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Standard Specification for Reflective Insulation for Building Applications[1]

This standard is issued under the fixed designation C1224; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the general requirements and physical properties of reflective insulations for use in building applications. These insulation materials consist of one or more low emittance surfaces, such as metallic foil or metallic deposits, unmounted or mounted on substrates. Reflective insulations derive thermal performance from surfaces with an emittance of 0.1 or less, facing enclosed air spaces.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

C390 Practice for Sampling and Acceptance of Thermal Insulation Lots

C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

C727 Practice for Installation and Use of Reflective Insulation in Building Constructions

C1258 Test Method for Elevated Temperature and Humidity Resistance of Vapor Retarders for Insulation

C1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings

C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

C1371 Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

E84 Test Method for Surface Burning Characteristics of Building Materials

E96/E96M Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

E2599 Practice for Specimen Preparation and Mounting of Reflective Insulation, Radiant Barrier and Vinyl Stretch Ceiling Materials for Building Applications to Assess Surface Burning Characteristics

2.2 *TAPPI Standard:*

T512 Creasing of Flexible Packaging Material Paper Specimens for Testing[3]

3. Terminology

3.1 *Definitions*—Terminology C168 shall apply to the terms in this specification.

4. Ordering Information

4.1 Prior to purchase, for sampling and acceptance procedures, Practice C390 is an option when agreed upon by the purchaser and the manufacturer.

4.2 Specify the required thermal resistance by the direction of the heat flow.

4.3 Specify the width, depth, and total area to be insulated.

4.4 Specify special markings, when required.

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.21 on Reflective Insulation.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, http://www.tappi.org.

5. Materials and Manufacture

5.1 Reflective insulation materials shall consist of low emittance surface(s) with, or without, substrates and adhesives required to meet the specified thermal performance and physical properties.

5.2 Multiple layer reflective insulations shall be designed to attain the intended separation of layers in normal application. Such multiple layer insulation shall form an attachment flange suitable for stapling, or other means of attachment.

5.3 *Dimensions*—Insulation shall be furnished in dimensions to fit framing members, at spacings standard in the construction industry, or as specifically agreed upon between the producer and the buyer.

6. Physical Properties Requirements

6.1 Low emittance materials shall have a surface with an emittance of 0.1 or less, as determined in accordance with 9.1.

6.2 *Permeance*—When the reflective insulation is to serve as a vapor retarder, the permeance of the material shall not exceed one perm, as determined in accordance with 9.2.

6.2.1 When the reflective insulation is to be vapor transmitting the permeance of the material shall be equal to or greater than five perms, as determined in accordance with 9.2.

6.3 *Surface Burning Characteristics*—Building code requirements specify flame spread and smoke development values determined in accordance with 9.3, except as follows:

(1) Maximum surface burning characteristics shall not exceed 25 flame spread index and 50 smoke development index for inside plenum applications.

(2) Maximum surface burning characteristics shall not exceed 25 flame spread index and 450 smoke development index in exposed building applications.

6.4 *Humidity Resistance*—The laminates of the reflective insulation shall be tested in accordance with 9.4. Three specimens shall be exposed. Shield the test specimens from condensate that drips from the ceiling of the humidity chamber.

6.4.1 The specimens shall be evaluated for visible corrosion and delamination. For purposes of corrosion evaluation disregard the outer 0.25 in. (6.4 mm) perimeter. No tested specimen shall exhibit visible crystalline deposits exceeding 2 % of the test area nor exhibit unaided delamination of layers.

6.5 *Adhesive Performance:*

6.5.1 *Bleeding*—Adhesives, when used, shall show no sign of bleeding when tested in accordance with the test procedure in 9.5.1. Disregard bleeding at cut edges. Bleeding or delamination, covering over 2 % of the specimen area, shall be cause for rejection.

6.5.2 *Pliability*—Specimens tested in accordance with the test procedure in 9.5.2 shall not show cracking or delamination.

