Loss prevention standards

# Fire Safety:

# Composite Panels

## Introduction

The use of composite panels (also sometimes referred to as 'sandwich panels') within building construction has increased during the last two decades. Composite panels have been specified as an effective way of achieving high levels of energy efficiency, whilst allowing for an aesthetic design of flexibility. They are now supplied with various types of insulation materials, differing metal finishes and various colours, some of which can include additional fire-retardant materials.

However, there have been a number of significant fire losses involving the use of combustible composite panels, especially in industries such as food, pharmaceutical and electronic.

Most expanded foams involved in a fire give off significant amounts of toxic smoke due to the chemical compositions of the foams involved. Expanded foams are widely used in the construction industry, for example, cement rendered expanded polystyrene is often used as an external insulation material in modern or prefabricated buildings that include unusual, contoured walls, and/or require high levels of thermal insulation to meet the latest building and environmental regulations.

Foil-faced expanded foams such as phenolic, are also used between roof joists or as cavity wall insulation to improve the building's energy efficiency.

Polystyrene has a high resistance to water and is often used on roofs beneath a weather resistant covering, below concrete floors, and beneath metal dock levellers used in refrigerated buildings to improve thermal insulation.

Most, if not all foams are combustible to varying degrees, with polystyrene in particular being extremely combustible.

Electronic, pharmaceutical, food and refrigerated storage industries generally have clean rooms and/or temperature-controlled compartments with ceilings and partitions constructed of metal faced composite panels, many of which are foam insulated.

A large number of lightweight steel framed buildings have composite panel walls and/or roofs, mainly due to modern fast construction techniques.

Many food processors undertake a degree of cooking using deep fat frying equipment, which increases the risk of fire, particularly when extensive amounts of polystyrene are present within the structure.

Excessive amounts of highly combustible insulated materials provide a significant challenge to fire fighters, often restricting operations to external fire fighting which may result in a total loss of the building.

Highly dense toxic smoke given off by foamed plastics during a fire will severely contaminate the building and any remaining susceptible goods such as food produce, sensitive electronic components, and pharmaceutical supplies, etc., leading to very expensive clean-up costs and the possible total loss of stock.

The risk of combustible composite panels contributing to the spread of fire may be significantly reduced by the maintenance of a good standard of fire safety management and the proactive replacement of ageing combustible composite panels with those tested for fire resistance.

## Panel Construction

Composite panels are made up of two coils of facing material, one external and one internal (paper, board, foil or metal), approximately 1.2-metres wide, that come together after being cleaned and dried to a pre-set depth/thickness at which point the insulation is added. Typically foamed insulated composite panels are manufactured using a blend of combustible polymer alcohol (polyol) which is sprayed onto the lower facing sheet along with methyl-di-phenol-isocyanate. The polyol contains various additives including catalysts, and in some cases fire retardants and surfactants.
Pentane is used as a blowing agent and is either added into the polyol before it is combined with the methyl-di-phenol-isocyanate or is simply combined at the same time as the polyol and the methyl-di-phenol-isocyanate.
When blended together, the methyl-di-phenol-isocyanate reacts with the polyol in an exothermic reaction, which produces sufficient heat to cause the blowing agent to boil, creating the foamed core. The centre of the foam insulation core reaches a temperature of around 150$^{o}$C.

The reaction can be closely controlled by varying quantities of reactants, etc., so as to create insulation cores of very precise thicknesses. The foam panels then pass through indirectly heated tunnels to cure at this stage between the two metal faces, set at the required thickness. As the panel travels along the production line, they are finally cut to the required lengths. The ends of the new facing sheets are manually joined to the ends of the previous facing coils, using strips of adhesive tape for the next production run.

Polyol contains approximately 3% fire retardant solution to lower its viscosity. When buildings are required to use fire retardant materials in their construction, an additional 10% of fire-retardant solution is added to the polyisocyanurate panel during the manufacturing process. These are rated as approved fire-retardant panels to satisfy local fire/planning authorities and/or property insurers.

The insulating cores within the panels can be rigid or expanded foamed plastics, glass fibre or high-density mineral fibre (when a degree of fire resistance is required). Foam glass and phenolic foams have also been used in composite panels but are less common.

