

# Meeting the Fire Code with Continuous Foam Plastic Insulation

The 2012 International Building Code (IBC) specifies the fire tests that must be passed if a foam plastic material is to be used in Type I-IV commercial construction. Chapter 26 of the IBC refers to the essential fire tests and other chapters refer to fire tests that are required for specific conditions. This paper outlines each area of tests within the IBC as it relates to foam plastic wall assemblies.

## Summary of Code Requirements and Product Properties

### Flame Spread and Smoke Developed

The ASTM E84 Tunnel test measures the Flame Spread and Smoke Developed fire properties of a given material. Section 2603.3 of the 2012 IBC defines maximum flame spread and smoke developed index limits for a foam plastic to be used in commercial construction: Flame Spread less than 75, Smoke Developed less than 450. Exterior Walls (Section 2603.5.4) places more stringent requirements on foam plastics: a flame spread of less than 25 and a smoke developed of less than 450. This requirement must be met regardless of meeting other fire test requirements.

### Thermal Barrier

IBC sections 2603.4 and 2603.5.2 stipulate that foam plastic insulations must be separated from the interior of a building by a thermal barrier (typically 1/2 inch gypsum). However, if a particular foam plastic has passed the appropriate fire test

(such as UL1715 or NFPA286) it can be left exposed to the interior of the building. All grades of **DuPont™ Thermax™ insulation** and most grades of **DuPont™ Styrofoam™ Brand XPS insulation** can be used exposed to the interior of the building in most circumstances (see the respective code reports for details).

### NFPA 285

Section 2603.5.5 is an assembly test and any particular assembly containing a foamed plastic must pass this test or demonstrate that it would pass this test. The following code reports describe the thousands of wall assemblies which contain the respective foam plastic that would pass the NFPA 285 fire test.

| Product                         | Code Report |
|---------------------------------|-------------|
| Styrofoam™ Brand XPS Insulation | ESR-2142    |
| Thermax™ Brand Insulation       | ESR-1659    |

### Fire-resistance-rated walls

Section 2603.5.1 of the 2012 IBC specifies that any wall assembly that requires a fire resistant rating (as measured using ASTM E119) must maintain that rating even when it contains a foamed plastic. There are many listed fire rated wall assemblies that contain **Styrofoam™ Brand XPS Insulation** or **Thermax™ Brand Insulation**. A simplified table of these wall systems is shown on the last page of this document.

| Product Family                                       | Code Required<br>Flame Spread | Code Required<br>Smoke Developed | Certified<br>Flame Spread | Certified<br>Smoke Developed |
|------------------------------------------------------|-------------------------------|----------------------------------|---------------------------|------------------------------|
| Styrofoam™ Brand XPS                                 | 25                            | 450                              | 0 – 15                    | 155 – 165                    |
| Thermax™ Polyiso                                     | 2.5                           | 450                              | <25                       | <450                         |
| Styrofoam™ Brand and<br>Froth-Pak™ Polyurethane Foam | 25                            | 450                              | <25                       | <450                         |

## Background Information

Over 60 years ago, foam plastic insulation was first introduced into the construction market, improving insulation standards in homes and buildings globally by increasing energy efficiency and overall building performance. Throughout that time the various foam plastic manufacturers have spent millions of dollars to demonstrate that their products meet all of the fire test requirements demanded by the building code. What follows is a more detailed description of the code requirements and how DuPont Performance Building Solutions using **Styrofoam™ Brand Insulation** and **Thermax™ Brand Insulation** meet these requirements.

### Flame Spread and Smoke Developed

The first code adopted fire test method to investigate the fire properties of combustible materials like foam plastics was the ASTM E84 Tunnel Test. Officially named “Standard Test Method for Surface Burning Characteristics of Building Materials” it was developed in the late 1940s. This is neither a pass/fail test nor one that measures a specific value or property. It describes the fire properties of a material based on an index from concrete panels at 0 to oak wood panels at 100. It measures both flame spread properties of a material and the amount of smoke generated.

The test takes place in a tunnel and is colloquially known as the Steiner tunnel test. The material to be tested is installed on the ceiling of the tunnel. A precisely metered fan draws air through the tunnel and the flames from a carefully metered burner are drawn into the tunnel and provide the fire source to conduct the test. The indexed rate of flame travel down the tunnel due to the combustion of the sample is known as the flame spread index and the indexed amount of smoke produced by the sample (measured by an electric eye) is known as the smoke developed index.

