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Standard Specification for Cellular Glass Thermal Insulation¹

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This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers the composition, sizes, dimensions, and physical properties of cellular glass thermal insulation intended for use on ~~surfaces operating at commercial or industrial systems with operating temperatures between -450 and 800°F (-268 and 427°C).~~ It is possible that special fabrication or techniques for pipe insulation, or both, will be required for application in the temperature range from 250 to 800°F (121 to 427°C). Contact the manufacturer for recommendations regarding fabrication and application procedures for use in this temperature range. For specific applications, the actual temperature limits shall be agreed upon between the manufacturer and the purchaser.

1.2 This specification does not cover cellular glass insulation used for building envelope applications. For cellular glass insulation used in building applications refer to Specification [C1902](#).

1.3 Cellular glass insulation has the potential to exhibit stress cracks if the rate of temperature change exceeds 200°F (112°C) per hour.

1.4 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.

1.5 *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.*

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](#)

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 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.

- C203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
 - C240 Test Methods for Testing Cellular Glass Insulation Block
 - C302 Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation
 - C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
 - C335/C335M Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
 - C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
 - C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
 - C450 Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
 - C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
 - C692 Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel
 - C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - C871 Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
 - C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
 - C1058/C1058M Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
 - C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus
 - C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
 - C1639 Specification for Fabrication Of Cellular Glass Pipe And Tubing Insulation
 - C1902 Specification for Cellular Glass Insulation Used in Building and Roof Applications
 - E84 Test Method for Surface Burning Characteristics of Building Materials
 - E96/E96M Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
- 2.2 *ISO Documents*.³
- ISO 3951 Sampling Procedure and Charts for Inspection by Variables for Percent Defective
 - ISO 8497 Determination of steady-state thermal transmission properties of thermal insulation for circular pipes

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *board*—~~fabricated sections of cellular glass adhered and together covered with a facing such as a laminated kraft paper adhered to both faces.~~

4. Classification⁴

4.1 Cellular glass insulation covered by this specification shall be classified in the seven grades shown in Table 1. Grades vary in compressive strength, density, thermal conductivity, and flexural strength. Cellular glass insulation is furnished in the following types:

4.1.1 *Type I*—Flat block manufactured,

4.1.2 *Type II*—Pipe and tubing insulation fabricated from Type I, and

4.1.3 *Type III*—Special shapes fabricated from Type I;

4.1.3 *Type IV—III—Board—Special shapes* fabricated from Type I,I.

NOTE 1—Types not listed here may not be commercially available. These would be considered special order items.

5. Ordering Information

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

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Type and grade designations are in accordance with *Form and Style for ASTM Standards*, Part B, Section B8, March 2002.

