

# Building Code Fire Performance Requirements for Roof Assemblies Containing Polyiso Insulation

## About Polyiso Insulation

Polyiso is a rigid foam insulation used in more than 70% of commercial roof construction and offers a continuous insulation solution for commercial and residential wall assemblies. As one of North America’s most widely used and readily available building products, Polyiso is a cost-effective insulation option for reducing building energy use and improving the overall service-life of roofs and walls.

The benefits of using Polyiso include:

- High R-value per inch of thickness
- Excellent fire test performance
- Extensive building code approvals
- Cost-effective continuous insulation (ci) solution
- Compatible with most roof and wall systems
- Dimensional stability
- Compressive strength
- Moisture resistance
- Thinner walls and roofs with shorter fasteners
- Long service life
- Preferred insurance ratings
- Virtually no global warming potential
- Zero ozone depletion potential
- Recyclable through reuse
- Recycled content (amount varies by product)
- Regional materials (nationwide production network)

Building owners, specifiers, roofing contractors and consultants, and designers consider many factors when selecting or designing a roof system. These factors may include roof assembly components, roof slope, climate zone, building location and size, and expected service life. While the list can go on, fire classification (for exterior fire exposure), fire-resistance, and the effects of interior (under roof deck) fire exposure of the roof assembly are important considerations when determining compliance with the fire safety provisions of applicable building codes. (See PIMA Technical Bulletin 104 “Fire Test Standards for Polyiso Insulation and Roof Assemblies” for additional information regarding the fire tests referenced below.)

## Building Code Requirements for Roof Assemblies – United States

The International Building Code® (IBC) and International Residential Code® (IRC) adopted in U.S. jurisdictions contain several fire safety provisions and test standard requirements for roof coverings and roof assemblies. These requirements are summarized in the table below.

Test	Test Type	Performance Evaluated
ASTM E84 <sup>1</sup> /	Material UL 723 <sup>2</sup>	Surface burning characteristics (Flame Spread Index and Smoke Developed Index)
ASTM E108 <sup>3</sup> / UL 790 <sup>4</sup>	Assembly	Roof assemblies exposed to exterior flame (Class A, B, or C)
ASTM E119 <sup>5</sup> / UL 263 <sup>7</sup>	Assembly	Fire resistance (1-hour, 2-hour, etc. when required)
UL 1256 <sup>7</sup>	Assembly	Flame spread of roof deck constructions from interior fire exposure
NFPA 276 <sup>8</sup>	Assembly	Heat release rate of roof assemblies with combustible above-deck roofing components (Note: This test is an interior fire exposure test.)

1. ASTM International, ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
2. UL Standards & Engagement, UL 723 Standard for Safety for Test for Surface Burning Characteristics of Building Materials
3. ASTM International, ASTM E108 Standard Test Methods for Fire Tests of Roof Coverings
4. UL Standards & Engagement, ANSI/UL 790 Standard for Safety for Standard Test Methods for Fire Tests of Roof Coverings
5. ASTM International, ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials
6. UL Standards & Engagement, ANSI/UL 263 Standard for Safety for Standard Fire Tests of Building Construction and Materials
7. UL Standards & Engagement, ANSI/UL 1256 Standard for Safety for Fire Test of Roof Deck Constructions
8. National Fire Protection Association (NFPA), NFPA 276 Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components



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Tests denoted as assembly fire tests in the table above provide results (along with any ratings or classifications) that are tied to the specific assembly configuration and materials that were tested. Any modifications to the as-tested components or assembly conditions (i.e., higher slope, greater insulation thickness, etc.) will require either re-testing or an analysis to determine the equivalency of the modified roof assembly. Also, compliance with the model building codes may require multiple fire performance tests depending on the specific details of a given project. For example, applicable code provisions may require a roof assembly to have both a Class A rating (ASTM E108 / UL 790) and a 1-hour fire-resistance-rating.

Additionally, both the IBC and IRC requirements limit the surface burning characteristics of polyiso insulation used in roofing applications to a maximum flame spread index of 75. There is no limitation on smoked developed index when the polyiso insulation is tested to ASTM E84<sup>9</sup> or UL 723<sup>10</sup>.

In the IBC, the applicable requirements for polyiso insulation are found in Section 2603 – Foam Plastic Insulation and for roof assemblies containing polyiso insulation in Chapter 15 – Roof Assemblies and Rooftop Structures. In the IRC, the applicable requirements are found in Section R316 – Foam Plastic and Chapter 9 – Roof Assemblies, respectively.

## Building Code Requirements for Roof Assemblies – Canada

The National Building Code of Canada (NBCC) published by the National Research Council Canada contains several fire safety provisions and test standard requirements for roof coverings and roof assemblies. The Canadian requirements are summarized in the table below.

Test	Test Type	Performance Evaluated
CAN/ULC-S102 <sup>11</sup>	Material	Surface burning characteristics (Flame Spread Index and Smoke Developed Index)
CAN/ULC-S127 <sup>12</sup>	Material	Flammability characteristics of non-melting foam plastic building materials
CAN/ULC-S101 <sup>13</sup>	Assembly	Fire resistance (1-hour, 2-hour, etc. when required)
CAN/ULC-S107 <sup>14</sup>	Assembly	Roof coverings (Class A, B, or C)
CAN/ULC-S126 <sup>15</sup>	Assembly	Flame spread of roof deck constructions from interior fire exposure

Tests denoted in the table above as assembly fire tests provide results (along with any ratings or classifications) that are tied to the specific assembly configuration and materials that were tested. Any modifications to the as-tested components or assembly conditions (i.e., higher slope, greater insulation thickness, etc.) will require either re-testing or an analysis to determine the equivalency of the modified roof assembly.

