ENCLOSURE SOLUTIONS TECHNICAL BULLETIN

FOAMGLAS® CELLULAR GLASS INSULATION FIRE PERFORMANCE

FOAMGLAS® cellular glass insulation is glass, without binders or fillers, so it does not burn, distort, contribute to smoke production or toxicity, or contribute to the fuel load and spread of the fire. This inherent feature enables it to deliver outstanding performance in all the common fire-related material tests of the building industry. Table 1 shows the results of these tests for unfaced block.

The non-combustibility test – as the name implies – assesses to what extent the material resists combustion as measured by a combination of temperature rise, mass loss, and/or flaming when exposed to a temperature of 1382°F. The results show that FOAMGLAS® cellular glass insulation meets all the requirements of this test to be deemed non-combustible.

The heat-of-combustion test supplies an ignition source to the material and then measures the energy release that results from the combustion. The results show zero energy release from FOAMGLAS® cellular glass insulation, which is another way of expressing its non-combustibility.

The surface-burning test is intended for exposed applications where a material experiences flame impingement. It assesses how effectively the material propagates that flame and generates smoke, all on a relative basis to red oak. The results show that FOAMGLAS® cellular glass insulation has no flame propagation and no smoke generated when experiencing flame impingement, which is another manifestation of its non-combustible nature and allows the material to be left exposed in occupied spaces.

TABLE 1 — MATERIAL TESTING UNFACED BLOCK

TEST TYPE	TEST METHOD	TEST DESCRIPTION	TEST RESULT
Non-combustibility	ASTM E136 EN ISO 1182	A specimen is placed in a tubular furnace at a temperature of 750°C, where it remains for 30 minutes or until failure occurs, which is a significant temperature rise, mass loss, or prolonged flaming.	Pass, EU Class A1 Δ T < 30°C, Δ m < 50%, no flames after 30 seconds
Heat of combustion	EN ISO 1716	A specimen is burned under standardized conditions, where the heat of combustion is determined based on the observed temperature rise of a jacketed water bath.	EU Class A1 0 MJ/kg
Surface burning	ASTM E84	A specimen is mounted in the ceiling position with the surface exposed face down to the ignition source to determine the relative burning behavior by observing the flame spread along the specimen and resulting smoke.	May be left exposed per IBC 720.3 Flame Spread Index = 0 Smoke Developed Index = 0

FIRE PERFORMANCE OF A FOAMGLAS® CELLULAR GLASS INSULATION ASSEMBLY

While FOAMGLAS® cellular glass insulation is non-combustible, its incorporation into an assembly may include materials that are combustible, such as facings, adhesives, and other surrounding materials, which begs the question of how these combustible additive materials affect the assembly's fire performance. This is where the various system tests – which often include the entire assembly – play an important role. They are shown in Table 2.

Combustibility from above the roof deck subjects the roof assembly to different types of fire exposure – a continuous, wind-driven flame, an intermittent flame, and a wind-driven burning brand – and assesses to what extent the fire spreads across the roof or penetrates to the roof deck. The Class A designation represents the best level of performance, which is achieved by the various FOAMGLAS® cellular glass insulation assemblies listed in Table 2.

Combustibility from below the roof deck subjects the assembly to a flame from the interior side for 30 minutes. The test assesses the flame propagation, which cannot exceed 10 feet within 10 minutes and 14 feet within 30 minutes. A fire-classified system must meet this level of performance. Table 2 lists various FOAMGLAS® cellular glass insulation assemblies that are fire-classified.

Fire resistance evaluates the duration that building elements can contain a fire and retain their structural integrity. The test exposes a test specimen to a fire controlled to achieve specified temperatures throughout a specified time period. The duration that the specimen can meet the performance requirements of the test (maintain structural integrity, limited temperature rise on unexposed side, and no burn-through) determines the hourly rating assigned to it. Table 2 shows roof and wall assemblies with ratings that range from ¾ to 3 hours.

TABLE 2 — SYSTEM TESTING

TEST TYPE	TEST METHOD	TEST DESCRIPTION	TEST RESULT
Combustibility from above the roof deck	ANSI/UL 790 similar to ASTM E108, NFPA 256	An assembly is subjected to three different forms of a fire that originates from the exterior. To achieve the Class A rating, the assembly must demonstrate resistance to: • Spread of flame – Does not spread a wind-driven flame for 10 minutes beyond 6 feet • Intermittent flame – Does not permit burn-through from 15 cycles of a flame applied in two-minute intervals • Burning brand – Does not permit flaming/glowing at underside of the deck, for the deck to become exposed, or for portions of the deck to fall or break away when subjected to a wind-driven 12-inch square burning brand	Class A rating for the following roofing systems: • Built-up • Single-ply membrane • Modified bitumen • Fluid applied Which include: • Combustible and non-combustible decks • Fully adhered, mechanically fastened, and ballasted systems See the UL & FM websites for more details.
Combustibility from below the roof deck	ANSI/UL 1256 similar to NFPA 276	An assembly is subjected to a fire that originates from the below the deck. A fire-classified system must limit the flame propagation on the underside of each assembly to not exceed 10 feet at 10 minutes and 14 feet at 30 minutes.	Fire-classified roofing systems: • Built-up roof with steel deck See the UL & FM websites for more details.
Fire-resistance rating	ANSI/UL 263 similar to ASTM E119	An assembly is exposed to a fire on one side that is controlled to achieve specified temperatures throughout a specified time. The duration that the specimen can meet the performance requirements of the test (maintain structural integrity, limited temperature rise on unexposed side, and no burn-through) determines the hourly rating assigned to it.	UL Designs for: • Roof-ceiling rated systems that provide 1-, 1.5-, 2-, and 3-hour ratings • Wall rated systems that provide ¾-, 1,- 1.5-, and 2-hour ratings See the UL website for more details.