Section 2603.3 of the 2012 IBC defines the flame spread and smoke developed maximum limits for a foam plastic to be used in commercial construction: Flame Spread Index of less than 75, Smoke Developed Index of less than 450. Additionally for Exterior Walls, Section 2603.5.4 places more stringent requirements on foam plastics: a Flame Spread Index of less than 25 and a Smoke Developed Index of less than 450. This requirement must be met regardless of meeting other fire test requirements.

A foam plastic which meets the more stringent 25/450 requirement is sometimes referred to as a “Class A” foam insulation. In reality, the Class A designation is not mentioned in Chapter 26. The Class A terminology was unofficially co-opted from Chapter 8 in the description of the fire characteristics of interior finishes. Since the same Flame Spread Index and Smoke Developed Index limit is imposed for both the interior finish and the exterior wall insulation, the “Class A” designation as applied to a foam plastic is reasonably appropriate. Most foam plastic manufacturers list their Flame Spread & Smoke Development properties in their Product Information Literature. If it is not listed, that may be an indication that it only meets the minimum 75/450 requirement for use in commercial construction but does not meet the 25/450 “Class A” requirement for use in Exterior Walls. It is recommended that you reference the Code Report of any manufacture's product if you are uncertain of its performance to this requirement.

### Thermal Barrier

IBC sections 2603.4 and 2603.5.2 stipulate that foam plastic insulations must be separated from the interior of a building by a thermal barrier (typically 1/2 inch gypsum).

#### 2603.4 Thermal barrier.

- Except as provided for in Sections 2603.4.1 and 2603.10, foam plastic shall be separated from the interior of a building by an approved thermal barrier of 1/2-inch (12.7 mm) gypsum wallboard or a material that is tested in accordance with and meets the acceptance criteria of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275. Combustible concealed spaces shall comply with Section 718.
- Combustible concealed spaces shall comply with Section 717

However, if a particular foam plastic has passed the appropriate fire test (such as NFPA286, FM 4880, or UL1715) it can be left exposed to the interior of the building. The Thermax™ Brand Insulation family of products has passed the FM 4880 test and can be installed without a thermal barrier.

| Product Family                                                                   | Code Required<br>Flame Spread Index | Code Required<br>Smoke Developed Index | Measured<br>Flame Spread Index | Measured<br>Smoke Developed Index |
|----------------------------------------------------------------------------------|-------------------------------------|----------------------------------------|--------------------------------|-----------------------------------|
| Styrofoam™ Brand XPS                                                             | 25                                  | 450                                    | 0–15                           | 155–165                           |
| Thermax™ Polyiso                                                                 | 25                                  | 450                                    | <25                            | <450                              |
| Styrofoam™ Brand Spray<br>Polyurethane Foam                                      | 25                                  | 450                                    | <25                            | <450                              |
| Froth-Pak™ Spray<br>Polyurethane Foam Insulation<br>(Maximum Thickness 2-inches) | 25                                  | 450                                    | <25                            | <450                              |
| Froth-Pak™ Ultra Spray<br>Polyurethane Foam Insulation                           | 25                                  | 450                                    | <25                            | <450                              |

**NFPA 285**

Section 2603.5.5 of the 2012 IBC stipulates that any particular assembly containing a foamed plastic must pass the NFPA 285 test or demonstrate that it would pass this test.

2603.5.5 Test standard. The wall assembly shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

The National Fire Protection Association (NFPA) test method 285 “Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components” is an assembly test which investigates the flame and damage spread properties of an exterior wall system. NFPA 285 takes place on a two story wall test assembly and investigates fire and damage spread taking place on the outside of the wall, within the wall, and through the wall/floor juncture. The test is pass/fail based on the extent of damage and the temperature limits for particular locations within the assembly.

NFPA 285 is NOT a product test, it is an assembly test. Any foam plastic product to be used in commercial wall construction Types I-IV must demonstrate that it could successfully pass the NFPA 285 test in the particular assembly in which it is to be installed. Also, any foam plastic used in an exterior wall assemblies must still meet the FSI/SDI 25/450 requirement as well as pass the NFPA 285 assembly test.

