Designation: C610 – 17 (Reapproved 2023)

Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation[1]

This standard is issued under the fixed designation C610; 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 molded expanded perlite block, fittings, and pipe thermal insulation intended for use on surfaces with temperatures between 80 to 1200°F (27 to 649°C).

1.2 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.

1.3 *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.*

1.4 *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

C203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation

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

C356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat

C390 Practice for Sampling and Acceptance of Thermal Insulation Lots

C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C421 Test Method for Tumbling Friability of Preformed Block-Type and Preformed Pipe-Covering-Type 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

C795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

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

C1616 Test Method for Determining the Moisture Content of Organic and Inorganic Insulation Materials by Weight

C1617 Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals

C1763 Test Method for Water Absorption by Immersion of Thermal Insulation Materials

E84 Test Method for Surface Burning Characteristics of Building Materials

E136 Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C

[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.

3. Terminology

3.1 *Definitions*—For definitions of general terms related to thermal insulation used in this specification, refer to Terminology C168.

4. Standard Shapes, Sizes, and Dimensions

4.1 Molded expanded perlite block, fitting, and pipe thermal insulation shall be as follows:

4.1.1 *Block*—Block shall be furnished in lengths of either 36 or 39.4 in. (914 or 1000 mm), widths of 6 in. (152 mm), 12 in. (305 mm), 18 in. (457 mm), or 24 in. (610 mm), and in thickness from 1½ to 6 in. (38 to 152 mm) in increments of ½ in. (13 mm).

4.1.2 *Pipe Insulation*—Molded expanded perlite pipe insulation shall be supplied either as hollow cylindrical shapes split in half lengthwise (in a plane including the cylindrical axis) or curved segments. The pipe insulation shall be furnished in sections or segments in lengths of either 36 or 39.4 in. (914 or 1000 mm) to fit standard sizes of pipe and tubing, and in nominal thickness from 1 to 4 in. (25 to 102 mm) in ½-in. (13-mm) increments. Inner and outer diameters of multilayer construction shall be specified. Inner and outer diameters shall be in accordance with those standard dimensions specified in Practice C585. Since outside diameter tolerances differ between individual manufacturing processes, it is acceptable to have pipe insulation furnished in two or more layers nested by the manufacturer. The purchaser shall consult the manufacturer for specific requirements.

4.1.3 *Fittings*—Molded (expanded insulation fittings shall conform to the inner and outer diameters in accordance with Practice C585. Mitered fittings shall be in accordance with Practice C450.

5. Description

5.1 *Composition*—molded expanded perlite block, fitting, and pipe thermal insulation shall be composed principally of expanded perlite and silicate binders may contain reinforcing fibers.

6. Dimensional Tolerances

6.1 *General*—The average tolerances for length, width, and thickness shall comply with the requirements shown in Table 1.

6.2 *Pipe Insulation*—The following additional tolerances apply to perlite pipe insulation supplied as half sections:

6.2.1 *Fit and Closure*—When fitted to the appropriate size pipe, the longitudinal seam of the pipe insulation shall close to within $1/16$ in. (1.6 mm) along the entire length of the section.

TABLE 1 Dimensional Tolerances

	Block	Pipe
Length	± ⅛ in. (3.2 mm)	± ⅛ in. (3.2 mm)
Width	± ⅛ in. (3.2 mm)	...
Thickness	± ⅛ in. (3.2 mm)	± ⅛ in. (3.2 mm)
Inner Diameter	...	in accordance with Practice C585
Outer Diameter	...	in accordance with Practice C585

6.2.2 *Concentricity*—The inner bore of the pipe insulation shall be concentric with the outer cylindrical surface. The deviation from concentricity shall not exceed ⅛ in. (3.2 mm) or 5 % of the wall thickness, whichever is greater.

6.2.3 *Half-Section Balance*—The plane formed by the split between half sections shall include the cylindrical axis. Deviation of the split plane from the cylinder axis over the 36 or 39.4-in. (914 or 1000-mm) length shall not exceed ⅛ in. (3.2 mm).

7. Workmanship, Finish, and Appearance

7.1 Since some requirements for this material are not easily defined by a numerical value, the insulation shall not have visible defects that will adversely affect its service qualities.

8. Physical Requirements

8.1 The insulation shall conform to the physical requirements in Table 2.

9. Sampling

9.1 The insulation shall be sampled in accordance with Practice C390. Specific provision for sampling shall be agreed upon between the purchaser and the supplier.

10. Qualification Requirements

10.1 The following requirements are generally employed for purpose of initial material or product qualification:

10.1.1 Flexural strength,
10.1.2 Compressive resistance,
10.1.3 Surface burning characteristics,
10.1.4 Linear shrinkage after soaking heat,
10.1.5 Water absorption after heat aging,
10.1.6 Apparent thermal conductivity,
10.1.7 Hot-surface performance,
10.1.8 Stress corrosion cracking of austenitic stainless steel,
10.1.9 Weight loss by tumbling,
10.1.10 Mass loss corrosion rate, and
10.1.11 Combustibility.

