Sheet No: 6.2.1

BEFORE READING THIS DATA SHEET PLEASE REFER TO THE INTRODUCTION

6.2 Roofs

Composite panels (sandwich panels), built up systems and external claddings protected by dry-lining systems

Main application in respect to this *Design Guide:*

Roofs of industrial buildings and other single storey buildings

FUNCTION OF ROOFS

- To make no significant contribution to a developing fire (see Part 2.2), whilst meeting any imposed requirements for thermal insulation
- To prevent fire spread over the top of a compartment wall by meeting the fire resistance requirements appropriate to the protected zone (see index of this *Design Guide* for references).
- Not be capable of spreading flame on their internal or external surfaces
- To prevent the combustion of the insulating core from accidental or malicious ignition of combustible materials
- To prevent, as far as possible, the passage of smoke
- To withstand wind loading, rain penetration and deflection to be experienced in use whilst maintaining the requirements above.
- To maintain the satisfactory performance over the lifetime of the building, or for a shorter duration if allowed for in the fire safety management plan, in respect of realistic impact and/or ambient conditions.
- To maintain the above functions when breached by openings for roof lights, roof ventilators etc. In respect to this, the advice from the cladding manufacturer should be obtained regarding the compatibility with such systems.

IMPORTANT

THESE DATA SHEETS ARE ONLY INTENDED TO GIVE GENERIC INFORMATION.

DATA ON PROPRIETARY PRODUCTS MUST BE OBTAINED FROM THE MANUFACTURERS

EVIDENCE OF PERFORMANCE

To ensure that insulated cladding panels for roofs meet in full the fire performance requirements of this *Design Guide*, it is important for the building designer to specify products that have been approved by LPCB to LPS 1181[24] and listed in the *List of Approved Fire and Security Products and Services*[19]. In addition, for portions of the roof that are part of the protected zone (see 3.4.2), these shall have sufficient fire resistance to resist fire inside to outside. Appropriate test is BS 476: Part 22: 1987, clause 9[1h].

Contribution to fire growth. For composite constructions such as insulated panels used for roofs, these shall have been tested to the wall and ceiling lining test described in LPS 1181[24] (a large scale reaction-to fire test)[8]. Even when a

non-combustible insulant is used, combustible materials may still be used in the roof construction, e.g. vapour barrier or joint seals and the use of the wall and ceiling lining test may still be appropriate. Roof claddings protected by dry lining systems are generally constructed from either non-combustible or materials of limited combustibility, and consequently meet the requirements of 2.2 of this *Design Guide*.

Note: Tests undertaken to BS 476: Part 33: 1993 (ISO 9705)[1k] *are not deemed to be suitable for external cladding systems constructed from composite panels for ensuring compliance with this* Design Guide.

Surface spread of flame. The internal and external surfaces of roofs shall have a surface spread of flame of Class 1 to BS 476: Part 7[1d] and be rated Class 0 as defined in England and Wales Building Regulations, Approved Document B[29]; or other national regulations. This must be verified by test.

External fire exposure. With respect to external fire exposure the roofing system, comprising the roof covering, thermal insulation and roof deck should be classified not less than EXT.F.AC or EXT.S.AC when tested in accordance with BS 476: Part 3[1a].

The provision of roof lights or ventilators* in any roof, may assist rapid fire spread to inside the building or to nearby roofs or buildings and they should therefore be classified not less than EXT.F.AC or EXT.S.AC when tested in accordance with BS 476: Part 3[1a].

The following wording appears in Approved Document B[29] Section 14.6: 'When used in rooflights, a rigid Thermoplastic sheet product made from polycarbonate or from plasticised PVC, which achieves a Class 1 rating for surface flame spread when tested to BS 476 Part 7[1d] . . . can be regarded as having an AA designation.'

In buildings containing high values or critical business equipment or processes, rooflights and ventilators should not have a dimension greater than 1m and be spaced not less than 3m apart in any direction. This restriction does not apply to rooflights or ventilators having a rating of EXT.F.AA or EXT.S.AA in accordance with the above test.

Fire resistance. For the parts of the roof adjacent to compartment walls defined in 3.2.1 of this *Design Guide*, that is those within the *protected zone,* these shall have a minimum fire resistance of not less than 30 minutes integrity and 15 minutes insulation. This must be verified by test to BS 476: Part 22[1h], clause 9, to meet the recommendations in this *Design Guide*. *Designers should not accept tests to clause 5 of that standard for roof applications.*

Care must be taken at the junction of the roof and compartment wall to maintain fire resistance and to allow for hot movement (see page 3.2.1.1 and 3.1.1.2).

