Standard for systemised building envelopes

Part 1 Scope, terminology, testing and classification

Part 2 Loads, fixings and movement

Part 3 Air, water and wind resistance

Part 4 Operable components, additional elements and means of access

Part 5 Thermal, moisture and acoustic performance

Part 6 **Fire performance**

Part 7 Robustness, durability, tolerances and workmanship

Part 8 Testing

Part 0 Specifiers' checklist and certification

CENTRE FOR WINDOW AND CLADDING TECHNOLOGY

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Standard for systemised building envelopes

Part 6
Fire performance

CENTRE FOR WINDOW AND CLADDING TECHNOLOGY

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FOREWORD

The purpose of these documents is to assist those who specify, design, manufacture or install building envelopes. They set performance criteria in a rational framework and provide a means for the consistent specification of building envelope performance. The documents are not a design guide and are intended for use by Designers and Specifiers with experience of building envelopes.

The Standard for systemised building envelopes comprises nine volumes:

Part 1 **Scope, terminology, testing and classification**
Part 2 **Loads, fixings and movement**
Part 3 **Air, water and wind resistance**
Part 4 **Operable components, additional elements and means of access**
Part 5 **Thermal, moisture and acoustic performance**
Part 6 **Fire performance**
Part 7 **Robustness, durability, tolerances and workmanship**
Part 8 **Testing**
Part 0 **Specifiers' checklist and certification**

Each volume should be read in conjunction with the other volumes and Standard test methods for building envelopes.

These documents are based on the CWCT Standards and Guide to Good Practice covering Curtain walling, Walls with ventilated rainscreens and Slope glazing systems. They have been combined in a single standard and rewritten to take account of new CEN standards in this field. These documents:

- **Set appropriate levels of performance for use in specific environments**
- **Set conditions when existing test results may be extrapolated to new projects**
- **Provide additional information not included within the CEN Standards.**

The black text is prescriptive, while the *blue italic text* gives background information or guidance on interpretation of the clause which it follows.

This Standard covers the performance specification, testing, inspection and assessment of building envelopes constructed from systems of components. They include but are not limited to:

Curtain walling
Rainscreen cladding
Composite panel systems
Slope glazing
Window wall
Glazing screens.

This Standard gives appropriate performance criteria and the basis for testing and verifying performance. However, there are many aspects of a building envelope that cannot be evaluated by these tests alone and so the testing requirements in the Standard should not be regarded as a substitute for proper assessment of a building envelope.

In drafting these documents, it has been assumed that the provisions will be applied intelligently, that the design will be undertaken by appropriately qualified and experienced designers, and the construction will be carried out by trained operators under the direction of suitably qualified supervisors.

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6 FIRE PERFORMANCE OF BUILDING ENVELOPES

6.1 Scope

6.1.1 General

This Standard is concerned with elements of the building envelope constructed predominantly from fully finished components and assemblies.

This includes all windows, doors, cappings, flashings, parapets, louvres and other penetrations through the envelope.

Interfaces to adjacent elements of the building envelope should also comply with the performance criteria of this Standard.

These elements of the envelope may be called:

Curtain walling
Rainscreen cladding
Slope glazing
Window wall
Glazing screen
Glazed roofing
Double skin facades

This Standard is concerned with the complete envelope and its structural support, not solely with the outer cladding elements.

6.1.2 Environments

The environmental conditions given in this Standard are applicable throughout the UK. They are also applicable in similar climates elsewhere but may need to be modified when specifying and testing facades to be constructed in other climates.

6.1.3 Building Regulations

The envelope shall also comply with the Building Regulations or local building code. This document refers to the Building Regulations for England and Wales, but these are cross-referenced to the equivalent regulations for Scotland and Northern Ireland in Appendix A.

Terminology used, including definitions of non-combustible materials and materials of limited combustibility, is those given in the Approved Document to Part B of the Building Regulations.

The Approved Document to Part B (AD B) of the Building Regulations for England and Wales relating to Fire has been split into volume 1 relating to dwelling houses and volume 2 relating to other buildings. The term 'dwelling house' does not include a flat or a building containing flats.

In Scotland there are separate volumes of the Technical handbook for domestic and non-domestic construction. The handbook for domestic construction includes flats and buildings containing flats.

There are differences in detail in the provisions of the regulations for England and Wales, for Scotland and for Northern Ireland. There are also differences in terminology even where the technical requirements are the same.