TABLE 1 Physical Requirements^{A,B}

TYPE I BLOCK							
Properties	Grade 6	Grade 8	Grade 10	Grade 12	Grade 14	Grade 16	Grade 24
Compressive strength, capped, min, psi (kPa) (Capped material in accordance with Test Methods C240)	60 (414)	80 (552)	100 (689)	120 (827)	140 (965)	160 (1103)	240 (1655)
Density, lb/ft ³ (kg/m ³) Minimum	6.12 (98)	6.3 (102)	6.9 (110)	7.4 (119)	8.0 (128)	8.5 (136)	10.6 (170)
Compressive resistance, uncapped, min, psi (kPa) (Uncapped at 0.2-in. deformation)	35 (242)	N/A ^C	N/A ^C	N/A ^C	N/A ^C	N/A ^C	N/A ^C
Flexural strength, min, psi (kPa)	41 (283)	45 (310)	51(351)	56 (386)	63 (434)	69 (476)	91 (627)
Water absorption, max, volume %	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Water vapor permeability, max, per-in. or grains-in. of thickness/h-ft ² -in. Hg (ng·Pa ⁻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)	0.005 (0.007)	0.005 (0.007)
Hot-surface performance warpage, in. (mm), max Cracking per 12.8.1	0.125 (3) pass	0.125 (3) pass	0.125 (3) pass	0.125 (3) pass	0.125 (3) pass	0.125 (3) pass	0.125 (3) pass
Behavior of materials in a vertical tube furnace	passed	passed	passed	passed	passed	passed	passed
Surface burning characteristics ^D							
Flame spread index, max	5	5	5	5	5	5	5
Smoke developed index, max	0	0	0	0	0	0	0
Mass Loss Corrosion Rate	≤ DI ^E	≤ DI	≤ DI	≤ DI	≤ DI	≤ DI	≤ DI
Apparent Thermal Conductivity ^{F,G} : flat block, max Btu-in./h-ft ² °F (W/m·K) at mean temperature of:							
°F (°C)							
400 (204)	0.58 (0.084)	0.58 (0.084)	0.58 (0.084)	0.60 (0.086)	0.61 (0.088)	0.61 (0.088)	0.66 (0.095)
300 (149)	0.48 (0.069)	0.50 (0.072)	0.51 (0.074)	0.51 (0.074)	0.52 (0.075)	0.52 (0.075)	0.58 (0.084)
200 (93)	0.40 (0.058)	0.41 (0.059)	0.42 (0.061)	0.43 (0.062)	0.44 (0.063)	0.45 (0.065)	0.50 (0.072)
100(38)	0.33 (0.048)	0.34 (0.049)	0.35 (0.050)	0.36 (0.052)	0.37 (0.053)	0.38 (0.055)	0.43 (0.062)
75 (24)	0.31 (0.045)	0.32 (0.046)	0.33 (0.048)	0.35 (0.050)	0.36 (0.052)	0.36 (0.052)	0.42 (0.060)
50 (10)	0.30 (0.043)	0.31 (0.045)	0.32 (0.046)	0.33 (0.048)	0.34 (0.049)	0.35 (0.050)	0.40 (0.058)
0 (-18)	0.27 (0.039)	0.28 (0.040)	0.29 (0.042)	0.30 (0.043)	0.31 (0.045)	0.32 (0.046)	0.37 (0.053)
-50 (-46)	0.24 (0.035)	0.25 (0.036)	0.26 (0.037)	0.28 (0.040)	0.28 (0.040)	0.29 (0.042)	0.35 (0.050)
-100 (-73)	0.21 (0.030)	0.23 (0.033)	0.24 (0.035)	0.25 (0.036)	0.26 (0.037)	0.27 (0.039)	0.32 (0.046)
-150 (-101)	0.19 (0.027)	0.20 (0.029)	0.22 (0.032)	0.23 (0.033)	0.24 (0.035)	0.25 (0.036)	0.30 (0.043)
-200 (-129)	0.17 (0.025)	0.18 (0.026)	0.20 (0.029)	0.21 (0.030)	0.22 (0.032)	0.23 (0.033)	0.28 (0.040)
-250 (-157)	0.16 (0.023)	0.17 (0.025)	0.18 (0.026)	0.19 (0.027)	0.20 (0.029)	0.21 (0.030)	0.26 (0.037)
TYPE II PIPE AND TUBING							
Apparent thermal conductivity ^{F,H,I} Pipe insulation, max, Btu-in./h-ft ² °F (W/m·K) at mean temperature of:							
°F (°C)							
400 (204)	0.63 (0.091)						
300 (149)	0.52 (0.075)						
200 (93)	0.43 (0.062)						
100 (38)	0.35 (0.050)						
75 (24)	0.34 (0.049)						
50 (10)	0.32 (0.046)						
0 (-18)	0.29 (0.042)						
-50 (-46)	0.26 (0.037)						
-100 (-73)	0.23 (0.033)						
-150 (-101)	0.21 (0.030)						
Hot-surface performance warpage, in. (mm), max Cracking per 12.8.1	0.125 (3) 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 Types II, III, II and IVIII are fabricated from Type 1, Grade 6 block.

^C N/A = Not Applicable.

^D For Types II and III, smoke developed index and flame spread index will remain constant with some fabrication techniques and will change with other fabrication techniques. For applications requiring a flame spread index of 25 and a smoke developed index of 50, contact fabricator or manufacturer.

^E DI = deionized water.

^F 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 12.3 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.

^G Evaluated at a small temperature difference in accordance with Practice C1058/C1058M.

^H Evaluated at a large temperature difference in accordance with Practice C1058/C1058M.

