

Façade Fire Performance: Understanding large scale façade fire testing

New Zealand, December 2019 Edition



Foreword

Fire is a complex phenomenon. How it develops depends on many different factors, only one of which is the fabric of a building.

For example the fire performance of a facade system depends on the interaction of all the components (including fixings, fasteners and sealants) in that system in response to a fire and also on other design and construction factors such as the position of fire barriers, the size of ventilation gaps and so on.

The building regulations governing fire safety are designed to preserve life, and this must always be the primary consideration in the design and construction of any building. To assist with this there are prescribed tests and standards that can be used to classify building products and guidance is provided to show which classifications are deemed to comply with the requirements of different building types.

The insurance industry recognises the importance of system testing for property protection in the event of a fire and as far back as the 1980s developed its own suite of large-scale system tests and standards to ensure that a more accurate assessment of risk could be made of specific building constructions. Over the years, case studies by independent experts have shown that there is a very close correlation between the results of insurance industry large-scale testing, and actual building performance in real fires.

This document examines the different standards that are relevant to facades and roof and wall insulated panel systems and demonstrates why large-scale testing, regardless of insulation type, should always provide the benchmark for fire safety performance.

Contents

01

Understanding large-scale façade fire testing	5
1.1 Introduction	6
1.2 Large-Scale Fire Facade Test: BS 8414/BR 135	7
1.3 Large-Scale Fire Facade Test: AS 5113	7
1.4 Large-Scale Fire Facade Test: FM 4881	8
1.5 Small-Scale Fire Test: ISO5660-1	9
1.6 Small-Scale Fire Test: AS1530.1 (Non-Combustibility Test)	9
1.7 Other Large Scale Facade Fire Tests	10
1.8 Other Performance Testing of Insulated Panels	12
1.8.1 Reaction to Fire Testing	12
1.8.2 Fire Resistance Tests	13

02

Kingspan BS 8414/BR 135 and AS5113 and Accredited Systems	15
2.1 BS 8414/BR 135 Classified Kingspan Insulated Panels	16
2.2 AS 5113 Classified Kingspan Insulated Panel Solutions	16
2.3 BS 8414/BR 135 Classified Architectural Facade Solutions	16

03

Real Fire Case Studies	19
Wharfedale Hospital, UK	20
Spider Transport, Ireland	22
Audi Dealership, Belgium	24
Furniture Retail Warehouse, Presov, Slovakia	26
Industrial Units, Heining, the Netherlands	28
Crude Oil Pool Fire, the Netherlands	30

04

Further Resources and Support from Kingspan	33
---	----



Understanding large scale façade fire testing

1.1 Introduction

The New Zealand Building Code (NZBC) is concerned with building design that gives people enough time to get safely out of a burning building, allowing time for fire fighters to access a building and resisting fire spread to adjacent buildings (or fire cells).

There are a range of different compliance tests, of varying sizes, contained within the NZBC:

- Small-scale testing (ISO5660-1)
- Large-scale testing (NFPA 285 or similar)
- Non-combustibility (AS1530.1)
- Firewalls (AS1530.1/BS/NZS476 Pt 22)

The requirements contained in Part C3 of the Building Code and acceptable solutions provides guidance for compliance to assist general building designers. Verification Method 2 (VM2) provides more detailed information for fire engineers. When the solutions are read in conjunction with each other a more detailed picture arises.



In February of 2019, MBIE published a guide discussing how 'wall cladding systems' can be tested to determine their fire performance. This document has references to various additional international fire tests and evaluation methods that can now be used as a compliance pathway for NZ.

The guide was published on the back of some significant high rise fire events globally, which have increased our understanding of how fire spreads externally and within modern façade construction. Many legislative bodies are now looking at their building codes and making adjustments where necessary.

The use of large scale fire tests to provide compliance and assurance that products are fit for purpose is consistent with changes being made around the world.

Over the next few pages we will explain what some of the relevant tests are, and what they entail.



Kingspan offer a number of through-wall insulated panel and rainscreen systems.

Tested as a fully assembled system including all components, see Section 2 for further details

Figure 1. This photograph shows a recent successful BS 8414 test on a Kingspan system.

1.2 Large-Scale Fire Facade Test: BS 8414/BR 135 (UK)

The BS 8414 test is an internationally recognized, large-scale façade assembly test, mimicking a high rise building, measuring fire spread and flame propagation to evaluate the spread of fire on the external surface of buildings. It replicates a fire starting inside a room, breaking out through a window and exposing the external façade to fire.

It is a test only and does not include performance criteria to assess a 'pass' or 'fail'. 'Pass' or 'fail' can be determined by the BR 135 document.

During the test, temperature is measured through thermocouples to see whether fire is propagating within the façade system.

The test also measures reaction to fire in so far as if fire breaks through the perimeter of the test rig it is deemed to have failed, according to BR 135.

A measured temperature of more than 600°C and flame exceeding the perimeter of the test rig is also classed as failure.

A recent report by Tenos International Fire Engineering Consultants compared BS 8414 to the NFPA 285 whole system tests used in other regulatory regimes, notably the USA, UAE and New Zealand. The Tenos study found that the fire load used in BS 8414 was more onerous than that in NFPA 285.

1.3 Large-Scale Fire Facade Test: AS 5113 (Australia)

The AS 5113 façade test is based on the similar BS 8414 façade test.

AS 5113 has adopted ISO 13735 and BS 8414 façade tests for local use, with variations and specific performance criteria.