11. Acceptance Requirements

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

11.1.1 Density,
11.1.2 Dimensions,
11.1.3 Workmanship, and
11.1.4 Moisture content.

12. Test Methods

12.1 The properties enumerated in this specification shall be determined in accordance with the following test methods:

12.1.1 *Density:*

12.1.1.1 *Block Insulation*—Test Method C303.

12.1.1.2 *Pipe Insulation*—Test Method C302, Procedure A.

12.1.2 *Apparent Thermal Conductivity:*

12.1.2.1 *Block Insulation*—Test Method C177 per Practice C1058/C1058M large temperature difference method or Test Method C518, using 1½ ± ½-in. (38 ± 13-mm) thick specimens.

TABLE 2 Physical Requirements[A]

		Block and Pipe
Density, lb/ft^3(kg/m^3)	max	15 (240)
Flexural Strength, lb/in.^{2} (kPa)	min	45 (310) Block only
Stress corrosion Cracking of Austentic Stainless Steel	pass	pass
Mass Loss Corrosion Rate	_	≤ DI water
Compressive Resistance at 5% Deformation or Yield whichever occurs first, lb/in.^{2} (kPa)	min	70 (483) Block only
Weight Loss by Tumbling, % loss in Weight after 10 minutes	max	70
Moisture content,[B] % by weight	max	10
Linear Shrinkage,% at 1200°F (649°C) for 24 h max	length	2
	width	2
	thickness	8
Apparent Thermal Conductivity[C] Btu-in./h-ft^2—°F (W/m/K), max	Mean Temperature	App. Thermal Conductivity by Test Method C177,C335/C335M, or C518
	100°F (38°C)	0.48 (0.069)
	200°F (93°C)	0.53 (0.076)
	300°F (149°C)	0.59 (0.085)
	400°F (204°C)	0.64 (0.092)
	500°F (260°C)	0.69 (0.099)
	600°F (316°C)	0.75 (0.108)
	700°F (371°C)	0.80 (0.115)
Water Absorption of Thermal Insulation after heat aging at 600°F and 48 h Water Immersion, weight gain %	max	50
Surface Burning Characteristics		
Flame spread index	max	0
Smoke developed index	max	5
Combustibility		
Pass the requirements of Test Method E136	Pass	Pass
Hot-surface Performance		
Warpage, in. (mm)	max	¼ (6) Block only
Cracking	No cracks completely through the insulation thickness. Surface cracks on hot face are acceptable.	

[A] Physical property requirements shown are for the materials in the as-manufactured condition. They may or may not represent the values of these properties under certain in-service conditions, depending on the type of installation and the ultimate temperature exposure.
[B] Water absorption values shown are for insulation in the as-manufactured condition. Those portions of the insulation exposed to elevated temperatures may not retain their water absorption characteristics.
[C] The thermal transmission properties of perlite block and pipe insulation may vary with temperature, temperature gradient, thickness, and shape. Note that the apparent thermal conductivity requirements in the table are based on samples tested under the conditions specified in Test Methods C177, C335/C335M, or C518. These are comparative values for establishing specification compliance. They may not represent the installed performance of the insulation under use conditions differing substantially from test conditions.

12.1.2.2 *Pipe Insulation*—Test Method C335/C335M, using 1½ ± ½ in. (38± 13-mm) thick specimens of pipe insulation as supplied for fit to a 3-in. (89 mm) nominal iron pipe.

12.1.2.3 Apparent thermal conductivity versus mean temperature shall be calculated in accordance with Practice C1045. Determinations shall be made at four or more mean temperatures. Two of the test mean temperatures shall be within 50°F (28°C) of the highest and lowest mean temperature specified in Table 2. The other two determinations shall be made at mean temperatures spaced equally within the specified range. All test temperatures shall be selected in accordance with Practice C1058/C1058M and reported in the test results. The results of these tests shall be interpolated through reasonable curve fitting or numerical techniques, to establish the apparent thermal conductivity at the specified mean temperature.

12.1.3 *Linear Shrinkage After Heat Soaking*—Refer to Test Method C356. The test temperature shall be 1200°F (649°C).

12.1.4 *Flexural Strength (Block Insulation Only)*—Test Methods C203 Method 1 (3 Point), Procedure D, test 2–in. (50mm) thick specimens. The flexural strength of pipe insulation cannot be tested.

12.1.5 *Compressive Resistance (Block Insulation Only)*—Test Method C165, Procedure A. Test nominal 1½ ± ½-in. (38 ± 13–mm) thick specimens.

12.1.6 *Weight Loss by Tumbling*—Test Method C421.

12.1.7 *Moisture Content*—Test Method C1616. The value reported should be the numerical average of the calculated moisture content of four specimens rounded to the nearest 1 %.

12.1.8 *Water Absorption After Heat Aging*—Test Method C1763, Procedure A.