The fire resistance should be increased to 60 minutes integrity and 60 minutes insulation for storage buildings or other occupancy types deemed to be high risk by the risk assessment.

Some claims for high fire resistance may only indicate integrity performance and the designer should enquire on the insulation achieved in each case.

* ***It may not be possible to maintain the prescribed underpressure conditions when testing ventilators. For the purpose of this*** Design Guide, ***ventilators used in roofs may be tested and classified without complying with the underpressure conditions prescribed in BS 476:Part 3***[1a].

It is important that only fire resisting roof decking systems and roof lights that have been tested in the horizontal orientation are used in the protected zone. Constructions that have only been tested in the vertical may fail prematurely if used horizontally and Method 9 of BS 476: Part 22[1h] must be used. Where a roof is not designed for means of escape, and can therefore be tested without load, this test is considered the most applicable.

Resistance to smoke. There are no suitable test methods to base a performance requirement on, but it should be recognised that some ability to prevent smoke leaking outside the building is still desirable from an environmental point of view.

This data sheet considers in detail the following generic roofing products:

1. Composite panels
    - 1.1 Polyurethane cored
    - 1.2 Polyisocyanurate cored
    - 1.3 Mineral wool cored (rock fibre)
2. Built up roofs
    - 2.1 Mineral wool insulant
3. Roof claddings protected by dry lining systems
    - 3.1 Calcium silicate lined system
    - 3.2 Gypsum board lined system

1. Composite panels

These generally encapsulate all surfaces and edges of the insulating core by steel facings. Insulating cores are typically polyurethane, Polyisocyanurate, or mineral wool. Facings are generally ribbed (profiled), with the longer edge having a deep rib to interlock with adjacent panels, with weather tightness being a particular feature of the design, but this can be developed to provide good fire integrity as well. 'Fire rated' panels are often provided with factory applied fire seals at the joints to help maintain joint integrity. They arrive at site fully assembled and only need to be fixed to the structural supports.

Fire performance data

Composite panels

1.1 Polyurethane (PUR) cored

Contribution to fire growth. Should not be regarded as meeting the requirements of Part 2.2 of this *Design Guide*, as if they are exposed to a sufficient size ignition source, may still make a significant contribution to fire growth. (☆☆)

Fire resistance. Provided they have adequate joint design, particularly in respect to adequacy of interlock between adjacent panels and provision of factory applied fire seals, is capable of providing (30 minutes integrity and 15 minutes insulation (thickness not less than 80mm)). (☆☆☆)

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of

smoke may be anticipated. The core material will generate smoke if heated and consequently it is important to ensure adequate joint integrity under fire conditions. (☆☆☆)

Strength and impact resistance. Should have adequate resistance to impact for most industrial applications provided only steel faced panels are used. (☆☆☆☆)

Durability. The coatings applied to the steel can be regarded as provided adequate resistance to corrosion for most industrial applications. Compatibility between the metal and the insulant used may have to be confirmed by the manufacturer. (☆☆☆☆)

FIRE PERFORMANCE DATA

Composite panels

1.2 Polyisocyanurate (PIR) cored

Contribution to fire. Only specially formulated PIR foams that have been tested and approved to LPS 1181[24] can be regarded as meeting the requirements of 2.2 of this *Design Guide*.

Standard PIR foams (☆☆)

LPCB approved systems to LPS 1181-2[24] (☆☆☆☆)

Fire resistance. Provided it has adequate joint design, particularly in respect to adequacy of interlock between adjacent panels and provision of factory applied fire seals, is capable of providing 30 minutes integrity and between 15 minutes and 30 minutes insulation depending on thickness. A thickness of at least 100mm is required to provide 30 minutes insulation performance. (☆☆☆)

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of smoke can be anticipated. The core material will generate smoke if heated and consequently it is important to ensure adequate joint integrity under fire conditions. (☆☆☆)

Strength and impact resistance. Should have adequate resistance to impact for most industrial applications provided only steel faced panels are used. (☆☆☆☆)

Durability. The coatings applied to the steel can be regarded as providing adequate resistance to corrosion for most industrial applications. Compatibility between the metal and the insulant used may have to be confirmed by the manufacturer. (☆☆☆☆)

