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Standard Specification for Cellular Glass Insulation Used in Building and Roof Applications¹

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1. Scope

1.1 This specification covers the general requirements for thermal insulation block composed of rigid cellular glass intended for use in building exterior and interior walls, foundation, floor, ceiling, and roofing applications. The insulation blocks are intended for continuous use at temperatures between 200°F and –50°F (93.3°C and –45.6°C).

1.2 This standard is intended to apply to rigid cellular glass thermal insulation block products that are commercially useful in building exterior and interior walls, foundation, floor, ceiling, and roofing construction. For engineering and design purposes, users need to follow specific product information provided by block manufacturers regarding physical properties, system design considerations and installation recommendations.

1.3 The use of thermal insulation materials covered by this specification is typically regulated by building codes, or other agencies that address fire performance or both. Where required, the fire performance of the material shall be addressed through standard fire test methods established by the appropriate governing documents.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only. For conversion to metric units other than those contained in this standard, refer to IEEE/ASTM SI 10.

1.5 *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.*

1.6 *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.*

¹ This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

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2. Referenced Documents

2.1 ASTM Standards:²

- C165 Test Method for Measuring Compressive Properties of Thermal Insulations
- 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
- C203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- C240 Test Methods for Testing Cellular Glass Insulation Block
- C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- 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
- C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
- C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
- D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E96/E96M Test Methods for Water Vapor Transmission of Materials
- E136 Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C

3. Terminology

3.1 For definitions used in this specification, see Terminology C168.

3.2 *Definitions of Terms Specific to This Standard:*

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.

3.2.1 *block, n*—unfaced cellular glass.

4. Classification

4.1 Cellular glass insulation covered by this specification shall be classified in the five Types shown in **Table 1**. Types vary in compressive strength, density, thermal resistance, and flexural strength. Cellular glass insulation is furnished in the following types:

4.1.1 *Type I*—minimum R-3.6 per inch thermal resistance at 75°F mean temperature, minimum compressive strength 50 psi.

4.1.2 *Type II*—minimum R-3.1 per inch thermal resistance at 75°F mean temperature, minimum compressive strength 55 psi.

4.1.3 *Type III*—minimum R-2.9 per inch thermal resistance at 75°F mean temperature, minimum compressive strength 100 psi.

4.1.4 *Type IV*—minimum R-2.6 per inch thermal resistance at 75°F mean temperature, minimum compressive strength 160 psi.

4.1.5 *Type V*—minimum R-2.3 per inch thermal resistance at 75°F mean temperature, minimum compressive strength 240 psi.

5. Ordering Information

5.1 Purchase orders for cellular glass insulation furnished to this specification shall include the following information:

5.1.1 Type designation (see 4.1).

5.1.2 Dimensions according to type (see Section 9).

6. Materials and Manufacture

6.1 The block material shall consist of a glass composition that has been foamed or cellulated under molten conditions, annealed, and set to form a rigid noncombustible material with hermetically sealed cells. The material shall be trimmed into blocks of standard dimensions that are rectangular or tapered.

7. Physical Properties

7.1 The cellular glass insulation shall conform to the following physical requirements in **Table 1**.

7.1.1 *Density*—Test in accordance with 12.2.1.

7.1.2 *Apparent Thermal Resistance*—Test in accordance with 12.2.2.

7.1.3 *Compressive Strength (capped)*—Test in accordance with 12.2.3.

7.1.4 *Flexural Strength*—Test in accordance with 12.2.4.

7.1.5 *Water Absorption*—Test in accordance with 12.2.5.

7.1.6 *Water Vapor Permeability*—Test in accordance with 12.2.6.

7.1.7 *Dimensional Stability*—Test in accordance with 12.2.7.

7.1.8 *Corrosiveness to Steel*—Test in accordance with 12.2.8.

7.1.9 *Surface Burning Characteristics*—Test in accordance with 12.2.9.

7.1.10 *Combustibility*—Test in accordance with 12.2.10.

