**REFLECTIVE WALL AND CEILING INSULATION**

# Table of Contents

**Page**



## List of Figures

## 1.0 SCOPE

This data sheet describes the characteristics of reflective insulation, provides guidance for their use and fire protection requirements for wall and ceiling installations.

Reflective insulation has an emittance ≤ 0.1 per ASTM International C1224-15 (2020), *Standard Specification for Reflective Insulation for Building Applications*. The reflective surface is usually aluminum foil or an aluminized plastic film laminated to a substrate that acts as a radiant barrier to heat transfer.

Follow FM Property Loss Prevention Data Sheet 1-57, *Plastics in Construction*, for foil-faced insulation boards including expanded polystyrene, polyurethane or polyisocyanurate.

### 1.1 Hazards

Current fire test standards referenced in building codes are, in many cases, not suited to adequately predict the real fire performance of reflective insulations. The result is that manufacturers advertise fire test results that allow them to market these products as compliant with the applicable building code, but the fire test results do not offer a meaningful way of evaluating the products.

Many of these products are highly combustible and present a significant exposure that may not be understood by building owners/managers, contractors or fire safety engineers.

Most of these products produce copious amounts of black smoke. Relatively lightweight roof construction can result in localized damage to the steel structure from even a small fire, including twisted purlins, deformed steel decking, etc.

### 1.2 Changes

**January 2023.** The following changes were made for this revision:

A. The title of this Data Sheet was changed to "*Reflective Wall and Ceiling Insulation*" from "*Reflective Ceiling Insulation*."

B. Removed guidance for non-FM Approved reflective insulations installed at existing buildings.

## 2.0 LOSS PREVENTION RECOMMENDATIONS

### 2.1 Construction and Location

2.1.1 Use FM Approved equipment, materials, and services whenever they are applicable and available. For a list of products and services that are FM Approved, see the Approval Guide and RoofNav®, online resources of FM Approvals.

2.1.1.1 When reflective insulation is used on walls or ceilings, select one of the following:

1. An FM Approved insulation for Interior Walls and Ceilings- Search www.ApprovalGuide.com under Walls, Ceilings and Associated Equipment -> Interior Walls and Ceilings or on www.RoofNav.com, for products currently approved by FM Approvals.
2. Foil-faced noncombustible insulation (See Appendix A), such as foil-faced glass fiber or foil-faced mineral wool.

### 2.2 Protection

2.2.1 Provide automatic sprinklers where the construction or occupancy is combustible, per FM Data Sheets.

### 2.3 Operation and Maintenance

2.3.1 Avoid hot work in areas where reflective insulation is present. If hot work must be performed, follow Data Sheet 10-3, *Hot Work Management*.

2.3.2 Maintain reflective insulation in good condition, repairing cuts and other damage. Use FM Approved materials when replacing damaged sections.

2.3.3 Provide a housekeeping program to keep the facility free of dust, oily deposits and other materials on building surfaces and especially on areas with exposed reflective insulation.

### 2.4 Use of Other Codes and Standards

The use of other codes and standards may not provide adequate testing and protection.

## 3.0 SUPPORT FOR RECOMMENDATIONS

### 3.1 Reflective Insulations

#### 3.1.1 FM Approvals

Search www.ApprovalGuide.com under Walls, Ceilings and Associated Equipmen → Interior Walls and Ceilings or on www.RoofNav.com, for products currently approved by FM Approvals.

Some insulation facings are listed by FM Approvals for use with glass fiber insulation, and the facing may be used alone as an acceptable reflective insulation.

#### 3.1.2 Foil-Faced Polyethylene Bubble Wrap

Foil-faced polyethylene bubble wrap is typically composed of one or two layers of polyethylene bubbles with a foil-face on one or both sides (See Figure 3.1.2-2). This product has a very thin fiberglass weave in it, making it very durable (tear proof) and, therefore, a popular product. It can be used as an effective insulating material and can often be found as an exposed wall and ceiling lining in industrial and warehousing occupancies in addition to the standard insulation found in ceiling voids (See Figure 3.1.2-1).