6.6 *Fungi Resistance*—Specimens shall not have growth greater than comparative item when tested in accordance with 9.6. Use Interpretation of Results (Paragraph 7.2) of Test Method C1338.

6.7 *Thermal Resistance*—Determine the thermal resistance in accordance with procedures in 9.7. The results of the procedures shall indicate the R-value of the product and the enclosed air space, in the assembly tested.

7. Workmanship, Finish, and Appearance

7.1 The insulation shall be manufactured, packaged, and shipped in such a manner that, when received by the customer, it shall be suitable for installation in accordance with Practice C727.

8. Sampling

8.1 Sampling shall be performed in accordance with Practice C390.

9. Test Methods

9.1 *Emittance*—The emittance of the product shall be tested in accordance with Test Method C1371.

9.2 *Permeance*—The permeance of the product shall be tested in accordance with Test Method E96/E96M, Desiccant Method.

9.3 *Surface Burning*—Surface burning characteristics shall be tested in accordance with Test Method E84 and shall be mounted according to Practice E2599.

9.4 *Humidity Resistance*—The humidity resistance of the product shall be tested in accordance with Test Method C1258.

9.5 *Adhesive Performance:*

9.5.1 *Bleeding and Delamination:*

9.5.1.1 *Scope*—This test method covers the determination of bleeding and delamination of the reflective insulation.

9.5.1.2 *Significance and Use*—It is necessary that reflective insulation not show adhesive bleeding or delamination since this contributes to loss of structural integrity and a change in water permeability.

9.5.1.3 *Sampling*—A minimum of three specimens of the reflective insulation, with dimensions of approximately 3 by 6 in. (7.62 cm by 15.24 cm), shall be tested. The test specimens shall be cut from separate locations on a roll or panel of the insulation.

9.5.1.4 *Procedure*—Suspend the specimens vertically in an oven and heat to a temperature of 180°F (±5°F) for at least 5 h. Determine, under 5× magnification the following: has the adhesive bled or extruded through the surface, or has any separation of foil from substrate (delamination) occurred.

9.5.1.5 *Precision and Bias*—No information is presented about either precision or bias of this test method for determining Bleeding and Delamination, since the test results are nonquantitative.

9.5.2 *Pliability:*

9.5.2.1 *Scope*—This test method covers the determination of cracking or delamination of the reflective insulation due to folding and bending. Any reflective insulation product that does not require bending during installation shall be exempt from the requirements of this section.

9.5.2.2 *Significance and Use*—Reflective insulation must not crack or delaminate, these characteristics contribute to loss of structural integrity and change in water permeability.

9.5.2.3 *Sampling*—A minimum of three specimens of the reflective insulation shall be subjected to two tests: one specimen shall contain a factory produced edge.

9.5.2.4 *Procedure*—Immediately prior to testing: (*1*) The specimens shall be conditioned at a temperature of 70°F (±2°F) and a relative humidity of 50 % (±5 %) for a period of no less than 24 h for the first test. The second test shall be at 32°F (±2°F) for a period of no less than 24 h. (*2*) The foil laminate shall be folded in accordance with TAPPI Standard T512, and the folded edge smoothed, using light finger pressure. The finished laminate shall not crack or delaminate when folded to a 180° bend.

9.5.2.5 *Precision and Bias*—No information is presented about either precision or bias of TAPPI Standard T512 for determining cracking or delamination, due to folding or bending, since the test result is nonquantitative.

9.6 *Fungi Resistance*—The fungi resistance of the product shall be determined in accordance with Test Method C1338.

9.7 *Thermal Performance*—The thermal performance of reflective insulation shall be determined in accordance with Test Method C1363 using the following criteria:

9.7.1 In order to determine the thermal performance of the reflective insulation materials used in a test panel, a uniform method of adjustment of the test panel results is needed.

9.7.2 The test panel shall consist of wood framing members sheathed with a homogenous material with a thermal resistance of no more than R-2, such as 0.25 to 0.75 in. (6.35 mm to 19.05 mm) plywood, OSB board, drywall or chipboard. The exposed surface shall not have an emittance less than 0.8. The width and depth of the cavities shall be representative of the installation for which the insulation product is intended. The reflective insulation shall be installed in the test panel according to the manufacturer's installation instructions.

9.7.3 The testing of the reflective insulation shall be performed at a cavity mean temperature of 75 ± 4°F (24 ± 2°C) with a temperature difference across the insulated cavity of 30 ± 2°F (16.7 ± 1°C).

9.7.3.1 To determine the cavity mean temperature and temperature difference, sufficient temperature instrumentation shall be applied to the interior surfaces of the sheathing to measure the average temperature of these surfaces. Temperature sensor layouts for 16 and 24 in. (40.64 mm and 60.96 mm) on center guarded or calibrated hot boxes are shown in Figs. 1 and 2, respectively.

9.7.4 To determine the heatflow in the cavity area, the net heat flow shall be adjusted to account for the heat flow through the framing members. To perform this adjustment, the thermal resistance of the framing material must be known to within ±10 % and the average temperature difference across the framing members shall be measured.

9.7.4.1 A sufficient number of temperature sensors shall be installed to determine the average temperature difference across the framing members. Framing member temperature sensor layouts for 16 and 24 in. (40.64 mm and 60.96 mm) on center guarded and calibrated hot boxes are shown in Figs. 1 and 2, respectively.

NOTE 1—When cavity depths of less than 1 in. (25 mm) are being tested, special care must be taken to install the thermocouples to accurately measure the temperature gradient across the test cavity. Significant uncertainties have been reported when large diameter temperature sensors (or thermocouples) are used and when the sensors are not installed to measure the temperature gradient accurately. Consult *Temperature Measurement* in Test Method C1363.

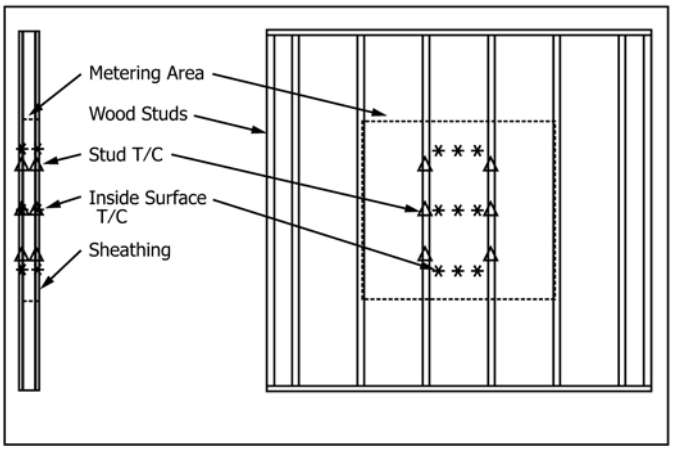
9.7.5 The steady-state heat flow through the reflective insulation in the cavity shall be determined from (Eq 1).

$$Q_{INS} = Q_{TOTAL} - (A_{FRAME} \cdot \Delta T_{FRAME} / R_{FRAME}) \quad (1)$$

where:

Q_{TOTAL} = the total heat flow rate across the test panel (BTU/h),
A_{FRAME} = the cross-sectional area of the framing (ft^2),
ΔT_{FRAME} = the average temperature difference across the framing (°F),
R_{FRAME} = the thermal resistance of the framing ($ft^2 \cdot h \cdot °F/BTU$), and
Q_{INS} = the total heat flow rate across the insulated cavity (BTU/h).

9.7.6 The thermal resistance of the reflective insulation, R_{INS}, shall be determined from (Eq 2).



NOTE 1—The diagram shows a total of 30 thermocouples. Eighteen of the thermocouples provide panel surface temperatures, twelve or more of the thermocouples provide stud surface temperatures. Use at least three thermocouples per side to measure stud surface temperature.

FIG. 1 Hot Box R-Value Test Panel Inside Surface and Stud Thermocouple Layout for 16 in. (406 mm) OC Stud Spacing