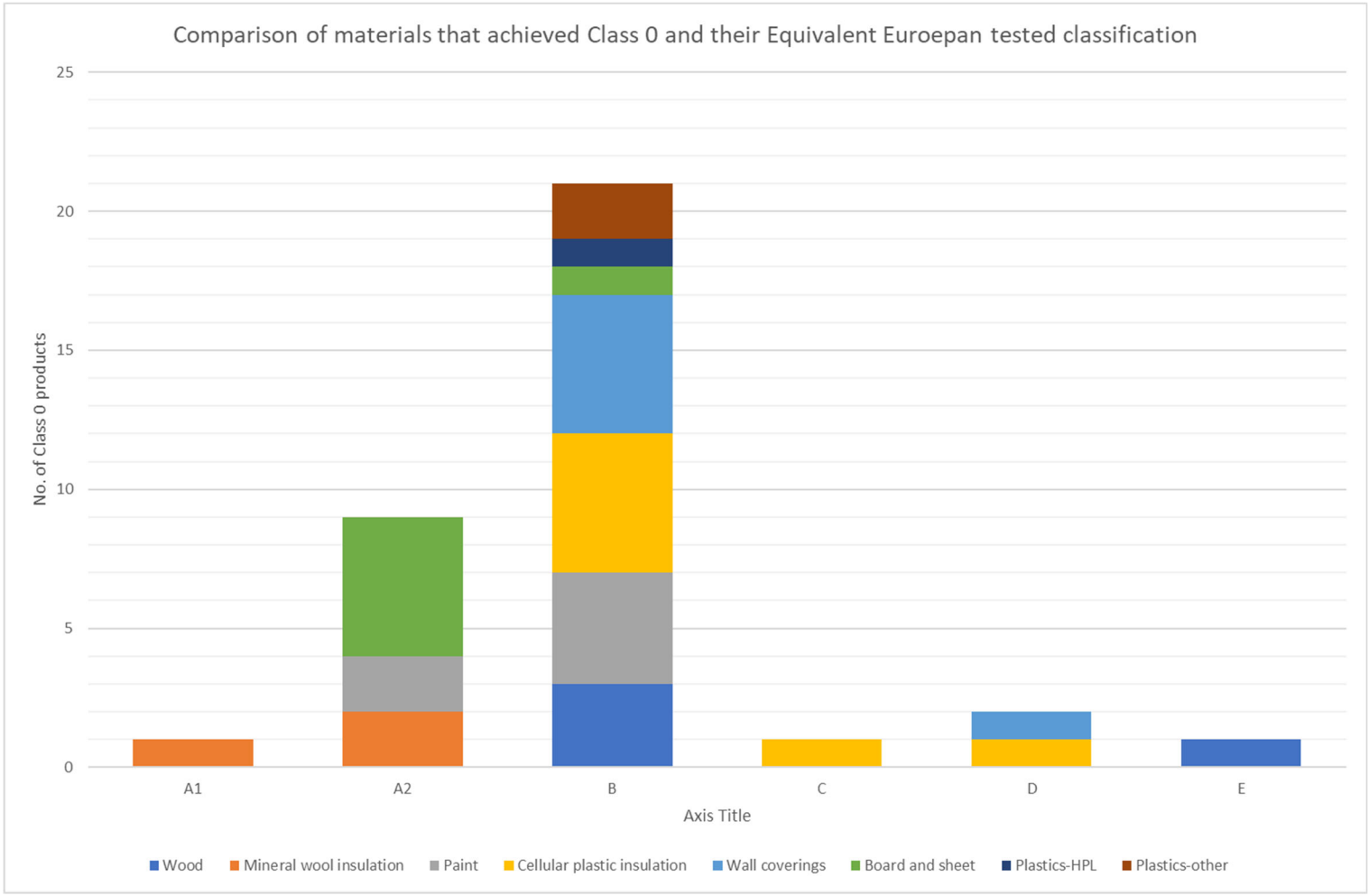

Class 0 Equivalence– RADAR report 2000

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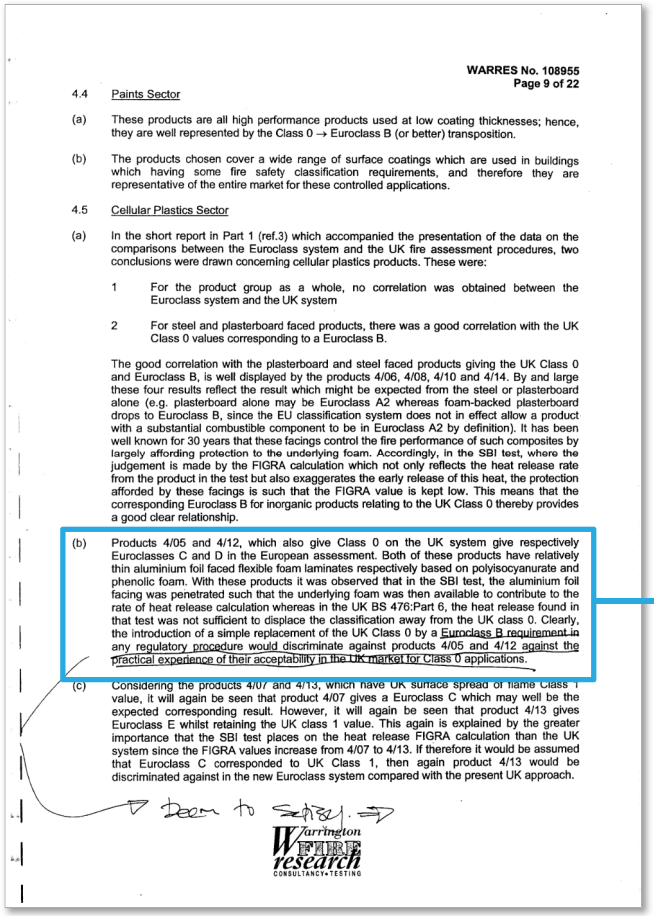

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4.4 Paints Sector

(a) These products are all high performance products used at low coating thicknesses; hence, they are well represented by the Class 0 → Euroclass B (or better) transposition.

(b) The products chosen cover a wide range of surface coatings which are used in buildings which having some fire safety classification requirements, and therefore they are representative of the entire market for these controlled applications.

4.5 Cellular Plastics Sector

(a) In the short report in Part 1 (ref.3) which accompanied the presentation of the data on the comparisons between the Euroclass system and the UK fire assessment procedures, two conclusions were drawn concerning cellular plastics products. These were:

1 For the product group as a whole, no correlation was obtained between the Euroclass system and the UK system

2 For steel and plasterboard faced products, there was a good correlation with the UK Class 0 values corresponding to a Euroclass B.

The good correlation with the plasterboard and steel faced products giving the UK Class 0 and Euroclass B, is well displayed by the products 4/06, 4/08, 4/10 and 4/14. By and large these four results reflect the result which might be expected from the steel or plasterboard alone (e.g. plasterboard alone may be Euroclass A2 whereas foam-backed plasterboard drops to Euroclass B, since the EU classification system does not in effect allow a product with a substantial combustible component to be in Euroclass A2 by definition). It has been well known for 30 years that these facings control the fire performance of such composites by largely affording protection to the underlying foam. Accordingly, in the SBI test, where the judgement is made by the FIGRA calculation which not only reflects the heat release rate from the product in the test but also exaggerates the early release of this heat, the protection afforded by these facings is such that the FIGRA value is kept low. This means that the corresponding Euroclass B for inorganic products relating to the UK Class 0 thereby provides a good clear relationship.

(b) Products 4/05 and 4/12, which also give Class 0 on the UK system give respectively Euroclasses C and D in the European assessment. Both of these products have relatively thin aluminium foil faced flexible foam laminates respectively based on polyisocyanurate and phenolic foam. With these products it was observed that in the SBI test, the aluminium foil facing was penetrated such that the underlying foam was then available to contribute to the rate of heat release calculation whereas in the UK BS 476:Part 6, the heat release found in that test was not sufficient to displace the classification away from the UK class 0. Clearly, the introduction of a simple replacement of the UK Class 0 by a Euroclass B requirement in any regulatory procedure would discriminate against products 4/05 and 4/12 against the practical experience of their acceptability in the UK market for class 0 applications.

(c) Considering the products 4/07 and 4/13, which have UK surface spread of flame Class 1 value, it will again be seen that product 4/07 gives a Euroclass C which may well be the expected corresponding result. However, it will again be seen that product 4/13 gives Euroclass E whilst retaining the UK class 1 value. This again is explained by the greater importance that the SBI test places on the heat release FIGRA calculation than the UK system since the FIGRA values increase from 4/07 to 4/13. If therefore it would be assumed that Euroclass C corresponded to UK Class 1, then again product 4/13 would be discriminated against in the new Euroclass system compared with the present UK approach.

Warrington FIRE research CONSULTANCY • TESTING

"With these products it was observed that in the SBI test, the aluminium foil facing was penetrated such that the underlying foam was then available to contribute to the rate of heat release calculation whereas **in the UK BS 476:Part 6, the heat release found in that test was not sufficient to displace the classification away from the UK class 0**.

"Clearly, the introduction of a simple replacement of the UK Class 0 by Euroclass B requirement in any regulatory procedure would discriminate against products 4/05 and 4/12 against the practical experience of their acceptability in the UK market for class 0 applications"

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Products used at Grenfell which referred to the European classes

European Classification – BBA Agrement certificate

ARUP

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 BS 476-6 : 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(1) 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.

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Section 3:
Cladding systems and *full scale* test data

ADB 2013: Cladding systems and full scale test data

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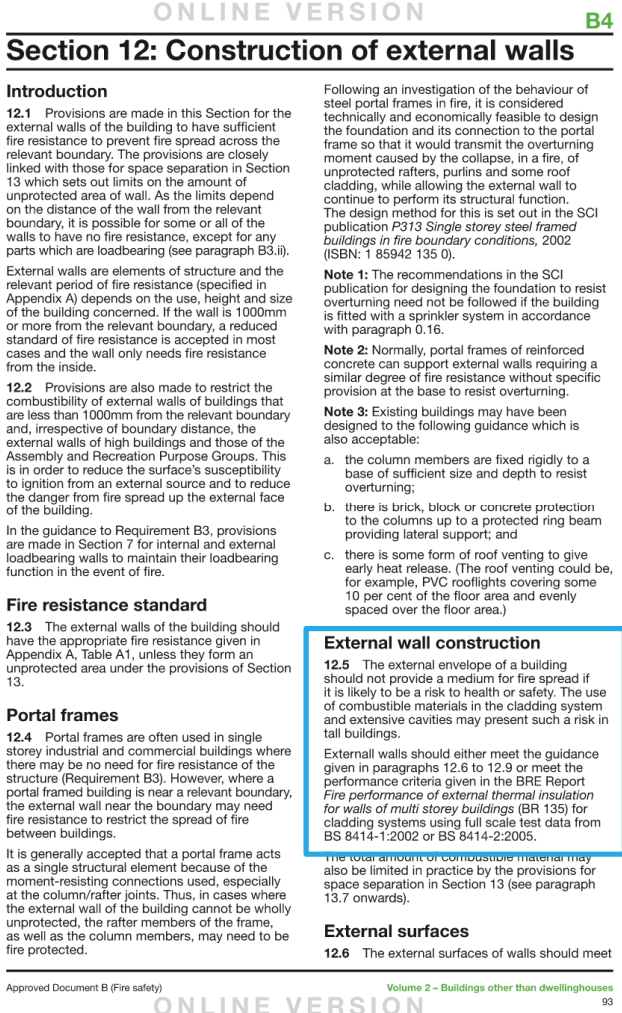

ONLINE VERSION

B4

Section 12: Construction of external walls

Introduction

12.1 Provisions are made in this Section for the external walls of the building to have sufficient fire resistance to prevent fire spread across the relevant boundary. The provisions are closely linked with those for space separation in Section 13 which sets out limits on the amount of unprotected area of wall. As the limits depend on the distance of the wall from the relevant boundary, it is possible for some or all of the walls to have no fire resistance, except for any parts which are loadbearing (see paragraph B3.ii).

External walls are elements of structure and the relevant period of fire resistance (specified in Appendix A) depends on the use, height and size of the building concerned. If the wall is 1000mm or more from the relevant boundary, a reduced standard of fire resistance is accepted in most cases and the wall only needs fire resistance from the inside.

12.2 Provisions are also made to restrict the combustibility of external walls of buildings that are less than 1000mm from the relevant boundary and, irrespective of boundary distance, the external walls of high buildings and those of the Assembly and Recreation Purpose Groups. This is in order to reduce the surface's susceptibility to ignition from an external source and to reduce the danger from fire spread up the external face of the building.

In the guidance to Requirement B3, provisions are made in Section 7 for internal and external loadbearing walls to maintain their loadbearing function in the event of fire.

Fire resistance standard

12.3 The external walls of the building should have the appropriate fire resistance given in Appendix A, Table A1, unless they form an unprotected area under the provisions of Section 13.

Portal frames

12.4 Portal frames are often used in single storey industrial and commercial buildings where there may be no need for fire resistance of the structure (Requirement B3). However, where a portal framed building is near a relevant boundary, the external wall near the boundary may need fire resistance to restrict the spread of fire between buildings.

It is generally accepted that a portal frame acts as a single structural element because of the moment-resisting connections used, especially at the column/rafter joints. Thus, in cases where the external wall of the building cannot be wholly unprotected, the rafter members of the frame, as well as the column members, may need to be fire protected.

Following an investigation of the behaviour of steel portal frames in fire, it is considered technically and economically feasible to design the foundation and its connection to the portal frame so that it would transmit the overturning moment caused by the collapse, in a fire, of unprotected rafters, purlins and some roof cladding, while allowing the external wall to continue to perform its structural function. The design method for this is set out in the SCI publication *P313 Single storey steel framed buildings in fire boundary conditions*, 2002 (ISBN: 1 85942 135 0).

Note 1: The recommendations in the SCI publication for designing the foundation to resist overturning need not be followed if the building is fitted with a sprinkler system in accordance with paragraph 0.16.

Note 2: Normally, portal frames of reinforced concrete can support external walls requiring a similar degree of fire resistance without specific provision at the base to resist overturning.

Note 3: Existing buildings may have been designed to the following guidance which is also acceptable:

a. the column members are fixed rigidly to a base of sufficient size and depth to resist overturning;

b. there is brick, block or concrete protection to the columns up to a protected ring beam providing lateral support; and

c. there is some form of roof venting to give early heat release. (The roof venting could be, for example, PVC rooflights covering some 10 per cent of the floor area and evenly spaced over the floor area.)

External wall construction

12.5 The external envelope of a building should not provide a medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials in the cladding system and extensive cavities may present such a risk in tall buildings.

Externall 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.

The total amount of combustible material may also be limited in practice by the provisions for space separation in Section 13 (see paragraph 13.7 onwards).

External surfaces

12.6 The external surfaces of walls should meet

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

ONLINE VERSION

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External wall construction

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The total amount of combustible material may also be limited in practice by the provisions for space separation in Section 13 (see paragraph 13.7 onwards).