Panel facings are usually coated with a polyvinyl chloride (PVC) covering, to enable easy and efficient cleaning when hygiene is important, such as in pharmaceutical or food processing plants. Unfortunately, when PVC is involved in a fire together with water spray from fire fighters, the resulting composition is often a corrosive atmosphere commonly referred to as acid rain. This corrosive atmosphere can severely damage sensitive metal engineering products that are machined to very fine tolerances (electronics/aerospace industries, etc.), resulting in the loss of the machinery and products.

Other systems can be used for insulated roof and/or wall cladding, which are 'built-up' on site. The components are assembled individually onto the building frame, usually starting with an internal liner of non-combustible board or profiled metal sheet, an insulating core (non-combustible mineral glass fibre, mineral wool, or a combustible foamed plastic slab), a vapour barrier usually consisting of plastic and finished with a profiled metal sheet.

## Types of Composite Panel Core Insulation

### Polystyrene – Expanded and Extruded

Polystyrene is a thermoplastic rigid cellular material, often known as expanded (EPS) or extruded (XPS) polystyrene foam, which melts and ignites easily and will rapidly burn. It is commonly used for packaging and as insulation within refrigerators, freezers, and cold stores, as well as in the construction industry.

A fire involving highly combustible polystyrene will very quickly develop and spread, including through the panels, creating thick toxic smoke, which makes firefighting extremely difficult, particularly when the insulation is part of a composite panel.

When polystyrene melts flaming particles are liberated, and if part of the roof assembly, these particles can ignite combustible materials below causing multiple seats of fire. The panels eventually delaminate and collapse, but by this time the building may either be totally destroyed by fire or severely damaged.

Polystyrene composite panels are used internally such as in partitions and false ceilings but are increasingly used externally on some modern buildings. The panels are often very vulnerable to impact damage which can expose the highly combustible foam, and the damaged combustible foam is then exposed to fires from external sources.

### Polyurethane

Polyurethane (PUR) materials are widely used in varying forms and like many foam plastics are organic, and similar to other organic materials such as wood and paper, which will readily burn if exposed to sufficient heat source. Polyurethane is a thermoset plastic that will initially char in a fire during the early stages, but if exposed to an intense prolonged heat source will ignite and burn.

Polyurethane contributes significantly to the fire load and once alight can quickly develop and spread creating thick toxic smoke, which makes firefighting extremely difficult, particularly when the insulation is within a composite panel.

### Phenolic

Phenolic foams are thermosetting and are used either as open or closed cell materials to produce a wide range of products. Phenolic foam is more commonly used for pipe and ductwork insulation and on a foil or board backing for wall insulation. When used as close cell insulation phenolic foam reacts similar to polyurethane in a fire situation, and tends to char, at least initially, but in general has a slower rate of burn/spread than polyurethane. Phenolic foam panels contribute to the building's overall fire load, particularly if damaged or exposed to an intense prolonged heat source. They will ignite, and once alight will develop and spread creating toxic smoke, which makes fire fighting extremely difficult, particularly when the insulation is within a composite panel.

### Polyisocyanurate

Polyisocyanurate (PIR) is manufactured from a number of different individual foam compositions which have varying degrees of performance and is very similar to polyurethane. However, when provided with the additional 10% fire retardant solution during the polyisocyanurate process, it is generally accepted as performing better in a fire than both polystyrene and polyurethane, although still contributing to the fire load. Some fire retardant grades of polyisocyanurate have passed basic surface spread of flame tests where a hot flame is placed up to the panel surface for a specific set time, then withdrawn. If the panel withstands the flame without significant damage and does not allow the spread of flame across the surface of the panel up to pre-determined distance/percentage, then the product passes the test.

These fire retardant polyisocyanurate panels are accepted as graded 'approved' products by a number of national fire/product testing agencies such as the UK's Loss Prevention Certification Board (LPCB) and the US's Factory Mutual (FM) Approvals.

### Mineral Fibre/Glass Wool

Mineral fibre/glass wool insulation is non-combustible and is widely used within the construction industry. However, consideration should be given to other materials used with this form of insulation, which may have a degree of combustibility, such as of vapour barriers, membranes and bonding agents.

### High Density Mineral Fibre

Panels containing high density mineral fibre insulation are also used in the construction industry and for higher risk occupancies requiring a degree of fire resistance. These systems are considered non-combustible and should have a fire resistance rating (insulation and integrity).

## Fire Resistance of Panels

All panel systems can be damaged to some extent by fire, irrespective of the insulating core. In the UK, insurers generally regard 'approved' composite panels used on the external envelope of a building and for internal applications, as those which meet or exceed the requirements of:

- LPS 1181 (Part 1: External envelope of buildings and Part 2: Internal constructions in buildings)
- LPS 1208 (Fire resistance requirements for elements of construction used to provide compartmentation).
- FM4880 Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings & Exterior Wall Systems
- FM4881 Class 1 Exterior Wall Systems
- FM4882 Class 1 Interior Wall and Ceiling Materials or Systems for Smoke Sensitive Occupancies
- FM4471.22 Class 1 Panel Roofs

LPS = Loss Prevention Standard & FM= Factory Mutual

Within these standards there are different grades of performance in respect of fire integrity and fire insulation, so it is essential that insurers and insurance agents are consulted to agree on the appropriate standard.

It is important to note that this 'approval' is subject to the panels being correctly installed in accordance with the manufacturer's instructions, in the correct joint orientation (either horizontally or vertically), with the correct panel fixing requirements, joint seals and stitching. The method of fixing is important as it can have a significant bearing on structural integrity in a developing fire. These panels should not become involved in a fire until very late in its development.

## General Guidance

For new buildings or extensions, or if installing false ceilings or partitions, consideration should always be given to the use of non-combustible panels where possible, or if not, then products which have been approved by a testing agency such as the LPCB or FM. Close liaison with your insurer is essential at the earliest design opportunity to ensure appropriate construction materials are considered.

Insurers place a great deal of importance on the type of building construction when considering the risk, and the use of readily combustible materials, such as combustible composite panels, can affect both premium and acceptability.

All building materials under consideration should form part of the general risk assessment process in the design of any new building, extension or alteration.

As a minimum measure, any hazardous processes or changes in occupancy should be separated from the remainder of the process or building, using non-combustible walls, floors and ceilings, to provide at least a 60-minute fire resistant compartment. However, dependant on the risk/occupancy hazard/exposure/sums insured etc., the fire segregation/enclosure may well need to be up to 120 or 240-minutes fire resistance rating and provided with an automatic active fire suppression system.

In existing buildings, the core materials of any composite panels should be established and clearly identified using previous drawings and information, or in some cases a careful intrusive survey by specialist contractors to test and establish the type and composition of the core materials used. Composite panels with combustible insulation should be clearly marked, and an example hazard notice can be found in Appendix 3.

Either a full or partial replacement or the addition of non-combustible linings to those panels deemed to present an unacceptable risk may be an option for improvement. Another option may be to remove combustible composite panels in strips of at least 10-metres wide across the entire building, along a number of intervals, and replace with non-combustible insulated panels, which is likely to create fire breaks and slow the spread of fire in the area concerned.

Any damaged combustible panels should be replaced with new panels that are either non-combustible or of the approved type, for example, LPCB or FM.

Further specific passive and active fire protection measures may also need to be considered to address the increased risk.

In addition to liaison with insurers, the local Fire Brigade and Environmental Agencies should also be consulted at the earliest stage if any new projects involve the use of combustible composite panels. Fire water contamination may be a concern particularly where plastics are involved.

Fire Brigades often complete a risk assessment before firefighting operations can commence and will require certain site-specific hazard information as part of their preplanning firefighting tactics. This could take the form of suitably annotated floor plans indicating the location and extent of combustible cored composite panels, any separation by fire resistant compartment walls, provision of fixed fire protection systems, hazard storage locations, main service isolation points, fire hydrant locations, etc.

There are a number of 'Panel Marking' schemes, in which standard indicator plates are fixed by entrances to buildings so as to inform the Fire Brigade of the type of panels to be found.

