Fire Regulations & Standards

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Agenda

1. Stages of a Fire
2. Fire Resistance and Reaction to Fire overview
3. Euro Classes (and BS 476)
4. National Regulations – Surface Spread of Flame / Reaction to Fire
5. National Regulations – Fire Barriers
6. National Regulations – Boundary Walls
7. National Regulations – High Rise
8. BR 135
9. BS 8414

Does not look at Fire Risk Assessment, Fire Design Strategy, Northern Ireland or Republic of Ireland and is the opinion of the author on their interpretation of the regulations

Stages of a Fire

Key stages associated with fire spread on the outside of a building envelope are: -

- Initiation of the fire event
- Fire breakout
- Interaction with external envelope
- Fire re-entry
- Fire service intervention

Stages of a Fire

Initiation of the Fire Event

This can be from inside the building, examples include chip pan fires, faulty electrics, burning cigarettes, etc.

This can also be from outside the building, examples include bin fires & car fires. Mostly malicious firesetting.

Stages of a Fire

Fire Breakout

If no intervention occurs, flashover may occur and the fire breaks out from the room of origin.

Flames breaking out will typically extend 2m above the top of the opening prior to engaging with the outer cladding.

Stages of a Fire

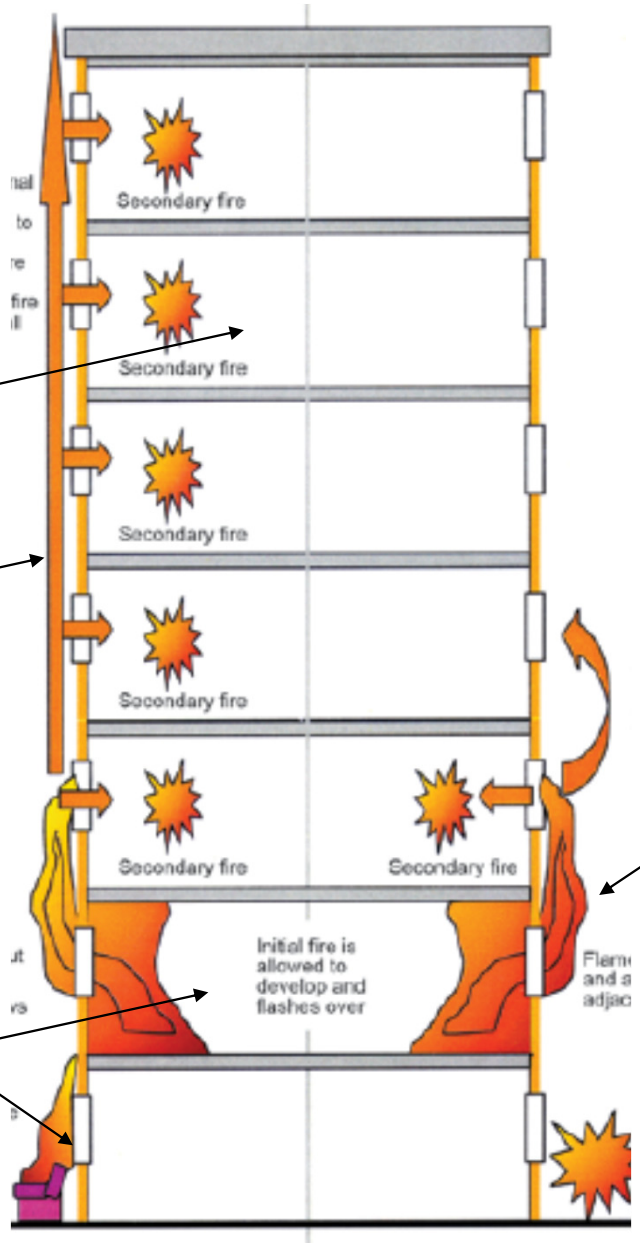
Interaction with the External Envelope

It is at this point that the design of the external cladding, including fire breaks, is tested.