Reference Documents

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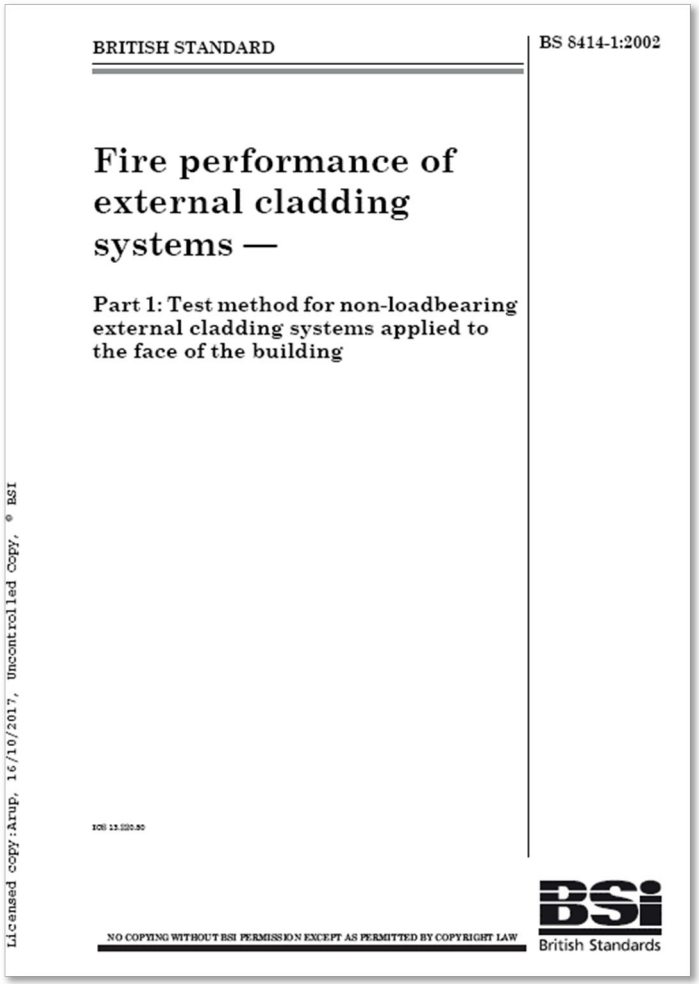


BRITISH STANDARD

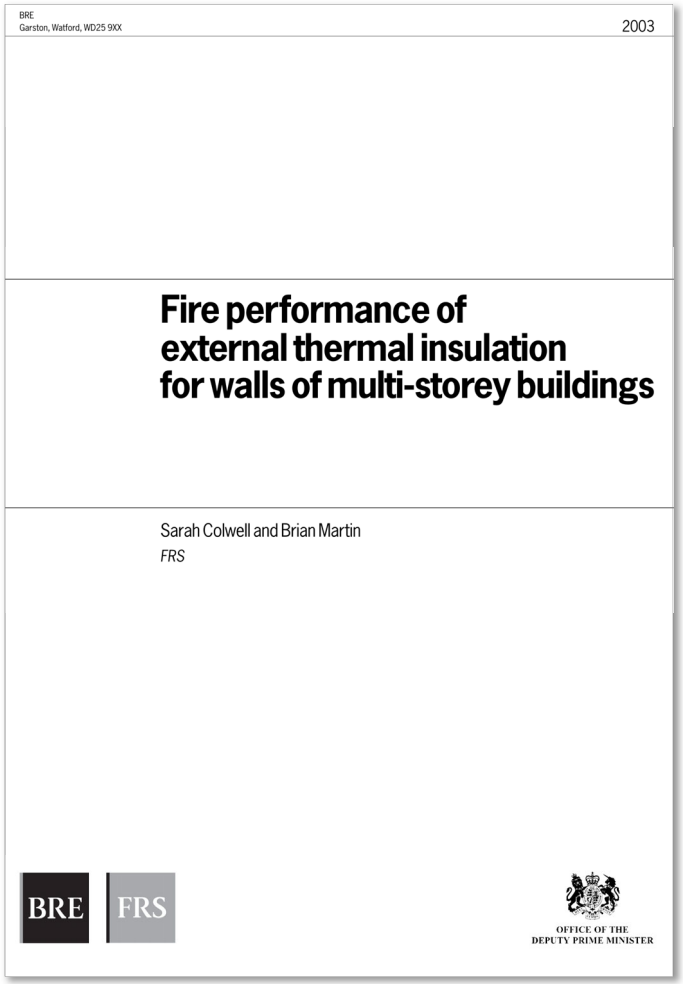
BS 8414-1:2002

Fire performance of external cladding systems —

Part 1: Test method for non-loadbearing external cladding systems applied to the face of the building

ICS 13.220.50

BSI British Standards



BRE
Garston, Watford, WD25 9XX
2003

Fire performance of external thermal insulation for walls of multi-storey buildings

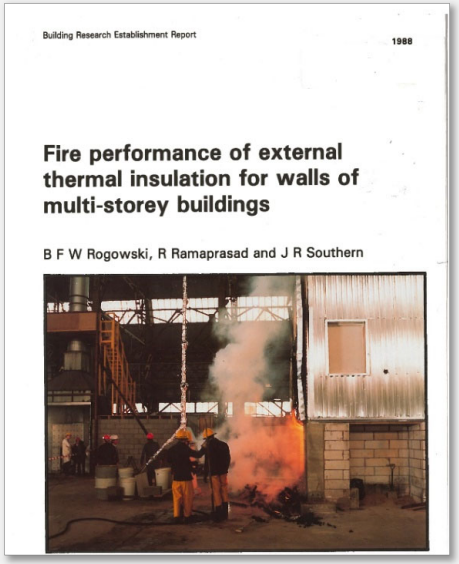
Sarah Colwell and Brian Martin
FRS

BRE FRS

OFFICE OF THE DEPUTY PRIME MINISTER

Rogowski,

Fire performance of external thermal insulation for walls of multi-storey buildings, BRE, 1988



Rogowski, Fire performance of external thermal insulation for walls of multi-storey buildings, BRE, 1988

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INTRODUCTION

The need for improved thermal insulation of buildings has led to the introduction of a range of systems designed originally for external application to solid masonry walls. Their applications have been extended to multi-storey developments where they have the advantage of improving insulation without disturbing the occupants during installation.

Insulation sandwiched directly between rendering and wall (Figure 1).
An insulant applied to the walls is protected either by a weathering finish of traditional sand/cement render, reinforced with metal lathing supported by fixings to the masonry, or by a thin rendering reinforced with glass fabric supported mainly by the insulant and finished with a masonry paint or chippings. Non-combustible inorganic insulating materials such as rock or glass fibre are marketed for such use, often as composite products incorporating a facing of breather paper and a metal lathing for use as a key for the rendering. Alternatively, the fibre insulant can be replaced by combustible thermoplastic or thermosetting cellular plastics insulants, applied as rigid boards or sprayed as appropriate. The insulant thicknesses can vary from 25 to 100 mm depending on the standard of insulation required. Other methods include products such as cementitious-based homogeneous lightweight renders incorporating, as an aggregate, expanded polystyrene beads or similar.

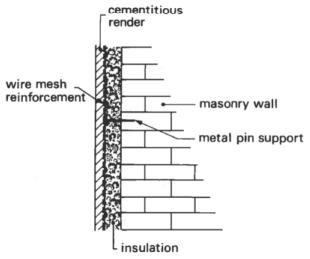

Figure 1 Typical non-sheeted external insulation system

Insulation protected by a ventilated cladding (Figure 2)
Again, insulants used may be mineral or plastics based but in these systems, non-combustible or metal facing sheets provide the weathering protection. In either case the resistance to the passage of water vapour introduces a risk of condensation within the wall/cladding system which could lead to corrosion problems and increased heat loss and consequently a ventilated cavity must be provided. This is sited

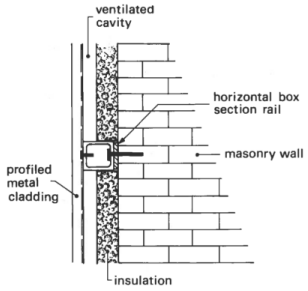

Figure 2 Typical sheeted system incorporating ventilated cavity

between the insulant, which is attached to the external wall and the cladding sheets which may be supported on a metal or timber framework.

Systems of both types have been widely used in Europe and recently in the UK at least four 12-storey blocks of flats have had rendered expanded polystyrene insulation systems applied to the walls and blocks of flats up to 22 storeys high have been treated with polystyrene incorporated behind a ventilated cladding, the cladding sheets being supported on a timber or metal framework. Other systems based on rock or glass fibre as insulant are used extensively. Possible advantages in terms of economy and ease of installation might favour increased use of polymeric insulants were there not fears about the effects of these on fire spread and doubts as to their acceptability under the provisions of the Building Regulations.

REGULATORY ASPECTS

Control over the external surface of walls of buildings, particularly those of multi-storey flats, to avoid ignition and flame spread which might endanger the lives of residents above by breaking down effective 'compartmentation*' is currently controlled[1,2] by reference to tests specified in BS 476: Parts 6[3] and 7[4]. However, these tests only provide information on surface fire behaviour. The overall fire performance of a ventilated cladding system or insulated assembly, incorporating independently-supported weathering finishes and complicated reveal details, can only be investigated under actual fire conditions on a full-scale building facade. To identify the design principles on which constructional recommendations might confidently be based demanded research. This would be to determine both the risk of flame spread over the

*compartmentation implies the confining of a fire to a given space by the provision of fire resisting walls and floors.

1

REGULATORY ASPECTS

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Rogowski, Fire performance of external thermal insulation for walls of multi-storey buildings, BRE, 1988

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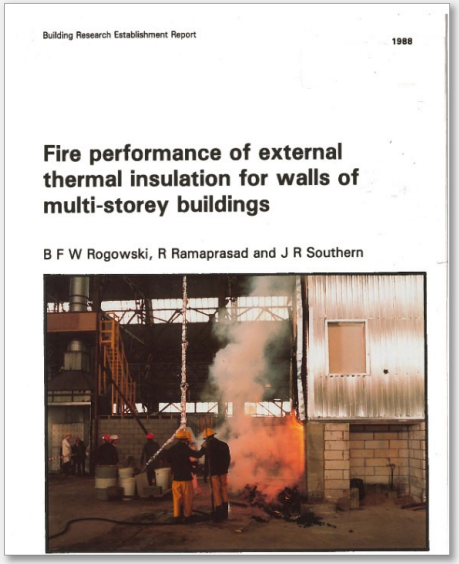
A 4-storey rig, 9.2 m high and 3.7 m square in plan rising above a recessed opening was constructed inside the FRS Cardington Laboratory (see Figure 3). This enabled in-situ fixing, and where appropropriate, the drying and curing of three experimental assemblies simultaneously. Instrumentation was provided to measure the temperatures and heat flux at various locations on the rig and the radiated heat likely to fall on an adjacent building.

Rogowski, Fire performance of external thermal insulation for walls of multi-storey buildings, BRE, 1988



RECOMMENDATIONS

To reduce the risk of vertical fire spread in existing and proposed external insulation systems the following recommendations based on this test programme are proposed by the Department of the Environment.

4. Proposed systems incorporating combustible insulants with sheeted overcladding should be designed to incorporate fire barriers in the ventilated cavity every two storeys.

6. Surface protection applied directly to all combustible insulants must be carefully designed and installed, round windows and other openings.

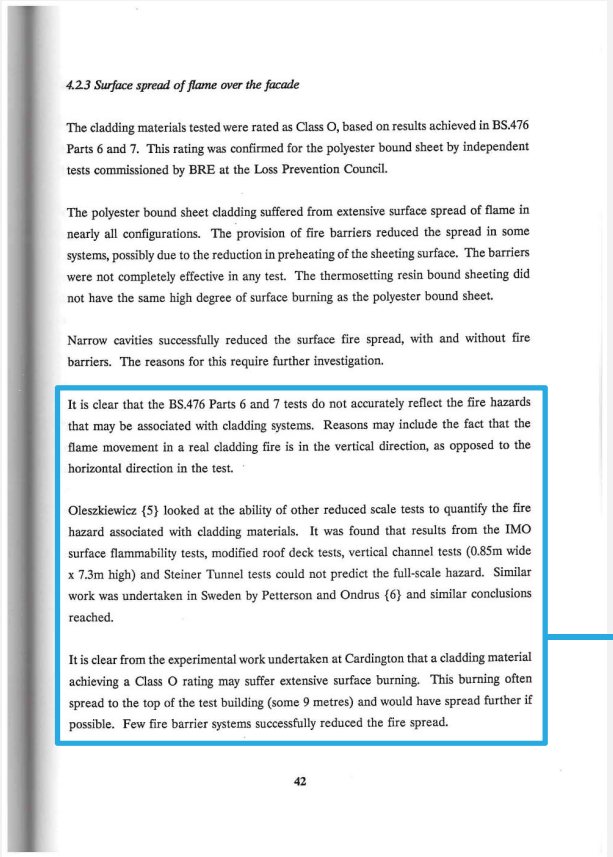
8. Timber cladding should continue to be used only in low rise developments (up to 15 m) to avoid extensive self-propagating flame spread over the surface.

Knowsley Heights Fire, Merseyside, 1991

Referred to in Dr Raymond Connolly's "*Investigation of the behaviour of external cladding systems in fire – report on 10 full scale fire tests*" – BRE April 1994

Dr Connolly, BRE
Report on 10 Full Scale Fire Tests, April 1994

Dr Connolly, BRE Report on 10 Full Scale Fire Tests, April 1994



4.2.3 Surface spread of flame over the facade

The cladding materials tested were rated as Class O, based on results achieved in BS.476 Parts 6 and 7. This rating was confirmed for the polyester bound sheet by independent tests commissioned by BRE at the Loss Prevention Council.

The polyester bound sheet cladding suffered from extensive surface spread of flame in nearly all configurations. The provision of fire barriers reduced the spread in some systems, possibly due to the reduction in preheating of the sheeting surface. The barriers were not completely effective in any test. The thermosetting resin bound sheeting did not have the same high degree of surface burning as the polyester bound sheet.

Narrow cavities successfully reduced the surface fire spread, with and without fire barriers. The reasons for this require further investigation.

It is clear that the BS.476 Parts 6 and 7 tests do not accurately reflect the fire hazards that may be associated with cladding systems. Reasons may include the fact that the flame movement in a real cladding fire is in the vertical direction, as opposed to the horizontal direction in the test.

Oleszkiewicz {5} looked at the ability of other reduced scale tests to quantify the fire hazard associated with cladding materials. It was found that results from the IMO surface flammability tests, modified roof deck tests, vertical channel tests (0.85m wide x 7.3m high) and Steiner Tunnel tests could not predict the full-scale hazard. Similar work was undertaken in Sweden by Petterson and Ondrus {6} and similar conclusions reached.

It is clear from the experimental work undertaken at Cardington that a cladding material achieving a Class O rating may suffer extensive surface burning. This burning often spread to the top of the test building (some 9 metres) and would have spread further if possible. Few fire barrier systems successfully reduced the fire spread.

42

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Garnock Court Fire, Irvine, 1999

Garnock Court
Fire, Irvine, 1999

14. The inquiry also prompted further research at the Fire Research Station of the Buildings Research Establishment (BRE). The conclusions arising from this research, which was carried out in 1994, support the claims of our witnesses that the small-scale tests upon which existing guidance relies are insufficient properly to evaluate the performance of complete cladding systems in a fire, and that there is therefore a clear need for full-scale testing.

15. BRE proceeded to develop an appropriate full-scale fire test, known as 'A test for assessing the fire performance of external cladding systems'. This test was submitted to the DETR in 1996. Witnesses suggested that this test would be a considerable improvement on the small-scale testing which is currently carried out to ascertain the fire performance of materials used in external cladding systems.

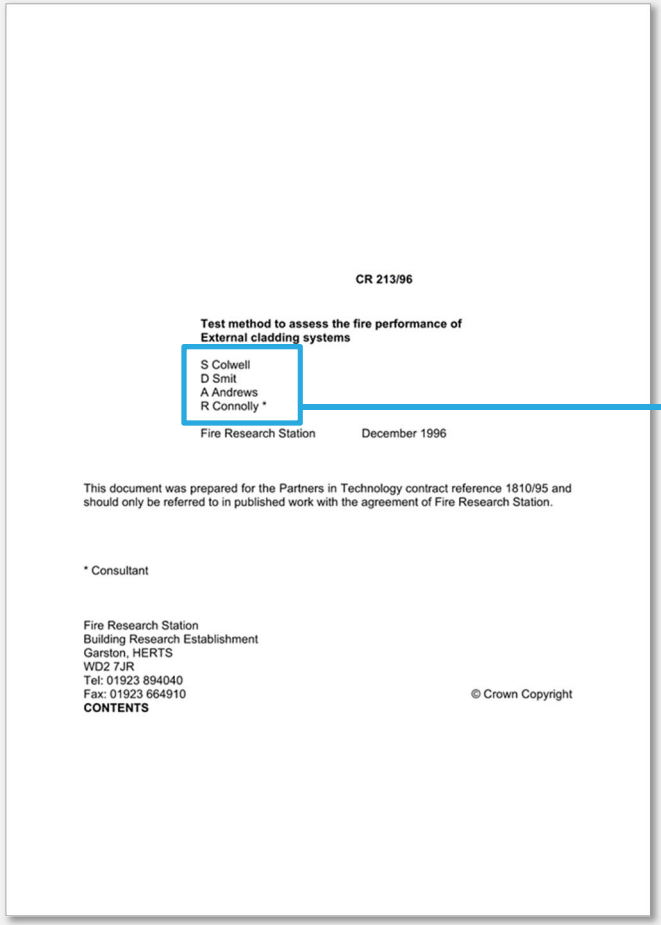
16. Other witnesses suggested that this test would not be suitable for all external cladding systems, and in particular that it would not be a suitable method of testing the fire performance of 'infill' systems such as that which was involved in the fire at Irvine.

However, we note the view of Peter Field of BRE, which developed the test, who told us,

"We believe the test facility itself could be accommodated to assess the fire performance of systems which are not the same as total cladding systems and may involve windows and decorative panels". The advice we have received concurs with this opinion.

17. The DETR told us in written evidence that this test will be referenced in Approved Document B, and that it was intended that it become a British Standard. However, such reference does not amount to a requirement that cladding systems pass the test: simply that the test is one way of ensuring that the system meets the requirements of the Building Regulations."

Further development of Test Standards by the BRE



CR 213/96

Test method to assess the fire performance of External cladding systems

S Colwell
D Smit
A Andrews
R Connolly *

Fire Research Station December 1996

This document was prepared for the Partners in Technology contract reference 1810/95 and should only be referred to in published work with the agreement of Fire Research Station.