For both **Thermax™ Brand Insulation** and **Styrofoam™ Brand XPS Insulation** there are millions of possible combinations of wall assemblies which can be demonstrated to meet the NFPA 285 test requirements. The following code reports describe the assemblies which contain the respective foam plastics that have passed the NFPA 285 fire test or have a third party supported

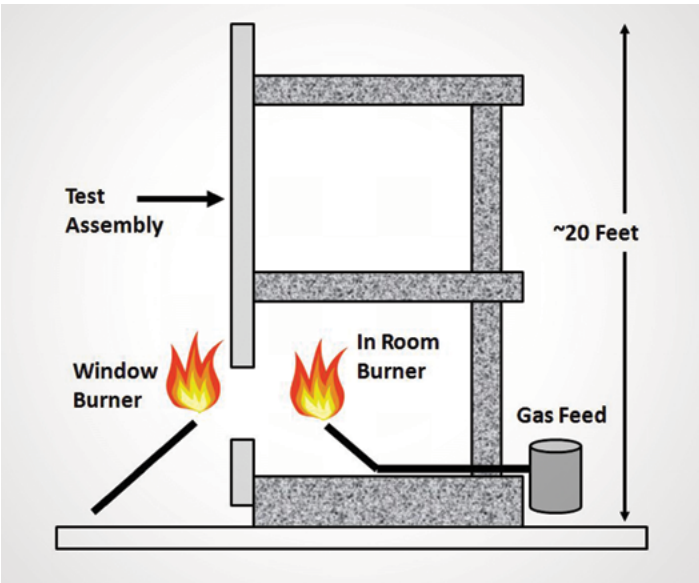
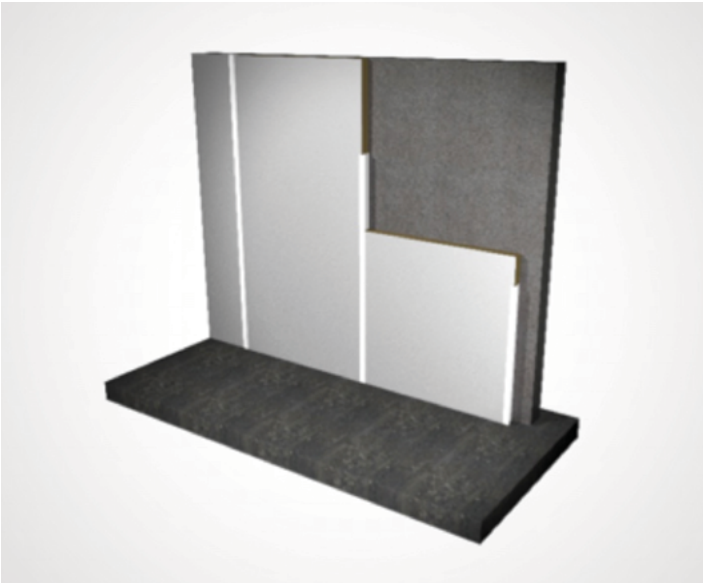
Engineering Analysis for its use in commercial construction exterior wall applications. Contact your local DuPont representative or the DuPont Customer Information Group at 800-586-2686 to get the most up to date information on approved materials for NFPA 285 compliant assemblies which may not yet be included in the respective code reports.

**Fire-resistance-rated walls**

Section 2603.5.1 specifies that any wall assembly that requires a fire resistant rating (as measured using ASTM E119) must maintain that rating even when it contains a foamed plastic. The determination of which walls (if any) in a building must be fire rated are outlined elsewhere in the code and are beyond the scope of this document.

| Product                         | Code Report |
|---------------------------------|-------------|
| Styrofoam™ XPS Brand Insulation | ESR-2142    |
| Thermax™ Brand Insulation       | ESR-1659    |

For decades Underwriters Laboratories (UL) has provided listings of wall assemblies that meet specific hourly fire ratings as demonstrated through testing or analysis. There are many listed fire rated wall assemblies that contain Styrofoam™ Brand XPS Insulation or **Thermax™ Brand Insulation**. The following table lists many of the wall assemblies which contain foam plastics and meet the fire resistance wall requirement. See the detailed listing on the UL or Intertek web site for the details behind each assembly.