There is the potential for the outer cladding to contribute to the fire load and spread of fire up the building façade through : -

- Surface propogation
  - This is where the reaction to fire of the surface finishes influence the rate of fire spread
- Cavities
  - Cavities may be part of the cladding design, or may be created due to delamination of cladding materials.
  - Flame extension up to 10 times of the original flame length can occur (chimney effect)

Extract from BR 135



Fire re-entry (secondary fires)

Interaction with external envelope

Fire breakout

Initiation of fire event

Other secondary fires from falling debris

Stages of a Fire

Fire Re-Entry

Openings and unprotected areas on the façade provide routes for fire to renter the building bypassing any compartment walls and floors.

This may lead to a second seat of fire, flashover occurring again, fire break out, etc.

Should a second seat of fire take hold, this is where rapid fire spread can occur.

Stages of a Fire

Fire Service Intervention

Intervention by the emergency services should prevent continued fire prorogation by way of the building envelope.

Where the cladding system is contributing to the fire propagation rate, several storeys may be affected making firefighting more difficult.

Fire Resistance and Reaction to Fire

These are very different items, but often confused with each other.

Fire Resistance

This is the ability of the cladding AND wall structure including linings to resist the passage of fire for a defined time period.

Not a normal test for a cladding manufacturer as it is the wall structure that provides the stability and integrity.

Reaction to Fire

This is the systems reaction to a fire and measures fire propagation as well as defining the systems contribution to a fire.

Around 80% of all construction products will be classified for their Reaction to Fire.

Euroclasses

In the past each EU member state has developed its own tests and assessments in support of their national building regulations and guidance. This made it difficult to compare goods from other countries, or test the same material multiple times.

Euroclasses provide a common system for testing and assessing the fire performance of products and allows the free trade of goods throughout the EU.

Superseded the BS 476 classifications in the Technical Standards for Scotland in 2002 and the Approved Documents for England and Wales in 2003.

There are two additional features that are new. The introduction of a smoke release rate (s1, s2 or s3) and the release of burning droplets (d0, d1 or d2) which may cause harm or a second seat of fire.

Euroclasses

Euroclass ‘A1’ is the highest rating that can be achieved with Euroclass ‘E’ being the lowest that can be tested. Euroclass ‘F’ being reserved for those products that are untested or do not meet the requirements for ‘E’

Euroclasses A2 through to D are accompanied with the smoke release rates in levels of s1, s2 or s3. Smoke accounts for 60% of deaths in fire across the EU.

Euroclsses A2 to E are accompanied with the hazardous release of burning droplets / particles in levels of d0, d1 or d2. These can cause serious harm or start additional fires.

Regulations typically state worst case for smoke and burning droplets as being compliant, i.e. B – s3, d2

For specifiers, it may be critical in the design and risk assessment to assess the difference between, for example, a Class C – s1, d0 product and a B – s3, d2 product.

Euroclasses

Euroclass Classification of ETICS systems is based on the performance of the complete system as defined in ETAG 004 / EAD.

The classification of individual items, such as insulation, is not required.

Euroclass Definitions in Regulatory Documents – **England and Wales**

Approved Document B was amended and became applicable in March 2003. The following is a snapshot of the transposition of the Euroclasses vs the BS 476 tests.

British Standard	Euroclass
Non-Combustible	A1
Limited Combustibility	A2 – s2, d2 or better
Class 0	B – s2, d2 or better
Class 1	C – s2, d2 or better
Class 3	D – s2, d2 or better

Euroclass Definitions in Regulatory Documents – **Scotland**

The Technical Standard was amended and became applicable in March 2002. The new standard introduced the concept of ‘risk’ alongside the reaction to fire.