* Consultant

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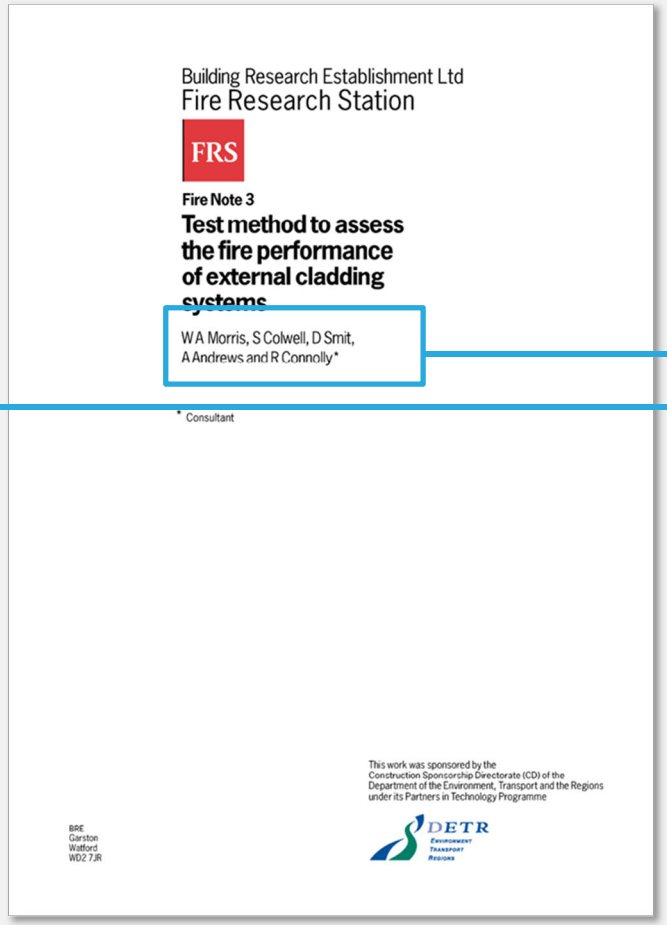

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Fire Note 3

Test method to assess the fire performance of external cladding systems

W A Morris, S Colwell, D Smit, A Andrews and R Connolly*

* Consultant

This work was sponsored by the Construction Sponsorship Directorate (CD) of the Department of the Environment, Transport and the Regions under its Partners in Technology Programme

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- A Andrews
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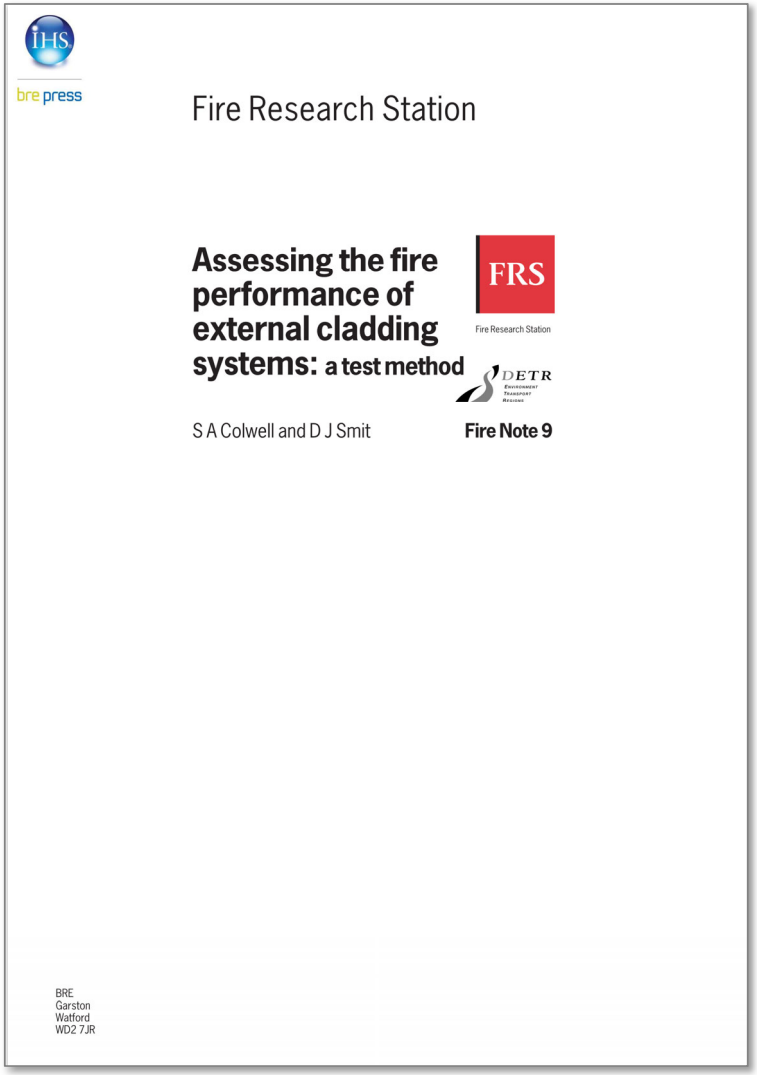

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S A Colwell and D J Smit

Fire Note 9

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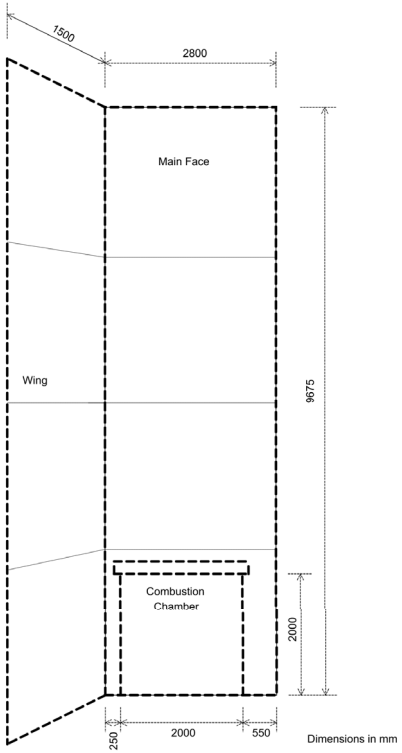

Figure 1 Typical Test Facility

Fire Note 3

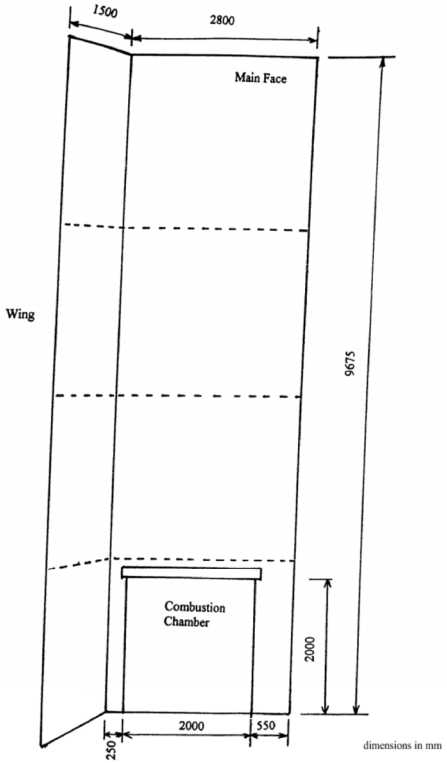

Figure 1 Typical test facility

Fire Note 9

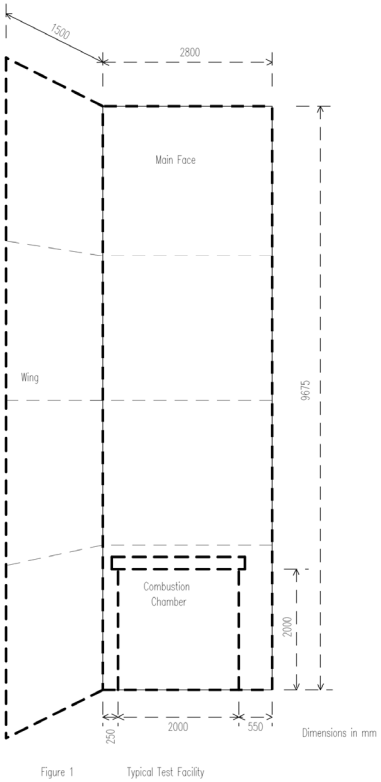

Figure 1 Typical Test Facility

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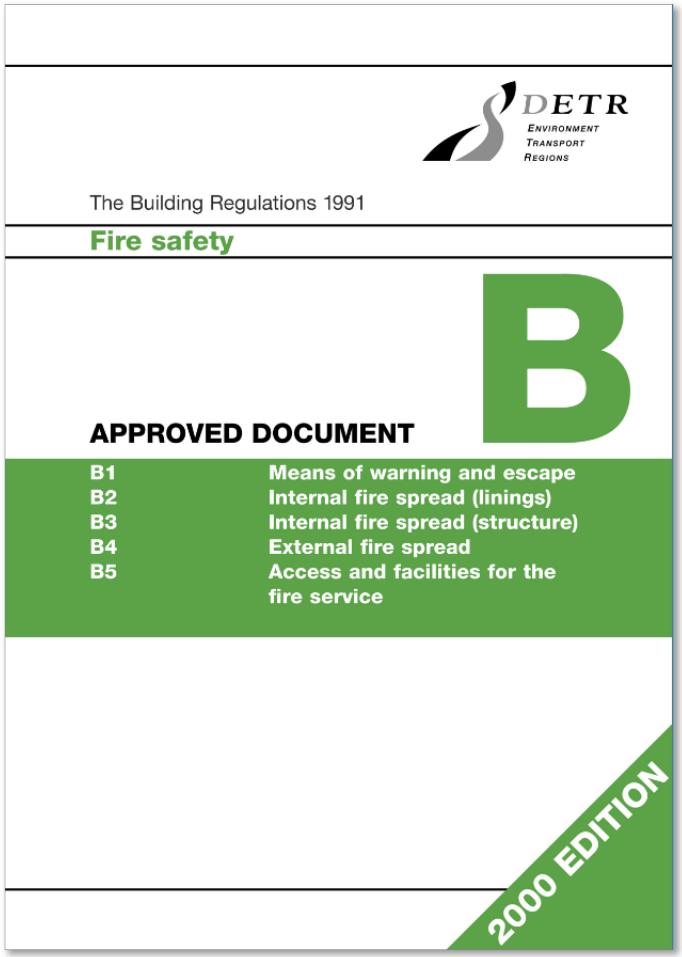
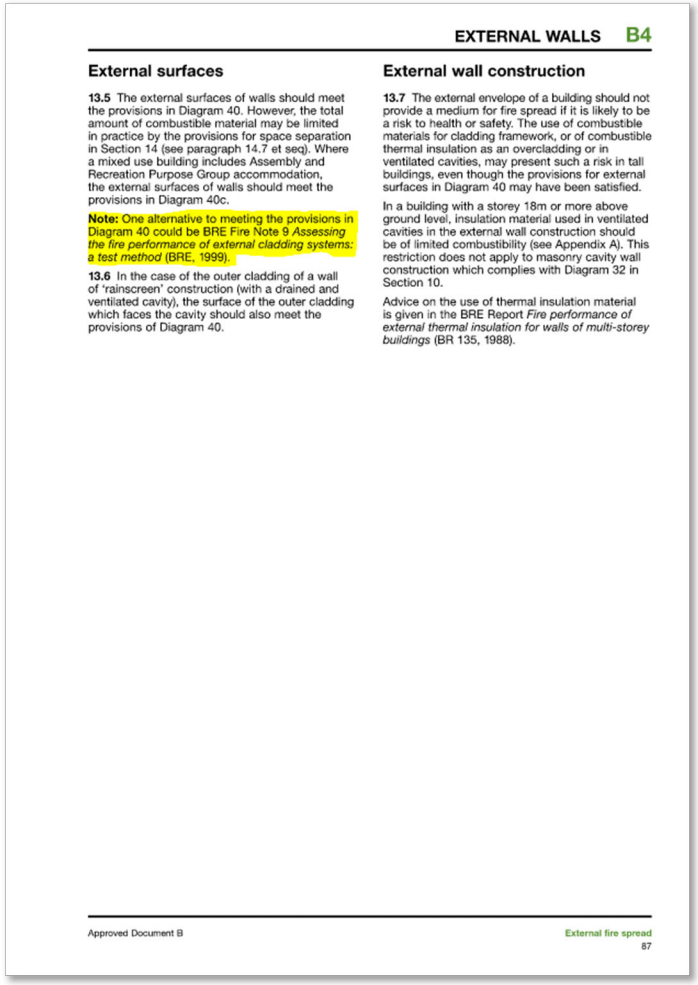




EXTERNAL WALLS B4

External surfaces

13.5 The external surfaces of walls should meet the provisions in Diagram 40. However, the total amount of combustible material may be limited in practice by the provisions for space separation in Section 14 (see paragraph 14.7 et seq). Where a mixed use building includes Assembly and Recreation Purpose Group accommodation, the external surfaces of walls should meet the provisions in Diagram 40c.

Note: 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* (BRE, 1999).

13.6 In the case of the outer cladding of a wall of 'rainscreen' construction (with a drained and ventilated cavity), the surface of the outer cladding which faces the cavity should also meet the provisions of Diagram 40.

External wall construction

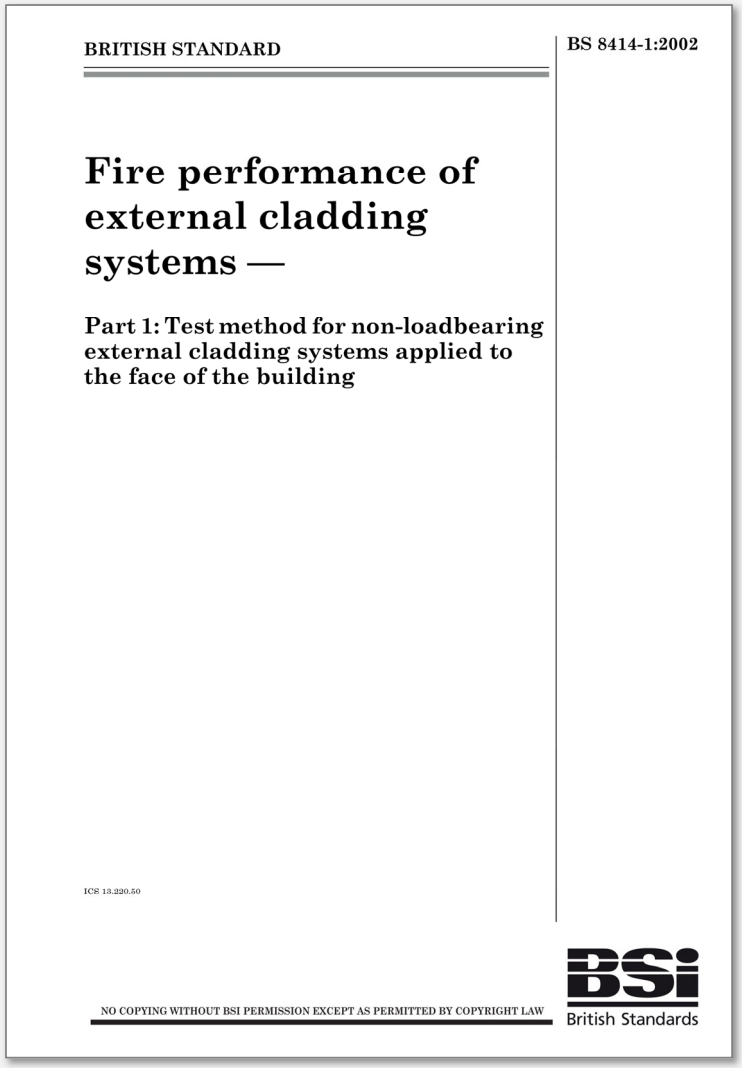
13.7 The external envelope of a building should not provide a medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials for cladding framework, or of combustible thermal insulation as an overcladding or in ventilated cavities, may present such a risk in tall buildings, even though the provisions for external surfaces in Diagram 40 may have been satisfied.

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 (see Appendix A). This restriction does not apply to masonry cavity wall construction which complies with Diagram 32 in Section 10.

Advice on the use of thermal insulation material is given in the BRE Report *Fire performance of external thermal insulation for walls of multi-storey buildings* (BR 135, 1988).