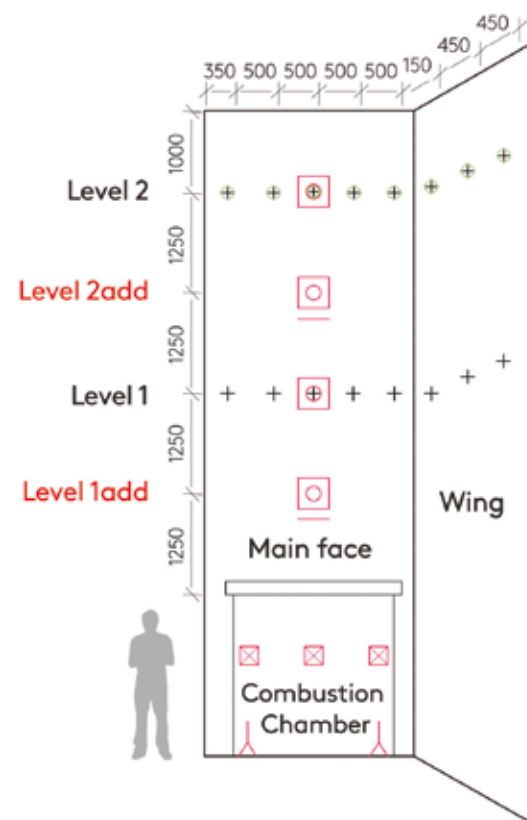


Figure 2. BS8414 Test Setup. This diagram shows level 1 and level 2 and the marks indicated in grey and green are thermocouples. During the test, temperature is measured through the thermocouples and there are levels that are not permitted to exceed. This measures fire propagating within the façade system.

1.4 Large-Scale Fire Facade Test: FM 4881

FM Global is a worldwide insurance and risk management enterprise. Part of FM Global, FM Approvals is an international third-party testing and certification service. They test property loss prevention products and services — for use in commercial and industrial facilities — to verify that they meet rigorous loss prevention standards of quality, technical integrity and performance.



The FM APPROVED mark is recognised and respected worldwide. Their certification instils confidence and commands respect in the global marketplace.

The most popular standards are: FM 4880, FM 4881, FM 4882 and FM 4471. Each of these standards deals with different panel applications.

- **FM 4880** is an approval standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials. It deals with internal applications only.
- **FM 4881** is an approval standard for Class 1 Exterior Wall Systems.
- **FM 4882** is an approval standard for smoke sensitive occupancies.
- **FM 4471** is an approval standard for Class 1 Roof Panels.

Important: for the external envelope to comply with FM requirements you need both FM 4880 and FM 4881 approval.

Also, for both FM 4880 and FM 4881, there are different standards depending on the building height; if your building is over 9.1m high then you will need an 'Unlimited Height' classification.

"FM Approved sandwich panels, for example, have a superior fire rating and prevent the spread of fire within the panel itself and, as such, can be compared to non-combustible panels for protection purposes."

FM Global

<https://www.fmglobal.com/insights-and-impacts/2017/food-industry-fires>
February 2017

Within the suite of FM testing, applicable to FM 4880 and FM 4881, is what's called the 50 foot corner test (shown below).

The two wings/walls are 50 feet high and 20 feet in width.

Some way up the wall you can see a horizontal line indicating a failure point.

Similar to other reaction to fire tests, there are also thermocouples embedded within the insulation and used on the test rig.

344kg of dry oak makes up the fire ignition source.

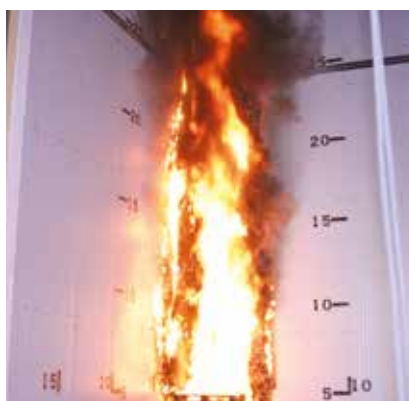
Based on the performance of the insulated panel system you can get the following classifications:

- Class 1 with no height restriction
- Class 1 to a 50ft max height
- Class 1 to a 30ft max height.

Figure 3. FM 4880/FM 4881 Test. The 50ft test shown below forms part of assessment requirements for approval to Class 1 internal wall and ceiling panels with no height restriction (FM 4880) and external walls with no height restriction (FM 4881).



Test set up



Fire development



End of test

1.5 Small-Scale Fire Test: ISO5660-1

ISO 5660-1 is a small-scale radiant heat test (no direct flames).

The test results are given as Peak Heat Release Rate (PHR) in kW/m^2 and Total Heat Released (THR) in MJ/m^2 . The lower the values the better the performance.

NZBC requirements are:

- Type A $<100\text{kW/m}^2$ PHR, $<25\text{MJ/m}^2$ THR
- Type B $<150\text{kW/m}^2$ PHR, $<50\text{MJ/m}^2$ THR
- Type – no requirements

The ISO 5660-1 test is used to determine suitability for use near a boundary (separate to FRR requirements) and is a relatively low cost test to undertake.

The inherent problem with small scale testing is that it is not a 'system' test.



Figure 4. Cone Calorimeter Small Scale Test.

1.6 Small-Scale Fire Test: AS1530.1 (Non-Combustibility Test)

A small-scale test that is used to determine non-combustible status, AS1530.1 is a pass or fail test.

Sample size of $45 \times 50\text{mm}$ is tested and failure occurs if:

- Any flaming of the specimen (5 seconds or more)
- Furnace temperature rises by more than 50°C
- Specimen temperature rises by more than 50°C .

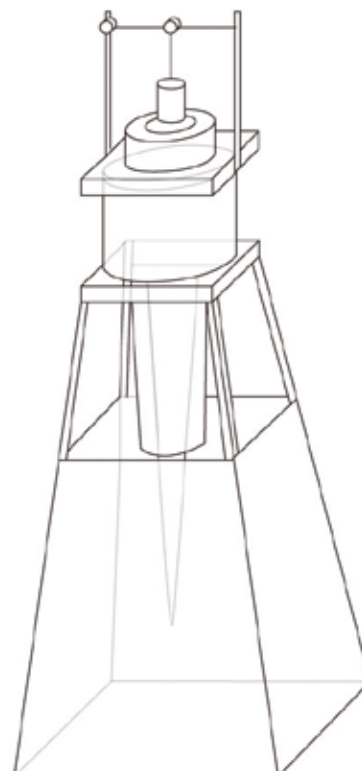


Figure 5. Non-Combustible Small Scale Test.