Performance Risk	British Standard	Euoroclass
Non-Combustible	Non-Combustible	A1 or A2
Low	Class 0	B
Medium	Class 1	C
High	Class 2 or 3	D
Very High	A material which does not meet the criteria for high risk	

There is no reference to Limited Combustibility and the definition of Non-Combustible is different to England and Wales

National Regulations

In England and Wales the National Regulatory document is Approved Document B.

In Scotland the National Regulatory document is Technical Handbook 2

For both the Approved Document and the Technical Handbook, they are split into domestic and non-domestic

They cover many factors that we as an industry don't consider such as: -

- Access for firefighting equipment
- Internal surface spread of flame
- Roof coverings
- Structural fire protection
- Fire in neighbouring buildings

For cladding, the key factors to be considered are: -

- External surface spread flame
- Cavities
- Boundaries locations

National Regulations – Surface Spread of Flame / Reaction to Fire

England & Wales – Approved Document B4

External wall surface classifications are defined in Section 12 and are shown in Diagram 40.

The classifications are split into 4 building types: -

	Below 18m in height	Above 18m in height
Less than 1000mm from boundary line		
More than 1000mm from boundary line		

National Regulations – Surface Spread of Flame / Reaction to Fire

England & Wales – Approved Document B4

External wall surface classifications are defined in Section 12 and are shown in Diagram 40.

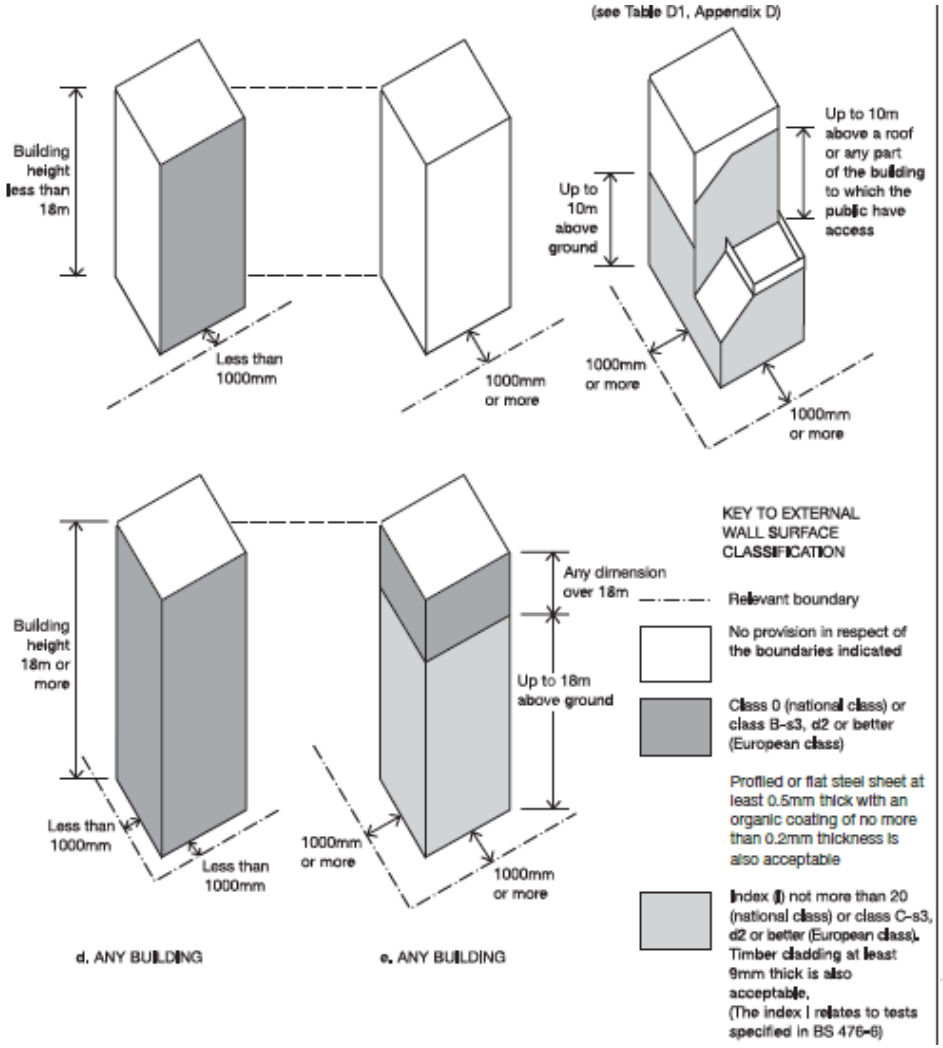
The classifications are split into 4 building types: -

