Fire Performance of composite panels: Remtech's ModuSec v Mineral wool and PIR.

The most important metric for the performance of building materials to protect critical infrastructure, IT and manufacturing facilities, should be measured by **BS/EN 1364-1:2015**. Essentially, this measures the time in minutes for fire to breach a wall or enclosure. This applies to fire from the outside - to reach the items within, and from the inside - to contain the spread of fire to the surrounding area. The two figures quoted are for 'insulation' (the measure of temperature to ignite items immediately on the other side of the barrier) and 'integrity' (time for flames to breach the barrier).

The Remtech ModuSec Phenolic Foam modular steel faced construction system offers the highest levels of performance for 100mm steel faced panel systems alongside mineral wool. Both provide 60/60 or 90/90 - depending on orientation and panel length. The Remtech ModuSec high security options offer 60 minutes insulation (74 minutes achieved) and 120 minutes integrity (the test was stopped at 124 minutes – but not failed). Note that our system has also been independently assessed by Warrington Fire as a complete building for fire from inside and outside, for a very sensitive area of a nuclear facility to meet their 60/60-minute criteria. Typically, 100mm PIR Panels offer only up to 30 minutes.

The other metric that is quoted is 'Reaction to Fire' under EN 13501-1. This includes combustibility classed as A1, A2, B, C etc (contribution to a fire), smoke production s1, s2, etc and production of burning droplets d0, d1, etc. The main importance of this metric is in assessing materials for use in high rise domestic or densely populated buildings – following on from Grenfell – in relation fire load, smoke and toxic fumes. It is far less important for the protection of critical infrastructure, IT and manufacturing, where there is an expectation of easier accessibility to the fire service and less complex in terms of escape and vulnerability of large numbers of occupants that you would get in a high-rise domestic situation. However, since our unique Phenolic system offers top levels of performance under EN 1364-1 in terms of time to protect from fire, the manufacturers of mineral wool and PIR mainly push the Reaction to Fire metric, to appear to be better, in the case of mineral wool, or equal in the case of PIR, as a binary choice. Neither reflects the reality of performance

Originally, Class A contained only 'non- combustible' materials such as concrete, glass and rock. According to BRE testing, Phenolics and mineral wool composite panels were alone in the next highest protection level - Class B1 (see Appendix 1). PIR and other panel types being in lower B2, B3 and C Classes. This reflects the huge variation they found in the performance of thermoset panels.

Whilst mineral wool fibres are 'non-combustible', the panels use phenolics to bind the fibres and 'combustible' PU adhesives to attach the steel skins to the core. Hence the panel are not 'non-combustible'. Despite this, under the influence of major mineral wool manufacturers, a Class A2 was created just for mineral wool. Phenolics were left alone in Class B1, with PIR, etc in lower B Classes. Then under the influence of major PIR manufacturers, all the B Classes were combined. Hence now, under this metric, Phenolics are conflated with PIR – both with a rating of B-s1, d0 – even though Phenolics produced much better results under initial testing to this metric by BRE (see Appendix 1).

Other Considerations

Over mineral wool:

1. Porosity: Phenolics are an almost 100% non-porous, closed cell material. Hence it will not absorb moisture and will maintain long term fire and structural integrity. Mineral wool is porous. It can eventually take moisture on board, possibly leading to ceiling sag and diminished fire protection towards the top of wall panels, i.e. diminishing its fire and structural integrity over time. Often hotly disputed, but we have first hand experience of this occurrence, replacing affected panels.
2. Strength: The core Phenolic material of our ModuSec system has its own strength and will support ceilings off walls in a fire situation - when panels eventually delaminate (skins come off) - as is the case for all panels. Mineral wool has no integral strength and thus needs perimeter steel to support ceilings.
3. Insulation: 100mm ModuSec panels have a U value of approx. 0.2 W/m2K. 100mm mineral wool panels have a U value of approx. 0.4 W/m2K. Hence ModuSec has a huge advantage in terms of insulation value and thus energy conservation.
4. Security: ModuSec has options to meet LPS1175 and the UK Government NPSA forced attack standards and uniquely for a fire rated system, options for blast and ballistic protection plus extremely high levels of sound attenuation and RF/EMC protection.
5. Design, manufacture, delivery and installation of ModuSec panels and doors are all in-house – hence providing a single point of responsibility.

Over PIR:

ModuSec Phenolics panels have been approved by the International Marine Organisation (IMO), (see Appendix 2) for use as cold stores, without secondary steel bulkheads, in passenger areas on ships. These enclosed environments need the highest levels of protection from smoke and toxic fumes, as well as fire. Testing showed that phenolic panel achieved A60 under IMO testing and was well within all the required limits for smoke and toxic substances - including Hydrogen Cyanide (zero). PIR stands for Polyisocyanurate. It produces toxic fumes under fire conditions – including hydrogen cyanide.

Hence the decision as to which material should be used in a project **should not be a binary one.** When considering critical infrastructure, IT and manufacturing projects, BS/EN 1364-1, i.e. fire resistance, should be the overriding metric, along with insulation value and levels of security, etc required – plus the level of expertise and experience your supplier can provide. Remtech has over 35 years' experience in building protected environments and almost 25 years protecting UK Government Critical infrastructure and other critical environments. We can, and have, provided external cladding, walls only, enclosures or complete buildings, from small server or meeting rooms to vast manufacturing facilities for MOD supply line companies and are happy to work with architects from the outset of a project, to provide the benefits of our experience.