1.7 Other Large Scale Facade Fire Tests

NFPA 285

The National Fire Protection Association (NFPA) 285 fire test (standard fire test method for exterior non-loadbearing wall assemblies) is a large scale test used to determine the potential for flame spread from one storey of a building to another via the exterior wall.

The test method is intended to evaluate the inclusion of combustible components within wall assemblies/panels of buildings that are otherwise required to be of non-combustible construction by NFPA or IBC building codes. Its purpose is to simulate the tested wall assembly's fire performance, over a period of 30 minutes, to evaluate flame spread within and on the outer surface of the wall.

One gas burner is placed inside the lower storey and provides a maximum heat output of 900kW after 30 minutes and a second smaller burner, placed near to the test wall is turned on after 5 minutes.

The key performance criterion is that flame propagation on the exterior face of the specimen should not occur beyond the area of flame plume impingement of the window burner.

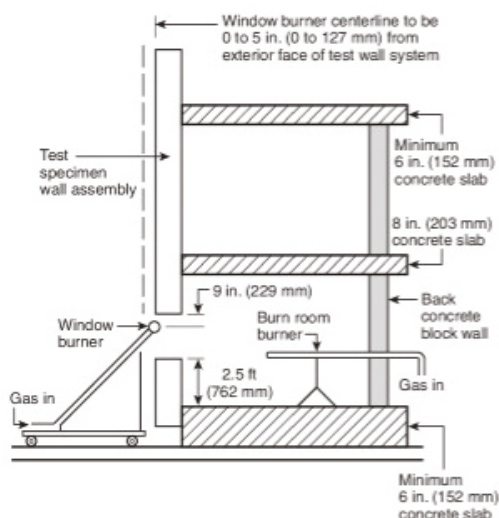


Figure 6. NFPA test: section view of burner placements for first-storey test room (not to scale)

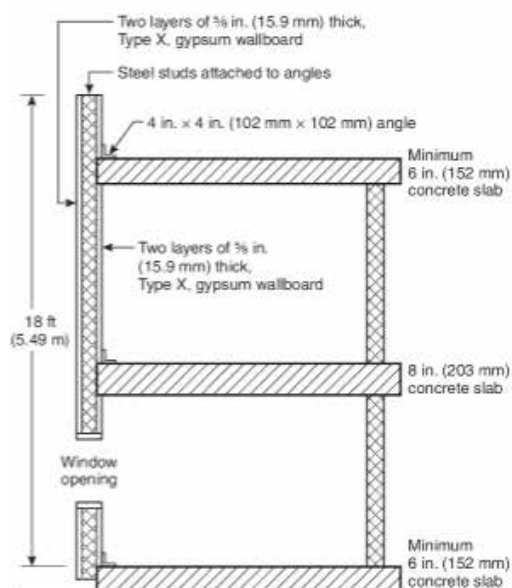


Figure 7. NFPA test: section view of calibration wall assembly (not to scale)

SP105 is a key requirement of the Sweden Building Regulations in allowing the use of this cladding system on a building with an unlimited number of storeys.

SP 105

Used in Sweden and the Nordic countries to assess the fire performance of facade systems, SP 105 is intended to represent a scenario of a fire in a particular storey in a building, of which the window has failed. It aims to assess the impact of flames emanating from a window on the cladding system above.

The size of the test facade is 4m wide x 6m high, and the test configuration should represent the actual facade system as closely as possible. Any falling pieces or droplets are noted and assessed. The temperatures of the fire effluents above the eaves are measured, as is the heat flux at the center of the window on the first storey.

The objective of the test is to confirm that the facade system does not play a significant role in fire spread.

Kingspan KS900-1200 AB and KS900-1200 CS panels met the pass criteria with:

- no large pieces of facade cladding falling down during the test;
- no fire spread occurring in the surface layer or in the insulation above the lower edge of the window on the second storey;
- the temperature at the eaves not exceeding 500°C during a continuous period of more than 10 minutes;
- the total incident heat flux at the center of the window on the first storey not exceeding 80 kW/m².

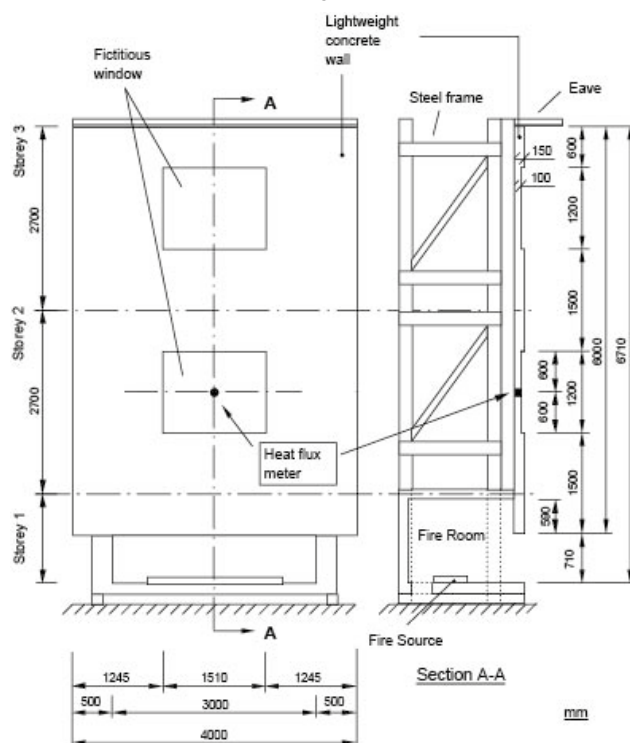


Figure 8. Test rig used in SP Fire 105.