FIRE PERFORMANCE DATA

Composite panels

1.3 Mineral wool cored (rock fibre)

Contribution to fire growth. Although not all mineral wool products are entirely non-combustible, particularly those with higher resin content, they can for all practical purposes be regarded as being non-combustible and therefore meet fully the requirements of Part 2.2 of this *Design Guide*. (☆☆☆☆☆)

Fire resistance. Provided it has adequate joint design, particularly in respect to adequacy of interlock between adjacent panels , subject to the panel thickness and the density, can easily provide 60 minutes integrity and 60 minutes insulation and can be regarded as having unrestricted application in respect to this *Design Guide.* (☆☆☆☆☆)

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of smoke from the fire can be anticipated. Any smoke generated from the mineral wool core will be minimal. (☆☆☆☆)

Strength and impact resistance. Should have adequate resistance to impact for most industrial applications provided only steel faced panels are used. (☆☆☆☆)

Durability. The coatings applied to the steel can be regarded as providing adequate resistance to corrosion for most industrial applications. Compatibility between the metal and the insulant used may have to be confirmed by the manufacturer. (☆☆☆☆)

2. Built up roofs

These are delivered to site as a range of components to be fixed together and assembled on site. These components comprise profiled outer metal skins, supporting grid, insulation, insulated internal panel and suitable fixings. Fire performance may be compromised by poor detailing or installation. For this reason, mineral wool is particularly recommended unless a combustible insulant can be adequately protected from the fire, e.g. by a suitable internal lining. For this reason, guidance is given only on built-up systems that use mineral wool as insulants. Mineral wools comprise both glass fibres and rock fibres.

Fire performance data

Built up roofs

2.1 With a mineral wool insulant

Contribution to fire growth. Although not all mineral wool products are entirely non-combustible, particularly those with higher resin content, they can for all practical purposes be regarded as meeting fully the requirements of Part 2.2 of this *Design Guide*, unless combined with combustible facing materials, where additional evaluation would be required. (☆☆☆☆☆)

Fire resistance. The level of fire resistance would very much depend on the type of mineral wool used, as well as joint design and therefore a level of fire resistance should not be assumed. The designer should demand test data in all cases. Currently, the designer may find that little test data to clause 9 of BS 476: Part 22^{1h} exists. (dependent on mineral wool used).

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of smoke from the fire can be anticipated. Any smoke generated from the mineral wool core itself will normally be minimal. (☆☆☆☆)

Strength and impact resistance. Should have adequate resistance to impact for most industrial applications provided only steel faced panels are used. (☆☆☆☆)

Durability. The coatings applied to the steel can be regarded as providing adequate resistance to corrosion for most industrial applications. (☆☆☆☆)

3. External claddings protected by dry lining systems

These typically comprise drylining materials such as gypsum or calcium silicate boards supported on a steel grid or channel system. The grid system is attached to the sheeting rails. Channel systems may be independent of the structural frame supporting the external cladding. Some systems offer fibre cement profiled sheets as an alternative to steel cladding sheets. To ensure adequate protection from an external fire, either a fire protection board will be provided on the cavity face of the external skin (fixed to the sheeting rail) and/or mineral wool insulation be suspended in the cavity.

Fire performance data

Dry lining protected systems

3.1 Calcium silicate lined systems (mineral wool insulation in cavity if 60 minutes fire resistance required)

Contribution to fire growth. These systems are constructed from non-combustible materials or materials of limited combustibility and therefore meet fully the requirements of Part 2.2 of this *Design Guide*. (☆☆☆☆☆)

Fire resistance. Systems currently offered for roof applications tend to cover internal fire exposure only and are based on membrane ceilings. They can provide typically between 30 minutes and 120 minutes fire resistance. (☆☆☆☆☆)

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints in the external cladding have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of smoke from the fire can be anticipated. Any smoke generated from the lining or mineral wool insulation will be minimal. (☆☆☆☆)

Strength and impact resistance. The lining will have reasonable resistance to impact for most industrial applications. (☆☆☆)

Durability. Under normal service conditions, product performance would be expected to remain unchanged during the life-time of the building. Any damaged panels must be replaced by trained installers immediately. (☆☆☆☆)

Fire performance data

Dry lining protected systems

3.2 Gypsum board lined systems

Contribution to fire growth. These systems can be regarded as meeting fully the requirements of Part 2.2 of this *Design Guide* provided the insulation material used in the cavity is limited to mineral wool. (☆☆☆☆☆)

Fire resistance. Designer will have to consult with the manufacturer to determine what specification is needed to cover protected zone applications. Test data currently appear to cover external wall applications only.