Additionally, depending on certain conditions, the NBCC may limit surface burning characteristics of polyiso insulation used in roofing applications to a maximum flame-spread rating of 500 when

9. ASTM International, ASTM E84 *Standard Test Method for Surface Burning Characteristics of Building Materials*

10. UL Standards & Engagement, UL 723 *Standard for Safety for Test for Surface Burning Characteristics of Building Materials*

11. ULC Standards, CAN/ULC-S102 *Standard Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies*

12. ULC Standards, CAN/ULC-S127 *Standard Corner Wall Method of Test for Flammability Characteristics of Non-melting Foam Plastic Building Materials*

13. ULC Standards, CAN/ULC-S101 *Standard Methods of Fire Endurance Tests of Building Construction and Materials*

14. ULC Standards, CAN/ULC-S107 *Standard Test Methods for Fire Tests of Roof Coverings*

15. ULC Standards, CAN/ULC-S126 *Standard Method of Test for Fire Spread Under Roof-Deck Assemblies*

tested to CAN/ULC-S102. Other applicable provisions may also require the roof assembly to have a 1-hour fire-resistance-rating (when tested to CAN/ULC-S101).

NBCC requirements applicable to polyiso insulation and roof assemblies containing polyiso insulation are found in Articles 3.1.4 – Combustible Construction, 3.1.5 – Noncombustible Construction, 3.1.15 – Roof Covering, and 9.26 - Roofing.

## Other Standards – FM Approvals FM 4470

In addition to building code requirements, one performance standard often referenced in the U.S. and Canadian roofing markets is the FM 4470<sup>16</sup> examination standard from FM Approvals. Roof assemblies installed on buildings insured against loss by FM Global are most often required to comply with FM 4470 and perhaps other FM Approvals standards. Compliance with FM 4470 is not a building code requirement for roof assemblies under the IBC, IRC, or NBCC. However, many polyiso manufacturers maintain third-party certification of roof assemblies to FM 4470 in addition to the fire tests required by the U.S. and Canadian building codes.

A “Class 1” rating under FM 4470 encompasses a comprehensive set of tests and performance requirements for the tested roof assembly configuration. The tests included in FM 4470 parallel several performance and fire safety provisions required by the building codes. However, the performance required by FM 4470 is not tied to, or determined by, requirements in the U.S. and Canadian building codes. Provisions in FM 4470 related to fire performance of roof assemblies are identified in the table below.

Test	Test Type	Performance Evaluated
ASTM E108	Assembly	Roof assemblies exposed to exterior flame (Class A, B, or C)
NFPA 276	Assembly	Heat release rate of roof assemblies with combustible above-deck roofing components (Note: This test is an interior fire exposure test.)

In addition to the fire performance tests listed in the table above, FM 4470 includes additional tests and performance requirements for properties that include wind uplift resistance, hail damage resistance, water leakage, foot traffic resistance, corrosion resistance, and susceptibility to heat damage. The FM 4470 is an evaluation of the entire roof assembly. As with the code-required assembly fire tests, an FM 4470 classification is tied to the specific assembly configuration and materials that were tested. Any alteration to the as-tested components or assembly conditions (e.g., higher slope, greater insulation thickness, etc.) will require either re-testing or an analysis to determine the equivalency of the modified roof assembly.

## Takeaways

Fire safety is an essential consideration for all buildings, their design, and their occupancy and use. When it comes to roof assemblies, building codes in the U.S. and Canada share similar approaches to fire safety that include fire testing and performance requirements for exterior fire exposure, interior (below roof deck) fire exposure, and fire-resistance (when required). Although the specific tests required by the U.S. and Canadian building codes differ, the tests address the same fire performance characteristics and associated fire safety principles. In addition to building codes, FM 4470 is a relevant performance standard in the U.S. and Canadian roofing markets, but is limited to specific projects where the building is insured by FM Global (or where otherwise specified).

16. FM Approvals, *Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction*

For more specific information regarding the fire performance, applicable building code requirements, building code compliance, available third-party certifications, and other recognitions for specific polyiso insulation products and roof assemblies, please contact the respective product manufacturers.

## ABOUT PIMA

Since 1987, PIMA has served as the voice of the North American rigid polyiso insulation industry. PIMA is a leading advocate for safe, cost-effective, sustainable, and energy-efficient construction. The Association is comprised of polyiso manufacturers and industry suppliers, and represents the public policy interests of its membership at the local, national, and international levels to advance high-performance building practices.

PIMA produces technical bulletins to address key topics related to polyiso insulation. These publications inform architects, specifiers, and contractors about the performance characteristics of polyiso insulation. Always consult individual manufacturers for product specific information, including product data sheets and installation instructions.

For more information on polyisocyanurate insulation, visit [www.polyiso.org](http://www.polyiso.org)