*Fig. 3.1.2-1. Foil-faced polyethylene bubble wrap reflective insulation below the roof/ceiling*

*Fig. 3.1.2-2. Multi-layer foil and bubble pack (Alububble) insulation*

### 3.1.3 Foil-Faced Polyester Nonwoven Insulation

Fire testing indicates that this insulation performs similar to foil-faced polyethylene bubble wrap. (See Figures 3.1.3-1 and 3.1.3-2)

*Fig. 3.1.3-1. Foil-faced and Unfaced Polyester Nonwoven Insulation*

*Fig. 3.1.3-2. Foil-faced polyester attached to underside of concrete ceiling*

### 3.1.4 Foil-Faced Closed-Cell Polyethylene Foam Insulation

The insulation is manufactured in continuous roll form and created by bonding reflective reinforced aluminum foils to an inner core of low density closed cell polyethylene foam (See Figures 3.1.4-1 and 3-1.4-2). This product may also have pin holes in it to allow it to breath (a requirement for cavity wall insulation).

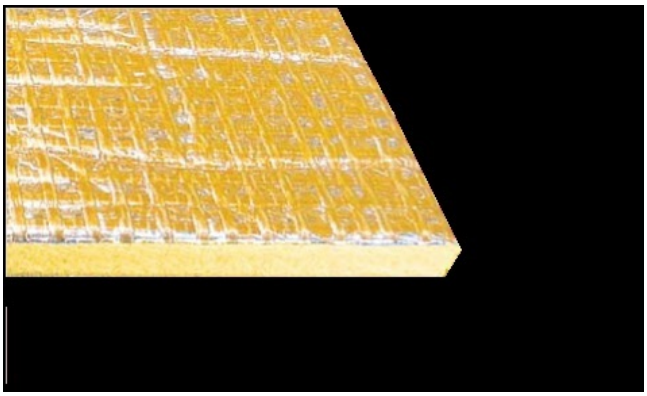

*Fig. 3.1.4-1. Insulbreak® is manufactured with a patented, physically cross-linked, closed-cell polyethylene foam structure, and sandwiched by highly reflective foil surfaces*

*Fig. 3.1.4-2. Insulbreak® is manufactured with a patented, physically cross-linked, closed-cell polyethylene foam structure, and sandwiched by highly reflective foil surfaces*

### 3.1.5 Cross-Linked Foil-Faced Polyolefin Foam Insulation

This product is more commonly used for duct insulation and under raised floors but is also used as reflective insulation below a roof or ceiling.

### 3.1.6 Firestopped Roof Deck Construction

The voids created by non-firestopped roof decks may allow for rapid horizontal fire spread.

The beams should be a minimum of 20 in. (508 mm) deeper than the sub purlins. This difference will reduce the potential for fire spread under the beams.

*Fig. 3.1.5-1. Cross-linked polyolefin foam with factory-applied reinforced 9 µm aluminum foil and G60 acrylic adhesive backing*

## 4.0 REFERENCES

### 4.1 FM

Data Sheet 1-10, *Interaction of Sprinklers, Smoke and Heat Vents, and Draft Curtains*
Data Sheet 1-57, *Plastics in Construction*
Data Sheet 10-3, *Hot Work Management*

### 4.2 Other

American National Standards Institute (ANSI). *Flame Resistance of Treated Paper and Paperboard.* ANSI/TAPPI T461.

ASTM International. *American National Standard for Evaluating (A) Insulated Wall or Wall & Roof/Ceiling Panels (B) Plastic Interior Finish Materials (C) Plastic Exterior Finish Material (D) Wall/Ceiling Coating Systems (E) Interior or Exterior Finish Systems.* ANSI/FM 4880

ASTM International. *Standard Specification for Reflective Insulation for Building Applications*. ASTM C1224-15 (2020),

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

Australian Building Codes Board (ABCB). *Building Code of Australia.*

International Organization for Standardization. *Fire Tests: Full-Scale Room Test for Surface Products.* ISO 9705.