BS 8414-1:2002

BR 135 2nd Edition (2003)



BRITISH STANDARD

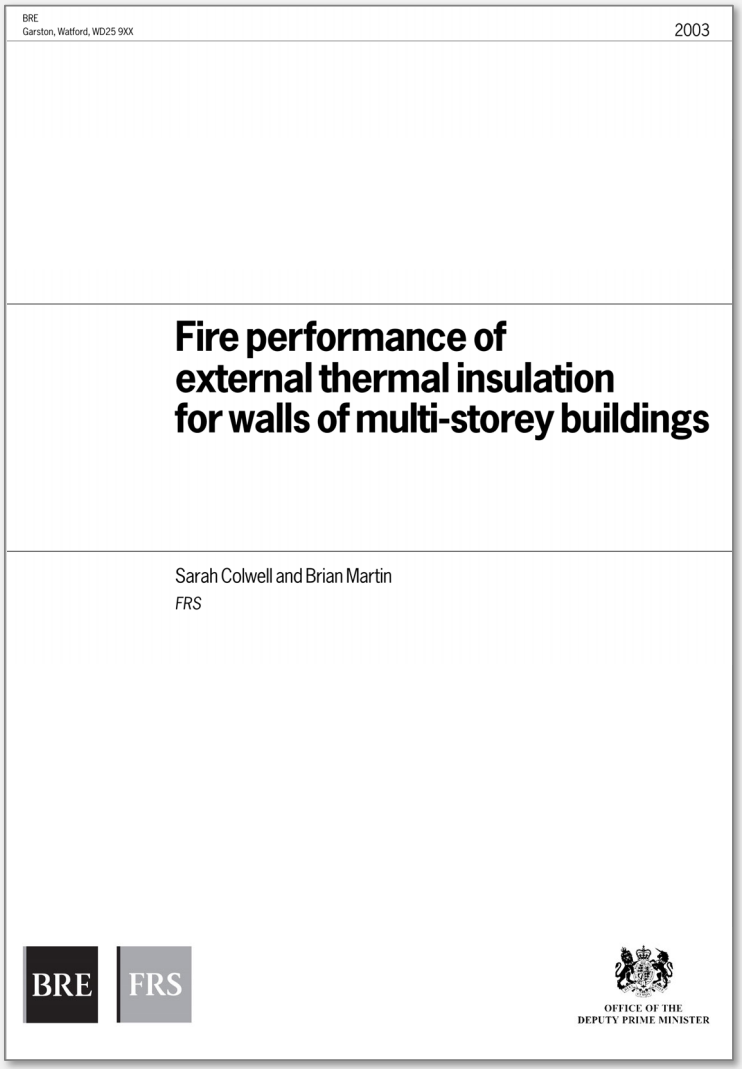
BS 8414-1:2002

Fire performance of external cladding systems —

Part 1: Test method for non-loadbearing external cladding systems applied to the face of the building

ICS 13.220.50

BSI British Standards



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2003

Fire performance of external thermal insulation for walls of multi-storey buildings

Sarah Colwell and Brian Martin
FRS

BRE FRS

OFFICE OF THE DEPUTY PRIME MINISTER

Further publications

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Year	Document title
2005	BS 8414-2. Fire Performance of external cladding systems – Part 2 Test methods for non-loadbearing external cladding systems fixed to and supported by a structural steel frame
2006	ADB 2006 published- Refers to BS 8414-1:2002; BS 8414-2:2005, and BR 135 2nd edition as means of demonstrating compliance with paragraph 12.5.
2007	Digest 501. BR135:Annex B Performance criteria and classification method for BS 8414-2:2005 Note this is annex B of the second edition of BR 135
2013	ADB 2013 published- Refers to BS 8414-1:2002; BS 8414-2:2005, and BR 135 2nd edition as means of demonstrating compliance with paragraph 12.5.
2013	BR 135. Fire Performance of external thermal insulation for walls of multi-storey buildings. Third edition
2015*	BS 8414-1. Fire performance of external cladding systems– Part 1: Test method for non-loadbearing external cladding systems applied to the masonry face of a building
	BS 8414-2. Fire performance of external cladding systems– Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

* BS 8414 parts 1 and 2 were subsequently updated in 2017

BS 8414 – Application

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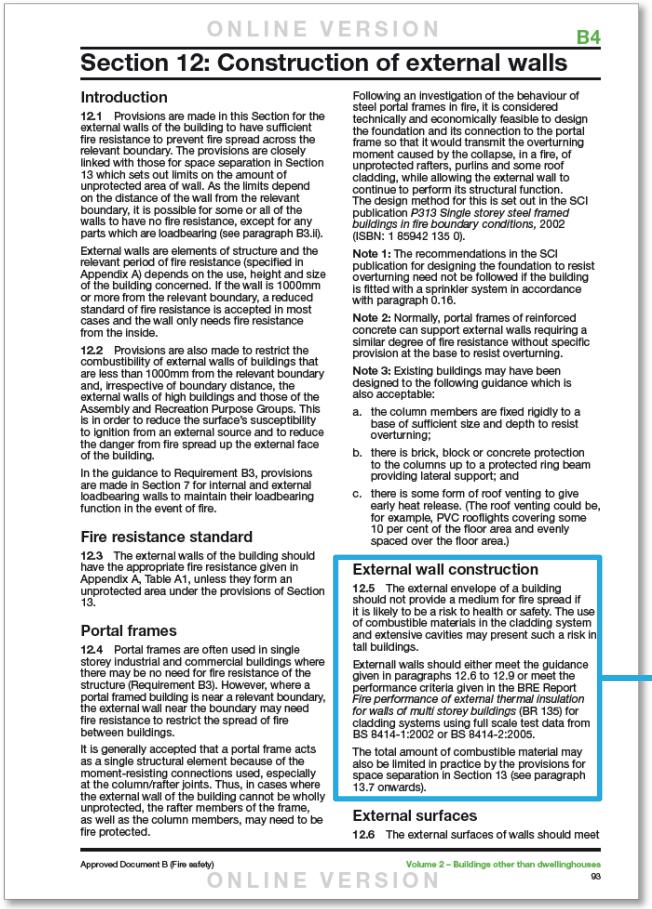

ONLINE VERSION

B4

Section 12: Construction of external walls

Introduction

12.1 Provisions are made in this Section for the external walls of the building to have sufficient fire resistance to prevent fire spread across the relevant boundary. The provisions are closely linked with those for space separation in Section 13 which sets out limits on the amount of unprotected area of wall. As the limits depend on the distance of the wall from the relevant boundary, it is possible for some or all of the walls to have no fire resistance, except for any parts which are loadbearing (see paragraph B3.ii).

External walls are elements of structure and the relevant period of fire resistance (specified in Appendix A) depends on the use, height and size of the building concerned. If the wall is 1000mm or more from the relevant boundary, a reduced standard of fire resistance is accepted in most cases and the wall only needs fire resistance from the inside.

12.2 Provisions are also made to restrict the combustibility of external walls of buildings that are less than 1000mm from the relevant boundary and, irrespective of boundary distance, the external walls of high buildings and those of the Assembly and Recreation Purpose Groups. This is in order to reduce the surface's susceptibility to ignition from an external source and to reduce the danger from fire spread up the external face of the building.

In the guidance to Requirement B3, provisions are made in Section 7 for internal and external loadbearing walls to maintain their loadbearing function in the event of fire.

Fire resistance standard

12.3 The external walls of the building should have the appropriate fire resistance given in Appendix A, Table A1, unless they form an unprotected area under the provisions of Section 13.

Portal frames

12.4 Portal frames are often used in single storey industrial and commercial buildings where there may be no need for fire resistance of the structure (Requirement B3). However, where a portal framed building is near a relevant boundary, the external wall near the boundary may need fire resistance to restrict the spread of fire between buildings.

It is generally accepted that a portal frame acts as a single structural element because of the moment-resisting connections used, especially at the column/rafter joints. Thus, in cases where the external wall of the building cannot be wholly unprotected, the rafter members of the frame, as well as the column members, may need to be fire protected.

Following an investigation of the behaviour of steel portal frames in fire, it is considered technically and economically feasible to design the foundation and its connection to the portal frame so that it would transmit the overturning moment caused by the collapse, in a fire, of unprotected rafters, purlins and some roof cladding, while allowing the external wall to continue to perform its structural function. The design method for this is set out in the SCI publication *P313 Single storey steel framed buildings in fire boundary conditions*, 2002 (ISBN: 1 85942 135 0).

Note 1: The recommendations in the SCI publication for designing the foundation to resist overturning need not be followed if the building is fitted with a sprinkler system in accordance with paragraph 0.16.

Note 2: Normally, portal frames of reinforced concrete can support external walls requiring a similar degree of fire resistance without specific provision at the base to resist overturning.

Note 3: Existing buildings may have been designed to the following guidance which is also acceptable:

a. the column members are fixed rigidly to a base of sufficient size and depth to resist overturning;

b. there is brick, block or concrete protection to the columns up to a protected ring beam providing lateral support; and

c. there is some form of roof venting to give early heat release. (The roof venting could be, for example, PVC rooflights covering some 10 per cent of the floor area and evenly spaced over the floor area.)

External wall construction

12.5 The external envelope of a building should not provide a medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials in the cladding system and extensive cavities may present such a risk in tall buildings.

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.

The total amount of combustible material may also be limited in practice by the provisions for space separation in Section 13 (see paragraph 13.7 onwards).

External surfaces

12.6 The external surfaces of walls should meet

ONLINE VERSION

External wall construction

12.5 The external envelope of a building should not provide a medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials in the cladding system and extensive cavities may present such a risk in tall buildings.

Externall 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.

The total amount of combustible material may also be limited in practice by the provisions for space separation in Section 13 (see paragraph 13.7 onwards).

Building Research Establishment Limited (BRE)

BRE Digest 208 I*ncreasing the fire resistance of existing timber floors* 1988 ISBN: 978 1 86081 359 7

BRE report (BR 368) *Design methodologies for smoke and heat exhaust ventilation* 1999 ISBN: 978 1 86081 289 7

BRE report (BR 274) *Fire safety of PTFE-based materials used in buildings* 1994 ISBN: 978 1 86081 653 6

BRE report (BR 135) *Fire performance of external thermal insulation for walls of multi-storey buildings* 2003 ISBN: 978 1 86081 622 2

BRE report (BR 187) *External fire spread: Building separation and boundary distances* 1991 ISBN: 978 1 86081 465 5

BRE report (BR128) *Guidelines for the construction of fire resisting structural elements* 1988 ISBN: 0 85125 293 1

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Section 3:
Cladding systems and *full scale* test data

BS 8414-1 and BS 8414-2 test standards

BS 8414 – Fire performance of external cladding systems

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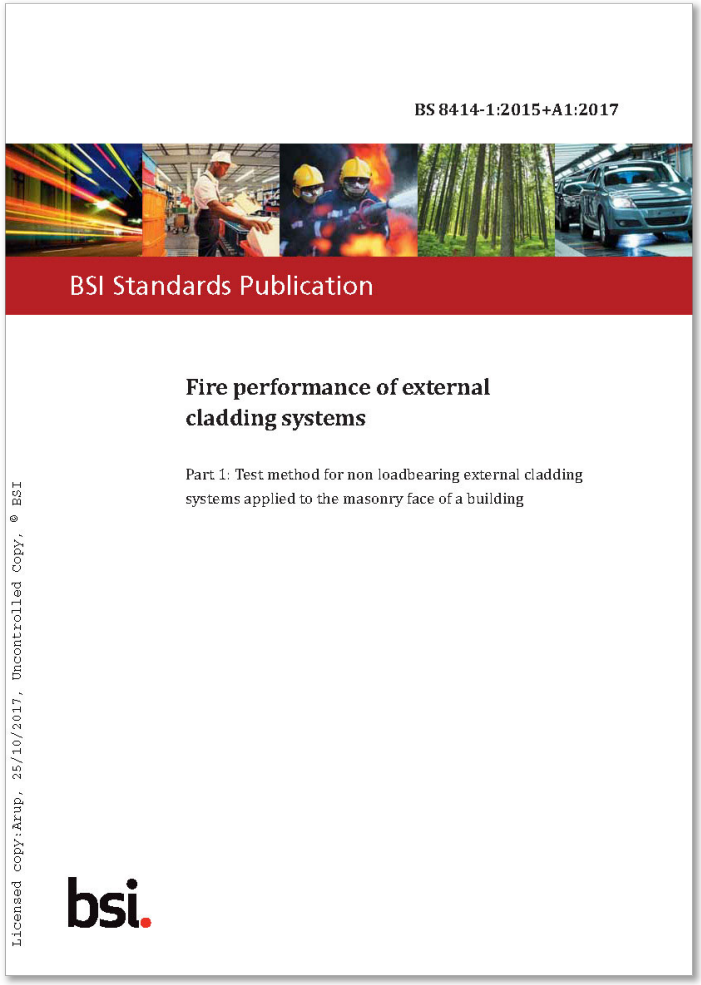

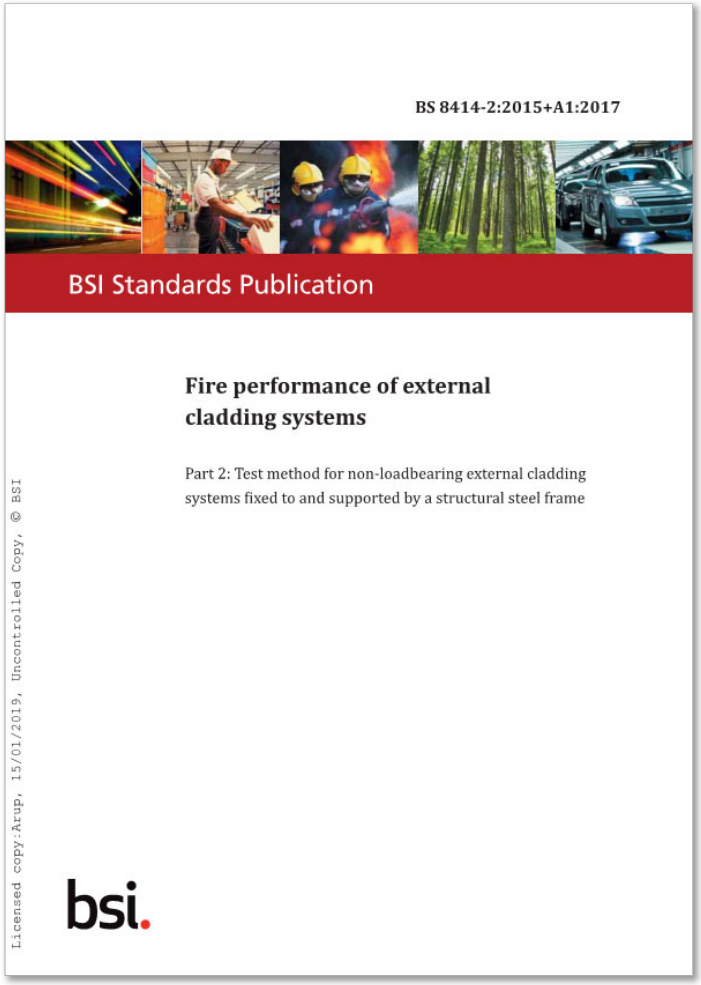

BR135 – Fire performance of external thermal insulation for walls of multi-storey buildings

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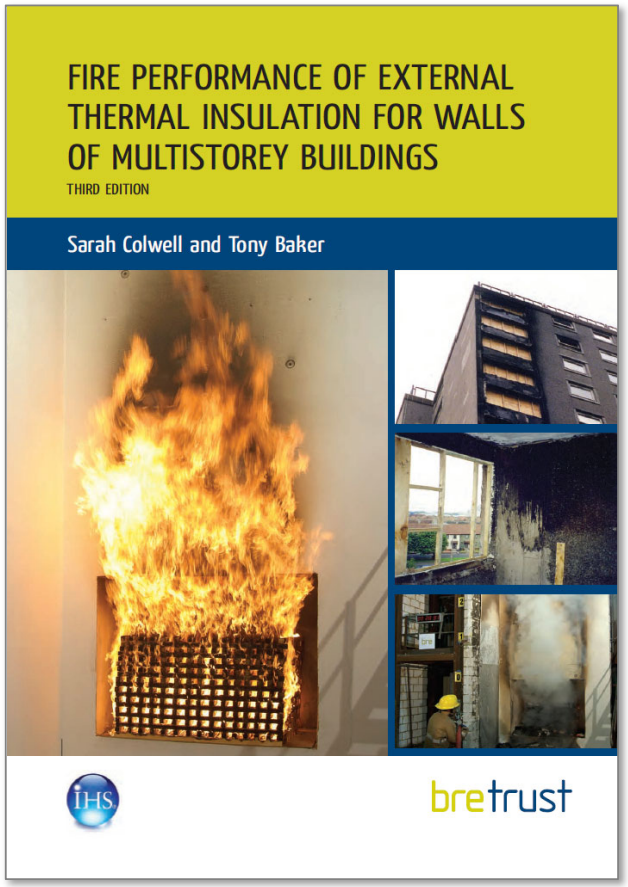
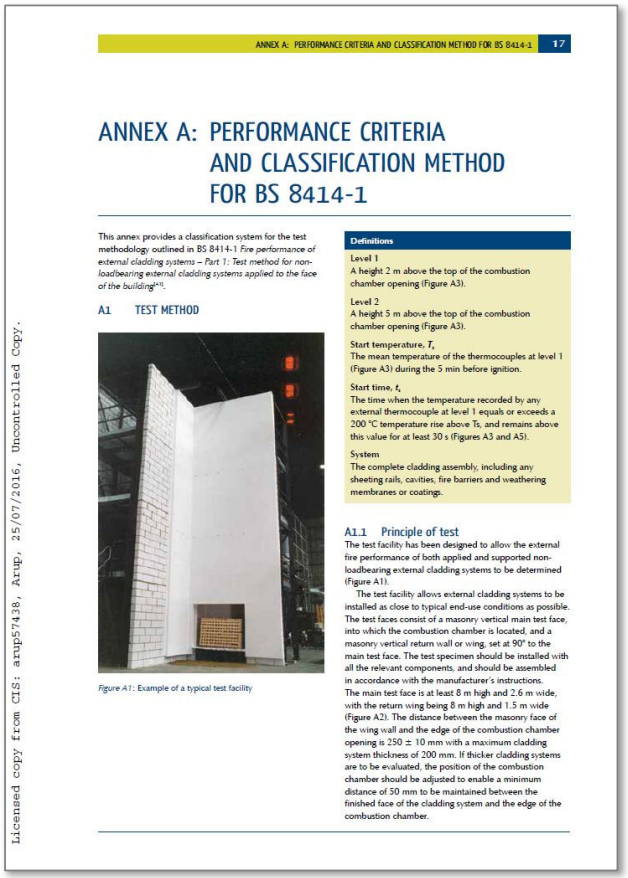




ANNEX A: PERFORMANCE CRITERIA AND CLASSIFICATION METHOD FOR BS 8414-1

This annex provides a classification system for the test methodology outlined in BS 8414-1 *Fire performance of external cladding systems – Part 1: Test method for non-loadbearing external cladding systems applied to the face of the building*[A1].

A1 TEST METHOD

Figure A1: Example of a typical test facility

Definitions

Level 1
A height 2 m above the top of the combustion chamber opening (Figure A3).

Level 2
A height 5 m above the top of the combustion chamber opening (Figure A3).

Start temperature, T_s
The mean temperature of the thermocouples at level 1 (Figure A3) during the 5 min before ignition.

