Risk Control Guide

Composite Panels

Introduction and scope

This guide covers fire safety measures for installation and maintenance of engineered combustible composite panels; typically insulated with polyisocyanurate, polyurethane or polystyrene foam. These are also known as sandwich panels. Structural Insulated Panels (SIPs) and exterior cladding systems are outside of the scope of this guide.

The best solution to reduce the hazard is to avoid the use of these combustible composite panels and where already installed to replace them with non-combustible insulated panels, e.g. with panels with mineral fibre insulation.

When combustible insulation is present it significantly increases the extent of a fire if it becomes involved. This risk control guide provides solutions where engineered combustible composite panels are present in building construction, to help prevent the combustible insulation from being exposed or involved in a fire. This is achieved by application of measures including panel fastening to delay the potential delamination and exposure of the core when exposed to a fire. It also considers equipment installation precautions, particularly the electrical equipment locations which are a common route for fire spread to combustible composite panels.

Loss history

Over recent years there have been significant fire losses associated with the use of composite panels. When involved in a fire, the combustible insulation of sandwich panels seriously increases the severity of the fire. For some materials, such as expanded polystyrene (EPS), it melts and forms flammable liquid on the floor of burning buildings.

August 2014 – US – A fire devastated 120,000m² of refrigerated warehousing. The cause is not determined. Due to ammonia release from chiller systems, the fire department ordered the evacuation of the area, which impacted 1,300 neighbouring homes.

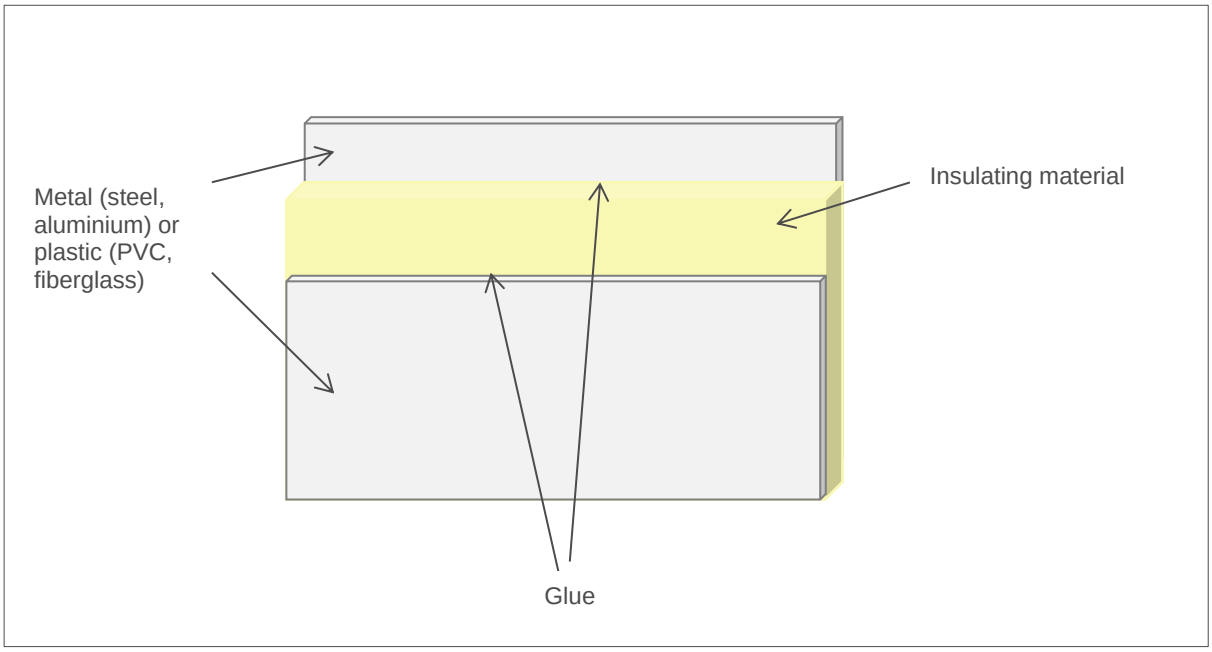
July 2013 – France – A fire destroyed three cold rooms installed inside a warehouse. The fire originated in a lift truck charger.

