Designation: C552 – 15

Standard Specification for Cellular Glass Thermal Insulation[1]

This standard is issued under the fixed designation C552; 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.

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 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 It is anticipated that single-layer pipe insulation in half sections or the inner layer of a multilayer system have the potential to exhibit stress cracks above 250°F (122°C).

1.3 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.

1.4 *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:*[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 of 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

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[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.

D226/D226M Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
D312/D312M Specification for Asphalt Used in Roofing
E84 Test Method for Surface Burning Characteristics of Building Materials
E96/E96M Test Methods for Water Vapor Transmission 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:*ies of thermal insulation for circular

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. Classification[4]

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,

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

4.1.4 *Type IV*—Board fabricated from Type 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:

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 up to 36 in. (914 mm), widths up to 18 in. (457mm), and thicknesses from 1.5 in. (38 mm) to 8 in. (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).

9.5 *Dimensional Tolerances:*

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

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

[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]

Properties	Grade 6	Grade 8	Grade 10	Grade 12	Grade 14	Grade 16	Grade 24
TYPE I BLOCK							
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	0.125 (3)	0.125 (3)	0.125 (3)	0.125 (3)	0.125 (3)	0.125 (3)	0.125 (3)
Cracking per 12.8.1	pass	pass	pass	pass	pass	pass	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 (0.087)	0.61 (0.088)	0.65 (0.094)
300 (149)	0.48 (0.070)	0.50 (0.072)	0.51 (0.074)	0.51 (0.074)	0.52 (0.075)	0.52 (0.076)	0.57 (0.082)
200 (93)	0.40 (0.058)	0.41 (0.058)	0.42 (0.061)	0.43 (0.062)	0.44 (0.063)	0.45 (0.064)	0.49 (0.071)
100(38)	0.33 (0.047)	0.34 (0.049)	0.35 (0.050)	0.36 (0.052)	0.37 (0.053)	0.38 (0.054)	0.42 (0.061)
75 (24)	0.31 (0.045)	0.32 (0.046)	0.33 (0.048)	0.35 (0.050)	0.36 (0.051)	0.36 (0.052)	0.40 (0.058)
50 (10)	0.29 (0.043)	0.31 (0.044)	0.32 (0.046)	0.33 (0.048)	0.34 (0.049)	0.35 (0.050)	0.39 (0.056)
0 (–18)	0.27 (0.038)	0.28 (0.040)	0.29 (0.042)	0.30 (0.043)	0.31 (0.045)	0.32 (0.046)	0.36 (0.051)
–50 (–46)	0.24 (0.034)	0.25 (0.036)	0.26 (0.037)	0.28 (0.040)	0.28 (0.040)	0.29 (0.042)	0.33 (0.050)
–100 (–73)	0.21 (0.031)	0.23 (0.033)	0.24 (0.035)	0.25 (0.037)	0.26 (0.037)	0.27 (0.039)	0.31 (0.045)
–150 (–101)	0.19 (0.027)	0.20 (0.029)	0.22 (0.032)	0.23 (0.034)	0.24 (0.035)	0.25 (0.036)	0.29 (0.042)
–200 (–129)	0.17 (0.025)	0.18 (0.026)	0.20 (0.029)	0.21 (0.031)	0.22 (0.032)	0.23 (0.033)	0.27 (0.041)
–250 (–157)	0.16 (0.023)	0.17 (0.025)	0.18 (0.026)	0.19 (0.029)	0.20 (0.029)	0.21 (0.031)	0.25 (0.036)
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	0.125 (3)						
Cracking per 12.8.1	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, and IV 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.