	Below 18m in height	Above 18m in height
Less than 1000mm from boundary line	Euroclass B – s3, d2	Euroclass B – s3, d2
More than 1000mm from boundary line	No restriction	Below 18m - Euroclass C – s3, d2 Above 18m - Euroclass B – s3, d2

National Regulations – Surface Spread of Flame / Reaction to Fire

While the cladding system can be B – s3, d0 for buildings with a storey height greater than 18m, the insulation must be of limited combustibility.

For systems with a lower Euroclass or using a combustible insulation, the guidance in BR 135 must be followed.



National Regulations – Surface Spread of Flame / Reaction to Fire

Scotland – Technical Handbook 2

Detailed in Section 2.7

	Below 18m in height		Above 18m in height
Less than 1000mm from boundary line	Non-Combustible, A1 or A2 – s3, d2		Non-Combustible, A1 or A2 – s3, d2
More than 1000mm from boundary line	Entertainment & Assembly less than 10m	Low Risk, B – s3, d2	Low Risk, B – s3, d2
	Entertainment & Assembly between 10m & 18m	Very High Risk	Low Risk, B – s3, d2
	Residential care & Hospitals	Low Risk, B – s3, d2	Low Risk, B – s3, d2
	All other buildings	Very High Risk	Low Risk, B – s3, d2

National Regulations – Surface Spread of Flame / Reaction to Fire

Scotland – Technical Handbook 2

The exception is to houses. The cladding may achieve a Low Risk classification, B – s3, d2, providing it achieves the correct fire resistance.

National Regulations – Fire Barriers

England & Wales – Approved Document B3

External wall surface classifications are defined in Section 9, unfortunately it does consider cladding other than twin skin panels (composite). It focuses mainly on cavity wall construction.

For this reason, most fire officers rely on BR 135 for the provision of fire barriers and location of them, but BR 135 is only guidance.

Fire barriers are made from Non-Combustible insulation (MW) and are secured by stainless steel anchors at maximum 500mm centres and supplementary adhesive. They must be a minimum of 100mm in height and the same depth as the system insulation.

National Regulations – Fire Barriers

Direct fixed systems to masonry or sheathing boards

Horizontal fire barriers are located at every compartment floor line starting at the 2nd floor line upwards.

The junction at ground to first floor is ignored, remember that fire typically extends 2m above the exit point before interacting with the cladding.

Vertical fire barriers are suggested, but most Building Control departments do not insist on them as there is no cavity present for the fire to propagate along.

National Regulations – Fire Barriers

NHBC / cavity systems

Horizontal fire barriers are located at every compartment floor line starting at the 2nd floor line upwards. The cavity must be maintained and intumescent must be capable of working when wet.

The junction at ground to first floor is ignored, remember that fire typically extends 2m above the exit point before interacting with the cladding.

Vertical fire barriers are located at every compartment wall line. These are typically made from Non-Combustible insulation extended back to the sheathing board.

National Regulations – Fire Barriers

Scotland – Technical Handbook 2

There is no direct guidance for fire barriers in external cladding, however most people adopt the same principle as required by cavity barriers.

They should be located at every compartment floor and compartment wall line.