Smoke resistance. There are currently no test methods available to measure this parameter. However, as the joints in the external cladding have to be weather tight and provided the deformation under fire conditions can be controlled, some containment of smoke from the fire can be anticipated. Any smoke generated from the lining or mineral wool insulation will be minimal. (☆☆☆☆)

Strength and impact resistance. The lining will have reasonable resistance to impact for most industrial applications. (☆☆☆)

Durability. Under normal service conditions, product performance would be expected to remain unchanged during the life-time of the building. Any damaged lining panels or insulation must be replaced by trained installers immediately. (☆☆☆☆)

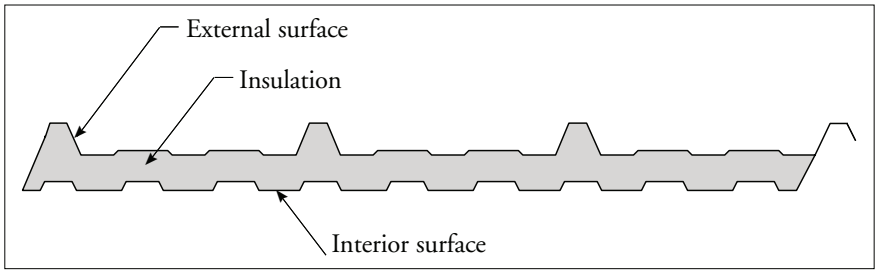

Figure 1. Typical composite cladding panel.

The above drawing is intended to illustrate a typical composite panel. This would not necessarily be a fire rated panel. In the above design, total encapsulation of the insulant would only occur once the panel is installed.

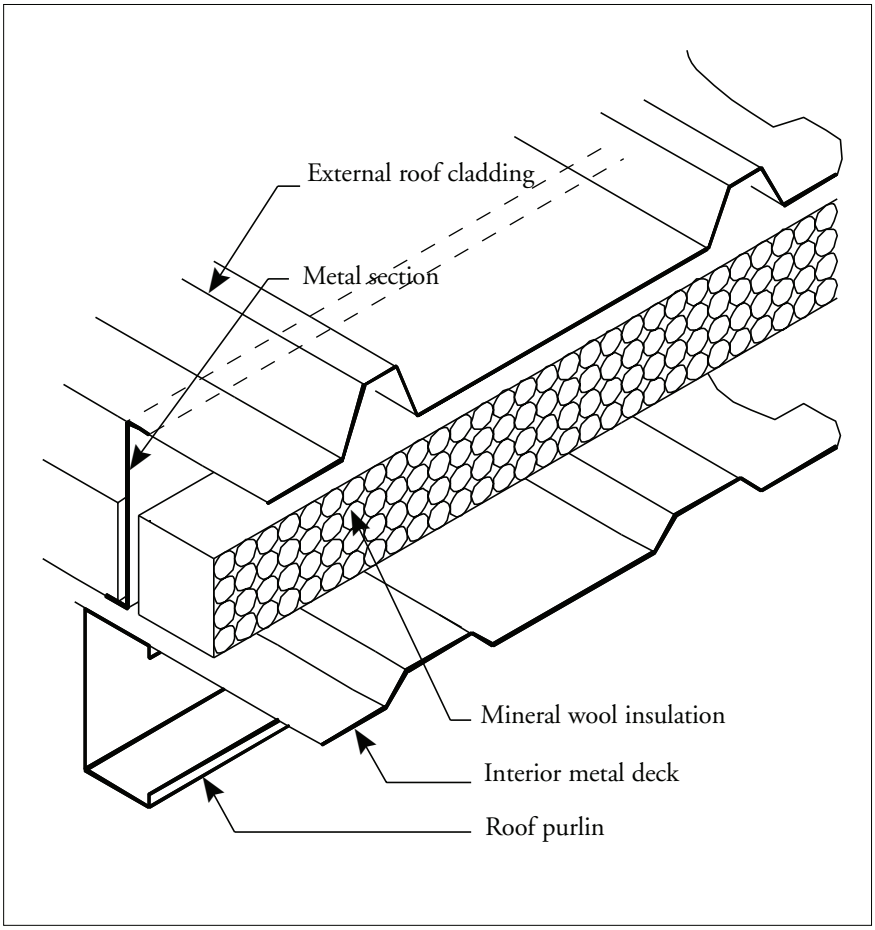

Figure 2. Typical built-up roofing system.