Type & use of composite panels

Engineered composite panels consist of an assembly of an insulating material between two thin facings generally made of metal (steel, aluminium) or plastic (PVC, fiberglass). Different types of insulating material can be found:

- Non-combustible mineral fibre (fibreglass, mineral wool);
- Polyisocyanurate foam (PIR);
- Phenolic foam (PF);
- Polyurethane foam (PUR);
- Expanded (XPS) or extruded polystyrene (EPS).

Such composite panels are typically used for walls but can also be used for ceilings, floors, and roofs.



Composition of a composite insulated panel

The main reasons for their popularity are:

- Good thermal and acoustic insulating properties in comparison with other types of insulating materials;
- Ability to withstand harsh conditions (frequent cleaning, moisture, low temperatures, etc.);
- Ease of cleaning (an important requirement in the food industry);
- Good mechanical resistance;
- Lightweight;
- Ease and speed of installation;
- Cost (cheaper than other solutions).

For these reasons, composite panels are typically used in food processing, cold storage facilities and clean rooms (pharmaceutical, painting rooms, semiconductors, etc.). Sandwich panels have also been applied as a cladding to the exterior surface of many other building types including warehouses, schools, hospitals, manufacturing buildings and retail outlets. They are also being used for high-rise office and residential buildings.

Sandwich Panels Approval & Fire Resistance classification

There are a number of approvals bodies around the world which deal with construction systems. One of the problems with the various bodies/standards that classify building materials is the level of testing completed. Often this testing is only small scale, so doesn't truly reflect the scale of a fire and give a full picture of how a building system will react in a fire. **FM, UL, LPCB and CNPP approved products go through larger scale fire testing, so there is a greater degree of confidence in the approvals given.**

When construction uses foam-plastic insulation, one of the following recognised and established international standards can normally be accepted as approximately equivalent to 'non-combustible' construction, provided in actual application all aspects of the test arrangement, including fixings, seals between panels and flashing/edging systems are replicated and installation is by competent contractors.

- In UK, building systems should be LPCB approved. The relevant standard is LPS 1181 Part 1 & 2 and LPS 1208.
- In France, a CNPP Approval of Pa1 is required.

- Worldwide:
  - ‘Non-combustible’ to Underwriters Laboratories (UL).
  - ‘Class 1’ for external walls, roof assemblies, internal walls and ceilings to Factory Mutual (FM).

Fire resistance standard: Euroclass System

One of the main standards used in Europe to classify the fire reaction of construction and partition products is the Euroclass system of categorisation. Overall there are 7 levels of categorisation within the Euroclass from A1 to F (A1 is the best) with further sub-categorisation in most levels.

The additional categorisation relates to smoke production and the occurrence of flaming droplets. The category for smoke is s1 to s3, where s1 is the best. For flaming droplets they range from d0 to d2, with d0 the best.

For the main categories, they can be effectively characterised as follows:

Euroclass	Combustibility and contribution to fire
A1	Non-combustible
A2	Limited Combustible – No flashover*
B	Combustible – No flashover*
C	Combustible – Flashover* after 10 minutes
D	Combustible – Flashover* before 10 minutes
E	Combustible – Flashover* before 2 minutes
F	Combustible – No performance Determined

*Flashover: it is a near-simultaneous ignition of most of the directly exposed combustible material in an enclosed area.

Either A1 (effectively non-combustible) or A2 products (minimal organic compound present), ideally with an s1 sub-rating, are considered as equivalent to a ‘non-combustible’ construction. However, currently ‘A’ ratings are only likely to apply to mineral fibre insulated panels.

The best that can be expected for expanded plastic insulated panels is Category B. Panels meeting Category B with s1 or s2 sub-rating and a d0 sub-rating are considered as a construction with limited combustibility, but not fully equivalent to ‘non-combustible’.

Fire hazards due to composite panels

Because it is difficult for firefighters to extinguish a fire involving the combustible core of engineered composite panels, fires in buildings containing such panels often result in a total loss situation. The fire can spread rapidly within the panels and is shielded from extinguishing water. With this in mind, it should also be noted that sprinkler protection, gas extinguishing systems, water mist systems, etc. are also unable to control or extinguish a fire involving the combustible core of sandwich panels.

When involved in a fire, the lack of fire resistance of the panels' fixings may lead to a sudden delamination or collapse of the panels, exposing the combustible insulation directly to the fire.