1.8 Other Performance Testing of Insulated Panels

1.8.1 Reaction to Fire Testing

Kingspan FIREsafe® Insurer-Certified insulated panel and facade systems can achieve high levels of reaction to fire performance in the tests specified for regulatory purposes as outlined previously in this document including:

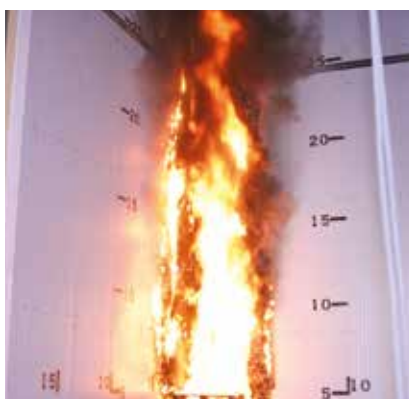
- New Zealand: ISO 5660, ISO 13784-1, AS 1366.2.
- Australia: AS5637 – Group 1-2, AS1530.3 – 0,0,0,2 indices, AS5113/BS 8414 facade testing.
- Europe: EN 13501-1, particularly B-s1,d0. The ‘s1’ rating, being the best (lowest emission) smoke rating.
- Europe: EN 11925 Part 3 Ignitability of Building Products.
- UK: BS 8414 Part 2 – Facade testing.
- UK: BS 476 Parts 3, 6 and 7.

In addition, Kingspan insulated panel and facade systems perform to high levels in large-scale tests developed by the insurance industry including:

- Global Insurance: FM 4880 – Class 1 Internal wall and ceiling panels without height restriction.
- Global Insurance: FM 4881 – Class 1 External wall panel systems without height restriction.
- Global Insurance: FM 4882 – Class 1 interior wall and ceiling panels for pharmaceutical manufacturing and storage areas, food preparation and storage areas or similar occupancies.*
- Global Insurance: FM 4471 – Class 1 Roof panel systems.
- UK/Ireland Insurance: LPS 1181 Part 1 Approval for external wall and roof panel systems.
- UK/Ireland Insurance: LPS 1181 Part 2 for internal wall and ceiling applications.



Test set up



Fire development



End of test

Figure 9. FM 4880/FM 4881 Test. The 50ft test shown below forms part of assessment requirements for approval to Class 1 internal wall and ceiling panels with no height restriction (FM 4880) and external walls with no height restriction (FM 4881).

* FM 4882 is applicable to some specific QuadCore™ insulated panel systems. Call Kingspan Technical Services for further information.

1.8.2 Fire Resistance Tests

Fire resistance tests refer to testing of systems designed to contain or resist fire over a specified period of time. They are very different to reaction to fire tests although the tests are sometimes confused. Fire resistance classifications are often expressed as a period of time such as '1 hour fire resistance' or three numbers such as 30/30/30. It is important to understand what the classification and each number classification means. When it comes to fire resistance, which is usually expressed in the form xx/yy/zz, the key elements to consider are structural adequacy (xx), integrity (yy), and insulation (zz).

For external wall systems, fire resistance criteria depends largely on application and proximity to the building boundary, and proximity to other buildings. These are an integral part of the NCC. In general more demanding applications and closer proximity to boundaries or other buildings requires higher levels of fire resistance.

Figure 9 illustrates the test rig for fire resistance. Typically the test rig will be 3 metres wide by 3 metres tall. Behind the unexposed surface of the insulated panel is a large furnace, which presents a large fire source to the exposed surface of the insulated panel system. Thermocouples are attached to the unexposed surface face, measuring temperature.

Kingspan FIREsafe® Insurer-Certified insulated panel and facade systems are extensively tested for fire resistance and can achieve the results shown in Table 1.

The use of Kingspan's next generation hybrid insulation core - QuadCore™ Technology - can deliver improved fire resistance performance as a result of the increased stability of the insulation when exposed to fire. For specific situations this can result in improved performance, greater spans and/or a reduction in fixings.

Fire resistance (FRR) tests involve a different suite of tests, including BS 476-22, LPCB LPS 1208 and EN13501-2.

There are two key objectives within fire resistance testing – measuring fire integrity and fire insulation.

Insulated panels are assumed to have no structural performance as that is provided by the steel/timber frame they are attached to.

Fire integrity is the amount of time it takes for fire to break through the insulated panel system.

Fire insulation refers to temperature increase. It measures the time taken for the average temperature across the thermocouples to rise by 140°C, or one thermal couple to rise by 180°C.

AS1530.4 Methods for fire tests on building materials, components and structures

Part 4: Fire resistance tests of elements of building construction

Table 1. Summary of FRL performance for Kingspan PIR products: Structural adequacy* / Integrity / Insulation.

Product	Thickness (mm)	Wall	Ceiling
KS1000 AWP	80	- / 60 / 28	-
	100	- / 132 / 28	-
KS1000 RW	40	- / 144 / 18	-
	100	- / 241 / 43	-
KS1100 CS	100	- / 195 / 31	- / 58 / 32
	200	- / 240 / 64	- / 148 / 67

* Structural rating is provided by the structure that the panels are fixed to.

Figure 10. Fire Resistance Test

Typically speaking the fire resistance test rig will be 3m wide by 3m tall. Due to the rig size, building designers have to consider the net allowable spans in firewalls; extended spans can be used however partition levels should be lowered.

In the left image you can see an unexposed surface of an insulated panel after being tested for fire resistance for 60 minutes. Thermocouples are attached to the unexposed surface face, measuring temperature.



After 60 mins



After 120 mins



After 180 mins

Behind the unexposed surface is a large furnace, which is presenting a large fire source to the exposed surface of the insulated panel system.

The picture in the middle shows the unexposed surface after 120 minutes and at right after 180 minutes.



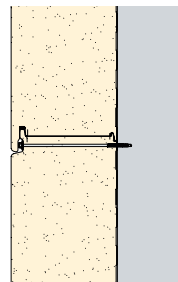
02

Kingspan BS 8414/ BR 135 and AS5113 and Accredited Systems

2.1 BS 8414/BR 135 Classified Kingspan Insulated Panels

Kingspan Insulated Wall Panel System

The architectural wall panel system is a versatile range of insulated panel profiles, delivering both aesthetic choice together with superior lifetime performance.



1. Panelised Facade System

BR 135
Classification
Report Number

289585 Issue 1

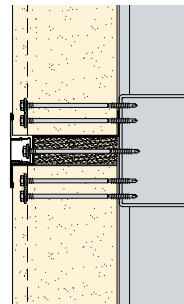
Relevant
Test Method

BS 8414-2:2005

2.2 AS 5113 Classified Kingspan Insulated Panel Solutions

Architectural Wall Panel: Panelised Facade System

Architectural Wall Panel is a finished external wall solution providing weather-tightness, insulation and fire performance. AWP passes all requirements of the BS8414 and AS5113 facade tests as a single panel, so can be installed with a range of internal finishes.