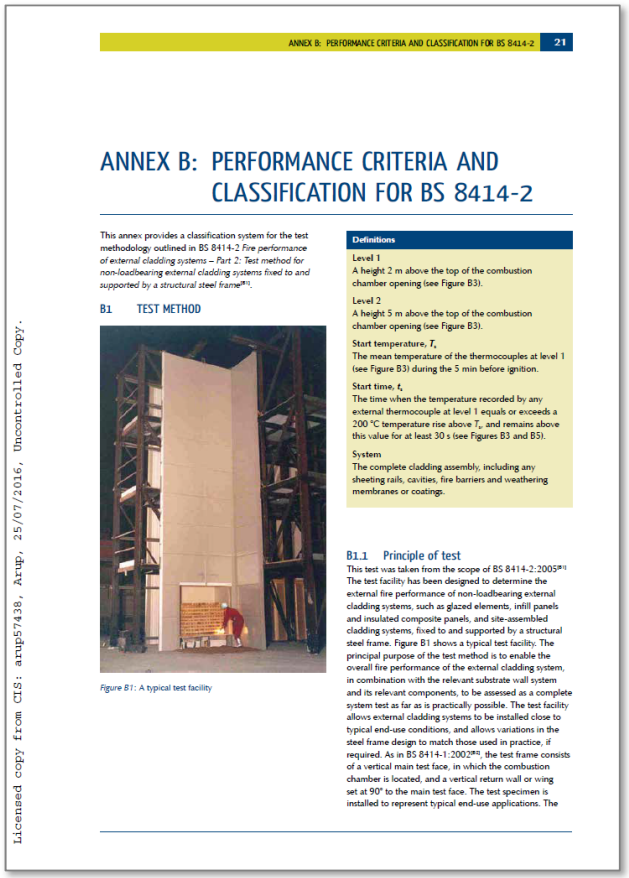
Start time, t_s
The time when the temperature recorded by any external thermocouple at level 1 equals or exceeds a 200 °C temperature rise above T_s and remains above this value for at least 30 s (Figures A3 and A5).

System
The complete cladding assembly, including any sheeting rails, cavities, fire barriers and weathering membranes or coatings.

A1.1 Principle of test

The test facility has been designed to allow the external fire performance of both applied and supported non-loadbearing external cladding systems to be determined (Figure A1).

The test facility allows external cladding systems to be installed as close to typical end-use conditions as possible. The test faces consist of a masonry vertical main test face, into which the combustion chamber is located, and a masonry vertical return wall or wing, set at 90° to the main test face. The test specimen should be installed with all the relevant components, and should be assembled in accordance with the manufacturer's instructions. The main test face is at least 8 m high and 2.6 m wide, with the return wing being 8 m high and 1.5 m wide (Figure A2). The distance between the masonry face of the wing wall and the edge of the combustion chamber opening is 250 ± 10 mm with a maximum cladding system thickness of 200 mm. If thicker cladding systems are to be evaluated, the position of the combustion chamber should be adjusted to enable a minimum distance of 50 mm to be maintained between the finished face of the cladding system and the edge of the combustion chamber.



ANNEX B: PERFORMANCE CRITERIA AND CLASSIFICATION FOR BS 8414-2

This annex provides a classification system for the test methodology outlined in BS 8414-2 *Fire performance of external cladding systems – Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame*[B1].

B1 TEST METHOD

Figure B1: A typical test facility

Definitions

Level 1
A height 2 m above the top of the combustion chamber opening (see Figure B3).

Level 2
A height 5 m above the top of the combustion chamber opening (see Figure B3).

Start temperature, T_s
The mean temperature of the thermocouples at level 1 (see Figure B3) during the 5 min before ignition.

Start time, t_s
The time when the temperature recorded by any external thermocouple at level 1 equals or exceeds a 200 °C temperature rise above T_s and remains above this value for at least 30 s (see Figures B3 and B5).

System
The complete cladding assembly, including any sheeting rails, cavities, fire barriers and weathering membranes or coatings.

B1.1 Principle of test

This test was taken from the scope of BS 8414-2:2005[B1]
The test facility has been designed to determine the external fire performance of non-loadbearing external cladding systems, such as glazed elements, infill panels and insulated composite panels, and site-assembled cladding systems, fixed to and supported by a structural steel frame. Figure B1 shows a typical test facility. The principal purpose of the test method is to enable the overall fire performance of the external cladding system, in combination with the relevant substrate wall system and its relevant components, to be assessed as a complete system test as far as is practically possible. The test facility allows external cladding systems to be installed close to typical end-use conditions, and allows variations in the steel frame design to match those used in practice, if required. As in BS 8414-1:2002[B2], the test frame consists of a vertical main test face, in which the combustion chamber is located, and a vertical return wall or wing set at 90° to the main test face. The test specimen is installed to represent typical end-use applications. The

BS 8414 – specimen size

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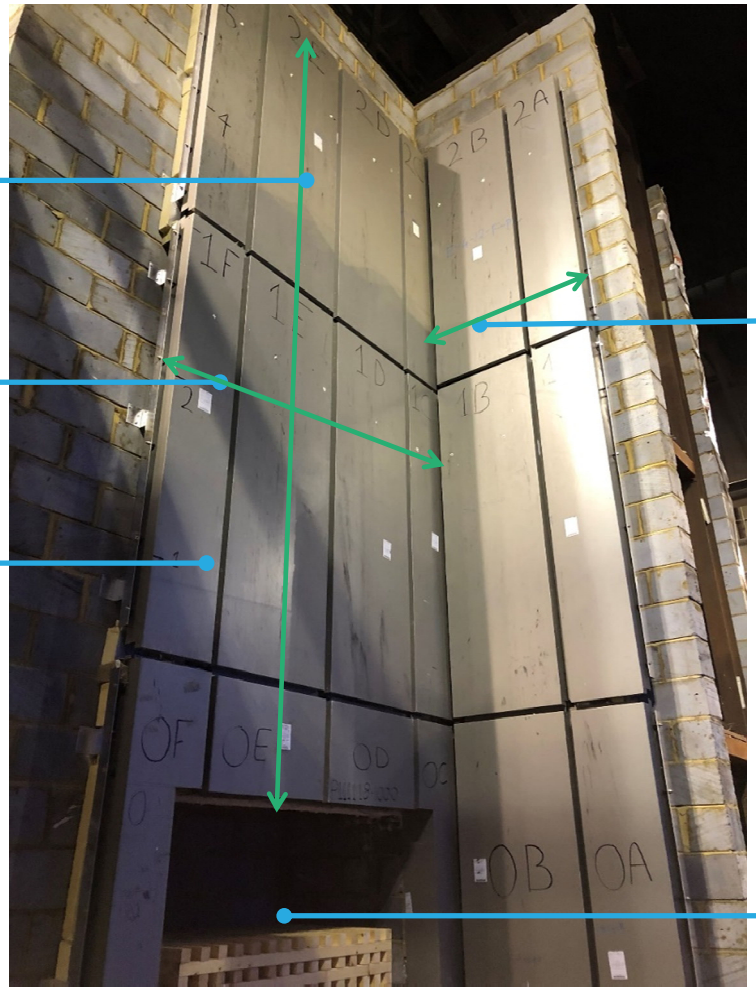

BS 8414 – location of temperature measurement

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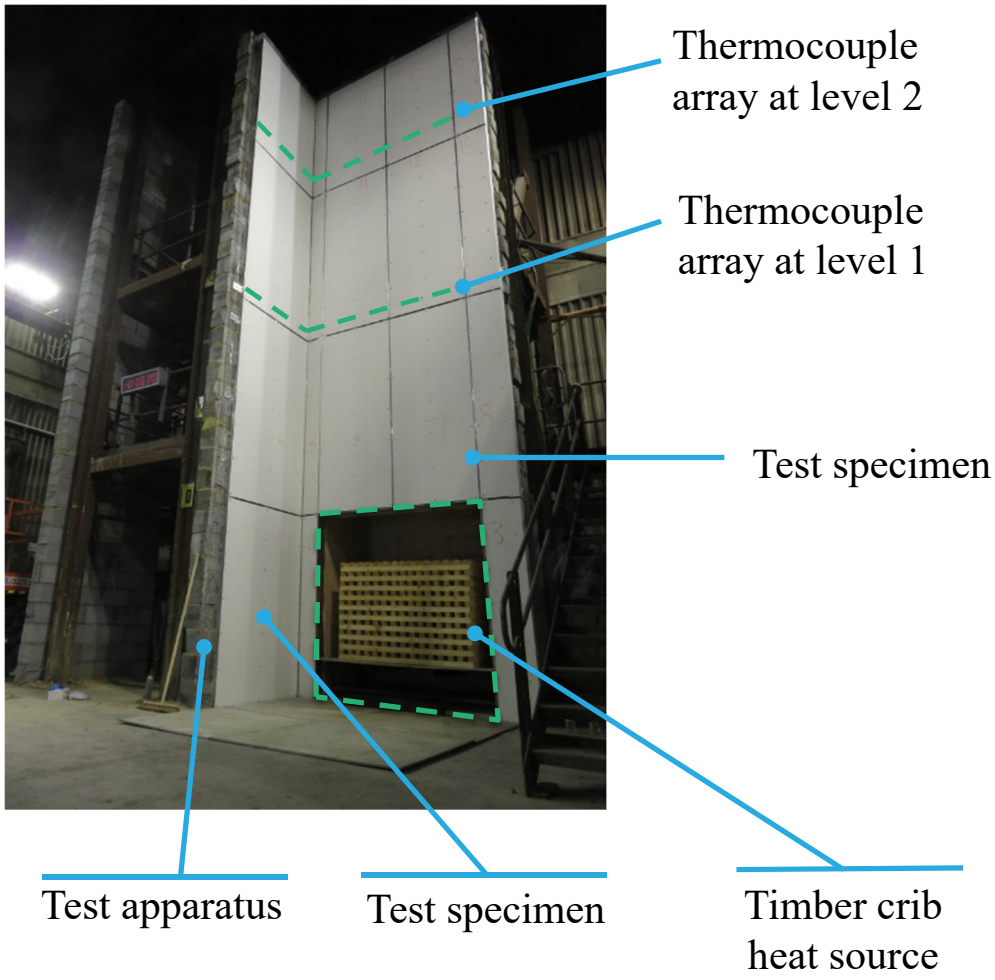

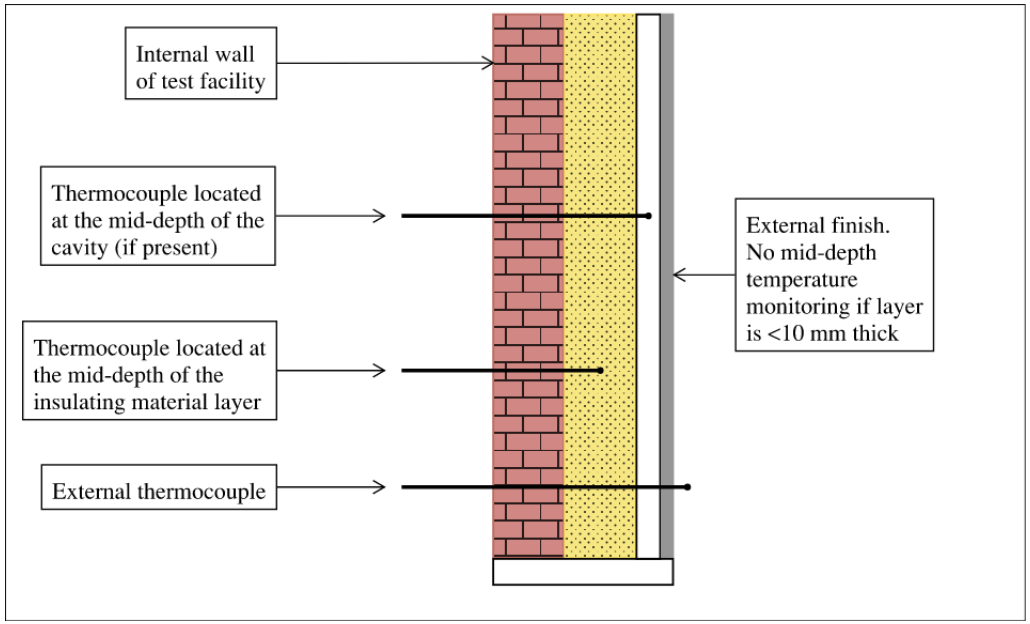

BS 8414 – protection of openings and joints

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Overmarked from Figure 2 of the MHCLG HPL BS 8414-1 fire test
Available at https://www.gov.uk/government/publications/fire-test-report-mhclg-bs-8414-hpl
Report reference 101856.00, version number 2.0

BS 8414 – Fuel source

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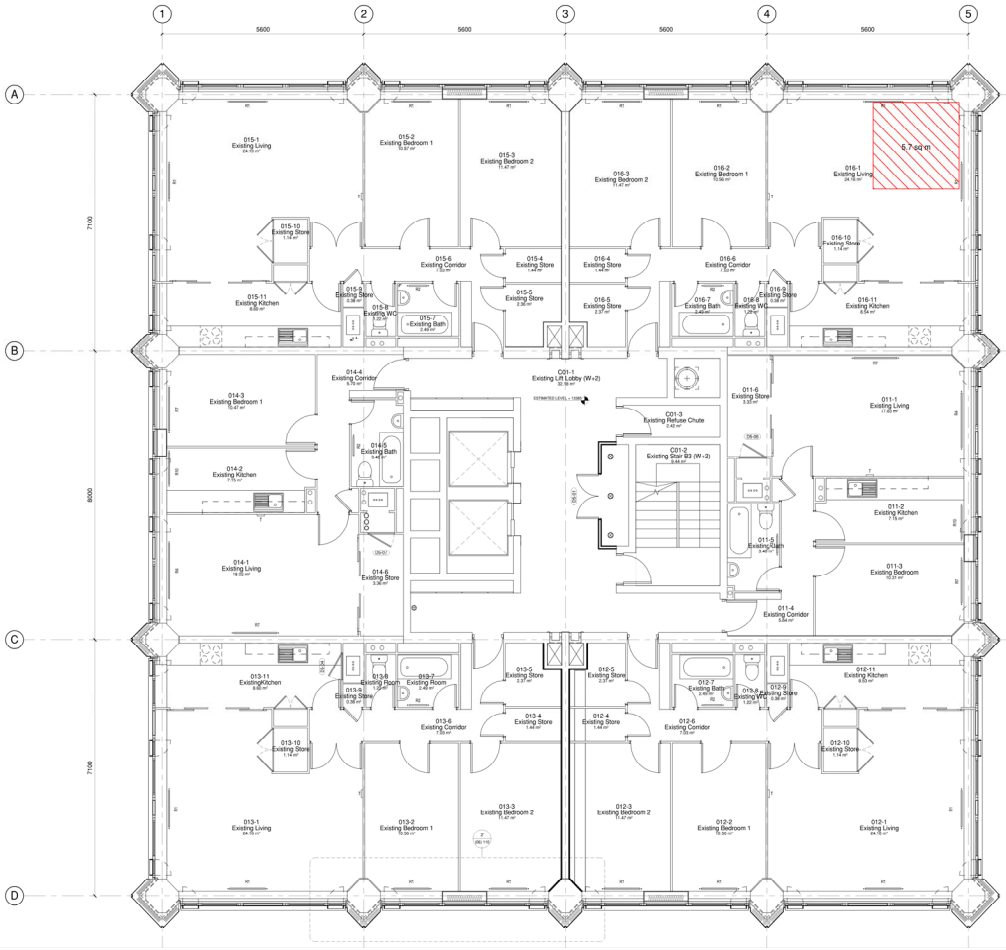

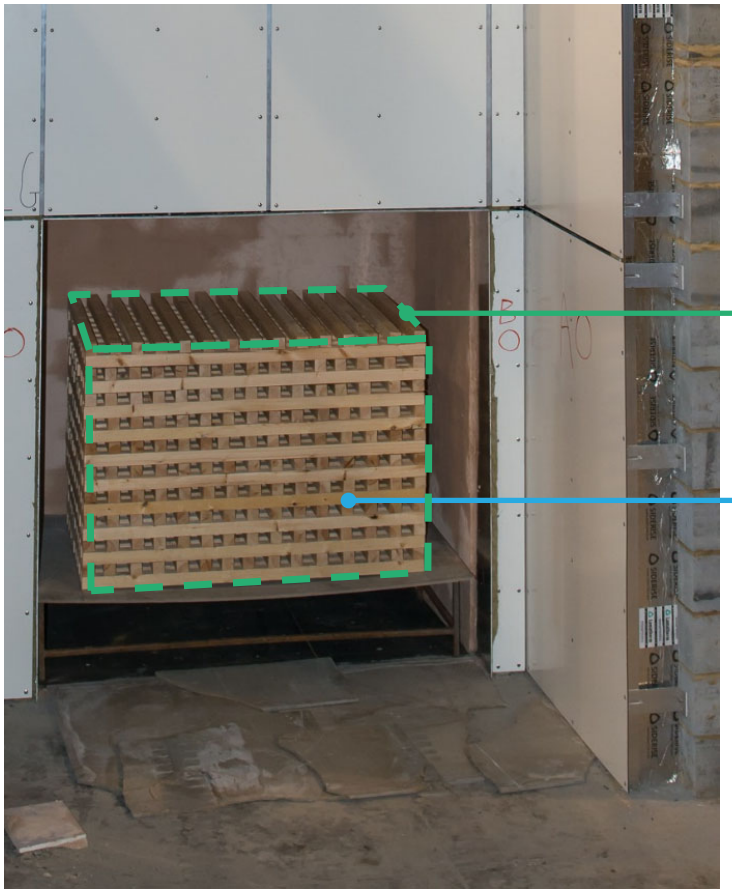

BS 8414 – Measurements taken – observations

ARUP

"The times of significant events such as change of flaming conditions and mechanical behaviour of the cladding system are to be recorded; especially detachment of any part of the cladding system (whether flaming or otherwise) or any other fire penetrations through fire stops incorporated within the cladding system."