Also, when the plastic insulation burns, considerable quantities of highly toxic, dense black smoke containing oily, sooty particulates is given off and can contaminate a large area. The emissions of acidic fumes can also cause the corrosion of electronic equipment.

Ignition sources can readily ignite the exposed core of combustible composite panels and when the combustible insulation burns, it is too late: the fire will spread quickly inside the panel.

Possible ignition sources can be:

- Hot works;
- Electrical equipment (low voltage and high voltage cabinets, cables, lightings, junction boxes, plugs, switches, etc.);
- Smoking;
- Heat released by a mechanical process (linked to a process or technical equipment).

Precautions recommended for combustible composite panels

Installation & Identification

- Clearly identify the nature and location of the internal and external building fabric.

- Record the above on a drawing. A distinction must be made between mineral fibre and other types of composite panels. The drawing should be used in conjunction with all applications of the hot work permit and must be provided to the emergency services and included in the emergency pack.

- Samples of existing core material may need to be analysed to determine their nature if no documentation is available.

- For new installations, the best option is to use non-combustible or as a minimum 'Approved' composite panels.

Fastening

For new or retrofitted installations

- Where 'Approved' panels are to be used this should be in line with recognised approvals bodies and meet specific approvals classifications.

- 'Approved' panels can have very specific fastening and height/orientation restrictions to be granted approval. The approval for the panel relates to the panel assembly and not just the panel.

- Metal screws should be used, in line with manufacturers and approval requirements.

- Where unapproved and combustible panels have been used, mechanical fastening must be done as following:
    - The panels should be assembled correctly: mechanical fastening with overlap at junctions to prevent apparent foam and chimney effect favouring fire spread.
    - Top and bottom of panels should be mechanically fastened to the building structure.
    - Panels should be through fastened to prevent the siding exposed to a fire from collapsing. If not the case, install a specific panel cladding support system (to be validated by a recognised body by a full scale test).

For new and existing installations

- Where the combustible core within the composite panels has been left exposed, flashing should be installed to seal off the insulation material. This should be in the form of steel plating applied over the opening and extending beyond to allow mechanical fastening, to give a similar level of integrity as the original installation. Foam fillers should not be used.

- There should be a formalised panel inspection. The panel inspection should look for damage or exposed insulation. It should cover both sides of the panels. Where there is a history of poor panel management, this should be completed monthly and remedial actions tracked to completion. Where there is a good history of panel management and little damage noted, this could be extended to three monthly inspections.

Equipment

- Wherever possible, equipment should not be supported on combustible panels and penetrations through panels (such as cables, pipes etc.) should be minimised.

- Where penetrations through panels are required, there should be sheathing provided for any electrical cables running through the panel and edges should be checked to ensure that they are not sharp or could damage the cables.

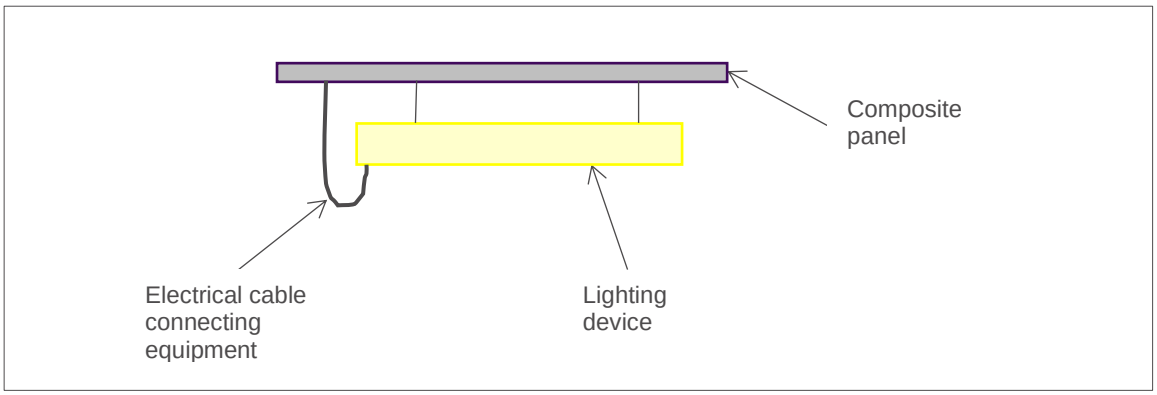
- Penetrations should be sealed with a non-combustible material to ensure the integrity of the panel. Foam based sealant should be prohibited, even when fire-proof.