1. Panelised Facade System

AS5113

Pass for all criteria
(including debris)

Relevant
Test Method

AS5113-2016 /
BS 8414-2:2005

2.3 BS 8414/BR 135 Classified Architectural Facade Solutions

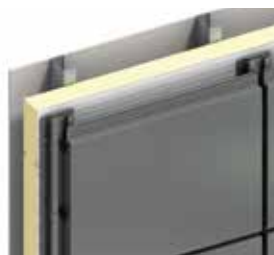
Karrier: Through-wall Insulated Panel & Rainscreen System

Our rainscreen systems combine the aesthetic flexibility of rainscreen facades with the practical benefits of a composite panel - quick installation, excellent airtightness and high R-values coupled with enormous design choice in colour, shape and material.

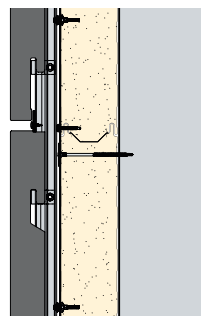
These lightweight insulated wall panel systems are safe and easy to install, providing a weathertight building envelope in a fraction of the time of other systems. The rainscreen facade can then be added as the project reaches completion.

Our BS8414/BR 135 classified solutions on insulated panels include Hook-on Cassettes, a versatile metal cassette with wide colour options and large cassette sizes.

The most recent test report is on the revolutionary Dri-Design cassette system that allows designers to achieve easily interchangeable patterns without the need for complicated rail and bracket systems. Its simple one-piece engineering eliminates many of the complexities of other systems and is up to twice as fast to install as comparable systems.



1. Metallic rainscreen with Karrier insulated panel



BR 135
Classification
Report Number

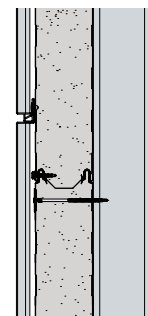
299571 Issue 1

Relevant
Test Method

BS 8414-2:2005



2. Dri-Design Metallic rainscreen with Karrier insulated panel



P107922-1001
Issue 1

BS 8414-2:2005

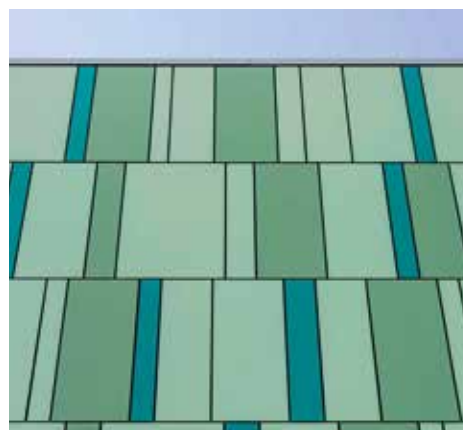
Substrate	Insulation	Fire Breaks / Cavity Barriers	External Finish	Generic Cladding Type
Lightweight Steel Frame	150mm Kingspan Evolution Wall Panel with ECOsafe PIR Insulation Core	No Cavity Barriers Used	150mm Kingspan Evolution Wall Panel with ECOsafe PIR Insulation Core	Insulated Sandwich Panel Facade System



Substrate	Insulation	Fire Breaks / Cavity Barriers	External Finish	Generic Cladding Type
Lightweight Steel Frame	140mm steel-faced Architectural Wall Panel with PIR insulation core	No Cavity Barriers Used	140mm steel-faced Architectural Wall Panel with PIR insulation core	Insulated Sandwich Panel Facade System



Substrate	Insulation	Fire Breaks / Cavity Barriers	External Finish	Generic Cladding Type
Lightweight Steel Frame	100mm steel-faced Wall Liner panel with PIR insulation core	Horizontal Intumescent Cavity Barriers	3 mm Aluminium Cassette System (Hook-on)	Aluminium Rainscreen Facade System
Lightweight Steel Frame	80mm QuadCore™ Insulation Core Karrier Panel POWERED BY QuadCore TECHNOLOGY	No Cavity Barriers Used	Aluminium Dri-Design Cassette Facade System	Aluminium Rainscreen Facade System





Wharfedale Hospital, UK



During the summer of 2003, a fire occurred at a hospital under construction. The building was steel framed with concrete floors. The first and second floors were clad with Kingspan ECOsafe PIR insulated panels approved by LPCB to EXT-B of LPS 1181 Part 1. At the date of the fire, the ground floor cladding had not yet been installed and the ground level was open sided.

It was thought that the fire was started deliberately by adhesive being poured over slabs of insulating material which were stored on the ground floor. *Photograph 1* shows the fire area.

The fire was discovered by on-site security staff and a call was made to the fire service who brought the fire under control within 40 minutes.

The heat generated by the fire was significant, as evidenced by cracking of the concrete floor above the fire and the distortion of steel beams that had been protected by a fire resisting intumescent coating.

The fire service found light smoke but no fire spread on the upper floors of the building. They also reported that although the joint between the floor and first floor walls had not been fire stopped there was no fire spread within the Kingspan ECOsafe PIR core material. *Photograph 2* shows where the flame damaged outer skin of the bottom panel has been lifted to inspect the slight charring of ECOsafe PIR core beneath.

Photograph 3 shows the inspection holes cut into the panels after the fire. The ECOsafe PIR insulation core can clearly be seen and is virtually unaffected by the direct flame impingement on the outer steel facing. The steel column was unaffected.

The main image above shows where the insulated cladding panels on the external face of the building had been attacked by flames.

Conclusions

In spite of a very severe fire at ground level (sufficient to damage the concrete floors and distort fire protected steel beams) the cores of the insulated panels:

- did not ignite; and
- did not promote fire spread.



Photograph 1



Photograph 2



"[The fire service] reported that although the joint between the floor and first floor walls had not been fire stopped, there was no fire spread within the Kingspan ECOsafe PIR core material."