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6.2 General

The Building Regulations relating to fire are primarily concerned with the risk to life. Compliance with the Building Regulations will go some way towards limiting damage to property but the designer may require higher standards to protect property and ensure business continuity. Higher standards may also be required to satisfy insurers' requirements.

The Regulatory Reform (Fire Safety) Order 2005, which applies in England and Wales, puts a responsibility on persons in control of buildings for the safe use of buildings. To fulfil this function they will require information on those aspects of the construction of the building that affect fire safety so that they can carry out the necessary risk assessments. Guidance on the information required is given in Appendix G of AD B.

The building envelope shall not be required to provide fire resistance unless a performance is stated by the Specifier.

The building envelope shall not be composed of materials which readily support combustion, add significantly to the fire load, and/or give off toxic fumes.

In all cases, products or elements of construction requiring a fire resistance or spread of flame performance should have the appropriate evidence of performance based on test information. The final installation should follow the applicable test evidence in all respects.

This clause is not intended to preclude the use of flexible gaskets, or sealant, with carbon-containing constituents, some of which may give off small quantities of toxic fumes in the event of a fire.

The suitability of materials should be judged in relation to their conditions of use. For example combustible insulation may give acceptable performance when used with a metal facing.

6.3 Fire resistance

The Specifier shall state any requirement for the building envelope to provide resistance to passage of fire, either from the inside to the outside of the envelope or from the outside to the inside of the envelope.

Where fire resistance is required it may be specified in terms of resistance to penetration of smoke and flame (integrity) and/or resistance to transfer of excessive heat (insulation). The classification should be in accordance with BS EN 13501-2.

Where the building envelope is required to provide fire resistance, the performance shall be assessed by use of appropriate tests in accordance with BS EN 1364 or by a competent person. There shall be no deviations from the certificated system and the fire resisting façade shall comply with the requirements of all other Parts of the CWCT Standard.

The main frame of the building can deflect a considerable amount during a fire. Where the building envelope is required to provide fire resistance these movements must not compromise the fire resistance of the building envelope.

Aluminium envelope systems do not normally have significant resistance to fire. Most unmodified aluminium building envelopes will provide only 10 to 20 minutes stability and integrity resistance and negligible insulation resistance.

Fire resistant curtain wall systems are available. These normally employ steel framing but modified aluminium systems are also available. These systems are tested as a complete system including glazing material, frame and sealing materials.

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By its nature a rainscreen wall is a multi-layer wall with each layer providing a separate function. As the cavity is ventilated to the outside, the rainscreen will not provide fire resistance and fire resistance of the overall wall construction is a function of the backing wall.

Where the building envelope is required to provide fire resistance, the use of local sprinklers to drench the facade may be an alternative to the use of inherently fire resistant construction. Further guidance is given in 'Sprinklers for safety: Use and benefits of incorporating sprinklers in buildings and structures' published by BAFSA.

Statutory instruments and regulations are not standard throughout the UK. Specifiers should consult local Building Control Officers at an early stage in the building's design process to determine any specific requirements.

AD B provides guidance on the fire resistance requirements for external walls.

External walls are often classed as unprotected areas and are not therefore required to provide fire resistance. Conditions for the classification of walls as unprotected areas are given in AD B.

Locations where fire resistance might be required include:

i) Boundary conditions, where the building envelope would be required to protect adjacent property from the effects of fire within the building.

ii) Alongside escape routes, where the building envelope would be required to protect persons using the route from radiated heat, hot gases and smoke. Escape routes may be either internal or external to the building, or both, and the Specifier should clearly identify the specific requirements on the drawings.

iii) External glazed sections to prevent fire transfer in the same building by breakout/break in, either on the same floor across re-entrant corners or on adjacent floors to prevent vertical fire movement and ignition of cladding. The specifier should evaluate the risk and use a fire resistant glazing strategy appropriate to the building that limits the threat of fire movement and protects critical areas, such as refuges and vertical escape stairs.

Fire engineering offers an alternative to the use of prescriptive provisions given in AD B.

6.4 Spread of fire

6.4.1 General

The building envelope should be designed to limit the spread of fire. This is normally achieved by limits on the materials used and the provision of fire stops and cavity barriers as set out in the following clauses. The tests described in BS 8414 have been developed to provide an alternative method of assessing the risk of vertical fire spread on the external face of the building and may be used as an alternative to the prescriptive requirements of Clauses 6.4.2.1, 6.4.4 and 6.6.1. Criteria to be used in assessing the results of tests in accordance with BS 8414 are given in BR135.

