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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Reflective Insulation for Building Applications[1]

This standard is issued under the fixed designation C 1224; 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 their 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 the standard. The values given in parentheses are provided for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 168 Terminology Relating to Thermal Insulating Materials[2]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[2]

C 236 Test Method for Steady State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box[2]

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots[2]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

C 727 Practice for Use and Installation of Reflective Insulation in Building Constructions[2]

C 976 Test Method for Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box[2]

C 1338 Test Method for Determining Fungi Resistance of Insulation Materials and Facings[2]

C 1363 Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus[2]

C 1371 Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers[2]

D 3310 Test Method for Determining Corrosivity of Adhesive Materials[3]

E 84 Test Method for Surface Burning Characteristics of Building Materials[4]

E 96 Test Methods for Water Vapor Transmission of Materials[2]

2.2 *Other Standard:*

TAPPI Standard T 512 om-86, Creasing of Flexible Packaging Material Paper Specimens for Testing[5]

3. Terminology

3.1 *Definitions*—Terminology C 168 shall apply to the terms in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *reflective insulation*—thermal insulation consisting of one or more low emittance surfaces, bounding one or more enclosed air spaces.

4. Ordering Information

4.1 Prior to purchase, for sampling and acceptance procedures, Criteria C 390 can be agreed upon between 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, if required.

5. Materials and Manufacture

5.1 Reflective insulation materials shall consist of low emittance surface(s) in combination with substrates and adhesives required to meet the specified thermal performance and physical properties.

6. Physical Properties Requirements

6.1 Low emittance materials shall have an emittance of 0.1 or less, as determined in accordance with Test Method C 1371.

6.2 *Water Vapor Transmission*—If the reflective insulation is to serve as a vapor retarder, the permeance of the material

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 15.06.

[4] *Annual Book of ASTM Standards*, Vol 04.07.

[5] Available from TAPPI, Technology Park/Atlanta, P.O. Box 105113, Atlanta, GA 30348.

shall not exceed 1 perm, as determined in accordance with Test Methods E 96.

6.3 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.

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

6.5 Surface burning characteristics shall be determined in accordance with Test Method E 84, in a configuration consistent with the intended application.

6.6 *Corrosivity*—The laminates of the reflective insulation shall be tested in accordance with Test Method D 3310. Evidence of corrosion shall be cause for rejection.

6.7 *Adhesive Performance*:

6.7.1 *Bleeding*—Adhesives when used in bonding shall show no sign of bleeding when tested in accordance with the test procedure in 9.2.1. Bleeding at cut edges may be disregarded. Bleeding or delamination, covering over 2 % of the sample area, shall be cause for rejection.

6.7.2 *Pliability*—Specimens tested in accordance with the test procedure in 9.2.2 shall not show cracking or delamination.

6.8 *Mold and Mildew*— Resistance shall be tested in accordance with Test Method C 1338. Use interpretation of results in 7.2 of Test Method C 1338.

6.9 *Thermal Resistance*—Determine the thermal resistance in accordance with procedures in 9.1.

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 C 727.

8. Sampling

8.1 Sampling shall be performed in accordance with Criteria C 390.

9. Test Methods

9.1 *Thermal Performance*—The thermal performance of reflective insulations shall be determined in accordance with Test Methods C 236, C 976 or C 1363 using the following criteria.

9.1.1 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.

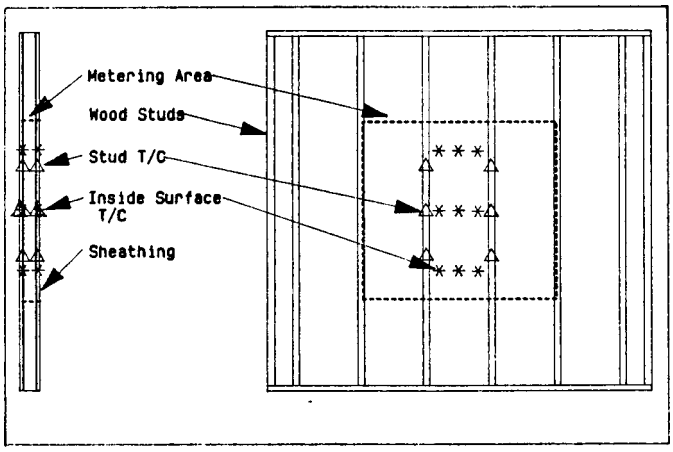
9.1.2 The test panel shall consist of wood framing members sheathed with ¾ in. thick plywood on each side. The width and depth of the cavities shall be representative of the installation for which the insulation product is intended. (See Sections 5 and 7 of Test Method C 236 or Sections 3 and 6 of Test Method C 976). The reflective insulation shall be installed in the test panel according to the manufacturer's specifications.