## Management of Composite Panels

Where combustible composite panels are present, a significant exposure exists, and these panels should be considered for replacement. As a minimum, strict risk management controls should be implemented including the formalisation of a panel management programme, which should include the following items as a minimum:

- Documented identification of panel types, insulation materials, their hazards, and the location within the facility.
- Detailed plans of the panelling should be drawn-up so contractors, maintenance employees, Fire Brigades, etc., are aware of the exact location of these combustible materials. The panels themselves should also be marked indicating the type of insulation material.
- Panels should be completely sealed with a metal facing and joints maintained in good condition.
- Any holes or damage to panels should require that panels are either replaced or repaired with metal caps or covers riveted to the panel. Silicone sealant is not suitable as in a fire it shrinks away and exposes the hole.
- Whenever alterations to the buildings, machinery or operations are planned, the risks and presence of combustible panels should be considered, and a Composite Panel Permit completed (see Appendix 1).
- Whenever work is undertaken on panels, power tools and cutting equipment should not be used. Manual drills and snips should be used.
- Electrical and other services penetrating panels should be fitted with non-combustible, fire rated sleeves to the full thickness of the panels. Equipment and cabling should be subjected to increased frequency of electrical testing including thermographic inspections.
- No storage should be located in close proximity to the panels, whichever is the greater of 10-metres distance or twice the storage height.
- A weekly documented inspection of panels should be carried out as part of the regular self-inspection programme and any holes or damage repaired as above. Management should check the logs regularly, e.g. monthly.

## Hot Work/Permits to Work

Hot work should not be permitted inside buildings containing combustible composite panels, and visual signs posted to emphasise this, an example hazard notice can be found in Appendix 3.

Where there is no alternative to hot work in close proximity to combustible construction, the hot work operation should be completed in accordance with the Aviva Loss Prevention Standard: Hot Work Operations utilising the hot work permit. Additional precautions include:

- There must be a suitable permit to work system in place, with specific comment required regarding composite panels.
- Permits to work including hot work permits must be issued and continuously supervised at all times by trained employees, preferably engineering managers/supervisors.
- Appointed permit staff must receive regular refresher training on hazard spotting, permit completion, supervision and fire watch precautions.
- All fire watches should be formal and recorded with formal documented hand overs between shifts.
- Permits must be issued daily and not passed across work shifts. They are to be closed off at the end of each shift and a new permit issued when work exceeds a single shift.
- Never permit any form of hot work to be allowed on or involving the composite panels.
- No hot work to be allowed within 10-metres of the composite panels.
- If hot work is closer than 10-metres then appropriate fire resistant/retardant blankets must be used to protect panels, with dedicated trained fire marshals/fire watch standing by continuously with fully functioning extinguishing appliances.
- The fire watch shall be continuous following cessation of hot work operations for at least 60-minutes, followed by additional intermittent checks every 15-20 minutes for a further 180-minutes minimum. The risk assessment may determine that the continuous monitoring period of 60-minutes may require extending.
- If hot work is at height where sparks/heat could travel through a floor or wall, multiple fire watches may need to be employed to each floor/area.

## Fire Risk Assessment

The presence of combustible composite panels must be recognised and recorded within your fire risk assessments, due to the potential for extremely rapid fire spread and the release of large volumes of toxic smoke.

## Please Note

This document contains general information and guidance and is not, and should not be, relied upon as specific advice. The document may not cover every risk, exposure or hazard that may arise, and Aviva recommend that you obtain specific advice relevant to the circumstances. Aviva accepts no responsibility or liability towards any person who may rely upon this document.

# Checklist

A generic Composite Panel Checklist is presented in Appendix 2 which can be tailored to your own organisation.

# Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services at preferential rates via our network of Specialist Partners.

For more information please visit:

Aviva Risk Management Solutions – Specialist Partners

## Sources and Useful Links

- Details of 'approved composite panels can be found at RedBookLive

## Additional Information

Relevant Loss Prevention Standards include:

- Managing Change
- Property Impairment Management
- Managing Contractors
- Smoking and the Workplace
- Fire Safety Inspections
- Housekeeping – Fire Prevention

To find out more, please visit Aviva Risk Management Solutions or speak to one of our advisors.

## Email us at riskadvice@aviva.com or call 0345 366 6666.*

*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.