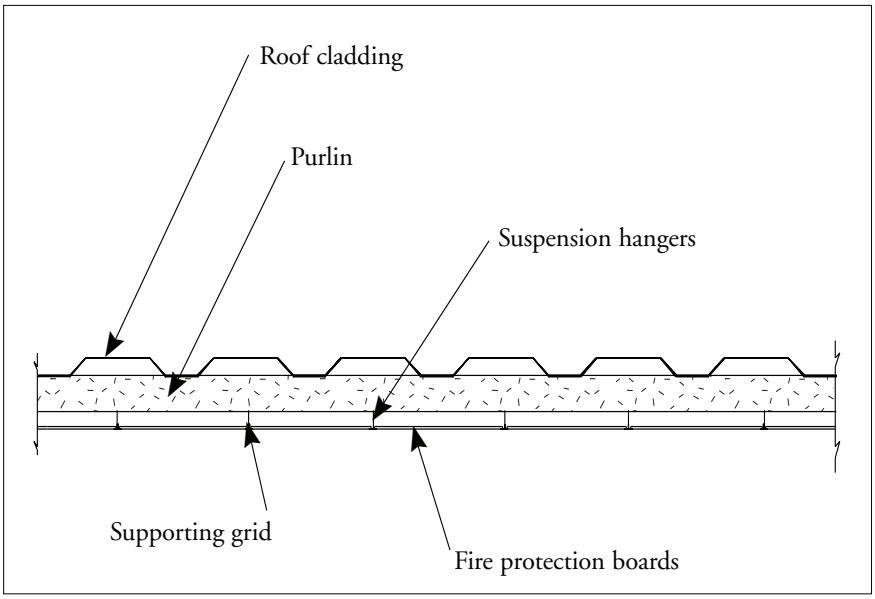

Figure 3. Dry lining system protecting roof from an internal fire.

Summary of data

Table 1 below summarises the assessed abilities of roof cladding systems to satisfy the identified performance requirements.

Table 1

Type of roof system	Contribution to fire growth	Fire resistance	Smoke resistance	Strength and impact resistance	Durability
Composite panel 1.1 polyurethane (PUR) cored	(☆☆)	(☆☆☆) Dependent on panel thickness and joint design	(☆☆☆)	(☆☆☆☆)	(☆☆☆☆)
Composite panel 1.2 polyisocyanurate (PIR) cored	(☆☆)	(☆☆☆) Dependent on panel thickness and joint design	(☆☆☆)	(☆☆☆☆)	(☆☆☆☆)
Composite panel ***LPCB approved*** 1.2 polyisocyanurate (PIR) cored	(☆☆☆☆)	(☆☆☆) Dependent on panel thickness and joint design	(☆☆☆)	(☆☆☆☆)	(☆☆☆☆)
Composite panel 1.3 mineral wool cored panel	(☆☆☆☆☆)	(☆☆☆☆☆)	(☆☆☆☆)	(☆☆☆☆☆)	(☆☆☆☆)
Built up roof systems 2.1 mineral wool core only	(☆☆☆☆☆)	Dependent on mineral wool used and joint design. Currently little test data exists for this type of system	(☆☆☆☆)	(☆☆☆☆)	(☆☆☆☆)
Dry-lining protected 3.1 calcium silicate board	(☆☆☆☆☆)	(☆☆☆☆☆)	(☆☆☆☆)	(☆☆☆)	(☆☆☆☆)
Dry-lining protected 3.2 gypsum board	(☆☆☆☆☆)	Designer should consult manufacturer for specification needed to satisfy *Design Guide* requirements for protected zone applications	(☆☆☆☆)	(☆☆☆)	(☆☆☆☆)

Sources for further information

EPIC (Engineered panels in construction), 95 York Street, London, W1H 1DU.

Association of Specialist Fire Protection, Association House, 253 Ash Road, Aldershot, Hampshire GU12 4DD.

Built-up Systems Association, 117 Columbria Drive, Lower Wick, Worcester, WR2 4XX.

EURISOL (UK Mineral Wool Association), 39 High Street, Redbourn, Herts AL3 7LW.

The Metal Cladding and Roofing Manufacturers Association, 18 Mere Farm Road, Noctorum, Birkenhead, Merseyside L43 9TT.