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6.4.2 Surface spread of flame

6.4.2.1 External surface spread of flame

The external surface of the envelope shall satisfy the requirements for Class 0 when tested in accordance with BS 476: Parts 6 and 7 (National class) or
Class B-s3, d2 or better in accordance with BS EN 13501-1 (European class).

For rainscreen panels this requirement applies to both the visible external surface of the panel and the surface of the panel facing the cavity.

Class 0 is the highest product performance classification for lining materials, when tested in accordance with BS 476 parts 6 and 7. It is defined in AD B and is achieved if a material or surface of a composite product is either:

i) Composed throughout of materials of limited combustibility.

or

ii) A Class 1 material which has a fire propagation index (I) of not more than 12 and a sub index (i1) of not more than 6.

In Scotland the term 'low risk' is used instead of Class 0.

Class B s3 d2 is defined in BS EN 13501-1 and is the equivalent European classification. The European classification uses different tests and direct correlation between National and European classifications is not possible.

Class 0 relates to the reaction to a flame. A more sophisticated approach would be to select materials based on their reaction to radiation.

6.4.2.2 Internal surface spread of flame

The Specifier shall state any requirement for the spread of flame performance of the internal (room surface) face of the external wall construction.

In general this will be the same as for the area the building envelope encloses.

6.4.3 Fire and smoke stopping

6.4.3.1 At floors and internal walls

All compartment walls and floors shall be continued to the back of the building envelope. Any gaps between the compartment wall or floor and the building envelope shall be sealed with fire and smoke stopping with the same performance as the compartment wall or floor.

The Specifier shall state the required performance of the fire and smoke stopping.

Reference should be made to the Building Regulations applicable to the building and its location.

The performance of fire stopping will depend on the properties of the fire stop, its method of fixing and the performance of the materials against which it is fixed, particularly any movement that occurs during the fire. The performance of fire stopping may be assessed in accordance with BS 476-20, BS EN 1364-4 or BS EN 1366-4. BS 476-20 is a general standard for fire resistance tests that sets out the principles to be used in developing appropriate tests, BS EN 1366-4 is specific to linear joint seals but not specific to curtain walls and BS EN 1364-4 specifically addresses seals between a curtain wall and a supporting floor.

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Fire stopping shall be capable of accommodating anticipated movement of the floor and building envelope during normal building use and during fire.

Some fire stops provide a watertight seal between the building envelope and the floor slab. This may be beneficial in forming a weathertight enclosure during construction or in controlling water during fire fighting.

6.4.3.2 Materials adjacent to fire stops

The effectiveness of fire stops will be increased where the surface of the building envelope against which they abut is composed of fire resistant material. This can be achieved by using spandrel panels with a non-combustible insulation. Alternatively where combustible insulation is used it may be contained within a steel liner.

6.4.4 Fire spread in cavities

6.4.4.1 General

Cavity barriers shall be incorporated into the envelope construction so as to prevent the transmission of fire or smoke through voids in the envelope assembly from bypassing any of the fire stops defined in clause 6.4.3.

The cavity fire barriers must provide the requisite period of fire resistance as set out in the Building Regulations.

This clause has particular application where floor slabs abut spandrel panels in which there is a void between, for example, an internal dry lining and an external panel.

In AD B cavity fire barriers are required to have a fire resistance of at least 30 minutes.

6.4.4.2 Cavities in rainscreen walls

All rainscreen walls have a cavity between the rainscreen and the backing wall. Some rainscreen walls have additional cavities between the framing members of the backing wall. The requirements below apply to the cavity between the rainscreen and the backing wall and may also apply to cavities within the backing wall.

i) Cavity barriers should be provided close to the edges of cavities to restrict entry of fire into cavities and to restrict movement of fire from the cavity to other parts of the building.

In a rainscreen cavity this requirement conflicts with the need to provide drainage and ventilation of the cavity. At the base of the cavity, provision of cavity closers that drain water out through the front face of the rainscreen will reduce the risk of entry of fire from below but still allow ventilation and drainage. At the head of the cavity it is difficult to close the cavity as there will normally be additional joints at a slightly lower level which could allow fire to escape from the cavity. The risk of fire escaping from the cavity and causing fire spread to other parts of the building should be assessed.

ii) Cavity barriers shall be provided to close the cavity around penetrations through the rainscreen for windows and doors.

Aluminium and aluminium alloys show a reduction in strength at temperatures much above 100°C and at 300°C most of the strength is lost. For this reason unprotected aluminium window pods will not satisfy this requirement.