| Assembly Number (UL/Intertek) | Time Rating | Base Wall  | Insulation                     |
|-------------------------------|-------------|------------|--------------------------------|
| BXUV.U026                     | 1           | Wood Stud  | Thermax™                       |
| BXUV.U326                     | 1           | Wood Stud  | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U330                     | 1           | Wood Stud  | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U354                     | 1           | Wood Stud  | Thermax™                       |
| BXUV.U355                     | 1           | Wood Stud  | Thermax™                       |
| BXUV.U364                     | 1           | Wood Stud  | Styrofoam™ Brand XPS           |
| BXUV.U424                     | 1, 2        | Steel Stud | Thermax™                       |
| BXUV.U425                     | 1, 2        | Steel Stud | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U460                     | 1           | Steel Stud | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U902                     | 4           | Block      | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U904                     | 3           | Block      | Thermax™                       |
| BXUV.U905                     | 2           | Block      | Thermax™                       |
| BXUV.U906                     | 2           | Block      | Thermax™                       |
| BXUV.U907                     | 3, 4        | Block      | Thermax™                       |
| BXUV.U912                     | 3           | Block      | Thermax™, Styrofoam™ Brand XPS |
| BXUV.U454                     | 1           | Steel Stud | Thermax™, Styrofoam™ Brand XPS |
| BXUV.V454/FI 60-02            | 1, 2        | Steel Stud | Thermax™, Styrofoam™ Brand XPS |
| BXUV.V482/FI 60-01            | 1           | Steel Stud | Thermax™                       |
| BXUV.V499/FI 120-01           | 1           | Steel Stud | Thermax™                       |

In summary, it is important when using a foam plastic in commercial construction to understand the different fire tests that must be passed. Each of the tests discussed in this paper are independent of one another. The Flame Spread and Smoke Developed, Thermal Barrier, and NFPA 285 requirements apply to all foam plastics used in a commercial wall assemblies. The Fire-Resistant-Rate Wall requirements (which walls in a buildings-if any) are outlined elsewhere in the code and may or may not be applicable in a particular project.

#### Exterior Walls Fire Test Requirements Checklist:

- ✓ FSI 25/450 check
- ✓ Thermal Barrier check
- ✓ NFPA 285 tested assembly pass check
- ✓ Fire-rated-Walls

#### References

- 1) 2006, 2009, and 2012 versions of the International Building Code (IBC) as published by the International Code Council (ICC). There have been no significant changes through these three versions which would impact any of the above information.
- 2) Test Method ASTM E119-14 "Standard Test Methods for Fire Tests of Building Construction and Materials"
- 3) Test Method ASTM E84-15 "Standard Test Method for Surface Burning Characteristics of Building Materials"
- 4) Test Method NFPA 285: "Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components." Current Edition: 2012



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Styrofoam™ Brand Spray Polyurethane Foam contains isocyanate, hydrofluorocarbon blowing agent and polyol. Read the instructions and Material Safety Data Sheets carefully before use. Wear protective clothing (including long sleeves), gloves, goggles and proper respiratory protection. Supplied air or an approved air-purifying respirator equipped with an organic vapor sorbent and a P100 particulate filter is required to maintain exposure levels below ACGIH, OSHA, WEEL or other applicable limits. Provide adequate ventilation. Contents under pressure. Styrofoam™ Brand SPF should be installed by a trained SPF applicator.

Thermax™ products should be used only in strict accordance with product application instructions. Thermax™ products, when used in a building containing combustible materials, may contribute to the spread of fire.

Froth-Pak™ Spray Polyurethane Foam contains isocyanate, hydrofluorocarbon blowing agent and polyol. Read the instructions and Material Safety Data Sheets carefully before use. Wear protective clothing (including long sleeves), gloves, goggles or safety glasses, and proper respiratory protection. Do not breathe vapor or mist. Use only with adequate ventilation. It is recommended that applicators and those working in the spray area wear respiratory protection. Increased ventilation significantly reduces the potential for isocyanate exposure; however, supplied air or an approved air-purifying respirator equipped with an organic vapor sorbent and a particulate filter may still be required to maintain exposure levels below ACGIH, OSHA, WEEL or other applicable limits. For situations where the atmospheric levels may exceed the level for which an air-purifying respirator is effective, use a positive-pressure, air-supplying respirator (air line or self-contained breathing apparatus). Spraying large amounts of foam indoors may require the use of a positive pressure, air-supplying respirator. Contents under pressure.

#### Styrofoam™ Brand Extruded Polystyrene Foam Insulation

**CAUTION:** This product is combustible. Protect from high heat sources. A protective barrier or thermal barrier may be required as specified in the appropriate building code. For more information call the DuPont Contact Center at 866-583-2583 or contact your local building inspector. For emergencies contact Chemtrec 800-424-9300, CCN (Contract Number) 7442. **WARNING:** Rigid foam insulation does not constitute a working walkable surface or qualify as a fall protection product.

Building and/or construction practices unrelated to building materials could greatly affect moisture and the potential for mold formation. No material supplier including DuPont can give assurance that mold will not develop in any specific system.

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