BS 8414 – Test methodology

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BS 8414 – ACP example test results

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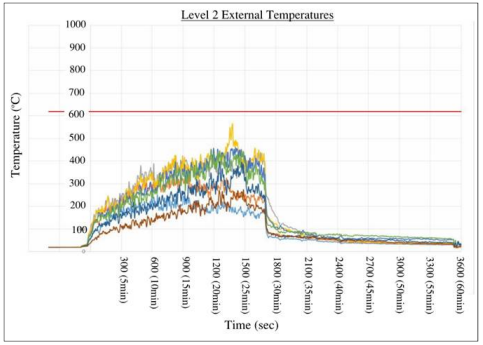
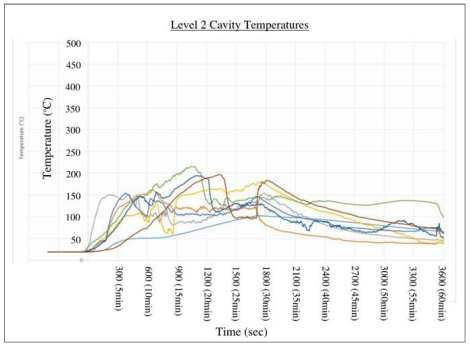
Level 2 temperatures measured 5.0m above the opening

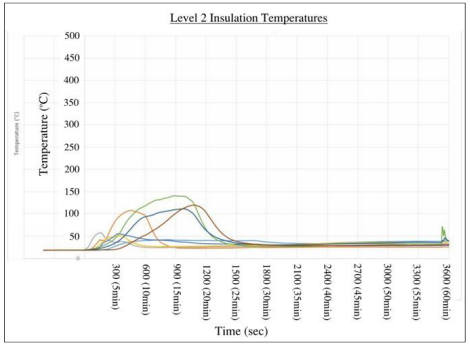
Externally



Cavity



Insulation



BS 8414 – Test report

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BRITISH STANDARD

BS 8414-1:2002

Fire performance of external cladding systems —

Part 1: Test method for non-loadbearing external cladding systems applied to the face of the building

ICS 13.220.50

British Standards

BRITISH STANDARD

BS 8414-2:2005

Fire performance of external cladding systems —

Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

ICS 13.220.50

Confirmed December 2011

British Standards

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Section 3:
BR 135 - performance criteria and classification method

BR135 – Fire performance of external thermal insulation for walls of multi-storey buildings

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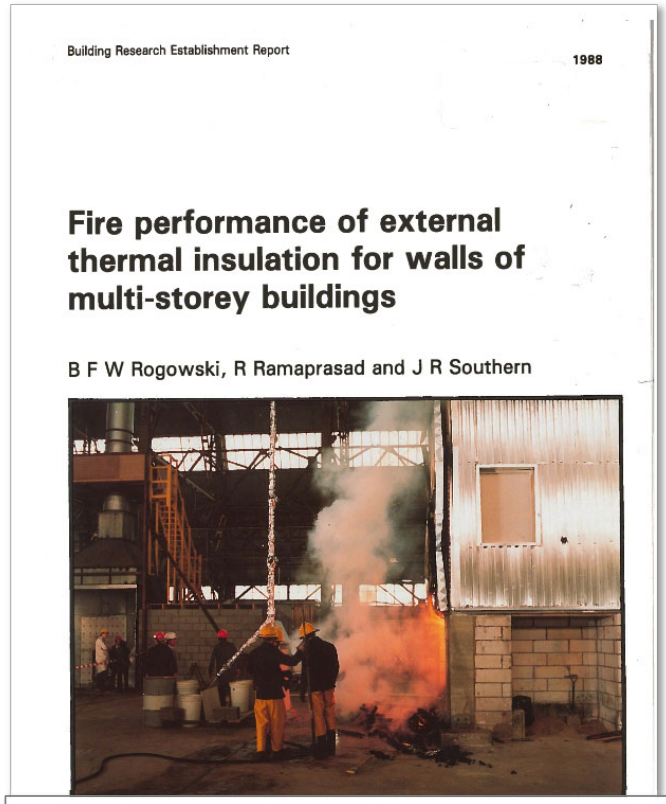
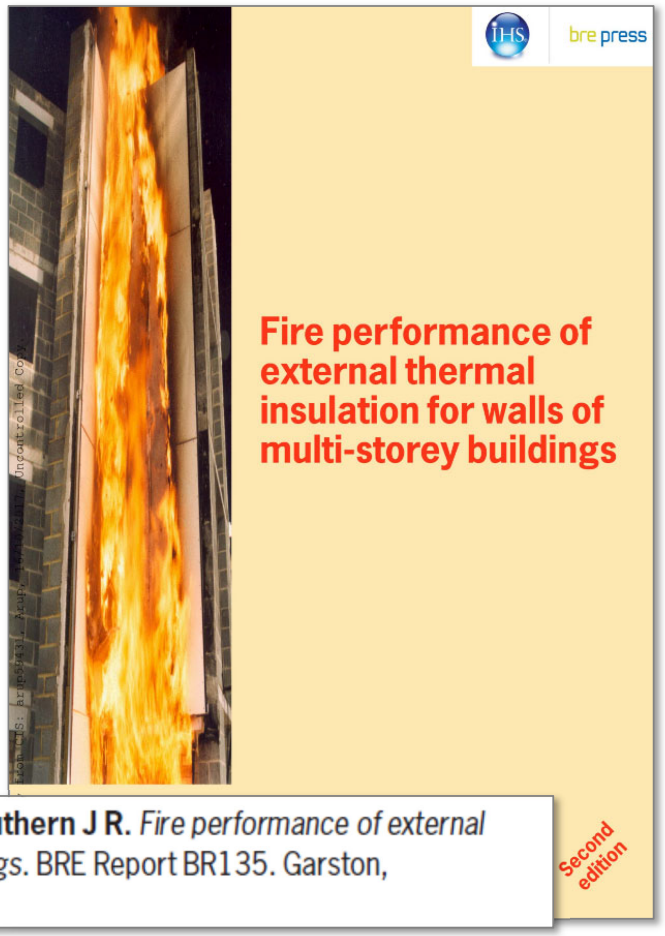
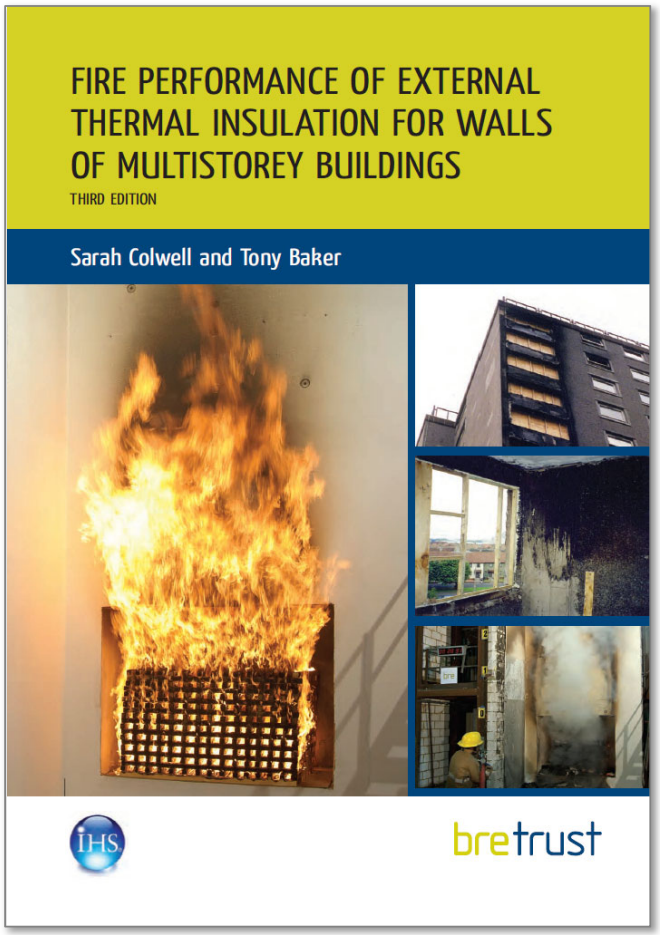






[2] **Rogowski B F W, Ramaprasad R and Southern J R.** *Fire performance of external thermal insulation for walls of multi-storey buildings*. BRE Report BR135. Garston, BRE Bookshop, 1988.

BR135 – Application

ARUP

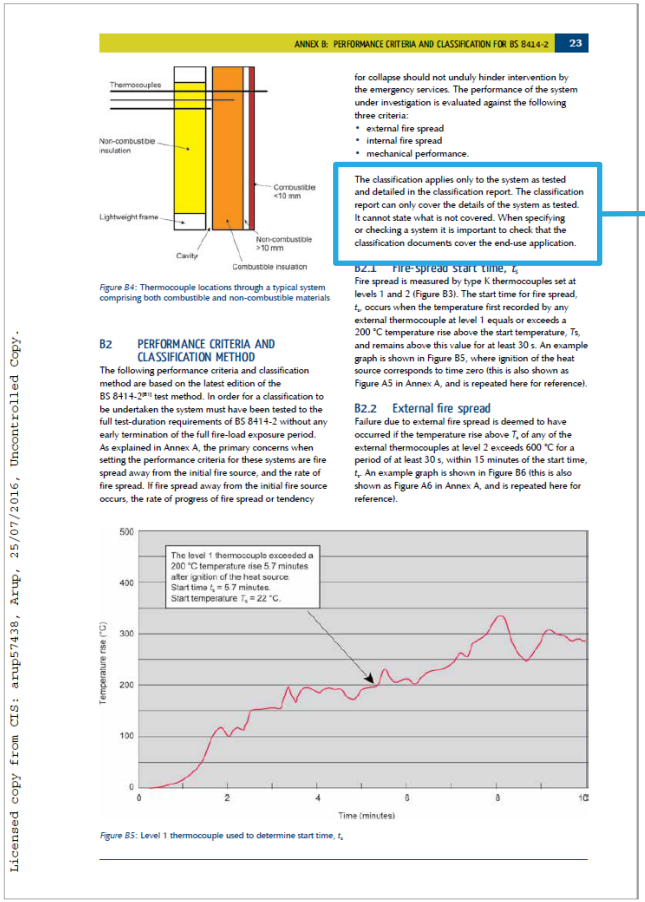


Figure B4: Thermocouple locations through a typical system comprising both combustible and non-combustible materials

B2 PERFORMANCE CRITERIA AND CLASSIFICATION METHOD

The following performance criteria and classification method are based on the latest edition of the BS 8414-2[BR135] test method. In order for a classification to be undertaken the system must have been tested to the full test-duration requirements of BS 8414-2 without any early termination of the full fire-load exposure period. As explained in Annex A, the primary concerns when setting the performance criteria for these systems are fire spread away from the initial fire source, and the rate of fire spread. If fire spread away from the initial fire source occurs, the rate of progress of fire spread or tendency for collapse should not unduly hinder intervention by the emergency services. The performance of the system under investigation is evaluated against the following three criteria:

- external fire spread
- internal fire spread
- mechanical performance.

The classification applies only to the system as tested and detailed in the classification report. The classification report can only cover the details of the system as tested. It cannot state what is not covered. When specifying or checking a system it is important to check that the classification documents cover the end-use application.

B2.1 Fire-spread start time, t_s

Fire spread is measured by type K thermocouples set at levels 1 and 2 (Figure B3). The start time for fire spread, t_s, occurs when the temperature first recorded by any external thermocouple at level 1 equals or exceeds a 200 °C temperature rise above the start temperature, T_s, and remains above this value for at least 30 s. An example graph is shown in Figure B5, where ignition of the heat source corresponds to time zero (this is also shown as Figure A5 in Annex A, and is repeated here for reference).

B2.2 External fire spread

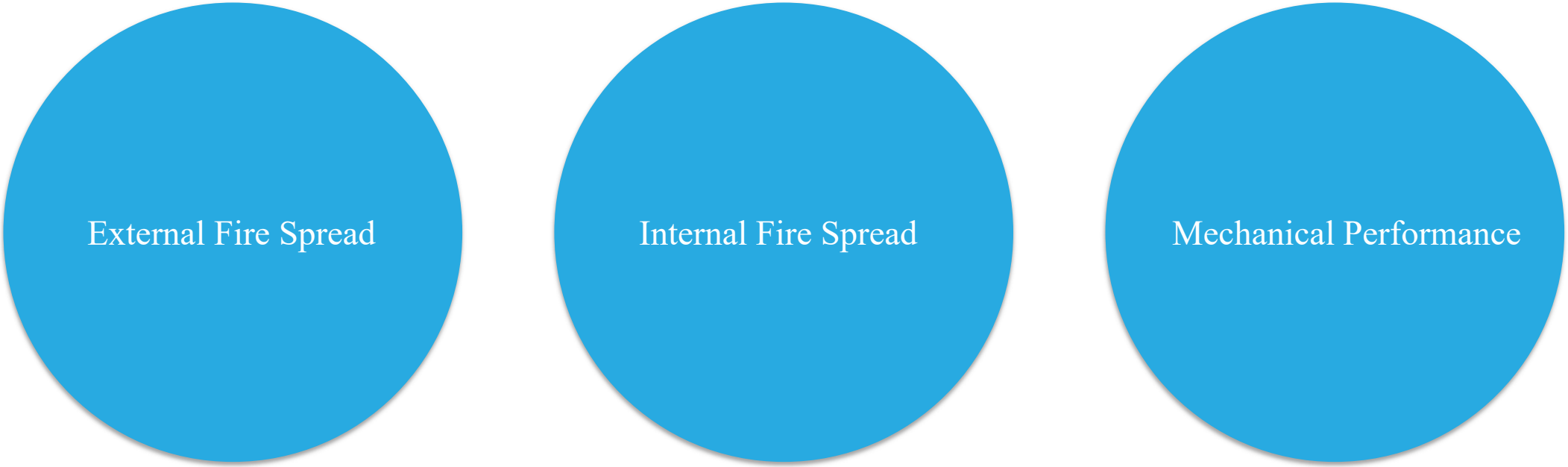
Failure due to external fire spread is deemed to have occurred if the temperature rise above T_s of any of the external thermocouples at level 2 exceeds 600 °C for a period of at least 30 s, within 15 minutes of the start time, t_s. An example graph is shown in Figure B6 (this is also shown as Figure A6 in Annex A, and is repeated here for reference).

Figure B5: Level 1 thermocouple used to determine start time, t_s

The classification applies only to the system as tested and detailed in the classification report. The classification report can only cover the details of the system as tested. It cannot state what is not covered. When specifying or checking a system it is important to check that the classification documents cover the end-use application.

BR135 – The three performance criteria

ARUP



Available at https://www.gov.uk/government/publications/fire-test-report-mhclg-bs-8414-hpl

Annex A – Performance criteria external fire spread

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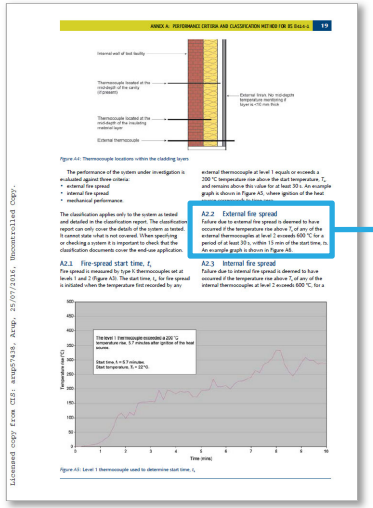
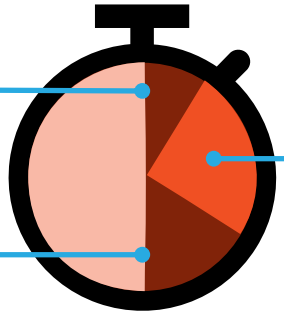


A2.2 External fire spread

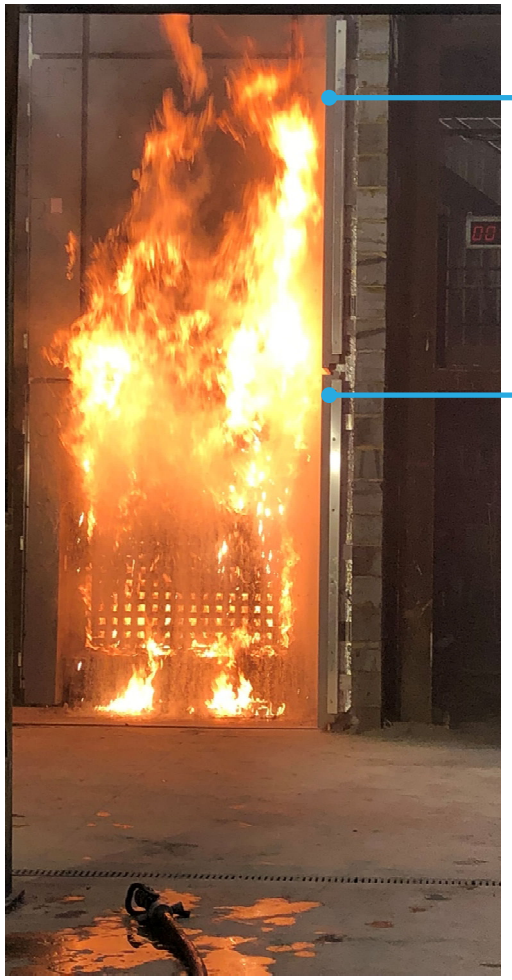
Failure due to external fire spread is deemed to have occurred if the temperature rise above T_s of any of the external thermocouples at level 2 exceeds 600 °C for a period of at least 30 s, within 15 min of the start time, *ts*.