National Institute of Standards and Technology (NIST). *Flame Resistant Paper and Paperboard.* NBS PS 46-71.

Standards Australia. *Methods for Fire Tests on Building Materials, Components and Structures, Part 2: Test for Flammability of Materials.* AS 1530 Part 2.

Universal Building Code (UBC). *Room Fire Test Standard for Interior of Foam Plastic Systems.* UBC 26-3.

Underwriters Laboratories (UL). *Fire Test of Interior Finish Material.* UL 1715.

## APPENDIX A GLOSSARY OF TERMS

**BCA:** Building Code of Australia.

**Bulk insulation:** Bulk insulation includes materials such as glass fiber, slag wool, rock fiber, cellulose fiber, polyester fiber, polystyrene, polyurethane and polyisocyanurate.

**Class 1:** A material or assembly that has limited combustibility such that it will not self-propagate fire.

**CSIRO:** The Commonwealth Scientific and Industrial Research Organisation. Australia's national science agency.

**EPS:** Expanded polystyrene.

**Fire barrier:** A fire-resistance-rated assembly designed to restrict the spread of fire and the movement of smoke in which continuity is maintained. Fire barriers are continuous fire separations with terminations at exterior walls, fire walls, other fire barriers, or the roof in order to constitute a complete fire separation. Fire barriers should be continuous through concealed spaces, such as the space above a suspended ceiling. Openings are protected with fire doors having a minimum fire protection rating of 20 minutes.

**Firestopped:** A construction method where the subpurlins dead-end into the purlins, which dead-end into the beams. Constructions in which the purlins and/or subpurlins are continuous over their respective supporting members are non-firestopped and thus allow for a large, contiguous space beneath the roof deck.

**FM Approved:** A product or service that has satisfied the criteria for Approval by FM Approvals. Refer to the Approval Guide for a complete list of products and services that are FM Approved.

**Glu-lam beams:** Wood beams made up of two or more wood laminations glued together.

**Heat release rate (HRR):** The rate at which combustion reactions produce heat. The HRR is measured in kilowatts (kW) or kilowatts per unit area ($kW/m^2$).

**Listed:** Listed by a reputable testing laboratory according to a widely recognized testing standard adopted by model building codes.

**Noncombustible:** A material or assembly that will not allow for a self-propagating fire and contributes a negligible amount of fuel to a fire but is not necessarily fire resistive.

**Noncombustible Insulation:** Those insulations meeting the limits for noncombustible core as defined in FM Approval Standard 4880.

**Plywood diaphragm roof deck:** A type of construction in which the plywood roof deck acts as a lateral load-resisting structural element. The roof diaphragm resists lateral loads in the plane of the roof, acting as a thin, deep beam.

**Reflective insulation (reflective foil laminates, radiant barrier products):** Insulation products that mainly resist radiant heat flow due to their reflectivity, low radiant heat absorption, and low emissivity defined by ASTM C1224 as $\leq 0.1$. Reflective insulation is usually shiny aluminum foil laminated with reinforcements, or low-density polyethylene bubble encapsulated with air and laminated to foil. It is normally supplied in rolls. Reflective insulation relies on the presence of a defined air space next to the shiny surface. Reflective surfaces should be positioned to face the brighter side downward.

**Thermal barrier:** A board stock material or coating material applied over a combustible foam insulation that is designed to delay ignition of the insulation for 10 to 15 minutes in a sprinklered application.

**XPS:** Extruded polystyrene.

## APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

**January 2023.** The following changes were made for this revision:

A. The title of this Data Sheet was changed to "*Reflective Wall and Ceiling Insulation*" from "*Reflective Ceiling Insulation*."

B. Removed guidance for non-FM Approved reflective insulations installed at existing buildings.

**October 2014.** This data sheet has been revised to include various materials in addition to aluminum foil/kraft paper construction. Major changes include the following:

A. Added foil-faced expanded polystyrene; foil-faced polyethylene bubble wrap; foil-faced polyester nonwoven; foil-faced closed-cell polyethylene foam; cross-linked foil-faced polyolefin foam; and foil-faced noncombustible insulations.