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iii) Cavity barriers shall be provided on the line of any compartment wall or floor.

iv) The cavity shall normally be sub-divided with horizontal and vertical cavity fire barriers at centres not exceeding 20m where the material within the cavity is Class 0 or Class 1 (National Class) or Class C s3, d2 or better (European Class). Where other materials are present in the cavity the spacing of cavity barriers shall be reduced to 10m.

Cavity fire barriers should not prevent ventilation during every day use.

Requirement iv does not apply when the backing wall is of masonry at least 75mm thick and the cavity does not contain combustible insulation and the building is not used for residential or institutional purposes.

v) Consideration should be given to the vulnerability of the rainscreen to external fires including arson. The risk of fire entering the cavity in such cases may be reduced by such methods as starting the rainscreen cladding at first floor and building the lowermost course in masonry.

6.5 Means of escape

The fire strategy for the building should identify means of escape in the event of fire. Materials and components should be selected to minimise the risk from falling debris to those escaping from the building during a fire and to fire fighters and rescuers.

The specifier shall identify any doors, windows or other parts of the façade that are required to provide means of escape and state any requirements for size of opening and means of operation.

The use of emergency egress windows is generally limited to rooms in dwellings and flats no more than 4.5m above ground level. Where they are used they should have an unobstructed openable area that is at least 0.33m^2 in area, 450mm wide and 450mm high. The bottom of the openable area should be not more than 1100mm above the floor.

6.6 Materials

6.6.1 Materials in rainscreen cavities

The cavity behind a rainscreen and in front of the air barrier should not include materials which can significantly promote flame spread within the unseen cavity. In general this zone may contain a timber, aluminium or other metal vertical framework and insulation of appropriate resistance to combustion.

The use of any combustible material for the supporting framework and insulation within the cavity may need to be considered as the building height increases.

6.6.2 Insulation materials

Insulation in walls of buildings with a storey more than 18m above ground level should be of limited combustibility.

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6.6.3 Composite components

When one of the cladding elements is a composite of two or more materials (mechanically jointed, bonded or fused together) the elements as a whole, must demonstrate the appropriate fire performance. Similarly it must be demonstrated that the composite will remain reasonably whole and not become prematurely separated from the building or framework.

Delamination by premature failure of resin bonding or other type of fixing can cause a hazard to both fire fighters and occupants as well as expose larger areas to damage than would otherwise occur.

Those metal-faced insulated panels designed for use in building envelopes can normally demonstrate satisfactory performance.

6.6.4 Cavity fire barrier materials

The cavity fire barriers shall be constructed of materials commensurate with their location within the cavity and the design life of the building.

The cavity behind a rainscreen is deemed a moist zone. Materials selected for the fire barrier must not corrode or otherwise deteriorate so as to affect the performance of the fire barrier during the design life of the barrier. Some intumescent materials may be adversely affected in this situation.

6.6.5 Fire resistant glazing

Fire resistant glazing materials shall be appropriate for use in the building envelope.

Some fire resisting glazing materials are only suitable for use in internal screens.

The intumescent interlayer of fire resisting laminated glass may degrade if subjected to UV light and require the use of an additional glass ply and pvb interlayer on the externally exposed face of the pane to protect the intumescent interlayer.

The edge of intumescent laminated glass must be protected against moisture to prevent degradation of the interlayer.

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6.7 Construction

6.7.1 Junction of building envelope with compartment floors

At a junction with a compartment floor, the building envelope should be restrained to prevent movement away from the compartment floor during a fire.

6.7.2 Fire stopping

All fire and smoke stops shall be positively fixed in position in such a manner that they will not become dislodged in the event of a fire. The fixing method shall secure the stop in position for a period at least equal to that required of the compartment wall or floor against which the building envelope abuts.

The fixing should take account of the movement of the cladding and the supporting structure during the life of the building and during a fire.

Some fire stop materials may absorb water, and the fixings should be sufficient to retain the fire stop even when waterlogged.

6.7.3 Fixings and fasteners

The designer shall take reasonable care in the selection of all primary fixings, panel fasteners and insulation retainers to ensure that a fire does not result in premature system detachment.

By preventing premature failure of a connecting component, the occupants and fire fighters should not be exposed to unnecessary hazards. Failure of primary anchors, attaching the system framework, can cause significant areas of cladding and materials to detach; the use of well fitting insulation (when specified) around the fixings can help to protect them from heat.

