ALLIANCE FOR THE POLYURETHANES INDUSTRY
A BUSINESS UNIT OF THE AMERICAN PLASTICS COUNCIL

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Fire Safety Guidelines for Use of Rigid Polyurethane and Polyisocyanurate Foam Insulation in Building Construction

contents

Polyurethane or Polyisocyanurate Foam Insulation & Combustibility

Rigid polyurethane or polyisocyanurate foams are effective insulation materials for the construction industry(1). Depending on the chemical formulation and other product composition factors, combustibility characteristics of polyurethane or polyisocyanurate foams vary widely, as do those of other organic materials.

All organic foam insulations, regardless of whether they contain fire retardants, should be considered combustible and handled accordingly. Certain precautions must be taken to minimize any potential for fire through accidental ignition in handling, storage, and use. How polyurethane or polyisocyanurate foams are used in a building ultimately determines their fire safety. In many cases, type of occupancy and type of construction also may require the addition of sprinkler protection and/or smoke detectors.

The model building codes require that all foam insulation be separated from the interior of a building by an approved thermal barrier such as ½-inch gypsum wallboard. Under specific conditions, such as those discussed in this bulletin, this requirement may be waived. The model building codes provide for evaluation of the fire performance of new or improved products and systems of building construction through the use of "diversified" testing such as ANSI/UL 1256, FM 4450, UBC Standard 26-3, and FM 4880 fire tests. Thus, some polyurethane and polyisocyanurate foam insulations and systems have earned various building code acceptances for certain applications without a thermal barrier through these fire tests. Examples include (1) polyisocyanurate roof insulation and spray polyurethane foam roofing systems directly applied to steel roof decks, (2) some metal-faced polyurethane and polyisocyanurate laminate panel products, and (3) some polyurethane foam sealant applications. Always check applicable building codes for local area requirements. Consult the manufacturer for further information regarding specific code acceptance.

(1) For information about the performance features and applications of commercially available polyurethane and polyisocyanurate insulation products, consult the following publication by the Alliance for the Polyurethanes Industry: *Polyurethane and Polyisocyanurate Foams: Inch for Inch One of the Most Efficient Insulators* (AX106).

Fire Safety During Construction

Fire involving building construction materials including polyurethane and polyisocyanurate foams usually is more likely during construction than after a building is completed—during certain construction sequences, there may be storage of exposed foam board, incomplete installation of thermal barriers, improper disposal practices, poor housekeeping conditions, and the potential for exposure to open flame or other "hot work" from allied trades. Good construction practice suggests the following safety precautions at the *construction site*.

Storage

- Store drums of liquid materials within temperature and environmental conditions recommended by the material manufacturer.
- Store foam boardstock in limited quantities, in an accessible location, and free from ignition hazards.
- Consult your insurer and local fire officials for specific recommendations.

Application

Insulation contractors should observe the following recommendations:

- When opening drums of either resin or diisocyanate, first loosen the bung two turns to allow vapor pressure relief.
- Foamed-on-site polyurethane chemicals should be mixed and applied only by applicators trained in their proper use and familiar with their limitations. Foam chemicals should be handled and applied according to system manufacturer/supplier recommendations.
- Provide adequate fire alert and fire extinguishing equipment at the installation site. Water in a fine spray is an effective method for extinguishing rigid polyurethane or polyisocyanurate foam fires; however, other techniques may be required due to job-site conditions, such as fire involving electrical wiring, liquid chemicals, fuels in drum storage, etc. Local fire departments often will provide specific recommendations upon request. Firefighting information also should be available on the manufacturer's Material Safety Data Sheet (MSDS).

Trades performing hot work should comply with the National Fire Protection Association document, NFPA 51 B, as described by OSHA Standard 29 CFR 1910.252. Trades performing hot work are required to observe the following restrictions:

- No open flames, cutting and welding torches, high intensity heat sources, and smoking materials are permitted in storage and application areas.
- If "hot work" must be done within 35 feet of combustible materials, including exposed polyurethane or polyisocyanurate foams, (1) it must be shielded from heat and sparks by an acceptable fire resistant barrier, and (2) a fire watch should be required.
- No welding or cutting metal is permitted in contact with these foams.

Disposal

- Do not mix liquid waste components together for disposal convenience. Mixed "A" and "B" components can create pressure within closed containers causing rupture or explosion. Conditions also could exist for spontaneous combustion by improperly mixing "A" and "B" components.
- Prior to storage, residues in empty drums should be neutralized to prevent rupture or explosion of closed containers. For example, rupture or explosion might happen if water entered an "ISO" or "A" drum that then was sealed. (Refer to Polyurethane Division/SPI Technical Bulletin AX151, *Guidelines for the Responsible Disposal of Containers and Wastes from Polyurethane Raw Materials Processing*[2].)