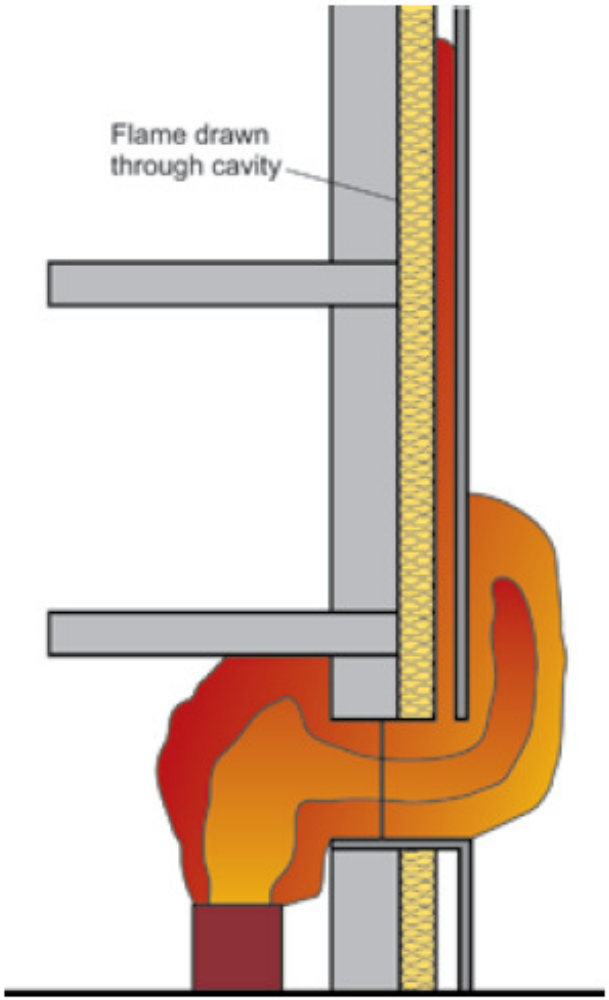
Some local authorities require them at the head and jambs of openings.

The design principles for cavity systems is the same as England & Wales

If in doubt, consult the local building control

National Regulations – Fire Barriers

Example of fire spread in a cavity showing the elongation of the flame compared to the outside



National Regulations – Boundary Walls

Boundary walls are more complicated than they used to be. A boundary wall is a wall that is within1000mm from the site's notional boundary line and is coincident with the boundary.

England & Wales – Approved Document B4

There are two requirements for boundary walls. Resistance to fire and Reaction to fire.

Resistance to fire is tested from both sides with the requirements being anything from 30 to 120 minutes depending on building height, purpose group and inclusion of sprinklers. As a cladding designer / supplier, this is outside our control.

Reaction to fire is dependant on the resistance to fire. Providing the fire resistance is achieved by the wall structure then the reaction to fire can be B – s3, d0 or better. If the reaction to fire classification is lower or the fire resistance is not achieved, then the calculations for unprotected areas need to be completed.

National Regulations – Boundary Walls

Scotland – Technical Handbook 2

Table 2.6 outlines the recommended fire resistance of external walls.

Resistance to fire is tested from both sides with the requirements being anything from 30 to 120 minutes depending on building height, purpose group and inclusion of sprinklers. As a cladding designer / supplier, this is outside our control.

The Reaction to fire for cladding on buildings within 1m of the boundary line must be Non-Combustible, Euroclass A1 or A2 – s3, d2

National Regulations – High Rise

England & Wales – Approved Document B4

In a building with a storey 18m or more above ground level, any insulation in the external wall construction should be limited combustibility.

Scotland – Technical Handbook 2

In a building with a storey 18m or more above ground level, the external cladding must be Non-Combustible, Euroclass A1 or A2 – s3, d2 (remember the difference in the classification of Non-Combustible).

OR

External walls should meet the performance criteria given in BR 135 using full scale test data from BS 8414

BR 135 – Fire Performance of External Thermal Insulation For Wall of Multistorey Buildings

First edition was published in 1988 in response to the increasing use of ETICS as part of refurbishing multistorey residential tower blocks.