^I Single layer or inner layer on a multilayer system piping insulation fabricated in half sections has the potential to exhibit stress cracks above 250°F (122°C). The thermal performance in this range is characterized with cracks present.

5.1.1 Type designation (see 4.1),

5.1.2 Dimensions according to type (see Section 9), and

5.1.3 Jacketing when required.

5.2 Any special requirements, such as, type, fabrication combinations not listed in accordance with Section 4, nonstandard dimensions in accordance with Section 9, inspection requirements in accordance with Section 13, or certification requirements in accordance with Section 16 shall be agreed upon between the purchaser and the supplier and stated in the purchase contract.

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.

6.2 Special shapes and pipe covering shall be fabricated from blocks in accordance with Practices C450, C585 and Specification C1639.

~~6.3 Board, tapered or flat, shall be fabricated from blocks.~~

7. Physical Properties

7.1 The cellular glass insulation shall conform to the physical requirements in Table 1. Contact the manufacturer for specific design recommendations for all material types.

8. Qualification Requirements

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

8.1.1 Compressive strength.

8.1.2 Flexural strength.

8.1.3 Water absorption.

8.1.4 Water vapor permeability.

8.1.5 Thermal conductivity.

8.1.6 Hot-surface performance.

8.1.7 Surface burning characteristics.

8.2 The following requirements are generally employed for qualification of Type II, pipe and tubing insulation:

8.2.1 Thermal Conductivity.

8.2.2 Type II, pipe and tubing insulation shall be fabricated from material having met the qualification requirements of Grade 6 Type I block.

~~8.3 Type III and Type IV material shall be fabricated from material having met the qualification requirements of Grade 6 Type I block.~~

9. Dimensions, Mass, and Permissible Variations

9.1 *Type I, 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 available in lengths from 24 in. to 36 in. (600 mm to 914 mm) and widths from 18 in. to 24 in. (450 mm to 610 mm). Cellular glass thermal insulation block is available in thicknesses from 1.5 in. to 8 in. (38 mm to 203 mm).

9.2 *Type II, Pipe and Tubing Insulation*—See Specification **C1639**.

9.3 *Type III, Special Shapes*—Dimensions of special shapes shall be as agreed upon between the supplier and the purchaser.

9.4 *Type IV, Board*—Dimensions of board shall be agreed upon between the purchaser and the supplier. Cellular glass thermal insulation board is available in lengths up to 48 in. (1219 mm), widths up to 24 in. (610 mm), and thicknesses from 1.5 in. (38 mm) to 8 in. (203 mm).

9.4 *Dimensional Tolerances:*

9.4.1 For ~~Types I and IV~~, Type I, the average measured length, width, and thickness tolerances shall be in accordance with those listed in **Table 2**.

9.4.2 For Type II, the dimensional tolerances are given in **Table 3**.

9.4.3 For Type III, dimensional tolerances shall be agreed upon between the purchaser and the supplier.

9.4.4 For ~~Types I, II, I and IV, II~~, 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 Since some requirements for this material are not easily specified by numerical value, the insulation shall have no visible defects that will adversely affect its service qualities.

11. Sampling

11.1 The insulation shall be sampled for the purpose of testing in accordance with Practice **C390** or ISO 3951⁵. Any specific provisions for sampling shall be agreed upon between the purchaser and the supplier.

12. Test Methods

12.1 All cellular glass is produced initially in block form. When special shapes are required, cellular glass is fabricated into pipe, curved or segmental insulation, or precision V-grooved (material specifically cut to fit around the exterior surface of piping or equipment with no gaps), or board. All initial 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 *Density:*

12.2.1 *Type I*—Block insulation: Test Method **C303**.

TABLE 2 Manufacturers Dimensional Tolerances

Dimensions, in. (mm)	Block (Type I) and Board (Type IV)
Length	$\pm 1/16$ (1.6)
Width	$\pm 1/16$ (1.6)
Thickness	$\pm 1/16$ (1.6)

⁵ ISO 3951 Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL, ISO copyright office Case postale 56 • CH-1211 Geneva 20 Tel. + 41 22 749 01 11 Fax + 41 22 749 09 47 E-mail copyright@iso.org Web http://www.iso.org/iso/home.html