Designation: C552 – 16a

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

[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:*

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 (0.088)	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	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.

TABLE 2 Manufacturers Dimensional Tolerances

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

TABLE 3 Fabrication Tolerances

Dimensions, in. (mm)	Board (Type III, IV)	Pipe (Type II)
Length	±1/8 (3.2)	In accordance with Practice C1639
Width	±1/8 (3.2)	In accordance with Practice C1639
Thickness	±1/8 (3.2)	In accordance with Practice C1639
Inner diameter	. . .	In accordance with Practice C1639
Outer diameter	. . .	In accordance with Practice C1639

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

9.5.4 For Types I, II, and IV, 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 3951[5]. 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, 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.

12.2.2 *Type II*—Pipe insulation: Test Method C302.

12.3 *Thermal Conductivity*—Make determinations at four mean temperatures in accordance with Practice C1058/C1058M. Use the results of these tests to calculate thermal transmission properties in accordance with Practice C1045.

NOTE 2—At the time of developing the thermal conductivity values in the Type II Cellular Glass Pipe and Tubing Insulation table, ISO 8497 was used to develop below ambient values for mean temperatures from -150°F (-101°C) to 75°F (24°C) since no known commercial C335/C335M apparatus had the capability of performing such testing.

12.3.1 *Type I: Block Insulation*—Use either Test Method C177, C518, or C1114 in conjunction with Practice C1045, using the following specimen preparation. Test Method C518 shall not be used at temperatures or thermal resistances other than those in the range of calibration. Test Method C1114 shall not be used at temperatures or thermal resistance ranges other than those with comparable/verifiable results to Test Method C177. In case of dispute, Test Method C177 is recognized as the final authority. Specimen preparation is as follows:

12.3.2 To achieve flatness and parallelism of the surface as required by the preceding test methods, the following method is suggested: By sawing from the original block, prepare a specimen with the required dimensions, its thickness being 2 or 3 mm greater than the final thickness needed.

12.3.3 Place the specimen on a flat metal plate slightly larger than the specimen itself and put two machined metal bars on the metal plate near two opposite sides of the specimen. Insert a uniform sheet of paper having about 0.01-in. (¼-mm) thickness between the flat base plate and the metal bars but not under the sample. The metal bars are as thick as the final thickness of the specimen and machined so that their top and bottom surfaces are flat and parallel. Alternatively to machined bars use cold rolled steel bars. These bars are generally sufficiently flat and uniform in thickness.

12.3.4 Using a third straight metal bar long enough to lap metal bars on each side, carefully rub off the upper face of the specimen until the scraping bar just contacts thickness bars. Turn the specimen upside down and place it back on the flat metal plate and put the two metal bars on the metal plate near two opposite sides of the specimen, this time without the sheet of paper under each metal bar. Repeat the rubbing operation.

12.3.5 If the specimens have to be shipped, provide adequate protection.

12.3.6 Due to the rigid nature of the material and its open cell surface, it is preferable to have the thermocouples mounted in the surface of the plates and not adhered to the surface of the specimens.

12.3.7 For maximum accuracy, it is recommended that the temperature difference between the hot and cold surfaces of the specimens is such that the temperature gradient in the specimen equals or exceeds 40°F/in. (900 Km^{-1}). Specimens made from several pieces of cellular glass are not acceptable. Joints are prohibited in the central measuring area and their number are to be minimized in the guard area.

12.3.8 The number of specimens to be tested and the sampling plan shall be in accordance with Practice C390 where applicable. For the purpose of inspection by the user's representative or independent third party, the number of specimens shall conform to ISO 3951 Inspection Level S-3, 10.0 % AQL using the S Method.

[5] ISO 3951 Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lotby- 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

12.3.9 *Type II, Pipe and Tubing Insulation*—Test Method C335/C335M in conjunction with Practices C1058/C1058M and C1045 for above ambient mean temperatures. For below ambient mean temperatures use test method ISO 8497 in conjunction with Practices C1058/C1058M and C1045.

12.3.10 Samples shall be fabricated into 1½ + ½ , – 0-in. (38 + 13, – 0-mm) thick specimens of pipe insulation.

12.4 *Compressive Properties—(Type I-Block)*—Determine the compressive strength in accordance with Test Method C165, Procedure A, with the following test parameters and specimen preparation techniques. This process indicates a failure point in compressive loading.

12.4.1 Each of the two parallel bearing surfaces of the specimens shall be plane. If necessary, rub them on a suitable abrasive surface to produce the required flat surface.

12.4.2 The test specimens shall preferably be one half-block 12 by 18-in. (300 by 450-mm) by nominal received thickness. Alternates include a quadrant 9 by 12-in. (225 by 300-mm) or a full block 18 by 24-in. (450 by 600-mm) by nominal received thickness. A quadrant specimen shall be taken from any one of four equal area quadrants of the preformed block. The minimum acceptable specimen size is 8 by 8 in. (200 by 200 mm) The report shall include the specimen size.

12.4.3 Cap both bearing surfaces of the specimens as follows: Coat one surface with molten Specification D312/D312M Type III or Type IV asphalt (preheated to 350, +50, –25°F (177, +28, –14°C)), completely filling the surface cells with a small excess. Such a coating application rate is approximately 0.20 lb/ft^2 ± 25 %. Immediately press the hot-coated block onto a precut piece of felt or paper laying on a flat surface. This is to prevent the asphalt surface from sticking to the compression platen during the test. A lightweight kraft paper is suitable, although traditionally Type 1 roofing felt paper, commonly called No. 15 asphalt felt, in accordance with Specification D226/D226M has been used. Properly capped surfaces need to be approximately plane and parallel. Set the specimens on edge, exposing both capped surfaces to room temperature for a minimum of 15 min to allow the asphalt to harden before testing.

12.4.4 The number of specimens to be tested and the sampling plan shall be in accordance with Practice C390 or ISO 3951 where applicable. For the purpose of inspection by a representative of the user or an independent third party, the number of specimens shall conform to an ISO 3951 Inspection Level agreed upon between the purchaser and manufacturer.

12.4.5 Compress the specimen until failure. The deformation at failure will vary, depending on the thickness of insulation and the thickness of the capping materials. Record the load at the failure point or definite yield point. The compressive strength is calculated from this load divided by the specimen cross-sectional area in accordance with Test Method C165.

12.4.6 The rate of loading will depend on the type of equipment used. With a hydraulic test machine, use a constant load rate of 500 lb/s (2200 N/s). With a screw-driven machine use a crosshead speed of 0.01 in. (0.25 mm)/min/1 in. (25.4 mm) of specimen thickness, within a tolerance of ±25 % (on the crosshead speed or loading rate). Using the preferred specimen size in accordance with Test Methods C240, the preceding load rates correspond to a nominal 2.3 psi/s (16 kPa/s). Another alternate testing procedure is to reach the failure within 30 to 90 s (nominal 2.3 psi/s (16 kPa/s).

12.4.7 Due to the sample preparation, with the inclusion of felts and asphalt, the test method described in Test Method C165 to determine compressive modulus of elasticity does not apply for cellular glass as a material by itself.

12.4.8 For compressive resistance of uncapped material, use Test Method C165, Procedure A, preferably test a half block, or quadrant, 2-in. (50-mm) thickness to a deformation of 0.2 in. (5 mm). This process does not indicate a failure point in compressive loading.

NOTE 3—For ultimate yield strength with no deformation, capping in accordance with Test Methods C240 is required.

12.5 *Flexural Strength (Type I Block)*—Test Methods C203, using Procedure A, Method I or II.

12.6 *Water Absorption (Type I-Block)*—This test method covers the determination of water absorption of cellular glass insulating blocks by measuring the amount of water retained as a result of complete immersion for a prescribed time interval. Surface blotting is used to correct for the water absorbed on the cut surface cells.

12.6.1 This test method provides a means of measuring the water absorption of cellular glass insulating blocks under isothermal conditions as a result of direct immersion in liquid water. It is intended for use in product evaluation and quality control.

12.6.2 *Equipment and Materials:*

12.6.2.1 Balance with about 1.5-kg capacity and at least 0.1-g sensitivity.

12.6.2.2 Immersion tank equipped with inert specimen supports and top surface weights such as stainless steel.

12.6.2.3 Cellulose sponge at least 4 by 7 by 1.5 in. (100 by 180 by 40 mm). Predampened sponges and wring them out thoroughly.

12.6.2.4 Test room with a temperature of 70 ± 5°F (21 ± 3°C) and a relative humidity of 50RH ± 10 %.

12.6.2.5 Distilled water.

12.6.3 Carefully measure the thickness, width, and length to the nearest 1 mm of a cellular glass block, preferably 2 by 12 by 18 in. (50 by 300 by 450 mm) and calculate the volume and exposed surface area.

12.6.4 Weigh the specimen to the nearest 0.0002 lb. (0.1 g) (W_1), then submerge it horizontally under 25 mm (1 in.) of water maintained at 70 ± 5°F (21 ± 3°C). Inert top surface weights are required to keep it submerged. After submerging for 2 h, set the specimen on end on a damp cotton bath towel to drain for 10 min. At the end of this period, remove the excess surface water by hand with a damp sponge for 1 min per large face and 1 min for the four sides, wringing out the sponge before and once in between for each face and passing at least two times on each surface. Blot each face of the specimen equally by compressing the sponge by 50 % of its thickness. Weigh the specimen immediately (W_2) to the nearest 0.0002 lb. (0.1 g).

12.6.5 Calculate the weight of water absorbed ($W_2 - W_1$) and express it as a function of the exterior surface of the sample in grams per square centimetre. Water absorption can also be expressed as a function of volume percent minus absorbed water volume divided by specimen volume, or as a function of weight percent minus weight of water absorbed ($W_2 - W_1$) divided by the dry specimen weight (W_1). Compare results on specimens of identical sizes.

12.6.6 The precision was determined in interlaboratory tests.[6] The repeatability or single-laboratory operator precision is ±0.00060 g/cm^2 or ±0.030 volume percent (±1S). The reproducibility or multilaboratory operator precision is ±0.00071 g/cm^2 or ±0.035 volume percent. Due to a lack of a standard, no statement can be made regarding bias.

12.7 *Water Vapor Permeability (Type I-Block)*—Test Methods E96/E96M. Use water method at a temperature in the range from 73.4 to 90°F (23 to 32.2°C).

12.8 *Hot Surface Performance (Type I-Block)*—Test Method C411 tested at 4-in. (102-mm) thickness (double layer of 2-in. or 51-mm blocks with staggered joints). (*Type II-Pipe*—tested at 3-in. (76-mm) thickness (double layer of 1.5-in. or 38-mm layers with joints staggered). The test temperature shall not exceed the manufacturer's maximum use temperature. A heating rate not exceeding 200°F/h (112°K/h) shall be employed. Test specimens shall be unfaced.

12.8.1 Through cracks through the outer layer of block or pipe specimens based on a visual examination prior to removal of the test specimen from the apparatus shall constitute a failure.

12.9 *Surface Burning Characteristics (Type I-Block)*—Test Method E84.

12.10 *Stress Corrosion (Type I, Block)*—For use in contact with austenitic stainless steel refer to Specification C795. For Types II, III, and IV, the cellular glass to be tested, composite or plain, must include any manufactured/fabricated joint compounds, facing and adhesive if applicable. The amount of the adhesive or joint compound, and so forth, in the test sample, is an amount proportional to that present in the fabricated product.

12.10.1 *Specimen Preparation for Chemical Analysis*—When specified in the purchase order or contract, the following chemical analysis results shall be furnished to the purchaser.

12.10.2 *Chemical Analysis for Leachable Chloride, (Fluoride), Silicate, and Sodium Ions*—Determine leachable chloride, (fluoride), silicate, and sodium ions in accordance with Test Methods C871 with the following precautions. It is very important that 7.1.1 in Test Methods C871 be followed where the specimen is cut into thin, approximately 1/16-in. (2-mm), wafers, then in accordance with 8.2 of Test Methods C871, to grind this specimen more than 60 to 120 s. If any material is floating on the surface, this is an indication that the wafers were too thick or additional grinding is needed, or both. In case of question/dispute, run a particle size analysis on the dried material left on the filter paper during the extraction process.

NOTE 4—Test Method C692 was originally titled "Evaluating the Influence of Wicking-Type Thermal Insulation on the Stress Corrosion Cracking Tendency of Austenitic Stainless Steel" and the companion standard Test Methods C871 was developed to do the chemical analysis on such materials. Since cellular glass is not a wicking insulation, it is necessary to grind up the sample into a fine powder for the leaching part of Test Methods C871. In order to get reproducible chemical results, this powder must consist of a reproducible particle size, thus careful preparation following the directions of Test Methods C871 is necessary.

12.10.3 All of the other chemical requirements of the preceding specifications are to be followed.

12.11 *Mass Loss Corrosion Rate (MLCR)*—The MLCR, of Type I materials, 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.

13. Acceptance Requirements

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

13.1.1 Compressive strength.
13.1.2 Dimensional tolerances.
13.1.3 Thermal conductivity.
13.1.4 Workmanship.

14. Inspection

14.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

15. Rejection

15.1 Material that fails to conform to the requirements of the agreed upon specification is permitted to be rejected. Report rejection promptly and in writing to the producer or supplier.

16. Certification

16.1 When specified in the purchase order or contract, the producer or supplier shall furnish a certificate to the purchaser that the material was manufactured or fabricated, sampled, and tested or inspected in accordance with this specification and was found to meet the requirements.

16.2 Upon the request of the purchaser in the contract or order, the certification by an independent third party indicating conformance to the requirements of this specification is an acceptable alternative to the manufacturer's certification.

17. Packaging and Package Marking

17.1 *Packaging*—Unless otherwise agreed and specified between the purchaser and the manufacturer or supplier, the insulation shall be packaged in the manufacturer's standard commercial containers.

17.2 *Marking*—Unless otherwise specified, each container shall be plainly marked as follows:

[6] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C16-1007.

17.2.1 *Block*—The name of the manufacturer, size, and quantity of the material in the container.

17.2.2 *Pipe and Tubing Insulation*—The name of the manufacturer, pipe size, quantity, nominal thickness, and jacket, if any, of the material in the container.

17.2.3 *Special Shapes*—The name of the manufacturer, shape, and quantity of the material in the container.

17.2.4 *Board*—The name of the manufacturer, size, and quantity of the material in the container.

18. Keywords

18.1 cellular glass; cellular materials; cellular materials-preformed thermal insulation; thermal insulating materials; thermal insulating materials-block and board; thermal insulating materials-block and pipe; thermal insulating materials-glass; thermal insulating materials-pipe