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Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation¹

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1. Scope

1.1 This test method covers a procedure for predicting the long-term thermal resistance (LTTR) of unfaced or permeably faced rigid gas-filled closed-cell foam insulations by reducing the specimen thickness to accelerate aging under controlled laboratory conditions (1-5).²

NOTE 1—See Terminology, 3.2.1, for the meaning of the word *aging* within this standard.

1.2 Rigid gas-filled closed-cell foam insulation includes all cellular plastic insulations manufactured with the intent to retain a blowing agent other than air.

1.3 This test method is limited to unfaced or permeably faced, homogeneous materials. This method is applied to a wide range of rigid closed-cell foam insulation types, including but not limited to: extruded polystyrene, polyurethane, polyisocyanurate, and phenolic. This test method does not apply to impermeably faced rigid closed-cell foams or to rigid closed-cell bun stock foams.

NOTE 2—See Note 8 for more details regarding the applicability of this test method to rigid closed-cell bun stock foams.

1.4 This test method utilizes referenced standard test procedures for measuring thermal resistance. Periodic measurements are performed on specimens to observe the effects of aging. Specimens of reduced thickness (that is, thin slices) are used to shorten the time required for these observations. The results of these measurements are used to predict the long-term thermal resistance of the material.

1.5 The test method is given in two parts. The Prescriptive Method in Part A provides long-term thermal resistance values on a consistent basis that can be used for a variety of purposes, including product evaluation, specifications, or product comparisons. The Research Method in part B provides a general relationship between thermal conductivity, age, and product thickness.

¹ This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.30 on Thermal Measurement.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

1.5.1 To use the Prescriptive Method, the date of manufacture must be known, which usually involves the cooperation of the manufacturer.

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.7 *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.*

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1.9 *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:³

- 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
- C518** Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C578** Specification for Rigid, Cellular Polystyrene Thermal Insulation
- C591** Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- C1029** Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation
- C1045** Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
- C1126** Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
- C1289** Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- D1622** Test Method for Apparent Density of Rigid Cellular Plastics
- D6226** Test Method for Open Cell Content of Rigid Cellular Plastics

2.2 Other Standards:

- CAN/ULC S770** Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams⁴

³ 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.

⁴ Underwriters Laboratory of Canada, 333 Pflugsten Road, Northbrook, IL 60062-2096 USA, www.ulc.ca

2.3 ASTM Adjuncts:

- Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation⁵

3. Terminology

3.1 *Definitions*—For definitions of terms and symbols used in this test method, refer to Terminology **C168**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aging, v*—the change in thermophysical properties of rigid closed-cell plastic foam with time, primarily due to changes in the composition of the gas contained within the closed cells.

3.2.2 *bias, n*—a generic concept related to a consistent or systematic difference between a set of test results from the process (that is, the predicted thermal conductivity at 5 years) and an accepted reference value of the property being measured (that is, the actual thermal resistance after 5 years of full-thickness products taken from the same lot as the source of the thin slices).

3.2.3 *core slice, n*—a thin-slice foam specimen that was taken at least 5 mm [0.2 in.] or 25 % of the product thickness, whichever is greater, away from the surface of the full-thickness product.

3.2.4 *effective diffusion thickness, n*—one-half of the geometric thickness minus the total thickness of damaged surface layer(s) (TDSL).

3.2.5 *facing, n*—a material adhered to the surface of foam insulation, including any foam product that has been suffused into the facing material, but not inclusive of any skin formed by the foam insulation itself.

3.2.6 *homogeneous material, n*—sufficiently uniform in structure and composition to meet the requirements of this test method (see **A1.2**).

3.2.7 *long-term, adj*—for the purposes of the Prescriptive Method, long term refers to five years.

3.2.8 *normalized service life, n*—product service life divided by the square of the full product thickness, units of time/length².

3.2.9 *scaled time, n*—time divided by the square of the specimen thickness.

3.2.10 *scaled service life, n*—time necessary for a thin specimen to reach the same thermal conductivity that a full thickness specimen would reach at the end of its service life, equals the product service life multiplied by the square of the ratio of the average slice thickness to the full product thickness, value has units of time.

3.2.11 *service life, n*—the anticipated period of time that the material is expected to maintain claimed thermophysical properties, may be dependent on the specific end-use application.

3.2.12 *surface slice, n*—a thin-slice foam specimen that was originally adjacent to the surface of the full-thickness product

⁵ Available from ASTM International Headquarters. Order Adjunct No. **ADJC1303**.