Spider Transport, Ireland



Photograph 1

A deliberate act of arson took place in the early hours of the morning on 17th September 2008, outside the Spider Transport building which was used as a warehouse and distribution point in Wicklow, Ireland.

The fire was started maliciously by two people pouring a flammable liquid over the interior of a vehicle parked across the front of the building. CCTV footage recorded the whole incident and clearly shows the intensity of the fire. Flames impinged on the building and there was an 'explosion' of debris from the sides and top of the vehicle causing a fireball and burning debris to be projected onto the cladding, as captured by the CCTV image (1:33:19 am, opposite page).

Photograph 1 shows the aftermath of the fire. The upper parts of the external wall consisted of Kingspan Trapezoidal KS1000 RW insulated panels which complied with LPCB Grade EXT-B to LPS 1181 Part 1, whilst the lower parts were constructed of blockwork.

Although the bottom of the insulating core of the Kingspan insulated panels was directly exposed to flame impingement above the up and over door, there was no delamination of the skins of the panels and the insulation remained in place.



Photograph 2

The CCTV footage shows the duration and intensity of the truck fire. *Photograph 2* demonstrates that the fire did not get into the building.

Spider Transport were very relieved and happy with the panels' performance as the building contained large stock of valuable IT equipment including computers and iPods.

John Docherty of Spider Transport said, "As a business we are delighted with the performance of the Kingspan cladding system. There was virtually no internal damage at all despite the massive fire completely destroying the large van located right next to the building. The performance of the insulated panels in helping to stop the fire getting into the building ensured we could operate as normal the next day with no damage to any stock or interruption to our business."



1:11:43 am



1:20:29 am



1:20:33 am



1:20:38 am



1:22:14 am



1:24:02 am



1:28:09 am



1:33:19 am



1:42:16 am



1:43:09 am



1:45:39 am



1:48:04 am

My insurance company was also very impressed with the performance of the cladding – particularly in preventing the fire getting into the building and the fact that the damage was very localised and easy to repair."

Conclusions

- The integrity of the Kingspan insulated panels was maintained, even immediately above the up and over door where the bottom of the insulating core was exposed to flame impingement and suffered severe charring.
- There were no signs of any spread of heat via the cores of the Kingspan insulated panels to any point within the building and no signs of spread within the cores of those panels.
- There is no indication that the Kingspan insulated panels contributed to the heat damage caused by the fire.

"As a business we are delighted with the performance of the Kingspan cladding system. There was virtually no internal damage at all despite the massive fire completely destroying the large van located right next to the building."

John Docherty, Spider Transport.

Audi Dealership, Belgium

The fire occurred in the external compound of a large Audi dealership in Belgium in October 2014. It was a deliberate act of arson.

The building is of steel frame construction clad with 1m wide by 100mm thick Kingspan FM/LPCB Approved ECOsafe PIR cored sandwich panels and provides single storey showroom and workshop accommodation and an internal mezzanine floor for additional vehicles and back of house accommodation.

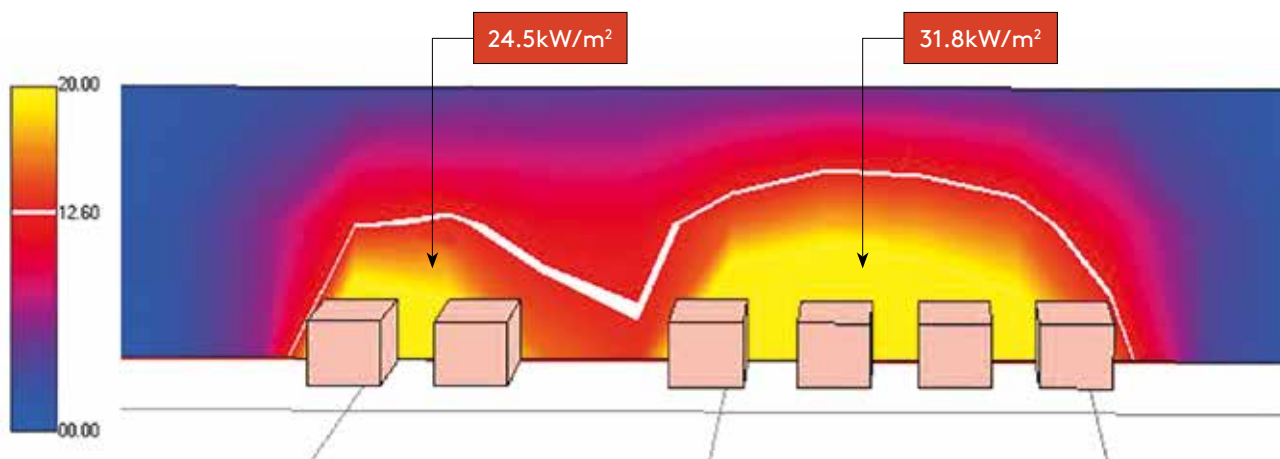
Photograph 1 shows the aftermath of the fire and is a photograph taken (by others) shortly after the fire event. The car in the foreground is understood to be an Audi Q3 with other cars being of at least a similar overall dimension and construction type.

Photograph 2 shows a sample of the ECOsafe PIR core material removed from the cladding panel at the location of predicted peak incident radiative heat flux of 31.8kW/m^2 . The photograph indicates that the ECOsafe PIR core had pyrolysed to a carbon char to a depth of about 40mm at this location. At locations remote from the area of peak incident radiative heat flux, the charring of the ECOsafe PIR core was significantly reduced, demonstrating that combustion had not been propagated by the ECOsafe PIR core material.

The inside of the workshop showed no evidence of fire penetration in an area adjacent to the external fire attack.



Photograph 1





No evidence of fire penetration to interior of the workshop



Photograph 2

Conclusions

- The ECOsafe PIR cored sandwich panels were subject to a fire likely to have lasted at least 15 minutes from ignition.
- It is likely that the cladding will have been subjected to peak incident radiative heat flux of at least 31.8kW/m^2 for a period of at least 10 minutes.
- The sandwich panels exposed to these conditions sustained damage in terms of delamination of the exposed steel skin of the panels away from the ECOsafe PIR core, removal of the paint coating and pyrolysis of the ECOsafe PIR core material to a depth of approximately 40mm.
- There was no evidence of fire propagation within the panels.

