



Technical Data (Flammability and Fire codes)

❖ Polyurethane Metal Faced Sandwich Panels

Sandwich panels have a rigid polyurethane foam (PUR/PIR) core with profiled and in most cases metal facings on both the upper and lower surfaces. Sandwich panels are particularly suited for roofing and wall applications, for the various support structures in halls and industrial buildings, as well as for refrigeration and cold-storage units. The lightweight panels are easy to process and can be installed in all weather conditions. PUR/PIR sandwich panels are to a high degree pre-fabricated, giving them structural and constructional design properties that offer a high level of security, both in the processing stages and in the finished building.

❖ Core insulating materials

1. Polyurethane foam (PUR)

An organic insulation material made from a reactive mixture of two principal liquid components and a number of additives, to produce highly cross linked polymers with a closed cell structure. The liquid components may be a hydroxyl group of a polyester, polyether, or polyalcohol with a di-isocyanate.

The foam produced will not normally be ignited by a small heat source, but a larger flame will cause ignition and fire spread, with abundant smoke and toxic decomposition giving off hydrogen cyanide, oxides of nitrogen, and carbon monoxide. The Flash Ignition temperature is 320-420 degrees C. The self ignition temperature is 420-550 degrees C.

2. Polyisocyanurate foam (PIR)

Polyisocyanurate is made in the same way as polyurethane, but the ratio between the components and the type of additives is usually different, to produce a polymer containing chemical bonds with a higher temperature resistance. The increase in the decomposition temperature depends entirely on the concentration of these bonds and on the aromatic content. Process control factors are more critical than with PUR. The smoke and decomposition products are similar to PUR.

3. Polystyrene foam

Expanded Polystyrene (EPS) is an organic insulation material made by the addition of catalysts and a blowing agent (normally pentane) to a styrene monomer derived from crude oil, by a combination of ethylene and benzene. The bead is then made into a foamed product containing entrapped air.

Extruded Polystyrene (XPS) is manufactured, using the same materials as EPS, by a continuous extrusion process where blowing agents are added to produce a closed cell material. The process creates superior properties to EPS.

The flash ignition temperature is 290-350 degrees C. The self ignition temperature is 490 degrees C.

When exposed to a small flame, polystyrene melts and shrinks away from the heat source. A larger heat source will produce flaming molten droplets and rapid emission of dense black smoke/soot.

4. Rock wool

Stone or rock wool is produced by melting naturally occurring rock with coke and dolomite and/or slag. The molten rock is formed into stone wool by contact with spinning wheels. The woolen structure entraps air, and

is bonded together with cured resin, to form non-combustible insulation in a variety of densities with very low calorific content. The fiber direction can be selected to optimize shear and tensile strength properties suitable to the application.

❖ Fire behavior (Terms & definition)

1- Fire retardant

A substance added, or a treatment applied to, a material in order to suppress, significantly reduce or delay the combustion of the material.

2- Non-combustible

Not capable of undergoing combustion under specified test conditions.

3- Reaction to fire

The fundamental behavior of a material in fire described in terms of rate of heat release, Potential energy release, surface burning, smoke release, tendency to produce burning droplets or particles.

4- Resistance to fire

The ability of an element of building construction to fulfill for a stated period of time the required load-bearing function [resist collapse], integrity [resist fire penetration] and insulation [resist the transfer of excessive heat].

▪ Classification based on single burning test

When the materials fire behavior has been determined in accordance with the standard, it divides into:

Building material class			designation
Class A		A1	Non-combustible materials
		A2	
Class B	PIR	B1	hard flammable
	PUR	B2	Not easily flammable
		B3	Easily flammable

Class A

- **A1**: Materials may be classed as A1 materials if they:
 - Pass the test specified according the standard corresponding parts.
 - Meet the requirements for class A2 materials.
- **A2**: Materials may be classed as A2 materials if they:
 - Pass the test specified according the standard Corresponding parts.
 - Pass the test specified DIN 4102-16.

Class B

- **B1**: All materials, except flooring, may be classed as B1 materials if they:
 - Withstand the test specified in DIN 4102-16 using the 'Brandschacht' apparatus specified in DIN 4102-15.
 - Meet the requirements for class B2 materials.
 - For core: the flam not exceeds 10 ft in 15 sec.
 - For panel: the class is nearly become (A2) to be hard ignited.



➤ **B2**: Materials may be classed as B2 materials if they:

- Pass the test specified according the standard corresponding parts
 - Flooring materials may be assigned to material class B2 if they meet at least the requirements for class as in DIN 66081.
 - For core: only the flame not exceeds 15 ft in 15 seconds.
 - For panel: class is become (B1). And the panel is not easily ignited.
- **B3**: Combustible materials which cannot be classed as B1 or B2 materials shall be classed as B3 materials
- Containing all physical and insulation properties of polyurethane foam but it's not a good fire resistance material to withstand flame not to exceed 15 ft in 15 second

❖ Conclusion

Burning Characteristics Of Polyurethane Foam

properties	Class A,B1	Class B2	Class B3
Exposure time	60 second	60 second	60 second
Ignitability	No ignitable	Normally ignitable	Easily ignitable
Flammability	Nonflammable	Hard Flammable	Highly flammable
Burning rate	0.1 mm/second	1.0 mm/second	2.5 mm/second
Flame spread	No flame spread	No flame spread	Fast spread
Weight loss	21 percent	42 percent	100 percent
Melting	No melting	No melting	Melt
Dripping	No dripping	No dripping	Dripping
Burn length	Charred up to 7 mm	Charred up to 15 mm	Burning entire length

NOTE THAT

- ✚ The mentioned above characteristics is belong to foam only.
- ✚ Cladding foam with metal face upgrade the foam class to a higher level of fire classification class starting from B2 Class i.e.; (B2 class react the same characteristics of B1 Class).
- ✚ All mechanical and fire behavior properties is directly proportional to the thickness of foam.

See references below



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References

- [1] Commission Decision 94/611/EC: Official Journal of the European Communities L 241, 16.9.1994, p. 25.
- [2] Commission Decision 2000/147/EC: Official Journal of the European Communities L 50, 23.2.2000, p. 14.
- [3] EN 13501-1: 2002-02: Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to Fire tests.
- [4] DIN 4102-1 : 1998-05 : Brandverhalten von Baustoffen und Bauteilen. Teil 1: Baustoffe. Begriffe, Anforderungen und Prüfungen.