(2) The Polyurethane Division/The Society of the Plastics Industry, Inc. is the predecessor organization of the Alliance for the Polyurethanes Industry (API), a Business Unit of the American Plastics Council. As such, these Technical Bulletins can now be obtained by contacting API.

- As with all combustible construction material, do not allow large accumulations of waste polyurethane or polyisocyanurate foam. Good housekeeping practices should be observed.

Fire Safety in Design

Each polyurethane or polyisocyanurate foam product has its own maximum service temperature, which should be observed. Recommendations of material suppliers should be consulted for this information.

Local building codes, model building codes, fire code officials, insurers, and manufacturers' specifications and installation instructions must be consulted in each specific instance of product application, system design, and building occupancy. For example, most applications will require the use of a suitable thermal barrier covering the interior-exposed surface of polyurethane or polyisocyanurate foam insulation; some products and applications as a result of testing may not require thermal barriers. Additionally, certain applications and occupancies may require sprinkler protection and/or smoke detectors.

The following are some fire safety design guides for consideration by the architect and contractor based on building codes, as well as recommendations of the Alliance for the Polyurethanes Industry (API).

Interior Applications

- Effective thermal insulation, as provided by polyurethane and polyisocyanurate foams, can result in rapid heat buildup if a fire should occur. The improper use of polyurethane or polyisocyanurate foam insulation, in conjunction with other combustible materials in and within the building structure, may contribute to the rapid spread of fire. Thermal insulation should only be used and installed in strict accordance with manufacturer/supplier recommendations and local building codes, as well as insurance carrier considerations.
- Unless otherwise approved by authorities having jurisdiction, polyurethane or polyisocyanurate foams used in interior wall and/or ceiling construction or concealed spaces should be covered with an adequate thermal barrier, such as ½-inch gypsum wallboard or the equivalent.
- Unless otherwise approved by authorities having jurisdiction, foam installed above a suspended ceiling, such as in a refrigerated building, also requires protection by a thermal barrier above the foam, i.e., between the top side of the foam and the underside of the floor above (a thermal barrier on both sides of the foam).
- For panels comprising metal facings on foam cores, the model building codes specify minimum thickness for steel (0.016") or aluminum (0.032") facings and maximum flame spread and smoke ratings for the foam cores. The codes also may require automatic sprinklers. Some metal-faced polyurethane or polyisocyanurate-laminated panels have earned various building code and insurance approvals as exceptions to these requirements based on results of acceptable diversified testing provisions of the codes. Also, in certain building codes, walk-in coolers or freezers of less than 400-square-foot area are considered fixtures and do not require sprinklers.
- Fire blocks may be required in the design of large warehouse ceiling areas, between floors in certain multi-story building, in certain concealed spaces, and at penetrations into pipe chases and ventilation shafts. Consult local building codes for specific requirements.
- Polyurethane or polyisocyanurate foams should not be used in areas immediately adjacent to or above combustion equipment (such as furnaces and chimneys), high temperature process equipment or piping (unless specifically designed for such application), or in other locations that could subject the foam insulation to temperatures exceeding manufacturer/supplier recommendations.
- Polyurethane or polyisocyanurate foams may be used to fill cavities within masonry walls or under grade-level concrete floors. Consult manufacturers and suppliers of specific foam insulation products

for recommendations regarding protection against physical impact damage and the control of moisture and water vapor in such applications.

- The consideration of new "total system" concepts to provide improved fire safety for buildings incorporating such features as controlled ventilation and early fire detection, alarm, and suppression devices are recommended.

Exterior Applications

- Polyurethane or polyisocyanurate foam may be used as a roof covering over concrete, poured gypsum, tongue and groove planking, plywood, dimensional lumber or other properly prepared roof decks if the foam insulation is part of a Class A, B, or C roof covering per ASTM E-108 testing.
- Polyurethane foam insulation may be used as part of a roof over metal decks provided (1) a fire-rated underlay of perlite, gypsum board or other approved thermal barrier material is applied between the foam and the deck to provide protection from fire inside the building, (2) the roof assembly passes ANSI/UL 1256 or FM 4450, or (3) the roof assembly has earned the necessary approvals from building code officials and insurers based on results of acceptable diversified testing provisions of the codes. For example, polyisocyanurate foam roof insulation has been approved by both Underwriters Laboratories (UL) and Factory Mutual (FM) for installation direct to steel decks without a thermal barrier on the basis of ANSI/UL 1256 and FM 4450 fire tests.
- When used as an exterior insulating material on structures, such as tanks or chemical processing equipment, polyurethane or polyisocyanurate foam products also may require protection (1) from the weather and ultraviolet rays of the sun, (2) from severe physical impact, and (3) from accidental ignition.
- Consult your materials manufacturer/supplier, insurance underwriter, local building code official, or local fire official for specific requirements.