BS 8414 Part 1 was created due to the parliamentary review in 1999 of the fire in Scotland. BR 135 was revised in 2003 to provide the classification of fire performance to BS 8414.

BS 8414 Part 2 was created to accommodate changing building methods with the classification of fire performance being created as BRE Digest 501. BR 135 was revised for the third time in 2013 to incorporate BRE Digest 501.

BR 135

It is a guidance document and this is referenced several times within its content.

It's scope is to address the principles and design methods related to the fire performance and spread of fire of non-loadbearing external cladding systems.

It looks at direct fixed & cavity based systems.

It explains different cladding methods to help the readers understand how they differ.

BR 135

Key Notes

6.3.1 refers to BRE Defect Action Sheet 132 and states ‘Use no fewer than one stainless steel fixing (in addition to those of plastic) per square metre of insulation.’

6.3.1 also states ‘the stability of the finish coats should also be considered in order to avoid excessive system delamination, which may generate voids into which fire may spread.’

6.3.4 states ‘any fire travelling through the system should be contained to the floor level immediately above the fire origin. To do this, the installation of fire barriers at each floor level above the first floor level (i.e. starting with the second storey) should be considered’.

6.3.4 also states ‘The fire barrier should be at least 100mm high, and should form a continuous band through the insulation layer at each floor level.’ It goes on to say that through fixing with all stainless steel fixings to the primary substrates should also be considered to ensure no movement of the render coats occurs at fire barrier locations.

BR 135

Key Notes

6.3.4 suggests the use of intumescent based fire barriers in cavity systems in addition to the main fire barrier in the system. These should be able to operate when wet, remember the purpose of the cavity.

6.3.4 also states ‘Vertical fire barriers may also be required to prevent lateral fire spread when it is necessary to maintain compartmentation in the structure’

This is a debating point and should be taken up with the local fire officer and insurer if these are required as the compartmentation lines are typically created by the main structure.

It also states ‘the overall effectiveness of the barrier design can be fully assessed only as part of a system test at large scale.’

It discusses the different types of fire barriers and what they may need to contend with. It strongly advises full scale testing as the only real method of assessing complete system interaction in the event of a fire.

BS 8414

There are two publications in this series: -

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*

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

These are British Standards and not adopted within Europe. Large scale fire testing is being consider at EU level, but we are several years away from agreeing an EU harmonised standard

BS 8414

The test allows external cladding systems to be installed as close to typical end-use conditions as possible.

The test walls consist of a main wall at least 8m in height and 2.6m wide and a wing wall of at least 8m in height and 1.5m wide.

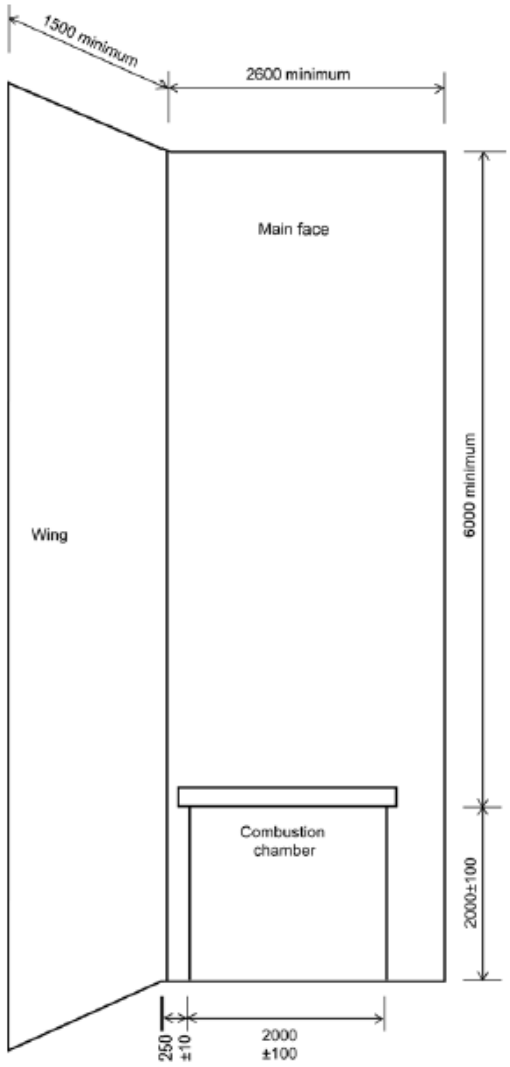
The fire crib is located on the main wall (recessed to replicate fire break out) at the junction with the wing wall.