Test ends at 60 mins

30 mins until extinguishment

15 mins window for some performance criteria

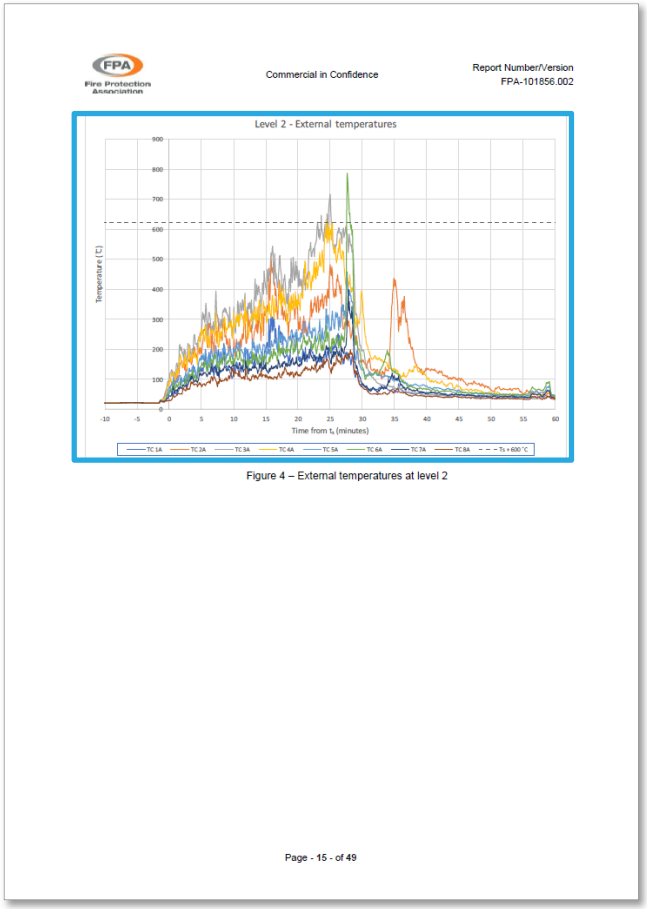


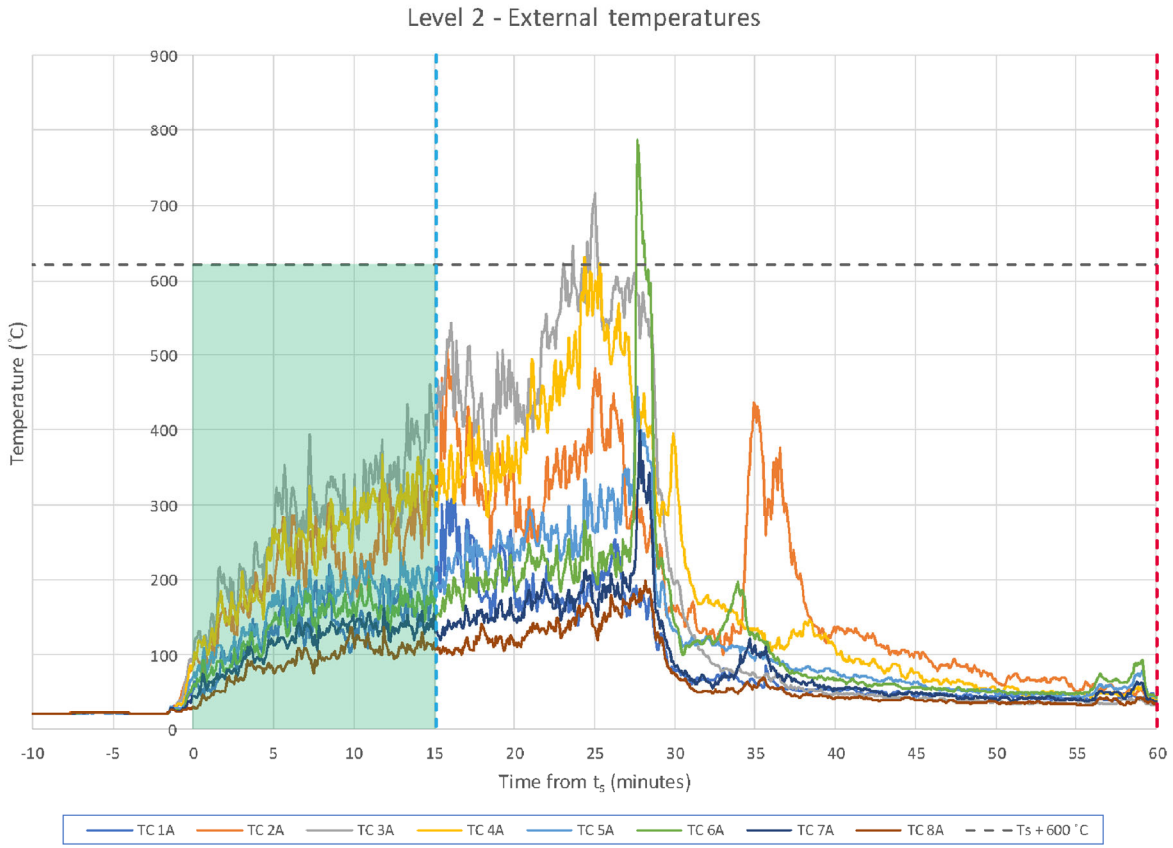
Level 2 – top of combustion chamber + 5000mm

Level 1 – top of combustion chamber + 2500mm

MHCLG Test on HPL panels 2019 Report No. 101856.002 – external fire spread

ARUP

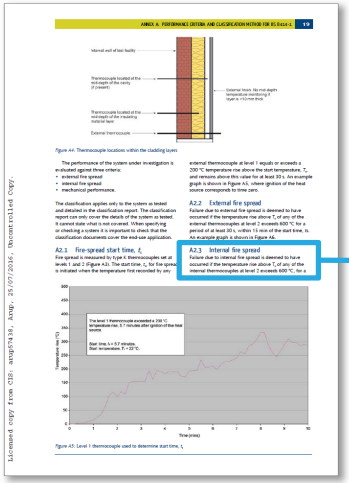


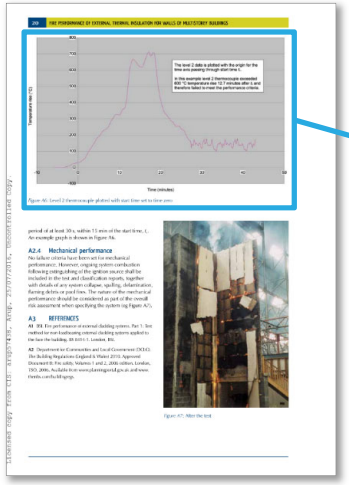


Available at https://www.gov.uk/government/publications/fire-test-report-mhclg-bs-8414-hpl
Report reference 101856.00, version number 2.0

Annex A – Performance criteria internal fire spread

ARUP





A2.3 Internal fire spread

Failure due to internal fire spread is deemed to have occurred if the temperature rise above T_s of any of the internal thermocouples at level 2 exceeds 600 °C, for a period of at least 30 s, within 15 min of the start time, t_s.

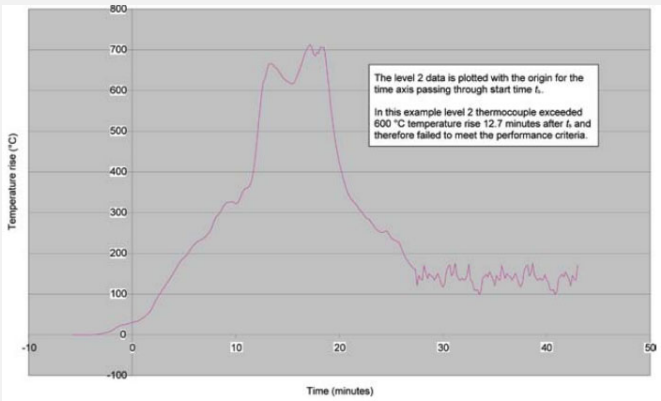
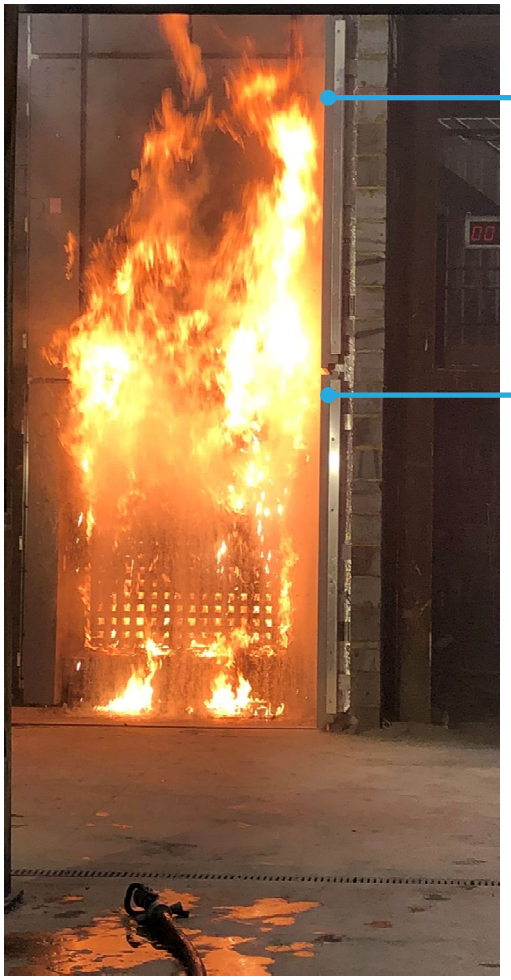


Figure A6: Level 2 thermocouple plotted with start time set to time zero

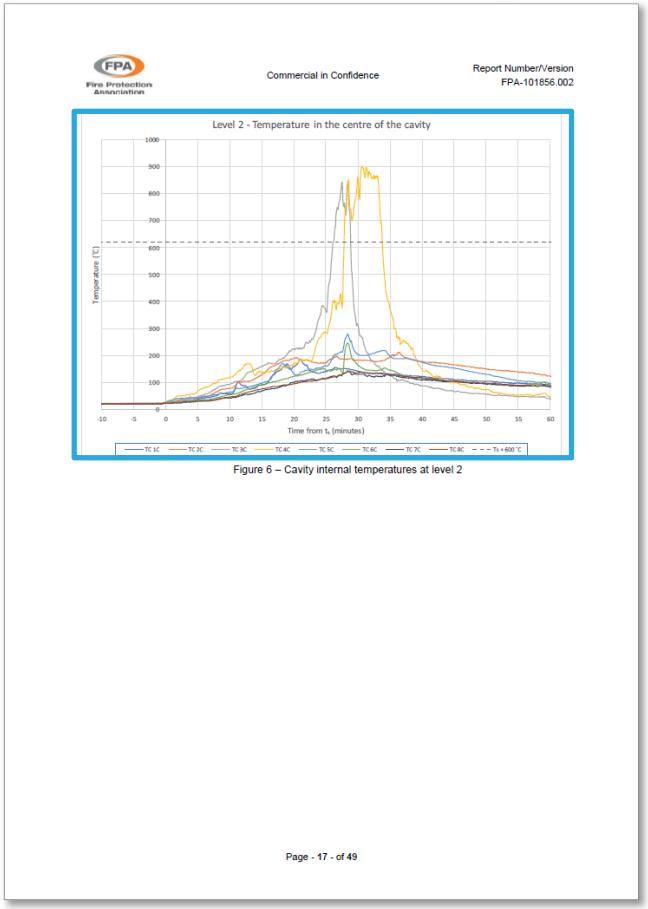


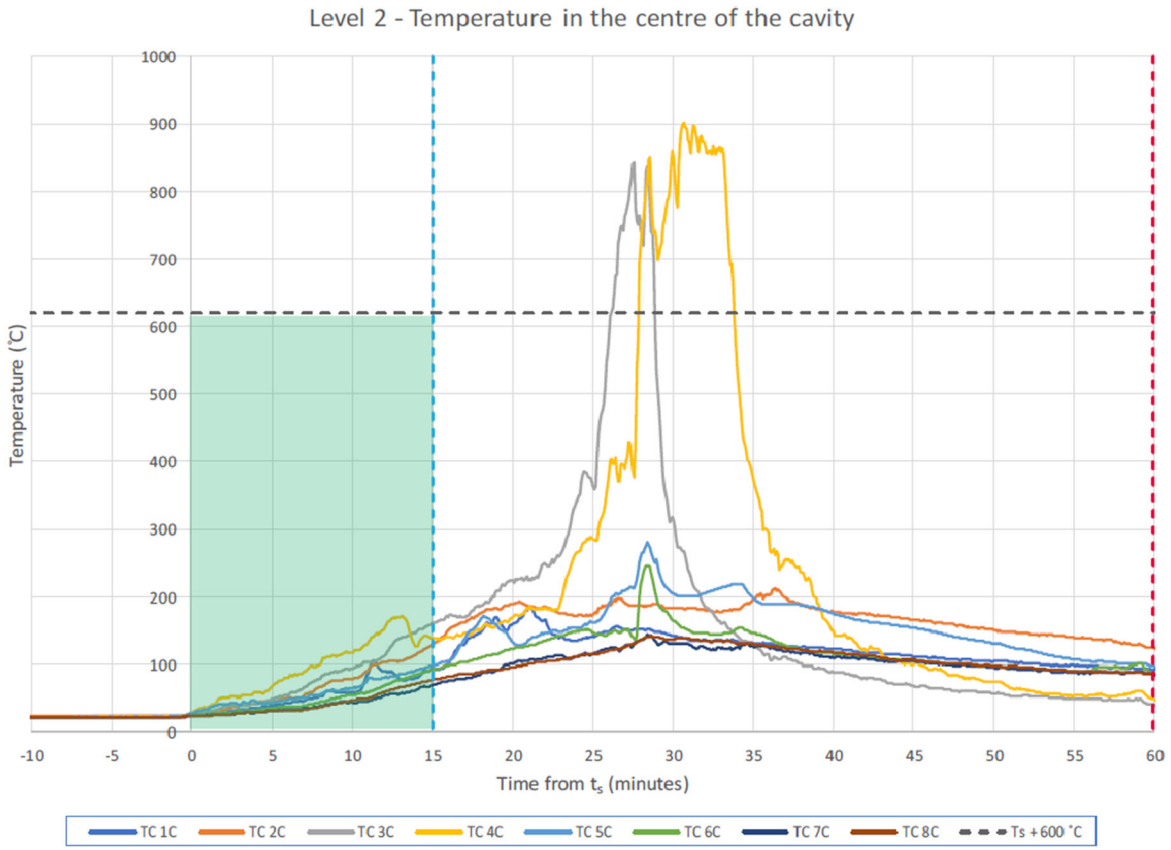
Level 2 – top of combustion chamber + 5000mm

Level 1 – top of combustion chamber + 2500mm

MHCLG Test on HPL panels 2019 Report No. 101856.002 – Internal fire spread

ARUP





Available at https://www.gov.uk/government/publications/fire-test-report-mhclg-bs-8414-hpl
Report reference 101856.00, version number 2.0