# Appendix 1 – Sample Composite Panel Permit

**To be used where any work involves composite panels or when any work is planned within 10 metres of composite panels.** A copy of the completed permit should be retained for auditing purposes.

| | | | |
|---|---|---|---|
| ISSUING COMPANY | | PERMIT NUMBER | |

## A. PROPOSAL (to be completed by the person responsible for carrying out the work)

| | |
|---|---|
| BUILDING | |
| EXACT LOCATION OF PROPOSED WORK | |
| NATURE OF WORK TO BE UNDERTAKEN | |

**I have completed and submitted the Checklist and understand the scope of work and precautions to be taken.**

| | | | |
|---|---|---|---|
| SIGNED | | BLOCK CAPITALS | |
| DATE | | POSITION | |

| | |
|---|---|
| CONTRACTOR COMPANY (WHERE APPLICABLE) | |

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## B. AGREEMENT (to be completed by Company Safety Officer or another nominated person – the 'Issuer of the Permit')

This permit is issued subject to the following conditions:

| | |
|---|---|
| DATE & TIME PERMIT ISSUED: | |
| EXPIRY OF PERMIT** (TIME): | |

** It is not desirable to issue permits for protracted periods. Fresh permits should be issued where, for example, work extends from morning to afternoon.

| | |
|---|---|
| A FINAL CHECK OF THE WORK AREA SHALL BE MADE, NOT BEFORE (TIME): | |
| ADDITIONAL CONDITIONS REQUIRED: | |

The above location has been examined and the precautions checklist that accompanies this form has been complied with. I have carried out a risk assessment and consider that there is no reasonably practical alternative to doing the job involving the composite panels. I have been provided with evidence of appropriate Public Liability Insurance.

| | | | |
|---|---|---|---|
| SIGNED | | BLOCK CAPITALS | |
| DATE | | POSITION | |

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## C. FOLLOWING COMPLETION OF WORK (to be completed by member of staff suitably trained or contractor responsible for the work. The permit should then be returned to the issuer)

| | |
|---|---|
| The work area and all adjacent areas (both sides of the wall, floor or ceiling and floor below) have been inspected and all holes have been sleeved and fire-stopped using non-combustible materials. | ☐ |
| Any isolated automatic fire detectors or detection zones have been reinstated. | ☐ |

| | |
|---|---|
| TIME INSPECTION COMPLETED (this must be at least 60 minutes after work has been completed): | |

| | | | |
|---|---|---|---|
| SIGNED | | BLOCK CAPITALS | |
| DATE | | POSITION | |

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## D. SIGN OFF BY ISSUER OF PERMIT

The hot work has been completed. Any detector(s) or zones of the fire alarm system that were isolated have been fully reinstated.

| | | | |
|---|---|---|---|
| SIGNED | | BLOCK CAPITALS | |
| DATE | | | |

# Appendix 2 – Sample Composite Panel Checklist

| | | | |
|---|---|---|---|
| ISSUING COMPANY | | PERMIT NUMBER | |

| | |
|---|---|
| Risk assessment completed and approved | ☐ |
| Method statement completed and approved | ☐ |
| Emergency plans reviewed and updated as necessary | ☐ |
| Contractor induction completed and signed | ☐ |
| Insurance cover reviewed and accepted | ☐ |
| Type of insulation known and recorded (plans updated) | ☐ |
| Have 'warning signs' been placed/re-attached to panels | ☐ |
| Permit to work on composite panels issued | ☐ |
| Areas up to 6-metres cleared and fenced off against unauthorised access | ☐ |
| Panels have no exposed foam present prior to work | ☐ |
| All panels within 10-metres are covered by fire resistant blankets/sheeting | ☐ |
| Portable fire extinguishers are provided | ☐ |
| Constant fire watch in place during and after work | ☐ |
| Use of heat/electrical drills or cutter is PROHIBITED | ☐ |
| Use of manual drill and cutting snips only perrmitted | ☐ |
| Services through panels are fitted with fire resistant sleeves | ☐ |
| Holes sealed around services and sleeve using fire resistant materials | ☐ |
| Inspection following completion to ensure all holes, seams or edges of panels are sealed with no exposed insulation | ☐ |

| | | | |
|---|---|---|---|
| SIGNED | | BLOCK CAPITALS | |
| DATE | | | |

# HAZARD!

## Composite Panels with Combustible Insulation

Use of heat/electrical drills or cutters is **PROHIBITED**

**Any work completed on or near these panels requires a Composite Panel Permit**

## Please Note

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# LOSS PREVENTION STANDARDS