Combustibility Tests, Ratings, and Hazards

Numerous federal regulations and state and local building codes refer to combustibility tests and standards such as ASTM E-84, UL 790, FM 4880, UL 1040, UL 1715, or UBC Standard 26-3. Laboratory tests and numerical ratings derived from these tests are the most common means available today to compare certain significant combustibility characteristics of plastics, other materials of construction, and assemblies. These tests and ratings also are used to communicate this information to knowledgeable consumers. However, the tests and ratings are valid only as measurements of the performance of these materials and/or assemblies under specific, controlled test conditions and are not intended to reflect hazards under actual fire conditions. More than one test may be necessary to adequately qualify a material for an intended or proposed use. Authorities having jurisdiction should be consulted.

*Fire Tests, Building Codes, and Standards**

ANSI/UL 1256	*Fire Test of Roof Deck Constructions*
ASTM E-84	*Standard Test Method for Surface Burning Characteristics of Building Materials*
ASTM E-108	*Standard Test Method for Fire Tests of Roof Coverings*
FM 4450	*Class 1 Insulated Steel Deck Roofs*
FM 4880	*Building Corner Fire Test Procedure*
NFPA 51B	*Fire Prevention During Welding, Cutting, and Other Hot Work*
OSHA 29 CFR 1910	*Occupational Safety and Health Standards*
UBC Standard 26-3	*Room Fire Test Standard for Interior of Foam Plastic Systems*
UL 790	*Tests for Fire Resistance of Roof Covering Materials*
UL 1040	*Fire Test of Insulated Wall Construction*
UL 1715	*Fire Test of Interior Finish*

*This table only contains fire tests, building codes, and standards referenced in this document. Other tests, codes, and standards may apply. Always consult with authorities having jurisdiction.

Rigid polyurethane or polyisocyanurate foams will, if ignited, release various products of combustion such as smoke and gasses that may be irritating, flammable, and/or toxic. As with other organic materials, such as wood, the most significant combustion gases are carbon monoxide and carbon dioxide.

The guidelines contained herein reflect practices generally recognized by federal agencies, the model building codes, insurers, and other regulatory bodies as providing requisite levels of safety to life and property.

Additional Information

Information on the fire tests, building codes, and standards may be obtained from:

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036
212.642.4900
www.ansi.org

American Society of Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
610.832.9585
www.astm.org

National Building Code
Building Officials and Code Administrators
International (BOCAI)
4051 West Flossmoor Road
Country Club Hills, IL 60478-5795
708.799.2300
www.bocai.org

Factory Mutual (FM)
1151 Boston-Providence Turnpike
Norwood, MA 02062
781.762.4300
www.fmglobal.com

International Building Code (IBC)
International Residential Code (IRC)
International Code Council (ICC)
Suite 708
5203 Leesburg Pike
Falls Church, VA 22041-3401
703.931.4533
www.intlcode.org

National Fire Protection Association (NFPA)
1 Batterymarch Park
PO Box 9101
Quincy, MA 02269-9101
617.984.7402
www.nfpa.org

Occupational Safety &
Health Administration (OSHA)
Office of Public Affairs – Room N3647
200 Constitution Avenue
Washington, DC 20210
202.693.1999
www.osha.gov

Standard Building Codes
Southern Building Code
Congress International (SBCCI)
900 Montclair Road
Birmingham, AL 35213-1206
205.591.1853
www.sbcci.org

Underwriters Laboratories Inc. (UL)
US Corporate Headquarters
333 Pfingsten Road
Northbrook, IL 60062-2096
847.272.8800
www.ul.com

Uniform Building Code (UBC)
International Conference of Building Officials (ICBO)
5360 Workman Mill Road
Whittier, CA 90601-2298
562.699.0541
www.icbo.org

Further information on the proper application of rigid polyurethane or polyisocyanurate foams may be obtained from the manufacturer or supplier of the materials, as well as the following trade organizations:

Alliance for the Polyurethanes Industry (API)
A Business Unit of the American Plastics Council
1300 Wilson Boulevard
Arlington, VA 22209
703.741.5656
www.polyurethanes.org
www.plastics.org

Polyisocyanurate Insulation Manufacturers Association (PIMA)
Suite 420
515 King Street
Alexandria, VA 22314
703.684.1136
www.pima.org

Spray Polyurethane Foam Alliance (SPFA)
A Business Unit of the American Plastics Council
Suite 800
1300 Wilson Boulevard
Arlington, VA 22209
703.253.0700
www.sprayfoam.org
www.plastics.org

api
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703.741.5656 Fax 703.741.5655
www.polyurethane.org www.plastics.org