TABLE 1 Physical Requirements – Block^A

Properties	Type I	Type II	Type III	Type IV	Type V
Density, min., pcf (kg/m ³)	5.0 (80)	5.5 (88)	6.9 (110)	8.5 (136)	10.6 (170)
Thermal Resistance of 1-in. (25.4 mm) thickness °F*ft ² *hr./Btu (K*m ² /W) ^B					
@ 100°F (38°C) mean temperature	3.4 (0.60)	3.0 (0.53)	2.8 (0.48)	2.5 (0.44)	2.2 (0.38)
@ 75°F (24°C) mean temperature	3.6 (0.64)	3.1 (0.55)	2.9 (0.51)	2.6 (0.46)	2.3 (0.40)
@ 50°F (10°C) mean temperature	3.8 (0.67)	3.3 (0.59)	3.0 (0.53)	2.7 (0.48)	2.4 (0.42)
@ 25°F (-4°C) mean temperature	4.0 (0.71)	3.8 (0.61)	3.2 (0.56)	2.8 (0.50)	2.4 (0.43)
Compressive Strength, min., psi (kPa)	50 (345)	55 (379)	100 (689)	160 (1103)	240 (1665)
Flexural Strength, min., psi (kPa)	30 (207)	35 (241)	45 (310)	65 (448)	85 (586)
Water absorption, vol.%, max.	0.5	0.5	0.5	0.5	0.5
Water Vapor permeability, max. per-in. (ngPa ⁻¹ *s ⁻¹ *m ⁻¹)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)
Dimensional Stability, Percent Linear Change, max. in any direction					
@ 200°F & Ambient R.H.	1.0	1.0	1.0	1.0	1.0
@ 158°F & 97% R.H.	1.0	1.0	1.0	1.0	1.0
@ -40°F & Ambient R.H.	1.0	1.0	1.0	1.0	1.0
Mass Loss Corrosion Rate (steel only)	≤ DI ^C	≤ DI	≤ DI	≤ DI	≤ DI
Surface Burning Characteristics					
Flame Spread Index, max.	25	25	25	25	25
Smoke Developed Index, max.	50	50	50	50	50
Combustibility in a Vertical Tube Furnace	Pass	Pass	Pass	Pass	Pass

^A Physical property requirements shown are for the materials in the as-manufactured condition. They do not necessarily represent the values of these properties under certain in-service conditions, depending on the type of installation and the ultimate temperature exposure.

^B Properties shown are for 1 in. thick material. Thermal transmission properties of insulation will vary with temperature, temperature gradient, thickness, and shape. Note the apparent thermal conductivity values in the table are based on samples tested under conditions specified in 12.2.2. These are comparative values for establishing specification compliance. They do not necessarily represent the installed performance for the insulation under use conditions differing substantially from the test conditions.

^C DI = deionized water.

8. Qualification Requirements

8.1 The following requirements are generally employed for the purpose of initial material or product qualification for Type I, Type II, Type III, Type IV, and Type V Block Material:

- 8.1.1 Density.
- 8.1.2 Thermal Resistance.
- 8.1.3 Compressive strength.
- 8.1.4 Flexural strength.
- 8.1.5 Water absorption.
- 8.1.6 Water vapor permeability.
- 8.1.7 Dimensional Stability.
- 8.1.8 Corrosion.
- 8.1.9 Surface burning characteristics.
- 8.1.10 Combustibility.

8.2 The physical properties stated in Table 1 shall not be used as design or engineering values unless this recommendation is made in writing by the product manufacturer. It remains the buyer's responsibility to specify design requirements and obtain supporting physical properties documentation from each product manufacturer and supplier.

9. Dimensions, Mass, and Permissible Variations

9.1 *Type I, Type II, Type III, Type IV, and Type V Flat Block*—Blocks shall be nominal rectangular sections. The dimensions shall be as agreed upon by the purchaser and the supplier. Cellular glass thermal insulation block is typically available in lengths up to 36 in. (914 mm), widths up to 18 in. (457 mm), and thicknesses from 1.5 in. (38 mm) to 8 in. (203 mm).