ABOUT THE TEST METHODS

ASTM E136 – Behavior of Materials in a Vertical Tube Furnace at 1382°F (750°C)

This test considers the combustion and heat-generating characteristics of building materials within a furnace environment, and only limited flaming is allowable. Testing continues until specimen thermocouples reach 1382°F (750°C) or until specimen failure. Visual observations regarding flame and smoke are made throughout the test. A material passes if three or four specimens: (1) do not have thermocouple temperatures more than 54°F (30°C) above the furnace temperature, (2) show no flaming after the first 30 seconds, and (3) show no temperature rise or flaming when specimen weight loss exceeds 50%.

EN ISO 1716 – Reaction to Fire Tests for Products - Determination of the Gross Heat of Combustion (Calorific Value)

In this test, a test specimen of specified mass is burned under standardized conditions. The heat of combustion determined under these conditions is calculated on the basis of the observed temperature rise while taking account of heat loss. The combustion process is initiated inside an atmosphere of oxygen in a constant volume container, the bomb, which is a vessel built to withstand high pressures. It is immersed in a stirred water bath, and the whole device is the calorimeter vessel. The calorimeter vessel is also immersed in an outer water bath.

ASTM E84 – Surface Burning Characteristics of Building Materials

This test compares a building material's surface burning regarding flame spread and smoke development with that of red oak and inorganic reinforced cement board. In a horizontal furnace, gas burners direct flames against the 24-inch-by-24-feet sample that is in the ceiling position with the surface to be evaluated facing downward. At the beginning of a test, base readings are observed, and, during the test, photoelectric cell output is recorded at least every 15 seconds. At the end of the test, chamber conditions are observed, the sample is further examined, and flame spread distance, temperature, and changes in the photoelectric cell readings are plotted. “Flame spread index” is a comparative, numerical measure relating to the progress of a flame zone. “Surface flame spread” is the advancement of flame away from an ignition source across a specimen’s surface. “Smoke developed index” is a comparative classification based on smoke observation.

ANSI/UL 790 – Tests for Fire Resistance of Roof Covering Materials

The fire test method mirrors ASTM E108, “Standard Test Methods for Fire Tests of Roof Coverings,” and NFPA 256, “Standard Methods of Fire Tests of Roof Coverings.” This method includes three tests that evaluate a roof assembly's resistance to external fire exposure: spread-of-flame test, intermittent-flame test, and burning-brand test.

The spread-of-flame test subjects a roof assembly to a 1400°F flame carried by about a 12-mph wind for 10 minutes. To achieve a Class A rating, the flame must not spread beyond 6 feet.

During the intermittent-flame test, a roof assembly is subjected to the same 1400°F flame as in the spread-of-flame test except the flame is turned on and off in two-minute cycles. To achieve a Class A rating, two successive assemblies must not burn through after 15 cycles.

The burning-brand test measures a roof assembly's ability to resist flame penetration from flaming embers. During the test, a wooden brand is ignited and placed on a roof surface while exposed to a 12-mph wind. The test continues until the brand is consumed and all evidence of flame, glowing, or smoke has disappeared from the top exposed surface and deck underside. For a Class A rating, one 12-by-12-inch wooden brand weighing 4.4 pounds is used.

ANSI/UL 1256 – Standard for Fire Test of Roof Deck Constructions

The test method evaluates the performances of metallic and nonmetallic roof deck constructions subjected to internal (under deck) fire exposures to determine the contribution of the roof covering material, insulation, and other roof system components to the spread of fire within a building. It contains two test methods – one large scale and one small scale. For roof deck constructions that, by experience in actual installations, were known to have contributed extensively to underdeck fire spread, the large-scale test is used, which is a 20-feet wide by 100-feet long by 10-feet tall building that is open on one end. On the opposite end, fire exposure is delivered whereby exposure temperatures increase with time. The maximum sustained flame front and falling flaming residue within the structure shall not exceed 60 feet during the 30-minute test period. For other roof deck constructions, the Steiner test apparatus is used (like ASTM E84), where a flame propagates on the underside of each assembly tested and shall not exceed 10 feet in 10 minutes or 14 feet in 30 minutes.

It is immersed in a stirred water bath, and the whole device is the calorimeter vessel. The calorimeter vessel is also immersed in an outer water bath.

ANSI/UL 263 – Standard for Fire Tests of Building Construction and Materials

The fire test method mirrors ASTM E119, “ Standard Test Methods for Fire Tests of Building Construction and Materials.” The intent of the test is to evaluate the duration for which building construction materials and assemblies can either contain a fire, retain structural integrity, or both. Specific requirements must be met for these building products to produce a successful (passing) result. The test exposes a specimen to a standard fire controlled to achieve specified temperatures throughout a specified time period. The performance criteria are related to load-bearing capacity, insulation, and integrity. For load-bearing assemblies, the test specimen shall not collapse in such a way that it no longer performs the load-bearing function for which it was constructed. For assemblies such as floors, ceilings, and walls that have the function of separating two parts of a building, the average temperature rise at the unexposed face of the specimen shall not exceed 282°F and the maximum temperature rise at the unexposed face of the specimen shall not exceed 358°F. The formation of openings through which flames or hot gases can pass shall not occur.

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