Furniture Retail Warehouse, Presov, Slovakia



A large fire took place in a furniture store in Presov, Slovakia – a large flat roofed retail building constructed with a concrete frame and clad with Kingspan Insurer Approved ECOsafe PIR core wall panels.

The building measures approximately 100m by 40m with a height to the roof parapet of approximately 8.5m. The fire took place in a food cooking grill area located approximately 1.2m from an external wall. The fire involved the combustible contents of the grill and 5 propane gas cylinders – at the height of the blaze the flames were over 10m high and were impinging directly onto the surface of the panels.



Conclusions

- The fire in the grill trailer subjected the external facade of the furniture store to an intense fire plume for a duration of approximately 10 minutes.
- The intensity of this fire plume was such that it was capable of melting the aluminium composite panel used for the store's mascot sign within this short fire exposure period.
- There is clear evidence that combustible materials used in the construction of the store's mascot sign and parapet perimeter lighting strip contributed to the intensity of this fire plume and would have been instrumental in the fire-fighters' initial opinion that the external wall construction was also burning.

"The effects were minor enough that the store was able to re-open about 3.5 hours after the fire."



- The Kingspan Insurer Approved ECOsafe PIR core material of the external wall panels charred to a depth of about 10mm in the area directly impacted by the fire plume and the external skin of the panels delaminated from the core in these areas.
 - Despite the intensity of the fire plume, the Kingspan Insurer Approved ECOsafe PIR core did not propagate the fire within the panel construction to areas within the core remote from the area of direct fire plume impingement.
 - After extinguishing the fire on the outside of the wall panels, fire-fighters found no evidence of smouldering or flaming combustion inside the wall panels.
- The effects of fire in the store were limited to minor smoke ingress at joints between Kingspan Insurer Approved ECOsafe PIR panels in the area of direct fire plume impingement. There was no spread of fire into the store. **The effects were minor enough that the store was able to re-open about 3.5 hours after the fire.**

Industrial Units, Heining, the Netherlands



Photograph taken by fire-fighters immediately after the fire.

The site is on an industrial state outside of Amsterdam and all the buildings involved in the fire were used by businesses carrying out automotive works and storing vehicles with associated equipment, parts and consumable materials.

The buildings of interest are the building clad with Kingspan FM/LPCB approved ECOsafe PIR core panels (A) and the building immediately adjacent which was destroyed by the fire (B). The former building measures approximately 31m long by 14m wide, with height of 4.5m to eaves and 6.5m to the ridge of its pitched roof. The latter building which was destroyed by the fire measured approximately 37m long by 16m wide and was about 4.5m high to its eaves.

The adjacent building B that was destroyed by the fire appeared to be constructed using single skin profiled sheet cladding on a steel portal frame structure. The owner of this building explained that it contained a number of vehicles, tyres, equipment and fuels, including a high value racing car and associated spares and equipment towards the western end of the building. These spares included magnesium race wheels and tyres. As a security measure, two Transit type vans were parked externally along the south facing elevation of the building across the roller shutter door providing access to this part of the building.

Conclusions

- The fire in building B would have subjected the external facade of building A to levels of radiative heat flux sufficient to cause delamination of the ECOsafe PIR panels and charring of the ECOsafe PIR core.
- The level of fire damage actually sustained by the ECOsafe PIR core panels on building A indicates that the actions taken by firefighters to cool the external facade of building A using water jets had a significant effect in reducing the temperatures achieved by the exposed surfaces of the ECOsafe PIR panels.
- The behaviour of the ECOsafe PIR wall panels in this fire was commensurate with that observed in previous fire case studies.

"...there was no visible damage to the roof cladding or to the wall cladding on the east and west elevations of building A."

Tenos Report.



Photograph taken by fire-fighters of the western elevation of building A.



Close-up of damage to the Kingspan ECOsafe PIR wall cladding of building A.



No heat transfer damage to interior of adjacent property (building A).

Crude Oil Pool Fire, the Netherlands



Photo: Roland Heitink

The facility at Arnhem in the Netherlands is used for the testing of equipment for the oil industry. On the 18th January 2013 a fire involving crude oil occurred in an external equipment testing area.

The test site was located adjacent to the main test building which was clad with Kingspan Insurer Approved ECOsafe PIR insulated wall panels up to a parapet wall which was constructed from polyurethane core panels.

The fire started at about 5.00pm and continued to burn intensely for about 10 minutes with the flame plume, during this period, ranging from 10m to 30m high. After this initial period the fire died down significantly to form a number of smaller separate pool fires. The available video information ends after about 18 minutes of burning; at which time only small pools of flaming remained.

There appears to have been little or no direct flame impingement on the external cladding of the building. However, the building would have been subject to high levels of radiant heat flux from the fire plume and this has been estimated to be of the order of 24 kW/m².



Conclusions

The intensity of radiation received by the panels caused some surface flaming but this ceased after approximately 30s (presumably after the surface coating had burned away). There was otherwise no evidence of self-sustaining flaming from the panel surface or at joints between panels.

As a result of the intensity of heat radiation the steel facing to the panels became rippled and delaminated from the foam core but there was only limited foam degradation at the core surface.

Despite the intensity of heat radiation being sufficient to cause ignition of the roofing system and being approximately double normal design values there was no evidence of any significant charring of the ECOsafe PIR panel cores or the promotion of fire spread via the panels.





Kingspan New Zealand Services

Product Selection Assistance

Sales representatives are available nationwide to answer queries on product options, assist with detailing, spans, colour swatches and other queries. They can also provide early stage budget estimates and co-ordinate the provision of project specifications.

Technical Assistance

Our technical team is available to provide specific advice on panel spans, product specifications, standard and bespoke detailing, panel optimisation, fire wall options, project specific acoustic solutions, panel guarantees, thermal condensation risk calculation along with general building science cladding advice.