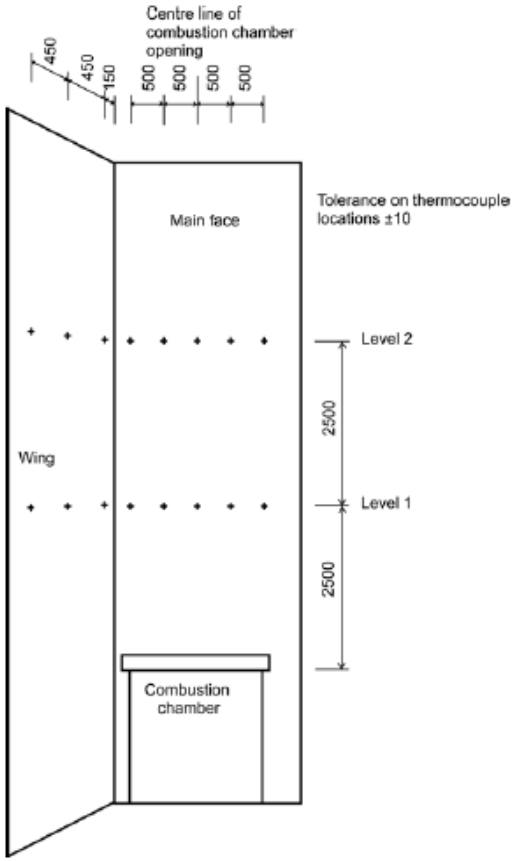
The combustion characteristics of the fire crib give a total nominal heat output of 4500 MJ over a 30 minute period.

Test results are only for the insulation thickness tested, render type tested and render colour tested. Variations to this will make the test results invalid.

BS 8414

Typical wall schematic





Thermocouple positions

BS 8414

The performance of the cladding system is evaluated against three criteria: -

- External fire spread
- Internal fire spread
- Mechanical performance

BS 8414

Fire spread start time

The start time for fire spread is when the temperature first recorded by any external thermocouple at level 1 equals or exceeds 200 °C temperature rise above the start temperature. Must be maintained for 30s.

External Fire Spread Failure

Failure is deemed to occur when any external thermocouple at level 2 reaches and maintains for 30s a temperature of 600 °C above start temperature within 15 minutes of the start time.

BS 8414

Internal Fire Spread Failure

Failure is deemed to occur when any internal thermocouple at level 2 reaches and maintains for 30s a temperature of 600 °C above start temperature within 15 minutes of the start time.

Where system burn through occurs so that fire reaches the internal surface, failure is deemed to occur if continuous flaming in excess of 60s is observed on the internal surface of the test specimen within 15m of the start time.

It is also considered a fail if continuous flaming in excess of 60s is seen exiting the top of the system.

Mechanical Performance

No failure criteria has been set against mechanical performance, however ongoing system combustion, details of system collapse, spalling, delamination, flaming debris or pool fires are included in the report to aid in the production of a full fire risk assessment. This is set at 30 minutes after the fire load is extinguished.

BS 8414

EPS system without fire breaks

EPS system with fire breaks

BS 8414

Example of what they look for after the fire is extinguished

Questions