B. Added recommendations to cover new and existing installations. Added guidance to cover new and existing installations.

C. Added information on the use of other codes.

**January 2003.** Recommendation 2.2.1, item 1 was revised and section 3.2 was added to reflect the acceptability of Approved insulation facings as a reflective insulation.

**January 2000.** This revision of the document was reorganized to provide a consistent format.

**May 1991.** The first publication of this document.

## APPENDIX C SUPPLEMENTAL INFORMATION

Reflective insulation is commonly used where air-conditioning loads are high in comparison to heating loads. This is generally prevalent in the western and southern United States, Australia, Southeast Asia, and Africa. In warm climates, heat flow tends to be down, from the warm outside, through the roof, to the cooler inside. The primary mode of heat transfer for this condition is radiation. Reflective insulation is very effective in reducing radiative heat flow.

### C.1 Insulation Types

#### C.1.1 Kraft Paper-Based Insulation

Kraft paper-based reflective insulations (see Figure C.1.1-1) can be broadly categorized into two types: single-layer and multi-layer. The former (single- layer) is actually a tri-laminate consisting of a kraft paper core faced on both sides with aluminum foil. The foil is adhered with a fire retardant-treated adhesive. The latter (multi-layer)is typically constructed with top and bottom layers of kraft paper and aluminum foil laminates with the aluminum foil facing outward. Intermediate layers are alternating sheets of aluminum foil and kraft paper. Each sheet is separated by a dead air space of approximately 1 in. (25 mm).

Multi-layer material is available with up to nine layers, although material with more than five layers is uncommon. The fire hazard is expected to increase with additional layers.

When first introduced, reflective insulation was usually not treated with fire retardant (FR). Most, if not all, reflective insulation manufactured since about 1980 is FR-treated and conforms to NBS PS 46-71. Fire performance of the FR material is expected to be better than the non-FR material.

#### C.1.2 Foil-Faced Polyethylene Bubble Wrap

Typically made of one or two layers of polyethylene bubbles with a foil face on one or both sides, this product contains a very thin fiberglass weave that makes it a very durable (tear proof) and popular product. It can be used as an effective insulating material and can often be found as an exposed wall and ceiling lining in industrial and warehousing occupancies in addition to the standard insulation found in ceiling voids.

#### C.1.3 Foil-Faced Polyester Nonwoven Insulation

This insulation is manufactured in continuous roll form and is created by bonding an aluminum reflective facer to an inner core of non-woven polyester insulation.

#### C.1.4 Closed-Cell Polyethylene Foil-Faced Foam Insulation

This insulation is manufactured in continuous roll form and is created by bonding reflective reinforced aluminum foils to an inner core of low-density closed-cell polyethylene foam.

Sometimes this type insulation also has tiny pin holes in it to allow it to breath (a requirement for cavity wall insulation). FM has not tested this specific product yet. It is a thermoplastic expanded foam-like material that is expected to have the same fire characteristics as polyethylene bubble wrap insulation.