Kingspan Technical Services can provide 'side by side' assistance with regard to project detailing, attending design meetings, providing training and undertaking site visits when required.

Area Sales Managers

Available to assist you in the appropriate selection and specification of our range of products, the Area Sales Manager can provide you with a local and responsive service.

Customer Services

The Kingspan customer services team can offer advice on lead times and minimum order quantities. The team is responsible for issuing quotes, coordinating the manufacture of your panel requirements with the production team, scheduling delivery and keeping you updated with the progress of your order.

Technical Services

Providing technical advice and support throughout the design and construction process. From the provision of project specific details through to the creation of project-specific specifications, Kingspan Technical Services can help to ensure that your building performs and complies with local building regulations.

Field Services

Free contractor training is offered on the installation of new and existing products. A site inspection service is offered throughout the construction stage and is on hand to offer advice on mechanical handling solutions.

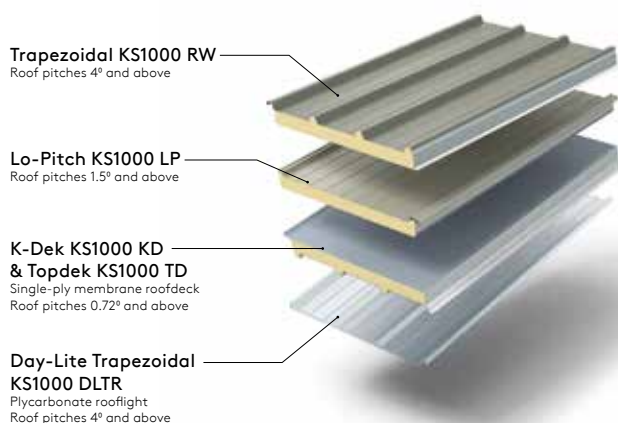
Marketing Services

The marketing team is on hand to organise literature, samples and metal colour swatches.

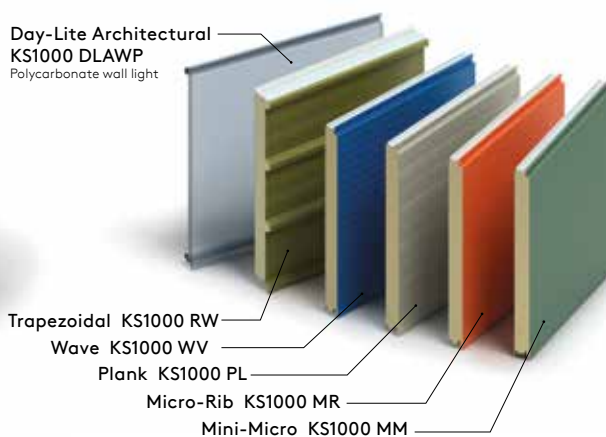


Kingspan New Zealand Complete Envelope Solutions

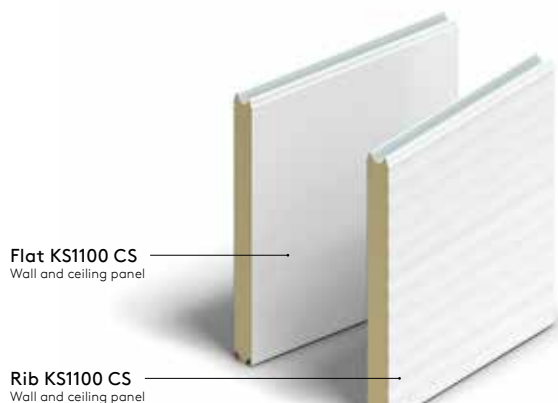
Insulated Roof Panels



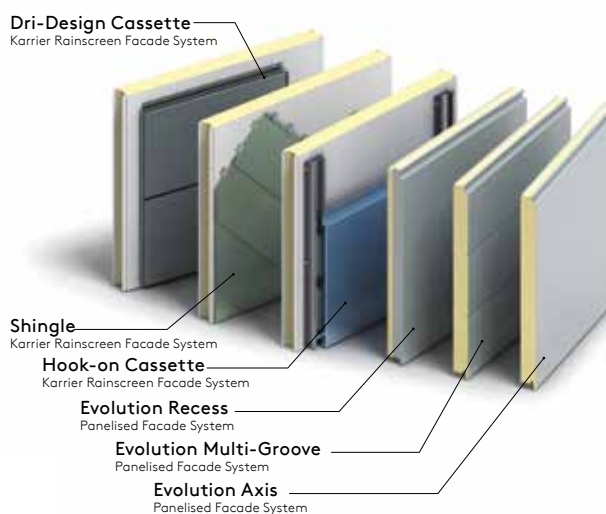
Insulated Wall Panels (horizontally or vertically laid



Controlled Environments

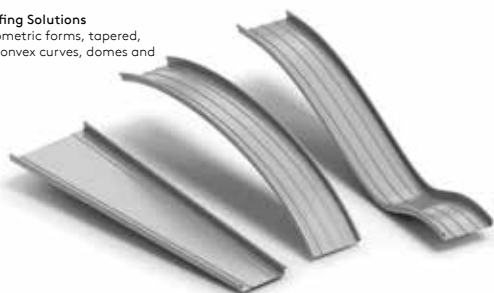


Kingspan Facade & Roof Systems



Architectural Roofing

KingZip
Freeform Roofing Solutions
2D and 3D geometric forms, tapered,
concave and convex curves, domes and
waves



Roofliner KingZip

Roofliner Membrane

Single-ply Membrane option

New Zealand

Kingspan Ltd

97 Montreal Street, Christchurch 8023

T: 0800 12 12 80 | 03 260 5530

E: info@kingspanpanels.co.nz

www.kingspanpanels.co.nz

For the product offering in other markets
please contact your local sales representative
or visit www.kingspan.com

Care has been taken to ensure that the contents of this publication are accurate, but Kingspan Limited and its subsidiary companies do not accept responsibility for errors or for information that is found to be misleading. Suggestions for, or description of, the end use or application of products or methods of working are for information only and Kingspan Limited and its subsidiaries accept no liability in respect thereof.