6.7.4 Insulation fixings

Where the insulation within the cavity of a rainscreen wall is attached to the inner wall, a minimum of one extra non-combustible fixing per square metre or per batten of insulation, whichever is the lesser, shall be provided to prevent detachment of the insulation in the event of fire.

There is an opinion that the early detachment of insulation mats in the cavity can afford some restriction to flame spread. Consequently the use of non-metallic insulation retainers can be considered if:

i) The insulation is not part of the fire resisting element of the whole wall.

ii) The random collapse of the insulation is only considered to be fortuitous in restricting fire spread in the cavity - the appropriate cavity fire barriers should always be incorporated.

6.7.5 Electrical and mechanical services in rainscreen walls

All electrical and mechanical services shall pass directly through the wall, and they shall be sealed at the air barrier. Exhaust into or intake from the cavity shall not be permitted.

6.7.6 Ventilation of rainscreen cavities

All electrical and mechanical services shall pass directly through the wall, and they shall be sealed at the air barrier. Exhaust into or intake from the cavity shall not be permitted.

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6.8 Smoke vents

The method of agreeing the free area of smoke vents shall be agreed with the Building Control Officer. Some guidance is given in Appendix C of AD B.

Smoke vents shall be fitted with a locking device that may be opened with a fireman's axe or other mechanism approved by the Building Control Officer.

Specifiers may wish to discuss the possibility of using 'break out panels' with the statutory authorities. These are panels of toughened glass which are easily and safely broken by the point of a fireman's axe.

Smoke vents generally open outwards although inwards-opening windows, used as smoke vents, are increasingly acceptable to Building Control Officers. This approach should be agreed with the Building Control Officer at an early stage, preferably by the Specifier and prior to tender.

It is strongly recommended that all manual operating mechanisms for smoke vents are colour-highlighted and not colour-matched to the general surrounding colour as is common practice for other operating mechanisms.

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Appendix A – Relevant Building Regulations

The Building Regulations listed below are relevant to this part of the Standard. A full list of Building Regulations is available in Part 0 of this Standard.

Cross referencing of Building Regulations

Scope	England and Wales	Scotland	Northern Ireland
Fire	Part B	Section 2	Part E

Building Regulations (England and Wales)

Approved Documents

AD B Fire safety Volume 2 Buildings other than dwelling uses.
Note: Flats are not considered as dwelling houses

Building Regulations (England and Wales) may be downloaded from http://www.planningportal.gov.uk/

Building Regulations (Scotland)

Technical Handbooks

There are separate Handbooks for Domestic and Non Domestic construction. Both follow the format given below.

Section 2 Structural fire precautions

Building Regulations (Scotland) may be downloaded from http://www.sbsa.gov.uk

Building Regulations (Northern Ireland)

Technical Booklets

Part E Fire safety

Building Regulations (Northern Ireland) may be downloaded from
http://www.dfpni.gov.uk/index/law-and-regulation/building-regulations.htm

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Appendix B – References

The documents listed below are relevant to this part of the Standard. A full list of relevant documents is available in Part 0 of this Standard.

Normative references

BS 476-6	Fire tests on building materials and structures-Part 6 Method of test for fire propagation for products.
BS 476-7	Fire tests on building materials and structures-Part 7 Method of test to determine the classification of the surface spread of flame of products.
BS 8414-1	Fire performance of external cladding systems. Test methods for non-loadbearing external cladding systems applied to the face of a building.
BS 8414-2	Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame.
BS EN 13501-1	Fire classification of construction products and building elements. Classification using data from reaction to fire tests.
BS EN 13501-2	Fire classification of construction products and building elements. Classification using data from fire resistance tests, excluding ventilation services.
BS EN 1364-1	Fire resistance tests for non-loadbearing elements. Walls.
BS EN 1364-3	Fire resistance tests for non-loadbearing elements. Curtain walling. Full configuration (complete assembly).
BS EN 1364-4	Fire resistance tests for non-loadbearing elements. Curtain walling. Part configuration.
BS EN 1366-4	Fire resistance tests for service installations. Linear joint seals.
	Fire performance of external thermal insulation for walls of multi-storey buildings.

Supporting references

BS 476-20	Fire tests on building materials and structures-Part 20 Method for determination of the fire resistance of elements of construction (general principles).
BS EN 1366-4	Fire resistance tests for service installations. Linear joint seals.
BAFSA	Sprinklers for safety: Use and benefits of incorporating sprinklers in buildings and structures, 2006, ISBN: 0 95526 280 1.

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