9.2 *Dimensional Tolerances*—For all Types the average measured length, width, and thickness tolerances shall be in accordance with those listed in Table 2, as determined in accordance with Test Method C303.

9.3 For all Types special dimensional tolerances shall be agreed upon between the purchaser and the supplier as stated in the purchase contract.

10. Workmanship, Finish, and Appearance

10.1 The insulation shall have no visible defects that will adversely affect its service qualities. The blocks shall be of uniform texture and free of foreign materials.

11. Sampling

11.1 Unless otherwise specified, the insulation shall be sampled for the purpose of testing in accordance with Practice C390. Any specific provisions for sampling shall be agreed upon between the purchaser and the supplier.

TABLE 2 Manufacturer's Dimensional Tolerances

Dimension	Type I, Type II, Type III, Type IV, and Type V Block Tolerance, in. (mm)
Length	±1/8 (3.2)
Width	±1/8 (3.2)
Thickness	±1/16 (1.6)

12. Test Methods

12.1 *Conditioning*—Sample boards shall be conditioned at 73 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity for a minimum of 24 h prior to the start of the tests or as specified in the applicable test procedure.

12.2 All cellular glass is produced initially in block form. All qualification testing shall be made on block specimens. All tests shall be conducted on specimens with no surface moisture. The properties referenced in this specification shall be determined in accordance with the following test methods:

12.2.1 *Density*—Determine the density of all block insulation Types in accordance with Test Method C303.

12.2.2 *Thermal Resistance*—Determine the thermal resistance in accordance with Test Method C518 or C177 and Practice C1045. In case of dispute with other test methods, Test Method C177 is recognized as the final authority. Prepare thermal samples as described in Test Method C240. The mean reference testing temperature shall be 75 ± 2°F (24 ± 1°C). In addition, thermal resistance values shall be provided at 100 ± 2°F (38 ± 1°C), 50 ± 2°F (10 ± 1°C), 25 ± 2°F (−4 ± 1°C) to establish compliance with this specification. All thermal resistance testing shall be conducted with a minimum temperature differential of 40°F (22°C).

12.2.3 *Compressive Properties*—Determine the compressive strength in accordance with Test Methods C240, and C165 Procedure A.

12.2.4 *Flexural Strength*—Determine the Flexural Strength in accordance with Test Method C203, using Procedure A, Method I.

12.2.5 *Water Absorption*—Determine the Water Absorption in accordance with the Test Method C240.

12.2.6 *Water Vapor Permeability*—Determine the Water Vapor Permeability in accordance with Test Methods E96/E96M, Procedure B.

12.2.7 *Dimensional Stability*—Determine the Dimensional Stability in accordance with Test Method D2126. Specimen shall be 12 by 12 in. (300 by 300 mm) by the sample thickness.

12.2.7.1 The standard environmental schedule shall be as follows:

Temperature	Relative Humidity	Exposure Time, days
+200 ± 4°F (93 ± 2°C)	ambient	7
+158 ± 4°F (70 ± 2°C)	97 ± 3 %	7
−40 ± 6°F (−40 ± 3°C)	ambient	7

12.2.8 *Corrosiveness to Steel*—The mass loss corrosion rate, when tested with extracted solutions, shall be equal to or less than that determined when tested with the de-ionized water reference standard in accordance with Practice C1617.

12.2.9 *Surface Burning Characteristics*—Determine the Surface Burning Characteristics in accordance with Test Method E84.

12.2.10 *Combustibility of Materials in a Vertical Tube Furnace*—Determine the Combustibility of the cellular glass in accordance with Test Method E136.

13. Acceptance Requirements

13.1 The following requirements are generally employed for purposes of acceptance sampling of lots or shipments of qualified material: