



# **Fire Protection Requirements for EWI Systems**

The four geographic regions to which the Building Regulations apply, namely England, Wales, Scotland and Northern Ireland, each have their own provision for achieving an acceptable standard of fire protection. These take into account the resistance to fire spread over external walls, structure height, space separation between buildings, position in relation to boundaries, unprotected areas, and the intended use of the structure. Until recently, the requirements between individual regulations differed; however, a common consensus of underlying principles has now been reached which are outlined in this guide.

**Insulated Render and Cladding Association (INCA)**  
**6-8 Bonhill Street, London, EC2A 4BX**  
**T: 0844 249 0040 F: 0844 249 0042 E: [info@inca-ltd.org.uk](mailto:info@inca-ltd.org.uk)**  
**W: [www.inca-ltd.org.uk](http://www.inca-ltd.org.uk)**



## Building Regulations

The Building Regulations in the UK apply to most new buildings and many refurbishments of existing structures and compliance to all aspects, including fire regulations, is a legal requirement. England, Wales, Scotland and Northern Ireland all have their own guidance documents and within these are dedicated parts relating to all aspects of building fire safety. Each has provision for achieving adequate containment of fire spread over the external envelope of a structure and although the underlying principles are common to all, the detail of the individual regional regulations have some differences.

Within the Regulations reference is made to both British and European fire standards applicable to their surface spread of flame and fire performance on multi storey buildings. This guide considers fire safety requirements in relation to both fire regulations and these standards.



## Legislation

When considering the design of EWI systems the parts of the Regulations relating to the construction of external wall cladding include specific reference to non-load bearing EWI systems in terms of combustibility, structure height and the intended use of the structure. However, these should never be assessed in isolation without reference to other related parts and sections of the regulations.

The documents and associated sections that require consideration are listed below.

### England and Wales

Building Regulations Approved Document B - 2010

- Approved Document B - Volume 1 - Dwelling houses - Fire safety - Part B4 External Fire Spread
- Approved Document B - Volume 2 - Buildings other than dwelling houses - Fire Safety Part - B4 External Fire Spread - Section 12.6 to 12.9

Other sections, but not limited to:

- Volume 1 - B3 Section 5 Compartmentation, B4 Section 9 Space separation (Boundaries, unprotected areas)
- Volume 2 - B3 Section 8 Compartmentation, Section 9 cavities, B4 Section 13 Space separation (Boundaries, unprotected areas)

### Scotland

The Scottish Regulations Technical Handbook 2015 Edition

- Technical Handbook: Domestic - Fire Part 2 - 2.7 spread on external walls
- Technical Handbook: Non-Domestic - Fire Part 2 - 2.7 spread on external walls

Other sections within the Technical Handbook, but not limited to:

- 2.1 Compartmentation
- 2.2 Separation
- 2.4 Cavities
- 2.6 Spread from Neighbouring Building
- 2.8 Spread from Neighbouring Building



## Northern Ireland

- Technical Booklet E - Fire Safety - Section 5 External fire Spread.

Other sections, but not limited to:

- Section 4 Internal Fire spread structure

In England, Wales and Northern Ireland National Standards are used to define grades of material combustibility from within a range, from non-combustible to Class 3. In Scotland a Performance Risk Classification is used in a similar manner for non-combustible to very high (risk). A comparison is shown in Table 1 (Page 15) where in England & Wales and Northern Ireland there is a National Standard for limited combustibility which is not applicable in Scotland. Limited Combustibility is defined in Table A7 of England and Wales and 1.9/1.10 of Northern Ireland. In recent years these British standards have been matched as a guide to equivalent European Fire classifications to BS EN 13501-1, but do not automatically equate unless confirmed by testing.

Sections within each regulatory document refer to external wall construction, external spread of fire and the use and definition of materials classified as either Non-Combustible, of Limited Combustibility or Low Risk making reference to British Standards, European Standards, National Classification and Building Research Establishment (BRE) publications.

Where systems are to be considered as non-combustible the total external wall insulation (EWI) system, not only the insulation, must be non-combustible and have either achieved an A1 or A2 European classification under test conditions or none of the materials are to contain more than 1% of homogeneously distributed organic material.

Building Regulations in England and Wales and Northern Ireland for EWI systems used on buildings greater than 18 m in height must either conform to the Regulation definition for limited combustibility (or better) or alternatively meet the provisions in BR135. Likewise external wall cladding less than 1 m from a relevant boundary should conform to the same requirement.

In Scotland Building Regulations for EWI systems used on buildings greater than 18 m in height must be totally non-combustible or conform to the alternative guidance given in BR135 (see later section). Similarly non-domestic buildings, flats and maisonettes external wall



cladding less than 1 m from a relevant boundary should meet the same requirement, but does not apply to domestic houses.

## Fire standards

External wall systems are assessed for combustibility and ignitability by reaction to fire performance tests that measure the contribution to fire growth, not the ability of a system to resist the passage of fire against time in terms of insulation and integrity.

British and European fire tests will coexist in use until the British Standard classifications are withdrawn.

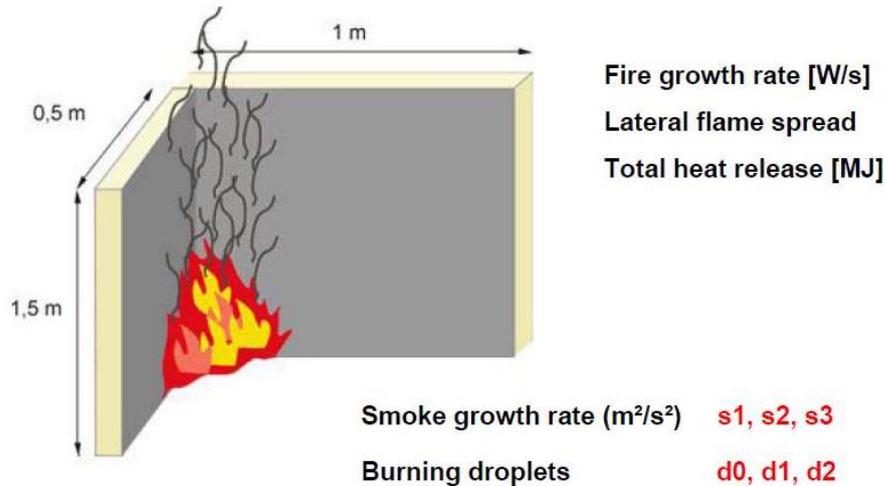
## European Standards

### ***EN ISO 11925-2 Single Flame Ignitability (SFI) test***

Small scale test simulates a cigarette lighter flame being placed on the exposed insulation edge of the specimen surface for a short duration (15 or 30 seconds).

### ***EN 13823: Single Burning Item (SBI) test***

The principle EWI reaction to fire test used to determine European Classes B, C and D of fire impingement on an internal corner. The speed of fire development in the first 10 minutes is a key factor in allowing time for evacuation from a building. The test method measures oxygen consumption, carbon dioxide generated and temperature and from these results the Total Heat Release and Fire Growth Rate (FIGRA) for the first 10 minutes of flame exposure can be calculated. During this time visual assessment is made for the secondary classifications for both flaming droplets given as d0 (best result), d1 or d2, and via light reduction the Total Smoke Production (TSP) and Smoke Growth Rate (SMOGRA) to give a Smoke Index s1 (best result), s2, s3.



Typical example of test rig

### EN 13501-1: 2002 Classification

Values obtained from EN ISO 11925-2 and FIGRA and SMOGRA from EN13823 allows EWI system classifications to be determined for B, C, D, E and F performance. A1 classification is derived from BS EN ISO 1182 non combustibility test and BS EN ISO 1716 Heat of combustion (Bomb Calorimetry). A2 classification requires both these tests and values from BS EN 13823.

### British standards

#### BS 476 Part 6 and 7

Part 7 is carried out using apparatus commonly referred to as fire propagation box and measures the amount and rate of heat released by a product under standard heating conditions. Test results are given as an Index of Performance (I) which is based on three sub-indices (i1, i2, i3). The higher the value of the Index, (I), the greater the material contribution to fire growth. The higher the value of the sub-index, i1 the greater the ease of ignition and flame spread.

The Part 6 test measures the spread of flame initially provided by a pilot flame applied to the bottom corner of the specimen during the first minutes of test. The specimen is mounted in the vertical plane and placed perpendicular to a radiant heat panel for 10 minutes. Materials are classified into Classes 1 to 4 in descending order of performance according to the rate and extent of flame spread over their surface under standard heating conditions.

***Class 0 (England, Wales and NI only)***

Classification is achieved with a material performance of Class 1 to BS 476: Part 7 which has a fire propagation index (I) of not more than 12, and a sub-index (i<sub>1</sub>) of not more than 6 to BS 476: Part 6.

Although this system is still valid and has served the construction industry well over the years it is not accepted for inclusion on European Technical Assessments so is gradually being superseded by the now more widely accepted European classification system.

***BS 8414 Parts 1 and 2***

These test methodologies allow full scale testing of EWI systems on either a solid substrate (Part 1) or a sheathed structural lightweight steel frame (Part 2). The test procedure for each is identical with the EWI system installed on a main test wall 8 m in height, 2.6 m wide with a 1.5 m wide return wing. A 2m x 2m combustion chamber is located in the base of the main wall and a wooden crib ignited in the chamber to simulate fire break out from a window or doorway and its propagation over the facade. Thermocouples installed through and within the EWI system at various heights on the walls constantly monitor temperature to determine external and internal fire spread over the 30 minute fire duration which is followed by a 30 minute post fire observation period.



*Typical example of test rig*



### **BR135**

Building Regulations refer to BR135 “Fire performance of external thermal insulation for walls of multi-storey buildings” as an alternative classification to non-combustible systems written by the Building Research Establishment (BRE) and was republished in 2014. It provides explanation to mechanisms of fire spread and the principles and design methodologies related to the fire spread performance characteristics of EWI systems particularly in regard to fire break details within combustible systems. Additionally Annex A and B2 provide the performance criteria and classification method for the BS 8414-1 and BS 8414 test methodology respectively. This is evaluated by analysis of the thermal couple data to determine external and internal fire spread and visual assessment of mechanical performance, although it does not contribute to the final classification. Each classification is for the system exactly as detailed in the test report and, for example, is specific to a given thickness of insulation tested, not a thickest and thinnest range.

### **LPS 1581 and LPS 1582**

These Loss Prevention Certification Board (LPCB) standards are nationally accredited third party approval schemes leading to a LPCB Red Book listing. The standards allow full scale testing of EWI systems on either a solid substrate (LPS 1581) or a sheathed structural lightweight steel frame (LPS 1582). Fire testing is similar to BS 8414 and BR135 classification, but with more stringent acceptance criteria for mechanical performance, burning debris and pool fires and glowing combustion (insulation). In addition to the fire testing there is a full review of product documentation and specifications combined with an annual manufacturing plant quality surveillance audit are required to provide a level of accreditation widely accepted by insurers. Certification is more “flexible” than BR135 classification and for example often covers a maximum and minimum thickness range of insulation and all thicknesses in-between.

## **Storey Height and Boundary Distance**

### **England, Wales and Northern Ireland**

Fire classification requirements for EWI systems change according to storey height greater or less than 18 m in height above ground level and/or a boundary distance between structures greater or less than 1m. Systems of at least limited combustibility and including those meeting the provisions of BR135 are compliant to all combinations of height and boundary conditions, but combustible systems are required to fulfil a number of criteria to meet the various area regulations which can also be dependent on the structure usage and whether there may be



roof areas below the building height with public access. In the case for assembly or recreation buildings or special use buildings the full regulations should be referred to for specific detail.

Combustible systems less than 18 m in height and greater than 1 m from a boundary require no special fire provisions, but within 1 m of a boundary must meet at least European Class B. Combustible systems greater than 18 m in height and greater than 1 m from a boundary must comply with at least a Euro Class C up to a height of 18 m and Euro class B above. When less than 1 m from a boundary the EWI over the full building height is required to meet European Class B. Additionally, combustible systems installed above 18 m irrespective of boundary distance must be classified to BR135.

## Scotland

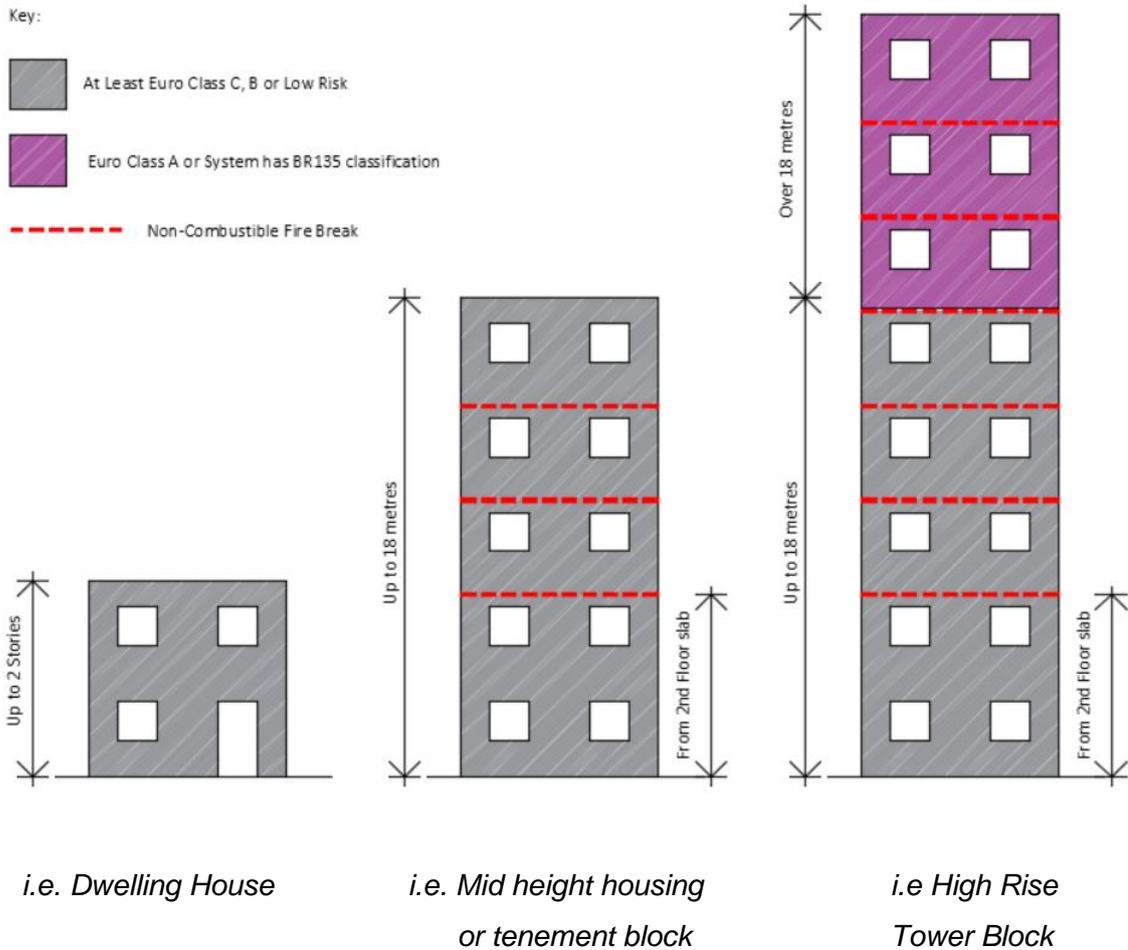
Fire classification requirements for EWI systems change according to storey height greater or less than 18 m in height above ground level and/or a boundary distance between structures greater or less than 1m. Systems that are non-combustible or conform to the alternative guidance given in BR135 are compliant to all combinations of height and boundary conditions, but combustible systems are required to fulfil a number of criteria to meet the various unprotected area regulations which can also be dependent on the structure usage, the construction of the existing external wall and whether there may be roof areas below the building height with public access. In the case for assembly or recreation buildings or special use buildings the full regulations should be referred to for specific detail.

Combustible systems less than 18m in height and greater than 1 m from a boundary require no special fire provisions, but not more than 1m from a relevant boundary must meet at least European Class B the low risk reaction to fire classification. This follows harmonisation of Scottish guidance issued in November 2013 in line with the rest of the UK.

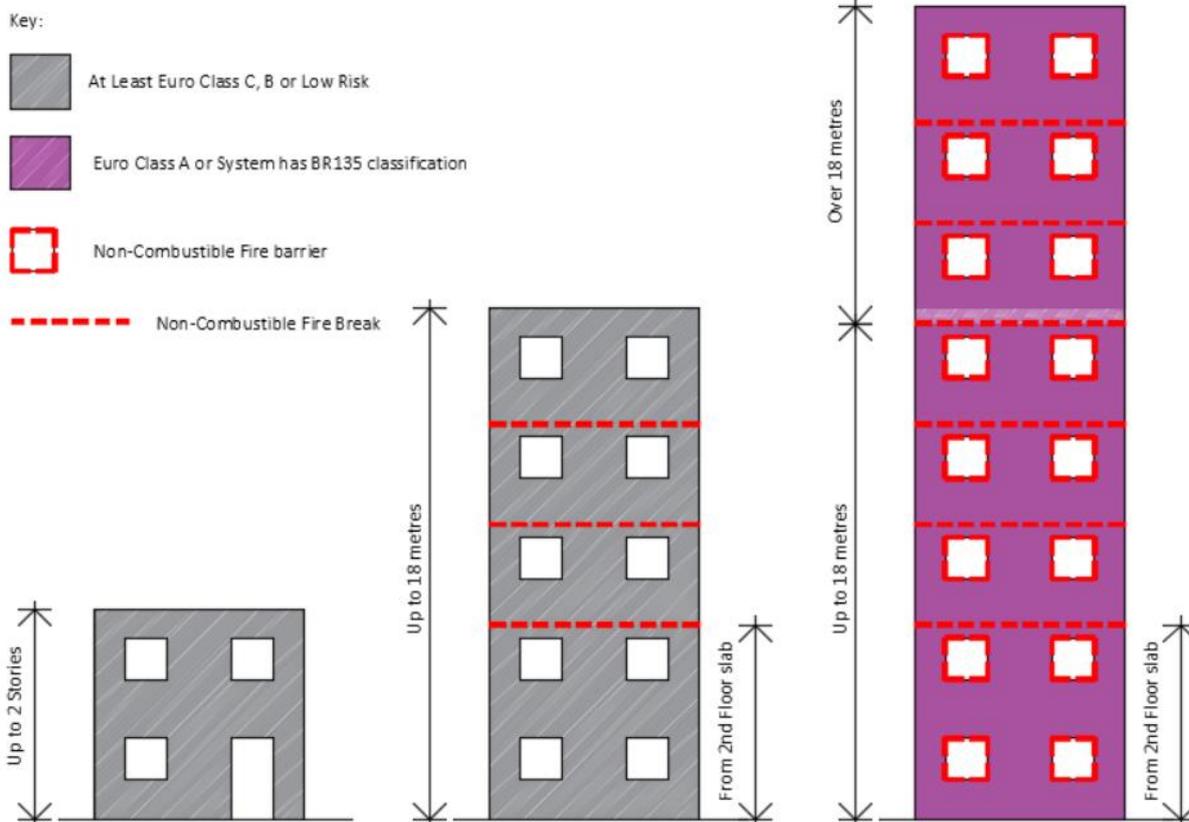
For buildings exceeding 18m a non-combustible cladding system must be used on every part of the external wall irrespective of boundary distance or alternatively if a combustible system is used it must be classified to BR135.

INCA have provided clarification in the diagram below based on a Technical Committee consensus for the requirements in England, Wales, Scotland and Northern Ireland, centred / established by an assessment of the Building Regulations and Scottish Standards

**England, Wales and Northern Ireland**



**Scotland**



*i.e. Dwelling House*

*i.e. Mid height housing  
or tenement block*

*i.e High Rise  
Tower Block*

**Note:**

The diagrams indicate INCA’s recommendations and guidance based on interpretations from industry. Each project should be taken on its own merits and the Local Authority Building Control Officer and appointed Fire Officer should always be contacted for approval or guidance.



## Principle Insulation types and their fire performance

Mineral wool, often referred to as “stone wool”, is a mineral based fibre product compressed and bound together with a small percentage of resin binder. It is classified as non-combustible A1 or A2 and a material of limited combustibility (in E & W and NI regs) and non-combustible in Scotland. It is supplied in two forms commonly referred to as slab and lamella. It is also used within combustible systems to form fire breaks. Typically mineral wool based systems have a Euro fire classification of A.

Expanded Polystyrene – generally abbreviated to EPS, is a combustible lightweight cellular plastic insulation, and very commonly specified for EWI systems. It is available in a standard white grade and recently a grey grade with enhanced thermal resistance. When used in EWI systems they must contain a flame retardant additive and provided the system is installed to the suppliers instructions and the insulation fully enclosed in a protective layer of base coat and mesh its fire performance is greatly enhanced. Typically EPS based systems have a Euro fire classification of B or C.

Phenolic, a combustible closed cell insulation faced with a flexible tissue layer surface, has gained wide acceptance for use in EWI during recent years. It has a low flame spread and negligible smoke emission properties. Typically phenolic foam based systems have a Euro fire classification of B or C.

Polyurethane (PUR) and Polyisocyanurate (PIR) – Both combustible closed-cell rigid foam insulation similar in physical form, but PIR has improved insulating qualities and exhibits increased fire performance and reduced combustibility and higher working temperature limits compared to Polyurethane Typically PIR based systems have a Euro fire classification of B or C.

Table indicates Full System classifications.

	<b>Generic description</b>	<b>Euro classification</b>	<b>England</b>	<b>Scotland</b>
Mineral Wool Slab	Mineral based fibre	A1/A2	Non-combustible/limited combustibility	Non combustible
Mineral Wool Lamella	Mineral based fibre	A1/A2	Non-combustible/limited combustibility	Non combustible
Expanded polystyrene (EPS) Standard (white)	Thermoplastic	B or C	Combustible	Combustible
Expanded Polystyrene (EPS) Enhanced (Grey)	Thermoplastic	B or C	Combustible	Combustible
Phenolic Foam	Thermoset	B or C	Combustible	Low risk
Polyurethane (PUR)	Thermoset	B or C	Combustible	Combustible
Polyisocyanate (PIR)	Thermoset	B or C	Combustible	Combustible

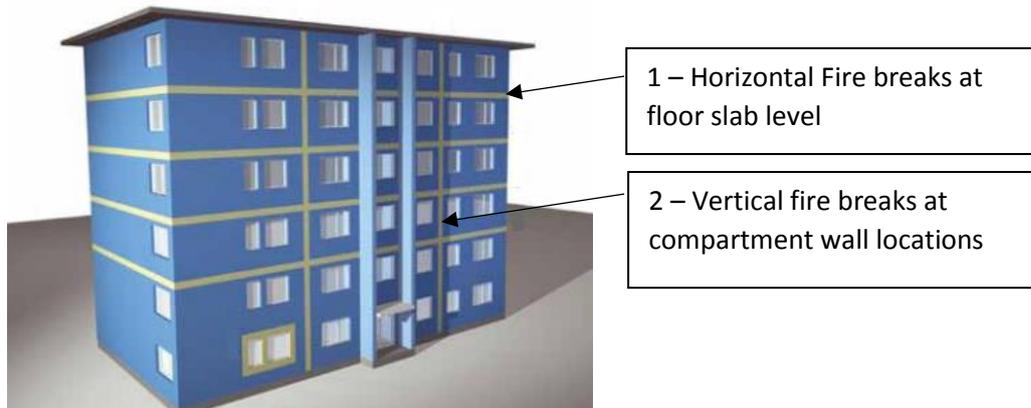
## Key Design Considerations

Full guidance should be taken from the recommendations provided in BR135 with documented evidence of the system having been tested to BS 8414-1 or 8414-2, to achieve BR135 classification.

Reference should always be made to Approved Document B for domestic and B2 for non-domestic buildings of the Building Regulations England and Wales and Technical Handbook – Fire, for domestic and non-domestic buildings of the Scottish Building Standards.

## Fire Barrier Locations

Fire spread should be contained to the floor level immediately above the origin of the fire. To achieve this in both thermoplastic insulated systems e.g. expanded polystyrene (EPS) and thermoset insulated systems e.g. phenolic foam, horizontal “fire barriers should be installed at each floor level above the first floor level i.e. starting with the second storey”.



*Typical example of fire barrier locations*

## Design Principles of Fire barriers

A typical fire barrier used with systems comprising of thermoset and thermoplastic insulation components must be constructed of non-combustible insulation material and cover the full depth of the insulation used in the system. The fire barrier, as recommended in BR135, should be at least 100 mm high and form a continuous band through the full thickness of the insulation layer. Systems using mineral wool insulation are considered continuous fire barriers in themselves. Systems using mineral wool insulation throughout fastened back to the substrate, if classified totally non-combustible or compliant to BR135/LPS criteria, may be considered continuous firebreaks in their own right.

## Cavity Systems (to meet NHBC requirements)

To meet the NHBC standard EWI systems must be designed and certificated to ensure adequate in-service performance is achieved. This includes the introduction of a cavity, which can be either vented and drained – Timber Frames, or vented – Steel Frames, of at least 15mm between the substrate and the insulation to allow any incidental moisture the



ability to naturally dry, or a free passage of drainage during normal usage. In the event of fire the installed horizontal fire barriers must have the capability of preventing fire spread through the cavity by closing it off. Many systems incorporate heat activated intumescent strips or grill systems to fulfil this requirement which is applicable to both combustible and non-combustible EWI systems. In accordance with the guidance provided in BR135 the only effective way to assess fire performance of these types of fire barriers is to test the complete system at large scale e.g. BS 8414.

The cavity must not impede ventilation or moisture drainage during normal usage, but in the event of fire the barrier installed must have the capability of preventing fire propagation through the cavity. Special attention to detailing around vulnerable openings such as windows and doorways should be made and if required vertical fire breaks to prevent lateral fire spread.

## Fixing details

A suitable through the mesh fixing method is required to ensure the system will not collapse in a fire. This can be adhesive, adhesive supplemented by mechanical fixing or solely mechanical fixing. Additional guidance on the latter is provided in BRE Defect Action Sheet DAS 132.

## Design approval

The location, type and fixing of all horizontal and vertical fire barriers (that may be necessary to prevent lateral fire spread) should be outlined in the design drawings submitted to the Building Control Department and would ultimately be approved by the Building Control Officer.

## Standards Summary

<b>BS EN ISO 1182</b>	Reaction to fire tests for building products. Non-combustibility test.
<b>BS EN 13501-1</b>	Fire classification of construction products and building elements. Classification using data from reaction to fire tests.
<b>BS EN 13823</b>	Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item (SBI).
<b>BS EN ISO 1716</b>	Reaction to fire tests for building products. Determination of the heat of combustion.
<b>BS EN ISO 11925-2</b>	Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single-flame source test (SFI).
<b>BS 476 Part 4</b>	Fire tests on building materials and structures. Non-combustibility test for materials.
<b>BS 476 Part 6</b>	Fire tests on building materials and structures. Method of test for fire propagation for products.
<b>BS 476 Part 7</b>	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products.
<b>BS 476 Part 11</b>	Fire tests on building materials and structures. Method for assessing the heat emission from building materials.
<b>BS 476 Part 20</b>	Fire tests on building materials and structures. Methods for determination of fire resistance of elements of construction (General Principles).
<b>BS 476 Part 22</b>	Fire tests on building materials and structures. Methods for determination of fire resistance of non-load bearing elements for construction.
<b>BS 8414 Part 1</b>	Fire performance of external cladding systems. Test methods for non-loadbearing external cladding systems applied to the face of a building
<b>BS 8414 Part 2</b>	Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame.
<b>BR 135: (Annex A)</b>	Fire performance of external thermal insulation for walls of multi-storey buildings (including Performance criteria and classification method for BS 8414-1
<b>BR 135: (Annex B)</b>	Performance criteria and classification method for BS 8414-2 given in BRE Digest 501.
<b>LPS 1581 – Issue 2</b>	Formerly LPS 1181 part 4, a Loss Prevention Certification Board (LPCB) third party accreditation standard for non-load bearing external thermal insulated cladding systems with rendered finishes fixed to a solid substrate.
<b>LPS 1582- Issue 1</b>	A Loss Prevention Certification Board (LPCB) third party accreditation standard awaiting publication, but will cover non-load bearing external thermal insulated cladding systems with render finishes fixed to and supported by a structural steel frame.
<b>Class 0</b>	National Classification of fire performance referred to in Building Regulations and derived from BS476 parts 6 and 7, but is not a British Standard.

### Table 1 – Comparison of National Fire Performance Classifications

Equivalent European classifications and European and British Standards required to attain the respective classification.

National Classification - England Wales and N Ireland	European Classification	Building Regulation Performance Risk classification - Scotland	European Classification	European Standard test methods required to achieve classification	British Standard test methods required to achieve classification
Non - Combustible	A1	Non - Combustible	A1 or A2	BS EN ISO 1182 and BS EN ISO 1716	BS 476 part 4 or BS 476 part 11 or BS 8414 classified to BR 135 or LPS accreditation
Limited Combustibility	A2	N/A		BS EN ISO 1182 or BS EN ISO 1716 and BS EN 13823 (N/A Scotland)	BS 476 part 4 or BS 476 part 11 or BS 8414 classified to BR 135 (N/A Scotland) or LPS accreditation
Class 0	B – s3, d2 or Better	Low	B – s3, d2 or Better	BS EN 13823 and BS EN ISO 11925-2	BS 476 parts 6 and 7 (BS476 part 6 Scotland)
Class 1	C – s3, d2 or Better	Medium	C – s3, d2 or Better	BS EN 13823 and BS EN ISO 11925-2	BS 476 parts 6 and 7 (BS 476 part 7 Scotland)
Class 2 & 3	D – s3, d2 or Better	High	D – s3, d2 or Better	BS EN 13823 and BS EN ISO 11925-2	BS parts 6 and 7 (BS 476 part 7 Scotland)
Class 4	E – s3, d2 or Better	Very High	E – s3, d2 or Better	A material which does not attain the performance for high risk or has no performance determined	

- 1) National classifications do not automatically equate with the equivalent European classifications.
- 2) When a classification includes s3, d2 there is no limit set for smoke production and/or flaming droplets

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Requests to use any part of this guide should be made in writing to:

Insulated Render and Cladding Association (INCA)  
6-8 Bonhill Street,  
London,  
EC2A 4BX

E: [info@inca-ltd.org.uk](mailto:info@inca-ltd.org.uk)