Limitations of BR135 performance criteria

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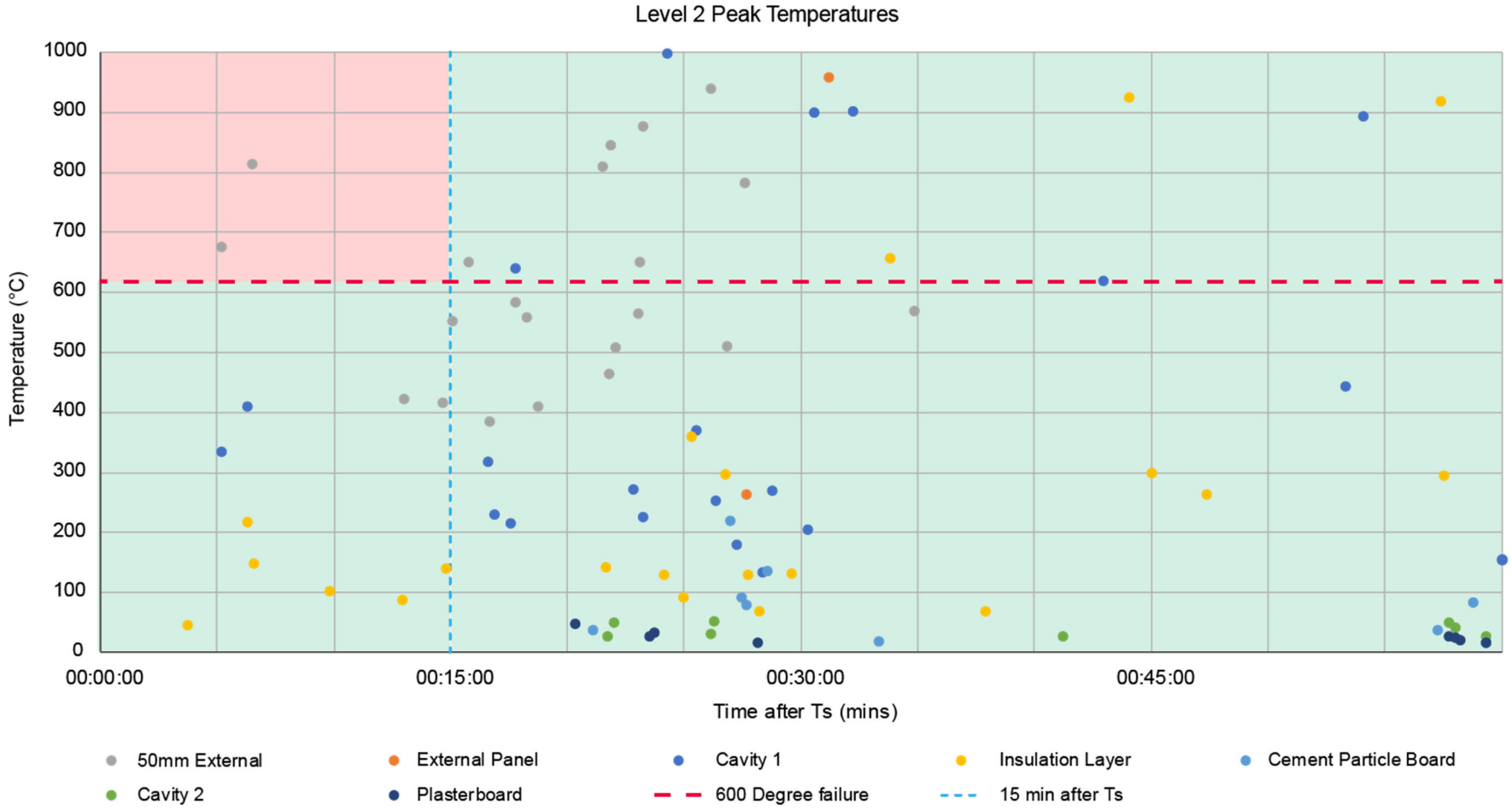

Limitations of BR135 performance criteria

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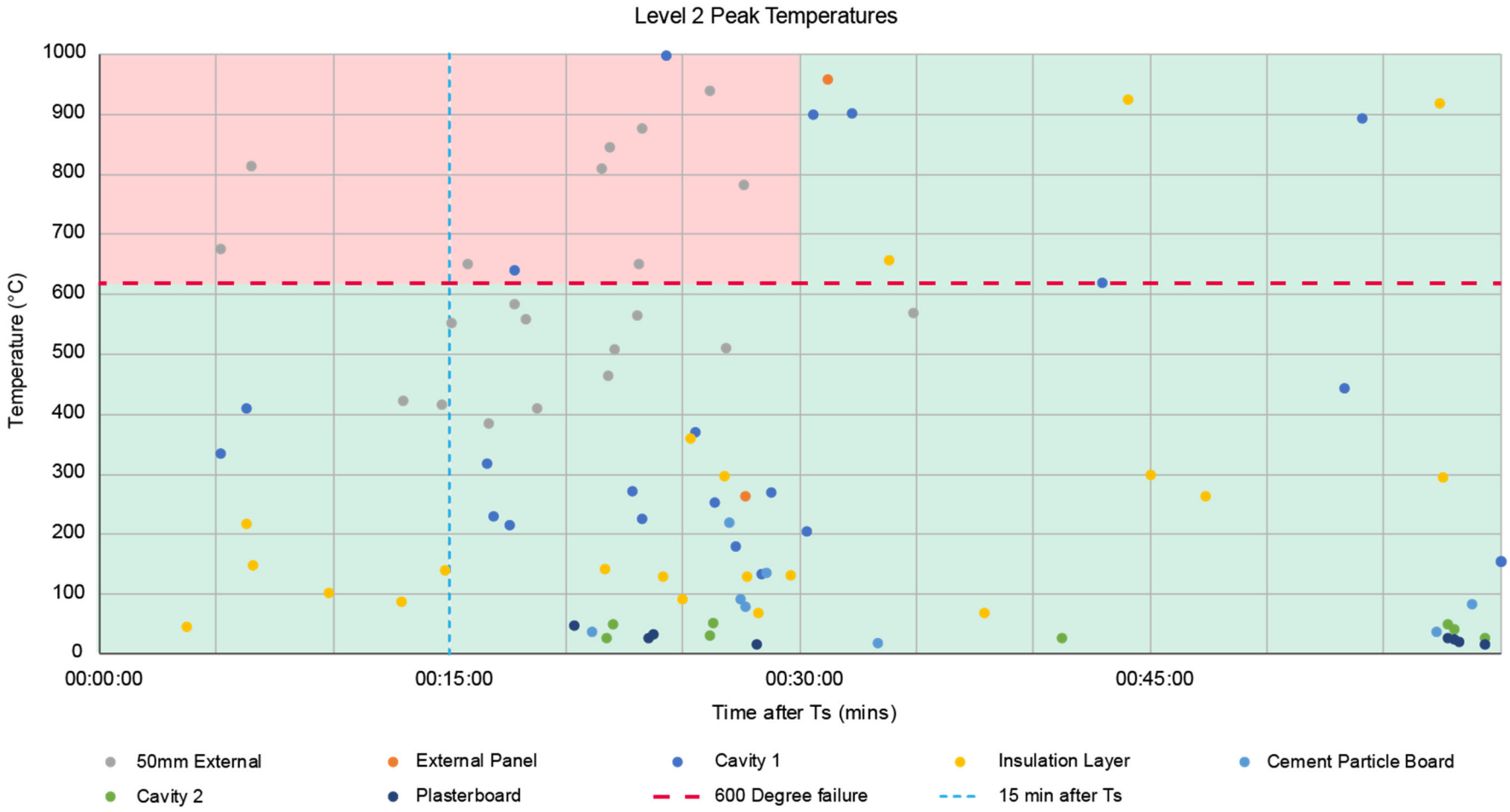

Annex A – Mechanical Performance criteria

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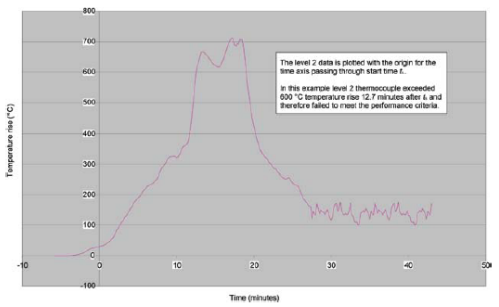

Figure A6: Level 2 thermocouple plotted with start time set to time zero

period of at least 30 s, within 15 min of the start time, t_s.
An example graph is shown in Figure A6.

A2.4 Mechanical performance
No failure criteria have been set for mechanical performance. However, ongoing system combustion following extinguishing of the ignition source shall be included in the test and classification reports, together with details of any system collapse, spalling, delamination, flaming debris or pool fires. The nature of the mechanical performance should be considered as part of the overall risk assessment when specifying the system (eg Figure A7).

A3 REFERENCES

A1 BSI. Fire performance of external cladding systems. Part 1: Test method for non-loadbearing external cladding systems applied to the face the building. BS 8414-1. London, BSI.

A2 Department for Communities and Local Government (DCLG). The Building Regulations (England & Wales) 2010. Approved Document B: Fire safety, Volumes 1 and 2, 2006 edition. London, TSO, 2006. Available from www.planningportal.gov.uk and www.thenbs.com/buildingregs.

Figure A7: After the test

A2.4 Mechanical performance

No failure criteria have been set for mechanical performance. However, ongoing system combustion following extinguishing of the ignition source shall be included in the test and classification reports, together with details of any system collapse, spalling, delamination, flaming debris or pool fires. The nature of the mechanical performance should be considered as part of the overall risk assessment when specifying the system (eg Figure A7).

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References to BR135 and BS8414 during the Grenfell Refurbishment

The use of Celotex RS5000 at Grenfell

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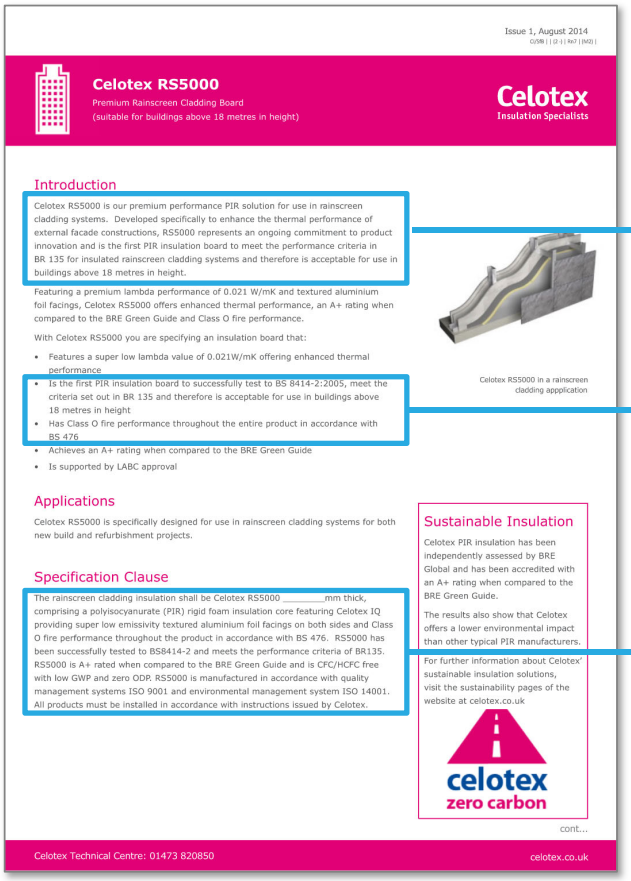

Issue 1, August 2014

Celotex RS5000
Premium Rainscreen Cladding Board
(suitable for buildings above 18 metres in height)

Celotex
Insulation Specialists

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 O 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 O 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

Celotex RS5000 in a rainscreen cladding application

Applications

Celotex RS5000 is specifically designed for use in rainscreen cladding systems for both new build and refurbishment projects.

Specification Clause

The rainscreen cladding insulation shall be Celotex RS5000 _____mm thick, comprising a polyisocyanurate (PIR) rigid foam insulation core featuring Celotex IQ providing super low emissivity textured aluminium foil facings on both sides and Class O fire performance throughout the product in accordance with BS 476. RS5000 has been successfully tested to BS8414-2 and meets the performance criteria of BR135. RS5000 is A+ rated when compared to the BRE Green Guide and is CFC/HCFC free with low GWP and zero ODP. RS5000 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.

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.

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
zero carbon

cont...

Celotex Technical Centre: 01473 820850 celotex.co.uk

Page 1 of
{RYD00018155}

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.

- 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 O fire performance throughout the entire product in accordance with BS 476

The rainscreen cladding insulation shall be Celotex RS5000 _____mm thick, comprising a polyisocyanurate (PIR) rigid foam insulation core featuring Celotex IQ providing super low emissivity textured aluminium foil facings on both sides and Class O fire performance throughout the product in accordance with BS 476. RS5000 has been successfully tested to BS8414-2 and meets the performance criteria of BR135. RS5000 is A+ rated when compared to the BRE Green Guide and is CFC/HCFC free with low GWP and zero ODP. RS5000 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.

The use of Celotex RS5000 at Grenfell

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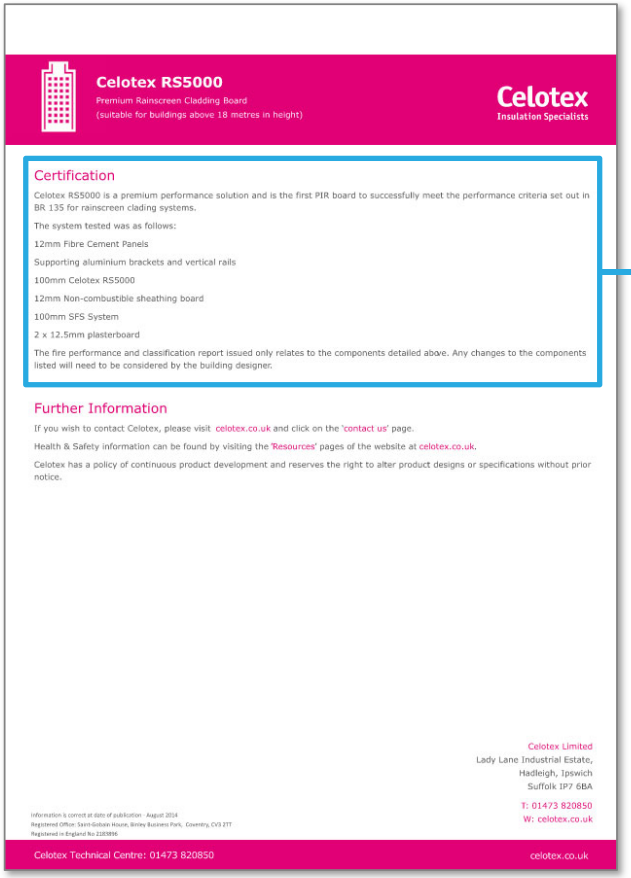

Celotex RS5000
Premium Rainscreen Cladding Board
(suitable for buildings above 18 metres in height)

Celotex
Insulation Specialists

Certification

Celotex RS5000 is a premium performance solution and is the first PIR board to successfully meet the performance criteria set out in BR 135 for rainscreen clading systems.

The system tested was as follows:

12mm Fibre Cement Panels

Supporting aluminium brackets and vertical rails

100mm Celotex RS5000

12mm Non-combustible sheathing board

100mm SFS System

2 x 12.5mm plasterboard

The fire performance and classification report issued only relates to the components detailed above. Any changes to the components listed will need to be considered by the building designer.

Further Information

If you wish to contact Celotex, please visit celotex.co.uk and click on the 'contact us' page.

Health & Safety information can be found by visiting the 'Resources' pages of the website at celotex.co.uk.

Celotex has a policy of continuous product development and reserves the right to alter product designs or specifications without prior notice.

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Information is correct at date of publication - August 2014
Registered Office: Saint-Gobain House, Binley Business Park, Coventry, CV3 2TT
Registered in England No 2185896

Celotex Technical Centre: 01473 820850 celotex.co.uk

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Cladding products and systems - scale of test samples and test durations

Scale of test samples

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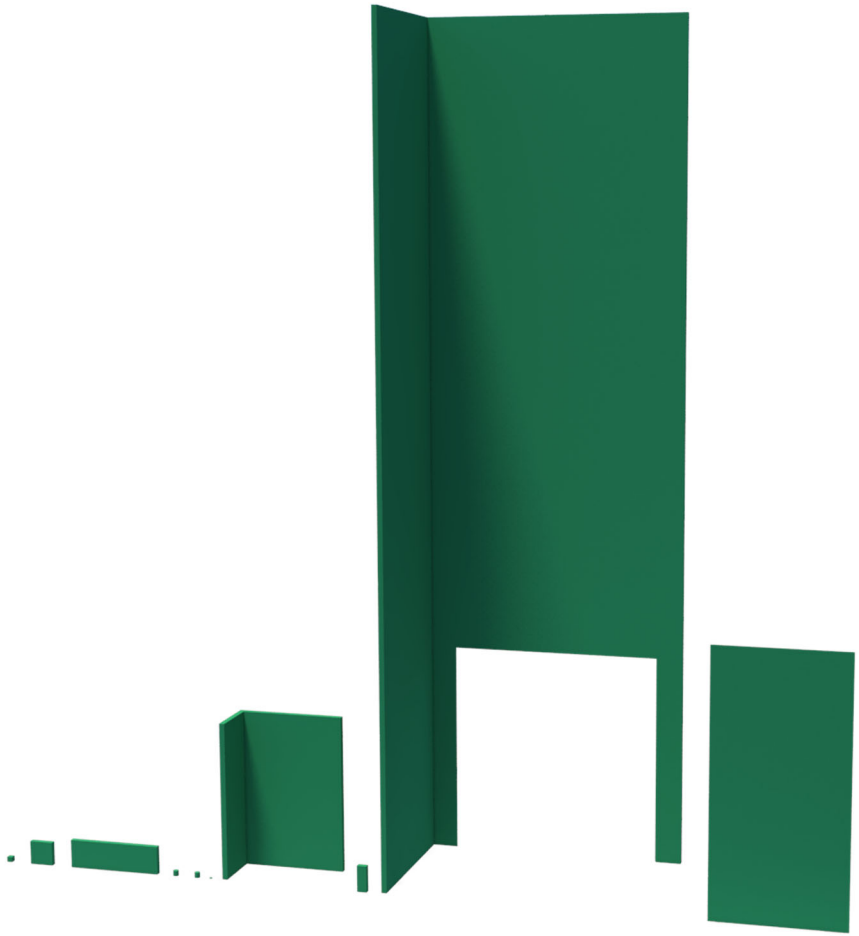

Maximum duration of test

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Test	Description	Maximum test duration (mins)
BS 476-4	Non-combustibility test for materials	20
BS 476-6	Method of test for fire propagation for products	20
BS 476-7	Surface spread of flame of products	10
BS 476-11	Method for assessing the heat emission from building materials	120
BS EN ISO 1182	Reaction to fire tests for products. Non-combustibility	60
BS EN ISO 1716	Determination of the gross heat of combustion (calorific value).	Until sample is fully combusted
BS EN 13823	Single burning item test	26
BS EN 11925-2	Single flame source test	1
BS 8414-1; BS 8414-2	Fire performance of external cladding systems	60

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Summary of points to consider