9.1.3 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 (16.5 ± 1°C).

9.1.3.1 To determine the cavity mean temperature and temperature difference, sufficient temperature instrumentation shall be applied to the interior surfaces of the plywood sheathing to measure the average temperature of these surfaces. Recommended temperature sensor layouts for 8 ft by 8 ft guarded and calibrated hot boxes are shown in Fig. 1 and Fig. 2, respectively.

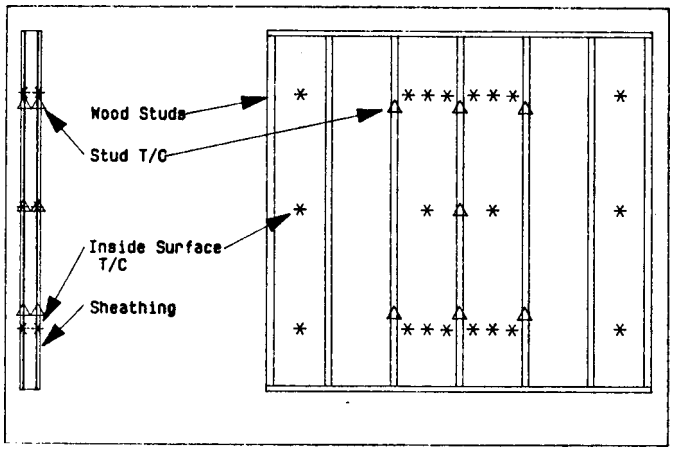
9.1.4 To determine the heatflow in the cavity area, the net heat flow shall be adjusted to account for the heat flow through the framing members. To perform this adjustment, the thermal resistance of the framing material must be known to within ±10 % and the average temperature difference across the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

9.1.4.1 A sufficient number of temperature sensors shall be installed to determine the average temperature difference across the framing members. Recommended framing member temperature sensor layouts for 8 ft by 8 ft guarded and calibrated hot boxes are shown in Fig. 1 and Fig. 2, respectively.



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. As few as 3 thermocouples minimum, per side, may be used to measure stud surface temperature.

FIG. 1 Recommended GHB R-Value Test Panel Inside Surface and Stud T/C Layout for 16 in. OC Stud Spacing



NOTE 1—The diagram shows a total of 54 thermocouples. Forty of the thermocouples provide panel surface temperatures, 14 of the thermocouples provide stud surface temperatures.

FIG. 2 Recommended CHB R-Value Test Panel Inside Surface and Stud T/C Layout for 16 in. OC Stud Spacing

9.1.5 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/hr),
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 ($ft^2 \cdot hr \cdot °F/BTU$), and
Q_{INS} = the total heat flow rate across the insulated cavity (BTU/hr).

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

$$R_{INS} = A_{INS} \cdot \Delta T_{INS} / Q_{INS} \quad (2)$$

where:

A_{INS} = the cross-sectional area of the insulated cavity (ft^2), and
ΔT_{INS} = the average ΔT across the insulated cavity measured from the inside surface of the warm-side plywood to the inside surface of the cool-side sheathing.

9.1.7 The heat flow correction due to the presence of the framing members resulting from (Eq 1) shall be verified by repeating the hot box measurement with a mass insulation material of known thermal resistance, which has been verified by laboratory tests in Test Methods C 518 or C 177 apparatus. The thermal resistance of the mass insulation after correcting for framing member heat flux shall differ by no more than 10 % from the laboratory derived thermal resistance.