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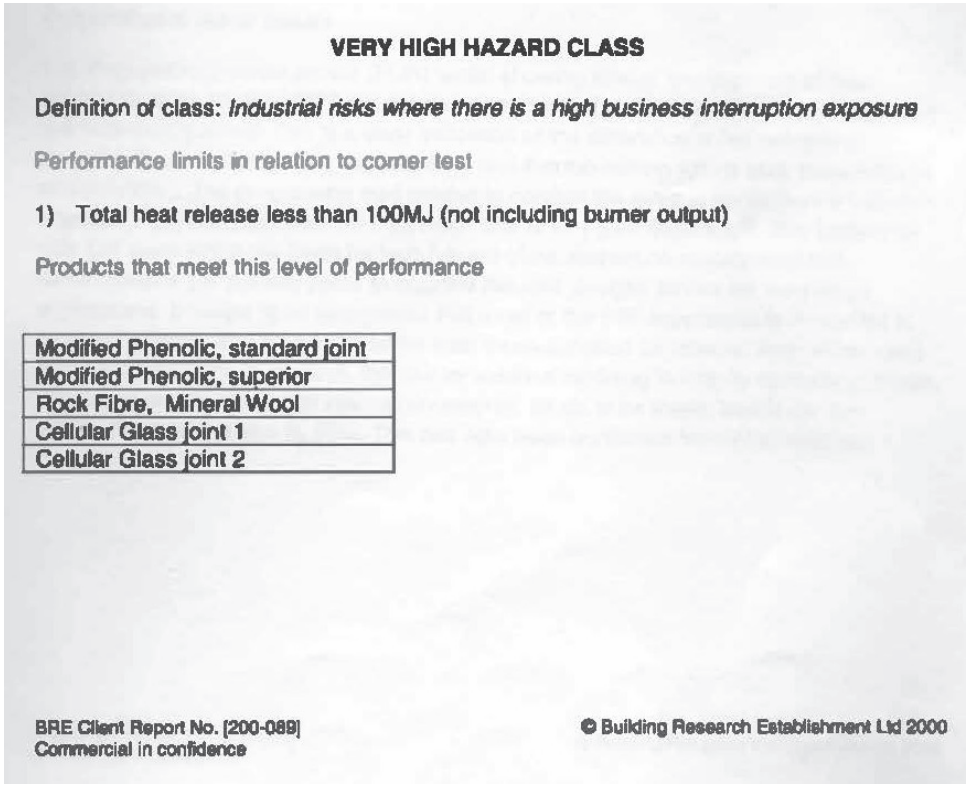
Appendix 1: Reaction to Fire Performance

Extract from report on verification of **reaction to fire** performance of sandwich panels prepared by BRE (Report no 200089) for the Association of British Insurers. '*This is in respect to LPS1181, to recognise the different risk levels that occur in **real** buildings. It is recommended to have several performance levels that can be incorporated in LPS 1181. This will include 2 lower levels and 1 higher level to the existing performance level'.*

Top level (Very High Hazard Class) definition:
Industrial risks where there is a high business interruption exposure.
Total heat release less than 100MJ (not including burner output).
Products that meet this level of performance:

- Modified Phenolic, standard and superior joints (i.e. Remtech/RCS panels)
- Rock Fibre, Mineral Wool
- Cellular Glass (no longer available)

All other products tested (e.g. PIR) were placed in a lower class. Note that due to influence of major players in the manufacture of other panels, this split categorisation was later dropped.



VERY HIGH HAZARD CLASS

Definition of class: *Industrial risks where there is a high business interruption exposure*

Performance limits in relation to corner test

1) Total heat release less than 100MJ (not including burner output)

Products that meet this level of performance

Modified Phenolic, standard joint
Modified Phenolic, superior
Rock Fibre, Mineral Wool
Cellular Glass joint 1
Cellular Glass joint 2

BRE Client Report No. [200-089]
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See video of LPS1181 whole room test: https://www.remtech.com/fire-protection/.
Excuse the mistaken term 'Fireproof'.

Appendix 2: Smoke and Toxicity Testing

Smoke and Toxicity Test carried out at Warrington Fire for the International Maritime Organisation for the use of Phenolic panels for the fitout of ships. Obviously, a critical issue for shipping closed environments – particularly the Hydrogen Cyanide level that are zero in our case. Not so in Polyisocyanurate (PIR). So, a crucial difference along with smoke (Optical Density). All other gases emitted by Phenolics were well below the permitted limits.

Summary

Specimens of your composite panel product consisting of a phenolic foam core (product referenced "Pyro-Foam") with a glass fibre tissue faced steel sheet , bonded with the steel sheet exposed, to both faces of the foam core, have been tested for smoke generation and toxicity in accordance with IMO Resolution MSC 61 (67), Annex 1, Part 2 as amended by MSC/Circ.916 dated 4th June 1999.

The specimens as tested achieved the criteria for smoke generation and toxicity for the surface of bulkheads, wall and ceiling linings specified in the Resolution.

Table 1 Summary of Results.

GAS		Limit (ppm)	Reading (ppm)		
			Condition 1	Condition 2	Condition 3
Carbon Monoxide	CO	1450	158	28	198
Hydrochloric Acid	HCl	600	7	10	32
Hydrogen Bromide	HBr	600	0	0	0
Hydrogen Fluoride	HF	600	0	0	0
Hydrogen Cyanide	HCN	140	0	0	0
Nitrous Fumes	Nox	350	6	0	4
Sulphur Dioxide	SO2	120	55	82	104
Averaged Corrected Specific Optical Density		200	5	1	50

Introduction

This test method, adopted by the International Maritime Organisation, is used for measuring fire characteristics of bulkhead, ceiling and deck finish materials as a basis for characterising their production of smoke and toxic products and thus their suitability for use in maritime construction.

Warrington FIRE research CONSULTANCY • TESTING