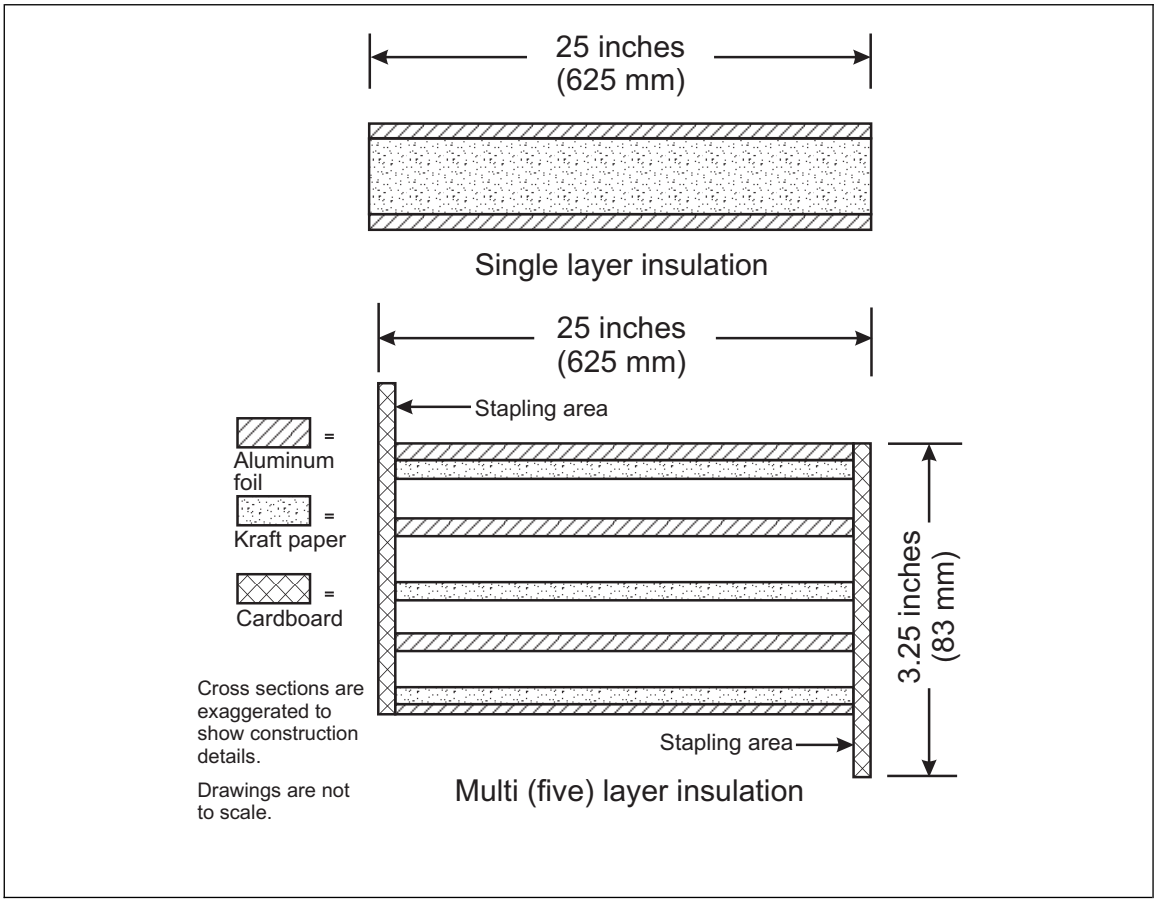


*Fig. C.1.1-1. Typical reflective insulations end views*

### C.1.5 Cross-Linked Foil-Faced Polyolefin Foam Insulation

This product is more commonly used for duct insulation and under raised floors, but is also used as a ceiling lining.

### C.2 Plywood Diaphragm Roofs

The plywood diaphragm roof is the most common type of roof to which kraft paper-based reflective insulation is attached. In this type of construction, a plywood deck is supported on 2 x 4 in. (51 x 102 mm) sub purlins spaced approximately 2 ft (0.6 m) on center. The sub purlins butt into and are supported by 4 in. x 12 to 24 in. (102 mm x 305 to 610 mm) purlins spaced approximately 8 ft (2.4 m) on center. These in turn butt into and are supported by 7 in. x 24 to 40 in. (178 x 610 to 1020 mm) glue-laminated beams. The glulam beams are usually spaced 20 to 24 ft (6 to 7 m) apart.

Member sizes and spacing may vary somewhat in individual installations. This type of construction is considered firestopped because the smaller members are not continuous over their respective supporting members. In some installations, the glulam beams run in both directions.

In some plywood deck constructions, the sub purlins and/or purlins do not butt into their respective supporting members but are continuous over them. This type of construction is not considered firestopped because of the voids created over and between the supporting members. In this type of construction, a fire in the insulation could spread over the supporting members and possibly overtax the sprinkler system.