9.1.8 *Reporting Requirements*—The report shall include all the requirements of Test Methods C 177, C 236, C 518, C 976 or C 1363 as well as the parameters listed in Eq 1 and Eq 2 of Section 9. The date of the last frame verification shall also be reported along with any specific test results affecting the present experiment.

9.2 *Adhesive Performance*:

9.2.1 *Bleeding and Delamination*:

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

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

9.2.1.3 *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) will be tested. The test specimens shall be cut from separate locations on a roll or panel of the insulation.

9.2.1.4 *Procedure*—Suspend the specimens vertically in an oven and heat to a temperature of 180°F (±5°F) at 50 % (±5 %) relative humidity for at least 5 h. Determine, under a 5× magnification, if the adhesive has bled or extruded through the surface, or if separation of foil from substrate (delamination) has occurred.

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

9.2.2 *Pliability*:

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

9.2.2.2 *Significance and Use*—It is necessary that reflective insulation not crack or delaminate since this could cause a loss of structural integrity and a change in water vapor permeability.

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

9.2.2.4 *Procedure*:

(*a*) The specimens shall be conditioned at a temperature of 70°F (±2°F) for the first test and at 32°F (±2°F) for the second test, and at a relative humidity of 50 % (±5 %) for a period of

no less than 24 h immediately prior to testing.

(*b*) The foil laminate shall be folded in accordance with TAPPI Standard T 512 om-86, and the folded edge smoothed using light finger pressure. The finished laminate shall not crack or delaminate when folded to a 180° bend.

9.2.2.5 *Precision and Bias*—No information is presented about either the precision or bias of TAPPI Standard T512 om-86 for determining cracking or delamination, due to folding or bending, since the test result is nonquantitative.

10. Inspection

10.1 Inspection of the material shall be agreed upon between the purchaser and supplier as part of the purchase contract as specified in Criteria C 390.

11. Rejection and Rehearing

11.1 *Requirements Determined by Visual Inspection:* Samples shall be inspected visually for mechanical damage as follows:

11.1.1 *Surface Punctures*—not to exceed one puncture per 500 ft.

11.1.2 *Damage (bleeding adhesive, corrosion) to reflective properties of surface coatings*—not to exceed 2 % of the insulated area.

11.1.3 *Crinkling (as evidenced by numerous creases and bends resulting in nonparallel surfaces)*— not to exceed 5 % of insulated area.

11.1.4 *Evidence of Corrosion*:

11.1.5 *Improper Assembly (when referenced to manufacturer's specifications)*—not to exceed 1 % of area.

11.1.6 *Improper Expansion (to designed form or size, or both)*—not to exceed 1 % of area.

11.2 If inspection of the samples shows failure to conform to the requirements of this specification, a second sample from the same lot shall be tested and the results of this retest averaged with the results of the original test.

11.3 Upon retest, as described in 11.2, material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make a claim for a rehearing.

11.4 In case of rejection, the manufacturer or supplier shall have the right to reinspect the rejected shipment or resubmit the lot after removal of that portion of the shipment not conforming to the specified requirements.

12. Packaging and Package Marking

12.1 All insulation products shall be packaged in a manner which will protect the reflective surfaces from physical damage during storage and transportation.

12.2 *Package Marking*:

12.2.1 All packages shall be marked to identify product origin.

12.2.2 All packages shall be marked with a lot number.

12.2.3 Thermal resistance values referenced to this specification will be given for heat flow up, heat flow down, or heat flow horizontal, as applicable.

12.2.4 Width and length of material when installed.

12.2.5 Total area, square feet (square meters) covered by the package contents when installed according to the manufacturer's recommendations.

12.3 *Insulation Marking*:

12.3.1 Insulation shall be imprinted with the manufacturer's or distributor's name or trademark, or both.

12.3.2 Insulation markings shall not reduce the stated thermal performance of the product. Insulation markings shall be repeated at intervals not exceeding 8 ft (2.4 m).

13. Keywords

13.1 emittance; reflective air spaces; reflective insulation; R-value; thermal resistance