PIMA Technical Bulletin #103

Fire Performance in Walls and Ceilings

About Polyiso Insulation

Polyiso is a rigid foam insulation used in over 70% of commercial roof construction, in commercial sidewall construction and in residential construction.

The Benefits of using Polyiso include:

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

PIMA and polyiso products have received many environmental awards. These include an honorable mention in the Sustainable Buildings Industry Council's (SBIC) - "Best Practice" Sustainability Awards Program and the U.S. EPA's Climate Protection Award for the association's leadership in promoting energy efficiency and climate protection. The EPA also awarded PIMA and its members the Stratospheric Ozone Protection Award for "leadership in CFC phase-out in polyiso insulation and in recognition of exceptional contributions to global environmental protection."

POLYISO
The top performer.

The Importance of Building Codes in Construction

Building codes are in place to provide a means to safeguard life and protect the public welfare through regulating the design, construction practices, construction material quality (including fire performance), location, occupancy, and maintenance of buildings and structures. When regulating materials, many of the model building codes refer to quality standards developed by standard-setting organizations such as the American Society for Testing and Materials (ASTM). Some building codes and insurance rating organizations also rely on test information from FM Global (FM) and Underwriters Laboratories Inc. (UL).

Foam Plastic Insulation and Building Codes

Sheathing and Wall Applications for Polyiso Insulation

The ICC model building code includes a specific section pertaining to the safe use of foam plastics in construction. For the typical wall application, there are three requirements:

- Flame spread of 75 or less on the foam core, as tested in accordance with ASTM E84
- Smoke development of 450 or less on the foam core, as tested in accordance with ASTM E84
- Use of a thermal barrier, such as 1/2 inch (12.7 mm) gypsum board on the interior or occupied side of the building

ALL POLYISO INSULATION PRODUCTS PRODUCED BY PIMA MEMBERS MEET THESE REQUIREMENTS.

Special Wall Applications for Polyiso Insulation

Building codes have specific requirements for the use of foam insulation in special applications. For example, the need for a thermal barrier may be eliminated if the polyiso insulation product has performed successfully in a large scale fire test at accredited testing laboratories. Consult the polyiso insulation manufacturer for specific test results, code approvals, and recommended exposed applications.

Similarly, some polyiso insulation products have been formulated and tested for use in one and two-hour masonry and wood frame wall constructions. The standard test used to qualify time-rated assemblies is ASTM E119. Consult the polyiso insulation manufacturer and code authorities before installing the product in time-rated constructions.

Fire Tests Definitions

ASTM E84 (Standard Test Method for Surface Burning Characteristics of Building Materials) is a standard method to assess the spread of flame on the surface of a material. Often referred to as the "Tunnel Test", E84 involves installing a sample of material 20 inches wide and 25 feet long as the ceiling of a horizontal test chamber. The material is exposed to a 4-foot-long gas flame at one end of the tunnel for a period of 10 minutes. The rate of flame front progression on the material is compared to selected standards and calculations are made to produce a flame spread rating. Smoke from the fire in the tunnel is measured in the exhaust stack by using a light beam to evaluate smoke developed ratings. ASTM E84 also has a number of other designations, such as UL 723, NFPA 255, or ICBO 8-1.

Since ASTM E84 is a standard laboratory fire test on a single material, numerical ratings derived from E84 are not intended to reflect hazards presented by the test material under actual fire conditions.

ASTM E84: Polyiso Insulation vs. Polystyrene Insulation

Polyiso insulation, a thermoset material, stays intact during the fire exposure and successfully remains in place during the tunnel test, thereby meeting the necessary ratings dictated by building codes. Thermoplastic materials, such as polystyrene, perform much differently in the tunnel test. Because the material softens at 165°F and melts at approximately 200°F, polystyrene melts away from the fire front and often drips to the floor of the tunnel, where it can continue to burn.

Although many polystyrene insulations claim a flame spread of 5, an examination of a testing laboratory certification label[1] for an extruded polystyrene insulation reveals:

Max. 1-inch thickness	**Max. 4-inch thickness**
Max. 1.86 pcf density	**Max 4 pcf density**
Unfaced	**Faced or Unfaced**
Flame spread 5**	**Flame spread 5++**
Smoke developed 115**	**Smoke developed 165 ++**

** Flame spread and smoke developed recorded while material remained in original test position. Ignition of molten residue on the furnace floor resulted from flame travel equivalent to calculated flame spread classification of 45 and smoke developed classification of 350.

++ Flame Spread and Smoke Development recorded while material remained in original test position. Ignition of molten residue on the furnace floor resulted from flame travel equivalent to calculated flame spread classification of 90 and smoke developed classification of over 500.

ASTM E119 (Standard Test Method for Fire Tests of Building Construction and Materials) is used to determine the fire resistance of a complete assembly. For example, a wall rating is measured by constructing a 10-foot by 10-foot section of total wall system: framing, cavity insulation, sheathing, siding, and gypsum wall board. The wall section is installed vertically on a gas furnace, and the wall system is exposed to flame for the time period for which a rating is desired, i.e., one, two, three, or four hours. Failure points during time of fire exposure are as follows: flame penetration through the wall section, an unacceptable temperature increase on the unexposed side of the assembly, and structural failure or collapse of the assembly. Therefore, a one-hour fire resistance rating is taken to mean that a structure incorporating the tested wall construction will not collapse, nor transmit flame or a high temperature, while supporting a design load for at least one hour after a fire starts.

Ceiling constructions can also be tested horizontally in accordance with ASTM E119. The building code authorities usually designate the duration of fire resistance needed in a building. Factors affecting the duration of fire resistance include type of construction, occupancy designations, location of building, and insurance criteria.

ASTM E119 is also known as UL 263, NFPA 251, and UBC 7-1.

1 Underwriters Laboratories Inc. Classification Certificate D-369 for Styrofoam Brand Insulation manufactured by Dow Chemical U.S.A

Testing Laboratories

The testing and evaluation of polyiso insulation to show conformance with building code requirements is conducted by several nationally recognized testing agencies accredited by ICC or state or local code authorities.104

PIMA

For over 20 years, PIMA (Polyisocyanurate Insulation Manufacturers Association) has served as the unified voice of the rigid polyiso industry proactively advocating for safe, cost-effective, sustainable and energy efficient construction.

PIMA produces technical bulletins in an effort to address frequently asked questions about polyiso insulation. PIMA's technical bulletins are published to help expand the knowledge of specifiers and contractors and to build consensus on the performance characteristics of polyiso. Individual companies should be consulted for specifics about their respective products.

PIMA's membership consists of manufacturers and marketers of polyiso insulation and suppliers to the industry. Our members account for a majority of all of the polyiso produced in North America.

SAFETY

Polyiso insulation, like wood and other organic building materials, is combustible. Therefore, it should not be exposed to an ignition source of sufficient heat and intensity (e.g., flames, fire, sparks, etc.) during transit, storage or product application. Consult the product label and/or the PIMA members' Material Safety Data Sheets (MSDS) for specific safety instructions. In the United States, follow all regulations from OSHA, NFPA and local fire authorities; in Canada, follow all regulations from Health Canada Occupational Health and Safety Act (WMHIS) and local fire authorities.

For more information on polyisocyanurate insulation, visit www.polyiso.org

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