- Where there is an accessible ceiling void created by combustible composite panels, storage should be prohibited from these areas. Walkways across panels should be identified.

- If hot fluids are running through pipes, they should be insulated properly to reduce heat spread into combustible panels.

- Where exhaust systems (e.g. oven extraction) pass through the combustible panels, combustible construction should be stripped back and a gap of at least 250mm should be provided around the entire perimeter of the duct or approved insulated sleeves and collars should be used. Should the gap need to be sealed for operational/hygiene reasons, this should be completed using a non-combustible material.

- In cold rooms, electrical cables should connect equipment (such as lights) below the equipment (the length of the cable below equipment should be of some centimetres) in order to prevent condensation from reaching the electrical equipment. See the below figure for more explanation:



Electrical connection of equipment

- Lights should have a minimum ingress protection grading IP55 (as per the EN 60529).

- Electrical equipment should not be installed against combustible sandwich panels but placed at distance from the panel with the help of metallic support, cable trays, etc. Separation of equipment from the combustible panels is needed to prevent that the core reaching a temperature of 80°C or higher. The recommended distances are summarised in the table below:

Equipment	Recommended minimum distance between equipment and panel
Cables (1)	10 mm
Junction boxes (2)	50 mm
Switches, outlets	50 mm
Emergency lighting	50 mm
Lighting fixture on wall (3)	50 mm
Lighting fixture under ceiling (4)	200 mm
Cable tray	200 mm
Electrical cabinet	200 mm
Power input ≤ 2 kW	200 mm
Power input from 2 to 50 kW	800 mm
Power input from 50 to 200 kW	1,500 mm
Power input > 200 kW	2,500 mm
Notes: **(1) Electrical cables should not run directly along the panels. They should be covered by a fire retardant protection, or be low flame spread cabling which should then run in ducting (10mm separation).** **(2) When Junction boxes are installed they should be placed in walk-through areas.** **(3) HID lamps are in any case not recommended.** **(4) Lights should be suspended rather than recessed into composite panels.**	

Human element

- Good loss prevention procedures must be in place in buildings where combustible composite panels are installed i.e.: smoking controls, watchman service, self-inspections.

- Housekeeping is of high importance in buildings with combustible composite panels. Prohibit uncontrolled storage in hidden areas and close to the panels (pallets, flammable liquids, etc.).

- Any work on the panels themselves should never be done using equipment that could ignite the core such as acetylene torches or high speed electrical saws. No welding onto panels should be attempted. Low speed reciprocal saws and drills can be used.

- Reduce hot works inside buildings built with combustible composite panels to an absolute minimum. When such works cannot be avoided, the hot work procedure must be carefully respected.

- Regular infrared thermography inspections of electrical equipment are of high importance in buildings built with combustible composite panels, to identify overheating.

Protection

The precautionary measures listed above are intended to limit the opportunity of ignition and fire spread in the combustible core of a composite panel.

But these will not limit the spread of a fire in a building using large quantities of combustible composite panels, once started.

- Fire compartmentation is needed to separate hazardous areas or to divide a single building into several fire areas. This will help to prevent a total loss in case of a fire, but it must be achieved according to recognized standards.

- Automatic fire detection may not prevent or limit the spread of a fire in buildings containing significant quantities of combustible composite panels, unless there is a quick response to a fire from trained staff or the fire service.

- Sprinkler protection may be recommended to prevent a large loss in the event of fire. This fire protection must be installed according to a recognized standard (NFPA 13, LPC, EN 12845, APSAD R1, etc.). In order to limit the failure of a standard sprinkler system in cold storage rooms, sprinkler protection should be provided above and inside the room.

- Heat and smoke venting is important in buildings with combustible composite panels because of the release of significant quantities of black smoke and hot gases. If these products are not properly extracted, a flashover could occur leading to a potentially large loss.
  But in a sprinkler protected building, attention must be paid to the opening temperature of heat and smoke vents so that it does not delay the opening of sprinkler heads.